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Spillover effects of debt and growth in the euro area: Evidence from a GVAR model

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ABSTRACT

This paper employs a global vector autoregression model to analyze two-way spillover effects of public debt and growth between Germany as the largest economy of the euro zone and its core and periphery groups of countries. Using quarterly data over the period 1991Q1-2014Q4, we find that positive growth shocks originating in any of the three entities spill over into higher growth rates in the other regions of the euro area, and also reduce debt levels at least transitorily in all regions. In contrast, debt shocks exert no significant impact on the growth dynamics across the euro zone, but spill over to the debt levels of the other regions through increases in real interest rates, particularly for shocks emanating from the euro area core and periphery.

1. Introduction

Rising public debt levels in the aftermath of the Great Recession and the recent debt crisis in the euro zone have renewed interest in investigating the causal relationship between government debt and economic growth. In an influential study, Reinhart and Rogoff (2010) focus on the correlation between debt and growth for a large sample of countries, finding no effect at low debt levels, but a significant negative impact of debt on growth for countries with high debt-to-GDP ratios. A subsequent literature using standard growth equations to investigate potential nonlinear effects of debt on growth for different country samples has come up with conflicting results as to the existence or size of any such threshold values (see, e.g., Checherita-Westphal and Rother (2012), Herndon, Ash, and Pollin (2014), Pescatori, Sandri, and John (2014), Eberhardt and Presbitero (2015)). Rather than focusing on the unidirectional causality of debt on growth, a different strand of recent literature analyzes the potential of two-way causality between debt and growth on the basis of vector-autoregressive models, which have the advantage of allowing debt and GDP to be simultaneously treated as endogenous variables (Lof and Malinen (2014), Puente-Ajovín and Sanso-Navarro (2015), and Kempa and Khan (2016)). In this literature, hardly any affirmation of the notion that debt causes growth is found, although there is strong evidence of a reverse and negative causality of growth on debt.

One drawback of the literature cited above is the exclusive focus on analyzing the debt-growth nexus within individual countries or country groups without considering potential spillover effects between them. This omission appears to be particularly striking in an increasingly globalized world economy, with countries being more interdependent today than ever before. In fact, a debt or growth shock in one country may have repercussions on the debt and growth dynamics of other countries. Such international transmission effects are likely to be of particular relevance for shocks originating in large countries or in countries with strong trade and financial linkages, such as within the common market of the EU or the currency union of the euro zone.

This paper analyzes two-way spillover effects of public debt and growth in the euro zone. To this end we employ the global vector

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autoregression (GVAR) model pioneered by Pesaran, Schuermann, and Weiner (2004). The GVAR model augments individual country VAR or vector error correction (VECM) models by the corresponding foreign variables, and then combines the individual country models to construct a global model which can be used to analyze national interdependencies by means of impulse response analysis. While the GVAR model is ideally suited to study international shock transmission, it has not yet been widely applied to investigate the debt-growth nexus.

A number of studies use the GVAR methodology to trace the transmission of fiscal policy measures across European countries. These include Hebous and Zimmermann (2013) and Ricci-Risquete and Ramajo-Hernandez (2015) who estimate spillover effects of a fiscal shock in one country on outputs of other countries within the euro zone and EU respectively, and Caporale and Giradi (2013) who investigate the dynamic effects of fiscal imbalances in individual euro zone member states on the borrowing costs of other members of the euro area. However, none of these papers considers the debt-growth nexus directly. In fact, the only paper we are aware of using a GVAR model in this context is Konstantakis and Michaelides (2014). They study the transmission of growth and debt between the US and an aggregate of 15 European Union (EU15) countries. Their results turn out to be mostly insignificant, with the exception of a US debt shock which causes a short-run increase in the debt level of the EU15.

Rather than using US and EU15 aggregate data, we study the transmission of debt and growth shocks between Germany as the largest economy of the euro zone and its core and periphery groups of countries. Apart from evaluating the claim that a growth impulse in Germany raises the growth prospects and lowers debt levels in the euro zone periphery, we can also ascertain whether and how the recent debt crisis in the southern periphery has affected the economic performance of Germany and the other euro zone core countries. Using quarterly data over the period 1991Q1-2014Q4, we find that positive growth shocks originating in any of the three entities spill over to the other regions of the euro area, and also lower debt levels at least transitorily in all regions, albeit not always significantly so. In contrast, debt shocks exert no significant impact on the growth dynamics across the euro zone, but spill over to the debt levels of the other regions through increases in real interest rates, particularly for shocks emanating from the euro area core and periphery.

The remainder of the paper is structured as follows: Section 2 describes the GVAR model, Section 3 introduces the data and reports on some of their statistical properties which need to be satisfied as a prerequisite to apply the GVAR methodology, Section 4 discusses the results by means of impulse response analysis, and Section 5 concludes.

2. The GVAR model

The GVAR methodology constitutes a simple yet rigorous way to analyze interdependencies across economies or regions in a multi-country setting. The GVAR model is implemented in two steps. In a first step separate VAR or VECM models are estimated for each individual country or region. These models are augmented by appropriately weighted averages of corresponding weakly exogenous foreign variables, and are referred to as VARX models. In a second step the individual VARX models are combined in a consistent manner by means of a link matrix to build and simultaneously solve the global model.

Let $N + 1$ be the number of countries or regions in the model indexed by $i = 0, 1, 2,.. N$, with $i = 0$ as the reference country and $t = 1, .., T$ denoting time. The individual country or regional VARX (q_i, q_i^*) models are given by:

$$\boldsymbol{x}_{i,t} = \boldsymbol{a}_{i,0} + \boldsymbol{a}_{i,1}t + \sum_{m=1}^{q_i} \boldsymbol{\phi}_{i,m}\boldsymbol{x}_{i,t-m} + \sum_{n=0}^{q_i^*} \boldsymbol{\Lambda}_{i,n}\boldsymbol{x}^*_{i,t-n} + \boldsymbol{u}_{i,t}, \tag{1}$$

with $\boldsymbol{x}_{i,t}$ a $k_i^* \times 1$ vector of region-i endogenous domestic variables and $\boldsymbol{x}^*_{i,t}$ a $k_i^* \times 1$ vector of the corresponding weakly exogenous foreign variables, where $\boldsymbol{\phi}_i$ and $\boldsymbol{\Lambda}_i$ are $k_i \times k_i$ and $k_i \times k_i^*$ coefficient matrices associated with the domestic and foreign variables respectively. Moreover, $\boldsymbol{a}_{i,0}$ is a $k_i \times 1$ vector of fixed intercepts, $\boldsymbol{a}_{i,1}$ is a $k_i \times 1$ vector on the deterministic time trends, and $\boldsymbol{u}_i$ is a $k_i \times 1$ vector of region-specific shocks, where $\boldsymbol{u}_i \sim N(0, \sum_{ii})$, and $\sum_{ii}$ is a non-singular covariance matrix. Region-specific shocks are assumed to be serially uncorrelated, but cross-regional correlations between entities i and j among the idiosyncratic shocks are allowed for, so that $E(\boldsymbol{u}_{i,t}, \boldsymbol{u}'_{j,s}) = \sum_{ij}$ for $t = s$, and $E(\boldsymbol{u}_{i,t}, \boldsymbol{u}'_{j,s}) = \boldsymbol{0}$ for $t \neq s$.

The vector of foreign region-specific variables, $\boldsymbol{x}^*_{i,t}$, is obtained from weighted averages of each variable across all other countries of the sample. More specifically, for any $i, j = 0, 1 ,., N$,

$$\boldsymbol{x}^*_{i,t} = \sum_{j=0}^{N} w_{i,j}\boldsymbol{x}_{j,t}, \tag{2}$$

where $w_{i,j}$ is a weighting factor that captures the importance of region j for region i, with $\sum_{j=0}^{N} w_{i,j} = 1$ and $w_{i,i} = 0$. We follow standard practice by using as weights the fixed trade shares between countries.

Setting $p_i = max(q_i, q_i^*)$, the model of Eq. (1) can be rewritten as

$$\boldsymbol{A}_{i,0}z_{i,t} = \boldsymbol{a}_{i,0} + \boldsymbol{a}_{i,1}t + \sum_{m=1}^{p_i} \boldsymbol{A}_{i,m}z_{i,t-m} + \boldsymbol{u}_{i,t}, \tag{3}$$

where the $(k_i + k_i^*) \times 1$ vector $z_{i,t} = (\boldsymbol{x}_{i,t}', \boldsymbol{x}^{*\prime}_{i,t})'$ contains both the domestic and foreign variables, and where the $k_i \times (k_i + k_i^*)$ coefficient matrices are given by $\boldsymbol{A}_{i,0} = (\boldsymbol{I}_{k_i}, -\boldsymbol{\Lambda}_{i,0})$ and $\boldsymbol{A}_{i,m} = (\boldsymbol{\phi}_{i,m}, \boldsymbol{\Lambda}_{i,m})$ for $m = 1, \dots, p_i$.

In order to allow for co-integrating relationships within and between regions, the individual-region VARX models of Eq. (1) can also be estimated in error-correction form: