7. RETHINKING THE EFFECTS OF FISCAL POLICY ON MACROECONOMIC AGGREGATES: A DISAGGREGATED SVAR ANALYSIS

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Abstract

This paper characterizes the dynamic effects of net tax and government spending shocks on several macroeconomic aggregates in four OECD countries using a structural VAR approach. For the first time in the literature, I propose a structural decomposition of total net taxes into four components: corporate income taxes, income taxes, indirect taxes and social insurance taxes. The paper provides estimates of the responses of macroeconomic aggregates to innovations in these net tax components. Decompositions of total net tax innovations show that net tax components have different impacts on economic variables depending upon the strength of wealth, substitution, and income effects reflecting the structure of the economies.

Keywords: Fiscal shocks; Tax policy; decomposition; income effect, wealth effect
JEL classification: E62; H20; H30

1. Introduction

A common approach in both empirical and theoretical studies on fiscal policy shocks is to evaluate the response of macroeconomic aggregates to exogenous changes in the fiscal policy variables. From a theoretical point of view, the impacts of discretionary fiscal policy on the economy hinge on a number of key assumptions. For instance, in examining the transmission mechanism of fiscal policy, the presence or absence of forward-looking behavior plays a crucial role. If agents do not look forward, expected future changes do not have any effect on current-period decisions. Agents with rational expectations, on the other hand, do look forward in anticipation of future changes in key macroeconomic variables.

The empirical evidence, however, does not provide a common picture either. In particular, even though the most recent and standard strand of the literature, which

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started with Blanchard and Perotti (2002), shows positive short-term output multipliers resulting from government expenditure increases and tax cuts, the estimated size and duration of these effects vary across studies. In fact, the magnitude of the multiplier may depend on the specification and/or sample period employed. Interestingly, there is even evidence of negative government spending multipliers for Australia, Canada and the UK for some sub-sample periods (Perotti, 2004).

There is a substantial body of literature devoted to the effects of fiscal policy on key macroeconomic indicators using Structural Vector Autoregression (SVAR) models. For instance, Alesina, *et al.* (2002) investigated the effects of a change in fiscal policy on private investment using a panel of OECD countries. Their finding that increases in taxes have a negative impact on output is parallel to the findings of Blanchard and Perotti (2002)[2]. In addition, the latter concludes that private consumption increases following an increase in tax rates.

Both of these studies demonstrate that any increase in taxes will reduce private investment. Further, Perotti (2004) points out that the impact of any change in tax policy on GDP and its components becomes weaker over time. Mountford and Uhlig (2008) try to distinguish the effects of fiscal policy shocks for the US economy between 1955 and 2000. They envisage three different scenarios: a deficit-financed spending increase, a balanced budget spending increase, and a deficit-financed tax cut. They conclude that among these three scenarios the deficit-financed tax cut is the most efficient one to help raise the GDP. More recently, by employing a new database, Burriel et al (2010) analyze the effect of fiscal policy for the US economy and Euro area as a whole. They find that GDP and inflation increase in response to government spending shocks even though the output multipliers are very similar and steadily increasing after 2000, possibly due to the "global saving glut", in both areas.

Alternatively, Burnside et al. (2004), Pappa (2009) and Ramey (2007) report a decrease in unemployment in response to a positive spending shock. Considering a 4-variable VAR model, Unal (2015) concluded that unemployment rises in response to a fiscal contraction whereas it falls following a fiscal expansion. On the other hand, a few studies consider the reaction of the real wage following an increase in government spending. Among those, Pappa (2009) documents an increase whereas Burnside et al. (2004) report a decrease in the real wage in response to an expansionary fiscal policy.

Some of the stylized facts above appear to contradict either neo-classical theory, real business cycle (RBC) model or Keynesian approaches which are the two main types of the DSGE models[3] and will be further discussed in section 4. In other words, the sign and magnitude of the effect of discretionary fiscal policy on macroeconomic aggregates often offers opposite conclusions. For instance, following a positive government spending shock, New Keynesian theory tends to predict an increase in output, real wages and interest rate and a decrease in consumption and private investment. Yet in

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[2] *For a detailed discussion, see also Fatas and Mihov (2001), Tenhofen and Wollf (2007), De Castro and De Cos (2008), Mertens and Ravn (2009), Romer and Romer (2010), Unal (2014) and Gnip (2015).*

[3] *The open economy DSGE models were built for the first time by Obstfeld and Rogoff (1995, 2000), under the framework of the so-called new open economy macroeconomic. For a further discussion, please see Caraiani (2008).*

RBC models, the expansionary fiscal policy will lead to a decrease in real wages and an increase in private investment.

Additionally, economic theory suggests that different forms of taxation have different impacts in macroeconomic activity. For instance, Barro (1990) points out that while non-productive expenditures financed by a distortionary tax have an unambiguously negative growth effect, non-distortionary tax-financed increases in productive expenditures are predicted to have a positive impact upon the growth rate. Baxter and King (1993) point out that financing government spending with lump-sum taxes and distortionary taxes have different effects on economy. Gordon et al. (2004 and 2004a) analyze the impact on revenue and costs of a substantial change in fiscal policy, such as the effects of switching from capital income taxation to consumption-based tax system. They both find that consumption taxes and income taxes have different impacts on saving and investment decisions.

In view of these discrepancies, the central message of this paper is that different tax groups have different effects on macroeconomic aggregates, depending on the underlying cause of the tax increase. Our results suggest that analyzing the fiscal policy by decomposing total net taxes and examining their effect on the aggregate economy provide a more accurate picture than treating total net taxes as the fiscal policy variable. To this end, under the Blanchard and Perotti (2002) identification scheme, a five-variable VAR model, which includes total government spending, total net taxes, GDP, a measure of inflation and the interest rate is used as a benchmark for Canada, France, the UK and the US. Thereafter, I propose a structural decomposition of total net taxes into four components: corporate income taxes, income taxes, indirect taxes and social insurance taxes. The paper provides estimates of the responses of macroeconomic aggregates to innovations in different tax groups by replacing total net taxes with each tax components separately. In other words, the total net taxes are decomposed into four components using identical VAR models but replacing total net taxes with each tax component in each VAR model in turn. In a further step, the responses of the GDP components, private investment and consumption, to a shock to each tax component will be examined.

Decompositions of total net tax innovations will help us assess the macroeconomic implications of fiscal policy shocks for four major economies with different economic structures. In this context, corporate income tax shocks, for instance, will have a very different impact on macroeconomic indicators than an indirect tax innovation. It is, therefore, important that we understand the extent to which increases in net taxes are driven by one shock or another, before concerning ourselves possible policy responses.

The main conclusions of the analysis can be summarized as follows: 1) decompositions of total net tax innovations show that net tax components have different impacts on economic variables; 2) the size and persistence of these effects vary across countries depending upon the strength of wealth, substitution, and income effects reflecting the structure of the economies; 3) positive tax multipliers reported in previous studies are found only for the corporate income tax in the US, Canada, and France and for the social security tax in the US; 4) while we find that private investment is crowded out both by taxation and government spending in the UK and the US as consistent with the neo-classical model, our results for France and partially for Canada, indicate that there are opposite effects of tax and spending increases on private investment in line with Keynesian theory; and 5) private consumption is crowded in by government spending for all countries except the UK and crowded out by taxation in all countries except France. While the former result is consistent with a Keynesian model, the latter is in line with neo-classical theory.

The remainder of the paper is organized as follows. Section II focuses on the identification of the structural shocks. Section III describes the data. Section IV investigates the impacts of the shocks identified in Section II on macroeconomic aggregates of four countries. Section V analyzes the robustness of the results and section VI concludes.

2. The Identification Strategy

Our identification strategy follows Blanchard and Perotti (2002). Denoting the vector of endogenous variables by X_t and the vector of reduced form residuals by U_t, the reduced form VAR can be represented as

$$X_t = A(L)X_{t-1} + U_t \tag{1}$$

where X_t is a $N\,x\,1$ vector of endogenous variables, $A(L)$ is a $N\,x\,N$ matrix lag polynomial, and U_t is a $N\,x\,1$ vector of reduced-form innovations which are assumed to be independently and identically distributed with covariance matrix equal to the identity matrix. In our benchmark specification X_t and U_t consist of the following variables: $X_t = [g_t, T_t, y_t, p_t, r_t]'$ and $U_t = [u_t^g, u_t^T, u_t^y, u_t^p, u_t^r]'$.

I start by expressing the reduced form innovations of the government spending and net taxes equations as linear combinations of the structural fiscal shocks e_t^g and e_t^T to these variables and the innovations of the other reduced form equations of the VAR, namely: u_t^y, u_t^p and u_t^i. This leads to the following formal representation of the reduced form residuals:

$$u_t^T = \alpha_y^T u_t^y + \alpha_p^T u_t^p + \alpha_i^T u_t^r + \beta_g^T e_t^g + e_t^T \tag{2}$$

$$u_t^g = \alpha_y^g u_t^y + \alpha_p^g u_t^p + \alpha_i^g u_t^r + \beta_T^g e_t^T + e_t^g \tag{3}$$

As mentioned by Perotti (2004), in this framework, the coefficients α_j^i measure both the automatic response of fiscal variable i to the macroeconomic variable j and the systematic discretionary response of fiscal variable i to the macroeconomic variable j. The coefficients β_j^i capture the random discretionary fiscal policy shocks to fiscal policies; these are the "structural" fiscal shocks. It should also be noted that we avoid using the Cholesky decomposition method. Regardless of the order of fiscal variables, Cholesky orthogonalization will not provide consistent estimates of the structural shocks if, as is the case here, the α_j^k's are different from zero[4].

Direct evidence on the conduct of fiscal policy suggests the existence of decision lags in the sense that it is not possible to learn about a GDP shock, decide what fiscal

[4] *For details, see Perotti (2004) and Blanchard and Perotti (2002).*

measures to take in response, pass these measures through the legislature and implement them within three months as pointed out by Blanchard and Perotti (2002). Thus, the discretionary change in variable i in response to a change in variable j is zero. As a consequence, in quarterly data the systematic discretionary component of u_t^T and u_t^g will be zero: the coefficients α_j^i's will only reflect the automatic response to economic activity. Because the reduced form residuals are correlated with the e_t's, it is not possible to estimate the α_j^i's by ordinary least squares.

We, therefore, need to construct the elasticities of fiscal variable i to the macroeconomic variable j to compute cyclically adjusted reduced form fiscal policy shocks:

$$u_t^{T,CA} = u_t^T - \alpha_y^T u_t^y - \alpha_p^T u_t^p - \alpha_i^T u_t^r = \beta_g^T e_t^g + e_t^T \qquad (4)$$

$$u_t^{g,CA} = u_t^g - \alpha_y^g u_t^y - \alpha_p^g u_t^p - \alpha_i^g u_t^r = \beta_T^g e_t^T + e_t^g \qquad (5)$$

The next step of the estimation procedure is to decide the relative ordering of the fiscal variables to identify the structural shocks to those. While imposing $\beta_g^T = 0$ postulates the priority of tax decisions, β_T^g can be set to zero if government spending decisions are deemed to come first. It might be hard to find plausible arguments that fully justify any of these orderings. In the baseline specification the latter assumption is employed. The reverse ordering does not affect the results given the low correlation between the two reduced form fiscal shocks.

Consequently, it is possible to estimate β_g^T by OLS from the following equations:

$$u_t^{g,CA} = e_t^g \qquad (6)$$

$$u_t^{T,CA} = \beta_g^T e_t^g + e_t^T \qquad (7)$$

Finally, the coefficients of the equations for the macroeconomic variables will be estimated recursively by means of instrumental variables regressions. With respect to real GDP, the following equation will be employed:

$$u_t^y = \gamma_g^y u_t^g + \gamma_T^y u_t^T + e_t^y \qquad (8)$$

using $\boldsymbol{e_t^T}$ and $\boldsymbol{e_t^g}$ as instruments for $\boldsymbol{u_t^T}$ and $\boldsymbol{u_t^g}$ respectively. Likewise, the price equation

$$u_t^p = \gamma_g^p u_t^g + \gamma_T^p u_t^T + \gamma_y^p u_t^y + e_t^p \qquad (9)$$

can be estimated by using e_t^T, e_t^g and e_t^y as instruments. Finally, the interest rate equation

$$u_t^r = \gamma_g^r u_t^g + \gamma_T^r u_t^T + \gamma_y^r u_t^y + \gamma_p^r u_t^p + e_t^p \qquad (10)$$

can be estimated accordingly once e_t^p is recovered. After the reduced form of the VAR and all the coefficients are estimated, we can proceed to estimate the impulse responses using the structural moving average representation of the VAR.

3. Specification, Samples and Data:

3.1 The Data:

Our sample comprises four countries: Canada, France, the United States and the United Kingdom. The benchmark specification of the VAR includes quarterly data on government spending (g_t), net taxes (T_t) and GDP (y_t) all in real terms[5]; the GDP deflator (p_t), and the Treasury bill rate (r_t)[6]. T_t is defined as public revenues net of transfers, whereas g_t includes both public consumption and public investment. All the variables, except the interest rate, are log-transformed. Since the availability of the quarterly fiscal variables, particularly for the net tax components, is a binding constraint, the sample runs from 1960:1 to 2011:4 for the US, 1961:1 to 2011:4 for the UK, 1970:1 to 2011:4 for Canada and 1970:1 to 2008:4 for France. All variables have been seasonally adjusted by the original sources. For all countries, the Treasury bill rate and the GDP deflator data are obtained from the IMF International Financial Statistics database. The rest of the data have been taken from the Bureau of Economic Analysis for the US and OECD World Economic Outlook for the other countries.

3.2 The Specification:

Equation (1) is estimated by OLS and the number of lags was set according to the information provided by likelihood ratio (LR) test, the Akaike, Schwarz and Hannan-Quinn information criteria and the final prediction error in general[7].

In order to obtain the response of macroeconomic aggregates to various tax policy innovations, the VAR specification described in the previous section is estimated. Each model comprises of the following variables: government expenditures (g_t), tax revenue (T_T, measured by the tax revenue of the i^{th} tax group), the GDP (y_t), the GDP deflator (p_t) and the Treasury bill rate (r_t). After the benchmark model (with total net taxes and government spending) is estimated, we estimate the responses of macroeconomic aggregates to innovations in different tax groups by replacing total net taxes with each tax components separately. Such an identification will lead us decompose the total net taxes into four components using identical VAR models but replacing total net taxes with each tax component in each VAR model in turn. In a further step, we estimate a number of other specifications where GDP is substituted in turn by its private components (consumption and investment).

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[5] Following the standard literature, the GDP deflator is employed to obtain the corresponding real values.

[6] The data source defines the Treasury bill rate as the rate at which short-term securities are issued or traded in the market.

[7] Most of the time, the information criteria suggest different results. For instance, while estimating the model with corporate income taxes for the US, Hannan Quinn and Schwarz criteria suggest 2 lags, whereas final prediction error and Akaike information criteria suggest 6 lags. Here, I choose 6 lags, since 2 lags is often regarded as too short to capture enough economic interpretations among variables for a model with quarterly data as also mentioned in Kim and Roubini (2008). However, as a robustness check, the model is also estimated with the alternative lags and led to very similar conclusions. For an extensive survey of model selection criteria, see also Lutkepohl (1991).

Following the leading studies in the literature[8], the elasticities of taxes to GDP is constructed from data provided by the OECD[9]. We also assume that, in quarterly data, the contemporaneous elasticity of government purchases with respect to output is zero[10]. Given that interest payments on government debt are excluded from the definitions of government net taxes and spending, the semi-elasticities of these two variables with respect to interest rate, α_r^g and α_r^T, innovations are set to zero[11]. Furthermore, the elasticity of the fiscal variables with respect to real private consumption and investment are equal to the elasticities with respect to real GDP component in the sum of both. Finally, following Tenhofen et al. (2006), the GDP deflator elasticity is simply the real GDP elasticity of the fiscal variable less 1[12]. Table 1 provides an overview of the quarterly elasticities in use.

4. Empirical Results

I compute the effects of various types of fiscal policy shocks on the basis of the estimated SVAR model. The figures depict the results displaying the impulse responses to a 1% exogenous increase in the corresponding fiscal variable. In all cases, impulse responses are reported for five years and the 90% confidence bands, corresponding to the 5th and 95th percentiles of the responses, have been obtained by bootstrapping with 200 replications. In this respect, it is worth noting that, the choice of the confidence interval width is wider than that of the 68% literature standard.

Figures[13] (1)-(4) display the impulse responses of the various macroeconomic indicators to a total net tax shock. Specifically, while the response of output in France is statistically insignificant, GDP falls on impact in response to net taxes innovations in the US, Canada and the UK. While the response of GDP in the European countries and Canada remains significant almost for a year, the significant decline of GDP in US[14] appears to be more persistent, which is in line with the results of Burriel et al. (2010). Moreover, it should be noted that, in the UK, Canada and France, GDP tends to increase after ten quarters which is consistent with the findings of Perotti (2004)[15].

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[8] For instance, Monacelli and Perotti (2010), Perotti (2007).

[9] The calculations are based on Van den Noord (2000), Daude et al (2010).

[10] This is standard in the literature for most of the studies i.e. Blanchard and Perotti (2002), Burriel et al. (2010), Perotti (2004) or De Castro and De Cos (2008) among others.

[11] This is again one of the standard assumptions in the literature. See Perotti (2004), Castro and De Cos (2008), Tenhofen et al. (2006).

[12] The authors mainly follow the assumption that "the response of the nominal fiscal variable is the same to both price and real GDP movements, which is, in turn, given by the real GDP elasticity of the real fiscal variable. Provided nominal prices do not influence real GDP, the GDP deflator elasticity is the real GDP elasticity of the fiscal variable less 1".

[13] All figures are presented in Appendix B, available in the online version of the paper.

[14] Here, it is worth recalling that I have been working on 0.90 probability which indicates that the bands in this study are broader. Therefore, most of the results for US turn out to be significant in 0.68 probability (which is the common probability measure in the literature).

[15] Perotti (2004) finds positive tax multipliers for Australia, UK and West Germany. According to him, it is because of the smaller output elasticities of net taxes. However, here, I did not identify any positive impact effect. What we are ending up with is that GDP tends to increase after

In France, private consumption is consistently crowded in even though the increase becomes significant after two years which is in line with a Keynesian model. Furthermore, we find that private consumption is crowded out by taxation in the US, Canada and the UK as is consistent with neo-classical theory. Here, it should also be noted that, due to the increase in taxes, as consumers reduce their consumption, the national savings will increase lowering the real interest rate in these countries in the medium-run.

As regards investment, figures (1)-(4) and (5)-(8) point to the following results: In the standard Keynesian approach, an increase in spending may yield either an increase or a decrease in investment depending on the relative strength of the effects of the increase in output and the increase in the interest rate; but, in either case, increases in spending and taxes have opposite effects on investment as mentioned in Blanchard and Perotti (2002). While this is the case in our results for France and partially for Canada, we did not reach the same conclusion for the US[16] and the UK.

Figures (5)-(8) shows the responses of macroeconomic aggregates to an increase in government spending. The impact response of GDP is positive[17] and significant in all countries except the UK. While the size of the response is similar in the US, Canada and France, the shape of the impulse response of output is slightly different, in the sense that, after an initial rise, GDP starts declining and after about 10 quarters, it slightly rises again in France. In Canada, after an initial increase, there is a decrease in output, whereas in the US the increase in output is persistent. In the UK, the response of GDP is insignificantly negative which is consistent with the results of Perotti (2004) for this country.

In addition, the behavior of private consumption largely mimics that of GDP: it basically increases on impact in the US, Canada and France but decreases in the UK. While the former result is consistent with a Keynesian model, the latter is in line with neo-classical theory.

Government spending shocks have positive effects on the interest rate in three countries (Canada, France and the UK) and essentially no impact effect in the US[18]. It is useful to note here that, the former result can be reconciled both with a neo-classical and a Keynesian model.

It is clear from the literature that dynamic stochastic general equilibrium (DSGE) models have been gaining importance and macroeconomic theory is widely built upon these models to derive micro-founded relations. The setup of these models is straightforward. The agents are rational so that the consumers maximize their expected utility given their budget constraint, firms maximize their profits subject to the available technology and

three years in France and almost four years in UK which turns out to be rather counter-intuitive. Yet, even though the standard literature studies the effects of fiscal policy by employing conventional VARs, it should be noted that the forecasting limitations of this methodology for such long horizons advise against drawing conclusions from this result (De Castro and De Cos, 2008).

[16] *This is, again, supporting the results of Blanchard and Perotti (2002).*

[17] *For the US, this is in line with the positive response estimated by Blanchard and Perotti (2002), Burnside et al. (2004), Pappa (2009), Favero and Giavazzi (2007) and Fatas and Mihov (2001).*

[18] *Note that the interest rate response in the US and UK are insignificant for the entire period.*

governments are required to satisfy the government budget constraint (Hebous, 2011). DSGE models are generally successful in capturing the responses of macroeconomic variables following a shock. However, it should be noted that different DSGE models may generate different impacts. Thus, the two main types of DSGE models Real Business Cycle (RBC) and New Keynesian (NK) have different assumptions: while the former assumes flexible prices and perfect competition, the latter considers sticky prices and imperfect competition. So, the outcomes of different DSGE models may distinguish. For instance, following a positive government spending shock, NK theory tends to predict an increase in output, real wages and interest rate and a decrease in consumption and private investment. Yet in RBC models, the expansionary fiscal policy will lead to a decrease in real wages and an increase in private investment.

As regards to our results, in response to an expansionary fiscal policy, while the result for the UK is in line with the RBC theory, France follows the NK approach. However, as mentioned in the previous section, following a contractionary fiscal policy, the results are not in line with the DSGE literature outcomes[19].

Figures (9)-(12) present the effects of a shock to social security contributions on macroeconomic indicators. As is widely known, social security taxes are levied on labor as a payroll tax. A priori, the impact response of output will, therefore, depend on two effects: the substitution effect and the income effect.

According to NK models social security tax innovations will lead to a decrease in tax-payer's after tax reward for each extra hour worked, lowering the cost of leisure. Thus, the individual will be willing to work less in response to lower reward. This is the substitution effect (SE). On the other hand, a decrease in the real wage will reduce household lifetime earnings and, thus, human wealth. So, they will not be able to afford additional leisure and, as a result, will supply more labor. This is the income effect (IE). The relative magnitude of the two effects depends on the circumstances such as the elasticities of labor supply and demand. Hence, the hours worked may increase, decrease or remain the same after the tax innovation.

It is seen from figure (9) that in the US, IE dominates SE yielding a significant increase in output on impact. It is also worth noting that the behavior of private investment and private consumption mimic that of GDP: it typically increases on impact in this country. For Canada, France and the UK, higher social security taxes decline output, which decreases significantly and remains significant for five years in France. As far as GDP components are concerned, investment and private consumption responses, in general, mimic the GDP's one. Some slight differences may be observed though, particularly in the short-run behavior. The price level in Canada decreases significantly after four quarters and remains significant for five years due to the decrease in demand in response to a social security tax innovation in this country. However, the opposite behavior is observed in France in the sense that, after a significant decline in the short-run, prices insignificantly rise in the medium-run due to the 0.4 % decrease in output in response to a shock to social security contributions. The results are again in line with

[19] This is not surprising as the results are in line with Blanchard and Perotti (2002) the milestone of the relevant literature.

the modified DSGE, namely NK, models depending on the relative strength of the IE and SE.

The impact effect of the social security tax innovation on the interest rate is positive in the US due to the increase in money demand and private investment, whereas the estimated impact effect on the interest rate is insignificant for the rest of the countries.

Figures (13)-(16) present the effects of a shock to indirect taxes on macroeconomic indicators. The response of each component is typically similar across countries, hence summarizing their shapes is not difficult. Over the whole sample, the impact response is negative for GDP in all countries. Because they lower the purchasing power of real after-tax wages, indirect taxes lead to a strong incentive to curtail investment as seen in figures. On the other hand, since the indirect taxes can be defined as the sales taxes, taxes on goods and services, there is a decrease in consumption in response to an increase in tax levels. Indirect tax innovations also lead to a decrease in the price level due to lower demand. Note that, with the partial exception of Canada and France (where we have seen an insignificant increase in the interest rate for three quarters), there is a decline in the interest rate on impact in response to an indirect tax innovation. This can be explained by the decrease in income and investment levels.

Figures (17)-(20) depict the responses of the endogenous variables to an income tax innovation. Here, two opposing effects need to be taken into account. First, an increase in income taxes reduces the household wealth by increasing the present value of household tax liabilities. Thus, consumption decreases while saving, interest rate and labor supply increases. However, the rise in hours worked will lead to a decline in real wages, therefore, investment and output increase. This is the wealth effect. Second, the same policy will slow down economic activity by decreasing output. Because the money demand depends on income, the decline in output decreases the interest rate which partially crowds in private investment. The degree of crowding in will hinge on the sensitivity of private investment to income and the interest rate. Yet, the final effect of the contraction will be a decline in consumption, investment and output. This is the output effect. Hence, the overall effect on macroeconomic indicators will depend on these two effects.

For the US, Canada and the UK, the output effect dominates the wealth effect and therefore the impact response of consumption, investment and output are negative. For France, although the impact response of output and investment are negative, the output persistently increases, and there is an insignificant increase in investment after the third quarter. On the other hand, it should be noted that consumption significantly rises in Canada and France. There are several ways to explain this[20] as there are several modelling strategies that are implemented in DSGE framework to provide an increase in consumption. For instance Linnemann (2006)[21] applies a non-seperable utility

[20] *Another plausible explanation takes place when habit formation is included in any model. For more details, see Ravn, Schmitt-Grohe and Uribe (2006), Bouakez and Rebei (2007). Alternatively, Corsetti, Meier and Muller (2009) modeled a spending reversal effect and ended up with the same conclusion.*

[21] *A second method can be introducing two types of households such as Ricardian and Non-Ricardian. For more information please see Coenen and Straub (2005) and Galí, Vallés and López-Salido (2007). A third method can be introducing habit persistence at the good level.*

function in consumption and leisure in a RBC setup in which consumption and leisure are substitutes. The negative wealth effect of the fiscal contraction raises hours worked which decreases leisure. The marginal utility of consumption, therefore, increases. In order to lessen the negative wealth effect, individuals are willing to work more and to consume more which will lead to an increase in consumption. So, our results for Canada and France are in line with the modified DSGE setup when the response of consumption is considered.

Figures (21)-(24) display the responses of the macroeconomic indicators to a corporate income tax innovation. The impulse responses show a significant positive response of GDP on impact for all countries except UK. This can, again, be explained by the negative wealth effect and output effect. Here, the wealth effect dominates the income effect for Canada, France and US. Moreover, it should be further noted that the increase in capital income tax will be reflected in the prices. It will lower the purchasing power of real after-tax wages and therefore the positive impact on output caused by the wealth effect will be accentuated. As a result, an increase in corporate income tax will lead to a positive impact effect on GDP and all the private components of GDP. Thus, after an increase on impact, private consumption and private investment will fall in the medium and the long-run in the US. However, the significant positive impact on investment persists for almost three years in Canada whereas there is an insignificant increase in consumption. Here, it should be noted that our results are in line with and Arin and Koray (2006) and Heppke-Falk et al. (2006)[22]. It is also worth mentioning that corporate income tax innovations have positive effects on impact on the nominal interest rate in three countries (Canada, France and the US) due to the increase in income and investment on impact; and essentially an insignificant impact effect in the UK. Here, it should again be noted, the results for US and Canada particularly for the short-run is consistent with the NK approach which is a main type of DSGE models.

5. Robustness Checks

I performed a variety of robustness checks to our 5 variable VAR specification. First of all, a different ordering of the expenditure variables when identifying the shocks was employed. So far, government spending was ordered first. Yet, there is no basis for choosing one orthogonalization over the other as mentioned in Perotti (2004). Nevertheless, all the responses were re-estimated under the assumption that

For more information as mentioned by Ravn, Schmitt-Grohé and Uribe (2006), Bouakez and Rebei (2007). Finally, another method could be implementing spending reversals as in Corsetti, Meier and Müller (2009).Our results are for Canada and France, again, are in line with the these papers that are using DSGE framework.

[22] *The former study is done for Germany whereas the latter is for Canada. Both of the papers ended up with an increase in GDP in response to a corporate income tax innovation. According to Heppke-Falk et al. (2002), this might result from some sort of reverse causality stemming from identification difficulties due to problems with exogenous elasticities. However, this is not the case in this study. Although I am confident that the presented elasticities accurately capture the automatic stabilizers, as a robustness check, I re-estimate the SVAR assuming slightly different elasticities, without any substantive change of the results.*

government spending was ordered after taxes. The results obtained with this alternative specification were very close to those of the benchmark model.

As mentioned in Perotti (2004), the implementation of lags of fiscal policy could undermine the predictability of the estimated fiscal policy shocks. It might require some time for fiscal policy changes to be implemented and according to the author, the private sector might anticipate these changes before the econometrician. However, it is shown in Blanchard and Perotti (2002) that allowing for anticipations of fiscal policy does not substantially alter the results. Nonetheless, in order to check the robustness of the baseline results, I tried some alternative lag lengths. Even though there were some minor differences in point estimates, the results were generally involved in the 68% bandwidth of baseline estimates.

In addition, although we were confident that the elasticities we used accurately capture the working of automatic stabilizers, we reassessed the sensitivity of the results was assessed by varying those values. First, following Perotti (2004), I assumed a -0.5 price elasticity of government spending. The results were, again, very close to the benchmark model. The differences were minimal in the sense that there was a slight change on point estimates of the impulse responses.

Finally, I evaluated the sensitivity of the results to different values for the output and price elasticity of various tax instruments. It is shown in Cohen and Folette (1999) that there has only been a slight fluctuation in tax elasticities over time in the US. Therefore, to see whether there is a significant change in impulse responses, the benchmark elasticities were replaced with their +- 10% bandwidth values. The results obtained with these alternative elasticities were, again, very close to those of the benchmark model. There were only a few percentage points change in estimates of the impulse responses.

Conclusion

This paper characterizes the dynamic effects of total net tax and government spending shocks on GDP, prices and interest rates in four OECD countries using a structural Vector Autoregression approach with the Blanchard and Perotti (2002) identification scheme. Moreover, we propose a structural decomposition of net taxes into four components: corporate income taxes, income taxes, indirect taxes and social insurance taxes. Our results suggest that analyzing the fiscal policy by decomposing net taxes and examining their effect on the aggregate economy provide a more accurate picture than treating net taxes as the fiscal policy variable.

The main conclusions of the analysis can be summarized as follows: 1) Decompositions of total net tax innovations show that net tax components are found to have different impacts on economic variables; 2) The size and persistence of these effects vary across countries depending on different effects (i.e. negative wealth and output effects, substitution effect and income effect) resulting from the structure of these economies; 3) The positive tax multipliers reported in previous studies are found only for corporate income tax in the US, Canada and France and for social security tax in the US; 4) As regards macro theories, on the one hand, we find that private investment is crowded out both by taxation and government spending in the UK and the US as is consistent with the neo-classical model. On the other hand, our results for France and partially for

Canada indicate that there are opposite effects of tax and spending increases on private investment that are in line with Keynesian theory; 5) Private consumption is crowded in by government spending for all countries except the UK, and crowded out by taxation in all countries except France. While the former result is consistent with a Keynesian model, the latter is in line with neo-classical theory.

My analysis sheds light on the interpretation of positive net tax multipliers found in the existing literature. Decompositions of net tax innovations will help us better assess the macroeconomic implications of fiscal policy shocks and, it is, therefore, important that we understand the extent to which increases in net taxes are driven by one shock or another.

The findings in this paper also indicate that existing approaches to modeling fiscal policy shocks have to be re-thought. First, the results suggest that the usefulness of the existing macroeconomic applied work built on the assumption of “total” tax changes may be unclear. In examining the transmission mechanism of fiscal policy shocks, it is seen from our results that the traditional priority on net tax shocks may be misleading. Instead, more attention needs to be paid to different tax policy instruments.

References

Alesina, A. *et al*., 2002. Fiscal Policy, Profits and Investment. *American Economic Review*, 92(3), pp.571-589.

Arin, P.K. and Koray, F., 2006. Are Some Taxes Different than Others? An Empirical Investigation of the Effects of Tax Policy in Canada. *Empirical Economics*, 31, pp.183-193.

Barro, R., 1990. Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy* 98(1), pp.103-117.

Baxter, M. and King, R.G., 1993. Fiscal Policy in General Equilibrium. American Economic Review, *American Economic Association*, 83(3), pp.315-34.

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,* 177, pp.1329-1368.

Bouakez, H. and Rebei, N., 2007. Why Does Private Consumption Rise After a Government Spending Shock?. *Canadian Journal of Economics,* 40, pp.954-79.

Burnside, C. Eichenbaum, M. and Fisher, J., 2004. Fiscal Shocks and Their Consequences. *Journal of Economic Theory*, 115, pp.89-117.

Burriel, P. *et al.*, 2010. Fiscal Policy Shocks in the Euro Area and the US: An Empirical Assessment. *Fiscal Studies*, 31(2), pp.251-285.

Caraiani, P., 2008. An Analysis of Domestic and External Shocks on Romanian Economy Using A DSGE Model. *Romanian Journal of Economic Forecasting*, 9(3), pp. 100-114.

Coenen, G. and Straub, R., 2005. Does Government Spending Crowd in Private Consumption? Theory and Empirical Evidence for the Euro Area. *International Finance,* 8, pp. 435-70.

Cohen, D., Folette, G., 1999. The Automatic Fiscal Stabilizers: Quietly Doing Their Thing. Division of Research and Statistics, Federal Reserve Board.

Corsetti, G. Meier, A. and Müller, G., 2009. Fiscal Stimulus with Spending Reversals. *International Monetary Fund Working Paper* 09/106.

Corsetti, G. Meier, A. and Müller, G., 2010. Cross-border Spillovers from Fiscal Stimulus. *International Journal of Central Banking,* 6, pp.5-37.

Daude, C. Melguizo, A. and Neut, A., 2010. Fiscal Policy in Latin America: Counter-cyclical and Sustainable at Last? *OECD Development Centre*, Working Paper No: 291.

De Castro, F. and De Cos, P., 2008. The Economic Effects of Fiscal Policy: The Case of Spain. *Journal of Macroeconomics*, 30, pp.1005-1028.

Fatás, A. and Mihov, I., 2001. The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence. *CEPR Discussion* 2760.

Favero, C. and Giavazzi, F., 2007. Debt and the Effect of Fiscal Policy. *NBER Working Paper* 12822.

Galí, J. López-Salido, J.D. and Vallés, J., 2007. Understanding the Effects of Government Spending on Consumption. *Journal of the European Economic Association,* 5, pp.227-70.

Giordano, R. *et al.,* 2007. The Effects of Fiscal Policy in Italy: Estimates from a VAR model. *European Journal of Political Economy,* 23, pp.707-733.

Gordon, R.H. *et al.*, 2004. Toward a Consumption Tax, and Beyond. *American Economic Review*, Papers and Proceedings 94(2), pp. 161-165.

Gordon, R.H. Kalambokidis, L. and Slemrod, J., 2004a. If Capital Income Taxes are So High, Why Do We Collect So Little Revenue? A New Summary Measure of the Effective Tax Rates on Investment. In: P. B. Sorensen, ed. *Measuring the Tax Burden on Capital and Labour*. Cambridge: MIT Press, ch. 4.

Hebous, S., 2011. The Effects of Discretionary Fiscal Policy on Macroeconomic Aggregates: A Reappraisal. *Journal of Economic Surveys,* 25(4), pp.674-707.

, R. Kell, M. and Mahfouz, S., 2002. The Effectiveness of Fiscal Policy in Stimulating Economic Activity- A Review of the Literature. *International Monetary Fund Working Paper* 02/208.

Heppke-Falk, K. Tenhofen, J., and Wolff, G., 2006. The Macroeconomic Effects of Exogenous Fiscal Policy Shocks in Germany: A Disaggregated Analysis. *Deutsche Bundesbank Discussion Paper* 41.

Kim, S. and Roubini, N., 2008. Twin Deficit or Twin Divergence? Fiscal Policy, Current Account, and Real Exchange Rate in the U.S. *Journal of International Economics,* 74, pp.362-83.

Linnemann, L., 2006. The Effects of Government Spending on Private Consumption: A Puzzle? *Journal of Money, Credit and Banking,* 38, pp.1715-35.

Lutkepohl, H., 1991. *Introduction to Multiple Time Series Analysis*. Berlin: Springer-Verlag.

Mertens, K. and Ravn, M., 2009. Understanding the Aggregate Effects of Anticipated and Unanticipated Tax Policy Shocks. EUI, mimeo.

Monacelli, T. and Perotti, R., 2010. Fiscal Policy, the Real Exchange Rate, and Traded Goods. *Economic Journal,* 120, pp.437-461.

Mounford, A. and Uhlig, H., 2008. What are the Effects of Fiscal Policy Shocks? *NBER Working Paper Series* 14551.

Obstfeld, M. and Rogoff, K., 1995. Exchange Rate Dynamics Redux. *Journal of Political Economy,* 103(3), 624-60.

Obstfeld, M. and Rogoff, K., 2000. New Directions for Stochastic Open Economy Models. *Journal of International Economics,* 50(1), 117-153.

Pappa, E., 2009. The Effects of Fiscal Shocks on Employment and Real Wages. *International Economic Review,* 50, pp.217-44.

Perotti, R., 2004. Estimating the Effects of Fiscal Policy in OECD Countries. *CEPR Working Paper* n. 276.

Perotti, R., 2007. In Search of the Transmission Mechanism of Fiscal Policy. *NBER Macroeconomic Manual* 2007-22.

Ramey, A., 2008. Identifying Government Spending Shocks: It's All in the Timing. UCSD, mimeo.

Ravn, M. Schmitt-Grohé, S. and Uribe, M., 2006. Deep Habits. *Review of Economic Studies,* 73, pp.195-218.

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, pp.763–801.

Tenhofen, J. and Wolff, G., 2007. Does Anticipation of Government Spending Matter? Evidence from an Expectation Augmented VAR. *Deutsche Bundesbank Discussion Paper* 14.

Unal, U., 2014. Impacts of Fiscal Policy Shocks in Finland. *The Empirical Economics Letters,* 13(9), pp.1017-1024.

Unal, U., 2015. The Unemployment Effects of Fiscal Policy in Netherlands. *Suleyman Demirel University The Journal of Faculty of Economics and Administrative Science,* 20(1), pp. 143-153.

Van den Noord, P., 2000. The Size and Role of Automatic Fiscal Stabilizers in the 1990s and Beyond, *OECD Economics Department Working Papers*, No. 230.

Appendix

Table 1

Exogenous Elasticities

	United States	Canada	France	United Kingdom
α_y^{tc}	1.8	1	1.8	0.6
α_y^{ti}	0.6	1.2	0.6	1.4
α_y^{ts}	0.6	0.9	0.5	1.2
α_y^{tind}	0.9	0.7	0.7	1.1
α_y^{T}	1.1	1	1	1.1
α_y^{g}	0	0	0	0
α_p^{tc}	0.8	0	0.8	-0.4
α_p^{ti}	-0.4	0.2	-0.4	0.4
α_p^{ts}	-0.4	-0.1	-0.5	0.2
α_p^{tind}	-0.4	-0.3	-0.3	0.1
α_p^{T}	-0.1	0	0	0.1
α_p^{g}	-1	-1	-1	-1
α_c^{tc}	1.44	0.75	1.35	0.48
α_c^{ti}	0.48	0.9	0.45	1.12
α_c^{ts}	0.48	0.675	0.975	0.96
α_c^{tind}	0.72	0.525	0.525	0.88
α_c^{T}	0.88	0.75	0.75	0.88
α_c^{g}	0	0	0	0
α_{inv}^{tc}	0.36	0.25	0.45	0.12
α_{inv}^{ti}	0.12	0.3	0.15	0.28
α_{inv}^{ts}	0.12	0.225	0.125	0.24
α_{inv}^{tind}	0.18	0.175	0.175	0.22
α_{inv}^{T}	0.22	0.25	0.25	0.22
α_{inv}^{g}	0	0	0	0

T: total net tax; t_c: corporate income tax; t_i: income tax; t_{ind}: indirect tax
t_s: social security tax; inv: private investment; c: private consumption
g: government spending (public consumption + public investment)