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Short-term effects of public debt on growth:

The spending multiplier pass-through

EL Mostafa Bentour*

Abstract: We examine the relationship between public debt and economic growth in the short term, through spending multipliers. We study the impact of public debt accumulation on the size of the expenditure multipliers, as well as the effects of the business cycle. We adopt the structural vector autoregressive (SVAR) methodology, running a panoply of bi-variate and tri-variate SVAR models on quarterly data for a sample of 18 OECD countries. Furthermore, we estimate an SVAR with six fiscal and monetary variables for the United States to highlight the channels through which public debt affects economic growth. In all the above-mentioned SVAR models, we control for the business cycle and the public debt movement effects. The results show that expenditure multipliers are higher in times of recession than times of expansion, which is in line with the recent findings about fiscal multipliers in advanced economies, being larger in recessions than expansion periods. Moreover, controlling exogenously for public debt, the estimations revealed larger spending multipliers in debt accumulation than in debt contraction periods, independent of the business cycle effects. However, introducing endogenously the public debt ratio leads to higher multipliers in recessions than in expansions. Moreover, the results do not support any tendency for weak spending multipliers for the recent periods compared to older ones, as suggested by some researchers in relation to increases in trade openness and exchange rate flexibility. Furthermore, the United States SVAR shows that public debt crowds out private investment, leading to a lower growth rate in times of expansion, while in times of recession the public debt effects on growth are positive. The results also revealed that government expenditure has a positive but short-lived impact on economic growth. The policy implication is that fiscal stimulus effects could take time to materialize in recessions, while such effects could be short-lived in expansions, which is something that should be considered by policy-makers in their spending decisions.

JEL Classification: C30, E62, H50, H60.

Keywords: Business Cycle, Debt Accumulation, Dynamic Multiplier, Fiscal Position, Government Expenditure, SVAR.

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1. Introduction

At the height of the 2008 financial crisis, fiscal policy was revived as the main and almost sole active government policy tool to cope with the financial crisis effects, after monetary policy was constrained in many advanced countries by the zero-lower bound (ZLB) interest rate or by countries being affiliated to a monetary union, as is the case for eurozone countries (Romer, 2011). The fiscal policy is solicited in two "distinct" but subsequent events. The first, advanced countries, were urged to implement massive fiscal stimuli plans and bail-out programmes[2] (in 2009–10) designed to dampen the negative effects of the crisis on the private sectors and households at the beginning of the crisis, and therefore boosting growth (OECD, 2009; ILO, 2011). Consequently, this leads to exacerbating fiscal positions, with the deficit widening and a sharp increase in debt to GDP ratios, which were already high in the pre-crisis year (IMF, 2009; Taylor, 2018). This issue pushed policy-makers, especially in the eurozone, where the debt ratios climbed from the pre-crisis level in almost all countries by 20 percentage points (European Commission, 2012), supported by advisors and economists' views from international institutions and think thank institutes (International Monetary Fund, World Bank, European Central Bank, OECD, G20) and other economists from academia, to reverse the track of the fiscal policy from stimuli programmes to fiscal consolidation. The argument of those economists stands for the modest results obtained from the assessment of fiscal stimuli programmes,[3] as reported by many studies (Baldacci et al., 2009; Freedman et al., 2010; Taylor, 2011; Coenen et al., 2012; Cogan and Taylor, 2012; Mian and Sufi, 2012; Phelps, 2018), and the likely negative impact of high public debt on economic growth, which triggered a large open debate between economists.[4]

However, the prolonged negative impacts of the financial crisis, under the two consequent programmes (fiscal stimulus and fiscal consolidation), have put the focus on another issue related to the role of fiscal multipliers in those programmes, namely, trying to find answers to the weak GDP recovery despite massive fiscal stimuli from one side and the persistent high debt ratios and deficits despite fiscal consolidation from the other. This triggered a permanent influx of empirical studies (re)-assessing the values of the multipliers and reviewing their determinants.

One research strand involves assessing the size of the multipliers due to positive fiscal shocks corresponding to the stimuli programmes (an important list of sample studies and their main

[2] Although these fiscal stimuli seem to be large in absolute size, approximately US$ 2 trillion in the G20 countries (ILO, 2011), some authors qualified these fiscal stimuli by insufficient and timid programmes (Aizenman and Pasricha, 2011; Stiglitz, 2018), especially compared to emerging countries in Asia and the Pacific, not including Japan and the Republic of Korea, where the average stimuli programmes were around 9.1% of GDP compared to just 3.4% of GDP in advanced economies (ILO, 2011).

[3] The two important fiscal stimuli that were reviewed are the ARRA programme (the American Recovery and Reinvestment Act), implemented in the United States, and the EERP programme (the European Economic Recovery Plan), implemented in Europe. A very large list of studies on fiscal stimulus measures and their main findings from the ILO (2011), shows very mixed results, especially on the ARRA programme. Among 47 studies and reports of this list, 22 reported mixed effects, 21 positive effects and 4 negative effects.

[4] More details about this debate are presented in Bentour (2020b).

findings about the effects of fiscal stimuli around 2008–10 is in ILO (2011)), while the other strand goes the opposite way, evaluating and designing strategies for successful fiscal consolidation[5] and austerity measures (Abbas et al., 2010; OECD, 2011, 2012; Molnár, 2012; Cogan et al., 2013; Estevão and Samake, 2013; Blot et al., 2014a; Alesina et al., 2015). In fiscal stimuli programmes, the fiscal instruments used are either related to the increase in spending programmes (and fiscal transfers to households and bail-out programmes) or based on tax cuts for households and investors to boost consumption and investment – or a mixture of the two. However, in fiscal consolidation, which directly aims, *ceteris paribus*, to sustain and improve the government's fiscal position (reducing debt and deficit) by increasing revenue and rationalizing expenditure, the course of the fiscal instruments is reversed, as in this case, where taxes should be increased and expenditure cut.[6]

Since the 2008 financial crisis, a significant body of literature assessing fiscal multipliers has flourished (Romer and Romer, 2010; Auerbach and Gorodnichenko, 2012, 2013; Delong and Summers, 2012; Farhi and Werning, 2017; Ramey, 2011; Ramey and Zubairy, 2018).[7] Although the story of fiscal multipliers was remounted at the edge of the Keynesian era following the 1929 Great Depression, their empirical assessment has recently been extensively revived as a result of the development of econometrics and statistics. Nevertheless, the renewed importance of fiscal multipliers showed large discrepancies in their values (whether in absolute values or sometimes even in algebraic signs), especially in the recent financial crisis (Ramey, 2018). These values are time- and country-specific and even sensitive to the assessment method (Baum et al., 2012; Batini et al., 2014).

Indeed, in explaining the values of fiscal multipliers, some authors have found those multipliers to be sensitive to the business cycle. In particular, fiscal spending multipliers were revealed to be larger in recessions than expansion periods. Auerbach and Gorodnichenko (2012, 2013) were the first to emphasize the tendency of fiscal multipliers to be large in recessions (potentially reaching more than 2) compared to expansions. Consequently, many other researchers confirmed their results, differentiating between fiscal multipliers in recessions and expansions (Barro and Redlick, 2011; Parker, 2011;[8] Corsetti et al., 2012; Caggiano et al., 2015; Fazzari et al., 2015; Glocker et al., 2019). This also pushed some researchers who were not totally convinced, or with opposing results, to refine their analysis, leading to finding out the vulnerability of fiscal multipliers to other determinants and not necessarily conditioned by the state of the economy in the business cycle.

[5] See the World of Work Report (2010) for a list of detailed consolidation and austerity measures for advanced countries.

[6] We should be cautious when the values of multipliers deducted from fiscal stimulus, for example, are used to draw conclusions and policy advice on fiscal consolidations, and vice versa, as there is no revealed symmetry of effects in the instrument changes: an increase/decrease in expenditure could have an effect that is not necessarily the same in absolute value for a similar decrease/increase in expenditure. Few authors cared about this issue (see Section 2.5).

[7] See, for example, Ramey (2018) for a recent and large literature review.

[8] Parker (2011) built on earlier versions of Auerbach and Gorodnichenko (2012, 2013) (as did some other authors), which are issued, respectively, as NBER working papers in 2010 (No. 16311) and 2011 (No. 17447).

Therefore, fiscal multipliers were revealed to be dependent on the fiscal position measured by the level of debt ratios and deficits (Corsetti et al., 2013; Huidrom et al., 2016), on the monetary policy stance (Hall, 2009), particularly the constrained monetary policy, either by the ZLB interest rate (liquidity trap) or by the loss of monetary independence, as in the pegged exchange rate or monetary union (Cogan et al., 2010; Christiano et al., 2011; Delong and Summers, 2012; Farhi and Werning, 2017).

However, the recent works of Ramey (2018) and Ramey and Zubairy (2018) consider that government spending multipliers are, on average, lower than unity.[9] This contrasts with the tendency of the post-2008 crisis researchers to confirm larger multipliers, especially in recessions. This also aligns with the consensus on spending multipliers before the last recession, considered to be weak, and that fiscal policy effects are short-lived (Coenen et al., 2012). Furthermore, the debate about the impact of government debt on economic growth (Bentour, 2020b) is directly related and assessed via the multiplier's effects. In particular, fiscal policy effects, taking into account the fiscal position of the economy, measured by the level of public debt and/or the fiscal deficit, have been highly debated in the aftermath of the 2008 financial crisis (Boussard et al., 2012; Corsetti et al., 2012; Blot et al. 2014b; Canzoneri et al., 2015; Bi et al., 2016; Huidrom et al., 2016; Perdichizzi, 2017; Poghosyan, 2017; Afonso and Leal, 2018; Auerbach and Gorodnichenko, 2017; Blanchard, 2019; Broner et al., 2019). Very recently, in a presidential lecture of the American Economic Association, Blanchard (2019) triggered another wave of public debt and growth debate related to the fiscal cost of high public debt, as well as its effect on welfare, minimizing worries about the public debt costs for the American economy, as, in historical records, the nominal interest rate has remained, on average (except for some small periods around the 1980s), below the nominal growth rate. These contrasting results about spending multipliers make it interesting to reconsider studying fiscal multipliers and contributing to this unsettled debate.

Despite the important flux of studies about fiscal multipliers, these studies show more uncertainties than certitude about their size. The differences in methods, as well as samples of countries and time periods, play an important role in this issue. The remainder of this paper is as follows. Section 2 presents the literature review on fiscal multipliers, focusing particularly on the fiscal spending multipliers and their determinants, especially for highly indebted countries and constrained monetary policies. Section 3 presents a methodology for assessing spending multipliers according to the way the public debt ratio is evolving. Section 4 presents the empirical results. Section 5 concludes.

[9] However, there are economic circumstances where spending multipliers lie outside this range, as well as the impact of approaches used to assess those multipliers. This range may widen if country characteristics, such as the exchange rate regime, and the type of government spending are considered.

2. Literature review

A fiscal multiplier is defined as the output change in response to an (exogenous) change in a fiscal variable in reference to their baseline levels (Spilimbergo et al., 2009; Coenen et al., 2012).[10] The concept of multiplier is generally associated with the *general theory* of John Maynard Keynes (1936).[11] The idea behind fiscal stimulus is that the fiscal multiplier, as the measure of the policy instrument effect, is de facto a Keynesian one, which means that the value of such a fiscal multiplier is larger than unity, making it rewardable/beneficial to go for such fiscal stimulus. In the Keynesian structural models, the simplest way to compute a spending multiplier is via the marginal propensity to consume.[12] The spending multiplier in the Keynesian framework decreases with the marginal propensity to import, as well as the rise in interest rates and increases with the rise of investment due to the expansion of GDP (the accelerator effects). In a vector autoregression (VAR) approach, spending multipliers are determined using the impulse response function and the methodology of identification proposed by Blanchard and Perotti (2002).

Despite a continuously growing body of empirical literature on fiscal multipliers in recent years, these tend to bring more confusion than forming a consensus about the size of the fiscal multiplier. There are many reasons why the size of the fiscal multiplier changes. Besides the proper characteristics of the studied economy, which are obviously due to macroeconomic fundamentals, as well as the institutional environment, the difference of methods and the accuracy of data make an important contribution to these differences. This section surveys the main important contributions of the literature on fiscal multiplier determinants, as well as the challenging issues presented by the methods used to gauge fiscal multipliers.

Recent researchers have mainly been interested in explaining why the recovery slowed in many advanced countries and fiscal consolidation is hurting many others. In this line of research, the frontier is not clear. For some, fiscal consolidation hurts in times of crisis, as fiscal multipliers are larger in recessions than expansions. If this is the case, a legitimate question to consider is why the large size of these multipliers in a time of crisis did not help fiscal stimuli to recover, especially in the eurozone countries. This may be because of the asymmetric effects of the two cases (fiscal stimulus versus austerity). To our best knowledge, very few studies have undertaken the issue of asymmetry. Our investigation of the recent empirical literature found only two papers with contrasting results (Baum and Koester, 2011; Riera-Crichton et al., 2014), while some papers draw

[10] If Y_t and Z_t denote, respectively, the output and the fiscal instrument at time t, the fiscal multiplier is simply expressed as $\frac{dY_t}{dZ_t}$. Or, while the effects come with different lag times, the cumulative fiscal multiplier is expressed as $\frac{\sum_{j=0}^{j=n} dY_{t+j}}{\sum_{j=0}^{j=n} dZ_{t+j}}$ (Chinn, 2013).

[11] Historically, according to Hegeland (1954), the concept of fiscal multiplier goes back at least to the "*Tableau Economique*" of Quesnay (1758), as mentioned by some authors (Mustea, 2015).

[12] The government spending multiplier for a closed economy under a fixed interest rate is given by: $1/(1-mpc)$ with mpc the marginal propensity to consume.

conclusions without paying attention to the asymmetry issue (Ramey, 2018; Ramey and Zubairy, 2018). More details about these papers are provided in Section 2.5.

This also triggered much research exploring the factors determining fiscal multipliers and concentrating on the economic and institutional fundamentals of advanced economies. Researchers in this way studied the effects of fiscal position related to the level of debt and deficit ratios, the exchange rate regime (monetary unions), the degree of openness, agents' expectations (foresight fiscal policy), the constrained monetary policy at the ZLB interest rate and hand-to-mouth consumers, among other things. Some have also found contrasting results while trying to explain the reasons for the failure of fiscal stimuli to deliver a fast recovery.

In what follows, as the literature on fiscal multipliers is somehow very rich and large and still evolving, with many different results, we try to highlight some important contributions without pretending to cover all of the literature, particularly the recent works related to the determinants impacting the size of the spending multipliers.

2.1. The state dependency of fiscal multipliers on the business cycle

Some works studied fiscal policy in the pre-crisis of 2008 and proved the linkages between fiscal policy and state dependence. The more recent example is the paper of Tagkalakis (2008),[13] who found, for OECD countries, larger effects of fiscal policy in recessions than expansions, with more emphasized effects in countries with less-developed consumer credit markets.[14] However, since the works of Auerbach and Gorodnichenko (2012), research assessing the effects of fiscal policy, considering the state dependency of the economy, have flourished, especially in the period of the 2008 financial crisis. Among these are the works of Bachmann and Sims (2012), Batini et al. (2012), Baum et al. (2012), Riera-Crichton et al. (2014), Caggiano et al. (2015), Canzoneri et al. (2015). The main result of these papers is confirmation of the dependency of spending multipliers on the business cycle, which is larger during recessions than expansions.

The contributions of Auerbach and Gorodnichenko (2012), which triggered a series of works studying fiscal multipliers during recessions and expansions, use a regime-switching structural vector autoregression (SVAR) methodology to assess fiscal multipliers in relation to the business cycle. They find large size of spending multipliers in recessions than in expansions, making expansionary fiscal policy more effective in times of recession than expansion. Moreover, at the disaggregated level, expenditure shows large differences in fiscal multipliers, with military spending having the largest multiplier. They also show that multipliers tend to increase once the real-time predictions of fiscal variables are controlled.

[13] The author used a panel of 19 OECD countries over the period 1970–2002 to assess the effects of fiscal policy changes on private consumption during recessions and expansions.

[14] This is explained by the presence of individuals facing binding liquidity constraints in a recession that will consume the additional income generated by the fiscal stimulus.

Also focusing on the United States case, Caggiano et al. (2015) estimate a non-linear VAR model to assess fiscal multipliers. They show two important results related to fiscal spending multipliers. First, fiscal spending multipliers are greater than 1 in recessions, and, second, they are not necessarily different from, or larger than, those in expansions. The second result opposes the main findings of the previous research, which confirmed that fiscal multipliers are larger in times of recession than expansion. Another important result raised by the authors is related to the non-linearity effects on fiscal spending multipliers, which seem to be emphasized in extreme events manifested by deep recessions or strong expansionary periods. Auerbach and Gorodnichenko (2013) extend the same methodology of Auerbach and Gorodnichenko (2012) to a panel of OECD countries and confirm their earlier results on the average of studied countries.

However, considering the discrepancies between countries in terms of the structure and behaviour of the economies, the fiscal adjustments and policy responses and private agents' expectations, and the impacts of all these factors on the multipliers' size, the results of the papers studying a single country or averaging a group of countries could not be transposed to other countries and remain debatable.

In this regard, Batini et al. (2012) and Baum et al. (2012) also confirm that fiscal multipliers tend to be larger in recessions than expansions, but importantly they differ substantially across groups of advanced countries, calling for a fit of fiscal policies and country-by-country assessment of fiscal multipliers. The two papers employ the same methodology of non-linear threshold VAR (TVAR) model. The only difference is that the threshold is endogenously determined by the sign of the output gap in the first paper, and output growth in the second paper. Data is split according to the threshold that separates expansions (positive output gap/growth) and recessions (negative output gap/growth), chosen to maximize the fit of the model and hence allowing different regression slopes for the explanatory fiscal variable. Using the output gap as the threshold variable is argued by the fact that excess capacities are available in the economy under a negative output gap, which reduces the crowding-out effects of private investment in response to government expenditure shocks. Besides, the share of credit-constrained households, adjusting spending in response to a change in disposable income, is higher in recessions. Other studies use output growth or its moving average (Auerbach and Gorodnichenko, 2012). Moreover, according to Bachmann and Sims (2012), the role played by household and firm confidence in the transmission of fiscal policy shocks into economic activity is significant, which emphasizes the evidence of country-specific properties that should be considered when studying the effects of fiscal policy.

Canzoneri et al. (2015), using a model of costly financial intermediation based on Curdia and Woodford (2016),[15] provide evidence of strong state-dependent fiscal multipliers that can exceed

[15] The model is a simple extension of the basic-representative-household new Keynesian model (as developed in Woodford, 2003) of the monetary transmission mechanism, allowing for a time-varying wedge between the interest rate available to households on their savings and the interest rate available to borrowers. This model introduces credit frictions and financial intermediation for the allocation of resources due to the introduction of heterogeneity in the spending opportunities currently available to different households.

the value of 2 in times of recession and may fall below unity during times of expansion. Furthermore, the size of the fiscal multiplier is inversely dependent on the size of the fiscal stimulus, with a smaller amount of fiscal intervention leading to a larger size of fiscal multiplier, and vice versa. According to the author, "*The reason large fiscal interventions are less effective than smaller ones is that the negative marginal wealth effect due to the higher tax liabilities is increasing with the size of the fiscal intervention while the positive marginal effect on the borrowers, from the reduction in the finance premium, is decreasing with the size of the fiscal expansion*" (Canzoneri et al., 2015). Using a regime-switching framework, Arin et al. (2015) also confirmed large spending multipliers for the United States over the period 1949Q1–2006Q4 during economic slowdown, while tax multipliers seem to be larger during periods of economic expansion.

The problem of large multipliers is challenging for fiscal consolidation and austerity measures intending, in times of high public debt, to reduce the latter. In this regard, some papers focus on studying the effects of fiscal consolidation on the public debt ratios, particularly in the short term. For example, Eyraud and Weber (2013) analyse the short-term fiscal multipliers considered to be the key linkages between instruments of fiscal consolidation, economic growth and public debt reduction. They find that, for many advanced countries, fiscal short-term multipliers in the recent financial crisis have been close to 1, judged to be larger than the average of the short-term multipliers observed before the 2008 recession. With the crisis environment of constrained monetary policy, constrained credit agents and depressed external demand, these are likely to raise the debt ratio in the short term under fiscal consolidation, and this could be emphasized if financial markets react negatively to this short-term behaviour of public debt.

Along the same lines, Parraga Rodriguez (2018), following an SVAR framework, finds that government spending multipliers and income transfers multipliers in the United States are by far below 1 in the short term (approximatively 0.2). However, compared to government fiscal income transfers multipliers that can reach more than 1 in the long term, the spending multipliers cumulate only to 1 in the long term. Ramey and Zubairy (2018), focusing again on the case of the United States, as the single country case for which multipliers are most evaluated in the literature, examine whether the government spending multipliers are sensitive to the zero bound interest rate and the business cycle in the economy.

Along the same lines, Egron (2018) estimate a threshold VAR for France, confirming the higher value of spending multipliers in recessions than expansions, and therefore warning about the dangerous effects of fiscal consolidation, particularly in the short term, leading to an increase, rather than reduction, in the government debt to GDP ratio. Nevertheless, the above results should be considered carefully with regard to the likely asymmetric effects of an increase versus a decrease in fiscal instruments (more details on this point in Section 2.5).

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For Ramey (2018), concluding that the average of fiscal multipliers (spending) reported in the previous literature is low and ranges between 0.6 and 1, averaging fiscal multipliers without distinguishing between the sign of the fiscal shocks[16] is misleading. Indeed, and surprisingly, to our best knowledge, this flux of very recent studies does not seem to distinguish between multipliers drawn from negative shocks and those from positive shocks, leading us to understand that the effects are similar in the two situations. For example, some studies may draw conclusions on the effect of fiscal multipliers, from fiscal austerity and fiscal consolidation, as if they were the same as in fiscal stimulus, thereby admitting the symmetrical effects in the two opposed shocks. One of these studies, Ramey and Zubairy (2018), draws the following conclusion "... *If multipliers are indeed this low, they suggest that increases in government purchases do not stimulate private activity and that fiscal consolidations based on reducing government purchases are unlikely to do much harm to the private sector*". Ramey (2018) also does not seem to distinguish between these situations (fiscal consolidation and fiscal stimuli) in averaging the fiscal multipliers reported in the previous studies. Another study, by Blot and al. (2014b), concludes that "... *Recent mainstream literature has emphasized that fiscal multipliers may notably be higher in time of crisis. Then, not only would fiscal consolidation drag down growth more severely, but it could even be self-defeating*".

In line with the literature studying fiscal multipliers' dependency on the business cycle, Ramey and Zubairy (2018) study the state dependency of fiscal multipliers, involving, at the same time, the zero lower bound for the United States. They contrast the findings of the previous research in line with Auerbach and Gorodnichenko (2012; 2013) and report multipliers ranging in a narrow band between 0.6 and 1. The higher magnitude of the fiscal multipliers in the zero lower bound is also of little evidence in Ramey and Zubairy (2018).

Ramey and Zubairy's (2018) results should be considered with caution, especially with regards to their data set. Indeed, while they have the advantage of pointing to their long history and more frequent data for the United States (sample between 1889 and 2013), half of the period sample is constructed for the World War periods and before (1889–1946) and interpolated using different methods in four different sub-periods. This quarterly constructed data could imply serious problems of accuracy and may have serious problems for the calculated multipliers. This may explain the difference between results where the multipliers seem to be larger in the post-war period when omitting the initial period (although they suggest that these multipliers are not statistically strongly significant). Furthermore, Ramey and Zubairy (2018) use narrative methods

[16] For example, the distinction should be made between positive expenditure shocks (fiscal stimulus) and negative shocks (austerity measures). The outcome of the fiscal policy is different under the two scenarios and depends on the economic environment and countries' economic fundamentals.

to extend Ramey's (2011) defence news series in order to identify shocks that are unanticipated and exogenous to the state of the economy.[17]

Important exceptions to these papers are Baum and Koester (2011) and Riera-Crichton et al. (2014), who mention that government spending is not necessarily acting counter-cyclically (going up in times of recessions); rather, it could be, as is the case in many industrial economies, pro-cyclical (decreasing). In this paper, the authors control for the sign of fiscal shocks (increase or decrease in government spending), as well as the size of the fiscal intervention, rather than distinguishing only between recessions and expansions. Their analysis reveals that fiscal expansions are much more expansionary in recession periods than in expansion periods. Using a threshold SVAR (TSVAR) to account for non-linearities, Riera-Crichton et al. (2014) find that the long-term multiplier for bad times and an increase in government spending is around 2.3 higher than the value of 1.3 if we control for recession only and expansion is considered. However, using the same methodology of threshold VAR, Baum and Koester (2011) find that public expenditure multipliers vary depending on the size of the shock, its sign and the level of the output gap. Consequently, a positive fiscal shock (increase in government expenditure) in crisis periods leads to a higher spending multiplier, and the latter increases with the size of the fiscal shock. However, in good times, multipliers are lower and seem to behave more linearly.

Furthermore, using an SVAR model for several MENA countries, Bentour (2020a) assessed spending multipliers considering the oil price fluctuations. The spending multipliers found to be sensitive to the oil price movements especially for oil exporting countries, being large (more than 2) in time of oil price decrease and weak in time of oil price increase.

With regard to the researchers tending to confirm larger multipliers in times of economic downturn compared to economic booms, some researchers contrast these results (Barro and Redlick, 2011; Ramey, 2011; Owyang et al., 2013). For example, Owyang et al. (2013) find multipliers to be smaller and less than 1. The authors use a large constructed quarterly data set for the United States (1980 to 2010) and Canada (1921 to 2011) and the unemployment rate as a measure of slack considering thresholds of 6.5% and 7% for, respectively, the United States and Canada. For a linear model (no threshold of unemployment considered), either in the United States or Canada, spending multipliers are all below unity and slightly larger in the United States than in Canada. However, in periods of high unemployment (period of slack), multipliers are slightly higher than those in Canada and lower than those in low unemployment rates. For the United States, spending multipliers are always less than 1 and comparable across all regimes.

[17] The news series is linked to government spending due to political and military events and is likely to be independent of the business cycle. This is an important difference from and other papers using the output gap and economic growth as the instrument variable to determine the turning points of the business Auerbach and Gorodnichenko (2019) cycle.

These clashing results about fiscal multipliers have pushed other economists to dig deeper and control for features related to the economic and institutional regimes of the countries, such as fiscal position, monetary policy stance and exchange rate regimes.

2.2. Fiscal multipliers' dependency on the fiscal position

Since the first wave of studies triggered by the public debt and economic growth threshold idea of Reinhart and Rogoff (2010), fiscal policy effects have also been revised distinguishing the presence of high debt and deficit impacts on fiscal multipliers. Until now, the results of these studies have continued to fuel the debate about such a subject.

Consequently, using a panel of 17 OECD countries, Corsetti et al. (2012) find that output and consumption multipliers are high during times of financial crisis. In particular, for weak public finances corresponding to "*government debt in excess of 100 percent of GDP or net government borrowing above 6 percent of GDP (each lagged once)*", they find that government spending responds negatively to a weak fiscal position, thereby contributing to stabilizing public debt.

Depending on the fiscal position, especially with the presence of high public debt, Bi et al. (2016), adopting a real business cycle (RBC) framework, find that the fiscal multiplier is generally smaller in a high-debt than a low-debt state when general income tax rates serve as an adjustment instrument, but the difference shrinks as the wealth effect on labour becomes strong. Furthermore, uncertainties involving household reactions to the timing and magnitude of the shock, as well as the debt target of fiscal consolidation, also matter. Expecting a higher debt target is not always expansionary, especially when households perceive consolidation to be implemented via adjusting labour tax rates, and expecting a higher debt target produces a positive wealth effect, which reduces the current hours worked and thus offsets positive government spending effects (Bi et al., 2016).

The previous results are in accordance with the findings of Huidrom et al. (2016), which confirm that fiscal multipliers are state-dependent of the fiscal position and tend to be systematically smaller when government debt and deficit are high (weak fiscal position). The authors also show that the fiscal multipliers' dependency on the fiscal position is independent of the business cycle effects. In particular, while the size of the fiscal multiplier tends to be larger in recessions and weaker in expansions, the effects of the fiscal position (weak/strong) apply independently of the economy being in recession or expansion.

In relation to fiscal consolidation under high public debt, Boussard et al. (2012) and Berti et al. (2013) tend to confirm the large effect of fiscal multipliers in times of crisis, which push the debt ratio to increase in response to fiscal consolidation, particularly in the short to medium term. However, these undesired effects on the debt dynamics are judged to be short-lived unless these large multipliers persist over time, which may be caused by non-credible fiscal adjustments and the very high (abnormal) impact on interest rates and sovereign yield. These two publications report "critical" fiscal multipliers, defined as "*multipliers that can then be defined as the value of*

the multiplier for which a fiscal shock would leave the public debt ratio unchanged (while a multiplier higher than the critical value would entail a short-term increase in the debt ratio)". They show that these multipliers are inversely correlated to the change in debt ratio. According to the authors, the true fiscal multiplier could be higher than the critical multipliers, especially for a group of highly indebted countries, namely, Belgium, Bulgaria, the Czech Republic, Ireland, Greece, Spain, France, Italy, Cyprus, Lithuania, Hungary, Portugal, Slovenia and the United Kingdom.

Moreover, Blot et al. (2014b) simulate the dynamic path of public debt and output, under fiscal consolidation, using a simple macroeconomic model for 11 eurozone countries and considering time-varying fiscal multipliers. They analyse the ability of EMU countries to reach public debt ratios below the threshold of 60% in 2032 to comply with the new fiscal rules of the EMU Stability and Growth Pact. The revised Stability and Growth Pact, which was signed in 2012, outlines converging (from an average level of debt ratios of around 80% across the eurozone in 2012) to a 60% debt to GDP ratio, by 1/20th of the adjustment yearly, which allows until 2032 to achieve the target. In this way, Aussilloux et al. (2018) make an exercise of simulation on public expenditure reduction for France, expecting that the public debt to GDP ratio could decrease by 25 points from 100% currently to 75% in 2040 for a best-case scenario of fiscal consolidation.

Canzoneri et al. (2015) and Broner et al. (2019) consider studying the type of financing spending to impact fiscal multipliers in times of economic downturn. Canzoneri et al. (2015) find that either tax-financed or debt-financed spending leads to multipliers that are higher than those in recessions, with the multipliers being much larger for debt-financed than tax-financed spending. According to the authors, "*The reason is that while higher government spending sets in motion the financial accelerator, higher taxes partly counter this by reducing the quantity of funds available to financially constrained individuals*". Broner et al. (2019) study fiscal multipliers, considering the portfolio of foreign public debt for a panel of 17 advanced countries from 1980 to 2014. In this case, they reveal that fiscal multipliers are stronger when the expenditure is financed by foreign resources. Their size increases, in particular, with the share of foreign public debt and is larger than unity in periods and countries with a high foreign share of public debt (as in the United States and Ireland today) and smaller than those in the opposite case (as in the United States in the 1950s and 1960s, and Japan today).

Moreover, Poghosyan (2017) studies the way that the public debt cycles interact with financial cycles for 57 advanced and emerging economies over the period 1960–2014. He finds that public debt cycles are asymmetrically linked to financial cycles in the way that public debt expansions that are preceded by fuelling in credit and financial markets are longer than any other expansions, while there is no substantial association between public debt contractions and financial cycles.

Afonso and Leal (2018) compute fiscal multipliers for government expenditure in the eurozone for quarterly data over the period 2001–16, using a structural VAR model. They consider the state

of the economy, particularly the reaction to the public debt level, the pace of economic growth and the output gap. Government expenditure multipliers accumulate to less than 1 over a year (0.64 yearly and 1.1 after two years), while tax multipliers are negative. Moreover, expenditure multipliers are larger for countries with higher public debt levels during recessions (compared to low public debt levels where the multiplier is close to 0) and in countries showing positive output gaps.

In contrast to the previous findings about the effects of fiscal position on fiscal multipliers, very recently some new studies have minimized the effects of the fiscal position on fiscal multipliers and then minimized the effects of high public debt on reducing the benefits of fiscal expansion in advanced economies (Auerbach and Gorodnichenko, 2017; Perdichizzi, 2017; Blanchard, 2019). For example, using a non-linear panel VAR model controlling for the macroeconomic properties of 12 eurozone countries over 1985–2015, Perdichizzi (2017) find that fiscal spending multipliers are insensitive to the level of government debt. Furthermore, these multipliers are larger in times of recession for countries with low degrees of trade openness, high deficit and fixed exchange rate regime, compared to countries with high degrees of trade openness, low deficits and flexible exchange rate regime.

Auerbach and Gorodnichenko (2017) also produce interesting results on this issue for 17 OECD countries. First, the government spending shock effects depend on a country's position in the business cycle, with the fiscal multipliers being larger in times of bad economic conditions than good ones. Second, fiscal expansion while the economy's fiscal position is weak is likely to boost economic output and reduce the debt to GDP ratio, as well as appeasing interest rates and CDS spreads on government debt. Consequently, these findings suggest that fiscal stimulus under a weak fiscal position is likely to boost the economy without worrying about the associated modest cost. However, these results should be considered with caution, as the authors themselves argue, based on the asymmetric effects of fiscal policy shocks (see discussion in Section 2.5).[18] The authors call for more detailed research on this issue using more frequent and variable data on public debt and more disaggregated categories of government spending, as well as structural models for clearer policy recommendations. Besides, Alichi et al. (2019) consider the size of the country and focus on estimating government spending effects for 23 small countries across the world. They conclude that fiscal policy in small countries using government primary spending is ineffective at stimulating the level of GDP over the medium term compared to government spending. However, in the short term, multipliers for government current primary spending are higher and sensitive to

[18] These results should be interpreted with caution, as the authors argue themselves, because of the problem of asymmetric effects "*… we recode fiscal shocks series so that the sign of the shocks is negative whenever the shocks take a nonzero value and thus estimated impulse responses show dynamics after an increase in government spending. This recording may be problematic since the effects of government spending cuts are not necessarily symmetric to the effects of government spending increase… thus one should bear in mind the caveat that, although we interpret results as showing responses to increases in government spending, the estimated responses are only based on cuts in government spending*" (Auerbach and Gorodnichenko, 2017).

the level of government debt, the position of the economy in the business cycle, as well as imports as a share of GDP, among other factors.

Along the same lines, in analysing the fiscal and welfare costs of higher debt with reference to the United States, where the safe interest rate[19] is less than the growth rate, Blanchard (2019) argues that both the fiscal and welfare costs of debt may be smaller than assumed in current policy debates. Blanchard (2019) seems likely to draw the same conclusions for European economies. His results have triggered a debate, which have been contained until now in economist blogs and some media. This new paper about debt cost nevertheless warns that the cost of austerity measures driven by the fear of high debt is likely to hurt more than the cost of debt build-up, since actual data shows that the interest rate differential/gap growth rate minus interest rate is positive enough to stabilize the public debt ratio while maintaining a small primary deficit. In this case, two important points are worth mentioning. First, the Committee of a Responsible Federal Budget (CRFB), in response to Krugman's "misinterpretation" of Blanchard's (2019)' conclusions, outlined that Blanchard's (2019) conclusions are correct if the primary balance in the United States is small, but the American economy is running a huge primary deficit.[20]

The second point highlights some arguments and counter-arguments of potential debt finance. The arguments that Blanchard (2019) reports in favour of potential debt finance (standing against fiscal consolidation) are: revised large multipliers, debt hysteresis, higher marginal product of public capital and necessary budget deficits to stimulate demand in the context of constrained monetary policy. Alternatively, the counter-arguments about the potential costs of public debt are as follows: the safe interest rate may be artificially lower than the observed one (which could happen in the case of liquidity discount); the future may be different to the past because of many factors related to total factor productivity (TFP) and an ageing population; and the last counter-argument relies on the existence of multiple equilibria.

However, while some enthusiastic supporters of fiscal stimulus welcome the message of this paper (Krugman, 2019),[21] this has not been commonly agreed by other economists, as historical data showed the opposite for the most important European economies (Mazza, 2019; Philippon, 2019).[22] This paper, while minimizing the effects of high public debt when the safe interest rate is below the nominal GDP growth (which is the case for many advanced economies), is likely to re-fuel the debate about public debt effects, and Blanchard (2019) himself argues that this should not be taken as an invitation for more debt rollover and calls for more investigation on this issue.

[19] Blanchard (2019) uses the terminology "safe interest rate" to describe, depending on the situation: the risk-adjusted rate of return on capital or the interest rate on nominal bonds (assuming no default).
[20] See http://www.crfb.org/sites/default/files/CRFB_DoNotMischaracterizeBlanchard.pdf.
[21] https://www.nytimes.com/2019/01/09/opinion/melting-snowballs-and-the-winter-of-debt.html.
[22] http://bruegel.org/2019/01/is-public-debt-a-cheap-lunch/ and https://www.stern.nyu.edu/experience-stern/faculty-research/true-cost-public-debt.

3. Methodology

In our empirical investigation we use a sample of 18 advanced countries over different periods of time, a panoply of structural vector autoregressive (SVAR) models to assess the fiscal expenditure impacts on the output. We especially test how the business cycle could affect expenditure multipliers, as well as the way accumulating public debt and reducing public debt are impacting the size of the expenditure multipliers. In what follows, we display, first, a detailed methodology of an SVAR model, particularly, its formulation, lag selection and identification of shocks. Second, we discuss the identification restrictions for the considered VAR models linking government expenditure with GDP, augmented exogenously by a dummy variable that controls for the business cycle (expansion/recession) and the public debt evolution (accumulation/decumulation), hence noted an SVAR-X. We also endogenize the public debt variable instead of its exogeneous effects, making a tri-variate VAR of government expenditure, debt and GDP. This model is also controlled for the business cycle impacts.

For our application, we run a bivariate SVAR linking government expenditure to the GDP to study the effects/multipliers of government consumption on the output. In order to control exogenously for the business cycle (expansion versus recession), debt to GDP evolution (accumulation versus reduction) and the existence of both debt accumulation/reduction under expansion/recession, the SVAR is augmented by variable dummies corresponding to each of the previous prescribed states, hence becoming an SVAR-X (X for exogenous).

The SVAR, in our case, linking two endogenous stationary variables describing, respectively, the relationship between government expenditure (g_t) and GDP (y_t) for each country, is formulated as:

$$\begin{cases} g_t + \beta_{1,2} y_t = c_{1,0} + c_{1,1} g_{t-1} + c_{1,2} y_{t-1} + \varepsilon_{g,t} \\ y_t + \beta_{2,1} g_t = c_{2,0} + c_{2,1} g_{t-1} + c_{2,2} y_{t-1} + \varepsilon_{y,t} \end{cases} \quad (1)$$

where $\varepsilon_{g,t}$ and $\varepsilon_{y,t}$ are, respectively, the structural shocks/innovations of the first and second variables in this bivariate SVAR, and could be formulated as:

$$\begin{pmatrix} \varepsilon_{g,t} \\ \varepsilon_{y,t} \end{pmatrix} = \varepsilon_t \approx i.i.d.\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_g & 0 \\ 0 & \sigma_y \end{pmatrix} \right) \quad (2)$$

The real government consumption/expenditure and the real output (GDP) are considered in log differentiated natural logarithm, hence designing the growth rate of the corresponding variables and allowing direct interpretation of simultaneous parameters as elasticities assigned to these variables in the SVAR equations (i.e. $\begin{pmatrix} \beta_{1,2} \\ \beta_{2,1} \end{pmatrix} = \beta$). Thus, Equation (1) can be formulated as:

$$\begin{bmatrix} 1 & \beta_{1,2} \\ \beta_{2,1} & 1 \end{bmatrix} \begin{bmatrix} g_t \\ y_t \end{bmatrix} = \begin{bmatrix} c_{1,0} \\ c_{2,0} \end{bmatrix} + \begin{bmatrix} c_{1,1} & c_{1,2} \\ c_{2,1} & c_{2,2} \end{bmatrix} \begin{bmatrix} g_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{g,t} \\ \varepsilon_{y,t} \end{bmatrix} \quad (3)$$

which could be also expressed in the form of:

$$Bv_t = C_0 + Cv_{t-1} + \varepsilon_t \quad (4)$$

We deduce the reduced form of the SVAR, called a standard VAR model, by multiplying equation (15) by the inverted matrix B^{-1}, assuming it exists, and solving for v_t in terms of v_{t-1} and ε_t:

$$v_t = B^{-1}C_0 + B^{-1}Cv_{t-1} + B^{-1}\varepsilon_t = a_0 + Av_{t-1} + u_t \quad (5)$$

Or equivalently, $A_1(L)v_t = a_0 + u_t$ with $A_1(L) = I - AL$.

We can easily deduce the residuals u_t as a linear combination of the structural errors ε_t:

$$u_t = B^{-1}\varepsilon_t = \frac{1}{(1-\beta_{1,2}\beta_{2,1})} \begin{bmatrix} \varepsilon_{g,t} - \beta_{1,2}\varepsilon_{y,t} \\ \varepsilon_{y,t} - \beta_{2,1}\varepsilon_{g,t} \end{bmatrix} \quad (6)$$

Thus:

$$v_t = \lambda + \Psi(\mathrm{L})u_t \quad (7)$$

The structural moving average (SMA) representation of v_t is based on an infinite moving average of the structural innovations ε_t, deduced by substituting $u_t = B^{-1}\varepsilon_t$ into equation (18), which leads to:

$$v_t = \lambda + \Psi(L)B^{-1}\varepsilon_t = \mu + \Phi(L)\varepsilon_t \quad (8)$$

where $\Phi(L) = \sum_{k=0}^{\infty} \varphi_k L^k$.

In order to solve an SVAR, the parameters must be identified, which requires some restrictions to be imposed. Typical identifying restrictions include either assuming no simultaneous equations effects from one variable to another in the SVAR (for example, $\beta_{1,2} = 0$ or $\beta_{2,1} = 0$) or linear restrictions on the elements of the matrix (for example, $\beta_{1,2} + \beta_{2,1} = 0$). In our case, we follow the methodology of Blanchard and Perotti (2002) by identifying government spending shocks using a Cholesky decomposition, ordering government spending first as the variable that is clearly the most exogenous compared to GDP.[23] For our case, we are only interested in government multipliers, and no tax multipliers are considered in the current paper. As explained in the general methodology, the number of restrictions needed is determined by the number n of endogenous

[23] Contrary to our bi-variate case, the Blanchard and Perotti (2002) is a tri-variate SVAR linking three variables: tax revenue, government expenditure and GDP.

variables of the VAR by the formulae, $n(n-1)/2$. Thus, for a bi-variate model, the number of restrictions is only 1 $(2(2-1)/2)$. Then, the matrix of shocks after restrictions is $\begin{bmatrix} c_{1,1} & 0 \\ c_{2,1} & c_{2,2} \end{bmatrix}$.

In our restriction, we especially consider that the response of government expenditure to the output comes with a lag, which means no contemporaneous effects of GDP to government expenditure. Thus, the coefficient $\beta_{1,2} = 0$. This is also interesting, as the reverse instantaneous causality from GDP to expenditure may alter, deducing the effect, *ceteris paribus*, of government expenditure on GDP (fiscal multiplier).

In order to draw fiscal multipliers, the formulae of impulse response functions are required. For the bivariate SVAR model, taking the structural moving average (SMA) representation in Equation (18) at the horizon time $t + h$, we have:

$$\begin{bmatrix} g_{t+h} \\ y_{t+h} \end{bmatrix} = \begin{bmatrix} c_{1,1} & c_{1,2} \\ c_{2,1} & c_{2,2} \end{bmatrix} \begin{bmatrix} g_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{g,t} \\ \varepsilon_{y,t} \end{bmatrix} \tag{9}$$

Fiscal multipliers are drawn from structural shocks assigned to each variable; in particular, we are interested in the effect of structural fiscal (expenditure) shocks on GDP in this case. For this purpose, we consider the structural moving average (SMA) representation of the SVAR. At the horizon time $t + h$, the SMA representation is:

$$\begin{bmatrix} g_{t+h} \\ y_{t+h} \end{bmatrix} = \begin{bmatrix} \varphi_{1.1}^{0} & \varphi_{1.2}^{0} \\ \varphi_{2.1}^{0} & \varphi_{2.2}^{0} \end{bmatrix} \begin{bmatrix} \varepsilon_{g,t+h} \\ \varepsilon_{y,t+h} \end{bmatrix} + \cdots + \begin{bmatrix} \varphi_{1.1}^{h} & \varphi_{1.2}^{h} \\ \varphi_{2.1}^{h} & \varphi_{2.2}^{h} \end{bmatrix} \begin{bmatrix} \varepsilon_{g,t} \\ \varepsilon_{y,t} \end{bmatrix} + \cdots \tag{10}$$

Then the structural dynamic multipliers are:

$$\frac{\partial g_{t+h}}{\partial \varepsilon_{g,t}} = \varphi_{1.1}^{h} \tag{11}$$

$$\frac{\partial y_{t+h}}{\partial \varepsilon_{y,t}} = \varphi_{2.2}^{h} \tag{12}$$

$$\frac{\partial g_{t+h}}{\partial \varepsilon_{y,t}} = \varphi_{1.2}^{h} \tag{13}$$

$$\frac{\partial y_{t+h}}{\partial \varepsilon_{g,t}} = \varphi_{2.1}^{h} \tag{14}$$

The structural dynamic multipliers/impacts measure how a unit impulse of the structural shocks at time t affects the level of endogenous variables at the horizon time $t + h$. In particular, the two first equations (11 and 12) represent the response of, respectively, government expenditure and GDP growth rates to their proper innovations. The two other equations (13 and 14) assess the crossing effects of the structural innovations between the endogenous variables of the SVAR. In particular, Equation (14) represents the response of the GDP growth rate to a structural unit shock

of government expenditure, which will be our emphasis in this application. Drawing the structural dynamic impacts $\varphi_{i.j}^{h}$ for the shocks $(i,j) = (1,2)$ allows us to visualize such dynamic impacts in what is referred to as the impulse response functions (IRFs). For the cumulative effects of the structural shock impacts, since the SVAR is designed to be stationary, which means that the effects $\varphi_{i.j}^{h}$ fade away in the long term (i.e. $\lim_{h\to\infty} \varphi_{i.j}^{h} = 0$), the long-term cumulative impact of the structural shocks is captured by the instant IFRs to infinity, which means:

$$\emptyset = \sum_{h=0}^{\infty} \varphi_{i.j}^{h}; (i,j) = (1,2) \tag{15}$$

The structural dynamic multipliers (short-term or long-term cumulative) defined above are different from the Keynesian concept of the fiscal multiplier, generally associated with the general theory of John Maynard Keynes (1936). The latter is defined as the output change in response to a (exogenous) change in a fiscal variable in reference to their baseline levels (Spilimbergo et al., 2009; Coenen et al., 2012). Hence, for G_t and Y_t denoting, respectively, the fiscal instrument (government expenditure here) and the output at time t, the Keynesian or simply fiscal multiplier is expressed as $\frac{\Delta Y_t}{\Delta G_t}$. Or, while the effects come with different lag times, the cumulative fiscal multiplier to the time horizon h is expressed by (Chinn, 2013): $\frac{\sum_{j=0}^{j=h} \Delta Y_{t+j}}{\sum_{j=0}^{j=h} \Delta G_{t+j}}$.

To compare our results with the findings in the literature and across countries, an exercise of mapping the IRF impacts to Keynesian fiscal multipliers is required. In the explicit SVAR, the government expenditure variable, as well as GDP, are introduced in per cent of first differences of the natural logarithm for the corresponding levels of the variables (i.e. the growth rates in per cent). The unit root augmented Dickey-Fuller and Phillips-Perron tests show that these variables are integrated of order one in levels. Thus, using the first difference of logarithms ensures stationarity of such variables. Furthermore, introducing the variables in logarithms allows us to draw the Keynesian multipliers directly from the effects of elasticities. Letting $\mu_{Y/G}$ define the elasticity of GDP to government expenditure,[24] we have:

$$\mu_{Y/G} = \frac{dlog(Yt)}{dlog(Gt)} = \frac{\Delta Yt}{\Delta Gt} \times \frac{Gt}{Yt} = k\frac{Gt}{Yt} \tag{16}$$

The Keynesian multiplier $k = \frac{\Delta Yt}{\Delta Gt,}$ measuring government expenditure effect on GDP, is then deduced as the elasticity of GDP to government expenditure scaled by $\overline{G_t/Y_t}$ representing the averaged share of government expenditure in GDP (or multiplied by $(\overline{Y_t/G_t})$) (Gonzales-Garcia et al., 2013; Ilzetzki et al., 2013; Barnichon and Matthes, 2017; Priftis and Zimic, 2018; Glocker et al., 2019). However, with the latter references, even though they scale their impact IRFs by share

[24] Razzak and Bentour (2013) use this approach to deduce foreign direct investment return from estimated elasticities of the Cobb-Douglas production function.

of consumption, the results are meaningful in terms of size only if the structural shock is expressed in percentage units. The reason for this is that the structural innovations, especially when using Cholesky innovations in an SVAR, are expressed in standard deviation units. Therefore, in practice, for accuracy of results, the impacts should also be scaled by a standard deviation σ_g of the fiscal variable (government expenditure), as in Combes et al. (2014). Following this precision, an adjustment coefficient is defined to deduce the short-term (immediate) fiscal (Keynesian) multiplier from the corresponding Cholesky impact multiplier, as:

$$k^{sr} = IM^{sr} \times \frac{\frac{\overline{Y}}{\overline{G}}}{\sigma_g} \tag{17}$$

where, from Equation (14), $IM^{sr} = \frac{\partial y_t}{\partial \varepsilon_{g,0}} = \varphi_{2.1}^0$ is the immediate effects of government expenditure Cholesky innovations. For the accumulated (long-term) expenditure multipliers k^{lr}, they are deducted in the same way as[25]:

$$k^{lr} = IM^{lr} \times \frac{\overline{Y}}{G} / \sigma_g = (\sum_{h=0}^{\infty} \varphi_{2.1}^h) \times \overline{Y/G} / \sigma_g \tag{18}$$

In the previous bivariate SVAR, the effect of public debt on the expenditure multipliers is exogenously tested by a dummy representing the way the public debt ratio is evolving. In the second case we endogenize the public debt effects and introduce the public debt to GDP ratio in a tri-variate SVAR linking government consumption, GDP and government debt ratio. For the identification in this tri-variate model, two other restrictions are needed. These are simply imposed by assuming that both government consumption and GDP do not have an immediate (simultaneous) effect on the public debt ratio. Thus, the only structural coefficients assumed to be non-null are those capturing the public debt effects on the other variables in the model, while the opposite effects (feedback effects) are delayed by at least one quarter. For the formulations (equations, IRFs, etc.), the methodology is the same as for the previous bi-variate, or as described by the general methodology.

4. Data

4.1. Data source

The sample of countries that was considered comprises 18 advanced countries, of which the majority are eurozone member countries, namely: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, The Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States. We first solicited the database of the Federal

[25] Other authors used formulae without mentioning any normalization with reference to the volatility of the fiscal instrument (σ_g) (Ilzetzki et al., 2013; Priftis and Zimic, 2018).

Reserve Bank of Saint Louis for the quarterly data on real government consumption, GDP and public debt, displayed on their website free of charge, and downloaded country by country, where data is seasonally adjusted. We noticed that this data, which was not available for all the 18 sample countries, has the OECD database as its main source. We therefore avoided the Federal Reserve Bank of Saint Louis data for the two first models and downloaded constructed national accounts of the 18 countries displayed in the OECD database. For the last model applied to the United States and requiring a long history, data was found and downloaded for all variables from the Federal Reserve Bank of Saint Louis.

Compared to annual data, high-frequency data, especially quarterly data, is considered to be the most important for assessing fiscal policy effects (Ilzetzki et al., 2013). However, some issues also arise when using such data. The availability of the observed quarterly national account in many of the advanced countries is recent and goes back to the 1990s. Although the data is displayed for the general government consumption and the GDP back to the 1960s, these are estimations rather than observations going back to pre-1990s, as indicated in the OECD database comments. The exception is the United States, the United Kingdom, Canada, Norway and France, where data goes back to before 1990. The same issue of observed sample data is encountered with government debt, where the observed data starts, for the majority, in the late 1990s, but for the latter variable, there is no estimation back in time. This constrained our estimations for these countries to the corresponding period (except for the United States), where the quarterly public debt is available when the latter is considered in estimation, whether as an exogenous variable or as an endogenous one.

4.2. Preliminary analysis of some previous fiscal multipliers with relation to public debt

In this sub-section, we undertake an exercise analysing some previous expenditure multipliers in links with public debt ratios, from previous works for 27 European countries. This sample includes 14 of the 18 countries included in this paper. We especially investigate the calculations and results of Boussard et al. (2012) and Berti et al. (2013) for this sub-sample of 14 countries. We draw scatter plots showing short-term expenditure critical multipliers (first year) and public debt to GDP ratios in 2011 and 2012 (Figures 1 and 2) for the 14 European Union countries. The calculations are simulated under fixed interest rates. The 14 countries are Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (EL), Ireland (IE), Italy (IT), The Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE) and the United Kingdom (UK).

The fiscal multipliers decrease exponentially with public debt to GDP ratios with an "elasticity/country" of -0.43 and -0.46 in 2011 and 2012, respectively.[26] The trendline of the scatter plot is compatible with a negative power curve, with a high coefficient of determination of around

[26] The same exercise was undertaken for the whole sample of 27 countries Boussard et al. (2012) and Berti et al. (2013), the elasticities was approximately -0.54 and -0.60 for the two curves, respectively in 2011 and 2012, with coefficient of determination around 91% and 93% (results are available upon request from the author).

88% and 94% for the two figures, respectively. We highlight the countries not affiliated with the eurozone with red dots (3 countries), and the 11 eurozone member countries with blue dots. Many countries of the latter group are more concerned with high public debt and lower fiscal multipliers of less than 1. Figures 1 and 2 show clearly that fiscal multipliers values decrease with the increase of public debt to GDP ratio..

These figures clearly show a quite different message to the conclusion of the two papers, namely, that large, short-term multipliers are likely to increase debt ratios under initial high public debt. It shows an picture of which high public debt is associated with low spending multipliers, which also raises a legitimate question. On the one hand, could high public debt also have led to lower fiscal multipliers (crowding-out effects, for example)? And it raises a similar debate to the one detailed in Bentour (2020b) between public debt and economic growth feedback effects (reverse causality). On the other hand, according to these results, fiscal expansion, as opposed to fiscal consolidation, is expected to be less effective under high public debt levels, particularly as the multipliers assumed to be calculated from an exercise of positive fiscal shocks are lower than unity for highly indebted countries.

Figure 1. Critical multipliers for EU member states versus the public debt to GDP ratios – year 2011

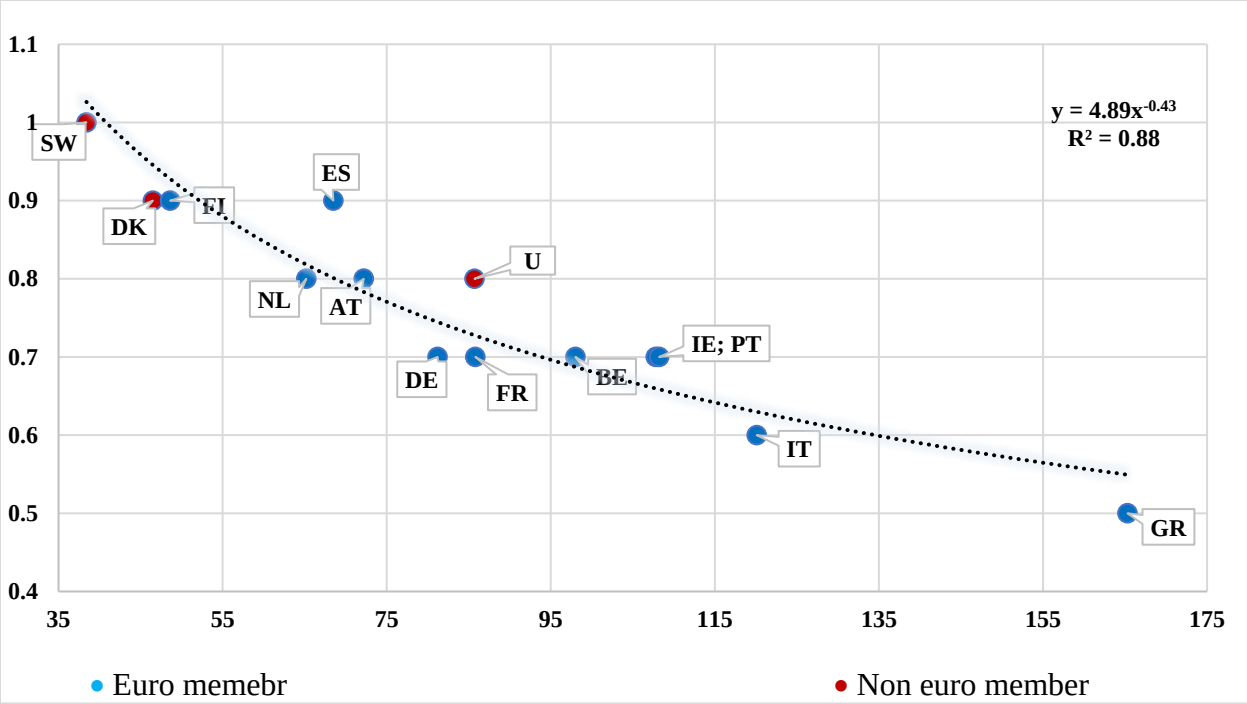
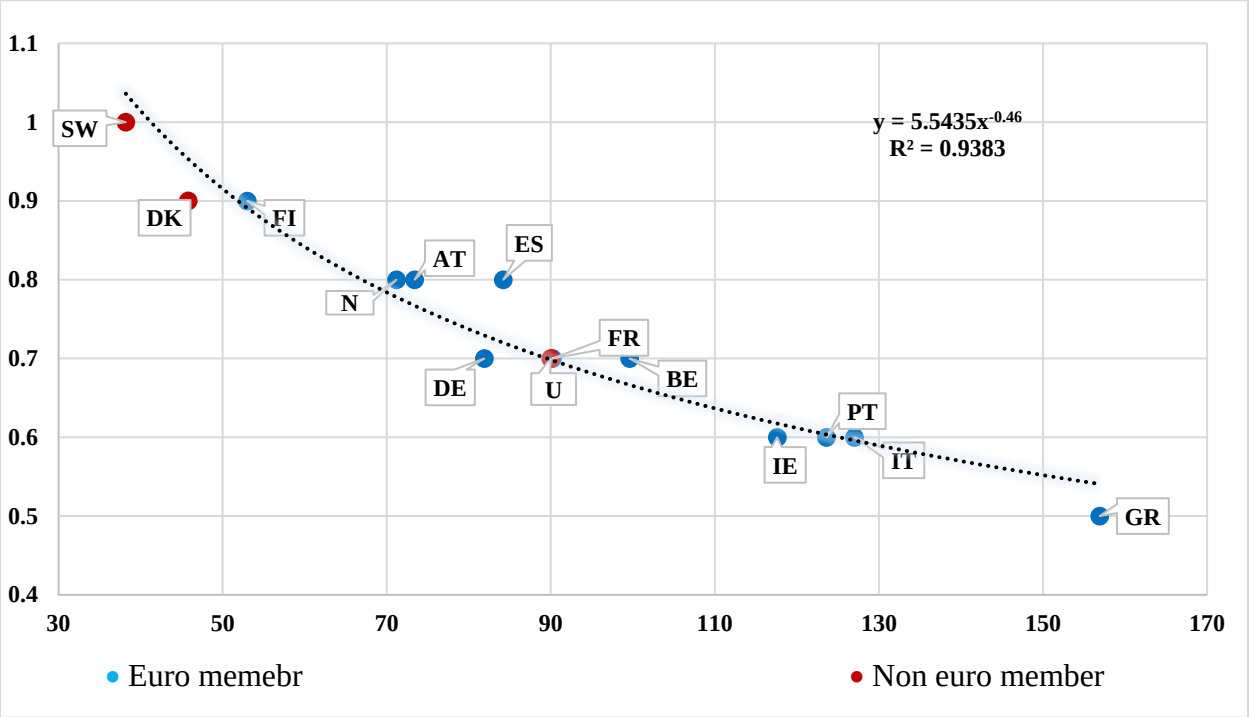


Figure 2. Critical multipliers for EU member states versus the public debt to GDP ratios – year 2012



Source of the two figures: Constructed from results of the European Commission working papers reported in Bouassard et al. (2012) – Table 3 (for figure 1) – and Berti et al. (2013) – Table 2 (for figure 2).

5. Results

In this section, we display the results of the models discussed in the methodology section and argue our results with a robustness check based on the United States data set using a more detailed SVAR with six endogenous (including monetary and fiscal) variables.

We used unit-root tests (augmented Dicky-Fuller and Phillips-Peron) for the stability of the variables, which confirmed that all the variables are integrated of order 1.[27] Thus, we introduced all the variables in the three models in first differences of the natural logarithm of such variables, except for prices (the interest rate and inflation). Furthermore, following Blanchard and Perotti (2002), we chose not to test for any long-term cointegration relationship, as this might also complicate the exercises of SVAR methodology, especially the way of resolving identification

[27] A summary of the stationarity tests is available upon request from the author for the three variables of GDP, government consumption and public debt to GDP ratios.

issues, and might deviate from comparing our results to the leading literature and the model results adopting the Blanchard and Perotti (2002) approach.[28]

5.1. The effects of the time periods

Do fiscal multipliers tend to be lower in recent periods than those of the previous decades of the 1960s and 1970s?

There are a set of determinants revealed in the economic literature that may work in reducing the size of the fiscal multipliers. First, there is the increase in trade openness: more closed economies tend to have higher multipliers (Barrell et al., 2012; Ilzetzki et al., 2013; Batini et al., 2014). Second, there is labour market flexibility: the more flexible the labour market is, the larger the fiscal multiplier. For example, based on this, it is expected that Europe will show higher multipliers than the United States, as the market in the former tends to be rigid, with the presence of stronger labour syndicates and unions. Rigidities play against wage flexibility, which tend to reduce the response of output to demand shocks (Cole and Ohanian, 2004; Gorodnichenko et al., 2012; Batini et al., 2014). Third, there is the size of automatic stabilizers: larger automatic stabilizers tend to reduce fiscal multipliers, by offsetting part of the initial fiscal shock (Dolls et al., 2012). Fourth, the flexibility of the exchange rate regime tends to lower the multiplier size, as the movements of the exchange rate may cushion the effects of fiscal policy actions (Born et al., 2013; Ilzetzki et al., 2013). Fifth, the fiscal position, with high public debt and fiscal deficit widening, reduce the size of the multipliers (Ilzetzki et al., 2013; Bi et al., 2016; Huidrom et al., 2016; Kirchner et al., 2010). Sixth, there is the effect of the active monetary accommodation to fiscal shocks, where expansionary monetary policy can offset the impact of fiscal contraction on demand.

Based on this, fiscal multipliers are likely to be smaller in recent decades, known as the "Great Moderation Era", especially the period 1986–2007, than the pre-1986 period. The reason for this is that, in this period, all the factors previously cited have been strengthened. The degree of openness has increased with the proliferation of the free trade agreements and increased international financial and economic integration. Many exchange rate systems have been switched to greater flexibility, except for countries that have adopted monetary unions. The monetary policy

[28] Although some pioneer researchers did not test for the number of lags to introduce in their SVAR, simply adopting an SVAR with one lag, we ran the exercise of the determination of such a lag for each country and each model. We found that 15 out of 18 countries have at least one criterion that indicates that the optimal lag is 1 (more likely indicated by Schwarz information criterion, SC). The three countries are Denmark, Greece and Japan. When controlling, for example, for the business cycle, Greece, Japan and Spain have an order of lags superior to 1 for models in times of recession, while in times of expansion, Austria, Japan, Portugal and Italy have order lags of 2 to 3. As a result of the multiplicity of the exercises undertaken here for each country individually (control for the business cycle, debt movements, etc.), and based on the higher number of countries pointing to only one lag, we preferred to follow the same approach as other researchers who fixed the model for all the countries to a unique optimal minimum lag equal to 1 (to save space, all the results are available upon request).

has been more active in fulfilling its role in stabilizing economies, among other things. All this leads us to think that fiscal multipliers may have a smaller size in the recent period than previously.

To examine these facts, we split our sample data for each country, 1966Q1–2019Q2, into two balanced sub-samples, 1966Q1–1991Q4 and 1992Q1–2019Q2, with, respectively, 104 and 110 observations each. We ran a bivariate stationary SVAR with differentiated logarithm of government expenditure and GDP (i.e. growth rates, in per cent) for all 18 countries for the 2 periods.

The results of the impulse response functions[29] (the structural dynamic impacts) are drawn for this exercise in Figures 1.B.a to 1.B.c in Appendix B. These results are also summarized in Table 2.A, which shows that the main sample of countries (12 out of 18) tends to confirm that the expenditure impacts are weak and substantially smaller in the first period than the second one. However, some exceptions were recorded, especially for small-sized economies such as Finland, Greece, Ireland and, to some extent, Italy, Portugal and Spain, particularly in the long term, which reported opposite results: fiscal multipliers tend to be higher in recent periods than previously. This may be in contrast to the idea that more openness decreases fiscal multipliers as the propensity to import increases. However, not only the degree of openness that acts on the size of the multipliers, but also other determinants, could play against the increase of fiscal multipliers, such as the monetary policy accommodation and the exchange rate regimes (Batini et al., 2014). For a few other countries, the impacts are even negative in the second period, namely, Canada, Denmark and Germany in the long term, and France and the United States in the short and long terms. Overall, for the first period, the multipliers average for the sample is around 0.96 (the impact is 0.18) for the first quarter, 1.5 (0.26) for the accumulated fourth quarter (first year) and 1.57 for the accumulated five years. However, for the second period (1992q1–2019q2), the corresponding multipliers are reduced by more than half, recording on average in the sample 0.47, 0.54 and 0.66, respectively for the first, the accumulated 4 and the accumulated 20 quarters (last row in Table 2.A).

Nevertheless, these results should be considered with caution for several reasons. The first, related to the data construction method, is that the quarterly national accounts data for the government expenditure variable, as well as for the GDP aggregate, is for many countries an estimation, rather than an observation, in the first period. OECD data downloaded for the purpose of this exercise displays a comment on each Excel cell data indicating whether the data cell is an observation or estimation. We noticed that for all the countries' samples – except for Canada, the United Kingdom and the United States, for which data is observed from the first quarter of 1966, and Norway and

[29] In all our applications, we reported the accumulated structural Cholesky IRFs, as defined in the methodology section, deduced from Equation 8 (the first impact is $\emptyset_0 = \varphi_{i.j}^0$; the second accumulated impact $\emptyset_2 = \sum_{h=0}^{2} \varphi_{i.j}^h$; …; until the long-term accumulated impact to time horizon q; $\emptyset_q = \sum_{h=0}^{\mathrm{q}} \varphi_{i.j}^h$). In all our applications, we considered $q = 20$, which corresponds to five years. The latter accumulated multiplier defined as the sum of effects to 20 quarters is to be differentiated from what some authors reported as the maximum multiplier; namely, the peak of the effects attained in a specific point of time.

France, for which the data observed starts in 1978 and 1980, respectively – the observed data starts after the 1990s (mainly in 1995Q1 for the majority; see Table 1.C in the appendix). The quarterly national account could be estimated using mechanical/statistical methods without any fiscal policy feedback or any business cycle impacts on the data, which may deviate any fiscal policy assessment from accurate outcomes.

The second reason, which is related to the values rather than the method of construction, is that although the Cholesky impact multipliers are higher in the first period than in the period of openness and financial globalization, the fiscal multipliers could be reduced or amplified between the two periods. The trick resides in the coefficient of adjustment enabling the expenditure multipliers to be obtained from the Cholesky impact multipliers. This coefficient has two components, the first being the share of government consumption to GDP, and the second the standard error of the growth rate of government consumption. The common tendency for all advanced economies is for the shares of government consumption to grow as countries prosper and the welfare state is enhanced. Direct factors of this are also related to an ageing population, especially in Japan and many European countries. The increasing/decreasing shares of government consumption could reduce/amplify the fiscal multipliers. The same is true for the second component, which is the standard error of government consumption, which seems to be lower in the second period than the first one (as opposed to the growing of the first component). Variables are less volatile in the second period (the Great Moderation Era). The product of the two components, which correct the Cholesky impacts to get spending multipliers, could then be higher, less or approximately the same for each country between the two periods. Calculus on the countries' data shows that the adjusting coefficient (Table 1.A) is higher for all countries except Ireland, Norway, Portugal and Spain, which may lead to a reduced gap (gap impacts shown by the Cholesky innovations) in government consumption multipliers between the two periods.

A third issue is related to the method of rescaling by the average of the share of government consumption to GDP ($\overline{G_t/Y_t}$). This method, issued from the elasticity of the output of the fiscal instrument, as explained in Equations (24), (25) and (26) and used by many authors (Ilzetzki et al., 2013; Gonzales-Garcia et al., 2013; Priftis and Zimic, 2018; Glocker et al., 2019), may lead to overestimated fiscal multipliers, which is the case here for many countries in periods of recession and long-term accumulated cases. This fact is valid for our results in the current section and subsequent sections, where some countries that have higher expenditure multipliers in the long term under a recession could attain more than five (examples are France, Spain, Portugal). The issue is because Y/G can display large movements over the sample period (Ramey and Zubairy, 2018). To dampen this effect, some authors use an *ex ante* conversion approach (Gordon and Krenn, 2010; Ramey, 2016; Barnichon and Matthes, 2017), which consists of re-scaling all the variables by an estimated "potential output" Y_t^p. Thus, the variables reconsidered for these authors are Y_t/Y_t^p, G_t/Y_t^p, and so on; for our case, we did not consider this issue and rather focused our analysis on comparing changes in both structural impacts and multipliers, among the considered

cases (first period versus second period, expansion versus recession, debt accumulation versus debt reduction, etc.), rather than focusing on the size of the fiscal multipliers.

5.2. The effect of the business cycle

We ran the same SVAR controlling for the business cycle in the current case. Some authors have used the output gap to control for the business cycle position (Batini et al., 2012). For our case, we used the growth of GDP, as used by Baum et al. (2012), noted ggr_t, instead of the output gap, and we defined a dummy variable for the business cycle, as follows: $bcd_t = \begin{cases} 1 \; if \; ggr_t > 0 \\ 0 \; if \; ggr_t \leq 0 \end{cases}$. The business cycle dummy indicates expansion, while its complement to unity is a proxy for recession. The SVAR model is augmented by this variable exogenously (SVAR-X) for considering the effects of the expansion periods only and its complement to unity to account for recessions.

The results of this exercise are displayed in Table 3.A, while the IRFs are plotted in Figures 2.B.a to 2.B.c in Appendix B. The table reporting short-term (first quarter) and long-term (five years) impacts, and their corresponding Keynesian multipliers, shows that these multipliers are either positive and very low or negative and very low (in absolute value) for many countries in the sample in times of expansion (exceptions are recorded for Greece and Ireland, where short-term multipliers are, respectively, 0.92 and 1.02, corresponding to impacts of, respectively, 0.42 and 0.55). However, in times of recession, these impacts are all positive and amplified in size. The maximum of the short-term Cholesky impact is recorded in Ireland by 1.53, corresponding to a multiplier of (1.02),[30] and in Norway by 0.82 (with a multiplier of 2.4). These higher impacts yield multipliers greater than 1 for many countries (11 countries) and approaching unity for the rest (between 0.52 and 0.92). On average, expenditure multipliers in the short term are near 0 (0.09) in times of expansion, while they are more than 1 in recessions (1.55). The long-term accumulated are negative in expansions (-0.24) and very high in recessions (4.8). Our results confirm the conjecture of the higher expenditure multipliers in periods of recession than in those of economic expansion, as revealed by the aftermath of the 2008 crisis literature, especially by Auerbach and Gorodnichenko (2012, 2013). Another important point is that, from the IRF plots, the effects are more persistent in times of recession than expansion, as convergence to the long term is more quickly achievable in the latter than in the former (Figures 2.B.a to 2.B.c).

5.3. The exogenous effect of the public debt accumulation/reduction

To control exogenously for the effect of public debt, we ran the previous bivariate SVAR, where the accumulation is proxied by a dummy variable equal to 1 whenever the growth rate of public debt to GDP ratio is positive, non-null and zero elsewhere. The public debt reduction case is controlled in the SVARX by the complement of the debt accumulation dummy to unity. The

[30] Although the Cholesky impact is higher, the multiplier is reduced by, in particular, the second component of the adjusted parameter used as pass-through to fiscal multipliers in Table 1.A. Indeed, government consumption volatility is higher (exceeding 2) for this country in the period of estimation.

dummy variable for the debt ratio accumulation is defined according to the sign of the debt ratio growth rate (dgr_t): $dad_t = \begin{cases} 1 \; if \; dgr_t > 0 \\ 0 \; if \; dgr_t \leq 0 \end{cases}$, where dad_t is the dummy indicating debt increase of the debt to GDP ratio (accumulation), and its complement to unity is a proxy for debt reduction. We do not care whether the public debt ratio is reduced by the high performance of GDP (the denominator) or accumulated because of weak GDP. In both situations, it is the ratio that is important, reflecting the capacity to repay or not based on the performances of the economy.

Table 4.A shows the Cholesky impacts and their corresponding values of expenditure multipliers under public debt movements: in the case where debt to GDP ratio is consequently accumulated; or in the opposite case, where debt is reduced. Overall, the multipliers (impacts) tend to be higher in times of debt accumulation than in times of reduction, except in a few countries, where the two cases are approximately the same, namely, in Finland, Italy, Japan and Norway. The latter has even larger multipliers in debt reduction cases than in debt accumulation. Convergence to the long-term accumulated multiplier varies across countries, where it is fast in more than half of cases, medium in around a third of cases and slow in a few cases (France, Spain and the UK). The convergence is defined as fast if the accumulated long-term multiplier is approximately attained in fewer than five quarters, medium if it is attained in between six and nine quarters, and slow when it is above ten quarters. The size of the expenditure multipliers varies considerably between countries. The accumulated impulse response functions' charts are presented in figures 3.B.a to 3.B.c.

The effects of the way the debt is moving, on multipliers, tends not to be different from the business cycle effects, especially if we assume that, generally, the public debt ratio increases in times of recession, which sounds more realistic, due to the double effects of GDP shrinking and the debt level accumulation in times of recession. For further examination of this, an exercise combining the business cycle effects jointly with the public debt movements was run. Table 5.A shows the results. The main conclusion is that, under expansion, multipliers are very low for some countries and negative for most countries, almost independently from the way the debt ratio is evolving. By contrast, under recessions, multipliers are higher and could be larger than unity even in the short term, as is the case for Belgium, Canada, Denmark, Greece, Ireland, Italy, Norway, Spain, Sweden, the United Kingdom and the United States.

5.4. The effect of the public debt ratio movements jointly with the business cycle

Controlling for the business cycle effects and the public debt ratio movements is captured by augmenting the SVAR by the product of the two corresponding dummies bcd_t and dad_t yielding the following four situations:

1- The effect of public debt accumulation under expansion, captured by ($bcd_t.dad_t$),
2- The effect of public debt accumulation under recession, captured by ($(1 - bcd_t).dad_t$,
3- The effect of public debt reduction under expansion, captured by ($(1 - dad_t).bcd_t$,

4- The effect of public debt reduction under recession, captured by ($(1 - bcd_t).(1 - dad_t)$.

The results of the structural dynamic impacts (Cholesky IRFs), as well as the corresponding multipliers, are presented in Table 5.A. The latter are deduced from Equation (13) for the short-term (first) multiplier and Equation (14) for the long-term multiplier, as explained in the methodology section. For the graphical IRFs, they are presented for each country by case of debt movements under the business cycle. Therefore, Figures 4.B.a to 4.B.c present the impulse response functions for the case of debt accumulation and the two business cycle cases. Similarly, Figures 5.B.a to 5.B.c show the impulse response functions for the case of debt contraction and the two business cycle cases.

From the results summarized for the short- and long-term impacts and multipliers in Table 5.A, we observe that the effects are negative or positive but near 0 for many of the countries in times of expansion, regardless of the debt development. Exceptions are recorded for Greece, Ireland and Italy. However, in times of recession, all 18 countries have positive important multipliers, whether under debt accumulation or debt reduction, except for The Netherlands and Portugal, which have weak negative multipliers only in the case of debt reduction under recession. Under recession and debt accumulation, many countries have expenditure multipliers higher than 1 in the short term, namely, Belgium, Canada, Denmark, Greece, Ireland, Italy, Norway, Spain, Sweden, the United Kingdom and the United States. However, under recession and debt reduction, the number of countries with multipliers greater than 1 reduced to six countries, namely, Belgium, Italy, Japan, Norway, Spain and the United States.

5.5. The endogenous effect of public debt

Controlling for the business cycle effects, and considering the endogenous public debt ratio, by the tri-variate SVAR model, the results confirm the previous results of the large multipliers under recession, while reporting weak or even negative multipliers in periods of expansion. Tables 6.A and 7.A present, respectively, the dynamic structural impacts and the associated expenditure multipliers for the first quarter (short term), first year, second year and fifth year (long term). The IRFs of these results are shown in Figures 6.B.a to 6.B.c. These results tend to confirm those reported for the case of the bi-variate model, while controlling exogenously for government debt.

We can conclude generally from the previous results of the bi-variate and tri-variate models that: in times of recession, multipliers tend to be higher than in times of expansion, but they tend to decrease with debt reduction rather than debt accumulation in times of recession. This may lead us to consider the self-defeating effects of austerity aimed at reducing public debt and based on expenditure cuts, as it tends to reduce the higher multipliers recorded in times of recession and high public debt.

5.6. Robustness check: the public debt crowding-in/out effects

In order to examine why spending multipliers are lower in times of expansion than in recessions, a more disaggregated model containing behavioural equations is required. For this purpose, we chose to study, in particular, whether the crowding-out effect that might be behind lowering spending multipliers originates from public debt. We particularly consider an SVAR with six fiscal and monetary variables for the United States.

In this section we present the SVAR with six endogenous variables applied to the United Sates only, as the country with a large quarterly data set available (1966Q1–2019Q2). This SVAR is intended to explain and check the robustness of the previous models' outputs, where other variables representing monetary policy aggregates and private-sector investment are introduced, leading to more interactions catching economic behaviour. The endogenous variables considered are the interest rate, the public debt ratio, prices, output, government expenditure and private investment. In this model, we follow nearly the same approach as in Sims (1986). The difference from Sims's model is that the latter considered money supply equation (which is an interest rate equation explained by money demand), money demand, output, price, unemployment and investment demand equations (the model is detailed in Sims (1986)).

In our case we modified the model to include fiscal variables that are of interest to us for studying the spending multipliers via the impact of expenditure and public debt. Moreover, in order to assess what is happening on the private demand side, especially the possibility of crowding-in/out effects of government spending and/or debt to private agent decisions, we kept the private investment equation. Private consumption could also be considered but we decided to reduce the size of this model into six variables to gain more degrees of freedom for the quality purpose estimation. The monetary policy action is presented by the equation of interest rate, and the dynamic of prices is captured by the inflation equation.

For the interest rate equation, we used the policy variable, which is the effective federal funds rate. Assuming that the feds follows a conventional monetary policy based on Taylor's rule, it seems suitable to assume that the feds policy rate (r_t) is determined by innovations (e_3, e_4) corresponding, respectively, to GDP growth rate (y_t) and inflation (π_t). GDP is a best proxy for the output gap, as we do not consider the output gap in this model. The second equation is related to public debt (d_t). For this equation, three variables are important from the classical debt sustainability rule; we could realistically assume that the public debt ratio is determined by the innovations (e_3, e_4, e_1) corresponding, respectively, to innovations from the GDP growth rate, the inflation rate and the interest rate.[31] The third equation is the output assumed to rely on innovations, e_5, e_6 and e_2, from,

[31] It is possible to provide an SVAR with identities equations such as Taylor's rule for the interest rate and the debt sustainability equation. However, the structural shocks associated with those identities would be zero, and the situation is more complex if the identity is dynamic (Cherif and Hasanov, 2017; Ouliaris et al., 2018). As assessment of the effects of fiscal and monetary policy structural innovations (shocks) on the other endogenous variables is our requirement, we keep such identities as functional structural equations.

respectively, private investment (i_t), government expenditure (g_t) (three options are tested: total, current and capital expenditure) and public debt. For the fourth equation of the system corresponding to inflation, the latter is assumed to be determined by the interest rate's innovations (e_1) and the investment private innovations (e_5). The private investment is assumed to be determined in the fifth equation as the function of innovations coming from the output (e_3) and the interest rate (e_1) (the accelerator equation). The last equation is an error term corresponding to government expenditure determined by its proper structural innovations (e_6). This means that the government expenditure variable does not react simultaneously to the other endogenous variables in this model, but its reaction comes with a delay.

Explicitly, the six simultaneous equations of the current model are formulated in the following system:

$$\begin{cases} r_t = c(1)y_t + c(2)\pi_t + e_{1t}; & interest\ rate\ equation & (1) \\ d_t = c(3)y_t + c(4)\pi_t + c(5)r_t + e_{2t}; & government\ debt\ ratio\ equation & (2) \\ y_t = c(6)i_t + c(7)\pi_t + c(8)r_t + e_{4t}; & output\ \ equation & (3) \\ \pi_t = c(9)r_t + c(10)i_t + e_{5t}; & inflation\ equation & (4) \\ i_t = c(11)y_t + c(12)r_t + e_{6t}; & private\ invesment\ equation & (5) \\ g_t = e_{3t}; & government\ expenditure\ \ equation & (6) \end{cases}$$

In this exercise, all the variables are made stationary by differentiated natural logarithms, and hence the variables are all in growth rates. The variables, which will appear in outputs and figures, are LGDP for GDP growth rate (y_t), LGE for government consumption expenditure, total, current and capital ($g_t = LGE = dlog(GOVEXP)$), LPRC for inflation (GDP deflator inflation, $\pi_t = LPRC = dlog(GDPdeflator)$), LDR for log differentiated of the debt ratio ($d_t = dlog(debtratio)$), LPINV for the real private investment growth rate ($i_t = LPINV = dlog(rpinv)$) and RINTR for the interest rate ($r_t = RINTR = ffr$).

We test the SVAR model with six endogenous variables applied to the United Sates only, as the country with a large quarterly data set. The data set covers, for many variables of this model, a long-observed history of quarterly data going back to 1953. However, the public debt quarterly data starts at 1996. Hence, the model is estimated over the period 1966Q1–2019Q2. This SVAR is intended to check the robustness of the previous models' outputs, where other variables representing monetary policy aggregates and private-sector investment are introduced, leading to more interactions catching economic behaviour. The model functional equations' determinants are discussed in the methodology section. The considered endogenous variables are interest rate, public debt ratio, prices, output, government expenditure and private investment.

In this SVAR we control exogenously for the business cycle and debt movements by introducing as exogenous the dummies controlling for expansion/recession and debt accumulation/reduction, as defined for the previous bivariate model. We also produce the cases where debt movements and business cycle are jointly considered (four cases).

Figure 7 (in the appendix) presents a panel of charts showing quarterly data over 1966Q1–2019Q2, by row order and column, from left to right, the public debt ratio development and output growth, the long-term interest rate and the inflation rate for the three first charts. The last chart shows the composition of the total government expenditure, capital and current expenditure growth rates.

The public debt of the United States stands at around US$ 20.42 trillion at the end of June 2019, from which: 1) about 66% is long-term liabilities, 2) more than 83% is denominated in domestic currency and 7% in foreign currency, and the rest is not allocated (see Table 6.C). For evolution over a long history (Figure 7), we observe that the growth rate is more volatile in the 1966–84 period, but with the public debt ratio in a downward trend. Staring around 1985, the real growth rate becomes less volatile than previously, while the public debt ratio reverses track to generally increase. For the relationship between public debt and interest rate, although the golden rule of public debt and economic growth stipulates that public debt is accumulated whenever the real interest rate is higher than economic growth, the public debt ratio and interest rate are evolving the opposite way. From the 1960s to early 1980s, the interest rate takes an upward trend, while the public debt to GDP ratio is on a downward trend. Starting from the 1980s up to 2019 the interest rate records a sustained decrease, while the public debt ratio reverses its path to a general upward trend (except 1996 until 2001, where it decreases). The same facts are observed when comparing the trend of inflation and GDP growth rate. The period starting from 1986 is known by economists as the "Great Moderation Era". In this period, we can conclude from the previous analysis that public debt in the United States has accumulated over this period of sustained growth and moderate inflation and interest rates, which is the case for many advanced countries in our sample. For the last chart in Figure 7, capital expenditure is less volatile in the second period (1986–2019) than the first period (1966–85), compared to current expenditure, which means that current expenditure is more mobilized in times of crisis in recent periods than in the decades of the 1960s and 1970s.

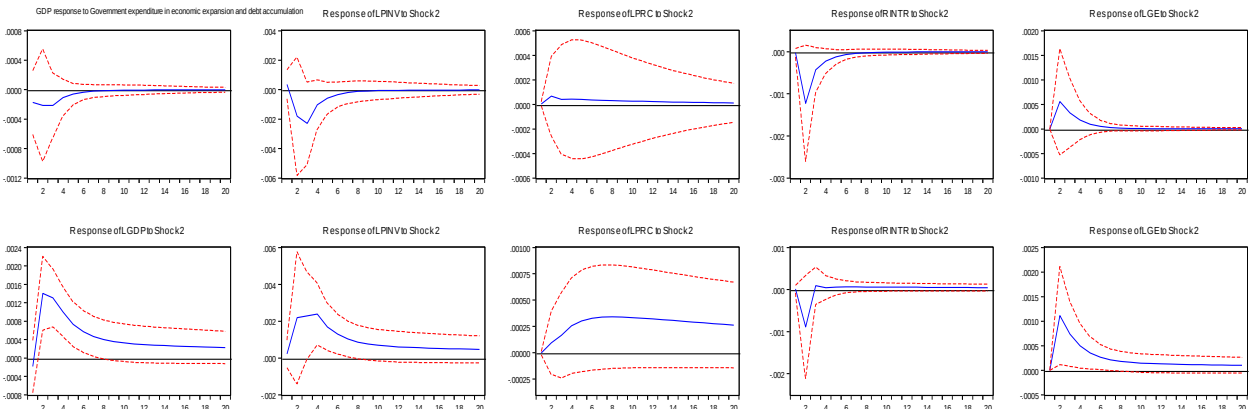
The estimation of the structural model (the block of equations described in the methodology by Equations (1) to (6)), controlling for expansion and recession, yields the following table. Standard errors of the estimated coefficients are displayed between parentheses below the estimated values of those coefficients.

Model's estimation controlling for expansion	Model's estimation controlling for recession
$r_t = \underset{(.256)}{.129}\, y_t + \underset{(.287)}{.311}\pi_t + e_{1t}$	$r_t = -\underset{(.192)}{.071}\, y_t + \underset{(.279)}{.383}\pi_t + e_{1t}$
$d_t = \underset{(.174)}{-1.05} y_t \underset{(.355)}{-1.12}\pi_t \underset{(.087)}{-.308} r_t + e_{2t}$	$d_t = \underset{(.181)}{-.639} y_t \underset{(.354)}{-1.20}\pi_t \underset{(.088)}{-.269} r_t + e_{2t}$
$y_t = \underset{(.018)}{.167} i_t + \underset{(.029)}{.209}\pi_t - \underset{(.020)}{.017} r_t + e_{4t}$	$y_t = \underset{(.021)}{.163} i_t + \underset{(.032)}{.245}\pi_t - \underset{(.024)}{.016} r_t + e_{4t}$
$\pi_t = \underset{(.030)}{-.024} r_t \underset{(.021)}{-.005} i_t + e_{5t}$	$\pi_t = \underset{(.031)}{-.022} r_t \underset{(.021)}{-.009} i_t + e_{5t}$
$i_t = \underset{(.605)}{-.636} y_t \underset{(2.07)}{-2.13} r_t + e_{6t}$	$i_t = \underset{(.368)}{.378} y_t \underset{(1.25)}{-1.15} r_t + e_{6t}$
$g_t = e_{3t}$	$g_t = e_{3t}$
(…) are standard errors	(…) are standard errors

From the previous estimations, we notice significant differences in some estimated elasticities between the two models (expansion versus recession). We also observe that some signs are inverted from positive to negative, or vice versa, between two situations in the equation of interest rate and private investment. This shows that some behaviour is changing over the business cycle, which could explain the differences in fiscal multipliers between periods of expansion and recession. For the rest of the application, we produce the impulse response functions to structural shocks of the interest rate (shock1), public debt variable (shock2), private investment (shock3) and public expenditure (shock6) for the variables output, investment, inflation, interest rate and debt. We produce these IRFs for eight cases: two for the business cycle periods (expansion versus recession), two for debt ratio movements (accumulation versus reduction) and four for the joint business cycle and debt movements (expansion and debt accumulation/reduction and recession and debt accumulation/reduction). These outputs are displayed by the eight figures in Appendix B (Figures 8.B.a to 8.B.h).

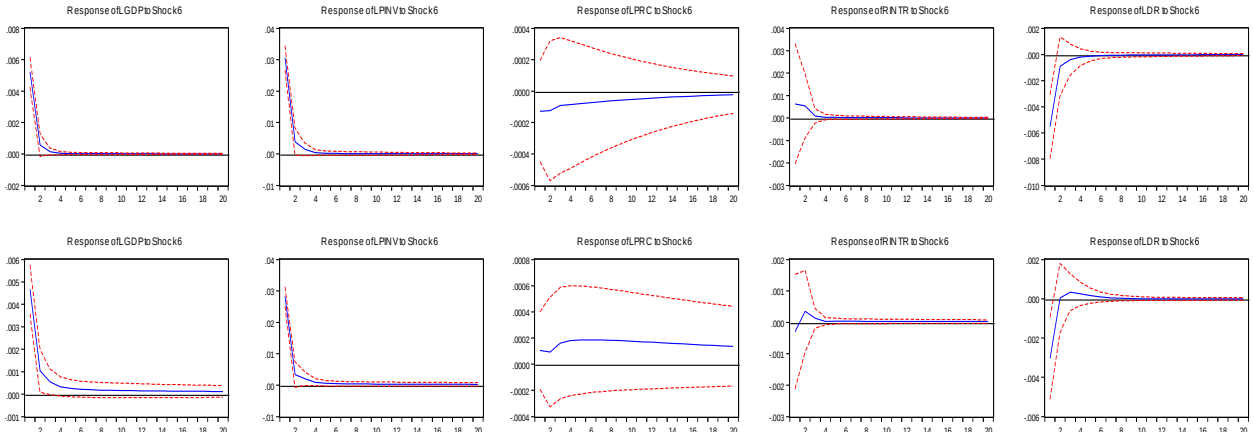
To shed more light on the effects of fiscal variables on output, inflation and private investment, we prefer to focus on the corresponding IRFs, which we reproduce in this section. For the effects of the innovations of public debt (shock2) on output, private investment and inflation, Figure 3 clearly shows in the first row corresponding to the expansion model's IRFs that public debt increase has a deflationary effect on the other variables by reducing economic growth, especially through crowding out private investment in the United States, and inducing an increase in government expenditure. However, in times of recession (the second row of Figure 3), an increase in public debt is likely to increase growth by even stimulating inflation and private investment while keeping the interest rate reduced in the second quarter and pushing up government expenditure. We also observe that the effects are generally happening with a delay of one quarter and are at their peaks in the second or third quarter, while fading away (or stabilizing at their long-term path) at the fourth or sixth quarter, except for inflation, which has a persistent long-term response.

Figure 3. Responses to a structural shock of the government public debt ratio (shock2) in times of expansion (first row of charts) and recession (second row of charts)



For the effects of the structural innovations of total government expenditure (shock6, in Figure 4) in periods of expansion and recession, we note that the effect is immediate and high (in the first quarter), especially for the response of GDP, private investment and the public debt ratio. The effects of government expenditure are generally independent of the business cycle effects, except for the inflation variable being reduced in times of expansion and pushed up in times of recession. For the periods of expansion and recession as well, an increase in government expenditure is likely to immediately increase the output and then reduce the public debt ratio, while inducing an increase in the interest rate, especially in the second quarter, to counter the inflationary effects, albeit less important, in times of recession. However, this reduction of the public debt ratio could be a consequence of an algebraic computation of the increase of GDP being the denominator of the debt ratio variable. An important point is that all the responses are very short-lived (the effects occur and fade way within the first year), except for the reaction of the prices. In concordance with the public debt and government expenditure effects, we can conclude that expenditure multipliers are mainly weakened in times of expansion and increased in times of recession (as found in the previous results) by the effects of the public debt that crowd out the private agent decisions of investing, while the effects of fiscal policy (by expenditure side) are positive and short-lived, independent of the business cycle.

Figure 4. Responses to a structural shock of government expenditure (shock6) in times of expansion (first row of charts) and recession (second row of charts)



For the effects of debt movements (Figures 5 and 6), we observe almost the same findings about the reactions of the variables as those observed for the business cycle, except for prices (inflation and interest rates). A structural innovation of the public debt ratio is likely to reduce output by crowding out investment and may have a deflationary effect when debt is accumulated. However, in times of decumulating public debt, the effects of the public debt increase on output, investment and prices are positive (Figure 5). For the effects of government expenditure, they are positive on output and investment, while reducing public debt. The prices' reactions are slightly different for debt accumulation and debt reduction cases.

Figure 5. Responses to a structural shock of the public debt ratio (shock2) in periods of debt accumulation (first row of charts) and debt contraction (second row of charts)

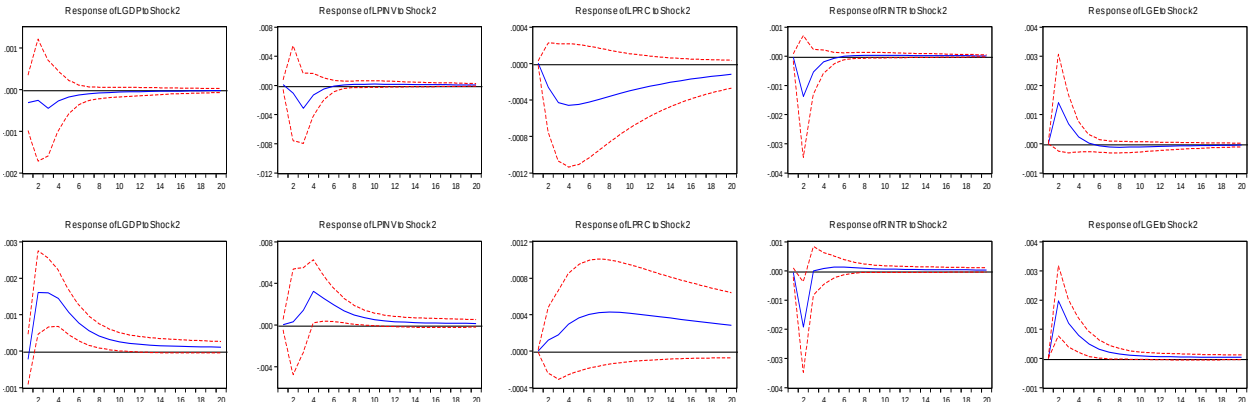
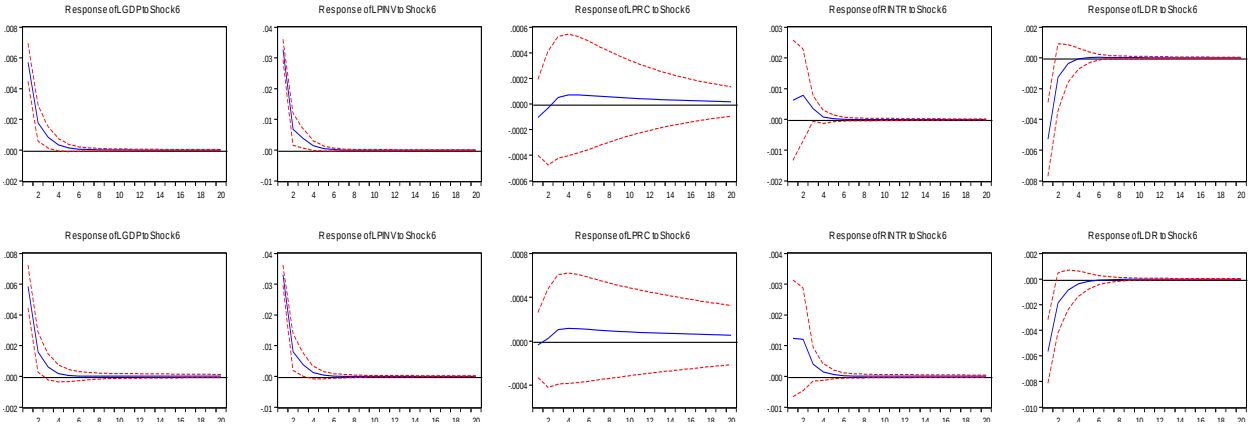


Figure 6. Responses to a structural shock of government expenditure (shock6) in periods of debt accumulation (first row of charts) and debt contraction (second row of charts)



For the effects of the business cycle and debt movements, we produce the four cases (in Figures 7 to 10). A structural innovation of the debt in periods of debt accumulation and expansion decreases simultaneously the GDP, investment and prices (inflation and interest rate), while increasing government expenditure (first row of the panel in Figure 7). For periods of debt accumulation in recession periods (second row of Figure 7), the effects are opposite (positive) on the first three variables, while the reaction of the interest rate and government expenditure have almost the same shape as in the first case. For the effects of government expenditure (Figure 8), they are short-lived and almost the same, independent of the two considered cases.

Figure 7. Responses to a structural shock of the government debt ratio (shock2) in periods of debt accumulation and expansion (first row of charts) and debt accumulation and recession (second row of charts)

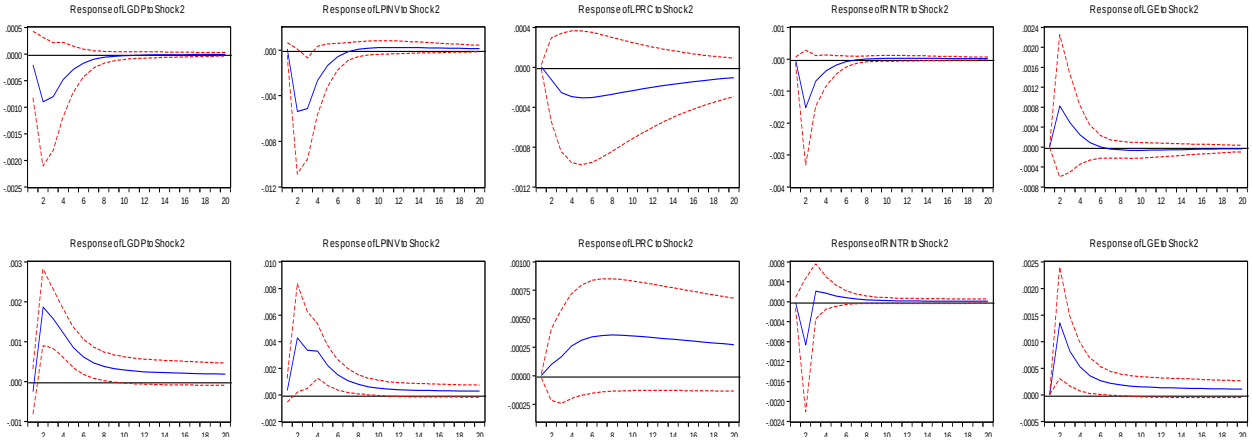
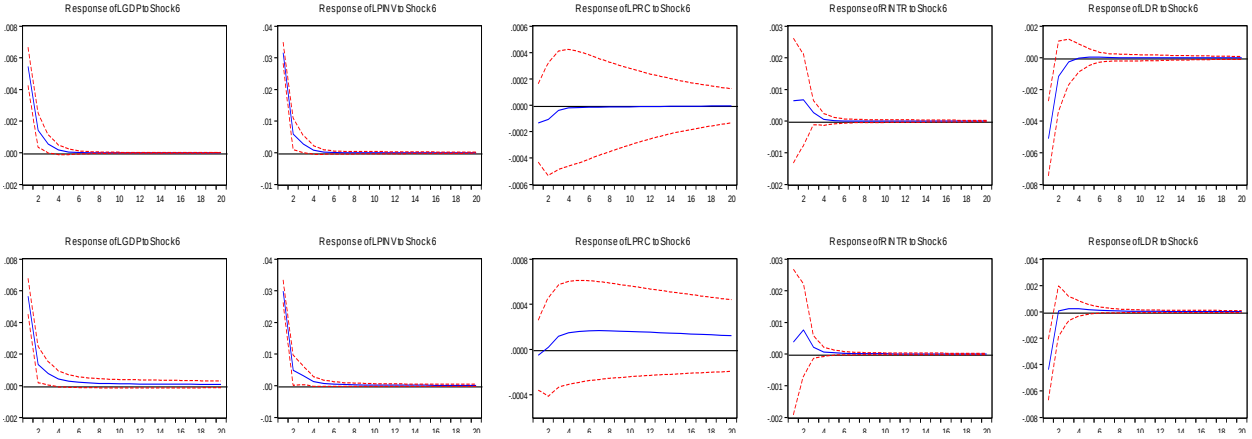


Figure 8. Responses to a structural shock of government expenditure (shock6) in periods of debt accumulation and expansion (first row of charts) and debt accumulation and recession (second row of charts)



For the government debt reduction case, jointly with the business cycle, unlike the case where debt is accumulated, the responses to the public debt structural shock are slightly different over the business cycle for private investment and interest rate, while they seem to behave the same way for the other variables, between the two situations. In particular, the output, investment and inflation are positively affected in the first year with persistent effects for inflation.

Figure 9. Responses to a structural shock of the government debt ratio (shock2) in periods of debt reduction and expansion (first row of charts) and debt reduction and recession (second row of charts)

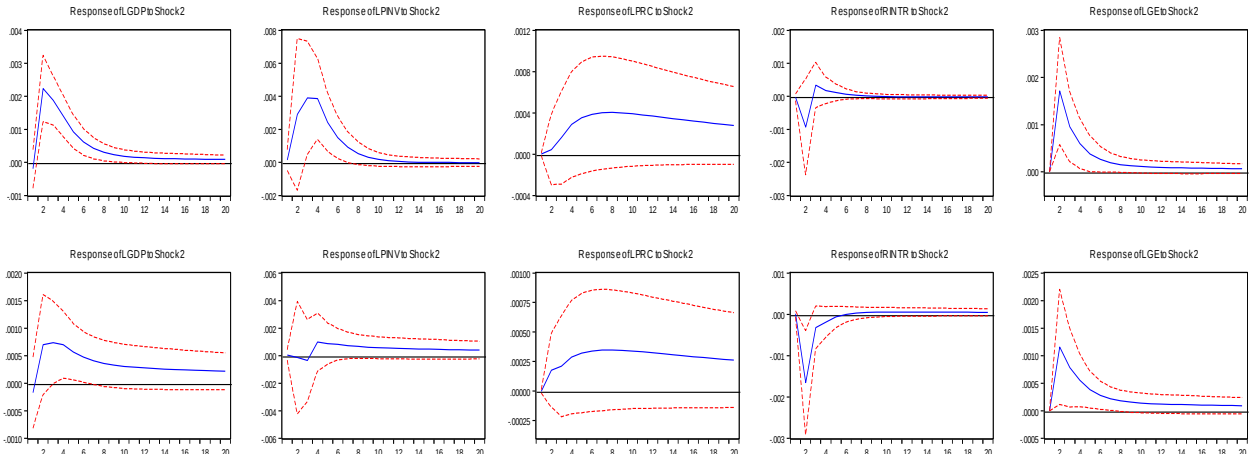
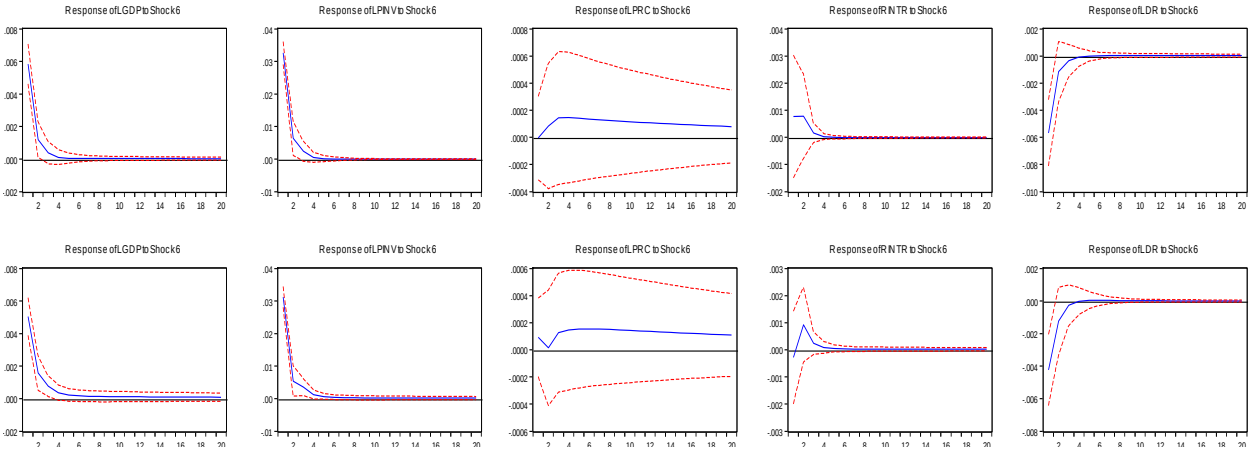


Figure 10. Responses to a structural shock of government expenditure (shock6) in periods of debt reduction and expansion (first row of charts) and debt reduction and recession (second row of charts)



This model, containing fiscal and monetary variables, sought to explain why the fiscal multipliers are weaker, or even negative, in times of expansion than recession. In times of high public debt, and particularly expansion, an increase in public debt ratio crowds out private investment, hence reducing output. By contrast, the government expenditure effects on output are all positive in the short term, independent of the public debt evolution (accumulation or decumulation) and business cycle. These results align with what we observed in a preliminary analysis (Section 4.2) of the works of Bouassard et al. (2012) and Berti et al. (2013) for 27 European countries, in which we highlighted the apparent decreasing relationship between expenditure multipliers' size and public debt ratio.

Conclusion

In this paper we used the methodology of a structural vector autoregressive model (SVAR), augmented by exogenous dummies variables controlling for the business cycle (expansion/recession) and public debt movements (accumulation/reduction). We applied this approach to assess the expenditure multipliers for a sample of 18 OECD countries (Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, The Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States) with different exchange rate regimes, monetary policies and degrees of openness.

The results show that, controlling for the business cycle effects, the expenditure multipliers are much higher in times of recession than times of expansion, and could attain, in recessions, more than 1 for many countries in the sample, in the short term, while going beyond the value of 2 in the long term. Moreover, it is noted that, generally, the idea of spending multipliers being weak, and even negative in recent decades, compared to the 1960s, 1970s and 1980s, is not well supported by our findings. The previous results are in line with what was observed in the recent literature about fiscal multipliers, in advanced economies, being large in times of recession but weak, or even negative, in times of expansion.

Considering these results, the fiscal policy in advanced countries should be designed according to business cycle fluctuations. In particular, fiscal policies should be designed to counter the business cyclicality. In times of recession, it is the role of the government sector to stimulate the economy, while public intervention in times of expansion seems to alter economic growth (as the multipliers are weak or negative for many countries) and less beneficial to the economy than in times of recession. These results also run contrary to any fiscal consolidation based on cutting expenditure in times of recession, which could harm the economy.

Controlling exogenously for the public debt movements, independent of the business cycle, it is revealed that spending multipliers are larger in periods of debt accumulation than in debt reduction periods. Furthermore, controlling jointly for debt movements exogenously and the business cycle reveals the previous tendency, that is, multipliers are higher under debt accumulation in cases of expansion and recession. However, introducing endogenously the public debt to GDP variable in an SVAR leads to higher multipliers in recessions than expansions.

Furthermore, a robustness check of the previous results was conducted on a long history of quarterly data for the United States, as the country with long quarterly time series of the six fiscal and monetary variables considered in this model, namely, public debt, GDP, private investment, public expenditure, interest rate and inflation. The period of estimation covers the range 1966q1–2019q2. The main results of this model show that government expenditure has positive but short-lived effects on economic growth. Furthermore, public debt crowds out private investment, leading to lowering growth rates in times of expansion, while in times of recession, the public debt effects

on growth are positive. This crowding-out effect may play pass-through to the expenditure multipliers and could explain, *ceteris paribus*, the weak size of spending multipliers, while in times of recession the crowing-in effect leads to higher multipliers.

In all our models the recession period generally has a persistent effect on variables for which convergence to the long-term path following the shock is achieved faster in times of expansion than recession. The policy implication of this, for highly indebted countries, is that fiscal stimulus effects could take time to materialize in times of depressed economies, while the effects are short-lived in times of expansion, which should be considered by policy-makers in their spending decisions.

Generally, the wide spread of results about the size of spending multipliers in the previous literature, leads us to conclude that these multipliers, despite their simple definition, reflect; 1/The difference of methods and models used to assess these multipliers: with the same data, and on a single country (the United States, for example), researchers find different results whether the used model is a structural model, a new Keynesian DSGE model or a (non-) linear VAR/SVAR model. The assumptions and features, as well as the methods of solving the three types of model, vary widely. 2/ The difference in macroeconomic fundamentals of the studied countries, although the most advanced countries share, to some extent, the same level of development and qualified institutions, fiscal policies effects may differ regarding the difference of monetary policy and exchange rate regimes, as well as economic conditions (the business and/or the financial cycle), as represented by the levels of debt and deficit, for example. Other determinants could play an important role as the degree of openness.

Consequently, all the differences in empirical results should not be seen as an incongruity between economists. It is a fact rather than a general theory that should apply to all countries. In this regard, a good way to study the effects of fiscal policy is to avoid considering the empirical results of one country or a group of countries as a universal benchmark for all countries. Therefore, studies of fiscal multipliers should be undertaken at country level and avoid drawing conclusions from a single country such as the United States, Japan, the United Kingdom or Germany. When it comes to assessing things empirically, each country's data set represents its own model of economic development and experience across a period of that country, and if this is not even valid to reproduce the future of this economy itself, it is hardly transposable to a different country. Whether in fiscal stimuli or fiscal consolidation, accurately estimating fiscal multipliers by type of expenditure helps policy-makers to know what categories of spending they should increase (in fiscal stimuli) or cut (in consolidation).

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Appendix A: Tables

Table 1.A: Coefficient of correction to get fiscal multipliers from Cholesky impacts innovations by periods and countries samples

	Government consumption growth rate standard error (σ_g)			Average of GDP to government consumption ($\overline{Y/G}$)			$\overline{Y/G}/\sigma_g$		
Countries	1966Q1/ 2019Q2	1966Q1/ 1991Q4	1992Q1/ 2019Q4	1966Q1/ 2019Q2	1966Q1/ 1991Q4	1992Q1/ 2019Q4	1966Q1/ 2019Q2	1966Q1/ 1991Q4	1992Q1/ 2019Q4
Austria	0.721	0.469	0.882	4.796	4.575	5.002	6.65	9.75	5.67
Belgium	0.679	0.700	0.599	3.877	3.643	4.096	5.71	5.20	6.84
Canada	1.056	1.288	0.704	4.091	3.616	4.536	3.88	2.81	6.45
Denmark	0.821	0.850	0.751	4.156	4.215	4.101	5.06	4.96	5.46
Finland	1.800	1.809	1.724	3.818	3.605	4.018	2.12	1.99	2.33
France	0.468	0.498	0.291	4.275	4.298	4.253	9.14	8.62	14.63
Germany	1.178	1.459	0.823	5.179	5.103	5.251	4.40	3.50	6.38
Greece	1.827	1.026	2.272	5.558	5.967	5.174	3.04	5.82	2.28
Ireland	1.898	1.116	2.415	5.002	3.717	6.205	2.64	3.33	2.57
Italy	0.706	0.456	0.713	5.050	4.829	5.257	7.15	10.58	7.38
Japan	0.928	1.119	0.576	5.758	6.067	5.469	6.20	5.42	9.49
Netherlands	1.415	1.821	0.884	4.165	4.163	4.167	2.94	2.29	4.71
Norway	1.423	1.444	1.350	4.590	4.756	4.435	3.22	3.29	3.28
Portugal	1.096	1.010	0.671	6.890	8.262	5.606	6.28	8.18	8.35
Spain	1.035	1.060	0.912	6.842	8.128	5.638	6.61	7.67	6.18
Sweden	0.923	1.013	0.749	3.236	2.994	3.463	3.51	2.96	4.62
United Kingdom	1.101	1.162	1.046	4.727	4.251	5.173	4.29	3.66	4.95
United States	0.830	0.952	0.680	5.298	4.400	6.139	6.38	4.62	9.03

Table 2.A. Sensitivity of government expenditure Cholesky impacts and the corresponding multipliers to different periods of time

	1966Q1-1991Q4						1992Q1-2019Q2					
	first Quarter		Fourth Quarter (one year)		20th Quarter (5 years)		first Quarter		Fourth Quarter (one year)		20th Quarter (5 years)	
Countries	Impact	Multiplier	Impact	Multiplier	Impact	Multiplier	Impact	Multiplier	Impact	Multiplier	Impact	Multiplier
Austria	0.27	2.59	0.34	3.31	0.34	3.35	0.03	0.17	0.03	0.19	0.03	0.20
Belgium	0.02	0.13	0.32	1.68	0.49	2.53	0.07	0.48	0.17	1.17	0.18	1.21
Canada	0.27	0.76	0.13	0.36	0.13	0.35	0.04	0.24	-0.09	-0.57	-0.11	-0.68
Denmark	0.24	1.20	0.47	2.35	0.50	2.46	0.10	0.53	-0.05	-0.28	-0.05	-0.28
Finland	-0.08	-0.16	0.01	0.02	0.01	0.01	0.25	0.58	0.44	1.03	0.44	1.03
France	-0.07	-0.58	0.18	1.53	0.18	1.53	-0.17	-2.42	-0.46	-6.73	-0.61	-8.85
Germany	0.26	0.91	0.21	0.73	0.21	0.73	0.02	0.14	-0.13	-0.83	-0.13	-0.84
Greece	-0.14	-0.82	0.16	0.96	0.70	4.05	0.66	1.50	0.97	2.20	0.97	2.21
Ireland	0.33	1.09	0.85	2.83	0.11	0.36	0.79	2.03	0.77	1.98	0.77	1.97
Italy	0.12	1.27	0.30	3.20	0.33	3.49	0.21	1.55	0.46	3.37	0.51	3.80
Japan	0.11	0.61	0.00	0.03	0.00	0.02	0.01	0.10	0.06	0.60	0.06	0.60
Netherlands	0.24	0.55	0.17	0.38	0.17	0.39	-0.01	-0.02	0.14	0.65	0.15	0.71
Norway	0.27	0.89	0.30	1.00	0.30	0.99	0.23	0.75	-0.04	-0.14	0.01	0.02
Portugal	0.72	5.92	0.79	6.47	0.70	5.72	0.20	1.68	0.61	5.11	0.87	7.30
Spain	0.22	1.71	0.22	1.67	0.22	1.66	0.27	1.65	0.77	4.74	1.09	6.74
Sweden	0.34	1.00	0.29	0.85	0.29	0.85	-0.01	-0.03	-0.06	-0.30	-0.07	-0.31
United Kingdom	0.00	-0.01	-0.04	-0.13	-0.04	-0.13	0.06	0.31	0.03	0.16	0.03	0.13
United States	0.03	0.16	-0.02	-0.10	-0.02	-0.12	-0.08	-0.72	-0.30	-2.72	-0.33	-3.02
Average	0.18	0.96	0.26	1.51	0.26	1.57	0.15	0.47	0.18	0.54	0.21	0.66

Note: Impact multipliers (*IM*) are adjusted by the corresponding adjustment coefficient from table 1.A to obtain fiscal multipliers (*FM*) according to the formulae $FM = IM * \overline{Y/G}/\sigma_g$.

Table 3.A: Business cycle effects on government expenditure short run and long run multipliers

1992Q1-2019Q2	Short run impact (1st quarter)		Long run accumulated impact (5 years)		Short run multiplier (1st quarter)		Long run accumulated multiplier (5 years)		Short run multiplier (Recession ***Minus*** Expansion)	Long run accumulated multiplier (Recession ***Minus*** Expansion)
Country	Expansion	Recession	Expansion	Recession	Expansion	Recession	Expansion	Recession		
Austria	-0.029	0.375	-0.085	1.292	-0.137	1.793	-0.404	6.175	1.93	6.58
Belgium	-0.014	0.276	0.025	1.196	-0.071	1.429	0.131	6.201	1.50	6.07
Canada	-0.027	0.383	-0.239	1.413	-0.137	1.907	-1.190	7.043	2.04	8.23
Denmark	0.009	0.419	-0.158	0.814	0.033	1.506	-0.570	2.929	1.47	3.50
Finland	0.071	0.366	0.108	0.752	0.141	0.728	0.215	1.498	0.59	1.28
France	-0.080	0.153	-0.461	1.428	-0.318	0.611	-1.835	5.689	0.93	7.52
Germany	-0.104	0.359	-0.307	0.805	-0.500	1.723	-1.474	3.861	2.22	5.33
Greece	0.423	0.514	0.457	0.603	0.917	1.113	0.990	1.308	0.20	0.32
Ireland	0.550	1.533	0.486	2.165	1.022	2.846	0.903	4.019	1.82	3.12
Italy	0.112	0.195	0.213	0.515	0.641	1.120	1.226	2.956	0.48	1.73
Japan	-0.085	0.322	-0.240	0.915	-0.461	1.745	-1.302	4.953	2.21	6.25
Netherlands	-0.065	0.279	-0.069	1.538	-0.246	1.051	-0.261	5.796	1.30	6.06
Norway	0.145	0.819	-0.004	0.906	0.427	2.405	-0.011	2.659	1.98	2.67
Portugal	0.109	0.234	0.295	1.623	0.488	1.051	1.323	7.280	0.56	5.96
Spain	0.085	0.407	0.087	1.481	0.396	1.893	0.406	6.895	1.50	6.49
Sweden	-0.099	0.377	-0.200	1.012	-0.303	1.158	-0.614	3.109	1.46	3.72
UK	-0.014	0.346	-0.117	1.414	-0.065	1.588	-0.535	6.488	1.65	7.02
USA	-0.024	0.310	-0.181	1.060	-0.174	2.224	-1.298	7.608	2.40	8.91
Average	0.05	0.43	-0.02	1.16	0.09	1.55	-0.24	4.80	1.46	5.04

Table 4.A. Short run and long run government expenditure multipliers in time or debt accumulation and debt reduction

	Cholesky impacts				Multipliers impacts				Convergence to long run multiplier	
	Under debt accumulation		Under debt reduction		Under debt accumulation		Under debt reduction			
Country	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Long run	Under debt accumulation	Under debt reduction
Austria	0.19	0.38	0.14	0.24	0.90	1.80	0.65	1.15	Fast	Fast
Belgium	0.34	1.23	0.21	0.48	1.76	6.36	1.11	2.48	Medium	Medium
Canada	0.31	0.85	0.10	0.03	1.54	4.21	0.51	0.13	Medium	Medium
Denmark	0.31	0.34	0.14	0.08	1.12	1.22	0.50	0.28	Fast	Fast
Finland	0.14	0.22	0.15	0.20	0.28	0.44	0.30	0.39	Fast	Fast
France	0.09	0.63	0.03	0.40	0.35	2.49	0.13	1.60	Medium	Slow
Germany	0.18	0.38	0.07	0.10	0.87	1.81	0.32	0.47	Fast	Fast
Greece	0.77	1.20	0.67	1.01	1.67	2.61	1.44	2.18	Fast	Fast
Ireland	1.48	1.70	0.38	0.14	2.75	3.16	0.70	0.27	Fast	Fast
Italy	0.35	0.90	0.31	0.74	1.99	5.19	1.79	4.22	Medium	Medium
Japan	0.09	0.16	0.07	0.21	0.48	0.89	0.37	1.12	Fast	Fast
Netherlands	0.12	0.88	-0.06	0.09	0.45	3.32	-0.23	0.35	Medium	Fast
Norway	0.52	0.30	0.62	0.50	1.54	0.89	1.83	1.48	Fast	Fast
Portugal	0.20	0.70	0.04	0.31	0.88	3.16	0.20	1.38	Medium	Medium
Spain	0.33	2.95	0.26	1.25	1.55	13.72	1.20	5.81	Slow	Slow
Sweden	0.32	0.75	0.04	0.04	1.00	2.30	0.12	0.13	Fast	Fast
UK	0.36	1.43	0.21	0.47	1.65	6.58	0.95	2.16	Slow	medium
USA	0.15	0.28	0.03	-0.11	1.09	2.02	0.22	-0.76	Medium	Fast
Average	0.35	0.85	0.19	0.34	1.22	3.45	0.67	1.38	--	--

Notes: Impact multipliers (*IM*) are adjusted by the corresponding adjustment coefficient from table 1.A to obtain fiscal multipliers (*FM*) according to the formulae $FM = IM * \overline{Y/G}/\sigma_g$. Convergence to the long run is fast if it is approximately attained in less than 5 quarters, medium between 6 and 9 quarters and slow in case it is reached in more than 10 quarters (this is clearly visible from the GDP responses charts).

Table 5.A.: The mutually effects of the business cycle and public debt (accumulation/reduction)

	Cholesky impacts								Multipliers impacts							
	Expansion				Recession				Expansion				Recession			
	Under debt accumulation		Under debt reduction		Under debt accumulation		Under debt reduction		Under debt accumulation		Under debt reduction		Under debt accumulation		Under debt reduction	
Country	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Long run
Austria	-0.06	-0.12	-0.08	-0.16	0.13	0.23	0.15	0.27	-0.30	-0.59	-0.38	-0.76	0.64	1.09	0.72	1.30
Belgium	0.04	-0.04	0.01	-0.11	0.31	1.08	0.23	0.58	0.21	-0.22	0.06	-0.58	1.60	5.58	1.21	2.98
Canada	-0.01	-0.18	-0.05	-0.28	0.28	0.83	0.19	0.36	-0.05	-0.91	-0.26	-1.38	1.41	4.12	0.94	1.79
Denmark	0.01	-0.12	0.00	-0.15	0.31	0.55	0.15	0.22	0.04	-0.43	0.02	-0.52	1.11	1.98	0.52	0.78
Finland	-0.01	-0.07	-0.04	-0.08	0.11	0.18	0.15	0.17	-0.03	-0.14	-0.08	-0.17	0.22	0.35	0.30	0.33
France	-0.09	-0.31	-0.11	-0.46	0.13	0.73	0.12	0.73	-0.35	-1.22	-0.44	-1.84	0.53	2.90	0.47	2.89
Germany	-0.19	-0.38	-0.23	-0.42	0.16	0.46	0.10	0.18	-0.89	-1.84	-1.09	-2.00	0.75	2.21	0.47	0.88
Greece	0.28	0.35	0.59	0.81	0.57	0.74	0.31	0.39	0.62	0.75	1.27	1.75	1.23	1.60	0.68	0.85
Ireland	0.35	0.16	0.25	0.07	1.48	1.91	0.34	0.12	0.64	0.31	0.46	0.12	2.75	3.55	0.64	0.23
Italy	0.21	0.36	0.19	0.40	0.25	0.66	0.25	0.52	1.18	2.09	1.10	2.30	1.45	3.81	1.41	2.97
Japan	-0.04	-0.11	-0.18	-0.44	0.12	0.17	0.22	0.54	-0.22	-0.60	-0.97	-2.37	0.63	0.93	1.22	2.93
Netherlands	-0.13	-0.12	-0.14	-0.12	0.11	0.78	-0.04	0.13	-0.51	-0.45	-0.54	-0.44	0.40	2.94	-0.15	0.51
Norway	0.15	0.05	0.20	0.09	0.56	0.51	0.60	0.72	0.45	0.14	0.58	0.27	1.63	1.49	1.77	2.10
Portugal	-0.02	0.06	0.06	0.12	0.17	0.46	-0.01	0.20	-0.07	0.27	0.26	0.54	0.78	2.06	-0.03	0.89
Spain	0.05	0.03	0.09	0.17	0.30	2.14	0.23	0.95	0.25	0.12	0.44	0.77	1.38	9.95	1.08	4.44
Sweden	-0.11	-0.16	-0.14	-0.22	0.34	0.85	0.10	0.23	-0.35	-0.50	-0.44	-0.68	1.03	2.62	0.31	0.70
UK	0.00	-0.07	-0.01	-0.11	0.28	0.86	0.20	0.50	-0.01	-0.33	-0.04	-0.52	1.31	3.95	0.93	2.27
USA	0.02	-0.09	0.00	-0.13	0.25	0.61	0.26	0.60	0.15	-0.66	-0.01	-0.96	1.82	4.35	1.87	4.30
Average	0.03	-0.04	0.02	-0.06	0.33	0.76	0.20	0.41	0.04	-0.23	0.00	-0.36	1.15	3.08	0.80	1.84

Note: Impact multipliers (*IM*) are adjusted by the corresponding adjustment coefficient from table 1.A to obtain fiscal multipliers (*FM*) according to the formulae $FM = IM * \overline{Y/G}/\sigma_g$.

Table 6.A. Short run and long run GDP response to a structural government consumption innovation from an SVAR with endogenous public debt

		Short run Impact (1st quarter)		Impact in one year		Impact in two years		Long run impact (5 years)		Convergence to the long run	
Country	Sample	Expansion	Recession	Expansion	Recession	Expansion	Recession	Expansion	Recession	Expansion	Recession
Austria	2000:1-2019:2	-0.05	0.29	-0.12	0.63	-0.12	0.69	-0.12	0.70	Fast	Medium
Belgium	1995:4-2019:2	0.03	0.17	-0.07	0.62	-0.08	0.84	-0.08	0.95	Fast	Slow
Canada	1990:1-2019:2	-0.02	0.29	-0.20	0.89	-0.22	1.16	-0.22	1.24	Fast	Medium
Denmark	2000:1-2019:2	0.09	0.30	-0.07	0.56	-0.07	0.58	-0.07	0.58	Fast	Fast
Finland	2000:1-2019:2	-0.05	0.23	-0.10	0.38	-0.10	0.38	-0.10	0.38	Fast	Fast
France	1998:4-2019:2	0.03	0.21	-0.08	0.70	-0.12	1.02	-0.13	1.22	Medium	Slow
Germany	1998:1-2019:2	-0.16	0.20	-0.35	0.68	-0.35	0.72	-0.35	0.72	Fast	Fast
Greece	1997:4-2019:2	0.45	0.57	0.60	0.82	0.60	0.83	0.60	0.83	Fast	Fast
Ireland	2000:1-2019:2	0.08	0.28	-0.05	0.61	-0.05	0.62	-0.05	0.62	Fast	Fast
Italy	1995:4-2019:2	0.11	0.19	0.23	0.54	0.24	0.59	0.24	0.59	Fast	Fast
Japan	1997:4-2019:2	0.00	0.24	-0.11	0.41	-0.12	0.42	-0.13	0.42	Fast	Fast
Netherlands	1999:4-2019:2	-0.11	-0.02	-0.06	0.33	-0.05	0.45	-0.05	0.48	Fast	Medium
Norway	1995:4-2019:2	0.13	0.70	0.02	0.83	0.03	0.82	0.03	0.82	Fast	Fast
Portugal	1999:4-2019:2	-0.04	0.12	-0.07	0.33	-0.10	0.39	-0.10	0.40	Medium	Medium
Spain	1995:4-2019:2	0.03	0.06	0.04	0.53	0.04	0.96	0.04	1.51	Medium	Slow
Sweden	1995:4-2019:2	-0.10	0.36	-0.18	0.97	-0.18	1.10	-0.18	1.11	Fast	Medium
UK	1995:1-2019:2	0.04	0.35	-0.02	1.07	-0.03	1.47	-0.03	1.68	Fast	Slow
USA	1995:1-2019:2	0.05	0.42	-0.06	1.17	-0.06	1.41	-0.06	1.46	Fast	Medium
Average		0.03	0.28	-0.04	0.67	-0.04	0.80	-0.04	0.87	--	--

Note: Convergence to the long run is fast if it is approximately attained in less than 5 quarters, medium between 6 and 9 quarters and slow in case it is reached in more than 10 quarters (this is clearly visible from the GDP responses charts).

Table 7.A. Short run and long run government expenditure multipliers from an SVAR with endogenous public debt

		Short run multiplier (1st quarter)		1st year multiplier		2nd year multiplier		Long run multiplier (5 years)	
Country	Sample	Expansion	Recession	Expansion	Recession	Expansion	Recession	Expansion	Recession
Austria	2000:1-2019:2	-0.25	1.40	-0.58	3.01	-0.57	3.31	-0.57	3.35
Belgium	1995:4-2019:2	0.16	0.90	-0.37	3.21	-0.41	4.37	-0.41	4.91
Canada	1990:1-2019:2	-0.11	1.44	-0.98	4.45	-1.08	5.79	-1.09	6.20
Denmark	2000:1-2019:2	0.33	1.06	-0.25	2.02	-0.25	2.07	-0.25	2.07
Finland	2000:1-2019:2	-0.10	0.47	-0.21	0.75	-0.20	0.76	-0.20	0.76
France	1998:4-2019:2	0.13	0.84	-0.32	2.78	-0.47	4.07	-0.51	4.84
Germany	1998:1-2019:2	-0.77	0.96	-1.69	3.25	-1.68	3.44	-1.68	3.44
Greece	1997:4-2019:2	0.98	1.23	1.31	1.78	1.31	1.80	1.31	1.80
Ireland	2000:1-2019:2	0.15	0.52	-0.10	1.14	-0.09	1.15	-0.09	1.15
Italy	1995:4-2019:2	0.65	1.11	1.31	3.09	1.36	3.39	1.36	3.41
Japan	1997:4-2019:2	0.00	1.30	-0.62	2.23	-0.67	2.25	-0.68	2.25
Netherlands	1999:4-2019:2	-0.42	-0.07	-0.21	1.23	-0.20	1.70	-0.20	1.79
Norway	1995:4-2019:2	0.39	2.04	0.07	2.44	0.08	2.42	0.08	2.42
Portugal	1999:4-2019:2	-0.18	0.54	-0.31	1.46	-0.45	1.74	-0.46	1.78
Spain	1995:4-2019:2	0.15	0.27	0.19	2.47	0.17	4.47	0.17	7.02
Sweden	1995:4-2019:2	-0.31	1.09	-0.55	2.99	-0.55	3.37	-0.55	3.41
United Kingdom	1995:1-2019:2	0.17	1.60	-0.09	4.90	-0.11	6.73	-0.12	7.69
United States	1966:1-2019:2	0.23	1.86	-0.25	5.15	-0.27	6.22	-0.27	6.43
Average		-0.25	1.40	-0.58	3.01	-0.57	3.31	-0.57	3.35

Note: Impact multipliers (*IM*) are adjusted by the corresponding adjustment coefficient from table 1.A to obtain fiscal multipliers (*FM*) according to the formulae $FM = IM * \overline{Y/G}/\sigma_g$.

Appendix B: Figures

Figure 1.B.a: Sensitivity of GDP responses to expenditures impact multipliers by period of time (1st set of countries)

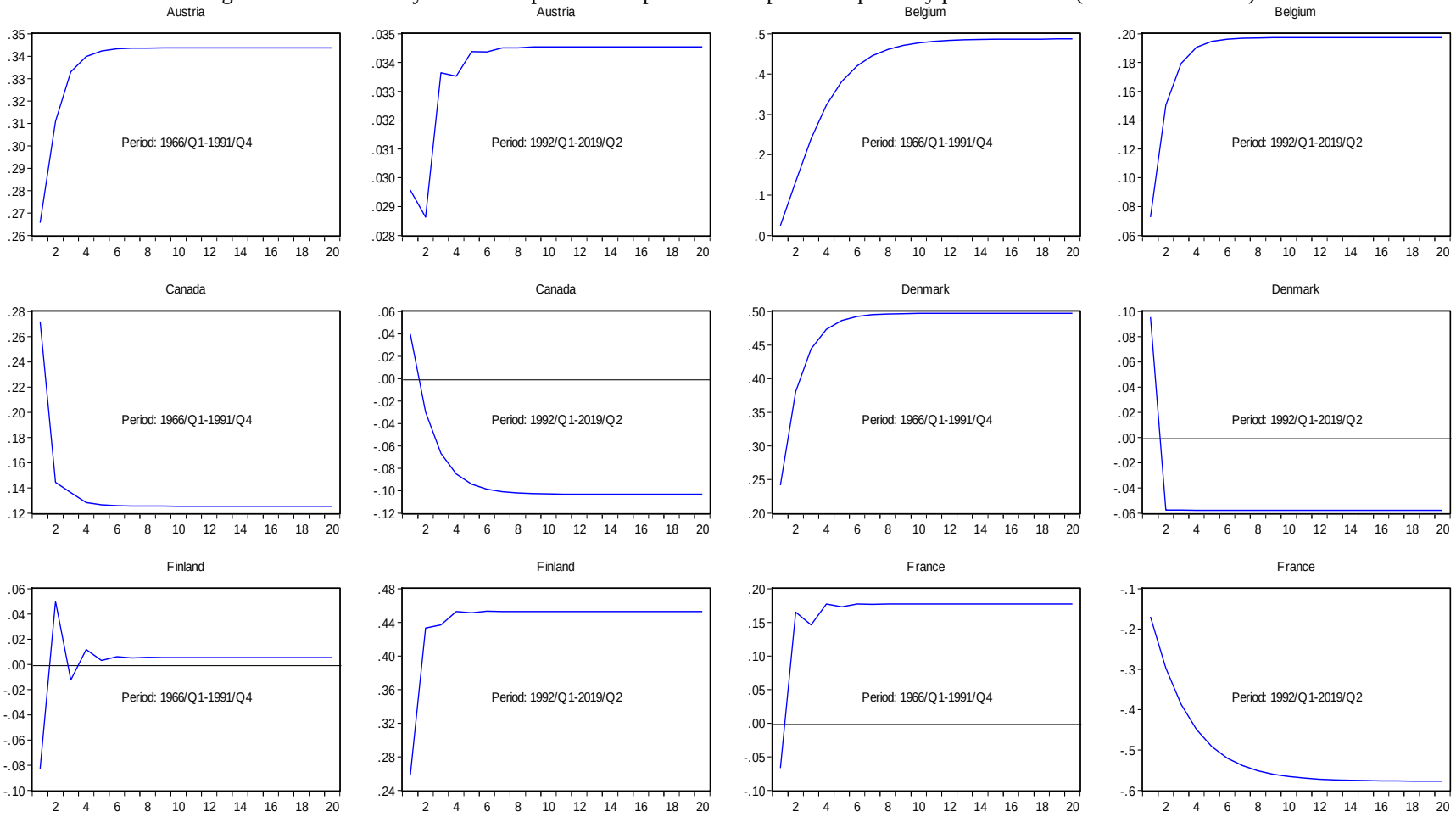


Figure 1B.b: Sensitivity of GDP responses to expenditures impact multipliers by period of time (2nd set of countries)

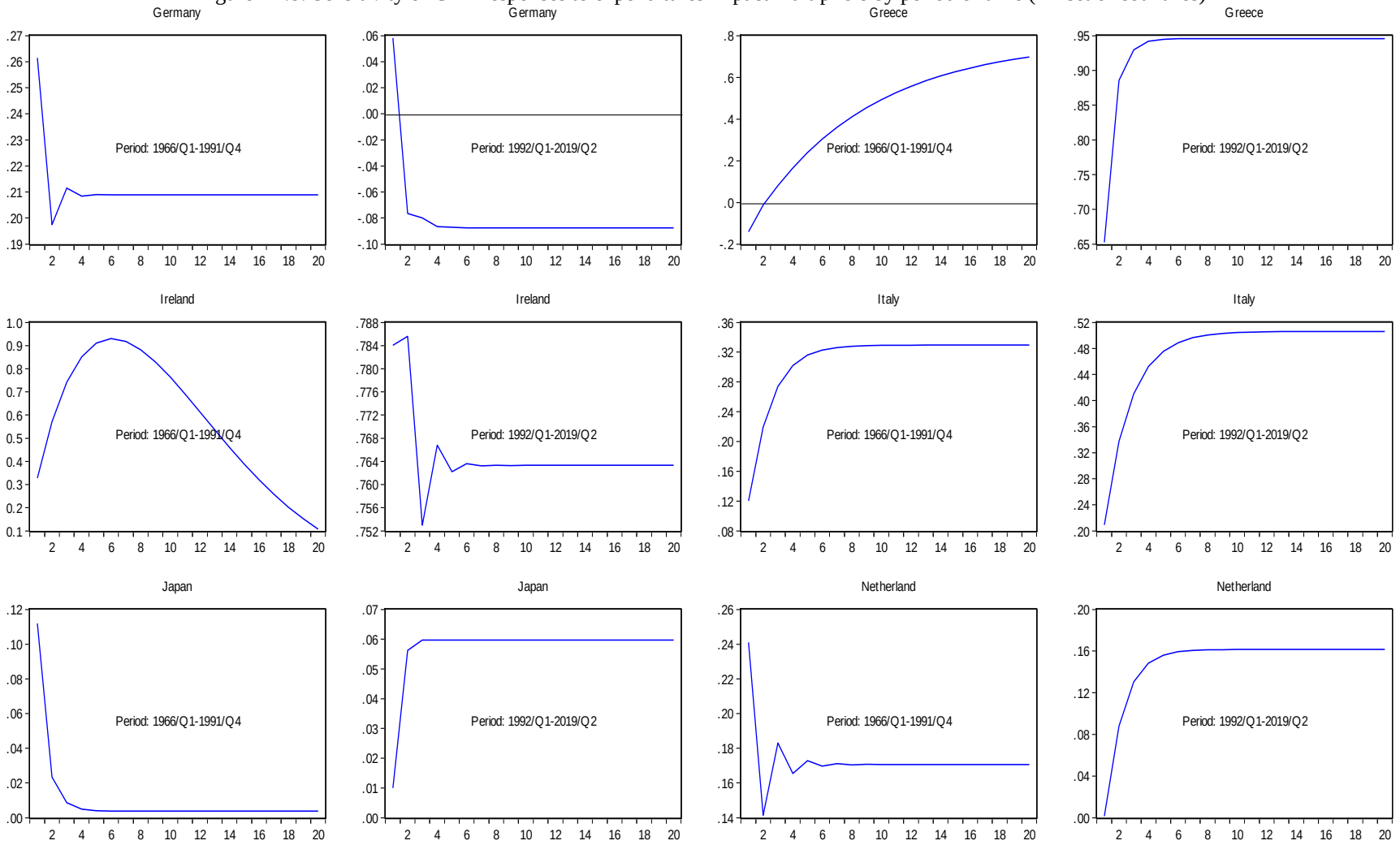


Figure 1.B.c: Sensitivity of GDP responses to expenditures impact multipliers by period of time (3rd set of countries)

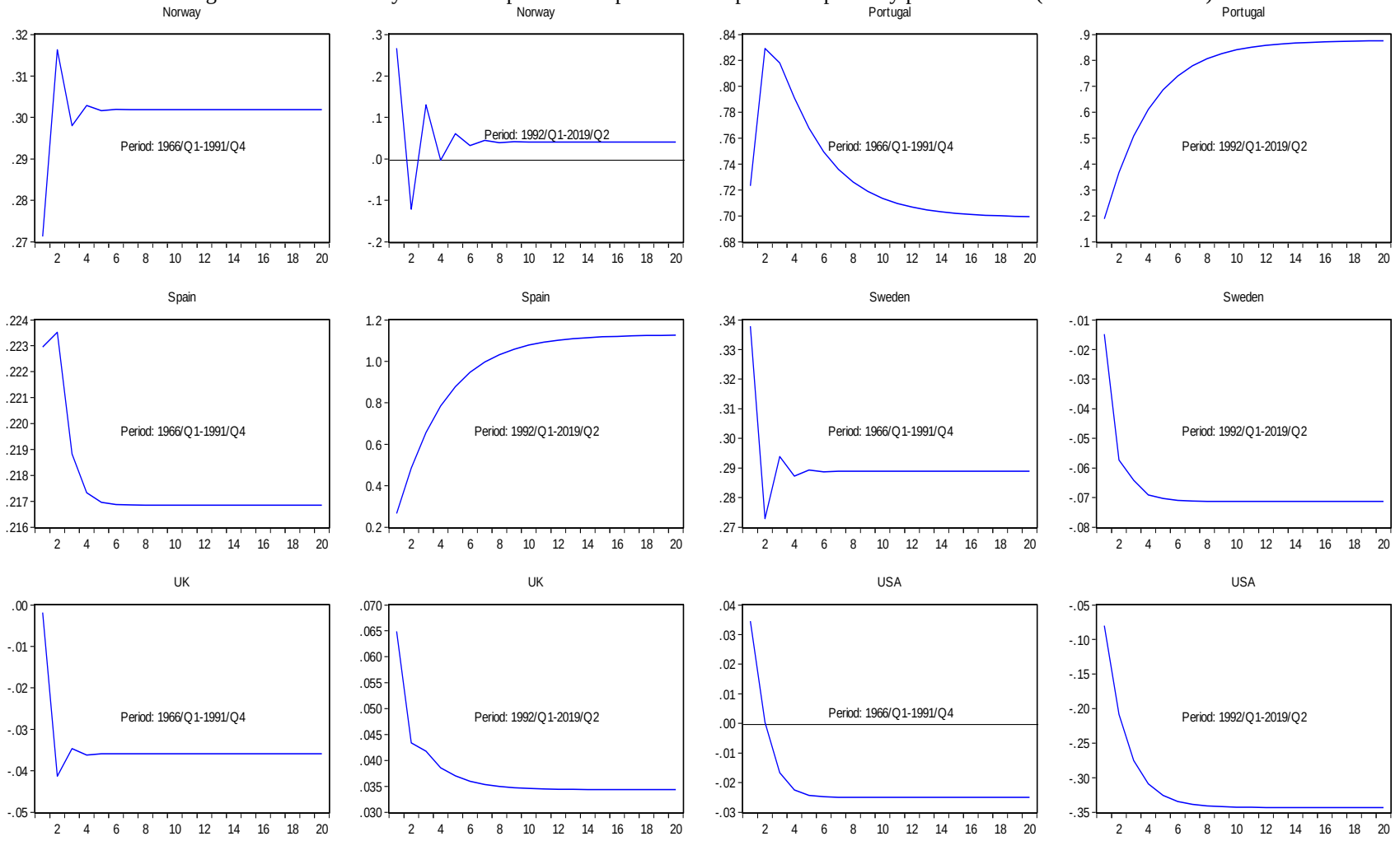
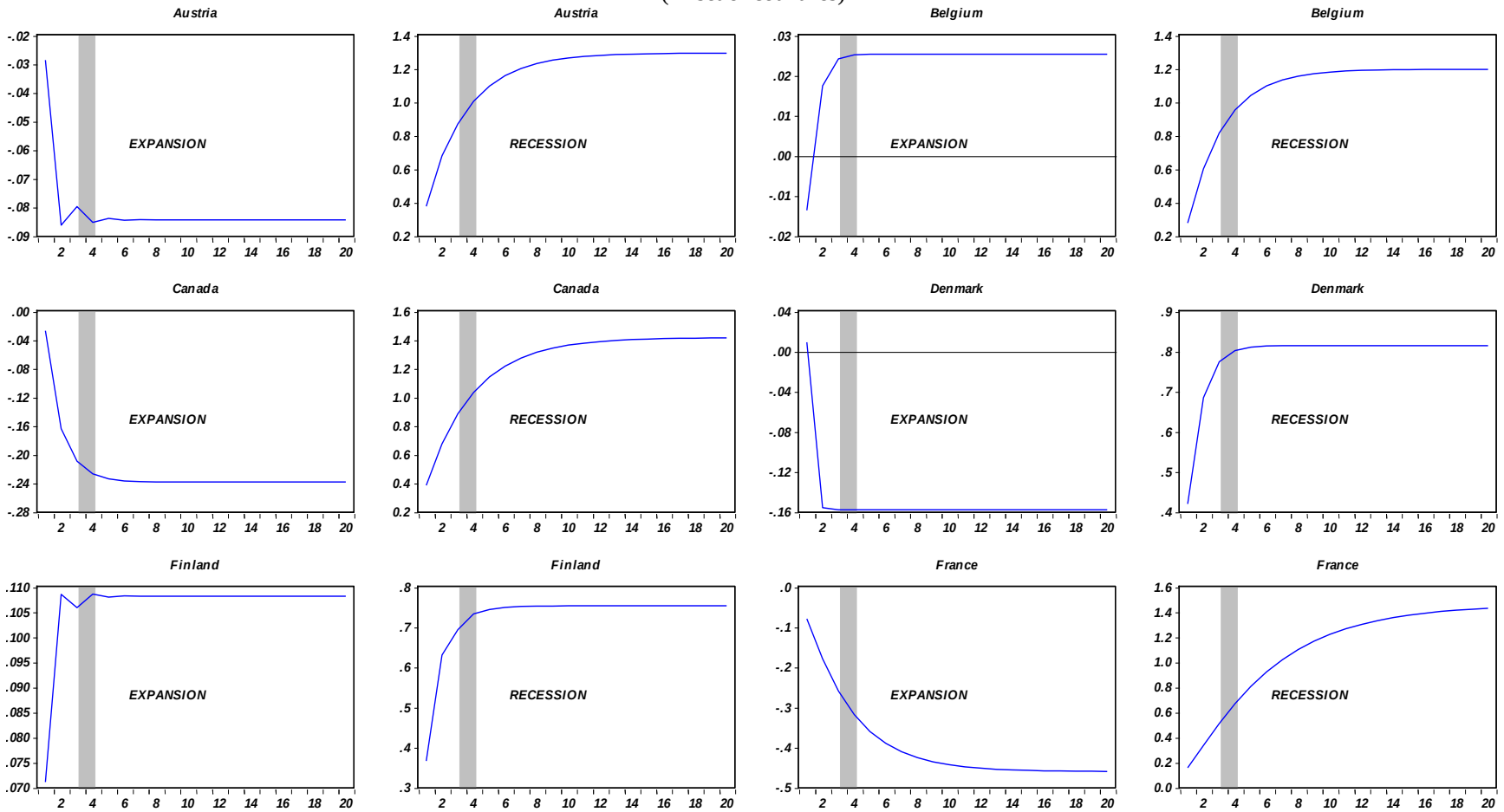
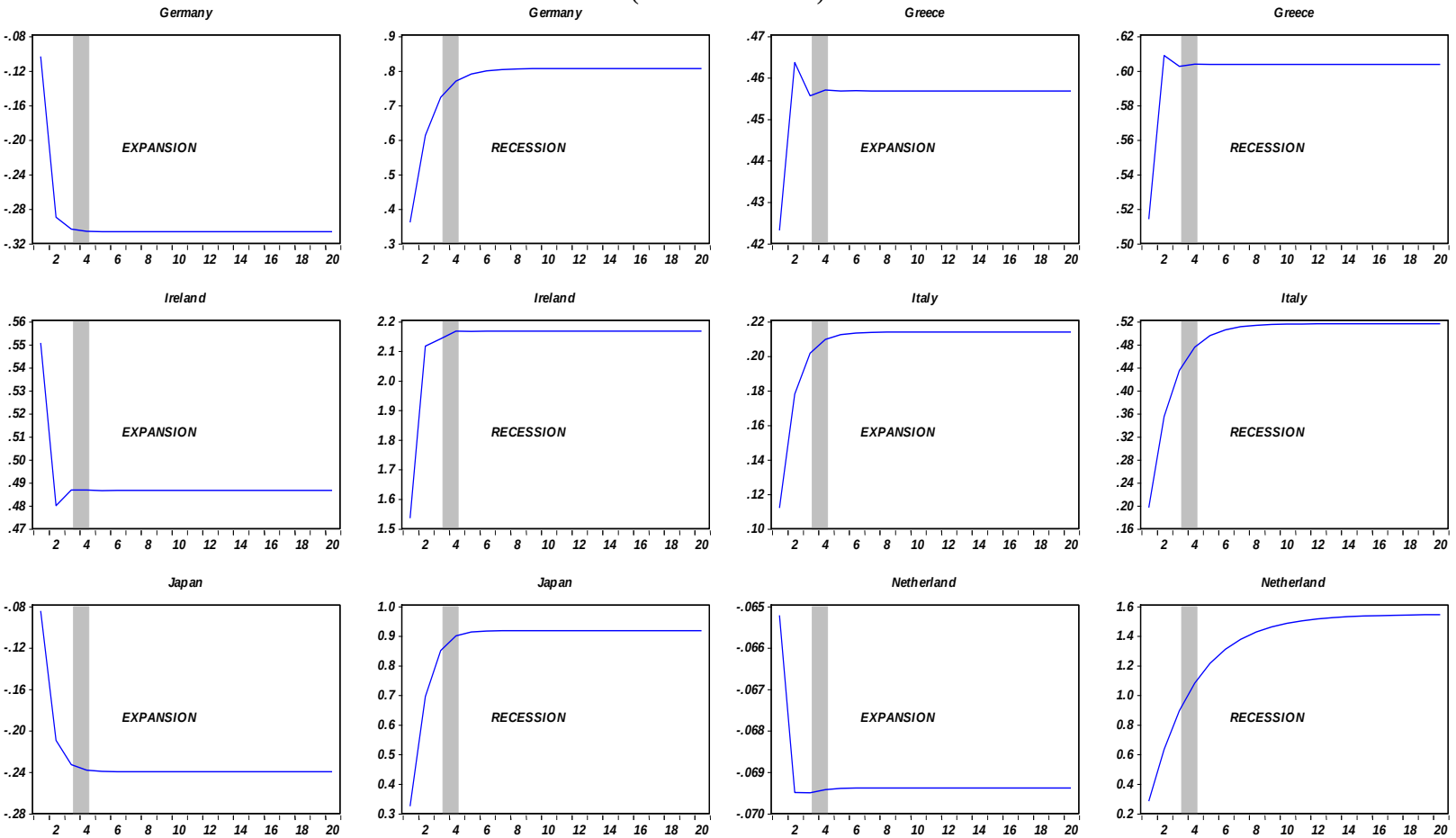


Figure 2.B.a: The effects of the business cycle (expansion verusus recession) on GDP responses to government expenditure dynamic structural shock (1st set of countries)



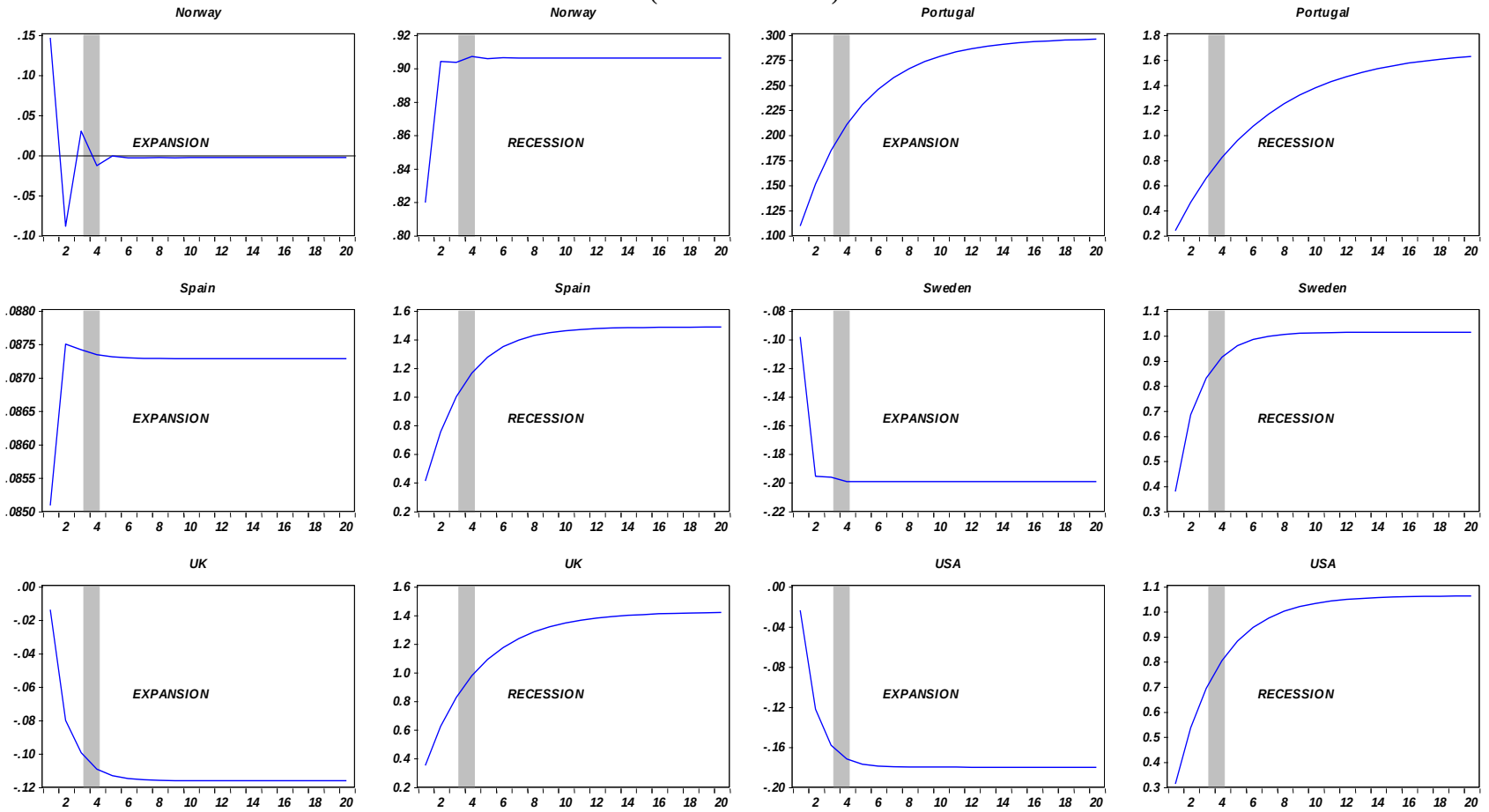
Note: Shaded area bar corresponds to the fourth quarter.

Figure 2.B.b: The effects of the business cycle (expansion verusus recession) on GDP responses to government expenditure dynamic structural shock (2nd set of countries)



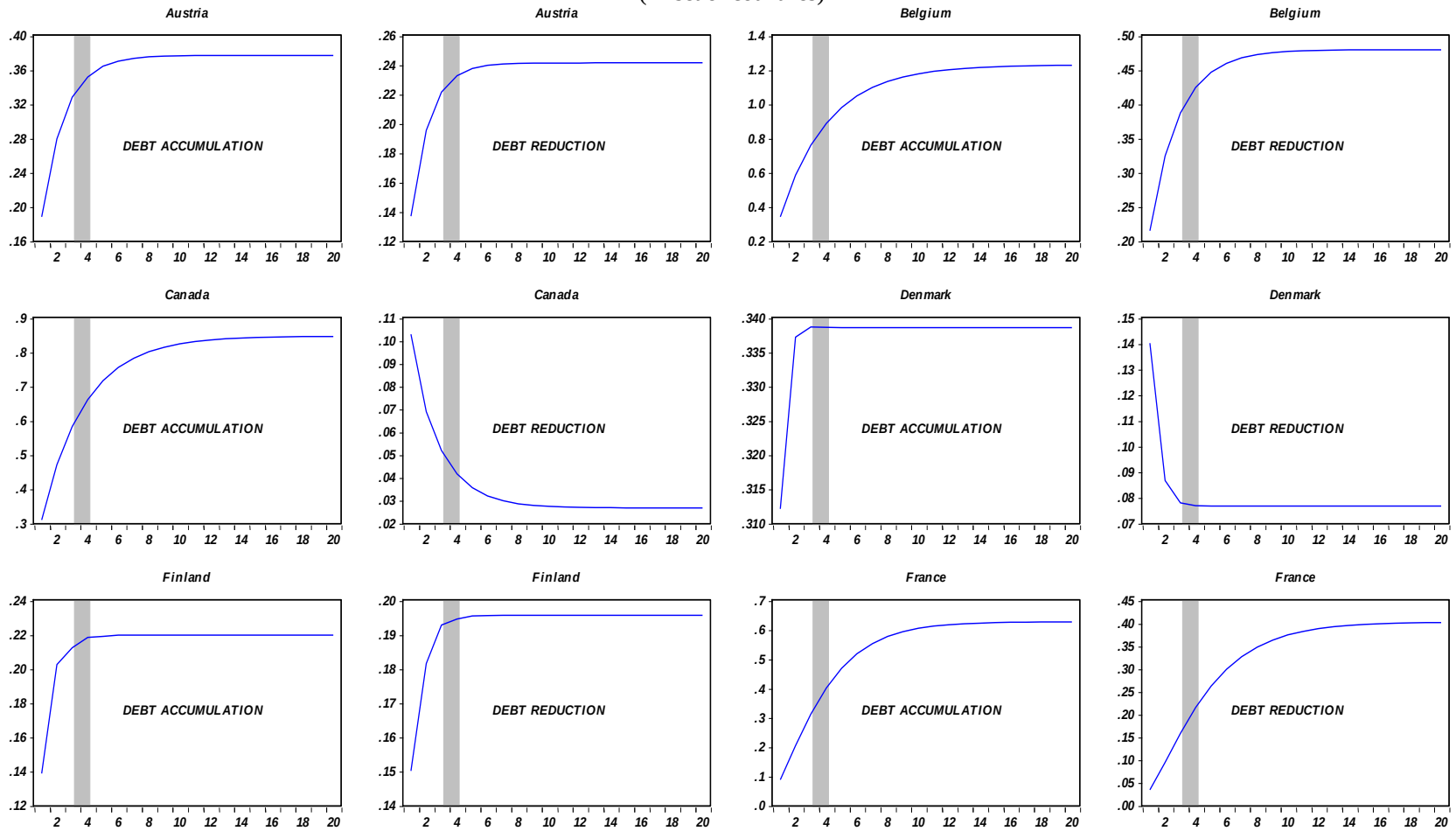
Note: Shaded area bar corresponds to the fourth quarter.

Figure 2.B.c: The effects of the business cycle (expansion verusus recession) on GDP responses to government expenditure dynamic structural shock (3rd set of countries)



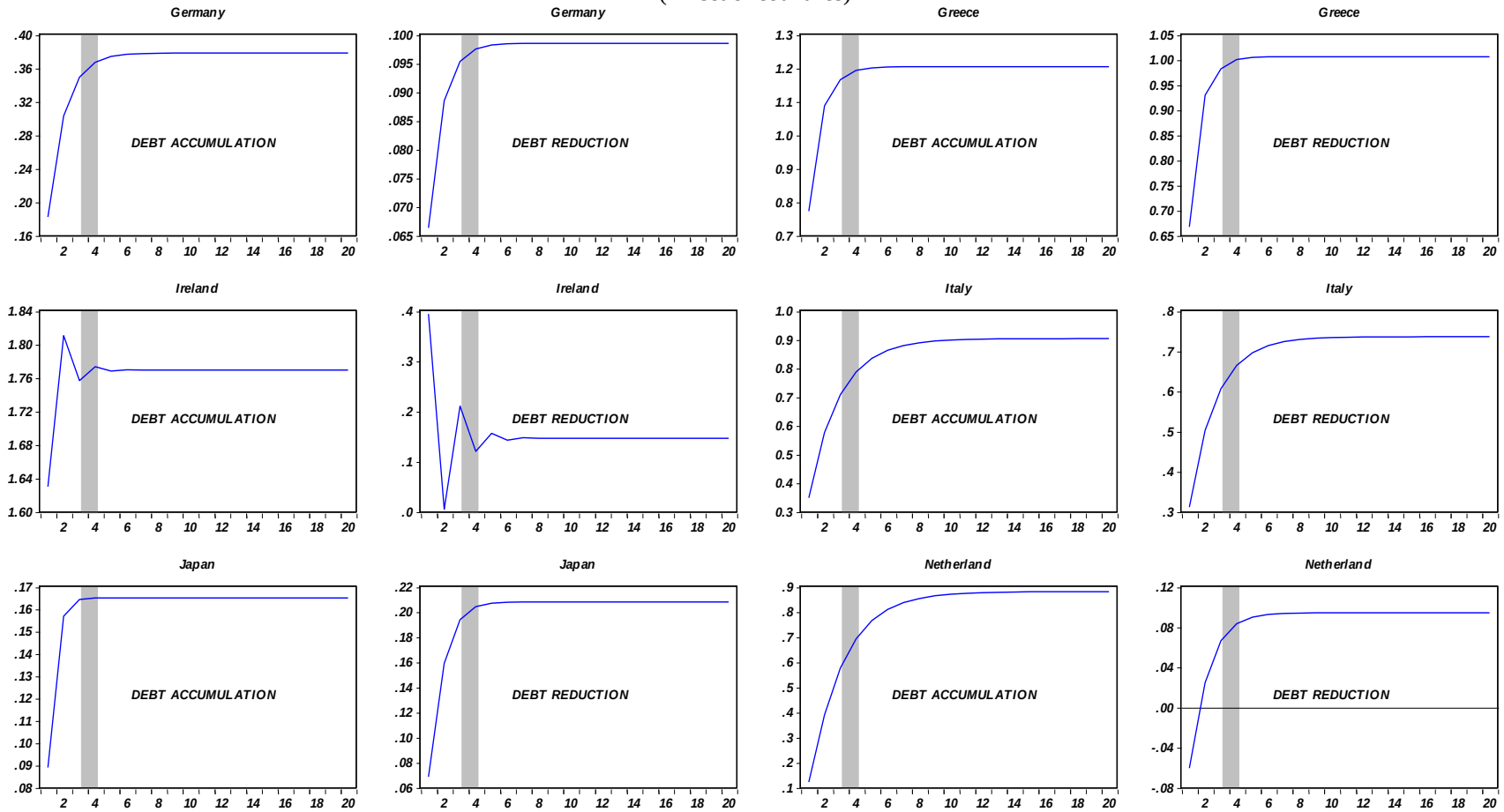
Note: Shaded area bar corresponds to the fourth quarter.

Figure 3.B.a: The effects of the debt ratio movments (accumulation versus contraction) on GDP responses to government expenditure dynamic structural shock (1st set of countries)



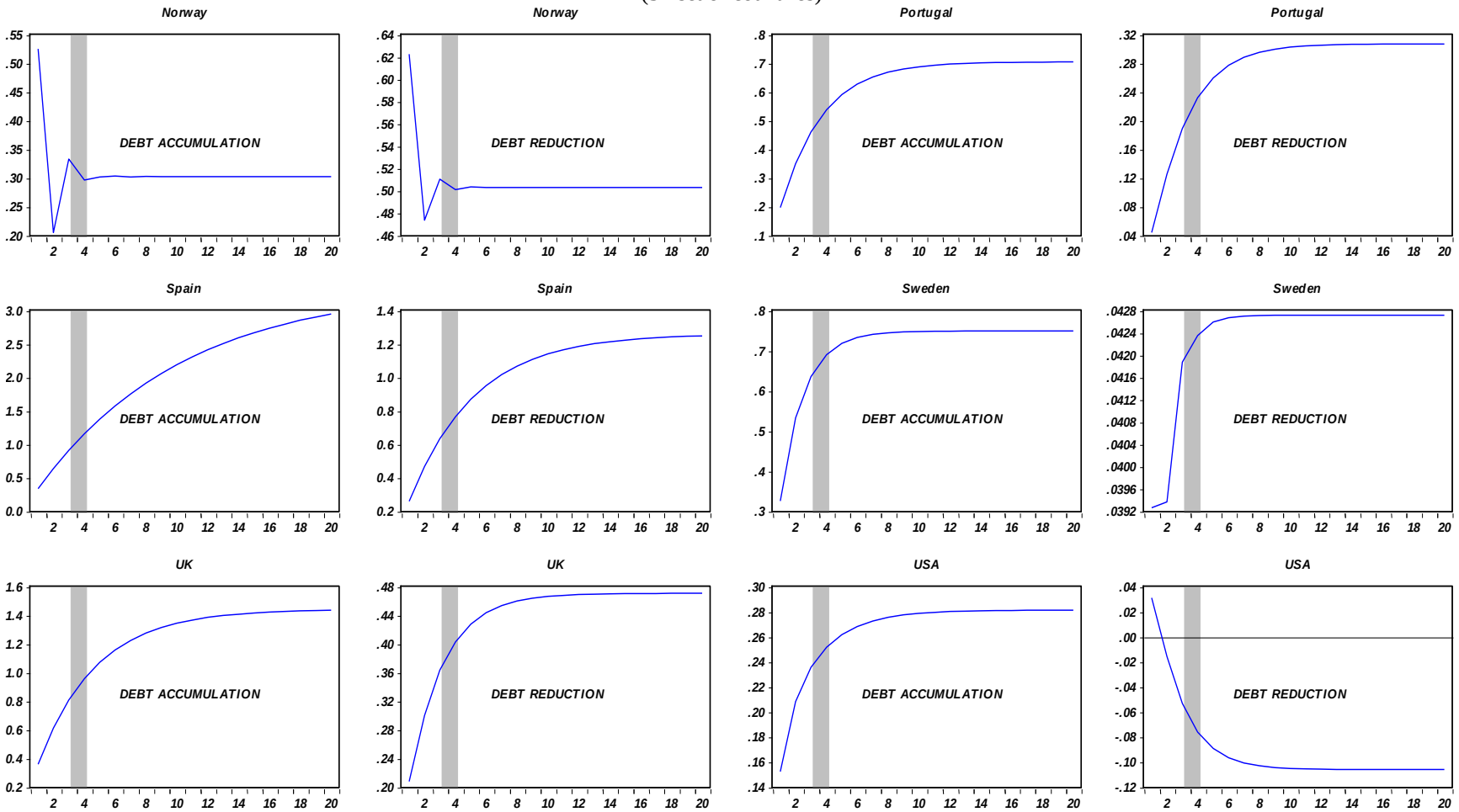
Note: Shaded area bar corresponds to the fourth quarter.

Figure 3.B.b: The effects of the debt ratio movments (accumulation versus contraction) on GDP responses to government expenditure dynamic structural shock (2^{nd} set of countries)



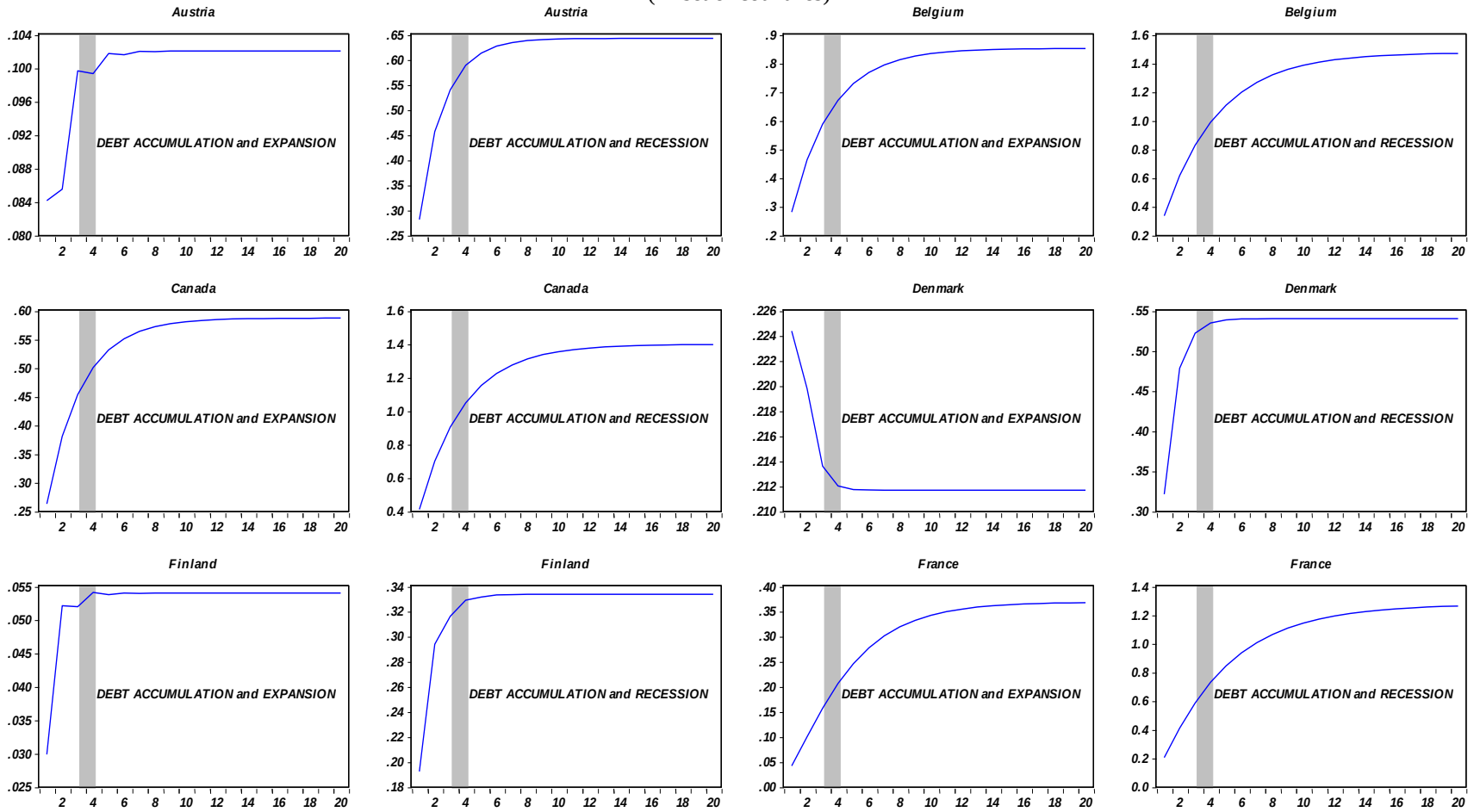
Note: Shaded area bar corresponds to the fourth quarter.

Figure 3.B.c: The effects of the debt ratio movments (accumulation versus contraction) on GDP responses to government expenditure dynamic structural shock (3rd set of countries)



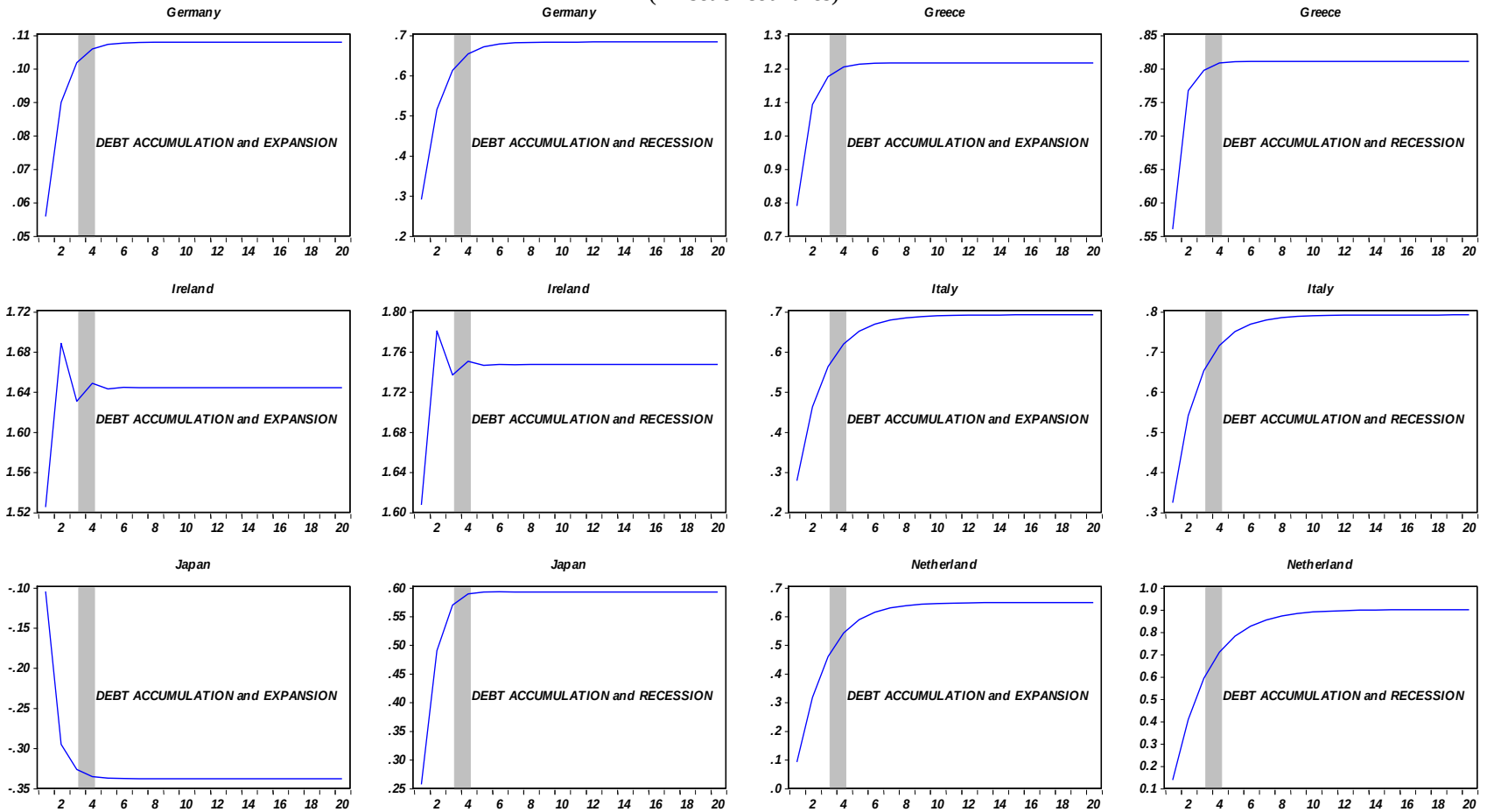
Note: Shaded area bar corresponds to the fourth quarter.

Figure 4.B.a: The effects of the debt ratio accumulation and the business cycle on GDP responses to government expenditure dynamic structural shock (1st set of countries)



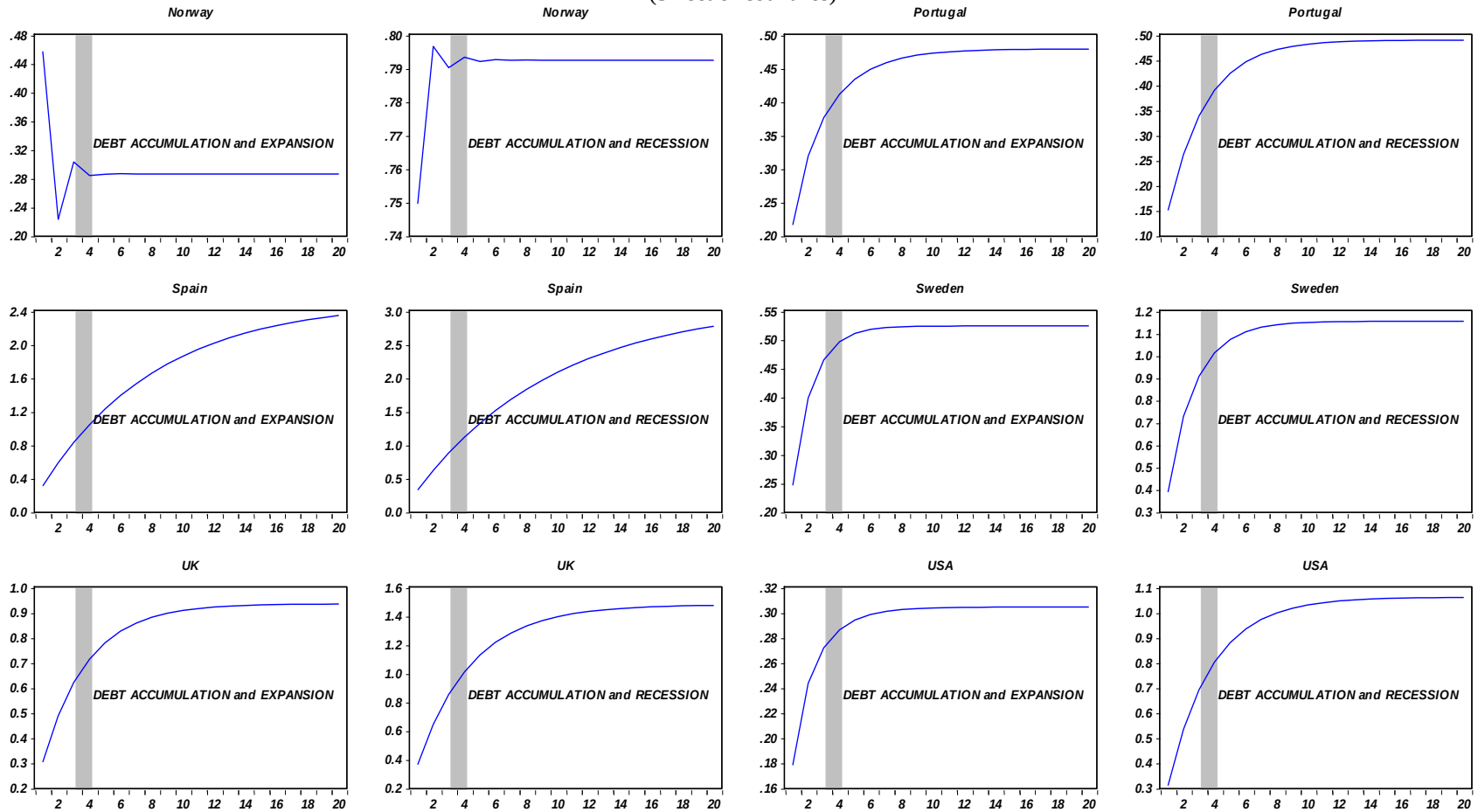
Note: Shaded area bar corresponds to the fourth quarter.

Figure 4.B.b: The effects of the debt ratio accumulation and the business cycle on GDP responses to government expenditure dynamic structural shock (2^{nd} set of countries)



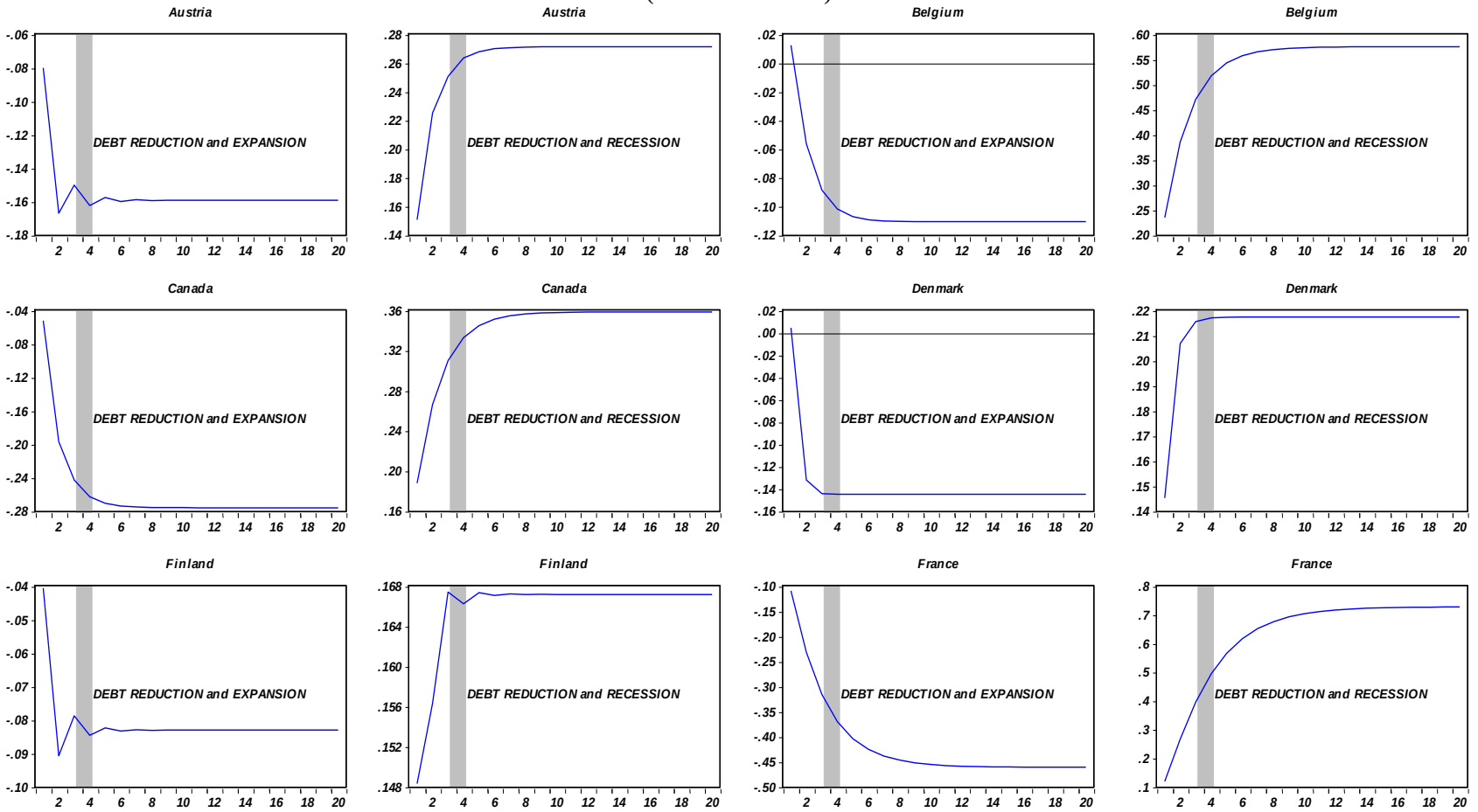
Note: Shaded area bar corresponds to the fourth quarter.

Figure 4.B.c: The effects of the debt ratio accumulation and the business cycle on GDP responses to government expenditure dynamic structural shock (3rd set of countries)



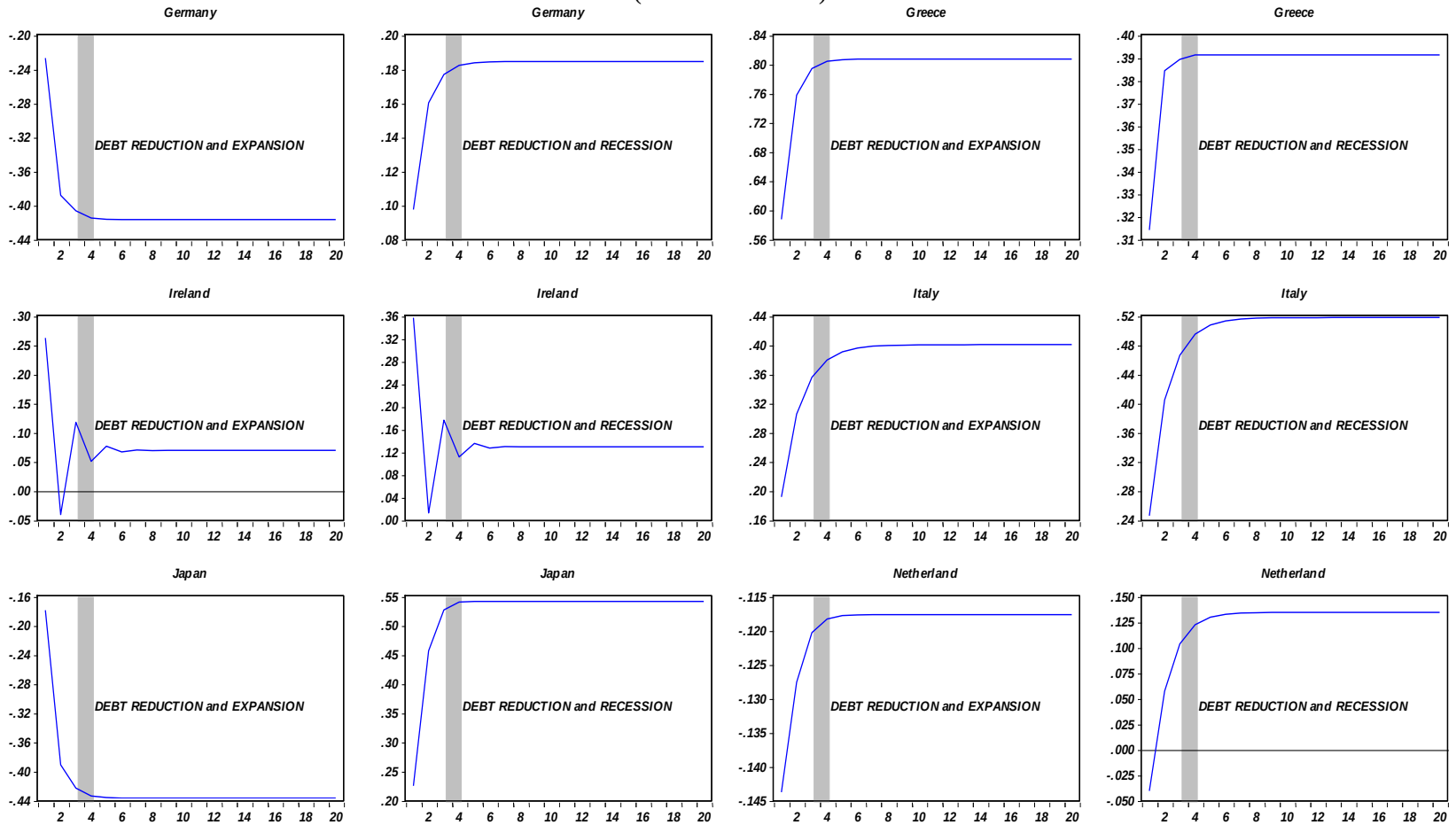
Note: Shaded area bar corresponds to the fourth quarter.

Figure 5.B.a: The effects of the debt ratio reduction and the business cycle on GDP responses to government expenditure dynamic structural shock (1st set of countries)



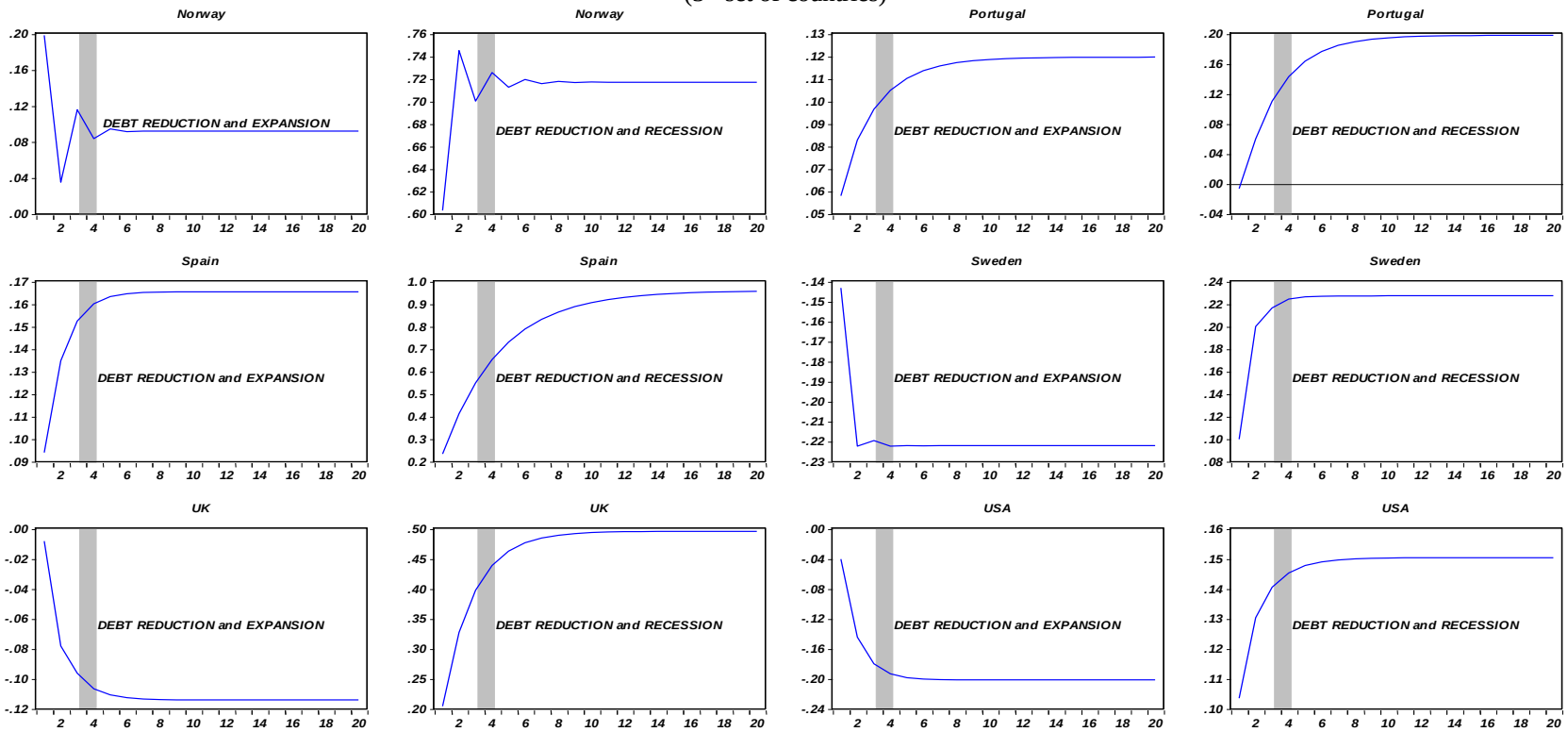
Note: Shaded area bar corresponds to the fourth quarter.

Figure 5.B.b: The effects of the debt ratio reduction and the business cycle on GDP responses to government expenditure dynamic structural shock (2nd set of countries)



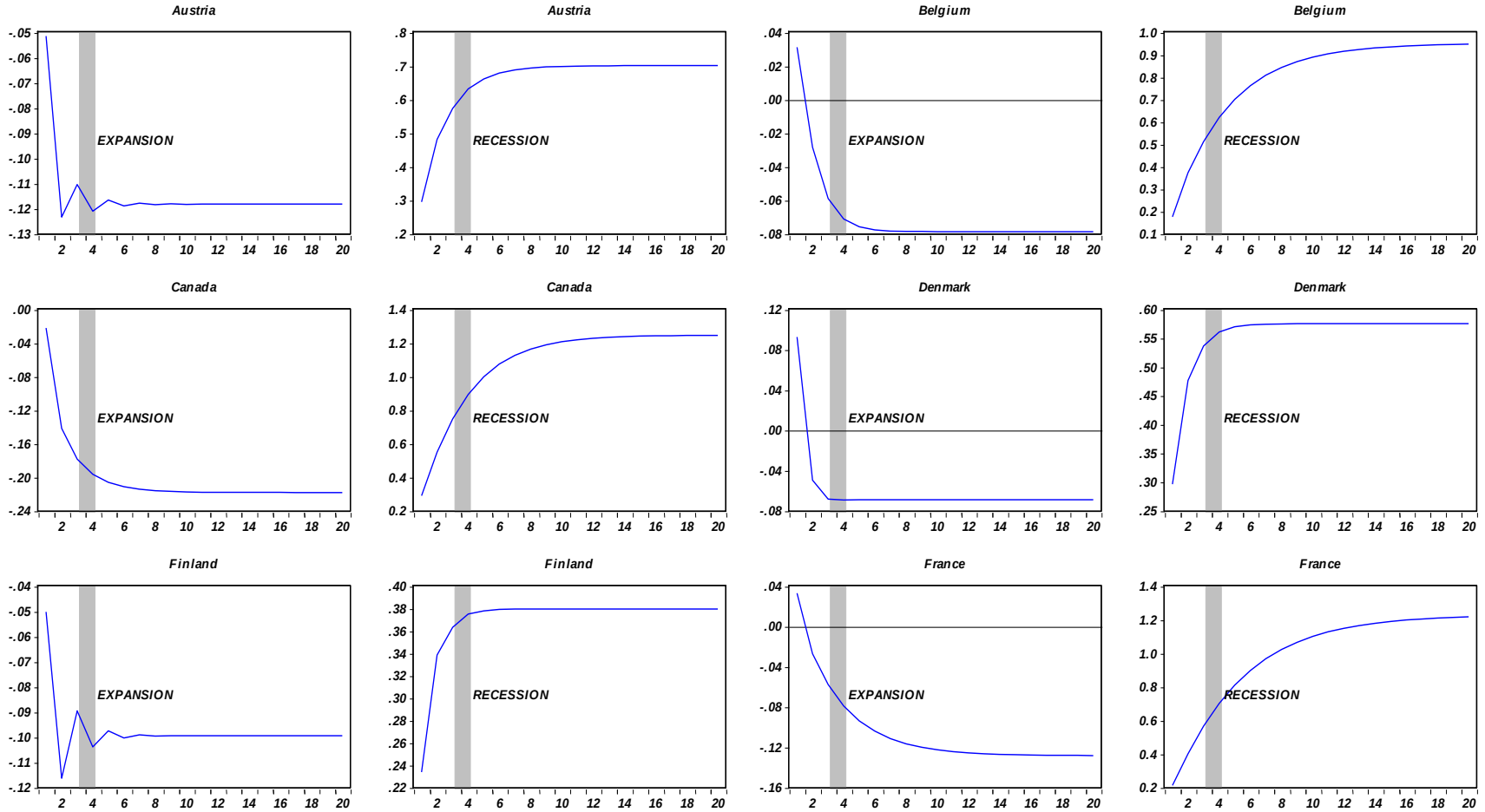
Note: Shaded area bar corresponds to the fourth quarter.

Figure 5.B.c: The effects of the debt ratio reduction and the business cycle on GDP responses to government expenditure dynamic structural shock (3rd set of countries)



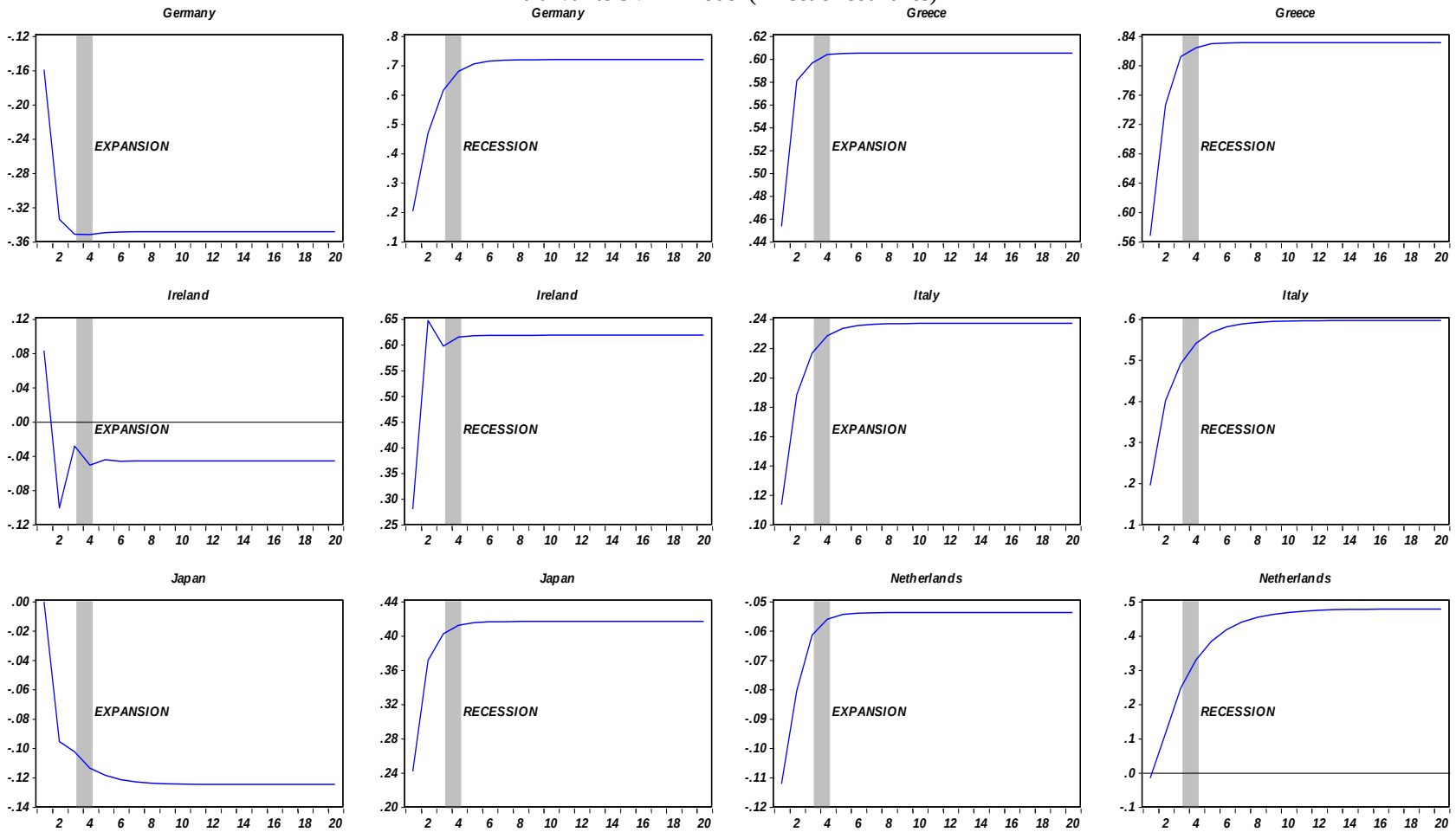
Note: Shaded area bar corresponds to the fourth quarter.

Figure 6.B.a: The endogenous effects of the public debt ratio and the business cycle on GDP responses to government expenditure dynamic structural shock from a trivarite SVAR model (1st set of countries)



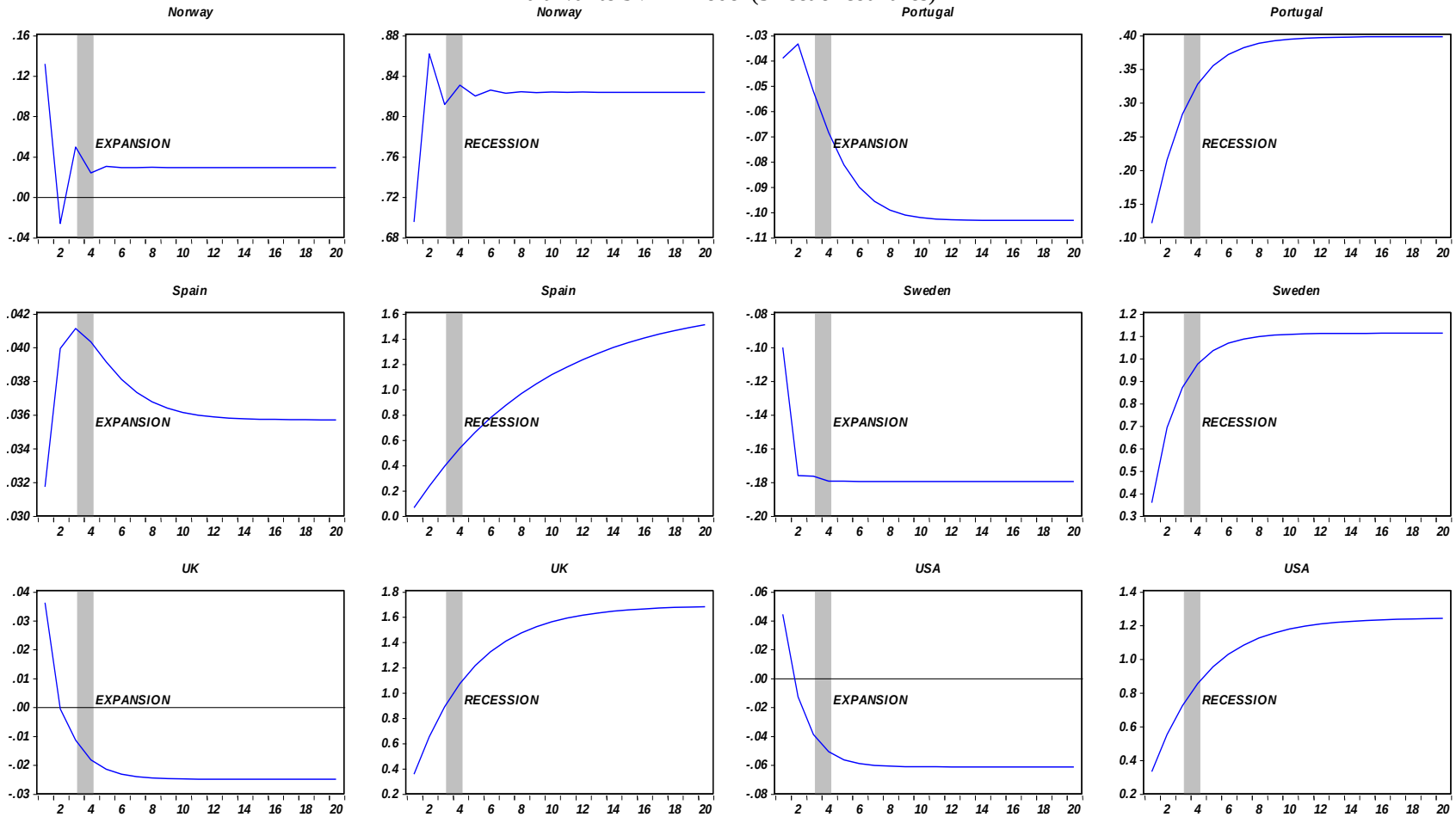
Note: Shaded area bar corresponds to the fourth quarter.

Figure 6.B.b: The endogenous effects of the public debt ratio and the business cycle on GDP responses to government expenditure dynamic structural shock from a trivarite SVAR model (2nd set of countries)



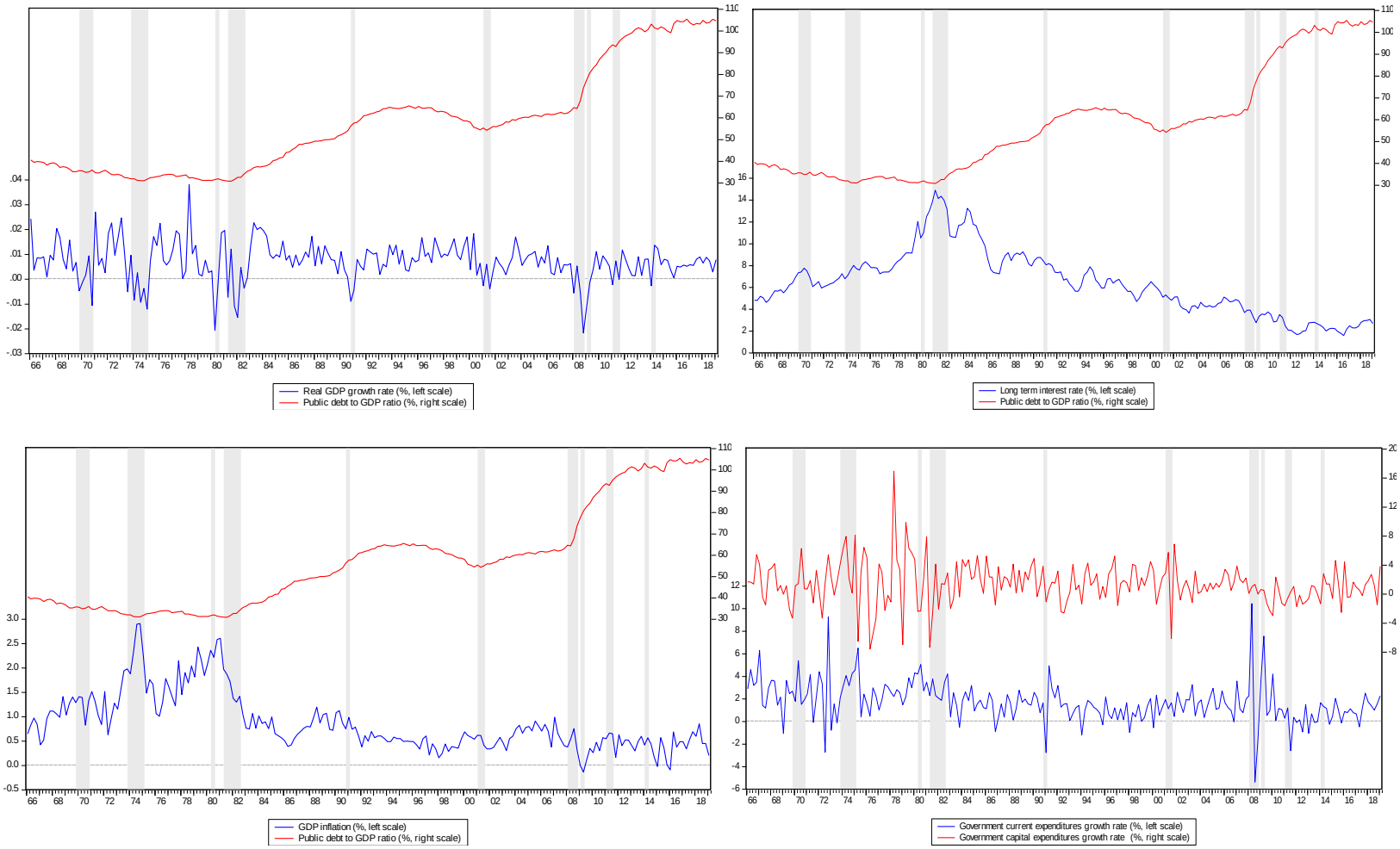
Note: Shaded area bar corresponds to the fourth quarter.

Figure 6.B.c: The endogenous effects of the public debt ratio and the business cycle on GDP responses to government expenditure dynamic structural shock from a trivarite SVAR model (3rd set of countries)



Note: Shaded area bar corresponds to the fourth quarter.

Figure 7. Evolution of some SVAR variables vis-à-vis public debt for the United States



Note: The shaded area corresponds to recession periods (two consecutive negative quarterly economic growth).
Source: Author's own construction.

Figure 8.B.a. Impulse response functions in time of economic expansion

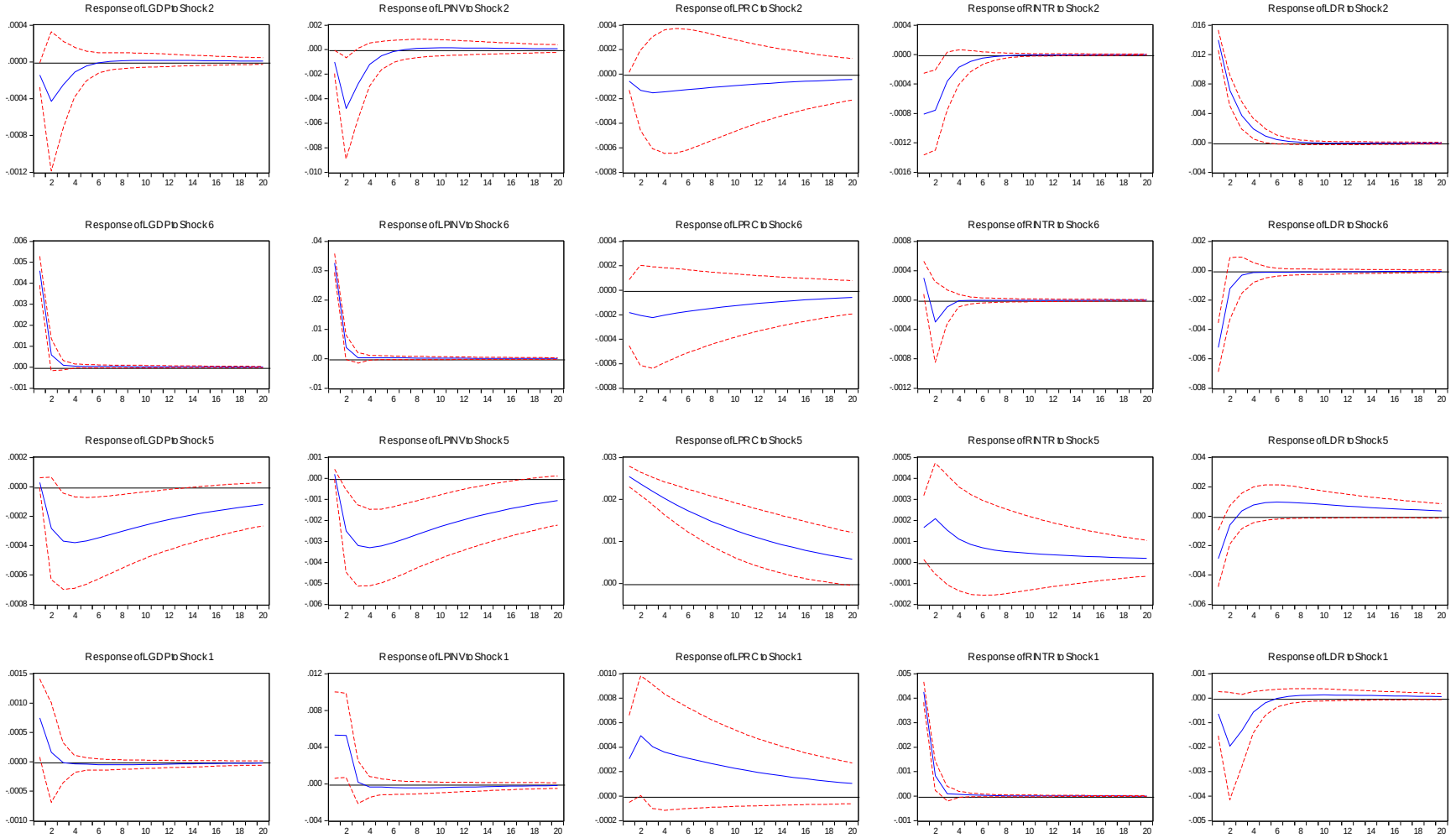


Figure 8.B.b. Impulse response functions in time of economic recession

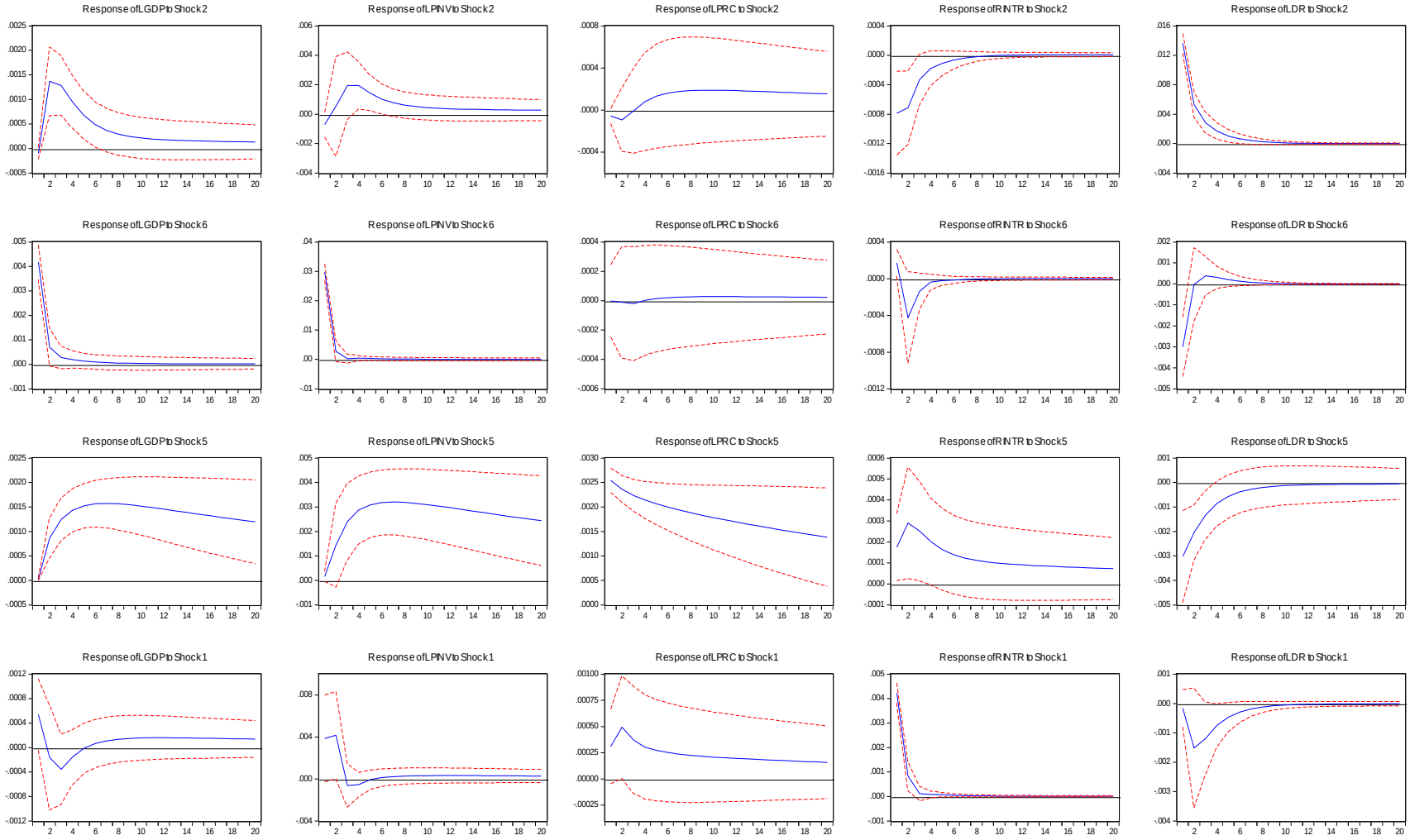


Figure 8.B.c. Impulse response functions in time of debt accumulation

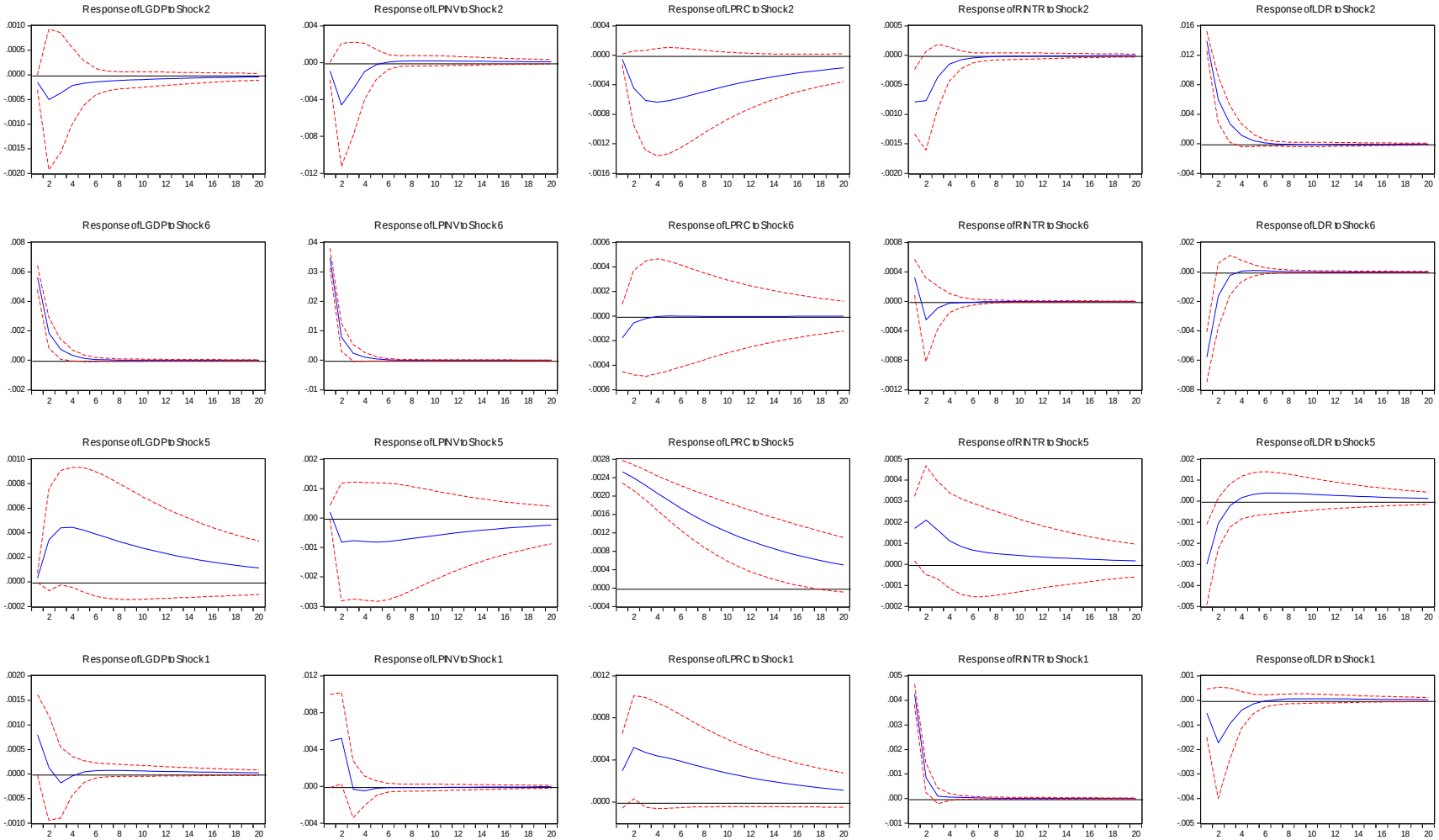


Figure 8.B.d. Impulse response functions in time of debt reduction

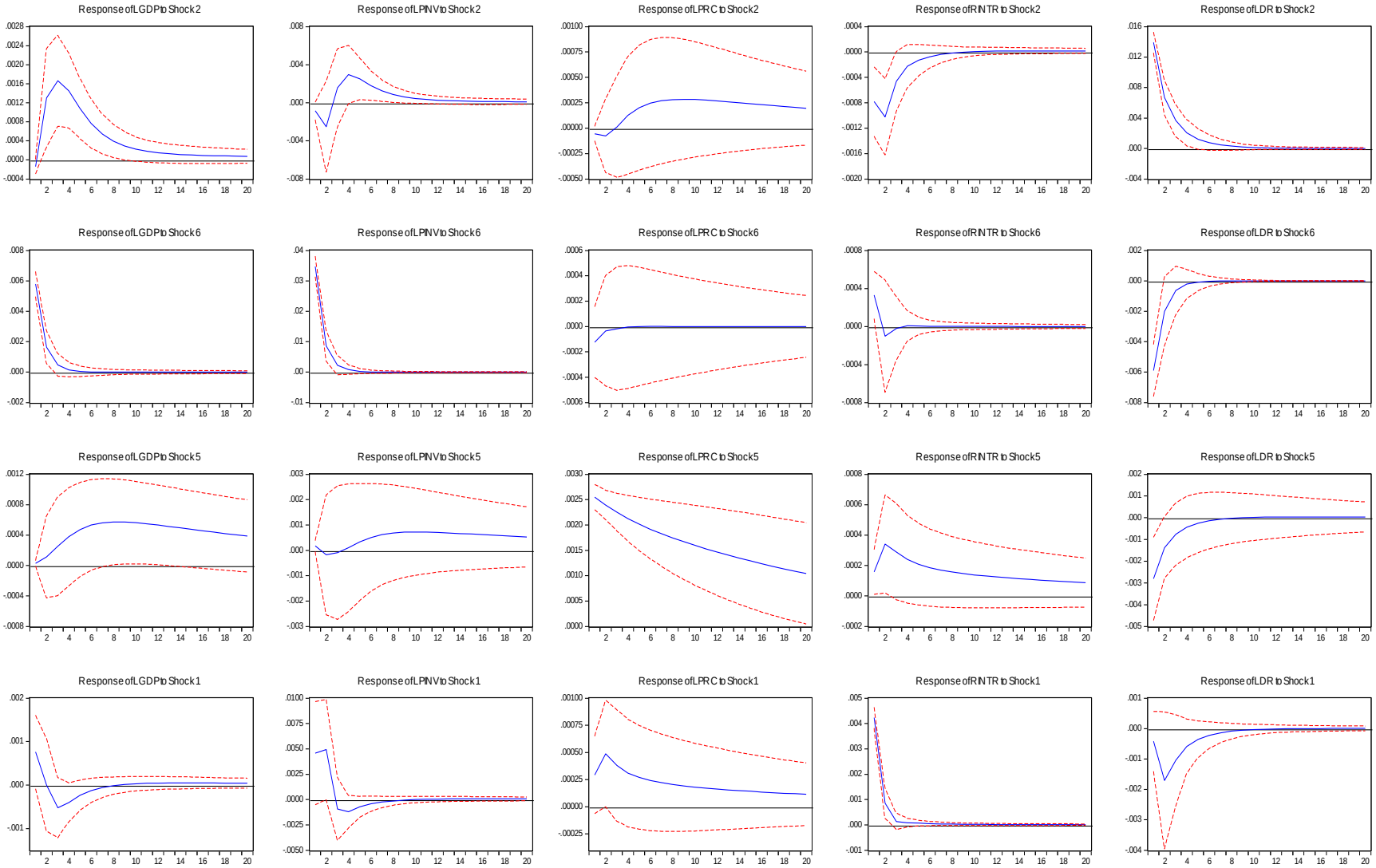


Figure 8.B.e. Impulse response functions in time of debt reduction and expansion

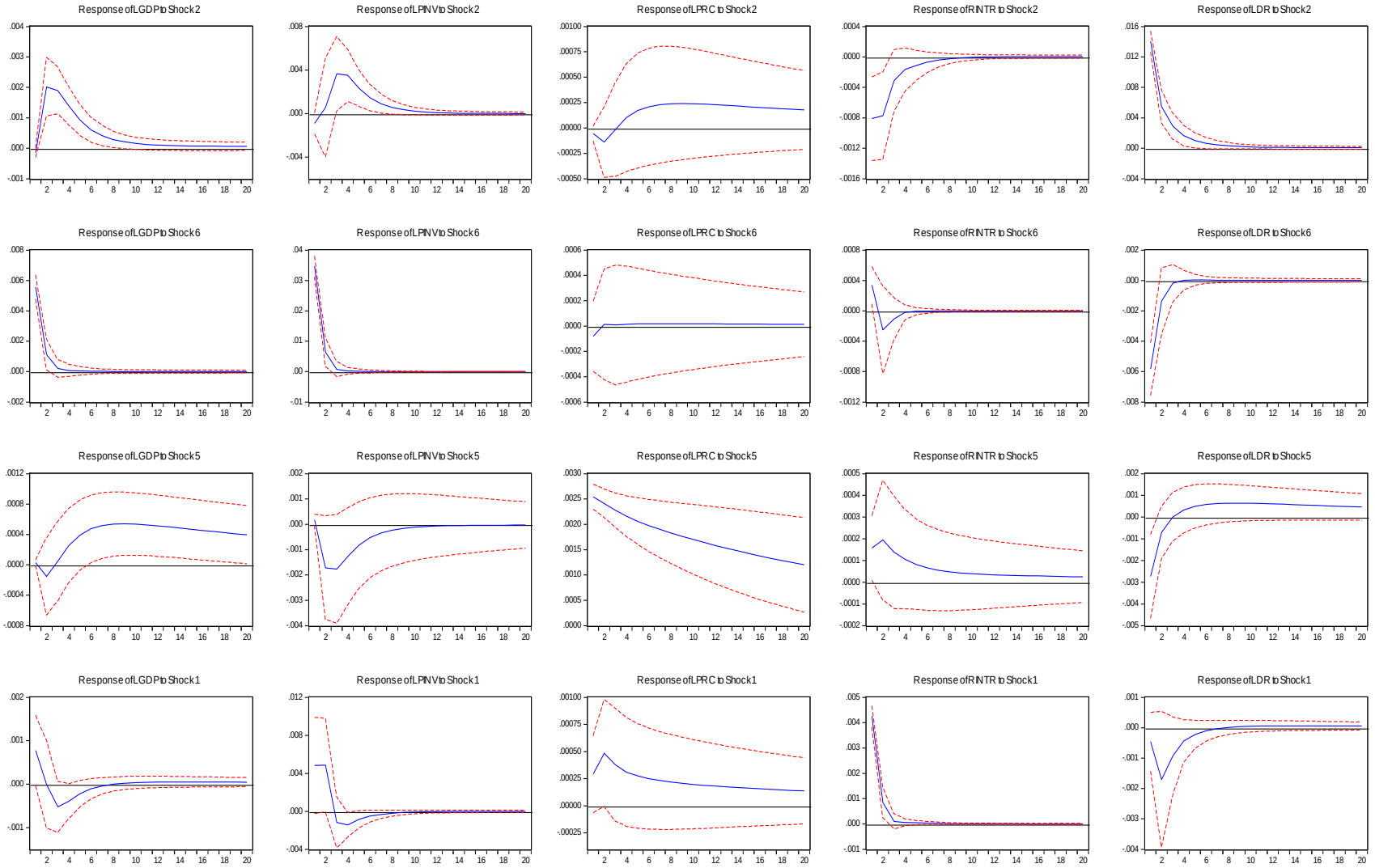


Figure 8.B.f. Impulse response functions in time of debt reduction and recession

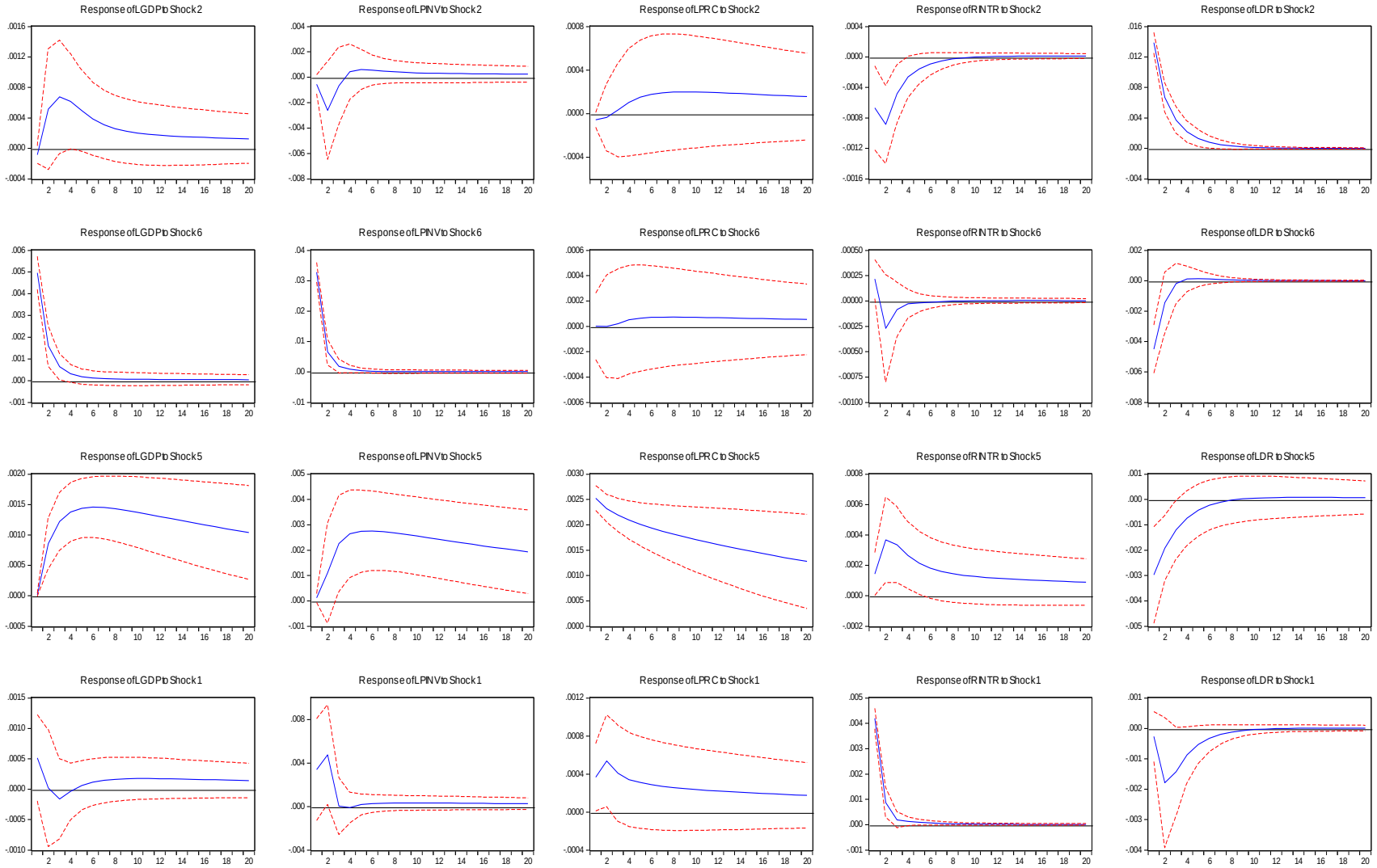


Figure 8.B.g. Impulse response functions in time of debt accumulation and expansion

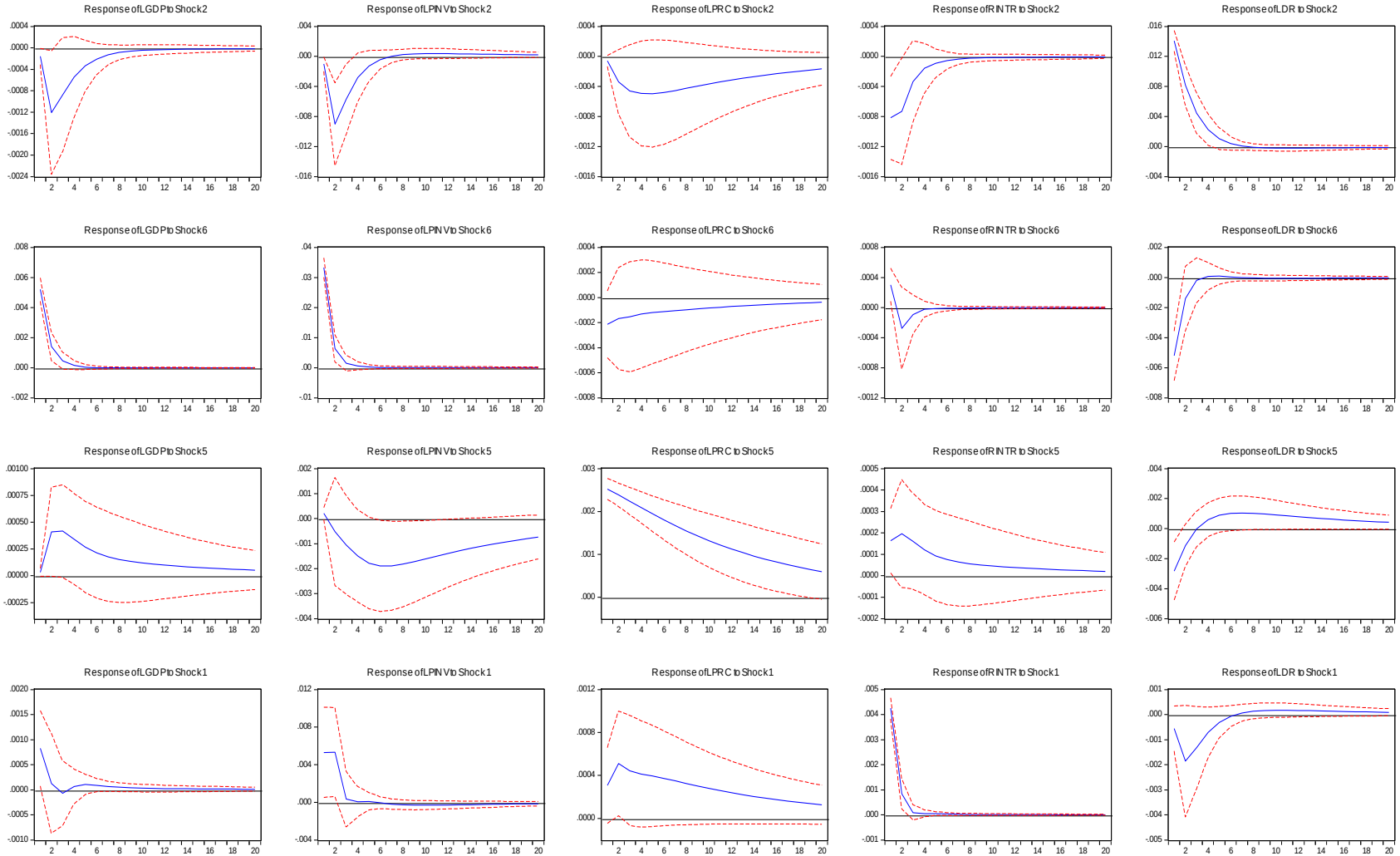


Figure 8.B.h. Impulse response functions in time of debt accumulation and recession