Journal of Macroeconomics 43 (2015) 93–107

Contents lists available at ScienceDirect

Journal of Macroeconomics

journal homepage: www.elsevier.com/locate/jmacro

The contractionary effects of tax shocks on productivity: An empirical and theoretical analysis ☆

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ARTICLE INFO

Article history:
Received 14 January 2014
Accepted 20 September 2014
Available online 16 October 2014

JEL classification:
E23
E62
H31
H32
O41
O47
O51

Keywords:
TFP
Taxes
VAR
DSGE
Learning by doing
Endogenous TFP

ABSTRACT

I analyze the effects of tax policy changes on US Total Factor Productivity. VAR estimates show that permanent and exogenous tax increases have strong, permanent, and negative effects on TFP which represent about 80% of change in output following the tax increase. I then build a DSGE model which has learning-by-doing and endogenous TFP evolution. The benchmark model is able to replicate the empirical impulse responses. However, when I calibrate the model as in the literature, the effect of taxes on TFP is substantially less elastic than in the data. I argue that this divergence may arise because tax changes labeled as exogenous can give spurious results or because of a mis-specified model.

1. Introduction

Total Factor Productivity (TFP), defined as the amount of output not explained by inputs used, is an important determinant of long run growth of an economy. TFP growth, in turn, is the culmination of investments in ideas and technologies, as stressed by recent work in new growth theory.[1] Given this endogenous nature of TFP, one would expect public policy to affect the path of TFP through its effect on the relative price of investments in skills and technology. Yet there have been few attempts to estimate the dynamic response of TFP to policy changes. This paper seeks to fill this gap by looking at the post war US economy to quantify the effects of tax changes on TFP.

The paper makes two important contributions to the literature on effects of tax shocks. First, it empirically estimates the effects of changes in taxes on TFP and other macroeconomic variables. It also looks at the effects of corporate and personal

☆ I would like to thank Ryan Michaels, William Hawkins, and Mark Bils for providing me with valuable feedback. I would also like to thank seminar participants at University of Rochester, NY and University of Winnipeg who provided me with useful comments. Thanks also to an anonymous referee for making extremely useful comments. All mistakes are my own.

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[1] See Ribeiro (2003) and Acemoglu (2008) for a comprehensive review of endogenous growth models and the various mechanisms they employ.

http://dx.doi.org/10.1016/j.jmacro.2014.09.006
0164-0704/

income taxes on these variables separately. Second, it builds a DSGE model with endogenous TFP and human capital evolution to rationalize the empirical results.[2]

The empirical part of the paper estimates the effect of increasing taxes on TFP using VAR models. For the TFP measure, I use the measure of Basu et al. (2006) who purify the Solow residual by controlling for unobserved variations in utilization of inputs. I obtain the measure of tax changes by pooling data on all "exogenous" tax changes documented by Romer and Romer (2009). There are two main results. First, TFP shows a strong, significant, and negative response to this policy change in the long run. This represents about 80% of the change in real output due to the policy change. Second, even in the short run, changes in TFP account for about one third of the response of output. Further, the results show that only changes in labor income taxes have a significant impact on TFP and other macroeconomic variables while changes in capital income taxes do not significantly affect most of the variables.

The second part of the paper asks whether the large estimated effects on TFP of taxes can be consistent with standard macroeconomic models. Many macroeconomic models of the business cycle, for example the real business cycle model (Kydland and Prescott, 1982; Long John and Plosser, 1983) and the New Keynesian model (Christiano et al., 2005), do not endogenize TFP, and so cannot be used to analyze the response of TFP to policy changes. One leading class of candidate models in which TFP is endogenous is the class of new growth models (Romer, 1990; Lucas, 1988); however, it seems unlikely that innovation is important for driving fluctuations in TFP. A leading possible explanation that could potentially account for movements in TFP following a tax change is a model in which learning-by-doing takes the form of an externality: the TFP of all firms is increased when human capital is high. Therefore I build a DSGE model with this feature, and ask whether it can be consistent with the empirical responses of TFP to tax policy changes.

Since the empirical results show that only labor income taxes significantly impact TFP and other macroeconomic variables, I only use labor income tax shock in the model. I consider two different estimation routines for the parameters of the model. In the benchmark case, I do not impose any restrictions on the estimation of model parameters. The results show that the model is successful in generating impulse responses that are qualitatively and quantitatively consistent with the empirical impulse responses. I then impose restrictions on the parameter estimation using external evidence on the effect of labor supply on human capital accumulation and the effects of factor inputs on TFP. The simulations of the model show that the model generated dynamic responses of various variables to tax shocks are qualitatively consistent with their empirical counterparts. However, quantitatively, these responses fall short of the empirical estimates.

The online appendix to this paper argues that based on external validation tests, the model with restrictions imposed on parameters estimation should be used. These external validation tests compare those responses from the model and the data that were not targeted when estimating the model parameters. I argue that the gap between the empirical and impulse responses generated from the model with restrictions can be either because the data overstates the true impact of changes in tax on TFP, or because of the model missing an important channel, or because the parameter values are underestimated by micro studies. These values when plugged into the model generate quantitatively smaller impulse responses.

This paper is the first to look at the effects of tax changes on TFP. Mertens and Ravn (2010) show that including tax shocks in the empirical analysis of effects of productivity shocks on hours worked invalidates the standard long run identifying assumption used in such studies. They show that tax shocks affect productivity significantly in the short and the long run. Heylen and Schoonackers (2011) use data on OECD countries from 1975 to study the effect of taxes and other fiscal variables on labor productivity. They find that a rise in personal income taxes significantly reduces the labor productivity. At a micro level, Gemmel et al. (2010) and Arnold and Schwellnus (2008) use a panel data of firms of OECD countries over the period 1996–2004 to show that raising corporate taxes reduces the productivity of firm by 0.2–0.4%. Kim (1998) used an endogenous growth model to explain that difference in tax rates explain about 30% of the difference in growth rates of the USA and Korea.

This paper contributes to the existing literature on the macroeconomic effects of tax shocks such as Mertens and Ravn (2013, 2011), Romer and Romer (2010), Blanchard and Perotti (2002), and McGrattan (1994). These papers look at the response of various macroeconomic variables to tax shocks. Mertens and Ravn (2011) also showed that a DSGE model is capable of replicating empirical responses of macroeconomic variables to tax shocks as identified by Romer and Romer (2009). The literature on tax shocks has not, so far, looked at the possible effects of tax shocks on TFP which can have important effects since effects on TFP translate into long term growth effects of the economy. This paper attempts to fill this void by using the data of Romer and Romer (2009) about tax shocks with TFP estimates by Fernald (2009) to empirically estimate the response of TFP to tax shocks.

2. Empirical analysis

2.1. Data

The data on tax shocks comes from Romer and Romer (2009). Romer and Romer (2009) study each major tax bill signed in the post war era in the United States. They classify each tax change as either exogenous or endogenous based on their anal-

[2] The online appendix to this paper also presents a comprehensive analysis of the effects of tax changes on TFP and other variables over time and rationalizes it with theory.