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US CORPORATE TAX REFORM AND ITS MACROECONOMIC OUTCOMES

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Abstract

Tax reform has been one of the most controversial issues among economists as it can have significant impacts on macroeconomic fundamentals. Though much has been said about the adverse effects of the corporate tax hikes on macroeconomic variables, less has been said about the magnitude of these effects. This study attempts to measure the impacts of corporate tax reform on macroeconomic variables, such as investment, real GDP, productivity, wages, unemployment rate, and consumer price index (CPI). Using quarterly data for the period of 1990 through 2020 and ordinary least squared (OLS) technique, the results of this research study suggest that a 10 percentage point increase in the effective corporate tax rate reduces private investment by 3.1 percent, real GDP by 1.5 percent, productivity by 2.6 percent, and hourly wages by 2 percent. Moreover, it raises the short-term unemployment rate by 0.5 percent, the natural rate of unemployment by 1 percent and the consumer price index (CPI) by 0.9 percent.
Keywords: Corporate tax reform, macroeconomic fundamentals, unemployment, GDP growth

INTRODUCTION

The views on tax hikes during the recession vary widely and fundamentally among economists; though much has been said about the adverse effects of taxmageddon on macroeconomic variables, less has been mentioned on how a corporate tax hike affects macroeconomic variables. To address this question, this paper attempts to measure quantitative effects of a rise in corporate tax rate on some macroeconomic variables including investment, GDP, productivity, wage index, unemployment rate, natural rate of unemployment, and CPI.

According to Orthodox Keynesian models, taxes serve as automatic stabilizers because they reduce effective demand during the upturns and increase it during the downturns. But the automatic stabilizer is only functional under price and wage rigidity. However, the price and wage rigidity does not apply to all circumstances. New Keynesians believe that small menu costs for price adjustment may give rise to large fluctuation in output (See Ball, Mankiw and Romer 1999)[1]. Indeed, in orthodox Keynesian models, prices are often assumed to be sticky and they do not necessarily bring equilibrium to all markets at all times. New Keynesians argue since the "menu costs" (costs for changing the prices and informing individuals) are small they provide weak foundation for sticky models. They believe that small menu costs can cause large welfare losses. "The claim that price adjustments are small does not rebut the claim that they are central to understanding economic fluctuations because private incentives produce too much price adjustment following an expansion in aggregate demand and too little price adjustment, following a contraction in aggregate demand. In this sense, prices are downwardly rigid but upwardly non-rigid".[2] Therefore, the automatic stabilizer notion of tax rates does not apply to their theory.

To investigate the automatic stabilizer notion of tax rates this paper tries to cast light on this issue by quantifying the effects of corporate tax hikes on macroeconomic variables. The study implements a large quarterly time series database from 1990-Q1 through 2020-Q4 to measure the effects of one standard deviation in corporate tax rate on private investment, real GDP, productivity, wage index, unemployment rate, and CPI.

LITERATURE REVIEW

Gummins and Hassett (1992) examine the effects of taxation on investment. They use industrial panel data from 1970-1989 and a Vector Auto-Regression (VAR) technique. They conclude that the effect of taxes on equipment and structure investment is statistically significant.

Engen and Skinner (1996) investigate the impact of tax reform on macroeconomic growth, labor supply, and productivity growth. They look at the U.S. historical data to see if there is a link between changes in tax policy and changes in economic growth. They find that the Regan tax cut lead to an average growth rate of 3.9 percent from 1983 to 1989, which was significantly above the preceding period of 1980-82.

[1] Laurence Ball, Gregory Mankiw, and David Romer, "The New Keynesian Economics and the Output-Inflation Trade off, at http://scholar.harvard.edu/sites/scholar.iq.harvard.edu/files/mankiw/files/new_keynesian.pdf.
[2] Gregory Mankiw, "Small Menu Costs and Large Business Cycles: A Macroeconomic Model of Monopoly", Quarterly Journal of Economics, Vol. 100, No2. May 1985, PP. 529-537, at http://www.jstor.org/sici?sici=0033-5533%28198505%29100%3A2%3C529%3ASMCALB%3E2.0.CO%3B2-O&origin=JSTOR-pdf.

Romer and Romer (2007) consider all significant legislated tax changes in the period of 1947 to 2006 to measure the impacts of tax changes on real economic performance. They examine the relationship between tax changes and growth rate of real output by estimating an equation where GDP growth is a function of tax rate. Their estimated results suggest that the maximum impact of a tax hike is a 3% fall in output.

Barro and Redlick (2009) investigate macroeconomic effects of government purchases and taxes. They use annual data from 1912 to 2006 and estimate an equation for per capita GDP growth rate as a function of tax rate and government spending. Their estimates suggest that a cut of 1 percentage point in marginal tax rate leads to a rise of 0.6% in per capita GDP growth rate.

Galindo and Pombo (2011) investigate the impact of corporate tax reform on investment and productivity. Using data for a set of 42 developing countries, they examine whether firms with different sizes are differently affected by taxation. Their results indicate that corporate tax rate has a negative impact for the medium and large firms.

Carroll and Prante (2012) investigate the long-run impacts of increasing tax rates on high income taxpayers in 2013. They use a General Equilibrium Model of the U.S. economy to examine the effect of the increase in the top tax rates in the long-run. Their report addresses four sets of policy changes: (i) the effects of increase in the top tax rates from 33% to 36% (ii) reinstatement of the limitations on itemized deductions for high income taxpayers (Pease provision) (iii) taxation of dividends as ordinary income (iv) and finally, an increase in the 2.9% Medicare tax to 3.8% for high income taxpayers. The combination of these tax changes at the beginning of 2013 means that the top tax rate on ordinary income will raise from 35% in 2012 to 40.9% in 2013. The top tax rate on dividend will rise from 15% to 44.7% and the top tax rate on capital gains will rise from 15% to 24.7% for the same period. The authors find that the higher marginal tax rates result in smaller economy, fewer jobs, less investment, and lower wages. Particularly, they find that higher tax rates will have significant adverse economic effects in the long-run: lowering output, employment, investment, capital stock and real after tax wages. Based on their results output would fall by 1.3%, employment by 0.5% (710,000 fewer jobs), investment by 2.4%, and real after tax wages would fall by 1.8%.[3]

Artruo Jose Galindo and Cristina Pombo (2011) investigate the impact of corporate taxation on investment and productivity. They use data for a set of 42 developing countries and examine whether firms with different sizes are affected differently by taxation. Their sample

[3] Robert Carroll and Gerald Prante, "Long-run Macroeconomic Impact of Increasing Tax Rates on High Income Taxpayers in 2013," Ernest & Young, July 2012, at http://waysandmeans.house.gov/uploadedfiles/ey_study_long-run_macroeconomic_impact_of_increasing_tax_rates_on_high_income_taxpayers_in_2013__2012_07_16_final.pdf

covers the years 2004 to 2006 and they measure the impacts of corporate tax rates on investment and total factor productivity. They use independent variables such as corporate tax rate, size, and GDP per capita. Their results indicate that corporate tax rate has a negative impact for medium and large firms. For example a one standard deviation increase in corporate tax rate (0.10) would reduce investment for large firms by 0.016. The results on productivity suggest that corporate tax rate hurt larger firms more than smaller ones. A one standard deviation increase in the corporate tax rate would reduce total factor productivity (TFP) by 0.8. Like many scholars they conclude that corporate taxes have a negative impact on investment and productivity; and the impact is bigger for larger firms. They argue that tax policies will have large implications for business environment and economic development. Indeed, there is a trade-off between collecting revenues by the government and long-term economic growth.[4]

Simeon Djankov, Tim Ganser, Caralee McLiesh, Rita Ramalho, and Andrei Shleifer (2010) investigate the effects of corporate taxes on investment. They use data on effective corporate income tax rates in 85 countries in 2004. The data covers 22 rich OECD countries, 10 East Asia, 17 Eastern Europe, 13 Latin America, 6 in Middle East, 14 in Africa, and 3 in South Asia. The data is received from Price Waterhouse Coopers accountants and tax lawyers. They primarily analyze the effects of corporate taxes on aggregate investment and entrepreneurship. They use two measures of investment: gross fixed capital formation and foreign direct investment (FDI) both as a percentage of GDP. They also examine two measures of entrepreneurship: the number of business establishment and the rate of new business registration and control for variables such as tax evasion, property rights, and government regulations, such as those of entry and labor market regulations, which affect investment and entrepreneurship. They find that there is a large statistically negative impact from corporate tax rate on both investment and FDI. Their estimates indicate that raising the effective tax rates by 10 percentage points reduces investment rate by 2.2 percentage points and FDI by 2.3 percentage points. The results are close to those found in the literature, where the elasticity of investment to the tax-adjusted user cost of capital is between -0.5 and -01.0. Moreover, their robustness check after using control variables suggest that these variables have not made much a difference on the effects of corporate tax on investment. In other words, none of the control variables appear to be as persistently important as do the tax rates. They conclude that corporate tax rates have substantial adverse effects on investment and entrepreneurship. They also investigate whether the corporate tax rate encourages debt financing. They find that a 10

[4] Arturo Jose Galindo and Cristina Pombo, "Corporate Taxation, Investment, and Productivity: A Firm Level Estimation, Journal of Accounting and Taxation, Vol. 5 (7), pp 158-161, November 2011 at http://www.academicjournals.org/JAT.

percentage points increase in the effective corporate tax rate raises the debt to equity ratio by highly statistically significant 40 percentage points. They find that countries with higher effective tax rate use more debt to equity ratios.[5]

Robert Barro and Charles Redlick (2009) investigate macroeconomic effects of government purchases and taxes at Harvard University. They use annual data from 1912 to 2006 and estimate an equation for per capita GDP growth rate as a function of tax rate and government spending. They also include lagged values of marginal tax rate in their model. Their estimates suggest that a cut of 1 percentage point in marginal tax rate raises next year per capita GDP growth rate by approximately 0.6% per year.[6]

To measure the impacts of tax changes on real economic performance Christian Romer and David Romer (2007) consider all significant legislated tax changes in the period of 1947 to 2006. They try to test whether tax changes cause output growth. They identify 49 tax laws during the mentioned period. They examine the relationship between tax changes and the growth of real output by estimating an equation where GDP growth is a function of tax rate. Their estimated results suggest that the maximum impact is a fall of 3 percent in output. They also consider two measures of changes in monetary policy. The first is a dummy for an anti-inflationary monetary policy and the second is a continuous indicator of monetary shocks derived as residuals of a regression of the change in the Federal Fund Rate target on the Federal Reserve's internal forecast of inflation and real growth. Controlling for monetary policy, their forecast of the impact of the tax increase on output is a decline of 3.1 percent. They also control for government spending by changes in real federal gross government expenditures less interest payments, divided by real GDP. The maximum impact of total tax increase by one percent of GDP is an output decline of 2.9 percent. Controlling for oil shock, the tax rise effect on output falls to in the range of 2.5 to 2.7 percent.[7]

James Gwartney and Robert Lawson (2006) examine how taxes, especially high marginal tax rates on high income groups, affect economic performance and the distribution of income. They implement cross-country data on changes in marginal tax rates since the 1980s to see how changes in the tax rates affect economic growth and inequality during 1990-2002. They collect data for seventy-seven countries that levied a personal income tax throughout 1980-

[5] Simeon Djankov, Tim Ganser, Caralee McLiesh, Rita Ramalho, and Andrei Shleifer, "The Effects of Corporate Taxes on Investment and Entrepreneurship, American Economic Journal: Macroeconomics 2 (July 2010): PP31-64, at http://www.aeaweb.org/articles.php?doi=10.1257/mac.2.3.31.

[6] Robert J. Barro and Charles J. Redlick, "Macroeconomic Effects from Government Purchases and Taxes", Harvard University, October 2009 at http://www.economics.harvard.edu/faculty/barro/files/Barro%2BRedlick%2Bpaper%2B_2_.pdf.

[7] Christian D. Romer and David Romer, "The Macroeconomic Effects of Tax Changes: Estimated Based on a New Measure of Fiscal Shocks, University of California, Berkeley, March 2007, at http://elsa.berkeley.edu/~cromer/RomerDraft307.pdf.

2002. Some countries tried to maintain top marginal tax rates at high levels during the 1980s and most of 1990s. They use regression analysis to investigate the links between changes in top marginal tax rates and economic growth for all of seventy-seven countries. Their dependent variable is the growth rate of real GDP per capita and they control for GDP per capita at the beginning of the period and the initial top marginal tax rates. They conclude that a 10-percentage point reduction in the top marginal tax rate is associated with 0.5 percent increase in long-term growth. They argue that high income countries like United Kingdom, United States, and New Zealand that have cut their high-top tax rates from 70 percent to 40 percent or less in the 1980s have experienced a growth of approximately 2 percent per year. Whereas countries like Japan, France, Germany and other members of the EU that have maintained a top marginal tax rate of 50 percent or more have experienced a growth rate of 1.5 percent since the 1990. They conclude that high marginal tax rates of 50 percent and above have retarded economic growth in many EU countries.[8]

Rodrigo Vergara (2004) investigates the impacts of taxation on private investment in Chile. Investment equation is estimated using annual macro data for the period of 1975-2003 to investigate the impact of tax reforms on macroeconomic variables. Their sample covers a period, in which the corporate income tax was substantially reduced. The tax reform in 2001 increased the corporate tax from 15% to 17% in a three-year period. It then rose to 16% in 2002, to 16.5% in 2003, and to 17% in 2004. He uses changes in interest rates, price of capital goods, and private credit as independent variables. His results indicate that for each 10 percentage point decrease in tax rate, private investment as a percentage of GDP jumps up by 0.57 percentage points in the short-run and by 0.9 percentage points in the long run. He concludes that lower corporate income tax rate in Chile after the reform of 1984 has had a significant positive effect on private investment. Indeed, both tax rate and taxes paid have negative significant effect on investment, because taxes affect investment through the cost of capital channel (higher taxes increase the cost of capital) and through the liquidity channel (higher taxes reduce the internal funds available for investment). His results suggest that for the period of 1975-2003 the tax reform explains an increase of three percentage points in private investment ratio to GDP.[9]

Eric Engen and Jonathan Skinner (1996) investigate the impact of tax reforms on macroeconomic growth, labor supply, and productivity growth. They use three approaches.

[8] James D. Gwartney and Robert A. Lawson, "The Impact of Tax Policy on Economic Growth, Income Distribution and Allocation of Taxes", Social Philosophy and Policy Foundation, 2006, at http://mailer.fsu.edu/~jgwartne/garnet-jgwartne/Documents/GwartneyLawsonSocialPhilosophyandPolicy.pdf .

[9] Rodrigo Vergara, "Taxation and Private Investment: Evidence for Chile", Pontificia Universidad Catolica de Chile, Instituto De Economia, Documento de Trabajo, July 2004, No.268. at http://www.economia.puc.cl/DT?docid=2512

First, they look at the U.S. historical data to see if there is a link between changes in tax policy and changes in economic growth across time. Second, they consider whether growth rates across countries can be attributed to various tax policies. Third, they underpin the micro-level studies to see how taxes affect specific subsectors of the economy. Using data from 1959-95, they argue that with the Kennedy-Johnson tax cuts in 1964 real GDP growth rate averaged 4.8 percent over 1964 to 1969. The Regan tax cut also lowered the average tax rate, leading to an average growth rate of 3.9 percent from 1983 to 1989, significantly above the preceding period of 1980-82. Finally, their third approach is to measure the impact of corporate tax rate reform on microeconomic variables, like labor supply and productivity. They find that both work hours and labor force participation for men are only mildly responsive to tax changes.[10]

Jason Gummins and Kevin Hassett (1992) investigate the effects of taxation on investment. They use industrial panel data from 1970-1989 and a Vector Auto-Regression (VAR) technique. Their results suggest that investment was on average lower than would have been using pre-tax reform information. They conclude that the effect of the cost of capital and tax rate on equipments and structures investment is both economically and statistically significant.[11]

Amazingly, both within and cross-country studies indicate that raising corporate tax rate will reduce investment, retard long-term economic growth and decrease total factor productivity. However, less has been said on the quantitative effects of corporate tax reforms on long-term and short-term unemployment rate, wages, and CPI. One of the novel features of this study is that it measures the magnitude of corporate tax rates not only on the investment and real output but also on natural rate of unemployment rate, wage index, and CPI.

Alverza Matinez et al. (2018) use a computable general equilibrium model (CGE) for European countries and find that countries are better off when lowering corporate tax rates and replacing the lost revenue with labor tax rises. They also find that uncoordinated tax reform among EU countries have significant country-specific impact on national economies, though they generate negligible on the aggregate EU macroeconomic variables. Their results suggest that spill-over effects on other EU countries are more significant when large economies implement a CIT rate cut.

Wielen (2020) examines the macroeconomic effects of tax changes in the European Union between 2000 and 2016. Using anticipated and unanticipated tax changes and panel

[10] Eric Engen and Jonathan Skinner, "Taxation and Economic Growth", National Tax Journal, Vol. 49. No. 4 (December 1996) pp.617-642 at http://www.dartmouth.edu/~jskinner/documents/EngenSkinnerTaxEconGrowth.pdf.
[11] Jason G. Gummins and Kevin A. Hassett, "The Effects of Taxation on Investment: New Evidence from Firm level Panel Data, National Tax Journal, Vol. 45, no.3, pp 243-51, at http://ntj.tax.org/wwtax/ntjrec.nsf/0/4f54fd9041aec3118525686c00686dfa/$FILE/v45n3243.pdf .

data, he finds that medium-term output multipliers are in the range of -1.1 to -1.9 for unanticipated tax changes. Finally, his results suggest that EU tax cuts and hikes differed in their absolute economic impact among different countries.

Baley, Blanco & Markiewitz (2022) study how monetary policy responds to corporate tax reforms. Using cross country data for the period of 1960-2020, they show corporate tax reform shocks are exogenous to current inflation and output. They find that the central banks raise the policy rates an average of 2 percentage points, following a drop of 10 percentage points in corporate income tax rates. They use a Keynesian model to assess the effects of tax rate reform on macro variables.

DATA AND METHODOLOGY

Since the empirical studies in the literature have shown contradicting results on the effects of tax reform on macroeconomic variables this study tries to estimate the quantitative effects of the corporate tax reform on macroeconomic variables by estimating econometric models with annual data for the period of 1990-2020. The reason for choosing this period is that several tax rate changes have occurred during the above-mentioned time period. The data are available on the Federal Reserve Bank of St Louis for the historical period at the following website: https://fred.stlouisfed.org/

The results can help us measure the effects of one standard deviation in the corporate tax rate on private investment, GDP growth rate, productivity, wage index, unemployment rate, CPI, foreign direct investment, and income distribution. Indeed, one of the advantage of this study compared to others is that it considers several macro variables that have not been considered in the previous studies, including FDI, income distribution, and natural rate of unemployment.

The results will have important policy implications for policy makers as it enables them to make a better decision on the corporate tax reform with better understanding the comprehensive macroeconomic outcomes of such a reform.

THEORETICAL FRAMEWORK

Data on investment, GDP, productivity, wage, unemployment, natural rate of unemployment, and CPI are retrieved from Federal Reserve Bank of St. Louis to investigate how changes in effective corporate tax rates affect the macroeconomic variables. Each equation will be estimated using OLS technique with quarterly data for the period of 1990-Q1 through 2020-Q4.

A Keynesian investment model as a function of real GDP and real interest rate will be estimated, where the effective corporate tax rate is embedded into the model.

$$Inv = \alpha_0 + \alpha_1 GDP + \alpha_2 R\text{int}erest + \alpha_3 Corptax \quad (1)$$

A Solow growth model is defined as a function of capital and labor, where the corporate tax rate is embedded into the model.

$$GDP = \alpha_0 + \alpha_1 Capital + \alpha_2 Labor + \alpha_3 Corptax \quad (2)$$

Similar to the study of Robert Gordon on NAIRU (1979)[12] productivity is defined as a function of unemployment rate, wage index, and oil shock.

$$\text{Pr}oductivity = \alpha_0 + \alpha_1 Unemploy + \alpha_2 Wage + \alpha_3 Oilp + \alpha_4 Corptax \quad (3)$$

Following David Card (1999)[13], the wage index is assumed to be a function of GDP growth, openness, and education.

$$Wage = \alpha_0 + \alpha_1 GDPG + \alpha_2 Openness + \alpha_3 Education + \alpha_4 Corptax \quad (4)$$

Unemployment rate is estimated as a function of investment, education, lagged values of unemployment rate, and CPI.

$$Unemploy = \alpha_0 + \alpha_1 Inv + \alpha_2 Education + \alpha_3 Unemploy1 + \alpha_4 CPI + \alpha_5 Corptax \quad (5)$$

Based on Okun's Law[14] long-run unemployment rate is a function of real interest rate, GDP growth, oil shock, and lagged value of unemployment rate.

$$NROU = \alpha_0 + \alpha_1 R\text{int}erest + \alpha_2 GDPG + \alpha_3 Oilp + \alpha_4 Unemploy1 + \alpha_5 Corptax \quad (6)$$

Finally, CPI is estimated as a function of money supply and Corporate tax rate.

$$CPI = \alpha_0 + \alpha_1 M2 + \alpha_2 Corptax \quad (7)$$

The effective corporate tax rate is embedded into all models to see whether it plays any role in affecting these variables.

ANALYSIS AND RESULTS

This section represents the data and the regression results for our models. This analysis uses quarterly data from the first quarter of 1990 through the fourth quarter of 2020 to estimate

[12] Robert Gordon, "The Time Varying NAIRU, and its Implications for Economic Policy, Journal of Economic perspectives, Volume 11, No 1, Winter 1997, pp 11-32 at http://www.rimini.unibo.it/fanelli/Gordon_1997JEP.pdf.
[13] David Card, The Causal Effect of Education on Earnings, Department of Economics, University of California Berkeley, 1999, at http://www.stanford.edu/group/scspi/_media/pdf/Classic_Media/Card_1999_Education.pdf.
[14] See Francesco Bartolucci, Misbah T. Choudhry, Enrico Marelli, and Marcello Signorelli (2011). Financial Crisis and Unemployment: Beyond the Okun's Law, at http://www.eco.unibs.it/~emarelli/AIEL.pdf. Also see Leopold Sogner and Alfred Stiassny, "A Cross-Country Study on Okun's Law", Vienna University of Economics and Business Administration, working paper No 13, at http://epub.wu.ac.at/996/1/document.pdf .

the effects of corporate tax rate changes on private investment, GDP, productivity, wage index, unemployment rate, and CPI. The list of variables, their summary statistics, and sources are presented in Table 1.

Table 1. List of Variables and their Summary Statistics

Variable	Definition	Mean	Maximum	Minimum	Stand. Dev.	Source
GDP	Real Gross Domestic product	7578.89	13491	2800.2	3337.68	Federal Reserve Bank of St. Louis
GDPG	Real GDP Growth	0.75	3.9	-2.3	0.87	Federal Reserve Bank of St. Louis
Inv	Private Investment	875.25	2352.1	68.1	700.33	Federal Reserve Bank of St. Louis
Invr	Investment ratio to GDP	0.63	0.78	0.42	0.06	Heritage Foundation calculation
Gexpr	Government Expenditures ratio to GDP	1.20	1.46	0.90	0.12	Federal Reserve Bank of St. Louis
Corptax	Effective Corporate Tax Rate	37.40	52.0	23.1	7.81	Heritage Foundation calculation from Corporate Tax Model
Interest	Effective Federal Fund Rate	5.62	17.78	0.07	3.47	Federal Reserve Bank of St. Louis
CPI	Consumer Price Index (1983=100)	111.50	228.34	29.39	64.24	Federal Reserve Bank of St. Louis
Inf	Inflation rate of CPI	0.99	3.94	-2.32	0.77	Heritage Foundation calculation
Rinterest	Real interest rate=Interest-Inf	4.63	15.69	-1.00	3.02	Heritage Foundation calculation
M2	Money Supply	4575.62	9764.1	1619.8	2165.5	Federal Reserve Bank of St. Louis
Oilprice	Oil price	24.94	123.96	2.92	24.50	Federal Reserve Bank of St. Louis
Employ	Employment	59.84	64.6	55.2	2.81	Federal Reserve Bank of St. Louis
Capital	Stock of Gross Fixed Capital	260.11	684.3	25.7	208.36	Federal Reserve Bank of St. Louis
Labor	Civilian Labor Participation Rate	63.70	67.3	58.5	2.91	Federal Reserve Bank of St. Louis
Wage	Hourly wage in dollars	9.37	19.07	2.14	5.37	Federal Reserve Bank of St. Louis
Productivity	Productivity Index	85.01	102.82	69.04	9.59	Federal Reserve Bank of St. Louis
Employ	Employment rate	59.84	64.6	55.2	2.81	Federal Reserve Bank of St. Louis

Table 1…

Unemploy	Unemployment	6.05	10.70	3.40	1.61	Federal Reserve Bank of St Louis
Unemploydur	Unemployment duration	8.10	23.20	4.20	3.68	Federal Reserve Bank of St. Louis
NROU	Natural Rate of Unemployment	5.62	6.27	5.00	0.44	Federal Reserve Bank of St. Louis
Openness	Ratio of Imports plus Exports to GDP	4.62	8.00	2.11	1.61	Federal Reserve Bank of St. Louis
Education	Tertiary ratio	67.74	94.80	47.12	13.23	World Bank Data Base (WDI)
BC	Business Cycle	1.28	3.95	-3.74	1.23	Federal Reserve Bank of St. Louis

Note: Data from Federal Reserve Bank of St Louis retrieved from http://research.stlouisfed.org/fred2/series and data from World Bank retrieved from http://databank.worldbank.org/ddp/home.do?Step=2&id=4&DisplayAggregation=N&SdmxSupported=Y&CNO=2&SET_BRANDING=YES and data for corporate tax rate from IRS.

Despite the controversy on the effects of tax policy reform; it is unarguable that a tax hike during a recession would exacerbate the economic recession. A tax burden adversely affects investment, and as a result other macroeconomic variable. Indeed, the estimated results in Table 2 suggest that corporate tax hike has statistically significant adverse impacts on macroeconomic variables such as investment, GDP, productivity, short-term unemployment, natural rate of unemployment and CPI. All models have been estimated in the logarithm form; therefore the coefficients are elasticities. All models are tested for robustness.

The results suggest that a 10-percentage point increase in effective corporate tax rate reduces investment by 3.1, real GDP by 1.5, productivity by 2.6, and hourly wages by 2 percent.

The effects on both short-run and long-run unemployment rates are positive as expected. The short-run unemployment shows a jump of 0.5 percent because of 10 percentage point increase in the corporate tax rate; and the long-run natural rate of unemployment will jump up by 1 percent. The CPI is expected to rise by 0.9 percent because of this tax policy shock. Interestingly, all the estimated models are able to explain more than 70 percent of dependent variables, and the F statistics are statistically significant.

Transmission Channels

As the results for the investment model suggest, an increase of 10-percentage point in effective corporate tax rate reduces investment by 3.1 percent. Indeed, the increase in tax rate not only reduces the availability of the resources or liquidity for investment but also reduces the

rate of return on investment and penalizes investors, which in turn adversely affects the amount of investment.

Table 2. Estimated Effects of Effective Corporate Tax Rates on Macroeconomic Variables

Dependent Variables / Independent Variables	Investment	GDP	Productivity	Wage	Unemploy	NROU	CPI
GDP	2.16***						
	(0.02)						
GDPG				-0.13		-0.005	
				(0.01)		(0.005)	
Corptax	-0.31***	-0.15**	-0.26***	-0.20***	0.052*	0.10***	0.09***
	(0.048)	(0.02)	(0.05)	(0.06)	(0.03)	(0.02)	(0.01)
Inv					-0.21***		
					(0.03)		
Capital		1.02***					
		(0.01)					
Labor		0.46*					
		(0.26)					
M2							0.57***
							(0.006)
Unemploy			-0.22***				
			(0.03)				
Wage			0.45**				
			(0.07)				
Rinterest	0.13***					0.033***	
	(0.01)					(0.005)	
CPI					0.33***		
					(0.05)		
Oilp			-0.20***			-0.03***	
			(0.02)			(0.004)	
Openness				1.07***			
				(0.07)			
Education				0.75***	-0.0007		
				(0.09)	(0.0007)		
Unemploy(-1)					0.92***	0.25***	
					(0.02)	(0.01)	
R-Squared	0.98	0.99	0.74	0.93	0.96	0.81	0.97
F Statistic	2563.57	8487.63	60.59	424.15	1032.98	153.02	4422.45

Note: * Statistically significant at 10%, ** statistically significant at 5%, *** statistically significant at 1%. Numbers in parentheses are standard errors.

The GDP drops due to lower investment; the productivity falls because higher corporate tax rate reduces hourly wages as investors try to reduce their costs to compensate for higher tax costs. Not only investors will try to reduce the wage costs, but also they will lay off some workers to compensate for a tax hike. Of course, this is the demand side effect, which affects wages, productivity, and unemployment rate. On the supply side, however, a higher corporate tax rate reduces hourly wages and therefore induces workers to work longer hours to retain their purchasing power constant, shifting the labor supply to the right and creating higher unemployment rate in the short-and the long-run.

The estimated results on the effects of taxes on the unemployment rate suggest that as a result of 10 percentage point increase in the corporate tax rate the short-term unemployment jumps up by 0.5 percent, however, the effects will be more intense in the long run (1 percent). Indeed, the reason for higher unemployment rate in the long-run is that though investors may be reluctant to lay off workers in the short-run due to some rigidities but in the long-run they will be able to lay off more workers as they replace workers by machines. Finally, consumer price index (CPI) is expected to rise because the higher tax rate reduces investment and real output, creating shortage in the supply of goods and services, which in turn leads to higher prices.

CONCLUSION

This paper examined the effects of corporate tax rates on a set of macroeconomic variables including real output, private investment, productivity, the wage index, unemployment rate, and consumer price index (CPI). One of the novel features of this study is that it captures the quantitative effects of corporate tax rate on short-and long-term unemployment rate.

Our results are very close to those of Robert Carroll and Gerald Prante (2012), who find output would fall by 1.3 percent. Our results are also close to their finding that a 10-percentage point increase in corporate tax rate is associated with a 2.2 percent reduction in investment; our results indicate a 3.1 percent reduction in private investment. Our results are also close to those of Simeon Djankov, Tim Ganser, Caralee McLiesh, Rita Ramalho and Andrei Shleifer (2010) who found a 10-percentage point increase in corporate tax rate is associated with 2.2 percent reduction in private investment.

Contrary to Eric Engen and Jonathan Skinner (1996) who find that labor force participation and productivity are only mildly responsive to tax policy changes, we find that a 10 percentage-point increase in corporate tax rate reduces the productivity by 2.6 percent. Indeed, one of the reasons that productivity has dropped dramatically during the past few years is due to higher corporate tax rates. As mentioned earlier, with a higher corporate tax rate investors will

have incentives to reduce wages to compensate for higher taxes, which, in turn, adversely affects labor productivity.

The results of this study__ in contrast to those of Robert J. Gordon who argues the drop in productivity can be attributed to globalization, household and government debt, baby boomers, and inequality__ suggest that the hikes in corporate tax rates are among the most important factors in lowering productivity, and wages.

Finally, while the short-term unemployment rate rises by 0.5 percent because of 10-percentage point increase in the effective corporate tax rate, the natural rate of unemployment rises by 1 percent. The more intense long-term effect of a tax policy on unemployment rate is due to the ability of investors to lay off more workers in the long run.

RECOMMENDATIONS

In sum, the adverse effects of corporate tax rates on macroeconomic variables suggest that any changes in corporate tax rate will have huge and significant impacts on macroeconomic variables and should be carried out with considerable attention to macroeconomic outcomes, otherwise a corporate tax hike will delay the recovery of a sluggish economy, which is already suffering from a burdening high rocketed inflation rate.

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APPENDIX

1: Selected Empirical Studies on the Effects of Tax Reforms on Economic Growth

Reference	Method/Data	Effects	Summary of Findings
Ergete Ferede & Bev Dahlby (2012) The Impact of Tax Cuts on Economic Growth: Evidence from the Canadian Provinces, 65 *National Tax Journal, Vol 65* (3) pp. 563-594.	Canadian provinces (1977-2006)	Negative	Reducing corporate income tax 1 percentage point raises annual growth by 0.1 to 0.2 points.
Karel Mertens & Morten Ravn (2012) The dynamic effects of personal and corporate income tax changes in the United States, *American Economic Review*, *Vol 103* (4), pp. 1212-1247.	U.S. Post-WWII exogenous changes in personal and corporate income taxes	Negative	A 1 % point cut in the average personal income tax rate raises real GDP per capita by 1.4 % in the first quarter and by up to 1.8 % after three quarters. A 1 % point cut in the average corporate income tax rate raises real GDP per capita by 0.4 % in the first quarter and by 0.6 % after one year.
Robert Barro & C.J. Redlick (2009) Macroeconomic Effects of Government Purchases and Taxes, 126 *Quarterly Journal of Economics* 126, pp. 51-102.	U.S (1912 to 2006)	Negative	Cut in the average marginal tax rate of one percentage point raises next year's per capita GDP by around 0.5%.
Christina Romer & David Romer. (2010). The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks, *American Economic Review 100,* pp.763-801.	U.S. Post-WWII (104 tax changes, 65 exogenous)	Negative	Tax (federal revenue) increase of 1% of GDP leads to a fall in output of 3% after about 2 years, mostly through negative effects on investment.
International Monetary Fund (2010). *Will it hurt?* Macroeconomic effects of fiscal consolidation, in, World Economic Outlook: Recovery, Risk, and Rebalancing.	15 advanced countries (170 fiscal consolidations over the last 30 years)	Negative	1% tax increase reduces GDP by 1.3% after two years.
Young Lee & Roger Gordon (2005), Tax Structure and Economic Growth, *Journal of Public Economics* 89 (5), pp. 1027-1043.	70 countries (1980 - 1997, cross-sectional and 5 year panels)	Negative	Reducing corporate income tax 1 percentage point raises annual growth by 0.1 to 0.2 points.