

Government Outlays, Economic Growth and Unemployment: A VAR Model

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Abstract

This paper examines the dynamic effects of government outlays on economic growth and the unemployment rate in the context of vector autoregression. We utilize data from 20 OECD countries over three recent decades. Our main conclusions are: (1) positive shocks to government outlays will slow down economic growth and raise the unemployment rate; (2) different types of government outlays have different effects on growth and unemployment, with transfers and subsidies having a larger effect than government purchases; (3) causality runs one-way from government outlays to economic growth and the unemployment rate; (4) the above results are not sensitive to how government outlays are financed.

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Keywords: government outlays; economic growth; unemployment rate; vector autoregression; Granger causality

1. Introduction

How do increases in government outlays affect the unemployment rate and economic growth? Unfortunately, there does not exist a consensus theoretical framework to address such a seemingly simple question. Are the effects short-run or long-run? Are the government outlays purchases or transfers? Are the outlays financed by debt or taxes? Are we assuming a neoclassical or an endogenous growth model?¹ Do we assume Ricardian equivalence, complete or partial crowding out, rational expectations, complications suggested by New Keynesians and supply-siders? Variations in these assumptions establish a wide variety of possible answers to the simple question.

On the one hand, government outlays (purchases and transfers) and their financing may adversely affect employment and economic growth. At one extreme, they can be considered a tax upon productive activities that provides a drag on the economy. Transfer programs such as social security and Medicare create social capital and tend to reduce private capital formation (Feldstein (1996)). Unemployment insurance and taxation on labor income distort work-leisure decisions and raise unemployment rates (Feldstein (1978)). Ill-considered government purchases of goods and services may yield little or no tangible employment and growth benefits, while adversely affecting employment and growth due to taxation distortions and borrowing effects.²

On the other hand, government purchases and transfers can be growth and employment enhancing (Agell, et al. (1997)). Government spending on education and infrastructure can raise labor productivity and complement private investment. Military spending can generate technological improvements that enhance growth. Clearly,

¹ See Agell, et al. (1997) for a nice summary of the theoretical alternatives regarding the size of the public sector and growth.

² A recent and well publicized \$250 million “bridge to nowhere” in Alaska is one example.

government outlays for public goods such as law enforcement may also facilitate growth and development.

Since economic theory paints an ambiguous picture of the role of government, the issue must be resolved empirically. This paper is a multivariate time series analysis of the dynamic effects of government outlays on economic growth and the unemployment rate. We utilize data from 20 OECD countries over three recent decades. We offer what we believe is a more complete and general vector autoregressive model (VAR) than has been used in earlier studies. Our main conclusions are: (1) positive shocks to government outlays will slow down economic growth and raise the unemployment rate; (2) different types of government outlays have different effects on growth and unemployment, with transfers and subsidies having a larger effect than government purchases; (3) causality runs one-way from government outlays to economic growth and the unemployment rate; (4) the above results are not sensitive to how government outlays are financed.

Section 2 reviews the empirical literature. Section 3 sets up our VAR models and discusses some methodological issues. Section 4 presents the empirical findings. Section 5 offers concluding remarks.

2. Empirical Literature

There is a rich empirical literature on the long-run effects of government outlays on economic growth. Using cross-country regressions, some studies found a statistically significant negative effect of government outlays on economic growth (e.g., Landau (1983), Grier and Tullock (1989) and Barro (1991)), while others do not (e.g., Kormendi and Meguire (1985), Ram (1986) and Lin (1994)). Agell et al. (1997) provide a good

review of the empirical relationship between economic growth and government outlays. In contrast, the effects of government outlays on the unemployment rate have not received much attention until recently. Abrams (1999) was the first to find support for the positive link between a nation's steady-state unemployment rate and its total government outlays. Using an error-correction model, Wang and Abrams (2007) also found that the steady-state unemployment rate increases with total government outlays. In addition, when government outlays are disaggregated, transfers and subsidies are found to have a strong negative impact on the steady-state unemployment rate while government purchases of goods and services play no significant role.

Besides the long-run effects, multivariate time series analysis has been conducted to examine the dynamic relationship between government outlays and economic growth and between government outlays and the unemployment rate.³ The causal pattern and impulse response functions in the context of vector autoregression (VAR) have received special attention. Conte and Darrat (1988) and Rao (1989) examined Granger-causal relationship between government outlays and economic growth using bivariate VAR models. Conte and Darrat (1988) found that total government outlays do not Granger-cause per capita output growth in the majority of OECD countries. Rao (1989) found no causal relationship between output growth and government purchases in most countries

³ Several studies have examined the short-term and long-term effects of government outlays on output or income levels but their empirical results were misinterpreted as the effects of government outlays on economic growth. Using VAR modeling, Ramey and Shapiro (1997), Fatas and Milhov (2001), Blanchard and Perotti (2002), Perotti (2004), Edelberg, et al. (1999), Burnside, et al. (2003) and Tagkalakis (2006) examined the dynamic responses of output to a one-time shock to government purchases. Overall, government purchases have been found to have an expansive output effect. Ahsan, et al. (1996), Ghali (1998) and Loizides and Vamvoukas (2005) used cointegrating techniques and found positive long-run relationships between output and government outlays. Ghali (1998) also found that government outlays Granger-cause output. Others have studied the effect of government outlays on employment. Edelberg, et al. (1999) and Fatas and Milhov (2001) found that total private employment rises following a positive shock to government purchases. Tagkalakis (2006), on the other hand, found that a positive shock to government purchases lowers the employment in the business sector. None of these studies examined the effects of transfer outlays.

and unidirectional causation from output growth to government purchases in a few others. Hsieh and Lai (1994) estimated a trivariate VAR of government purchases, per capita output growth and private investment. They found mixed results for the G-7 countries: the dynamic effects of government purchases on growth and the causal relationship between them vary substantially across countries. Christopoulos and Tsionas (2002) estimated a bivariate VAR model for ten OECD countries and found that unemployment rate increases following a positive shock to total government expenditures. They also found unidirectional Granger causality running from total government expenditures to the unemployment rate for most countries.⁴

3. VAR Models and Some Methodological Issues

This paper examines the dynamic effects of government outlays on economic growth and the unemployment rate in a VAR framework. We first set up the VAR models and then discuss some methodological issues concerning the estimation and statistical inference in VAR analysis.

VAR Model Specifications

A question that naturally arises in VAR analysis is what variables should be included in the system. In principle, the system should include any variable that is intimately connected to the variables of interest. Our benchmark specification (Model 1) is a standard VAR of the following variables: total government outlays as a percentage of

⁴ Christopoulos, et al. (2005) conducted panel cointegration tests and concluded that there is a positive long-run relationship between total government expenditures and the unemployment rate and that causality runs one-way from total government expenditures to the unemployment rate. Their econometric analysis is, however, seriously flawed. Specifically, the null hypothesis of no cointegration can be rejected when the unemployment rate is used as the dependent variable in the cointegrating regression, but not so when any other variable in the system, including total government expenditures, is used as the dependent variable. The inconsistent test results should be interpreted as a lack of cointegration (long-run relationship) between total government expenditures and the unemployment rate rather than unidirectional causality.

GDP (GO), the short-term nominal interest rate (R), the unemployment rate (U), the real per capita GDP growth rate (G_GDP) and the inflation rate (I).⁵ The short-term nominal interest rate is included as a control for the stance of monetary policy. The unemployment rate, real per capita GDP growth rate and inflation rate have been at the center of interest of economic policies during our sample period and are therefore expected to be jointly determined. As a matter of fact, since the early 1970s, most OECD countries have witnessed rising unemployment rates and slower economic growth accompanied by periodic bouts of strong inflationary pressures.

Total government outlays, a broad measure of government activity, serve as a portmanteau variable to measure the combined effects of the outlays-cum-taxation of government purchases and transfer programs. The use of an aggregative variable such as GO is consistent with “structuralist” models of unemployment. However, economic theory often predicts that government purchases have different effects than transfers since only the former has direct impact on the use of resources. To see if we can find any empirical support for this prediction, we experiment by disaggregating GO into transfers and subsidies as a percentage of GDP (TR) and government purchases of goods and services as a percentage of GDP (G). This results in a 6-equation VAR consisting of TR, G, R, U, G_GDP and I (Model 2).

To see if our findings are sensitive to how government outlays are financed, we experiment with some tax variables.⁶ Model 3 is a 6-equation VAR obtained by adding total tax revenues as a percentage of GDP (TAX) to Model 1. Model 4 is a 7-equation VAR obtained by adding net taxes as a percentage of GDP (TAX_NET) to Model 2.

⁵ Variable definitions and sources are given in the Appendix.

⁶ In a static panel data model of economic growth, Kneller et al. (1999) found that omitting taxes would cause the coefficient estimate on government expenditures to switch sign.

Besides the endogenous variables mentioned above, several exogenous factors are also expected to affect growth and unemployment. For example, tight labor market regulations and adverse economic shocks are often argued to be responsible for the high unemployment rates in the OECD countries since the 1970s. Changes in demographics also have the potential to affect the unemployment rate. Globalization may also affect the unemployment rate since higher globalization and higher competition in the goods markets will lead to a more turbulent environment, with more job destruction and job creation (Rodrik (1998)). To accommodate these factors, Models 1-4 include the following exogenous variables: minimum wage (MIN_WAGE), trade union density rate (UNION) and the unemployment benefits replacement rate (BENEFITS) for the effects of regulatory and labor-market institutions;⁷ oil price shock (OIL) for the effects of adverse economic shocks; population growth rate (G_POP) and share of female in the labor force (FEMALE) for the effects of demographics; and openness (OPEN), measured as the imports plus exports as a percentage of GDP, for the effects of globalization.

Compared to the previous VAR studies, our model has the following features: (1) it models economic growth and the unemployment rate jointly while previous studies have focused on one or the other; (2) it examines the potentially different effects of transfers and government purchases while previous studies have examined either total government outlays or government purchases alone; (3) it explicitly controls for the stance of monetary policy and various exogenous factors; (4) it allows us to study the relevance of government financing procedure for growth and unemployment. Our VAR

⁷ Other labor-market institutions, such as employment protection legislations, strictness of unemployment benefit conditions, active labor market programs and degree of coordination in collective bargaining, have also been shown to have significant impacts on the unemployment rate. See Elmeskov et al. (1998), Heckman and Pages-Serra (2000), Nickell et al. (2005), Belot and van Ours (2004), Botero et al. (2004). They are not included in this study due to lack of time series data for the sample period.

model is therefore more complete and general than those used in the earlier studies. This is particularly important for the Granger causality test because inadequately specified systems are subject to the omitted variable bias, resulting in spurious causality (Granger (1969)).

Some Methodological Issues

In VAR analysis, it is often difficult to interpret the coefficient estimates because the error terms tend to be contemporaneously correlated and the estimated coefficients on successive lags tend to switch in signs. We therefore follow the standard practice and examine the dynamic effects of a one-time shock to government outlays using the impulse response functions (IRFs). We also investigate the causal relationship between government outlays and the unemployment rate and between government outlays and economic growth using pair-wise Granger causality tests.

For the impulse response analysis, previous studies have reported the orthogonalized IRFs (e.g., Christopoulos (2002)), which by construction depend on the order in which the variables are arranged in the VAR and are therefore not unique unless the VAR error terms are uncorrelated across equations. The orthogonalized IRFs do not seem appropriate for our study for two reasons. First, for economic time series, variables included in a VAR model are expected to be closely related to one another, the error terms are therefore unlikely to be orthogonal. Secondly, the order in which the variables are arranged, in a sense, implies a particular restriction on the VAR. Taking a bivariate VAR for example, if the orthogonalized IRFs are computed while government outlays are ordered first followed by the unemployment rate, then we are implicitly assuming that government outlays do not automatically respond to unexpected changes in the

unemployment rate. In contrast, the generalized IRFs proposed by Koop, Pesaran and Potter (1996) are not sensitive to the ordering of the variables regardless of the VAR error structure. Given that there is no prior reason to choose any particular ordering over another, we report the generalized IRFs in this study.

In VAR analysis, estimation and statistical inference are often complicated by the presence of unit roots and cointegration. Toda and Yamamoto (1995) showed that if a VAR model contains unit root processes and the hypothesis involves more than one coefficient parameter, Wald statistics based on the OLS estimates in general do not have the chi-square limiting distribution. They proposed a lag-augmented OLS (LAOLS) estimator, which is consistent and asymptotically normally distributed whether or not unit roots and cointegration are present in the VAR. As a result, Wald statistics based on the LAOLS estimates always have the chi-square limiting distribution. In addition, the LAOLS estimator can accommodate VAR models in which variables have different orders of integration. The simulation study in Yamada and Toda (1998) indicates that LAOLS-based Wald tests for Granger causality have the desirable size and power properties. Therefore, if any variable in our VAR models is suspected to have a unit root, the LAOLS estimates should be used to construct the impulse response functions and Wald statistics for Granger causality tests. This ensures that our findings are not sensitive to the presence of unit roots or cointegration.

4. Empirical Results

Our empirical analysis is based on a panel of twenty OECD countries from 1970 to 1999.⁸ Thus, our data set covers the three decades leading up to the introduction of the euro. As a preliminary step, we performed several popular panel unit root tests for each endogenous variable (Table 1). Since all of these variables are expressed as relative terms or percentage changes and none of them displays a deterministic trend, the panel unit root regressions include constants but no time trends. All four tests suggest that GO, R and G_GDP are stationary, and I is a unit root process. However, the results are not unanimous for TR, G, TAX, TAX_NET and U. Therefore, as discussed in section 3, we construct the impulse response functions and Wald statistics for Granger causality test using the LAOLS estimates.

Given the dimension of our VAR models and the limited number of observations for each country, country-by-country estimation is unlikely to yield accurate estimates. Therefore, we use pooled estimation but include country dummies to control for unobserved country characteristics. Based on the Akaike information criterion, the lag order is set to 2 in each model. This is consistent with the view that fiscal and monetary policies do not have direct economic impact for more than two years.

Impulse Response Analysis

Figure 1 plots the generalized IRFs of U and G_GDP to a one-time unit shock to government outlays.⁹ The 95% confidence intervals are marked by the dotted lines. The first row gives the responses of U and G_GDP to a GO shock based on the estimates of model 1. The unemployment rate rises upon impact by 0.1 percentage point. The

⁸ Countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States. Data for Germany includes only West Germany prior to merger with East Germany.

⁹ A unit shock to GO is a one percentage point increase in GO in the current period, e.g., total government outlays increase from 20 to 21 percent of GDP. A unit shock to TR or G is defined in the same fashion.

response of U gains strength at first and then weakens gradually with a maximum increase of 0.21 percentage point two years after the shock. It stays positive and significant until six years after the shock. The real per capita GDP growth rate falls upon impact by 0.29 percentage points. The response of G_GDP is less persistent. It stays negative and significant for only two years after the shock.

The second row of Figure 1 gives the responses of U and G_GDP to a TR shock and the third row gives the responses of U and G_GDP to a G shock, both of which are based on the estimates of model 2. These IRFs display the same patterns as those based on model 1. However, compared to a GO shock, the responses of U and G_GDP to a TR shock are much stronger while their responses to a G shock are weaker. Following a one-time unit shock to TR, the unemployment rate rises upon impact by 0.3 percentage points and reaches a peak two years later with an increase of 0.66 percentage point. Real per capita GDP growth rate falls upon impact by 0.85 percentage points. Following a one-time unit shock to G, the unemployment rate rises upon impact by only 0.05 percentage points and the peak increase is merely 0.12 percentage points. The real per capita GDP growth rate falls upon impact by only 0.2 percentage points.

Granger Causality

Table 2 reports the Wald statistics for pair-wise Granger causality tests. In models 1 and 3, we find no Granger-causal relationship between the unemployment rate and total government outlays, and one-way causality from total government outlays to real per capita GDP growth. In models 2 and 4, the unemployment rate and real per capita GDP growth do not Granger-cause transfers or government purchases. However, transfers are found to Granger-cause both the unemployment rate and real per capita GDP growth,

while government purchases Granger-cause real per capita GDP growth only. Together, these results indicate that there is unidirectional causality from government outlays to growth and the unemployment rate.

The lack of causation from GO to U and from G to U may seem contradictory to the impulse response analysis. This can be explained by the fact that impulse response analysis makes use of all the coefficient estimates as well as the error correlation, while pair-wise Granger causality tests are based on only some of the coefficient estimates in a particular equation. Therefore, impulse response analysis and pair-wise Granger causality tests can (and in many cases will) yield different results. In such cases, the impulse response analysis tends to be more informative and the results from pair-wise Granger causality tests should be interpreted with caution. For instance, when pair-wise Granger causality tests fail to find causal relationship from GO to U and from G to U, we can only conclude that lagged values of GO and G have no direct impact on the current U. However, we cannot rule out the possibility that GO and G might affect U through a third variable or through the contemporaneous correlation in the error terms. As a matter of fact, GO and G are found to Granger-cause G_GDP which in turn is found to Granger-cause U. Therefore, GO and G have indirect impacts on U through G_GDP, which are not detected by the pair-wise Granger causality tests. This observation also points to the advantage of our VAR model specifications, i.e., modeling economic growth and the unemployment rate jointly allows richer dynamics than modeling one at a time as was done in the previous studies.

Relevance of Government Financing Procedures

The IRFs (rows 4-6 in Figure 1) and the Granger-causality tests based on models 3 and 4 are very close to those based on models 1 and 2. In addition, TAX and TAX_NET in models 3 and 4 do not Granger-cause U or G_GDP. Hence, the effects of government outlays on growth and unemployment do not seem to depend on whether outlays are financed through borrowing or taxation, suggesting Ricardian equivalence (i.e., borrowing and taxation produce equivalent macroeconomic effects).

Role of Exogenous Variables

Table 3 reports the coefficient estimates on the exogenous variables in the growth and unemployment equations.¹⁰ Most of the exogenous variables are insignificant in both equations except that union density rate appears to raise the unemployment rate and share of females in the labor force appears to hamper economic growth.¹¹ Some labor-market institutions are also found to have indirect effects on growth and unemployment through government outlays. For example, unemployment benefits are found to increase total government outlays and transfers. These findings are consistent with the common argument that labor market rigidities are responsible for the high unemployment rates in the OECD countries.

Sensitivity Analysis

To see if the parameters are stable across countries, we re-estimate the models using two sub-samples. First, Spain and Japan represent potential outliers in our sample. Almost all of Japan's dramatic growth in government outlays over the period was in the form of government purchases, while Spain's was in transfers and subsidies. Meanwhile,

¹⁰ Coefficient estimates for other equations are not reported here but available upon request.

¹¹ We have no prior expectation for the coefficient on the share of females in the labor force. The variable may be capturing the effects of some demographic or cultural factor that is not included in the model and, as we note in the sensitivity analysis, may be endogenously determined.

Spain's unemployment rate rose dramatically while Japan's increased little. To see if our findings that transfers have a stronger effect than government purchases are driven by these two countries, we drop Spain and Japan from the sample and re-estimate the models. Secondly, economic growth and unemployment rates in the European and non-European countries may have followed different dynamics. Therefore, we re-estimate the models using data from the 16 OECD-European countries. In both cases, the results are very close to those reported earlier.

We also experimented by dropping the exogenous variables from the models. This is due to the concern that variables such as labor institutions may in fact be endogenously determined. The results hardly change. Our empirical findings therefore seem to be quite robust to changes in samples and the exogenous variables.

5. Conclusions

This paper examines the dynamic effects of government outlays on economic growth and the unemployment rate for twenty OECD countries for the period 1970-1999. Our findings are broadly consistent with those in Christopoulos and Tsionas (2002) and Wang and Abrams (2007) but contrary to those in Conte and Darrat (1988) and Rao (1989). However, by modeling growth and unemployment jointly and disaggregating total government outlays into purchases and transfers, our VAR models are more general and offer more insights. We find that increases in government outlays hamper economic growth and raise the unemployment rate. Moreover, different types of government outlays are found to have different effects on growth and unemployment, with transfers and subsidies having a larger effect than government purchases. In addition, Granger

causality tests suggest unidirectional causation from government outlays to economic growth and the unemployment rate. Importantly, the estimated effects of government outlays on growth and unemployment do not seem to vary with government financing procedures. Since our empirical analysis is based on the LAOLS estimates, our findings are robust to the presence of unit roots and cointegration, which are common in macroeconomic time series data.

Understanding how government outlays affect growth and unemployment is particularly important for the United States in 2007. As debate rages over the desirability of greatly expanding the publicly-financed national health care, little is known about its potential macroeconomic impact. If our empirical findings are true, these macroeconomic costs need to be added into the cost-benefit assessment of this important public policy.

Appendix: Variable Definitions and Sources

U: Unemployment as a percentage of total labor force. Source: OECD Historical Statistics, various issues.

G_GDP: Annual percentage change in real per capita GDP measured in U.S. dollar. Source: World Bank, World Development Indicators (2004).

I: CPI-based inflation rate. Source: World Bank, World Development Indicators (2004).

GO: Total outlays of government as a percentage of GDP. Source: OECD Historical Statistics, various issues.

TR: Government subsidies and other current transfers as a percentage of GDP. Source: World Bank, World Development Indicators (2004).

R: Money market interest rate. Source: International Financial Statistics.

TAX: Total tax revenue as a percentage of GDP. Source: World Bank, World Development Indicators (2004).

TAX_NET: Total tax revenue minus transfers as a percentage of GDP. Source: World Bank, World Development Indicators (2004).

MIN_WAGE: Statutory minimum wage as a percentage of median wage. Source: OECD Labour Market Statistics (2001).

UNION: Trade union members as a percentage of all wage and salary earners. Source: OECD Labour Market Statistics (2001).

BENEFITS: Gross unemployment benefits as a percentage of the previous gross wage earnings. Source: OECD Labour Market Statistics (2001).

OIL: Oil price shock measured as percentage change in world oil price. Source: World Bank, World Development Indicators (2004).

G_POP: Population growth rate. Source: World Bank, World Development Indicators (2004).

FEMALE: Female labor force as a percentage of total labor force. Source: World Bank, World Development Indicators (2004).

OPEN: Imports plus exports as a percentage of GDP. Source: World Bank, World Development Indicators (2004).

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Figure 1: Dynamic responses to a one-time unit shock to government outlays

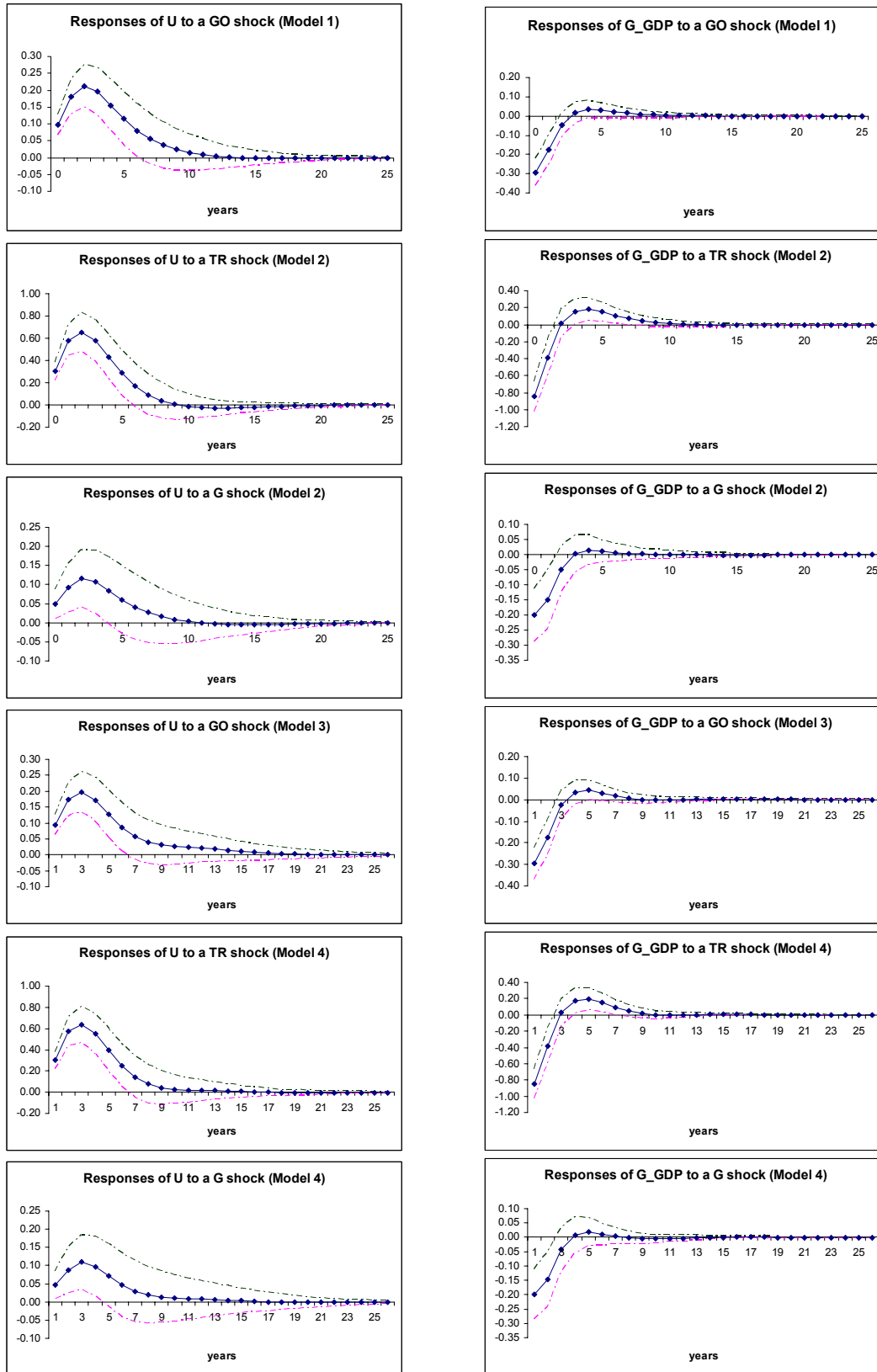


Table 1: Panel Unit Root Tests^a

	GO	TR	G	TAX	TAX NET	R	U	G GDP	I
Levin, Lin & Chu t-statistic ^b	-2.70 (0.0035)	-4.31 (0.0000)	-2.29 (0.0142)	-3.96 (0.0000)	-0.82 (0.2060)	-4.24 (0.0000)	-2.65 (0.0041)	-11.03 (0.0000)	0.58 (0.7174)
Im, Pesaran and Shin Wald-statistic ^c	-3.44 (0.0003)	-3.26 (0.0006)	-0.98 (0.1642)	-1.58 (0.057)	-2.40 (0.0082)	-3.57 (0.0002)	-0.92 (0.1787)	-12.08 (0.0000)	0.39 (0.6513)
ADF – Fisher Chi-square ^c	74.05 (0.0014)	67.32 (0.0044)	58.75 (0.0281)	47.95 (0.1815)	62.01 (0.0144)	68.73 (0.0032)	43.51 (0.3244)	219.26 (0.0000)	30.28 (0.8674)
PP - Fisher Chi-square ^c	64.07 (0.0092)	54.86 (0.0589)	51.79 (0.1002)	53.22 (0.0787)	50.82 (0.1173)	59.17 (0.0259)	28.89 (0.9037)	229.05 (0.0000)	28.00 (0.9234)

Notes: Numbers in parentheses are p-values.

^a Lag orders used in tests are selected according to the Akaike Information criterion (AIC).

^b Null hypothesis: common unit root process

^c Null hypothesis: individual unit root process

Table 2: Pair-wise Granger causality tests

Model 1	Dependent Variable				
	GO	R	U	G GDP	I
GO	---	0.27	3.60	14.97***	15.72***
R	19.21***	---	64.61***	82.21***	6.15**
U	0.83	0.63	---	1.62	9.63***
G GDP	3.18	10.37***	27.71***	---	13.34***
I	0.60	13.00***	5.22*	6.97**	---

Model 2	Dependent Variable					
	TR	G	R	U	G GDP	I
TR	---	4.20	0.94	8.32**	5.18*	1.59
G	2.10	---	1.13	0.03	10.45***	10.89***
R	31.70***	2.32	---	56.02***	74.85***	7.05**
U	1.18	0.67	0.41	---	1.71	6.96**
G GDP	2.80	1.29	6.65**	21.60***	---	11.36***
I	2.62	2.46	13.18***	4.63*	6.30**	---

Model 3	Dependent Variable					
	GO	TAX	R	U	G GDP	I
GO	---	6.55**	0.74	2.07	14.43***	12.14***
TAX	2.58	---	1.71	1.13	5.40*	7.87**
R	12.48***	4.99*	---	51.33***	66.35***	5.66*
U	0.53	0.12	0.76	---	1.92	10.19**
G GDP	2.71	9.59***	10.59***	26.87***	---	11.48***
I	3.00	0.47	18.51***	4.02	6.40**	---

Model 4	Dependent Variable						
	TR	G	TAX NET	R	U	G GDP	I
TR	---	5.29*	2.84	1.17	6.48**	9.58***	2.55
G	2.11	---	4.13	1.06	0.03	10.86***	11.64***
TAX NET	0.20	1.11	---	0.46	0.14	4.58	12.79***
R	29.19***	2.01	19.56***	---	51.88***	67.15***	4.55
U	1.44	0.46	0.95	0.59	---	1.40	9.21**
G GDP	2.36	1.45	11.68***	7.00**	20.32***	---	10.52***
I	3.05	2.86	0.40	16.03***	3.76	7.02**	---

Notes: The pair-wise Granger causality test has a limiting chi-squared distribution with 2 degrees of freedom. ***, **, * denotes statistical significance at the 1%, 5%, 10% level, respectively.

Table 3: Coefficient estimates on the exogenous variables

	Model 1		Model 2		Model 3		Model 4	
	U	G GDP	U	G GDP	U	G GDP	U	G GDP
MIN_WAGE	0.001 (0.13)	-0.019 (-0.97)	0.002 (0.21)	-0.017 (-0.87)	-0.002 (-0.17)	-0.009 (-0.46)	.0003 (0.04)	-.010 (-0.51)
UNION	0.021** (2.20)	-0.003 (-0.15)	0.017 (1.56)	-0.006 (-0.22)	.028*** (2.71)	-.012 (-0.53)	.020* (1.74)	-.018 (-0.70)
BENEFITS	-0.003 (-0.28)	0.017 (0.83)	-0.005 (-0.51)	0.017 (0.77)	-0.002 (-0.24)	.020 (0.93)	-.005 (-0.53)	.019 (0.88)
OIL	-0.199 (-1.47)	-0.083 (-0.27)	-0.203 (-1.36)	-0.100 (-0.29)	-.169 (-1.18)	-.182 (-0.56)	-.198 (-1.32)	-.164 (-0.49)
G_POP	-0.002 (-0.26)	0.005 (0.41)	0.001 (0.18)	0.004 (0.27)	-0.001 (-0.22)	.003 (0.19)	.001 (0.17)	.003 (0.20)
FEMALE	-0.024 (-0.80)	-0.211*** (-3.00)	-0.056 (-1.61)	-0.204*** (-2.62)	-.054 (-1.58)	-1.151** (-1.97)	-.066* (-1.87)	-.161* (-2.04)
OPEN	0.566 (0.89)	2.558* (1.77)	0.840 (1.28)	1.712 (1.15)	.642 (1.01)	2.184 (1.52)	.817 (1.24)	1.760 (1.19)

Notes: t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, 10% level, respectively.