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POLICY PAPER

Ireland's Fiscal Spending Multipliers

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Abstract: This paper estimates government spending multipliers for Ireland. We add to the existing literature on Ireland-specific fiscal spending multipliers in two key ways. First, we focus on measures of economic activity that remove distortions caused by foreign-owned multinational enterprises, thus allowing us to derive truer estimates of the impact on the domestic economy of changes in fiscal policy. Second, we employ a number of statistical approaches in order to sense-check the multiplier estimates we derive, including standard SVAR approaches, an expectations-augmented VAR (EVAR) approach, and estimates based on a large-scale structural model. Our results show that government investment can have positive and significant initial impacts on Irish output, though these effects tend to disappear and/or become statistically insignificant over the longer term. Other forms of fiscal spending do not have a statistically significant effect.

I INTRODUCTION

The aftermath of the Great Recession saw a resurgence of debate concerning the impact of discretionary fiscal policy on the real economy. The need for sound estimates of fiscal multipliers – estimates capturing this impact – was heightened as many countries underwent large corrections in their public finances.

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The need for rigorous estimates of fiscal multipliers was particularly acute in Ireland. Unsustainable banking and fiscal policies prior to 2008, including a reliance on transient revenues linked to the property bubble, meant that Ireland would ultimately embark on a €30 billion (17 per cent of GDP) correction in the public finances from 2008-2014 (Smyth, 2017; Scott and Bedogni, 2017).

Despite the importance of understanding the interaction between discretionary fiscal policy and the real economy, the literature on Irish fiscal multipliers has remained relatively limited. Moreover, estimates of Ireland's fiscal multipliers can be highly sensitive to distortions from multinational activities that affect standard measures of output.

Our paper contributes to the literature on Ireland-specific fiscal spending multipliers in two ways. First, we focus on measures of economic activity that remove distortions caused by foreign-owned multinational enterprises, thus allowing us to derive truer estimates of the impact on the domestic economy of changes in fiscal policy. Second, we use a variety of statistical approaches in order to sense-check the multiplier estimates derived.

We start by identifying fiscal spending multipliers based on a series of Structural Vector Autoregressions (SVARs) and using a Cholesky decomposition. We use Domestic Gross Value Added (GVA) as our main variable for economic activity. This choice is made in order to help to strip out the distortions caused by foreign-owned multinational enterprises. These distortions, if unremoved, can result in misleading estimates of fiscal spending multipliers, in particular as much of those activities are relatively more insulated from changes in domestic fiscal policy, while their production can vary substantially with little dependence on domestic factor inputs (Casey, 2018). The SVAR specification includes government spending, domestic GVA, government revenue and the long-term interest rate. This contrasts with the three-variable SVAR employed by Bénétrix and Lane (2009), which includes government spending, GDP, and the real exchange rate. By explicitly including government revenues, we control for both central components of fiscal policy. The inclusion of the interest rate acts as a control for the financial cycle, a factor which has been shown to have considerable impact on the Irish economy (Bénétrix and Lane, 2015).

We employ two further techniques to produce multiplier estimates. We explore an Expectations-augmented VAR (EVAR) model similar to that outlined in Auerbach and Gorodnichenko (2012). This method helps to control for expectations and to isolate unexpected shocks to expenditure, thus alleviating issues in relation to the timing of shocks. We also estimate multipliers using a large-scale structural model of the Irish economy: the ESRI's COSMO model (Bergin *et al*., 2017).

Our findings suggest that there is some positive significant initial impact on economic activity associated with fiscal policy, although this result is only consistent in the case of government investment, and these effects disappear over the longer term. The estimated impacts are wide-ranging and uncertain, with limited

evidence of positive impacts on the economy from government consumption as a whole. Within this, we find broadly negative – though insignificant – effects from public sector wages. Investment spending tends to have higher short-term multipliers, but the significance disappears over the medium to long term. This is consistent with theory and with the fact that Ireland's relatively large dependence on imports leads to high net leakages of income (Cronin and McQuinn, 2014).

II RELEVANT LITERATURE

A variety of approaches to estimating Ireland-specific fiscal multipliers have been used in the literature to date. Cronin and McQuinn (2014) provide estimates of the impact of fiscal policy at different stages of the economic cycle. They employ a threshold VAR using estimates of the output gap produced by the European Commission to gauge the different stages of the cycle. They estimate the impact of government consumption expenditure on GDP, private consumption and total unemployment. The findings show a positive impact multiplier for a government consumption shock at all points in the economic cycle for GDP, with a negative long-run multiplier when there is a positive output gap and the full sample is used. Bergin *et al*. (2009) examine the impact on the economy of shocks to a number of fiscal variables including a reduction in public sector pay and government investment, using the ESRI's HERMES macroeconomic model. The Bergin *et al*. paper provides multiplier estimates on the basis of GDP, a measure which since 2009 has become increasingly distorted. This paper seeks to update these estimates by using more recent data and also an alternative measure of economic activity, Domestic GVA. Additionally, while the Bergin *et al*. paper provides estimates on the basis of a structural model, this paper provides estimates based on a suite of approaches including a structural model (ESRI COSMO), an SVAR and an EVAR.

Bénétrix and Lane (2009) provide estimates of the impact of five government expenditure categories on Ireland's GDP. They find that the impact of government spending shocks on the level and composition of output depends on the nature of the fiscal intervention and note important differences between government consumption and investment spending. Their paper uses data from 1970-2006, and hence excludes the most recent crisis period. The measure of output used is GDP, a measure which since the publication of their paper has become increasingly distorted by multinational activities. Our paper follows a similar SVAR approach, but uses different variables, including an alternative measure of the economy, and employing a longer dataset which includes the recent crisis period. We also reinforce our estimates with additional methodologies, including estimates provided by a large-scale structural model and an EVAR approach based on expected forecast growth.

Internationally, a substantial literature has been developed exploring different ways of estimating the effects of fiscal policy on economic activity. Hall (2009) examines the fiscal multipliers of US military spending under a number of approaches, including regression analysis, VAR, and structural macro models. By examining military spending, Hall seeks to account for issues of endogeneity in government spending for which VAR analysis has been criticised. He notes a clear advantage of this approach is the ability of VAR to account for other influences on the variable of interest in order to identify the impact of government expenditure. This is a key benefit of VAR analysis that this paper seeks to take advantage of.

VAR analysis has become increasingly popular for estimating the impact of fiscal policy since the early 2000s. A key feature in VAR analysis is the way in which shocks are identified. Some of the main methods of shock identification used in literature are the SVAR approach (Blanchard and Perotti, 2002), the narrative approach (Ramey, 2011) and the sign restriction approach (Uhlig, 2005). The narrative approach was used by Ramey (2011) to demonstrate the impact of increases in US defence spending as a result of military events on the economy. Although appealing on face value for its simplicity, the narrative approach presents considerable challenges, a lack of clarity with regard to how the benchmark 'no-policy change' is defined, and the issue of multiple announcements/reversals of fiscal measures which can impede shock identification (IMF, 2014; Corsetti *et al*., 2012). Recent work by Beetsma *et al*. (2017) has shown that spending-based consolidation plans tend to have weaker implementation (i.e. the plans set out ex-ante aren't actually followed through on) compared to revenue-based plans. Corsetti *et al*. (2012) demonstrate that expected spending reversals can change the short-run impact of fiscal policy. This complicates the identification of shocks under the narrative approach, as an identified shock may be only partially implemented or not implemented at all. A more recent extension to this approach finds advantages in using the narrative approach and Blanchard and Perotti (2002) shocks jointly. The approach is intended to identify shocks and a local projections method is then employed to overcome some of these weaknesses (Ramey and Zubairy, 2018; Broner *et al*., 2018). Another method used by Uhlig (2005), involves imposing sign restriction on the response of prices, non-borrowed reserves and the federal funds rate to examine the effects of monetary policy on output. However, this means restricting the qualitative response to shocks, which is a factor this paper seeks to investigate.

Blanchard and Perotti (2002) provide the seminal paper in estimating fiscal multipliers using VAR and SVAR frameworks. Their paper relies on two key points; fiscal shocks are exogenous with respect to output, and decision and implementation lags in policy mean there is little or no discretionary response to unexpected contemporaneous movement in activity. These two assumptions taken together allow for the identification of fiscal shocks by recursive ordering and tracing of dynamics to GDP and its components. Blanchard and Perotti find a shock to

spending has a positive effect on output, and a shock to tax has a negative effect on output.

The SVAR approach has been used to estimate the impact of fiscal policy in a number of different economies. While Blanchard and Perotti (2002) apply it to the US economy, a number of papers have since used this approach to examine the effects of fiscal policy in other countries. Giordano *et al*. (2007) use an SVAR approach to examine the impact of fiscal policy on the Italian economy. They find that direct expenditures have a positive impact on the economy using a seven-variable VAR. Corsetti *et al*. (2006) use VAR analysis to examine the transmission of fiscal shocks and twin deficits for Australia, Canada, the UK and the US. They find effects vary depending on the degree of openness of the economy, a factor which is expected to be important in estimating the impact of fiscal policy in Ireland, as a small open economy. Broner *et al*. (2018) also finds that who the economy is open to, and the financing of debt has an effect on multipliers. Where expansions are financed by foreign debt, multipliers may be larger due to the 'crowding out' effects being exported.

The VAR approach has also been applied to a variety of spending variables. Fatás and Mihov (2001) use the VAR approach to examine the impact of government investment, wage and non-wage spending on consumption and employment. Hall (2010) notes a higher multiplier is expected in the case of government investment than in relation to benefit spending. Lane and Perotti (2003) examine the impact of government spending, differentiating wage and non-wage components in 17 OECD economies. They find important differences in the impact of several parts of the budget on the real wages and profitability of the traded sector.

Global DSGE models could also be used to examine the impacts of fiscal policy. Clancy *et al*. (2016) use a DSGE model to examine the implications of a shock to government expenditure in a small open economy. They show that if a budget-neutral shock to government investment can be implemented, financed by a reduction in consumption which is not complementary to private consumption, then a small but persistent stimulus can be delivered with lower debt in the medium term.

A recent strand of the literature has focused on the idea that fiscal policy can have different impacts throughout the economic cycle. Blanchard and Leigh (2013) posit that multipliers may be higher in a recession. They note that during recessions – when output and incomes are lower – consumption and investment show an increased tendency to rely on the current values of income and profits, leading to larger multipliers for government interventions. Similarly, Owyang *et al*. (2013) define periods of slack in relation to a threshold unemployment rate for both the US (6.5 per cent) and Canada (7 per cent) to examine defence spending shocks identified using the narrative approach. They find that in the US, fiscal multipliers are lower during times of high unemployment and that, in contrast, fiscal policy has a greater effect in times of high unemployment in Canada. Auerbach and

Gorodnichenko (2012) use a smooth transition autoregressive model to examine government spending multipliers in post-World War II US data. They find that fiscal policy is more effective in times of recession. The limited sample period available for Ireland hampers the feasibility of estimating state-dependent multipliers, though this presents a possible future extension to our analysis.[1]

Our paper contributes to the existing literature on Ireland-specific fiscal spending multipliers in two key ways: (1) it focuses on Ireland's measures of economic activity that remove distortions caused by foreign-owned multinational enterprises, thus allowing us to derive truer estimates of the impact on the domestic economy of changes in fiscal policy; and (2) it uses a variety of statistical approaches in order to sense-check the multiplier estimates we derive.[2]

III METHODOLOGY AND DATA

3.1 Data

We assess five government spending variables in addition to total government revenue. Data are obtained from the CSO Government Financial Statistics. The fiscal spending variables included, in separate versions of the specification, are government expenditure (GEXP) (government consumption plus government investment), government investment (GINV), government consumption (GC), wage government consumption (WGC) and non-wage government consumption (NWGC). The government revenue time series is computed net of transfers as is standard in the literature. All spending variables are deflated using the government consumption deflator. These annual data were obtained from 1970 to 2016. A long-term interest rate time series is also included. This time series is the interest rate on government bonds maturing in ten years sourced from the OECD Main Economic Indicators database for years 1971 to 2016.

In selecting the variables to include in VARs to estimate the effect of fiscal policy on the economy, a variety of approaches have been taken in the literature. While Blanchard and Perotti (2002) showed the impact of fiscal policy depends on whether a spending or tax intervention is employed, other papers such as Bénétrix and Lane (2009), and Fatás and Mihov (2001) have shown the importance of distinguishing between the different categories of expenditure. As such, this paper uses the above five categories of expenditure in order to assess the differences in

[1] The new approach demonstrated by Ramey and Zubairy (2018) and Broner et al. (2018) using the local projections method as opposed to VAR could be used to overcome this.

[2] Using domestic GVA in this approach complements existing literature examining Irish multipliers using different measures such as private consumption (Cronin and McQuinn, 2014).

[3] The inclusion of revenues ensures that spending plans are not considered in isolation, but that tax plans are also taken account of, which could also have an impact on the economy. As such, explicitly including government revenues seeks to control for these impacts and further isolate the effect of spending changes.

response pertaining to each type. The inclusion of government revenues allows for the model to explicitly take account of both central fiscal policy levers.[3] As an alternative, tax rates could also have been used. This would alleviate the problem of endogeneity of government revenues (which to some extent depend on economic activity). However, inclusion of government revenues as a variable in the VAR also allows for consideration of the effects of a spending shock on revenues through the increase in economic activity. The VAR also includes the interest rate, which acts as a proxy for the financial cycle. The financial cycle is an important variable to control for in estimating fiscal multipliers, particularly in Ireland. The financial cycle is a key factor for the effect of fiscal policy. At times when interest rates are high or credit supply is tight, the impact of fiscal policy may be lessened. Higher interest rates will lead to a fall in propensity to consume and an increase in propensity to save, while a tighter credit supply will lead to lower lending rates and investment by the private sector. These conditions could lead to lower multipliers. Bénétrix and Lane (2015) have also shown the importance of the financial cycle to the Irish economy.[4]

This paper employs a different measure of the economy from the standard GDP measure typically used for estimating fiscal spending multipliers, Domestic GVA. GDP has increasingly become less reflective of domestic economic activity in Ireland when compared to other countries. This reflects the high prevalence of foreign-owned multinational enterprises. As noted in Casey (2018), just 2.2 per cent of business enterprises in Ireland for 2012 are foreign-owned, yet these enterprises account for an estimated 58.4 per cent of total GVA. By contrast, resident-owned enterprises account for 97.8 per cent of enterprises, but less than half (41.6 per cent) of total GVA. The high concentration of foreign-owned multinational enterprises in production can mean substantial distortions to standard output measures like GDP. In particular, a small set of enterprises can vary their production substantially with little change in domestic capacity utilisation. Furthermore, their relatively greater integration in the global economy means that they are more insulated from domestic fiscal policy changes than other sectors.

The distortions caused by the activities of multinationals leads to considerable difficulties in interpreting economic activity in Ireland and it could bias fiscal spending multiplier estimates that fail to take account of the differential impact of these sectors. While these changes are relatively recent, this distinction may become more important in the future.

A good solution is to use an alternative measure of economic activity that strips out the impact of foreign-owned multinational enterprises on the economy. The Domestic GVA aggregate describes gross value added of non-multinational

[4] There may be some limitations to the use of the interest rate in the Irish context due to volatility of credit levels in the Irish financial sector throughout the period 2000-2012. A dummy variable is used to control for this in the SVARs below. A number of other variables could also be considered here, including house price inflation or the rate of credit growth.

enterprise dominated sectors of the economy.[5] In this way, estimating VARs using Domestic GVA gives a more precise view of the impact of fiscal policy on the domestic economy.[6] However, the VAR specifications were also run using GDP and a comparison of these results with the baseline GVA VAR is included in Appendix B. This illustrates the potential distorting effect of using GDP to estimate multipliers.

Another method explored in this paper is the use of fiscal forecasts to control for expectations of fiscal policy in an augmented VAR setting. The forecast series was gathered from budget publications from 1975-2016. The series is constructed by taking the t+1 forecast of gross expenditure, excluding social welfare (as a proxy for transfers) and interest expenditure. The growth rate of the real forecast of government spending (as obtained from budget documentation) was then attained for inclusion in the EVAR.

We also use the ESRI COSMO model to estimate fiscal spending multipliers. The data underpinning the ESRI COSMO model are as outlined in Bergin *et al*. (2017). Employing COSMO allows for the consideration of fiscal spending multipliers in a full and theoretically founded structural model of the economy.

Figure 1 shows the log of GDP and Domestic GVA over the period 1970 to 2016 and difference between the two measures in millions of euro. A considerable increase in this difference has developed over the past ten years. This is largely due to distortions introduced by activity in the multinational sector.

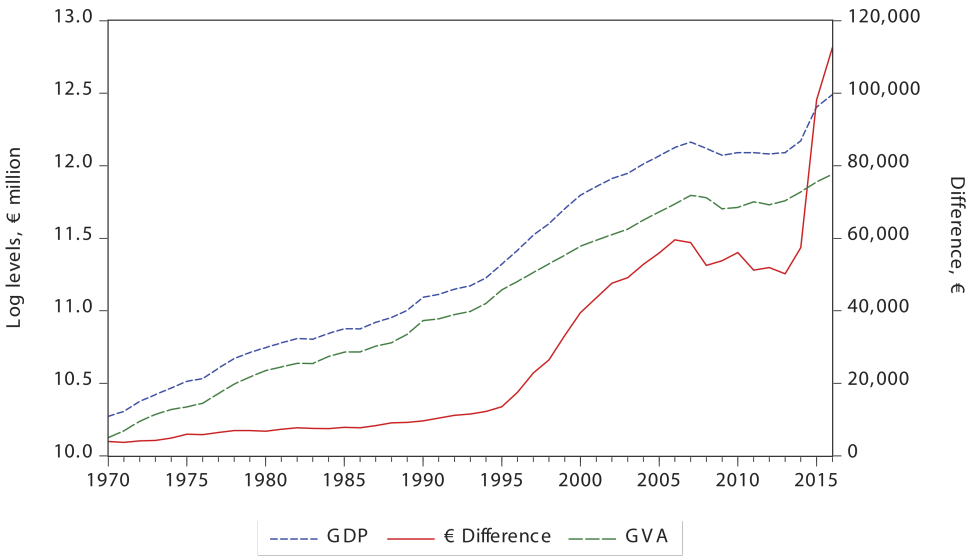
Figure 2 shows a graph of the government expenditure and revenue variables, all of which are measured in log levels. All government expenditure variables were impacted to some extent by the fiscal consolidation following the recent crisis. The most considerable fall evident in the years following the 2008 crisis appears in government investment (GINV). This is in part due to the less rigid nature of investment expenditure as much of this category will be large one-off projects.

An important consideration in estimating the impact of fiscal policy is whether annual or quarterly data are more appropriate (Beetsma *et al*., 2008; Blanchard and Perotti, 2002). One of the most common criticisms of annual data is that government expenditure is likely to react contemporaneously to output shifts. However, due to time lags in data publication and the fact that the budget is set in the October of the prior year, it is unlikely that Irish output will contemporaneously

[5] This is an official measure that is produced by the Central Statistics Office. The non-domestic sector is defined as sectors where foreign-owned multinational enterprise turnover on average exceeds 85 per cent of the sector total. Although Domestic GVA offers a way of removing some of the distortionary effects of foreign-owned multinational enterprises from measurement of the economy, it is not a perfect measure. By definition, it will exclude some domestic enterprises that are operating in sectors dominated by foreign-owned multinational enterprises too.

[6] While the multipliers calculated in this paper using the SVAR and EVAR approach consider the impact on Domestic GVA, the COSMO model estimates are on the basis of total GVA. As such part of the differences in these estimates may be due to differences in how foreign-owned multinational enterprises react to fiscal policy in comparison to the domestic sector.

Figure 1: Measures of the Irish Economy GDP and GVA (1970-2016)



Sources: CSO; and authors' own calculations.
Note: Difference, secondary axis, is the euro difference between GDP and Domestic GVA.

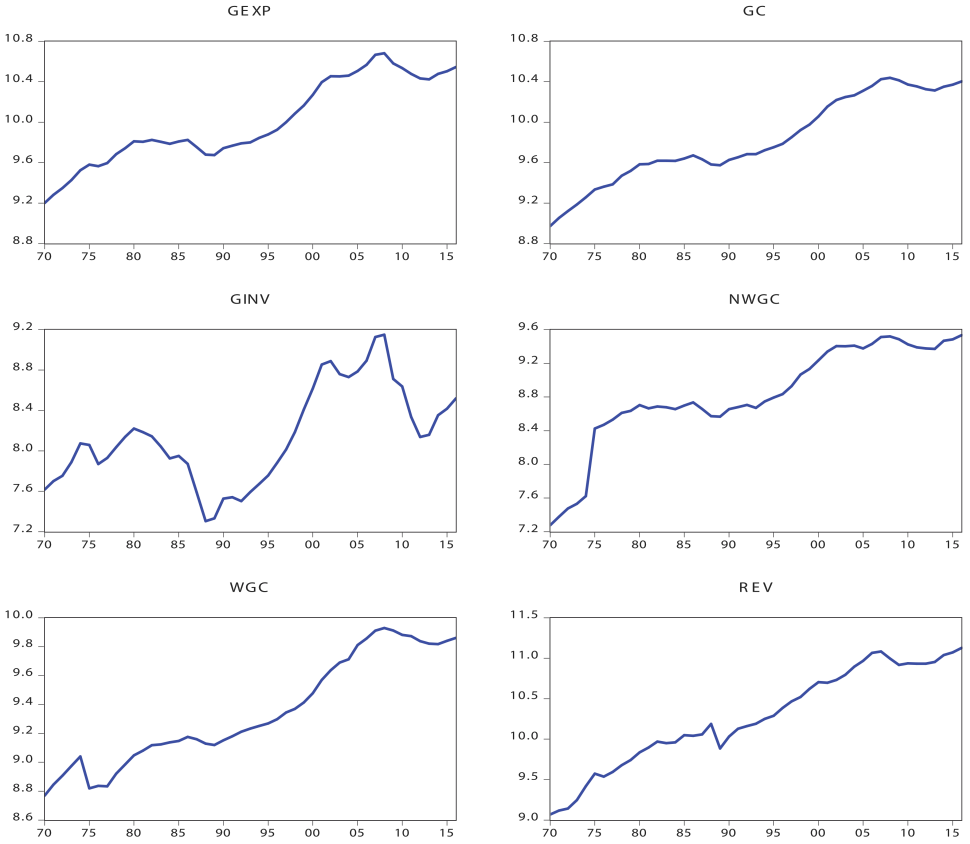
determine government expenditure.[7] The National Accounts data are produced with a time lag. By the time policymakers are notified that an unexpected change in economic growth has occurred and a policy response is formulated and approved, it is less likely that there will be in-year policy responses. As the budget is set annually, annual data will provide a more accurate representation of shocks to spending (Beetsma *et al*., 2008). While annual data allow for a longer time period to be used in the Irish case, there may still be concerns regarding anticipation effects. We seek to control for such effects in the expectations-augmented VAR discussed in Section 4.6. Considering these factors, we find that it is preferable to use annual data in the scope of this paper.

3.2 Methodology

A variety of approaches have been used in the literature to estimate fiscal multipliers. This paper uses the SVAR approach popularised by Blanchard and Perotti for estimating fiscal multipliers (Blanchard and Perotti, 2002). We then control for expectations in an attempt to further isolate unanticipated shocks using an EVAR approach similar to that used in Auerbach and Gorodnichenko (2012). In addition, we employ a large-scale structural model of the Irish economy, COSMO, as another means of deriving multiplier estimates.

[7] While in some years (for example 2009) there have been supplementary budgets, which allow for changes within-year, this is to a certain extent taken account of in the expectations-augmented VAR.

Figure 2: Fiscal Variables (Log levels, 1970-2016)



Sources: CSO; and authors' own calculations.
Note: Data are deflated using the government spending deflator.

A number of SVAR specifications are employed. In each specification, a separate SVAR is undertaken for each of the government spending categories; government expenditure, government consumption, government investment, wage government consumption and non-wage government consumption. All SVAR specifications control for Ireland's entry to the EMU in 1999.[8] Standard errors are generated at the 95 per cent confidence level based on Monte Carlo simulations with 1,000 replications.

[8] To control for the effect of joining the EMU, a dummy variable is introduced, which takes the value of one from the year 1999 on, and zero otherwise. This variable is interacted with all variables in the SVAR and then the interaction terms and the original dummy variable are included as exogenous variables in the SVAR specification.

The initial specification takes the form of a three-variable SVAR, with the following ordering: the government spending variable, Domestic GVA and government revenue. Note that in all SVAR specifications we use log levels of the variables specified. The SVAR is then extended to a four-variable specification with the long-term interest rate included as the final variable. Shock identification is achieved through a Cholesky decomposition, in which some variables are restricted from having a contemporaneous effect on others. Importantly, government expenditure is restricted so it does not react contemporaneously to shocks in output.

The structural specification is as follows:

$$A_0 Z_t = A(L)Z_{t-1} + CX_t + \varepsilon_t \tag{1}$$

where Z_t is the vector of endogenous variables, government spending (g_t), the measure of the economy (i.e. Domestic GVA) (y_t), government revenue (T) and the long-term interest rate (r_t). CX_t is a vector and parameter matrix for the intercept and a linear trend. A_0 is the matrix of contemporaneous relations between government spending, Domestic GVA, government revenue and the interest rate. $A(L)$ is a polynomial lag operator matrix that gives the relationship between these endogenous variables and their lags. ε_t is a vector of the structural shocks where $var(\varepsilon_t) = \Omega$.

$$Z_t = \begin{bmatrix} g_t \\ \mathrm{y}t_t \\ T_t \\ r_t \end{bmatrix},\ A_0 = \begin{bmatrix} 1 & -\alpha_{yg} & -\alpha_{Tg} & -\alpha_{rg} \\ -\alpha_{gy} & 1 & -\alpha_{Ty} & -\alpha_{ry} \\ -\alpha_{gT} & -\alpha_{yT} & 1 & -\alpha_{rT} \\ -\alpha_{gr} & -\alpha_{yr} & -\alpha_{Tr} & 1 \end{bmatrix}, X_{i,t} = \begin{bmatrix} c \\ t_t \end{bmatrix}, \varepsilon_t = \begin{bmatrix} \varepsilon_t^g \\ \varepsilon_t^y \\ \varepsilon_t^T \\ \varepsilon_t^r \end{bmatrix}$$

The reduced form specification is derived by pre-multiplying (1) by A_0^{-1} to attain the following:

$$Z_t = B(L)Z_{t-1} + DX_t + \varepsilon_t \tag{2}$$

where $B(L) = A_0^{-1}A(L)$, $D = A_0^{-1}C$, $\varepsilon_t = A_0^{-1}\varepsilon_t$ and $var(\varepsilon_t) = \Sigma$.

In order to identify structural shocks, we employ a recursive ordering and Cholesky decomposition. This limits the contemporaneous response of some variables to shocks in other variables. The Cholesky decomposition ordering used takes the government spending variable first, followed by the measure of economic activity (Domestic GVA), then government revenues and, finally, the interest rate. As such, the recursive ordering imposes that: $\alpha_{yg} = \alpha_{Tg} = \alpha_{rg} = \alpha_{Ty} = \alpha_{ry} = \alpha_{rT} = 0$

in matrix A_0. This has three implications. First, it means that spending is assumed to not be affected contemporaneously by shocks in economic activity, government revenues, or the interest rate.[9] Second, Domestic GVA is assumed to be unaffected contemporaneously by shocks to government revenues or the interest rate. Third, government revenues are assumed to not be affected contemporaneously by the interest rate.

Following the extension of the SVAR for the interest rate, which allows the model to control for the financial cycle, another extension is employed to control for the recent financial crisis. A dummy variable is introduced to control for the impact of the crisis, taking the value of zero up to 2008 and one for all years thereafter. This dummy variable is interacted with all variables in the SVAR and both the dummy and interaction terms are included as exogenous variables in the specification to control for the impact of the crisis. The trend variable is not interacted with the financial crisis variable, thus ensuring that the fundamental trend dynamics underlying the relationship between expenditure shocks and the outcome variables, which did not necessarily change with the crisis, are included. This method of accounting for the financial crisis allows for a longer time period to be included in the SVAR and the fundamental dynamics during the post-crisis period to be taken into account.

The four-variable specification is then submitted to robustness checks. A number of strategies can be used to check the robustness of these results. This paper employs two such strategies: First, we consider the inclusion of an additional variable to control for correlated fiscal shocks: the 'complement' government expenditure variable. The complement variable takes the form of government expenditure minus the spending variable included in the SVAR; for example for the government investment (GINV), the complement would be given by GINVCOMP = GEXP – GINV. In this way the SVAR will control specifically for the other components of government expenditure. This is important as often shocks will be correlated across budgets with, for example, a shock to consumption at the same time as a shock to investment. Including the complement variable ensures these other shocks are controlled for. Second, we explore a number of alternative orderings of the SVAR and of the contemporaneous relations. In particular the SVAR is reordered so that revenue is the first variable. This allows for revenue decisions to be taken before spending decisions.

[9] On rare occasions, it may be argued that government revenues do have an impact on fiscal policy within-year. For instance, 2016 saw an increase in expenditure after an increase in tax yield; this is not very common. Additionally, the SVARs were estimated below with alternative ordering so revenue could impact within-year spending; however, this ordering had little effect on the response of output. Blanchard and Perotti (2002) also found that the ordering of tax and expenditure has little effect on multipliers. Furthermore, there is a strong influence of GDP on government revenues within-year through all tax heads including VAT, Income Tax, Corporation Tax and Excise, the four biggest tax heads in Ireland. Therefore, this ordering is deemed reasonable.

We also extend our analysis to two alternative methods. First, we explore an Expectations-augmented VAR (EVAR) approach, which includes a forecast variable in the government consumption specification in order to take account of expectations.

3.2.1 Expectations-Augmented VAR (EVAR) Approach

Cimadomo (2012) notes the potential for considerable differences in realisation of fiscal plans in comparison to ex-ante plans. This can lead to different timings of fiscal shocks. In the Irish context, Cronin and McQuinn (2018) show that fiscal policy can be procyclical. It is therefore important to consider the role of expectations and whether outturns reflect more procyclical changes in policy mid-year. As outlined by Ramey (2011) and Auerbach and Gorodnichenko (2012), the timing of fiscal shocks can have a considerable role in determining how effective they are. A key aspect of this is expectations for fiscal policy. In order to account for expectations, we use a similar method to Auerbach and Gorodnichenko, and use official forecasts to account for the role of expectations.

We construct a series of one-year-ahead forecasts for government consumption from official Department of Finance budget documentation for 1975 to 2016. This was used to construct a series of forecast growth rates of real government purchases at time t denoted $\Delta G^{F}_{t|t-1}$. This series was then placed first in Z vector of the VAR to form an EVAR (Expectations augmented Vector Auto Regression). The forecast growth rate is ordered first, as an unanticipated shock in government consumption at time t cannot have a contemporaneous effect on the forecasts which were made at time $t-1$. Therefore, the vector of variables in the VAR is now $Z_t = [\Delta G=^{F}_{t|t-1}, G_t, Y_t, T_t, r_t]$ and an innovation in G_t that is orthogonal to $\Delta G=^{F}_{t|t-1}$ represents an unanticipated shock.

3.2.2 Estimates using COSMO: a Structural Model of the Irish Economy

Finally, we also avail of the ESRI's structural model of the Irish economy, COSMO, to produce estimates of the impact of government consumption and government investment on economic activity. COSMO is a large-scale structural model of the Irish economy which is used for medium-term projections and policy analysis (Bergin *et al*., 2017). The model is used to generate multipliers on total GVA, as opposed to Domestic GVA due to set up of the model, albeit that the model separates GVA into the traded and non-traded sectors of the economy, thus allowing for some differential responses to fiscal policy. Three shocks are implemented, a shock to government spending (which is the amalgamation of a 5 per cent shock to government investment, a 1 per cent shock to government consumption and 1.3 per cent shock to transfers), and then two separate shocks, a shock to government investment of 10 per cent, and a shock to government consumption of 2 per cent. Each shock is implemented so the specific spending variable is 'x' per cent higher each year than in the baseline case. There are a couple of limitations to this

approach. First, the COSMO model uses total GVA as opposed to Domestic GVA. This may limit the comparability of estimates, but also may highlight the potential differences in the response of domestic sectors and sectors dominated by foreign-owned multinational enterprises. Second, COSMO does not explicitly model direct improvements in productivity from investment through a 'productivity channel'; rather the improvements occur via the internal demand channel (Garcia-Rodriguez, 2018).

3.2.3 Calculation of Multipliers

All multipliers are calculated as cumulative multipliers (as per Equation (1)), i.e., the cumulative change in the economic activity measure (GVA) divided by the cumulative change in government spending (GS). This is then divided by the average ratio of the government spending variable to domestic GVA in the sample to correct for the fact that variables are in logs (Gonzalez-Garcia *et al*., 2013).[10]

$$Cumulative\ Multiplier = \frac{\Sigma_{h=1}^{H}\Delta GVA_h}{\Sigma_{h=1}^{H}\Delta GS_h} = \frac{\Sigma_{h=1}^{H}\Delta gva_h}{\Sigma_{h=1}^{H}\Delta gs_h} \div \frac{\overline{GS}}{\overline{GVA}} \qquad (1)$$

The use of cumulative multipliers allows for consideration of the impacts of spending shocks over time taking account of endogenous changes in spending which take place after the shock and the changes in domestic GVA as opposed to at a specific point. Both short run (Year 1, impact) multipliers and long run (Year 5) multipliers are calculated, in order to assess both the immediate impact of the shock and assess the persistence of these impacts.

IV RESULTS

In this section, we first present the results for the SVAR estimates of fiscal spending multipliers before subjecting these estimates to some robustness checks. We next consider estimates based on an Expectations-augmented VAR approach. Finally, we consider estimates based on the use of the ESRI's structural model of the Irish economy, COSMO.

[10] Owyang *et al*. (2013) note that if the share of government spending to output varies considerably over the sample there can be biases in the calculation of the size of multipliers. Although there is variation in the share of spending to domestic GVA around the mean there is no discerning trend which would point to a large bias. To further test this the analysis was repeated using the sample minimum and maximum values of the ratio to transform the log estimates. This did not lead to significant changes in the multiplier estimates, which remained within 0.02 for impact multiplier and 0.03 for the long run multipliers, and the overall trend in significance remained the same.

4.1 Three-Variable SVAR Specification

The first model we consider is a three-variable SVAR model that includes a measure of government spending, Domestic GVA, and government revenue. This three-variable model is estimated separately for each government spending variable considered. The model is later extended to include the interest rate forming a four-variable SVAR. The interest rate is ordered last in the SVAR specification, since it is assumed the most endogenous variable, as is standard in the literature (Fatás and Mihov, 2001).

All of the VARs we estimate are tested for stability. Some of the VARs are found to not be stable, in particular the wage government consumption specifications, and some of the government consumption specifications. As a result, the estimates obtained may not be as reliable in these cases.[11] However, Ramey (2016) notes that as long as stationarity is not required for identification, an SVAR in log levels will give consistent estimates.

Figure A.1 shows the impulse-response functions of Domestic GVA and revenue to a one per cent of Domestic GVA shock to government spending in the Three-Variable SVAR model.[12]

Looking at the Year 1 impacts, the government spending shocks are found to have a positive and statistically significant (at the 95 per cent confidence level) impact on domestic GVA for total government expenditure as well as for both public investment and government consumption. However, when we split government consumption into non-wage government consumption and wage government consumption, the impact is found not to be significantly different from zero in either case as of the first year.

In terms of the longer-run effects of government spending on Domestic GVA, we can see that effect from shocks tends to disappear by the fourth to sixth year and tends not to be statistically significant beyond three years. This is evident for total government expenditure, and also for both government investment and

[11] In order to test the stationarity of the SVAR models, the unit roots of the inverse characteristic equations were examined. The stability of each SVAR is verified once the roots are found to not be outside the unit circle. This ensures that the dynamics of the SVAR are non-explosive and convergence occurs. In some of government wage consumption specifications and the government consumption extension 2 SVAR specification, one root of the inverse characteristic equation was found to be just outside the unit circle. Roots outside the unit circle affect the estimation of standard errors and add a degree of caution to interpretation of results. However, under the five-variable preferred specifications, the government consumption SVAR is found to be stable. As annual data are employed it is deemed appropriate to use a lag length of two. Undertaking the LM test for serial correlation fails to reject the null hypothesis of no serial correlation at this lag length. Additionally, this lag length is used in much of the literature to date examining government spending multipliers with annual data (Bénétrix and Lane, 2009; Beetsma *et al*., 2008).

[12] Over the sample period, the average levels of each component of government expenditure (expressed as a share of GVA) were, 35.0, 5.8, 29.1, 18.2 and 10.9 per cent for government expenditure, investment, consumption, wage consumption and non-wage consumption, respectively. Therefore, a one per cent of GVA shock would represent a relatively large shock for investment but small for total government expenditure.

government consumption. We also find positive short-run impacts on government revenues from spending shocks, but this is insignificant in most cases and the results tend to dissipate over the long run.

Our results suggest that government spending shocks can have positive contemporaneous impacts. Yet, in the case of total government spending, public investment and government consumption, there is no evidence to suggest that positive impacts may be sustained over the medium to long term. As outlined below, this may be due to a number of factors including the small, open economy nature of the Irish economy which could lead to net leakages of income due to a relatively high propensity to import (Cronin and McQuinn, 2014).

4.2 Four-Variable SVAR Specification (including interest rates)

Figure A.2 shows the impulse-response functions obtained when the SVAR is augmented with the interest rate as a proxy for the financial cycle, an important factor in determining the impact of fiscal policy in Ireland (Bénétrix and Lane, 2015). The introduction of the interest rate to the SVAR leads to qualitatively similar results for the impact on GVA but improves the overall statistical significance of the impulse responses. In particular, the GVA impact response to a shock in non-wage government consumption is now both significant and positive. The impact response to a wage government consumption shock remains not significant. The estimation is improved by addition of the interest rate in most cases with tighter error bands.

A shock to government expenditure leads to a positive contemporaneous response in domestic GVA of 1.4 per cent, which falls in subsequent periods and becomes insignificant. The response of revenue is broadly similar to the three-variable case. There is a positive contemporaneous impact on the long-term interest rate, although not significant.

The response of GVA to a shock in investment is once again positive in the year of the shock and now the point estimate is slightly higher at its peak in the second year at 3.1 per cent. The response falls thereafter but remains positive and statistically significant until the third year. Similarly, the response of government consumption is both positive contemporaneously, at some 1.8 per cent, and significant until the third period. The impact of both the investment and consumption spending shock on government revenues remains similar to the three-variable case. The response of the interest rate to a shock in investment is not statistically significant. A shock to government consumption has a positive impact on the interest rate in the year of the shock, although not statistically different from zero.

In terms of the sub-components of government consumption, responses differ. In the case of a shock to wage government consumption, the response of GVA is broadly the same as in the three-variable case, although slightly more negative throughout, and still not significant. In contrast, the effect of a shock to non-wage

government consumption, which was not significant in the three-variable case, changes considerably; an impact of 0.6 is seen, remaining positive and significant until the third year. The responses of revenues and the interest rate to a shock in wage government consumption, are generally not statistically different from zero. The response of revenue to a shock in non-wage government consumption follows a broadly similar pattern to the three-variable case, although lower throughout.

Augmenting the SVAR with the interest rate as a proxy for the financial cycle leads to some improvements in significance across the SVAR specifications. There is a more positive impact seen in the case of a shock to expenditure, investment, consumption and non-wage consumption. This supports the view that the financial cycle affects fiscal outcomes. In particular, it may be the case that multipliers are higher due to lower interest rates in recent years, decreasing propensity to save and increasing demand for credit and investment in the private sector.

4.3 Four-Variable SVAR Specification (Including Interest Rates and Financial Crisis Period Dummies)

The recent financial crisis had a substantial impact on the Irish economy and fiscal policy in Ireland. To control for this atypical period, we include a dummy variable for the financial crisis period and interaction terms with the four endogenous variables. This ensures that estimates are based on a longer period of data, rather than just estimating the SVAR for the pre-crisis period. It also allows for the underlying fundamental dynamics of fiscal policy to be included, while controlling for the atypical impact of the financial crisis.

Figure A.3 compares the response of the GVA under the four-variable SVAR without controlling for the financial crisis, to that including the financial crisis control variables. A shock to government expenditure once again leads to a positive GVA response contemporaneously at 1.2 per cent, which remains statistically significant until the third period. The short-run effect of an investment shock is higher when the crisis is controlled for, with a contemporaneous impact of 2.5 per cent in comparison to 2.2 per cent previously. This response remains positive and statistically significant until the fourth year. The response of GVA to a shock in consumption is similar when the financial crisis is controlled for, with some overlap of the error bands, although slightly lower. The qualitative response of wage government consumption is broadly the same when the financial crisis is controlled for, although slightly more negative throughout.[13] Similarly, the response of non-wage government consumption is now slightly lower in the first year.

The inclusion of a dummy variable to control for the financial crisis further improves the statistical significance of the SVAR. Government expenditure,

[13] Error bands may be affected by stability of this VAR and caution is warranted in determining significance in both cases of the government consumption and wage government consumption VARs.

investment, and non-wage government consumption are found to have a positive contemporaneous response which is sustained in the following years to varying degrees. The response to an investment shock of 1 per cent of GVA remains higher than the response of consumption. The response of GVA to a shock in wage government consumption is broadly negative, although the result is not necessarily significant. Once again, any significant responses dissipate in the medium to longer term, consistent with theory that Ireland's relatively large dependence on imports leads to high net leakages of income (Cronin and McQuinn, 2014). This is further examined by controlling for net exports and imports in the SVAR as in Appendix C and D. These variations of the SVAR do not provide conclusive evidence of these effects. However, it is possible that the explanation of leakages still holds, but that the National Accounts measures of imports contain a high degree of distortions arising from the activities of foreign-owned multinational enterprises.[14] Other factors related to the degree of openness of an economy may also play a part in explaining these effects, such as which other economies the economy is open to, and the nature of the financing of debt. Where expansions are financed by foreign debt, multipliers may be larger due to the 'crowding out' effects being exported (Broner *et al*., 2018). Sin (2016) finds that multipliers are larger where financial market frictions exist. Using a new DSGE model of the Irish Economy, Varthalitis and Sakkas (2019) find that Irish Fiscal multipliers tend to be smaller both due to the degree of openness of the domestic economy, the size and influence of the tradeable sector, with a shock to government spending crowding in imports and crowding out exports.

4.4 Robustness Checks on SVAR Models

4.4.1 Complementary Government Spending

We next explore some robustness checks for our SVAR models. The first of these entails including the government spending complement as a separate variable; e.g. in the case of government investment (GINV) the complementary variable is GINVCOMP=GEXP-GINV. As government budgets for specific spending categories are set at the same time, there may be a correlation of shocks across budgets. Including the complementary spending variable ensures that the shock of interest, the shock to the specific government spending variable, is orthogonal to the rest of the budget. All specifications control for entry to the EMU and the 2008 financial crisis as above.

Figure A.4 compares the impulse response functions of Domestic GVA in the four- and five-variable cases. While the response of GVA is qualitatively similar to

[14] Unfortunately these distortions cannot be removed at this component level, given data considerations. In order to fully assess this channel and the impact on the domestic economy, as is the aim of the paper, a measure of domestic imports and net exports would have to be attained. It is not possible from this analysis to ascertain that the propensity to import is the main driver.

the five-variable cases, there are quantitative differences in some models, suggesting that the shocks to fiscal spending variables are somewhat correlated.

In line with the four-variable specification, the response of GVA to a shock in government investment is positive contemporaneously, although it is approximately 1 percentage point lower in magnitude. The positive response remains statistically significant as far as the second year. The response to a shock in government consumption is no longer statistically different from zero across the entire time horizon. This may be due to strong correlation between consumption and investment shocks, where in the four-variable SVAR the response to a shock in government consumption is in fact being driven by a contemporaneous shock to investment. The responses to wage and non-wage government consumption shocks are qualitatively similar in both the four and five-variable cases, although the immediate response to a shock in wage government consumption is now positive. We would caution that the standard errors still cannot be relied on for significance.

These specifications suggest there are some correlations across spending shocks. Differences in the response to shocks across four- and five-variable specifications, in particular, suggest that shocks to government consumption and investment are correlated and the consumption response of output may be influenced by investment spending.

4.4.2 Alternative Orderings

A common concern in the SVAR method with Cholesky decomposition is the possibility that the ordering of the SVAR can affect the multiplier estimates (Perotti, 2005). The ordering used in our previous specifications starts with the spending variable, then the measure of output, revenue and interest rate. This is in line with previous literature (Bénétrix and Lane, 2009; Blanchard and Perotti, 2002).

However, to examine the robustness of the estimates, the variables are reordered and each spending specification is rerun. The alternative ordering involves the revenue variable being placed first in the SVAR. This allows for consideration of the order in which decisions are made when formulating fiscal policy. Ordering revenue first would suggest revenue decisions are made before spending decisions. Figure A.5 shows this alternative ordering gives similar impulse response functions to the four-variable SVAR case. Table 1 shows the multipliers which are attained from these orderings.

Changing the ordering to allow revenue decisions to be taken first has very little impact on the multipliers. Although there are marginal differences in some specifications – for instance, the impact response to a shock in government consumption is 0.1 higher – by and large the estimates are similar.[15] This suggests the order in which fiscal decisions are made has little impact on the multiplier estimates.

Table 1: Alternative Ordering Multiplier Estimates

	GEXP	*GINV*	*GC*	*NWGC*	*WGC*
Four Variable Specification with Alternative Ordering (Revenue First)					
Impact	1.3*	2.5*	1.2*	0.5	–0.2
Long Run	0.9	2.3	0.7	1.7	–8.4

Sources: CSO; and authors' own calculations.
Note: Cholesky ordering of Revenue, Government Spending, GVA and Interest Rate, so the revenue decision is made before the spending decision. * denotes that the multiplier is statistically different from zero at the 95 per cent confidence level based on Monte Carlo simulations with 1,000 replications.

4.5 Summary of SVAR Model Results

The SVAR model results show that shocks to fiscal spending can have a positive impact on economic activity in the case of total government expenditure, government investment and government consumption; there is no evidence to suggest that it may be sustained over the medium to long term. These estimates are also inherently uncertain.

The estimated short-run (impact) and long-run multipliers are summarised in Table 2 for our four-variable SVAR specification and for our preferred five-variable SVAR specification. Figures A.6 and A.7 show the estimated multipliers for the two specifications respectively (the central scenario in blue), along with the range of multipliers provided by the 95 per cent confidence intervals (shaded pink). All multipliers are calculated as cumulative multipliers (as outlined in Section 3.2). Note that we favour the five-variable specification of our SVARs, given that there is likely to be a strong correlation between spending shocks over time. This correlation could bias our estimates of multipliers if not controlled for.

In terms of the four-variable specification, the short-run 'impact' (i.e. Year 1) fiscal spending multipliers are found to be positive and significant for total expenditure and investment.[16] In the preferred five-variable specification the impact multiplier is found to be significant for government investment and non-wage government consumption.[17] In all cases, however, we find that the long-run (i.e. Year 5) multipliers are insignificant. In other words, we cannot say that the

[15] Once again caution is warranted in relation the government consumption and wage government consumption standard errors, affecting determination of significance.
[16] While the government consumption multiplier appears to be significant for the impact multiplier, one of unit roots of the inverse characteristic equation lies outside the unit circle. As such, standard errors of the impulse response function may be affected and significance should not be relied upon.
[17] For the wage government consumption SVAR, one of unit roots of the inverse characteristic equation lies outside the unit circle. As such, standard errors of the impulse response function may be affected and significance should not be relied upon.

effects of these spending shocks are statistically different from zero at the 95 per cent level of confidence over the long term.

Table 2: Domestic GVA Multiplier Estimates

	GEXP	*GINV*	*GC*	*NWGC*	*WGC*
	Four-Variable Specification				
Impact	1.2*	2.5*	1.1*	0.5	–0.2
Long Run	0.9	2.3	0.9	1.7	–8.8
	Five-Variable (Preferred) Specification				
Impact	–	1.4*	0.5	1.0*	1.2
Long Run	–	2.0	–0.9	1.7	–4.8

Sources: CSO, and authors' own calculations.
Note: Impact multipliers are calculated at Year 1; long-run multipliers are calculated at Year 5. * denotes that the multiplier is statistically different from zero at the 95 per cent confidence level based on Monte Carlo simulations with 1,000 replications.

In terms of the magnitude of the impacts of spending shocks, we can see a wide range of variation depending on the type of fiscal intervention. Investment is found to have a greater impact on economic activity than other types of government spending, with an impact multiplier of 1.4 in the preferred specification, albeit that this cannot be said to be significantly different from zero over the long run. In contrast, government consumption has an impact multiplier of 0.5 and a long-run multiplier that is negative at –0.9, albeit that this is statistically insignificant. This may be somewhat driven by the wage component of government consumption, which does not increase output in the four-variable case and is not shown to increase output in the long-run for both cases.

4.6 Controlling for Expectations: an EVAR Approach

As outlined by Ramey (2011) and Auerbach and Gorodnichenko (2012), the timing of fiscal shocks can have a considerable role in determining how effective they are and so we use a similar method to Auerbach and Gorodnichenko to account for the role of expectations.

Figure A.8 shows the impulse-response functions for a 1 per cent of Domestic GVA shock to government consumption, which is ordered second in the EVAR specification. The response of Domestic GVA remains similar to the four-variable SVAR estimates, although it is not found to be statistically significant. As such, we can't say that government consumption shocks have significant (non-zero) impacts on Domestic GVA. However, this may indicate a contribution of anticipation effects to the response of Domestic GVA. Table 3 shows the estimated multipliers for government consumption controlling for expectations, along with the earlier four-

variable SVAR estimates. As before, the long-term estimate is not statistically significant. While estimates are relatively similar in the short run, differences over the medium term and wide error bands suggest estimates of multipliers are uncertain and could potentially be considerably lower in the long run.

Table 3: EVAR Government Consumption Multipliers (Domestic GVA)

	GC
Controlling for Expectations – EVAR	
Impact	1.2
Long term	0.4
Four-Variable SVAR	
Impact	1.0*
Long term	1.1

Sources: CSO; Department of Finance; and authors' own calculations.
Note: Sample period for EVAR 1976-2016, for Baseline VAR 1971-2016. * denotes that the multiplier is statistically different from zero at the 95 per cent confidence level based on Monte Carlo simulations with 1,000 replications.

4.7 Estimates using COSMO: a Structural Model of the Irish Economy

We also avail of the ESRI's structural model of the Irish economy, COSMO, to provide an alternative means of estimating multipliers for the Irish economy. Three shocks are studied:

1. a shock to overall government spending. This comprises a 5 per cent shock to government investment, a 1 per cent shock to government consumption and a 1.3 per cent shock to transfers.
2. a shock to government investment of 10 per cent; and
3. a shock to government consumption of 2 per cent.

Each shock is calibrated so that the specific spending variable is 'x' per cent higher each year than in the baseline case. The magnitude of the shocks is chosen so as to ensure the shocks are similar nominal amounts. Table 4 provides impact and long-term multipliers based on the three shocks assessed. The multipliers are calculated as cumulative multipliers, i.e., where the change in Domestic GVA is divided by the change in the government spending variable.

While the impact multiplier for government consumption and government spending is relatively similar to the four-variable SVAR estimates, considerable differences can be seen in the response to a shock to investment spending. The investment multipliers estimated using COSMO are considerably lower than in the four-variable SVAR case. This may in part be due to the limitations of the productivity channel in COSMO (noted in Section 3.2). Consumption estimates are

Table 4: Estimates of Multipliers using COSMO

	Shock 1 GEXP	*Shock 2 GINV*	*Shock 3 GC*
COSMO Estimates			
Impact	0.8	1.2	1.2
Long Run	1.4	1.6	1.7
Four-Variable SVAR Estimates			
Impact	1.2	2.5	1.1
Long Run	0.9	2.3	0.9

Sources: Results based on authors' own analysis using COSMO, the ESRI macro-economic model.
Note: The impact multiplier refers to Year 1, 2019; the long run multiplier is Year 5, 2023.

Table 5: Summary of Multiplier Estimates (Based on Domestic GVA unless stated)

	GEXP	*GINV*	*GC*	*NWGC*	*WGC*
Four-Variable SVAR Specification					
Impact	1.2*	2.5*	1.1*	0.5	–0.2
Long Run	0.9	2.3	0.9	1.7	–8.8
Five-Variable (Preferred) SVAR Specification					
Impact	–	1.4*	0.5	1.0*	1.2
Long Run	–	2.0	–0.9	1.7	–4.8
COSMO based Estimates (Total GVA)					
Impact	0.8^	1.2^	1.2^	–	–
Long Run	1.4^	1.6^	1.7^	–	–
Controlling for Expectations – EVAR					
Impact	–	–	1.2	–	–
Long Run	–	–	0.4	–	–

Sources: CSO; authors' own calculations; Department of Finance; COSMO estimates based on analysis by authors using COSMO, the ESRI macro-economic model.
Note: Impact multipliers are calculated at Year 1; long-run multipliers are calculated at Year 5. Sample period for EVAR 1976-2016, for Baseline VAR 1971-2016. * denotes that the multiplier is statistically different from zero at the 95 per cent confidence level based on Monte Carlo simulations with 1,000 replications. ^ It is not possible to determine the statistical significance of COSMO based estimates, though standard confidence intervals for other approaches would suggest that they are unlikely to be significant in the long run.

similar in the short-run, but higher over the longer term. It is not possible to determine the statistical significance of these results, though standard confidence intervals for other approaches would suggest that they are unlikely to be significant

in the long run. Moreover, the differences in estimates produced by alternative approaches further highlights the uncertainty in relation to estimating the impact of fiscal policy on the economy and the caution with which such estimates should be used.

4.8 Summary of Multiplier Estimates for All Approaches

Table 5 provides a summary of the multiplier estimates that we have estimated. It focuses on the preferred specifications for each of the modelling approaches employed.

A range of estimates can be seen for fiscal spending multipliers depending on the method employed. These differences suggest caution is warranted. Wide error bands are found in most of the estimates we obtain, and there is limited evidence of a lasting effect in the medium to long run. This demonstrates the uncertainty in relation to multipliers and the importance of employing a suite of approaches to better understand fiscal spending multipliers.

V CONCLUSIONS

This paper contributes to a relatively limited literature on Ireland-specific fiscal spending multipliers. We make two major contributions. First, we account for distortions caused by the impact of multinational activities on standard output measures. These distortions may bias multiplier estimates. By stripping out these activities, we are able to derive truer estimates of the impact on the domestic economy of changes in fiscal policy. Second, we use a variety of statistical approaches, including various specifications of SVARs, an Expectations-augmented (EVAR) VAR approach, and we obtain estimates based on a structural model of the Irish economy. This enables us to provide a better sense-check of the multiplier estimates that we derive.

Our results show that fiscal policy can have a positive short-run effect on the economy, yet, over the longer term, we find very limited evidence that the impacts are significantly different from zero. This likely reflects the fact that the Irish economy is highly open in nature. Net leakages of income could therefore result from a relatively high propensity to import.

Our results support previous findings in Ireland and internationally that the impact of fiscal policy depends crucially on the type of fiscal intervention employed (Bénétrix and Lane, 2009; Hall, 2010; Giordano *et al*., 2007). We find that public investment measures are seen to have a greater impact on activity than other types of government spending, yet these impacts are wide-ranging and are not found to be significantly different from zero over the long run. In contrast, government consumption spending is found to have more limited effects on output – this is largely driven by weaker estimates on wage consumption.

Our broad findings are robust to a number of different specifications. In addition to the SVAR approaches, we also examine an alternative estimation technique that controls for expectations in an EVAR setting. For government consumption, we find similar estimates in the short run, although the impact is not significant. In the long run, the effects on economic activity are not statistically different from zero. This further highlights the uncertainty of the estimates.

We also estimate multipliers by availing of the ESRI's large-scale structural model of the Irish economy, COSMO. The magnitudes of the multipliers differ, with smaller investment multipliers and slightly larger consumption multipliers. However, the estimates are not drastically different given the typical confidence intervals that we find for other fiscal spending multiplier estimates. It is not possible to determine whether the estimates produced using the structural model are statistically significant over the long run either.

In a small open economy such as Ireland, it is important to stress that no single estimate of a fiscal spending multiplier is likely to be correct. Estimates from a variety of techniques should be considered to account for the uncertainties involved. Estimates may also be sensitive to the output measure chosen and are likely to be substantially affected by globalisation. Thus, it is important to consider economic aggregates that are less prone to distortions from the multinational sector as we have done.

The differences in precise fiscal spending multiplier estimates obtained for Ireland suggest caution is warranted. Wide error bands are evident for most of the estimates we obtain, and we find very limited evidence that multipliers are significant in the medium to long run.

There are other factors determining the size of multipliers that we do not consider. These include, for example, financing considerations, debt sustainability considerations, the response (if any) of monetary policy, and the behavioural response of individuals to the specific measures introduced (i.e. the extent to which their response may be said to be Ricardian). Further work on state-dependent multipliers may be warranted, albeit that data availability and satisfactory estimates of the cycle are in short supply for Ireland.

REFERENCES

Auerbach A.J. and Y. Gorodnichenko, 2012. 'Measuring the Output Responses to Fiscal Policy', *American Economic Journal: Economic Policy*, Vol. 4, No. 2 (May 2012), pp. 1-27.

Beetsma R., F. Klaassen and M. Giuliodori, 2008. 'The Effects of Public Spending Shocks on Trade Balances and Budget Deficits in European Union', *Journal of the European Economic Association*, Vol. 6, No. 2-3, pp. 414-423.

Beetsma R., O. Furtuna and M. Giuliodori, 2017. 'Revenue- Versus Spending-Based Consolidation Plans: The Role of Follow Up', Discussion Paper DP12133, Centre for Economic Policy Research.

Bénétrix A.S. and P.R. Lane, 2009. 'The Impact of Fiscal Shocks on the Irish Economy' *The Economic and Social Review*, Vol. 40, No. 4, Winter, 2009, pp. 407-434.

Bénétrix A.S. and P.R. Lane, 2015. 'Financial Cycles and Fiscal Cycles', TEP Working Paper No. 0815, December 2015, Trinity Economics Papers, Department of Economics Trinity College Dublin.

Bergin A., N. Conroy, A. Garcia Rodriguez, D. Holland, N. McInerney, E. Morgenroth and D. Smith, 2017. 'COSMO: A new COre Structural MOdel for Ireland', ESRI Working Paper Series 553. Available at: https://www.esri.ie/pubs/WP553.pdf

Bergin A., T. Conefrey, J. FitzGerald and I. Kearney, 2009. 'The Behaviour of the Irish Economy: Insights from the HERMES Macro-Economic Model', ESRI Working Paper No. 287.

Blanchard O.J. and D. Quah, 1989. 'The Dynamic Effects of Aggregate Demand and Supply Disturbances', *American Economic Review*, Vol. 79, issue 4, pp. 655-673.

Blanchard O.J. and R. Perotti, 2002. 'An Empirical Characterisation of Dynamic Effects of Changes in Government Spending and Output on Capital', *The Quarterly Journal of Economics* (2002) Vol. 117, No. 4, pp. 1329-1368.

Blanchard, O.J. and D. Leigh, 2013. 'Growth Forecast Errors and Fiscal Multipliers', *The American Economic Review*, Vol. 103, No. 3, Papers and Proceedings of the One Hundred Twenty-Fifth Annual Meeting of the American Economic Association (May), pp.171-120.

Broner F., D. Clancy, A. Martin and A. Erce, 2018. 'Fiscal Multiplier and Foreign Holdings of Public Debt', European Stability Mechanism Working Paper Series 30/2018.

Casey E., 2018. 'Inside the 'Upside Down': Estimating Ireland's Output Gap', Irish Fiscal Advisory Council Working Paper No. 5, January 2018. Dublin: Irish Fiscal Advisory Council. Available at: https://www.fiscalcouncil.ie/wpcontent/uploads/2018/01/Casey-E-2018-Estimating-Irelands-Output-Gap.pdf

Cimadomo J., 2012. 'Fiscal Policy in Real Time', *The Scandinavian Journal of Economics,* Vol. 114 Issue 2, June, pp. 440-465

Clancy D., J. Pascal and L. Matija, 2016. 'Government Expenditure Composition and Fiscal Policy Spillovers in Small Open Economies Within a Monetary Union', *Journal of Macroeconomics*, Vol. 48 pp. 305-326.

Corsetti G., A. Meier and G.J. Müller, 2012. 'Fiscal Stimulus with Spending Reversals', *Review of Economics and Statistics*, Vol. 94, Issue 4, November 2012.

Corsetti G., G.J. Müller and A. Sibert, 2006. 'Twin Deficits: Squaring Theory, Evidence and Common Sense', *Economic Policy*, Vol. 21, No. 48 (October), pp. 597 and 599-638.

Cronin D. and K. McQuinn, 2014. 'Irish Fiscal Policy in Good Times and in Bad: Its Impact During Different Stages of the Economic Cycle', ESRI *Quarterly Economic Commentary*, Autumn 2014.

Cronin D. and K. McQuinn, 2018. 'The Cyclicality of Irish fiscal Policy Ex-ante and Ex-post', *The Economic and Social Review,* Vol. 49 No 1, Spring.

Economic Statistics Review Group (ESRG), 2016. 'Report of the Economic Statistics Review Group'. December 2016. Available at: http://www.cso.ie/en/media/csoie/newsevents/documents/reportoftheeconomicstatisticsreviewgroup/Economic_Statistics_Review_(ESRG)_Report_Dec_2016.pdf

Farhi E. and I. Werning, 2016. 'Fiscal Multipliers: Liquidity Traps and Currency Unions', *Handbook of Macroeconomics*, Vol. 2, 2016, pp. 2417-2492.

Fatás A. and I. Mihov, 2001. 'The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence', No 2760, CEPR Discussion Papers.

Garcia-Rodriguez A., 2018. 'Box 1 Macroeconomic Effects of the National Development Plan and Potential Alternatives' in ESRI *Quarterly Economic Commentary,* Summer 2018.

Giordano R., S. Momigliano, S. Neri and R. Perotti, 2007. 'The Effects of Fiscal Policy in Italy: Evidence from a VAR model', *European Journal of Political Economy,* Vol. 23, pp. 707-733.

Gonzalez-Garcia J., A. Lemus and M. Mrkaic, 2013. 'Fiscal Multipliers in the ECCU', IMF Working Paper, WP/13/117. May.

Hall R.E., 2010. 'Fiscal Stimulus', *Daedalus,* Fall 2010, The American Academy of Arts and Sciences.
Hall, R.E., 2009. 'By How Much Does GDP Rise if the Government Buys More Output?', NBER Working Paper Series, Working Paper 15496. November 2009.
Hebous, Shafik, 2011. 'The Effect of Discretionary Fiscal Policy on Macroeconomic Aggregates: a Reappraisal', *Journal of Economic Surveys*, Vol. 25, No. 4, pp. 674-707.
IMF, 2014. 'Fiscal Multipliers: Size Determinants and Use in Macroeconomic Projections', IMF Technical Notes and Manuals.
IMF, 2016. 'Fiscal Space – Assessing Fiscal Space: An Initial Consistent Set of Considerations', IMF Staff Paper.
Krugman, P., 1997. 'Good News from Ireland: A Geographical Perspective' in A. Gray (ed.) *International Perspectives on the Irish Economy*, Dublin: Indecon.
Lane P.R. and R. Perotti, 2003. 'The Importance of Composition of Fiscal Policy: Evidence from Different Exchange Rate Regimes', *Journal of Public Economics,* Vol. 87, pp. 2253-2279.
O'Grada, C. and B. Walsh, 1994. 'The Economic Effects of Emigration: Ireland' in B.J. Asch (ed.) *Emigration and Its Effects on the Sending Country*, Santa Monica, California: Rand.
Owyang M.T., V.A. Ramey and S. Zubairy, 2013. 'Are Government Spending Multipliers Greater during Periods of Slack? Evidence from Twentieth-Century Historical Data' *The American Economic Review,* Vol. 103, No. 3, Papers and Proceedings of the One Hundred Twenty-Fifth Annual Meeting of the American Economic Association (May), pp. 129-134.
Perotti R., 2005. 'Estimating the Effects of Fiscal Policy in OECD Countries'. (January). CEPR Discussion Paper No. 4842.
Ramey, V.A. 2011. 'Identifying Government Spending Shocks: It's All in the Timing,' *Quarterly Journal of Economics*, 126 (February), pp. 1-50.
Ramey, V.A. 2016. 'Macroeconomic Shocks and Their Propagation' published in 2016 *Handbook of Macroeconomics,* Vol. 2A, pp. 71-154.
Ramey, V.A. and S. Zubairy, 2018. 'Government Spending Multipliers in Good Times and in Bad: Evidence from US Historical Data', *Journal of Political Economy,* Vol. 126, No. 2 (April), pp. 850-901
Scott R. and J. Bedogni, 2017. 'The Irish Experience: Fiscal Consolidation 2008-2014', Irish Government and Economic Evaluation Service, Department of Public Expenditure and Reform, Staff Paper 2017. May 2017. Available at: https://igees.gov.ie/wp-content/uploads/2017/06/The-Irish-Experience-Fiscal-Consolidation-2008-2014.pdf
Sin J., 2016. 'The Fiscal Multiplier in Small Open Economy: The Role of Liquidity Frictions', IMF Working Paper WP/16/138, July.
Smyth D., 2017. 'The Recovery in the Public Finances in Ireland following the Financial Crisis', *Journal of the Statistical and Social Inquiry Society of Ireland,* Vol. XLVI. May 2017.
Stock J.H. and M.W. Watson, 2001, 'Vector Autoregressions', *The Journal of Economic Perspectives*, Vol. 15, No. 4 (Autumn), pp. 101-115.
Stock, J. and M. Watson, 1999. 'Forecasting inflation', *Journal of Monetary Economics*, Elsevier, Vol. 44, No. 2, pp. 293-335, October.
Turner, D., M. Chiara Cavalleri, Y. Guillemette, A. Kopoin, P. Ollivaud and E. Rusticelli, 2016. 'An Investigation Into Improving the Real-Time Reliability of OECD Output Gap Estimates', OECD Economics Department Working Papers, No. 1294, OECD Publishing, Paris.
Uhlig H., 2005. 'What are the Effects of Monetary Policy on Output? Results From an Agnostic Identification Procedure', *Journal of Monetary Economics,* Vol. 52 (2005), pp. 381-419.
Varthalitis P. and S. Sakkas, 2019. 'Public Debt Consolidation and its Distributional Effects', *The Manchester School*. July.
Whelan, K., 2014. 'Ireland's Economic Crisis: The Good, the Bad and the Ugly', *Journal of Macroeconomics,* Vol. 39, Part B, March 2014, pp. 424-440.

APPENDIX A

Figure A.1: Three-Variable SVAR: Response to 1 Per Cent of Domestic GVA Government Spending Shock

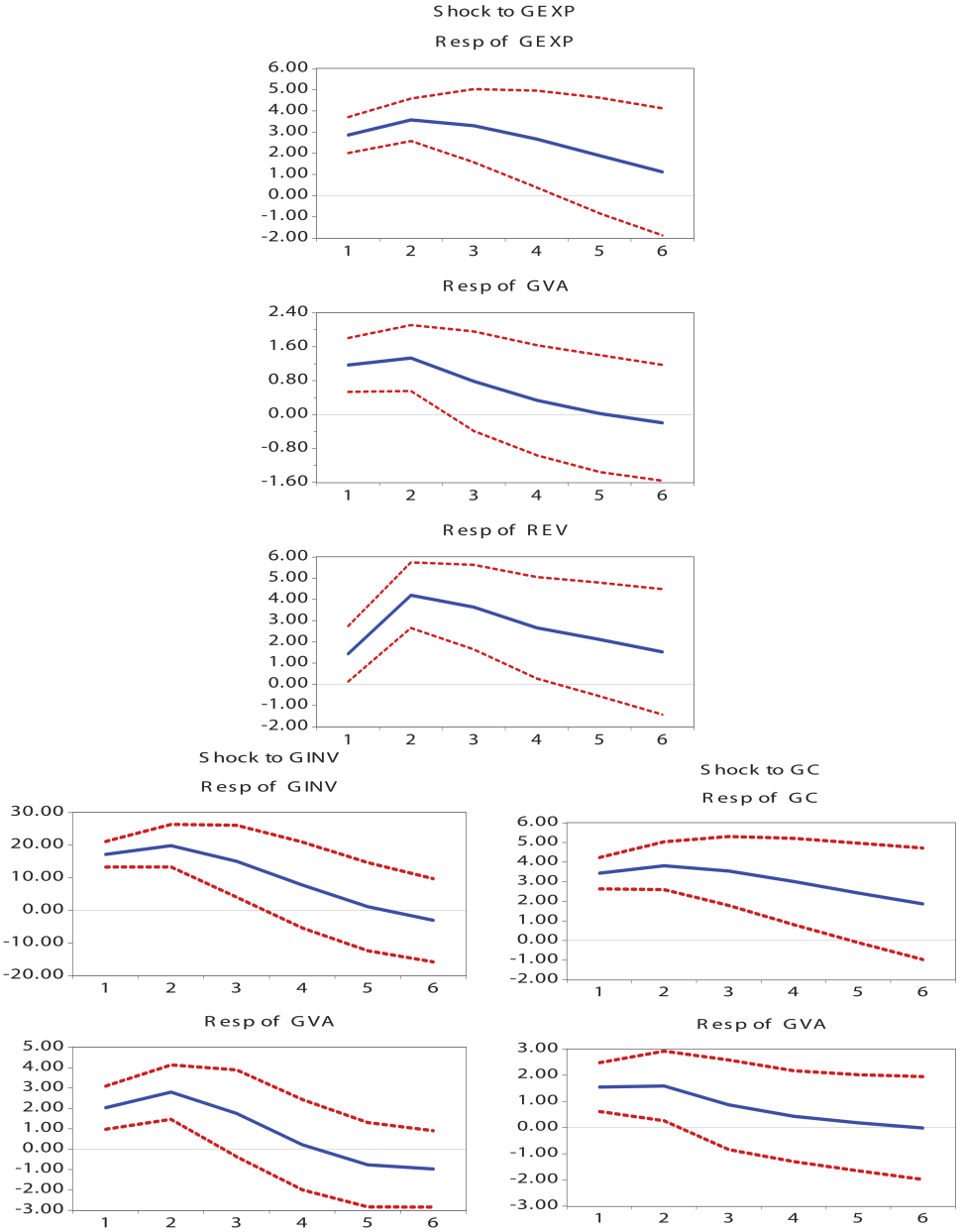
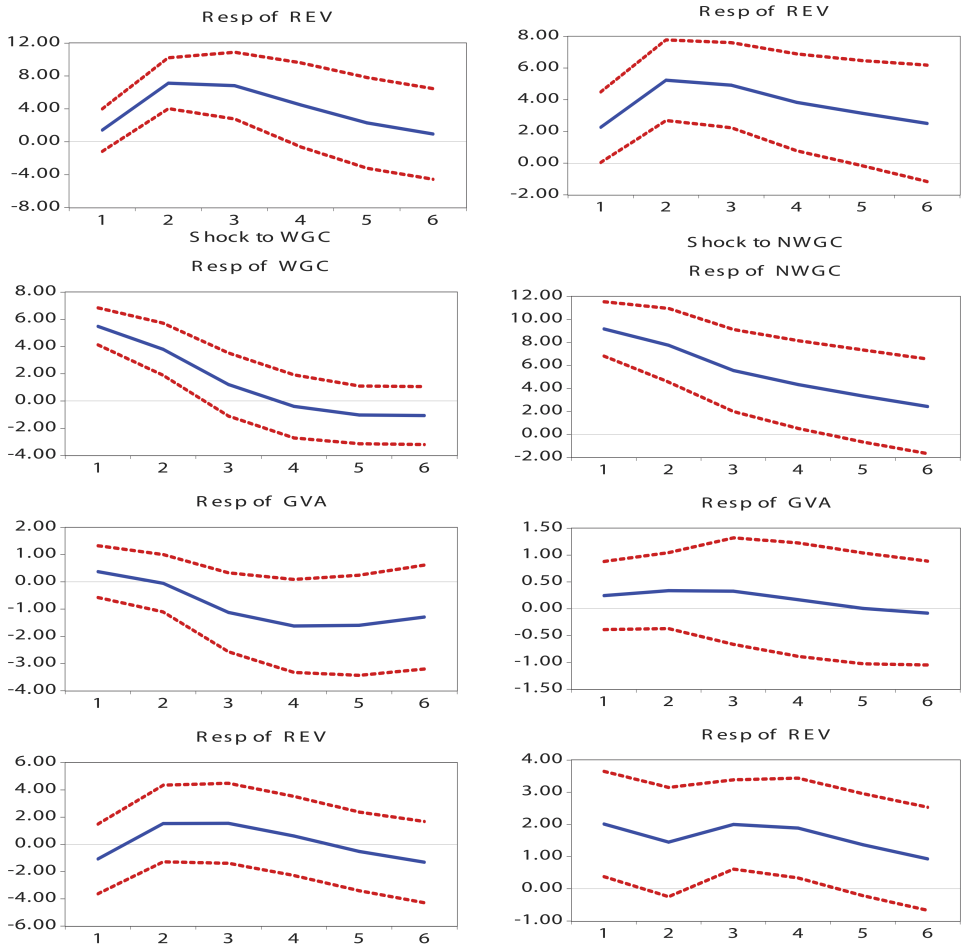


Figure A.1: Three-Variable SVAR: Response to 1 Per Cent of Domestic GVA Government Spending Shock (Contd.)



Sources: CSO; and authors' own calculations.
Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.

Figure A.2: Four-Variable SVAR: Response to 1 Per Cent of Domestic GVA Government Spending Shock

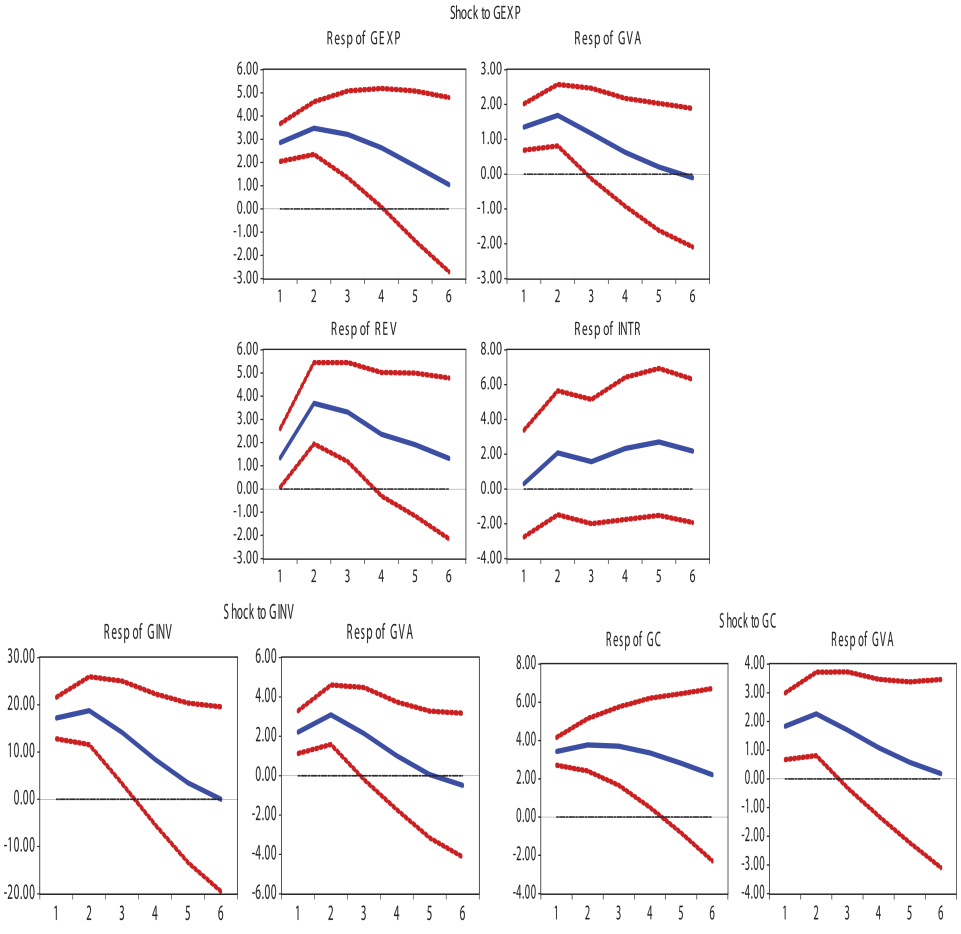
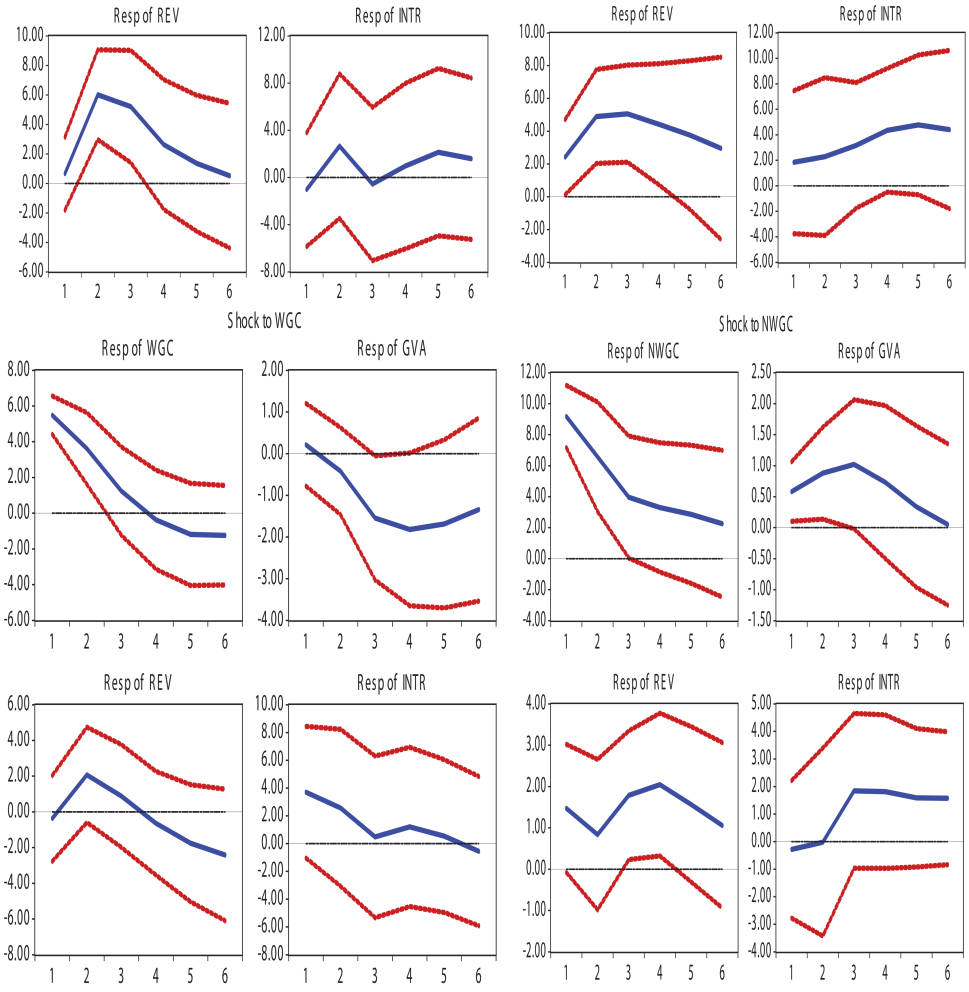


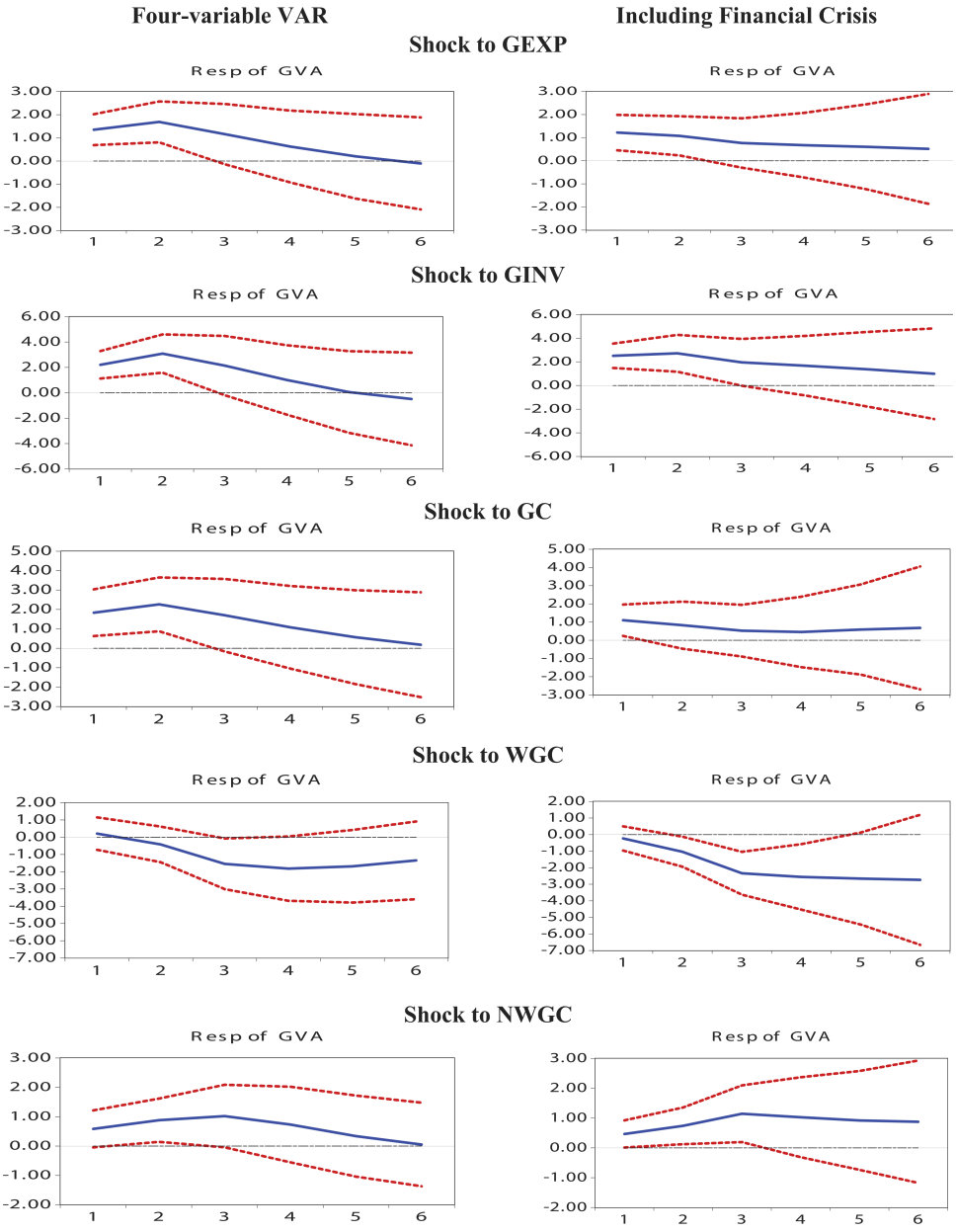
Figure A.2: Four-Variable SVAR: Response to 1 Per Cent of Domestic GVA Government Spending Shock (Contd.)



Sources: CSO; and authors' own calculations.

Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.

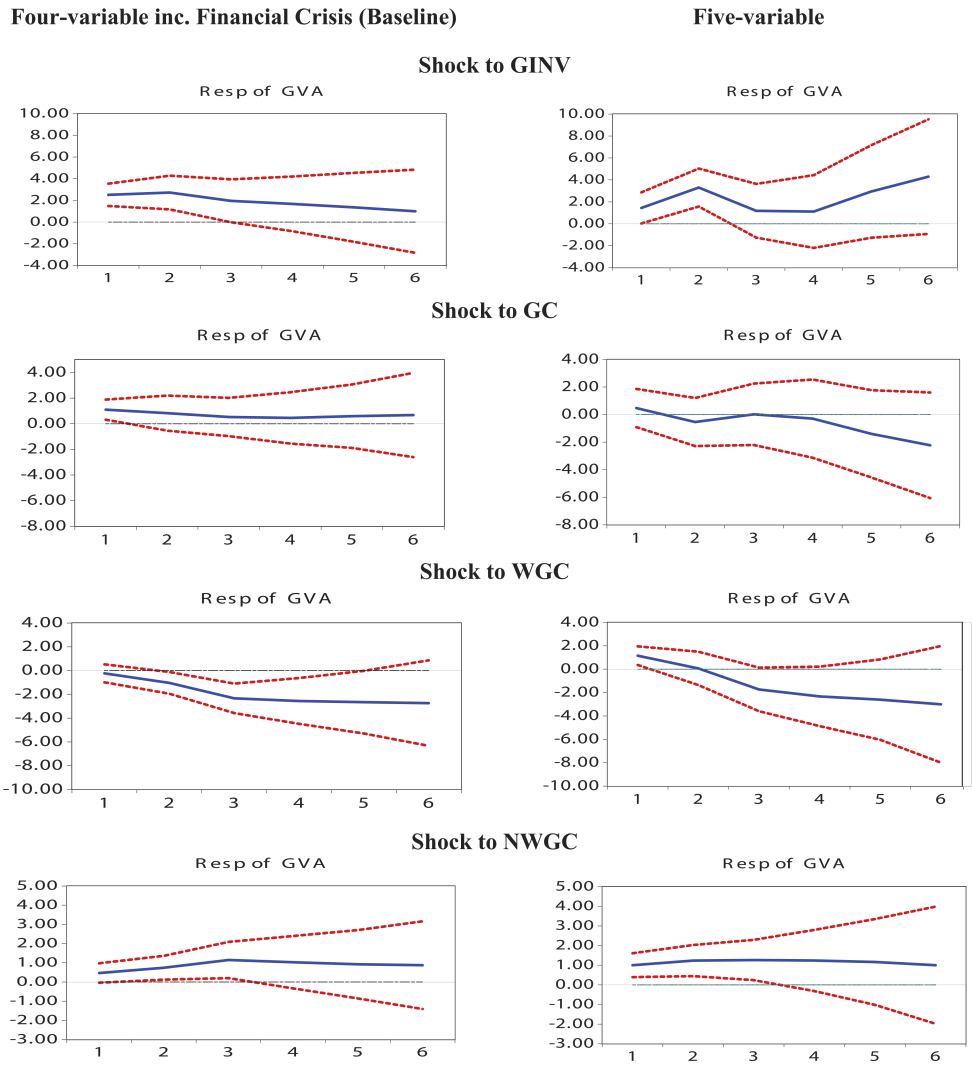
Figure A.3: Four-Variable SVAR with Financial Crisis Dummy: Response to 1 Per Cent of Domestic GVA Government Spending Shock



Sources: CSO; and authors' own calculations.

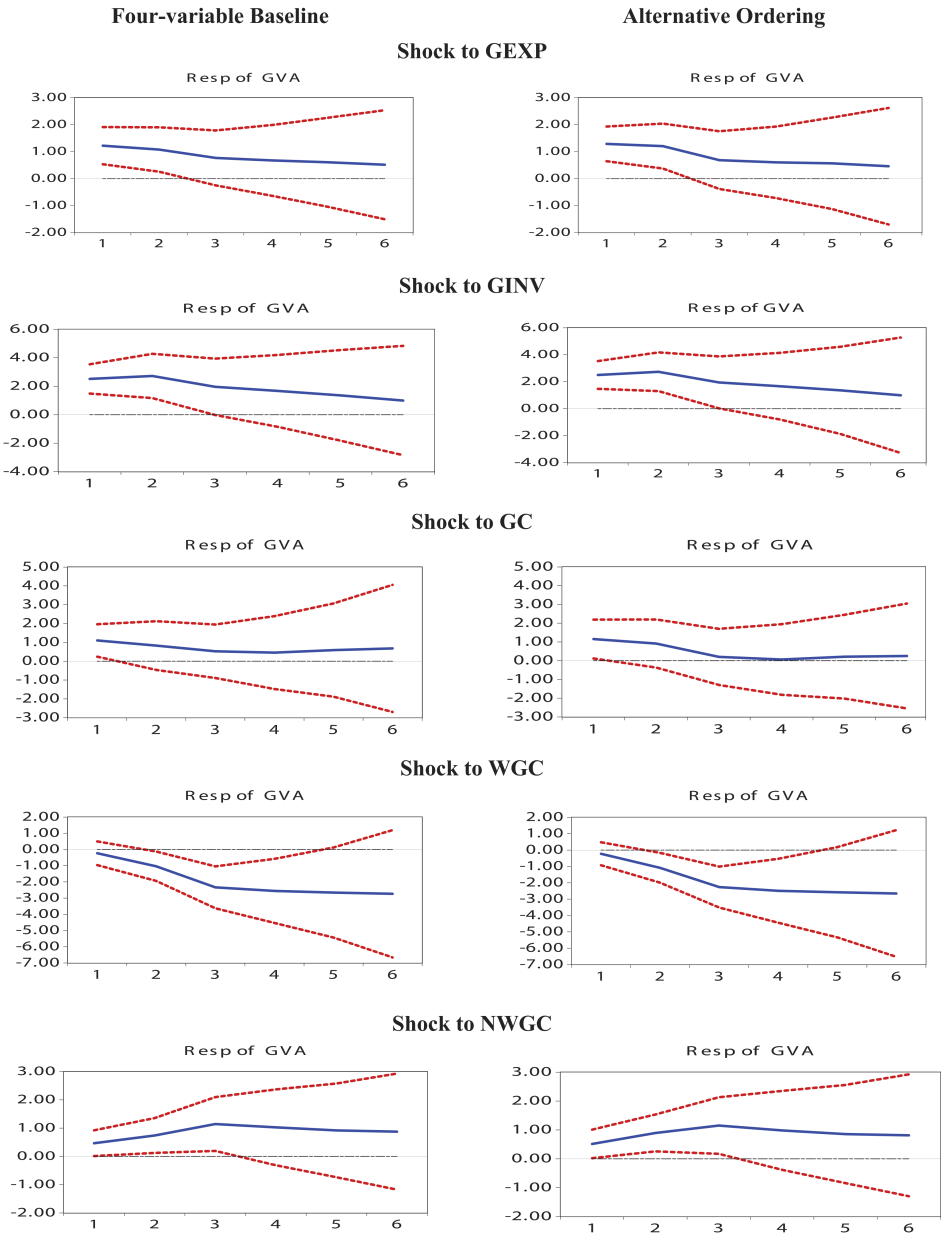
Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.

Figure A.4: Controlling for Other Spending, Five-variable SVAR, Shocked Variable Ordered Second: Response to 1 Per Cent of Domestic GVA Government Spending Shock



Sources: CSO; and authors' own calculations.
Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.

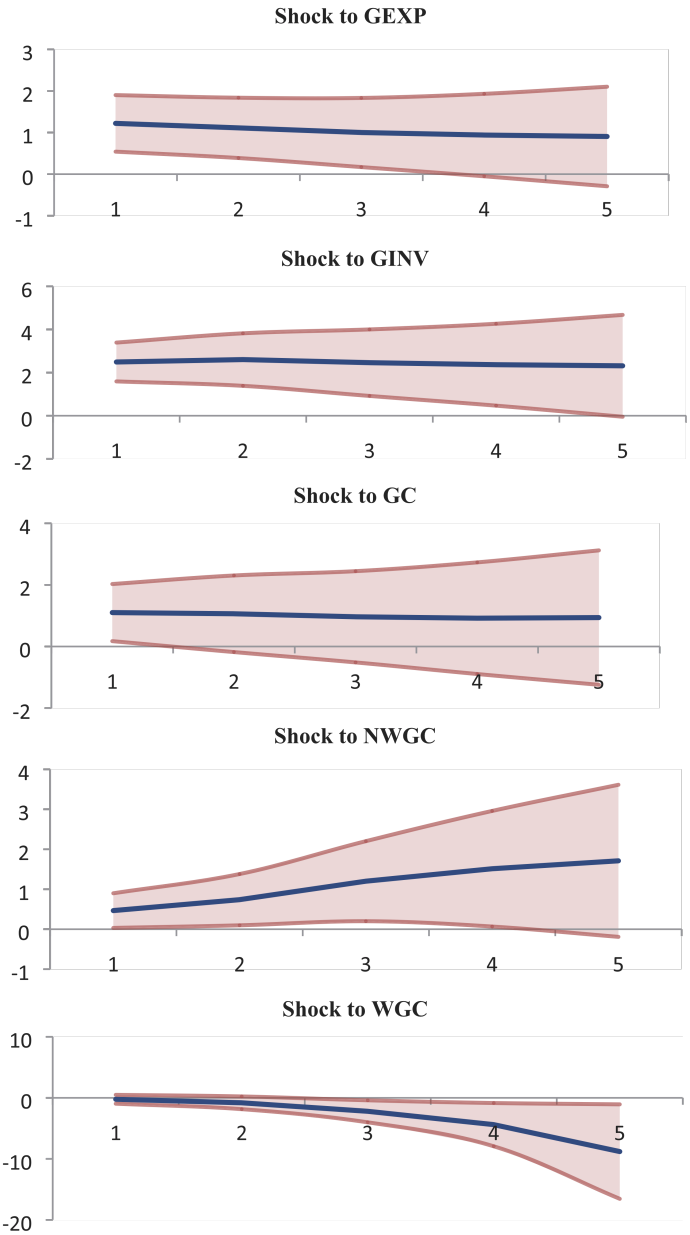
Figure A.5: Alternative Ordering SVAR, Revenue Ordered First: Response to 1 Per Cent of Domestic GVA Government Spending Shock Ordered Second



Sources: CSO; and authors' own calculations.

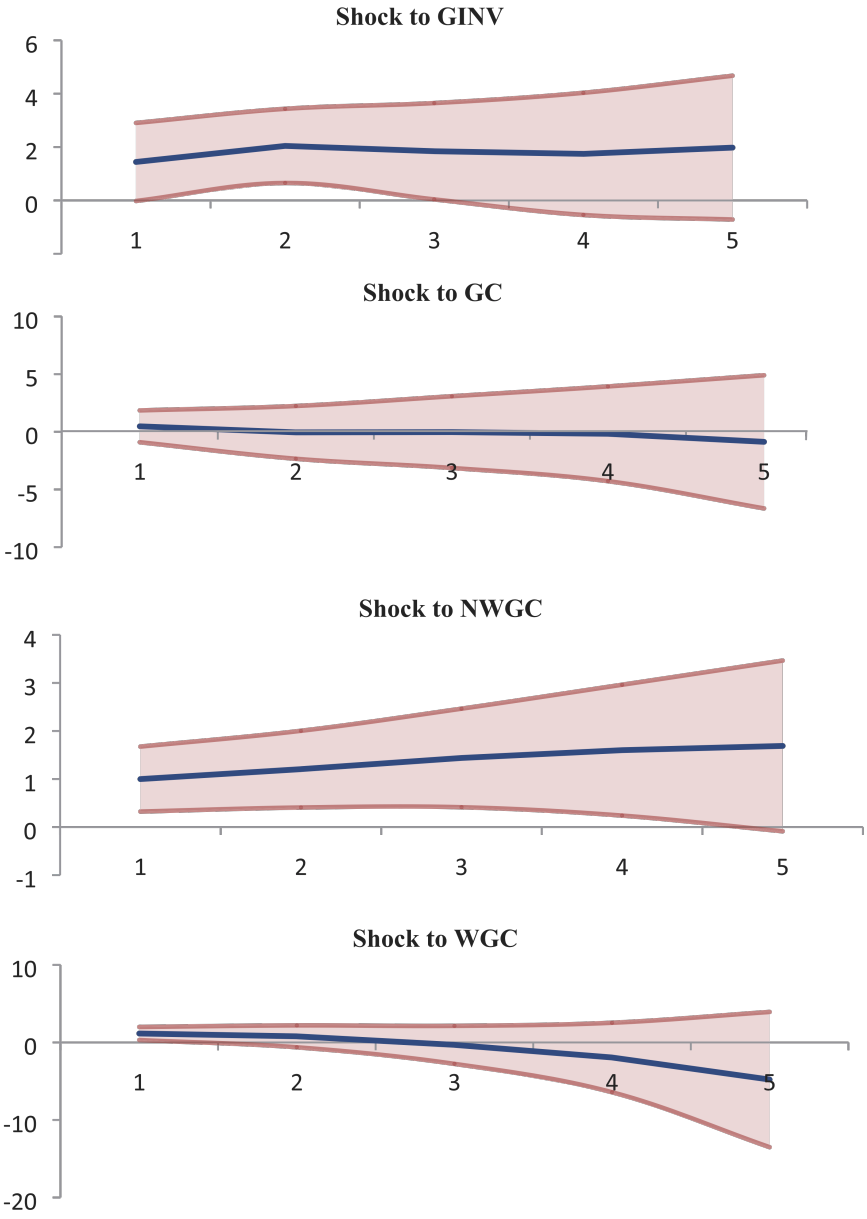
Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.

Figure A.6: Fiscal Spending Multiplier Estimates, Four-Variable SVAR: Response to 1 Per Cent of Domestic GVA Government Spending Shock



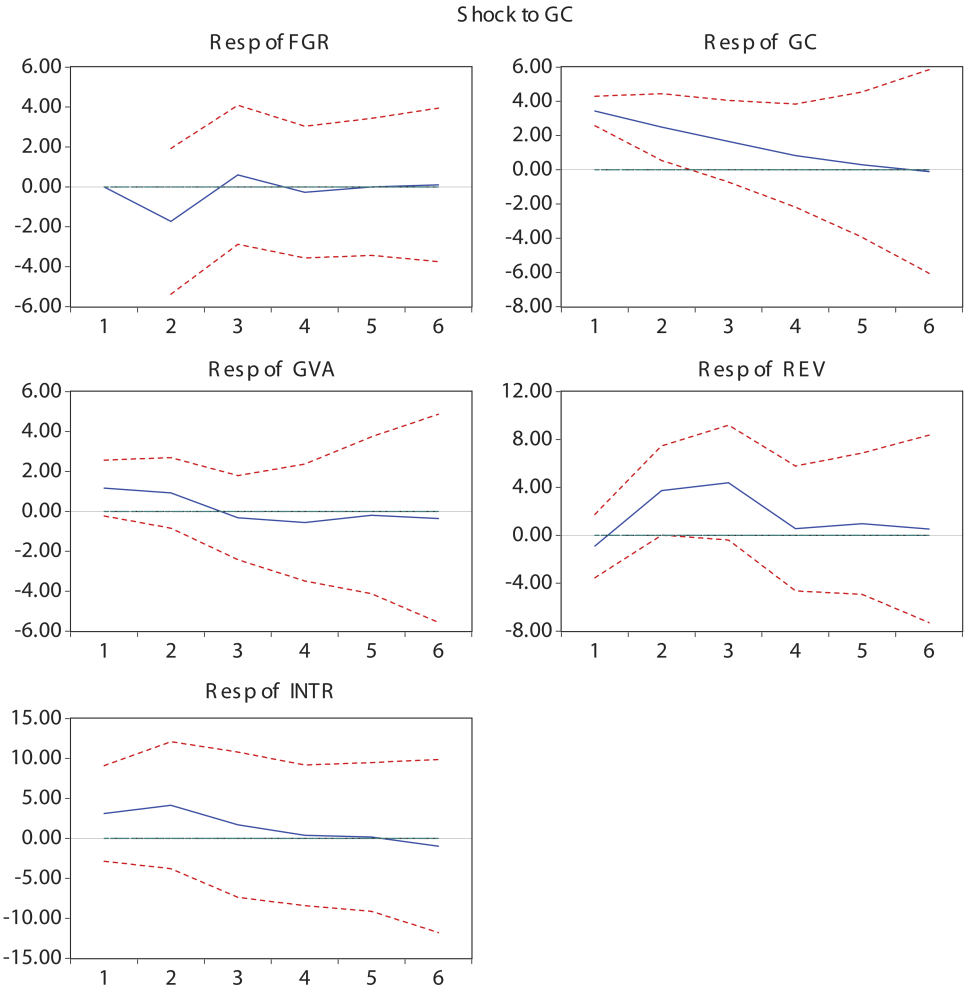
Sources: CSO; and authors' own calculations.
Note: Blue lines show the point estimates of the Impulse-Response mean. Shaded area shows the +/– 2 standard errors bands from Monte Carlo simulations with 1,000 replications. Note the WGC estimates are not stable and so standard error bands may be affected.

Figure A.7: Fiscal Spending Multiplier Estimates Five-Variable SVAR: Response to 1 Per Cent of GVA Government Spending Shock



Sources: CSO; and authors' own calculations.
Note: Blue lines show the point estimates of the Impulse-Response mean. Shaded area shows the +/– 2 standard errors bands from Monte Carlo simulations with 1,000 replications. Note the WGC estimates are not stable and so standard error bands may be affected.

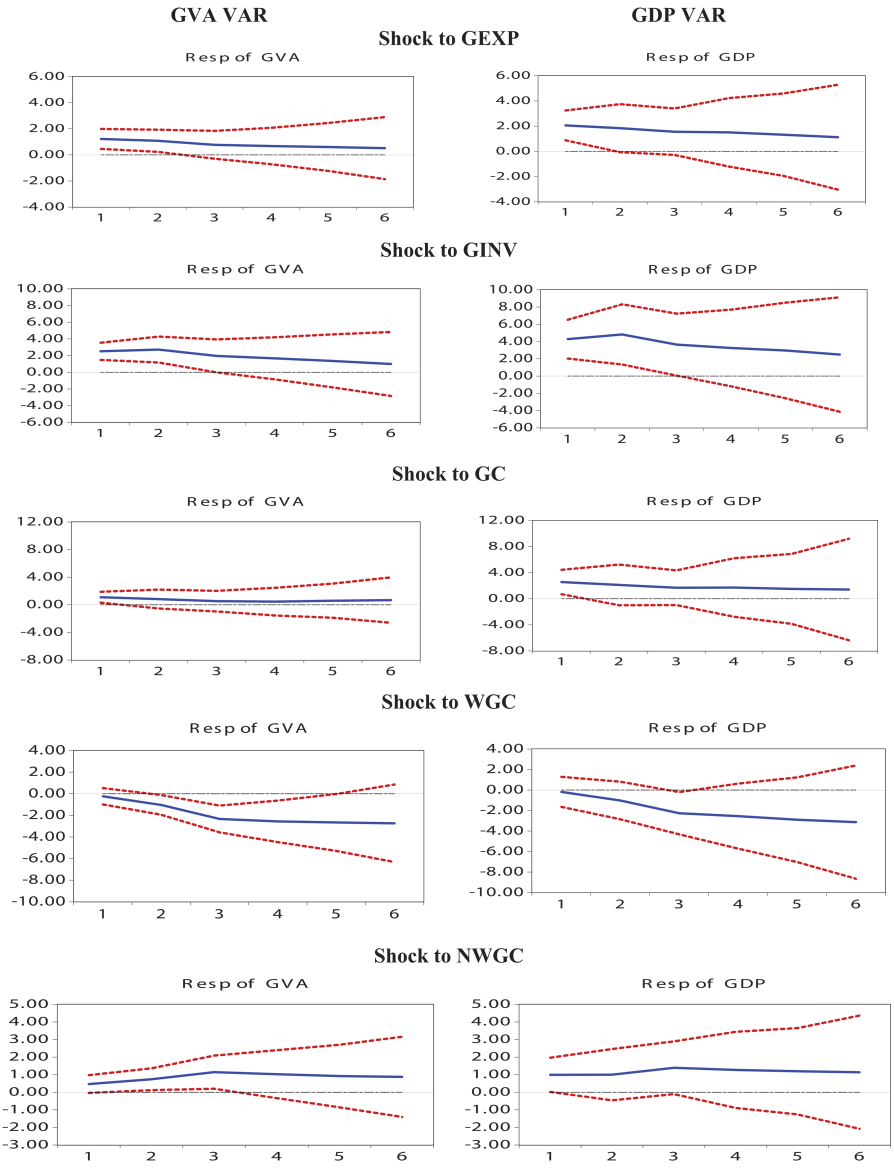
Figure A.8: Controlling for Expectations, Five-Variable SVAR, Shocked Variable Ordered Second: Response to 1 Per Cent of Domestic GVA Government Consumption Shock



Sources: CSO; and authors' own calculations.
Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.

APPENDIX B: COMPARISON WITH GDP

Figure B.1: Comparison with GDP, 4 variable VAR including Financial Crisis Dummy

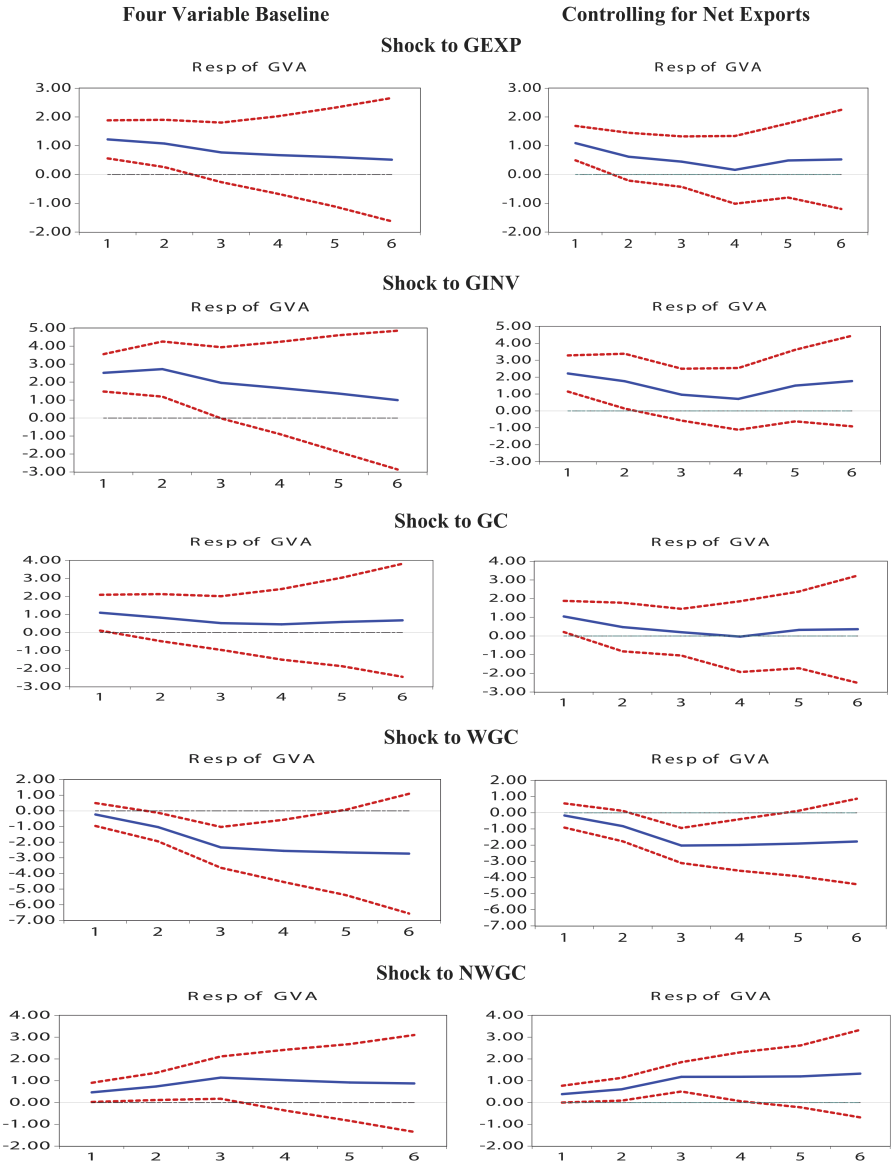


Sources: CSO; and authors' own calculations.

Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications. Response to 1 per cent of Domestic GVA/GDP Government Spending Shock.

APPENDIX C: CONTROLLING FOR NET EXPORTS

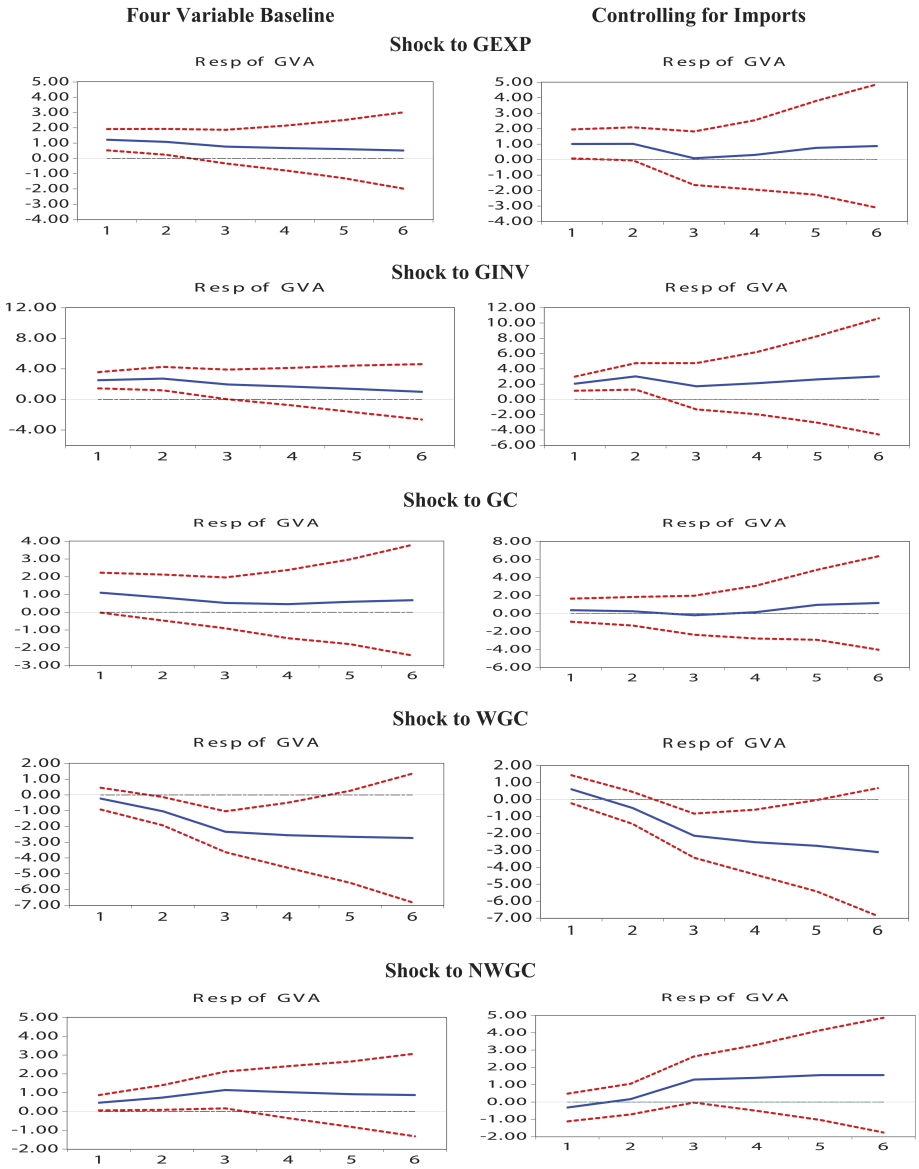
Figure C.1: Controlling for Net Exports, Response to 1 Per Cent of Domestic GVA Government Spending Shock



Sources: CSO; and authors' own calculations.
Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.

APPENDIX D: CONTROLLING FOR IMPORTS

Figure D.1: Controlling for Imports, Response to 1 Per Cent of Domestic GVA Government Spending Shock



Sources: CSO; and authors' own calculations.

Note: Solid lines show the point estimates of the Impulse-Response mean. Dotted lines are the +/– 2 standard deviations standard errors from Monte Carlo simulations with 1,000 replications.