The Short-Term Effects of Tax Changes in the United States: Evidence for State Dependence[1]

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[1]This presentation has not been subject to CBO's regular review and editing process. The views expressed here should not be interpreted as CBO's.

Introduction

- The impact of taxes on economic activity has long been a central area of interest to economists and policy makers alike.
- Empirical studies provide a wide range of estimates for the size of the effects on GDP from a tax change.
    - Romer and Romer (2010) find that the boost in GDP resulting from a decrease in tax revenues by one percent of GDP can be as large as 3 percent (in three years). That figure is estimated to be around 1 percent in Blanchard and Perotti (2002).
- To better understand the factors that influence the short-term impact of tax changes (and underlie these diverse results), this study evaluates how the effects from a tax change might vary across states of high and low unemployment.

Introduction Cont'd

- A tax change can potentially exert a range of effects on the economy that operate through a variety of channels (e.g., by altering individuals' decisions regarding work, consumption, and saving as well as firms' decisions regarding hiring, investment, and capacity utilization).
- While some of these effects predominantly influence the aggregate demand for goods and services, others primarily relate to the supply of labor.
- Depending on the relative magnitude of aggregate demand and labor supply effects, the state of the economy might have different implications on how the economy responds to a tax change.

Introduction Cont'd

- In a severe economic downturn, a tax cut that mainly influences the aggregate demand for goods and services by providing households with additional financial resources can have a larger impact on output and employment than during normal times or expansions.
  - During a recession, a larger segment of households become liquidity constrained, thus, tend to spend a greater fraction of their additional disposable income on goods and services.
  - Absent inflationary concerns, monetary policy is unlikely to offset the expansionary impact of fiscal policy.

Introduction Cont'd

- Contrary to a tax cut that primarily affects aggregate demand, tax changes that, for the most part, alter individuals' labor supply decisions can have a smaller impact on employment and output in recessions.
    - During times of high unemployment, a tax change that strengthens individuals' work incentives may not be as effective in raising actual employment as it would be when there is heightened competition among employers (i.e., during times of low unemployment).

Introduction Cont'd

- Constructing an empirical framework in which estimates for the economic effects of a tax change can be conditioned on a particular state of the economy (as measured the degree of slack in the labor market) can be very useful in
  - gaining insights into how individual effects from a tax change (such as those on aggregate demand and labor supply) might vary with the state of the economy, and in
  - interpreting the mixed results of the previous literature.

Contribution

- The main contribution of this study is to develop a strategy to estimate the effects of tax changes in a setting that allows for differentiated dynamic responses at different unemployment states.
- This is achieved by extending the recently developed methods of the tax policy literature to a state-dependent VAR framework.

Contribution Cont'd

- Our analysis draws two main conclusions:
  - Effects from a tax change can differ substantially depending on the unemployment state of the economy.
  - Greater slack in the labor market tends to reduce the impact of a tax change on employment and output because of a smaller effect on employment from changes in labor supply and despite a larger effect on aggregate demand.

The State Dependent VAR

- The state of the economy is described by an index variable, d.
- Variable d is a normalized and rescaled version of the unemployment rate gap series to have zero mean and unit variance.
- The benchmark VAR takes the form

$$X_t = \mu + \sum_{i=1}^{q} A_i X_{t-i} + \sum_{i=1}^{q} B_i d_{t-i} X_{t-i} + \sum_{i=1}^{q} C_i d_{t-i}^2 X_{t-i} + u_t,$$

where

$$u_t \sim N[0, \Omega(d_{t-1})], \text{ and } E[u_t u_j'] = 0 \text{ for } t \neq j,$$

with

$$\Omega(d_{t-1}) = [1 - h(d_{t-1})]\Omega_H + h(d_{t-1})\Omega_L,$$

$$h(d_t) = \frac{\exp\{-\eta d_t\}}{1 + \exp\{-\eta d_t\}}.$$

The State Dependent VAR Cont'd

- Our specification accounts for state dependence in two ways:
  - The interaction terms $d_{t-i}X_{t-i}$ and $d_{t-i}^2 X_{t-i}$ included in the core autoregressive part allows the propagation of shocks to vary with the state of the economy.
  - The covariance specification allows the contemporaneous responses of the VAR variables to various shocks to vary with the state of the economy.
- The residual covariance matrix $\Omega(d_{t-1})$ approaches Ω_H (Ω_L) as the unemployment rate gap increases (decreases).

Identification of Tax Shocks

- Tax changes are correlated with myriad economic factors. Isolating the variation in tax revenues that is truly exogenous with respect to macroeconomic aggregates is extremely difficult.
- The identification problem is addressed by drawing heavily on the narrative record of U.S. tax legislations documented in Romer and Romer (2010).
- The narrative record identifies the legislated tax changes implemented to improve the long run performance of the economy and in response to previous budget deficits.
- Identified tax changes are neither characterized by a motivation to stabilize macroeconomic fluctuations nor implemented because spending was changing.

Identification of Tax Shocks Cont'd

- Narratively identified tax changes do not perfectly overlap with structural tax shocks (i.e., exogenous and unexpected changes in tax revenues or rates).
    - The narrative record identifies the exogenous changes in tax liabilities, which correspond to *intended* changes in tax revenues.
    - Observations of exogenous tax changes in the narrative record are subject to measurement error.
- Instead of treating narrative tax changes as structural shocks *per se*, we view them as a series of noisy observations that convey information about exogenous tax shocks.

VAR Residuals, Tax Shocks, and Measurement

- The relationship between the true structural shocks ($v_t \sim N(0, I_{n\times n})$) and the reduced form VAR residuals (u_t) is assumed to be of the form

$$u_t = R(d_{t-1})v_t.$$

- The matrix $R(d_{t-1})$ is linked to the covariance matrix $\Omega(d_{t-1})$ through the relationship $\Omega(d_{t-1}) = R(d_{t-1})R(d_{t-1})'$.
- The relationship between the narrative tax change z_t and the structural tax shock $v_{1,t}$ (the first element of v_t) can be thought to take the form

$$z_t = \theta_t(\psi v_{1,t} + \alpha_t),$$

where $\alpha_t \sim N(0, \sigma_\alpha^2)$ represents measurement error, the parameter ψ is a non-zero constant, and the variable $\theta_t \in \{0, 1\}$ is an indicator function that takes the value 1 in a particular quarter if the narrative account shows a tax change for that quarter and takes the value 0 if otherwise.

Identification

- Using the relationship $u_t = R(d_{t-1})v_t$, the observation equation $z_t = \theta_t(\psi v_{1,t} + \alpha_t)$ can be rewritten in the form

$$\begin{aligned} z_t &= \theta_t \left[\psi \tau R(d_{t-1})^{-1} u_t + \alpha_t\right] \\ &= \theta_t \left[\kappa(d_{t-1}) u_t + \alpha_t\right], \end{aligned}$$

  where τ is a $1 \times n$ vector of all zeros but the first element is replaced with unity, and $\kappa(d_{t-1}) = \psi \tau R(d_{t-1})^{-1}$ denotes a vector-valued state dependent correlation function.
- Given estimates for $\kappa(d_{t-1})$ and $\Omega(d_{t-1})$, the impact vector of the tax shock can be recovered exploiting the relationship

$$R(d_{t-1})_1' = (1/\psi)\kappa(d_{t-1})\Omega(d_{t-1}).$$

Identification Cont'd

- To identify the impact vector $R(d_{t-1})_1$, we need estimates for the objects $\kappa(d_{t-1})$ and $\Omega(d_{t-1})$.
- As a first step, we show that the function $\kappa(d_{t-1})$ is of the form

$$\kappa(d_{t-1}) = g(d_{t-1})\overline{\kappa}$$

where $\overline{\kappa}$ is a $1 \times n$ vector of constants, and

$$g(d_{t-1}) = \psi \left\{ \frac{1 + \exp(-\eta d_{t-1})}{\overline{\kappa}\Omega_H\overline{\kappa}' + [\overline{\kappa}\Omega_H\overline{\kappa}' + \overline{\kappa}(\Omega_L - \Omega_H)\overline{\kappa}'] \exp(-\eta d_{t-1})} \right\}^{\frac{1}{2}}.$$

- This form is consistent with the presumed structure of $\Omega(d_{t-1})$.

Estimation

- All of the VAR objects (autoregressive coefficients and the parameters of the residual covariance matrix $\Omega(d_{t-1})$), are jointly estimated with the parameters of the correlation function $\kappa(d_{t-1})$ adopting a maximum likelihood approach.
- We show that given a series for the unemployment rate gap index $(d_{T-1}, ..d_0)$, the joint log-likelihood of the sample $(X_T, z_T, ..X_1, z_1)$ can be written as

$$\log \mathcal{L} = \overline{\mathcal{L}} + \frac{1}{2}\sum_{t=1}^{T}\left[\log\left|\Omega_{t-1}^{-1}\right| - (X_t - H_t'\beta)'\Omega_{t-1}^{-1}(X_t - H_t'\beta)\right]$$
$$+ \sum_{z_t=0} \log\delta + \sum_{z_t\neq 0}\left[\log(1-\delta) - \log\sigma_\alpha - \frac{1}{2}\left(\frac{z_t - \kappa(d_{t-1})u_t}{\sigma_\alpha}\right)^2\right].$$

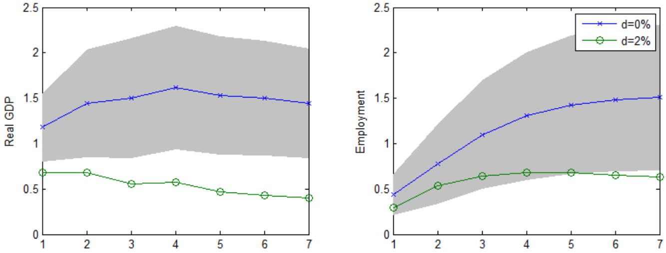
where

$$H_t = I_{n\times n} \otimes [1 \; X_{t-1}' ... X_{t-q}' ... d_{t-q}^2 X_{t-q}']'.$$

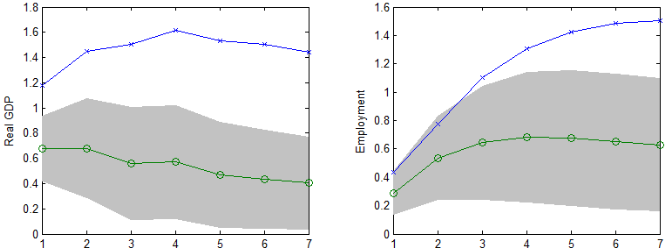
State-Dependent Effects of Tax Changes on Output and Employment

- The benchmark VAR involves a three-variable specification $X_t = [\tau_t \; y_t \; l_t]'$, which includes the change in tax revenues as a percentage of GDP (τ_t), the real GDP (y_t), and total nonfarm employment (l_t) (all except τ_t entered in log-differences).
- The VAR is estimated on quarterly U.S. data. The sample period runs from 1951:I to 2006:IV.
- We follow the Markov chain Monte Carlo (MCMC) approach developed in Chernozhukov and Hong (2003) to compute Laplace type estimates.

Error Bands for the Case d=0%



Error Bands for the Case d=2%



Sensitivity Analysis

- The observed pattern of state dependence remains unchanged under a series of alternative specifications including
  - a case with additional control variables (government debt and interest rates),
  - a specification in log-levels,
  - and a case in which anticipated tax changes are separated from those that are unanticipated.

Conclusion

- Our findings strongly support the notion that effects of tax changes on output and employment can be substantially different in different states of the economy.
- The boost in output and employment from a tax cut tends to become larger in lower unemployment states because of a greater effect on employment from changes in labor supply and despite a smaller effect on aggregate demand.
- Our findings also suggest a high level of labor supply elasticity.

Conclusion Cont'd

- Limitations:
    - Number of observations for a particular unemployment state can be small (and the length of time the economy remains in that state short).
    - Absence of a universal measure for the state of the economy and/or labor market slack
- Potential directions for future research include adopting more targeted measures of state and evaluating the degree of being in a particular state using alternative approaches.