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Transmission of sectoral debt shocks in OECD countries: Evidence from the income channel

Georgios Magkonis, Portsmouth Business School

Anastasia Theofilakou, Department of Economics and DG for Economic Policy, Hellenic Ministry of Finance, Greece

Portsmouth Business School
http://www.port.ac.uk/portsmouth-business-school/

Transmission of sectoral debt shocks in OECD countries: Evidence from the income channel

Georgios Magkonis* and Anastasia Theofilakou†

Abstract

We examine the propagation of debt shocks across sectors of the economy for OECD countries. Our focus lies on assessing the importance of the income channel as a main transmission mechanism of such shocks. Employing a Bayesian Panel VAR, we find strong debt contagion effects across sectors, which work through the income channel. Higher non-financial corporate debt drives down household incomes, increasing pressures for household deleveraging. By contrast, an increase in household debt boosts real incomes and domestic demand, and results in higher corporate leverage. Finally, we find that growth effects of sectoral debt shocks are conditional on country idiosyncrasies.

Keywords: Sectoral debt · macroeconomic shocks · panel BVAR

JEL Classification: H30 · E60 · C11

*Corresponding Author. Portsmouth Business School, University of Portsmouth, (Email: georgios.magkonis@port.ac.uk).

†University of Athens, Department of Economics, and DG for Economic Policy, Hellenic Ministry of Finance, Greece, (Email: a.theofilakou@minfin.gr).

1. Introduction

The 2008 financial crisis intensified the existing debt imbalances in many advanced economies and raised concerns over the debt linkages across sectors of the economy and the risks for macroeconomic stability. Private sector debt soared in many countries while the sovereign debt crisis in Europe weighed further on private sector balance sheets and economic growth.

This paper examines the transmission of debt shocks across sectors of the economy and the implications for growth for a panel of 19 OECD countries. Our focus lies on assessing the importance of the income channel as a main propagation mechanism of such shocks. The latter operates through the effects of debt shocks on disposable incomes and agents' spending decisions. Income effects are captured by fluctuations in real disposable incomes of households. We employ a structural Bayesian Panel Vector Autoregressive (PVAR) framework that accounts for potential small sample estimation bias, exploits the advantages of the panel-data structure and models dynamic feedback loops treating all variables in the system as endogenous.

The propagation mechanisms of sectoral debt shocks have not been fully explored in the literature. The "savings or income channel" could be an important transmission mechanism of debt shocks across sectors of the economy, with notable implications for economic growth (Bricogne and Mordonu, 2017; Occhino, 2010). Following an increase in leverage, non-financial corporates can decide to increase corporate savings via lower spending on recruitment and/or cuts in the wage bill.[1] This should drive down households' disposable income through either lower wages or increased unemployment, and affect household consumption and investment decisions as well as the level of household indebtedness. At the same time, changes in disposable incomes following a household debt shock would signal changes in future demand for corporates. The latter could have an impact on corporate profitability and therefore, on corporate leverage. Shifts in disposable incomes following private debt shocks would also affect public finances and government borrowing.

This paper contributes to the small but growing empirical literature on cross-sectoral

[1]The phrasings "debt" and "leverage" are used interchangeably to signal increased balance sheet liabilities, as these are defined in the Appendix.

debt linkages. Most studies have placed emphasis on the investment channel as a main transmission mechanism of the impacts of a build-up in non-financial corporate debt on economic growth and sectoral balance sheets (see, for instance, Kalemli-Özcan et al., 2016; Occhino and Pescatori, 2010; Ruscher and Wolff, 2012). The latter suggests that firms will adjust investment in response to adverse corporate debt shocks or a high debt overhang. This should dampen economic growth and weigh on balance sheets in other sectors of the economy. On the other hand, the empirical studies focusing on the income channel are scarce (e.g. Bricogne and Mordonu, 2017). To the best of our knowledge, our study is the first one to explicitly address the dynamic spillovers of debt shocks among sectors by focusing on the operation of the income channel.

Our paper also contributes to the empirical literature strand on the growth effects of sectoral debt (see, among others, Bornhorst and Ruiz-Arranz, 2013; ECB, 2014; European Commission, 2014; Panizza and Presbitero 2014). For instance, Cuerpo et al. (2013) examine the effects on growth of a joint debt shock in the household and corporate sector. This approach, however, masks the impact of individual sectoral debt shocks on economic activity. Most importantly, it cannot disentangle to what extent the impact on growth is enlarged via debt contagion effects across sectors. Cecchetti et al. (2011) confirm the existence of threshold effects of household, government and corporate debt on economic growth. However, the reported thresholds result from estimating average effects based on growth regressions.

Also, a large strand of the literature has focused on the growth effects of public debt (see, e.g., Baum et al., 2013; Checherita-Westphal and Rother, 2012; Reinhart and Rogoff, 2010).[2] Our paper, though, explicitly takes on board indebtedness in the household, corporate and government sector. This is of high relevance since a debt shock incurred in one sector of the economy can affect balance sheet vulnerabilities in the other sectors, impinging macroeconomic stability.

Finally, this paper contributes to the literature that examines the debt-growth relationship in a Structural VAR context (for a survey, see, Caldara and Kamps, 2008). Marcellino (2006) examines the response of the output gap to fiscal shocks adding public debt into the

[2]For a detailed survey on debt and economic growth, see Panizza and Presbitero (2013).

VAR modelling. He finds that public debt does not contribute to the explanation of output gap dynamics for Germany, France, Italy and Spain. References on the debt-growth nexus based on a panel VAR context are scarce. For instance, in a bivariate panel VAR, Lof and Malinen (2014) find no statistically significant long run effect of public debt on growth and a negative response of debt to a growth shock. They infer that the negative correlation between growth and debt is driven by growth.

Our findings lend support to the presence of strong debt contagion effects across sectors of the economy, notably in the private sector, that work through the income channel. Higher non-financial corporate debt drives down household incomes due to higher corporate savings and increases pressures for households' balance sheet repair; as a result, household debt declines. Increases in household debt, on the other hand, boost real incomes and domestic demand, and result in higher corporate leverage. Positive shocks in household and corporate debt yield varying effects on government indebtedness, depending on disposable income fluctuations following the debt shock. Finally, the effects of sectoral debt shocks on economic activity vary and are conditional on country idiosyncrasies.

The rest of the paper is structured as follows. Section 2 briefly reviews the related literature. Section 3 outlines the data, the empirical framework and the identification methodology. Section 4 presents the benchmark empirical estimates. Various robustness checks are discussed in Section 5. Section 6 summarises the main findings and concludes.

2. Related Literature

Standard inter-temporal models of consumption and investment decisions of households and corporations could help interpret cross-sectoral debt linkages. Specifically, the income channel has a prominent role for households' spending decisions. Kragh-Sørensen and Solheim (2014) suggest that an adverse income shock corresponding to a decline in households' disposable income could lead to lower consumption spending and housing investment. At the same time, a decline in households' disposable income reduces the funds available to repay

existing debt obligations but also the incentive to take on additional debt.[3] This would result in a higher household debt overhang intensifying pressures for household deleveraging and reducing further consumption spending. On the other hand, according to the permanent income theory, higher debt is associated with higher expected incomes and consumption smoothing effects (Hall, 1978; Modigliani, 1986). As household borrowing increases, the economy grows in the short-term, but it can become vulnerable to macroeconomic shocks due to increased leverage (IMF, 2017).

Moreover, shifts in leverage that signal lower expected domestic demand could weigh on corporate balance sheets and, in particular, on firms' ability to service their debt. Ruscher and Wolff (2012) find that a drop in demand can worsen expectations about firms' future profitability, making further increases in the stock of corporate debt more risky and their financing more difficult to obtain. This can intensify pressures for corporate balance sheet repair and result in depressed corporate investment and/or increased corporate savings. Several studies also find a negative relationship between firms' debt burden and their investment-to-capital ratio (e.g. Goretti and Souto, 2003). Occhino and Pescatori (2010) report that higher levels of outstanding corporate debt can have a dampening effect on corporate investment spending, mainly through affecting firms' benefit of investing. Equity holders have less incentives to undertake new investment projects, given that any increase in the firm's value will be used for repaying debt (Kalemli-Özcan et al., 2016). As a result, lower investment spending should have a negative effect on economic activity.

Firms' decision to increase corporate savings could also contribute to depressed consumption growth and lower economic activity. For instance, Occhino (2010) stresses that a high stock of corporate debt can induce firms to reduce spending on wages, leading to increased corporate savings. Cuts in the wage bill take the form of either lower wages and/or lower headcount employment, resulting in lower disposable income for households and increased pressure for household balance sheet repair.

Empirical studies that focus explicitly on debt linkages across sectors of the economy are

[3] Against the backdrop of increasing debt to smooth consumption, demographics and the distribution of income and debt can matter (Rajan, 2010; Kumhof et al., 2015) For instance, younger households that anticipate future income growth would borrow more against their future income (Blundell et al., 1994).

scarce.[4] In a recent study, Bricongne and Mordonu (2017) report important linkages between corporate and household leverage through the wage channel. Still, the effects of the wage channel are only implicitly captured by splitting the sample based on the wage share in the economy.

On the contrary, many studies have focused on the effects of sectoral debt on output growth, albeit empirical evidence is rather mixed. For the euro-area, Bornhorst and Ruiz-Arranz (2013) find that high corporate and household debt are associated with lower growth while, the negative impacts on growth are stronger as the number of indebted sectors in the economy increases. Government debt does not affect growth when controls for high corporate and household debt are excluded from the specification. Sutherland and Hoeller (2012) suggest that run-ups in household debt are linked to recessions (see, also, Hermansen and Röhn, 2017). Mian et al. (2013) find that large household debt build-ups are followed by deleveraging episodes and prolonged contractions in economic activity. Cecchetti et al. (2011) examine the presence of threshold effects of sectoral debt on growth and find that debt-to-GDP ratios above 85%-90% in the household, government and corporate sectors are related to a lower output growth rate. They do not identify on average a statistically significant effect of household debt on growth.

In a DSGE context, Cuerpo et al. (2013) simulate the growth effects of a combined household and corporate sector deleveraging shock in the euro area. The reduction of the private debt-to-GDP ratio triggers an output fall. Household deleveraging has a more detrimental impact on output than corporate deleveraging, but this is due to the hypothesis of a smaller contribution of the corporate sector in the joint deleveraging shock. Also, when the private sector deleverages, public indebtedness increases. Chen et al. (2015) focus on the macroeconomic impact of total private sector debt and find that a reduction in the private debt-to-GDP ratio is associated with an increase in annual growth. However, these studies do not explicitly account for the potential feedback loops of debt fluctuations across sectors

[4]The recent financial crisis has also underlined the importance of the financial sector leverage for macroeconomic stability. The empirical literature on the transmission channels between the financial and the real sector is vast. However, it mostly relies on the interaction of bank- and firm-level data with macroeconomic fundamentals, and thus, lies out of the scope of this study.

of the economy.

Finally, meticulous focus has been placed in the literature on the short- and long-run effects of sovereign debt on output growth. But neither theoretical nor empirical research has come to a conclusive answer.[5] According to Elmendorf and Mankiw (1999), the effects of debt on growth depend on the time horizon. In the short-run, debt has positive effects on income, aggregate demand and, consequently, on growth. However, in the long-run, Ricardian equivalence tends to become a binding constraint for agents and debt can dampen economic activity. Similarly, Cochrane (2011) emphasises that the adverse effects on growth from heightened uncertainty are triggered by higher debt. By contrast, DeLong and Summers (2012) suggest that expansionary fiscal policy and the accumulation of debt can have a positive impact on economies that find themselves close to a liquidity trap. Greiner (2013) shows that under the assumption of wage rigidities and persistent unemployment an increasing debt can positively contribute to economic growth.

Much of the empirical research confirms the existence of both positive and negative effects of sovereign debt on growth as proposed by theory. Reinhart and Rogoff (2010) analyse public debt and growth interactions for a large cross-section dataset by setting specific debt thresholds.[6] They find that debt ratios above 90% of GDP are related to a lower growth performance. Baum et al. (2013) find a lower debt ratio threshold, at around 67% of GDP and an upper one at 95%; for debt ratios below the lower threshold, a positive relation to growth exists, whilst, above the upper bound, a negative relation holds. On the contrary, Pescatori et al. (2014) find no support for debt-specific thresholds, while they emphasise the important inference issues caused by the endogeneity between growth and debt. Panizza and Presbitero (2014) focus solely on sovereign debt and do not find evidence that high public debt constrains output growth.

[5] Standard theoretical channels of the impact of public debt on economic growth refer to future distortions in taxation (Dotsey, 1994), increasing long-term interest rates (Gale and Orszag, 2003), higher inflation (Barro, 1995) and escalating volatility triggered by a currency crisis (Burnside et al., 2001).

[6] See also, Checherita and Rother (2010), Kumar and Woo (2010).

3. Empirical Model

3..1 Data and descriptive statistics

We investigate the transmission of debt shocks across sectors via the income channel for an annual balanced panel of 19 OECD countries from 1996 to 2014. An analytical description of the data definition and sources is provided in the Appendix. Debt series refer to the gross liabilities on a non-consolidated basis of households, non-financial corporations and the general government. Stylised evidence highlights the fact that sectoral debt in most OECD economies has increased substantially during the past decade. Table 1 outlines the decomposition of total economy balance sheet liabilities into the liabilities born by households, non-financial corporations and the general government by OECD country for the years 2000 and 2012, which is the peak year for debt in many countries. Accumulated liabilities in the three sectors of the economy differ across economies.

Table 1: Sectoral debt developments

	Household debt		Non-financial corporate debt		General Government debt	
	2000	2012	2000	2012	2000	2012
Austria	45	54	99	114	76	120
Belgium	40	57	145	191	130	134
Canada	62	96	124	142	114	119
Czechia	12	34	130	109	25	63
Denmark	95	142	106	140	73	72
Estonia	11	46	107	123	7	14
Finland	34	68	115	137	65	67
France	45	64	132	155	79	121
Germany	72	57	99	98	61	87
Greece	22	76	48	73	121	170
Hungary	9	35	96	141	64	99
Italy	35	58	96	126	127	141
Norway	58	88	170	180	36	40
Netherlands	98	128	166	145	67	87
Portugal	70	95	139	214	64	160
Spain	53	85	128	168	70	114
Sweden	48	84	186	185	79	58
UK	75	98	119	143	56	112
US	71	84	109	112	65	129

Notes: Figures refer to debt as a percentage of GDP. For a definition of debt in the respective sectors, see the Appendix.

During the reference period, both households and non-financial corporations' debt soared

in most countries (e.g. Finland, Denmark, Italy, Portugal, Spain).[7]

Also, the general government debt increased markedly, notably in southern European countries but also in large advanced economies (e.g. Greece, Portugal, France, UK, USA). On the opposite side, a set of OECD countries, such as Germany, Norway and Sweden have maintained broadly stable or even declining debt ratios in some sectors of the economy over the reference period. Therefore, country idiosyncrasies seem to play an important role for sectoral debt developments. Despite large hikes in sectoral debt, the deleveraging process progresses at a slow pace in most countries.

3..2 Methodology

We examine the transmission of debt shocks across sectors of the economy as well as the dynamic response of output growth to stochastic shocks in sectoral debt by employing a structural Bayesian Panel VAR (BVAR) modelling approach.[8] The advantage of this method is that it combines the standard VAR model where all variables in the system are endogenous with a panel data structure, eliminating the problem of low degrees of freedom. Furthermore, the use of Bayesian methods allows us to overcome the problems of over-parameterization and the lack of significant amount of data. In this study, we employ two different modelling strategies; a pooled-BVAR model and a version that allows country heterogeneities.

Our Bayesian Panel VAR specification can be briefly written as:

$$Y_t = X_t B + E_t \tag{1}$$

where Y_t is the vector of endogenous variables that includes real disposable income of households, real GDP growth, the short-term interest rate (that controls for the direct and indirect impact of monetary policy on debt servicing), and the general government, household and non-financial corporations' debt. X_t are the lags of the endogenous variables and E_t is the vector of error terms. The first model consists of the pooled version of VAR in which the

[7] Although it is not the focus of this study, financial sector balance sheet vulnerabilities have also exacerbated in the aftermath of the 2008 financial crisis; for instance, financial corporations' indebtedness nearly doubled between 2000 and 2012 in many OECD economies (e.g. Canada, Denmark, Finland, Italy, Spain, and the UK).

[8] Bayesian Panel VAR estimations are based on the code developed by Dieppe et al. (2016).

only panel characteristic comes from our multi-country dataset. Specifically, we assume a normal-Wishart identification strategy. The data generating model is assumed as follows. The likelihood function has the form

$$f(y|\bar{\Sigma}) \propto \bar{\Sigma}^{-1/2} \exp(-\frac{1}{2}(y - \bar{X}\beta)'\bar{\Sigma}^{-1}(y - \bar{X}\beta)) \tag{2}$$

According to normal-Wishart scheme, we specify a multivariate normal prior for β; i.e., $\beta \sim N(\beta_0, \Sigma_c \otimes \Phi_0)$, where Φ_0 is a $k*k$ matrix and Σ is the VAR residual variance-covariance matrix. The prior for the Σ is assumed to be an inverse Wishart, $\Sigma_c \sim IW(S_0, \alpha_0)$.

The second PVAR modelling strategy takes into account cross-country idiosyncrasies, which is of crucial relevance for sectoral debt developments in OECD economies. Under this specification, a domestic VAR is obtained for each country. Consequently, the coefficients of each VAR differ across countries, which leads to the following assumption $\beta_i \sim N(b, \Sigma_b)$ with b and Σ_b being the hyperparameters, which are treated as random variables following hyperprior distributions.[9] More precisely, for b a diffuse prior is assumed, i.e., $\pi(b) \propto |\Sigma_b| \, |\Sigma_b|^{-\frac{1}{2}(N+1)}$. Under this framework, the likelihood function is now written as:

$$f(y|\beta, \bar{\Sigma}) \propto \prod_{i=1}^{N} |\bar{\Sigma}|^{-1/2} \exp(-\frac{1}{2}(y_i - X_i\beta_i)'\bar{\Sigma}_i^{-1}(y_i - X_i\beta_i)) \tag{3}$$

For both models, we employ a first-order lag structure, given our annual dataset.[10] The dynamic interactions across the variables in the system are assessed using orthogonalized impulse response functions (IRFs). The IRFs identify the reaction of one variable to innovations in another variable in the system, assuming that all other shocks are zero. The orthogonalized IRFs are computed by employing a Cholesky decomposition based on an or-

[9] For more technical details about the hyperpriors, see Jarociński (2010).

[10] Robustness checks on the lag length of the Bayesian Panel VAR indicate that our results are robust to higher order dynamics (see, also Section 5).

dering scheme of the relevant variables. Variables listed earlier are presumed to impact the subsequent variables contemporaneously as well as with a lag. Contrariwise, the variables that appear later in the system affect the previous variables only with a lag. According to our ordering scheme, macroeconomic and monetary variables are ordered first, while the debt variables follow. The intuition is that monetary policy shocks have non-contemporaneous effects on output and, thus, they affect growth with a lag (see, also, Caldara and Kamps, 2008; Favero, 2002; Hasko, 2007). This is in line with adjustment lags in consumption and investment plans following economic policy shocks.

In this way, we start using the disposable income as our first variable and the real GDP growth rate as the second one. We order the interest rate third; this implies that monetary policy shocks can impact on the debt ratio at the same period, mostly through increased debt servicing costs. Finally, the debt variables are ordered last, thereby assuming a contemporaneous impact of disposable income, output growth and monetary policy on debt dynamics (see also Friedman, 2005). For the government debt, the latter presumption is consistent with the standard sovereign debt dynamics equation. Also, the debt can affect output growth with a lag, consistent with the gradual adjustment of income, consumption and investment decisions following a debt shock.

Concerning the ordering of the sectoral debt variables, we presume that the government debt affects contemporaneously the household and corporate sector debt, reflecting consumption smoothing effects and adjustment in corporate investment plans. This ordering also assumes that excessive private sector debt that could trigger asset price shocks and enhanced volatility can weigh on public sector balance sheets only with a lag. In addition, we order household debt before corporate debt, implying that a shock in household debt would impact on firms' profitability at the same period. All variables are stationary apart from debt variables that are included in first differences.

4. Empirical Findings

4..1 Baseline results

This section discusses the estimates from the pooled Bayesian VAR model which accounts for potential small sample bias but assumes that the dynamic coefficients are homogeneous across units, while coefficients are also time-invariant (see, Section 3). The presentation of the empirical findings focuses on debt contagion effects across sectors triggered by a debt shock in a particular sector and transmitted via the income channel. Given the notable implications of sectoral debt shocks for economic activity, we also discuss debt linkages with the macroeconomy.

4..1.1 Transmission of debt shocks across sectors

Figures 1-3 depict the orthogonalized impulse response functions (IRFs) that account for the contemporaneous and lagged responses of the endogenous variables. Results indicate that the propagation of debt shocks from the non-financial corporate to the household sector is pronounced and statistically significant (figure 1a). A positive debt shock in the non-financial corporate sector seems to weigh on households' balance sheets, leading to balance sheet repair and a lower stock of debt held by households. The effect peaks at about 3 years after the initial debt shock while, the income channel seems to be an important transmission mechanism (figure 1b). In light of servicing a higher stock of debt, non-financial corporations seem to reduce spending on wages, so as to build up profitability. As a result, a positive innovation in non-financial corporate debt is associated with lower real household disposable incomes and increased pressure for correcting households' balance sheets.

Estimates also show that spillover effects of debt shocks from the household to the non-financial corporate sector are positive and statistically significant (figure 2a). An increase in household debt is associated with higher leverage held by corporates. The effect is partly channelled through rising disposable incomes and improved domestic demand prospects; in particular, a positive innovation in household debt seems to increase household disposable incomes, in line with the permanent income hypothesis (figure 2b). Thus, higher debt allows

for consumption smoothing effects via increased household consumption and investment, and higher expected income.[11] In turn, favourable domestic demand developments can also encourage investment projects, boost corporate profitability and equity valuation and increase firms' borrowing.

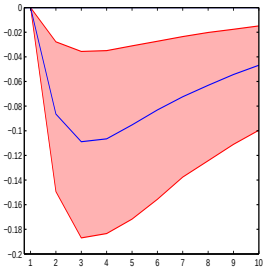
By contrast, based on the pooled BVAR estimates, we find no evidence on the propagation of debt shocks from the non-financial corporate to the government sector (figure 1c). The IRF analysis suggests that higher corporate borrowing will tend to increase sovereign debt, since higher debt of corporates is associated with a decline in disposable incomes and thus, lower tax revenue. Still, the effect is not statistically significant. Also, an increase in household debt does not impact government debt dynamics (figure 2c); the general government debt declines in the aftermath of a positive innovation in household debt, albeit the response is insignificant.

With regards to debt contagion effects from the public to the private sector, shocks in government debt seem to have no impact on non-financial corporate debt (figure 3a). Also, household indebtedness moderates in response to a positive sovereign debt shock (figure 3c); IRF estimates show that a shock in government debt translates to an improvement in households' balance sheet position. The latter suggests that as the state accumulates debt, which can impair households' financial assets and increase debt servicing costs, households would tend to repair their balance sheets. The deleveraging process of households by running down accumulated assets could also reflect consumption smoothing effects. Still, the overall reaction of household debt is statistically insignificant.

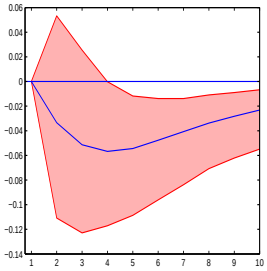
In sum, the pooled Bayesian VAR analysis identifies that debt shocks in OECD countries are on average propagated between the household and the non-financial corporate sector. We find no evidence on debt spillovers between the private and the government sector that are channelled via fluctuations in corporate savings and disposable incomes.

[11] Positive changes in the stock of household debt mainly reflect increases in household credit which is typically associated with higher economic growth (Beck et. al., 2000). However, as household indebtedness increases, the household sector becomes highly leveraged rending the economy vulnerable to macroeconomic and financial shocks (Mian and Sufi, 2011; IMF, 2017).

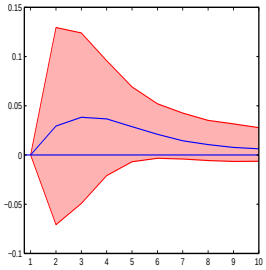
Figure 1: Responses to 1% Shock to non-financial Corporate Debt



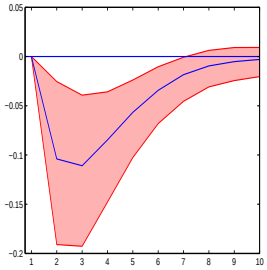
(a) Response of household debt



(b) Response of income



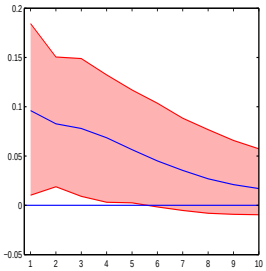
(c) Response of government debt



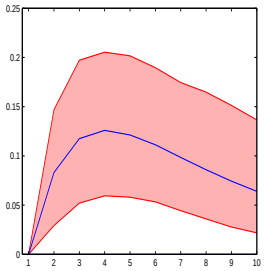
(d) Response of growth

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

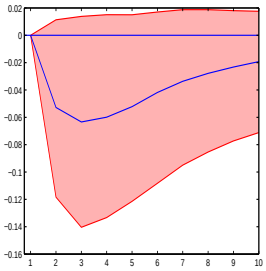
Figure 2: Responses to 1% Shock to Household Debt



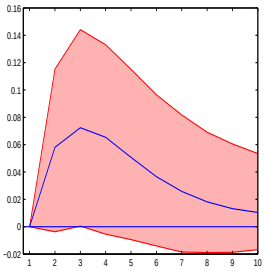
(a) Response of nf corporate debt



(b) Response of income



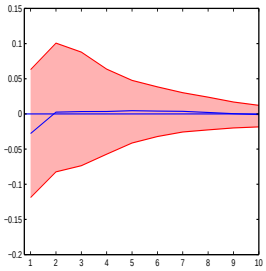
(c) Response of government debt



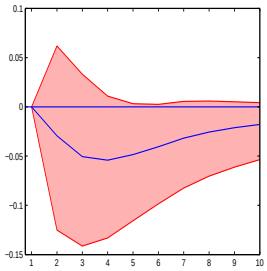
(d) Response of growth

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

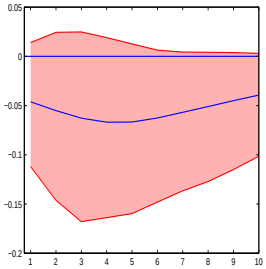
Figure 3: Responses to 1% Shock to Government Debt



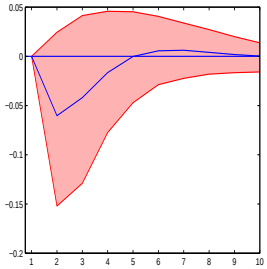
(a) Response of nf corporate debt



(b) Response of income



(c) Response of household debt



(d) Response of growth

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

4..1.2 Sectoral debt and macroeconomic linkages

The reaction of output growth to a positive debt shock differs across sectors of the economy. A positive innovation in non-financial corporate debt is associated with a decline in real output growth (figure 1d). The negative impact of the corporate debt shock on growth decays after two years and output growth gradually stabilises at about its initial level. This finding is in accordance with other empirical studies (see, for instance, Cecchetti et al., 2011; Priftis and Theofilakou, 2018). By contrast, household debt shocks exercise a positive but statistically insignificant impact on the economy's growth path (figure 2d). Finally, an increase in general government debt seems to decrease output growth, indicating that an adverse fiscal outlook dampens economic growth (figure 3d). Nonetheless, the negative impact of higher public-sector leverage on growth is not statistically significant.

Results on the monetary channel are also worth noting.[12] First, focusing on the interaction of monetary policy with sectoral debt, a rise in the short-term interest rate weighs

[12]Due to space limitations, the corresponding IRF graphs are not reported but are available upon request.

heavily on the overall debt burden in the non-financial corporate sector. The effects of monetary policy on corporate debt seem to work both through lower output growth and increased debt servicing costs. On the other hand, household debt declines in response to a more restrictive monetary policy stance. This could reflect households' need to rebalance their assets in view of higher debt servicing costs. The corresponding effect of interest rate rises on government debt is insignificant. On the reaction of monetary policy, this is accommodative after an adverse corporate and government debt shock, responding to adverse domestic demand effects.[13] Monetary policy turns restrictive following an increase in household debt and disposable incomes, owing to increased inflationary pressure in the economy.

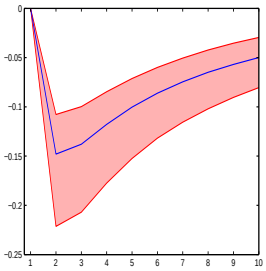
Second, considering the interplay of real output growth with monetary policy in OECD countries, several interesting interactions emerge. Monetary policy shocks seem to curtail output growth; an increase in the short-term interest rate in OECD countries is on average associated with lower real GDP growth. This finding supports the views on the importance of the monetary policy channel for output stabilisation. As expected, favourable economic developments are associated with a restrictive monetary policy stance. The short-term interest rate responds positively and significantly in all periods to improved economic conditions, amid higher inflationary pressures.

4..2 Introducing cross-sectional heterogeneity

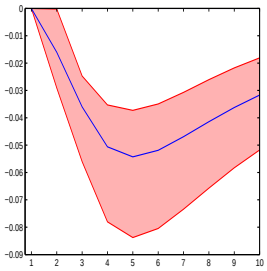
Country idiosyncrasies can play an important role in the propagation of debt shocks across sectors of the economy. In this section, we relax the baseline assumption of full pooling in the Bayesian VAR estimation and account for country-specific heterogeneity in assessing sectoral debt spillovers. Following Jarociński (2010), we report the mean IRFs in figures 4-6. Our results show that, once we account for country heterogeneity, the income responses to sectoral debt shocks remain valid and even strengthen. Higher corporate leverage results in increased corporate savings via cutting wages and therefore, in lower real disposable incomes (figure 4b). The effect is statistically significant in all periods and peaks 5 years after

[13] An additional explanation could be that policymakers have strong incentives to inflate their debt (Aizenman and Marion, 2011).

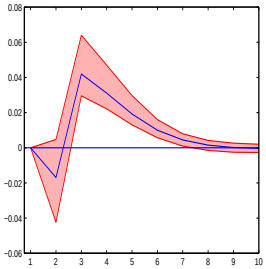
Figure 4: Responses to 1% Shock to Non-Financial Corporate Debt



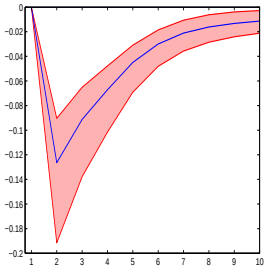
(a) Response of household debt



(b) Response of income



(c) Response of government debt



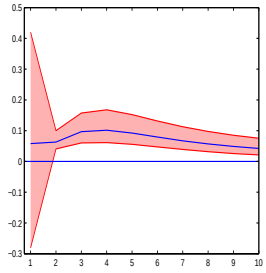
(d) Response of growth

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

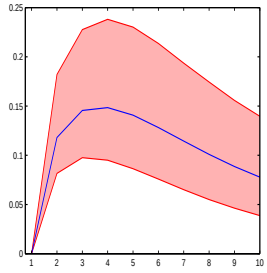
the initial debt shock. Also, an increase in household sector indebtedness is associated with higher real incomes and favourable growth prospects, in line with the pooled BVAR estimates (figure 5b). By controlling for country heterogeneity, the negative impacts of an increase in government debt on real incomes now turn statistically significant (figure 6b), signalling a drop in disposable incomes due to Ricardian equivalence effects and future increases in taxation.

The main findings on debt propagation across sectors that works through the income channel are broadly in line with the pooled BVAR estimates. An increase in non-financial corporate debt is on average associated with a decline in household indebtedness (figure 4a) amid lower household disposable incomes (figure 4b) and increased pressure for households' balance sheet repair. The drop in household debt peaks 3 years after the shock occurrence. Considering an increase in household debt, we find stronger evidence on the transmission of the shock to the non-financial corporate sector (figure 5a); the effect on corporate debt is again positive as in pooled estimates, albeit now statistically significant in almost all periods.

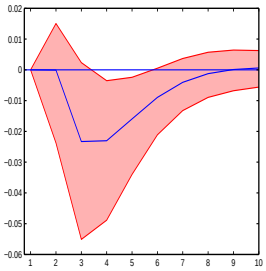
Figure 5: Responses to 1% Shock to Household Debt



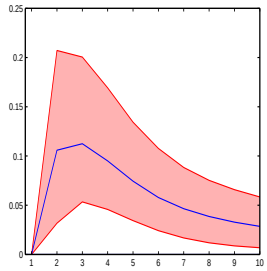
(a) Response of nf corporate debt



(b) Response of income



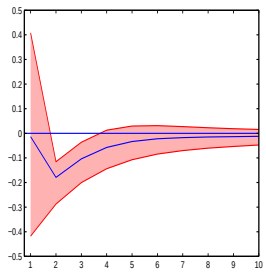
(c) Response of government debt



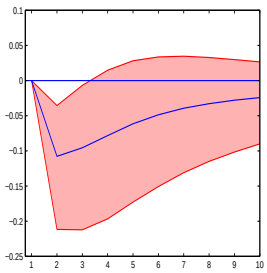
(d) Response of growth

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

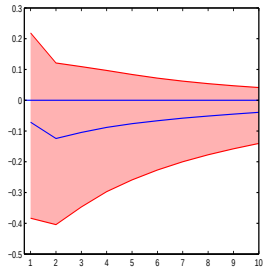
Figure 6: Responses to 1% Shock to Government Debt



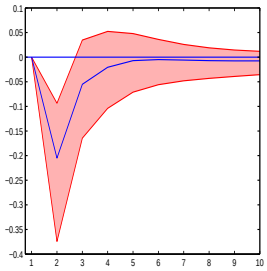
(a) Response of nf corporate debt



(b) Response of income



(c) Response of household debt



(d) Response of growth

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

Notwithstanding, accounting for country specificities seems to differentiate our preceding findings on debt interactions between the private and the government sector. An increase in non-financial sector debt weighs on the stock of government debt (figure 4c), with the effects channelled through changes in disposable incomes; higher indebtedness of corporates dampens real incomes of households and firms' profitability and thus, deteriorate public finances and increase sovereign borrowing. Compared to the pooled BVAR estimates, the effect is now statistically significant and takes place 3 years after the initial shock.

Results also show that higher leverage in the household sector is associated with a fall in sovereign debt (figure 5c). This finding equally implies that given a deleveraging process in the household sector, the state will tend to increase its borrowing (see, also, Bornhorst and Ruiz-Arranz, 2013; Eggertson and Krugman, 2012). Given our preceding discussion on the debt-income channel, the overall reaction could be driven by higher disposable incomes following the household debt increase, and thus, improved public finances. Still, the identified effect on government debt is only weakly statistically significant.

Moreover, an escalated government sector debt enhances pressures for balance sheet repair of corporates, though the overall effect on corporate debt is also marginally significant (figure 6a). Given the negative impacts of a government debt shock on incomes (figure 6b), the ensuing fall in non-financial corporate debt should reflect pressures for balance sheet correction on the back of expected subdued domestic demand. Finally, we find no evidence on the propagation of debt shocks from the government to the household sector; a shock in government debt leads to a negative but insignificant response of household borrowing (figure 6c).

With regards to the growth effects of sectoral debt shocks, an increase in leverage in the non-financial sector dampens real GDP growth, in line with pooled estimates (figure 4d). By contrast, results show that when controlling for country heterogeneity, higher debt in the household sector supports output growth and the effect is now statistically significant (figure 5d). This positive interaction can be explained by fluctuations in household income; a higher household debt corresponds to increased disposable incomes and thus, higher household consumption and investment that boost domestic demand and output growth. Moreover,

country-specific factors seem to drive the negative impacts of an increasing sovereign debt on economic growth (figure 6d); a positive innovation in government debt is on average associated with a decline in output growth within 3 years from the shock. This finding is consistent with the drop in disposable incomes and the adverse impacts on agents‘ spending decisions following the sovereign debt shock.

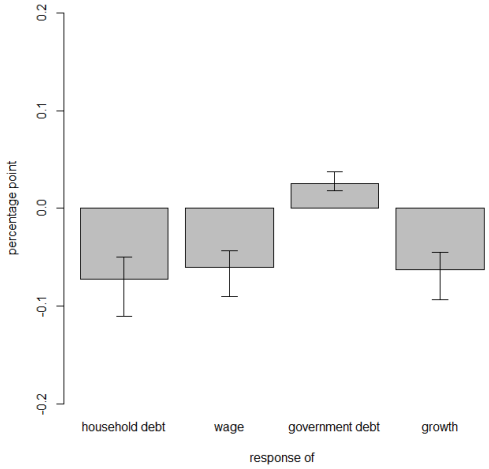
5. Sensitivity Analysis and Further Evidence

5..1 Alternative definitions of endogenous variables

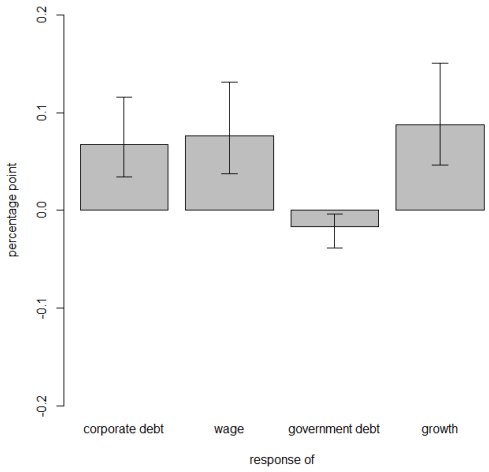
So far, the income channel in our panel BVAR estimates is captured by changes in the real disposable income of households. The latter reflects changes both in the wage rate and in headcount employment. Here, we consider instead that the income channel is proxied by changes in real wages. These should sufficiently capture changes in corporate savings and the wage bill but also consumption smoothing effects of households due to income fluctuations. Figure 7 summarizes the results based on the BVAR model that takes into account countries heterogeneities. Results show that the importance of the income channel for the transmission of debt shocks across sectors remains valid. The sign and the statistical significance of the response of real wages to a positive sectoral debt shock are in line with our preceding findings. Remaining estimates are also unchanged.

As an additional robustness check, we repeat the same analysis using all sectoral debt variables as a percentage of GDP, instead of debt in levels as in the baseline models. Debt-to-GDP ratios are often employed in the relevant literature to account for the ability of individual sectors to service their debt (see, among others, Cuerpo et al., 2013). Despite often discussed caveats, in several studies changes in sectoral debt-to-GDP ratios correspond to active leveraging/deleveraging of the individual sectors (see, e.g. European Commission, 2014). Our main findings on debt spillovers across sectors remain qualitatively similar. However, the impacts of a household debt shock on sovereign debt now turn highly statistically significant. Higher household debt triggers a sovereign debt decline. On the effects of public debt on growth and incomes, these are weakened; an increase in sovereign debt reduces

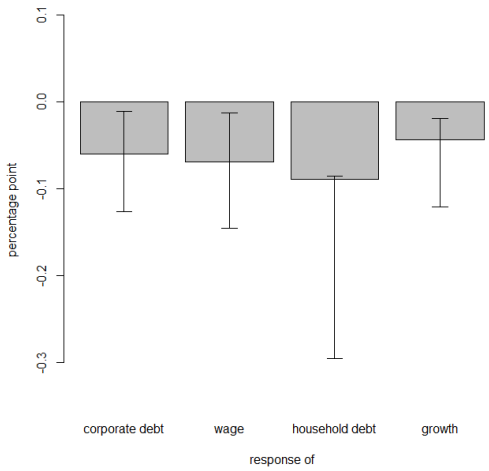
Figure 7: Using wages



(a) nf-corporate debt shock



(b) household debt shock



(c) government debt shock

Notes: The graphs indicate the responses 3 years after the shock.

disposable incomes and output growth but the responses are insignificant. As a final robustness exercise, we also use alternative ordering schemes. The results remain quantitative and qualitatively the same.[14]

5..2 Non-linearity effects

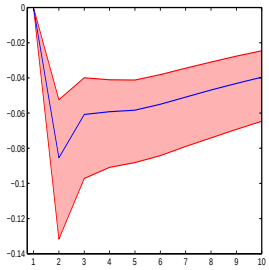
So far, our analysis has not accounted for potential non-linearities in the propagation of debt shocks across sectors. It could be, for instance, that the level of indebtedness in one sector matters both for agents' balance sheet reaction to a debt shock but also for economic growth (see, Bornhorst and Ruiz-Arranz, 2013). In particular, the recent economic crisis raised the issue whether countries facing an excessive public debt could be more vulnerable to debt contagion across sectors of the economy compared to countries with a less indebted sovereign. Literature evidence also suggests that excessive government sector indebtedness can exercise a pronounced contractionary effect on growth compared to lower levels of debt (see, Baum et al., 2013). We investigate these hypotheses by splitting the sample into two country groups according to government debt, i.e. one group with higher (8 countries) and one with lower (11 countries) sovereign debt ratio.[15] Figures 8-10 outline the IRFs for the high and low debt country groups.

Estimates show that debt shocks transmission across sectors depends on public sector's indebtedness. First, in the high debt group, a positive shock in non-financial corporate debt has an immediate negative impact on household disposable incomes (figure 8a). By contrast, in the low debt group, higher debt of corporates‘ initially increases incomes, which subsequently decline with a lag of 3 years (figure 8b). As a result, in the low debt group, a corporate debt shock is initially associated with a government debt reduction (figure 8d) compared to an increase in sovereign debt in the high debt group (figure 8c). The effects, however, on household debt remain the same for both groups; the household debt significantly decreases (figures 8e-f), consistently with the previous evidence.

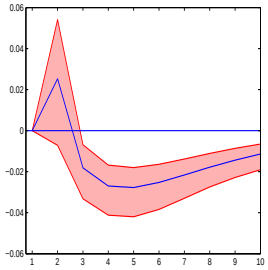
[14] All the results are available upon request.

[15] Government debt is high if the mean value of the government-to-GDP ratio for the particular country over the reference period is higher than the respective mean value in the sample (i.e. 81% of GDP). The countries identified in the high debt group are: Austria, Belgium, Canada, France, Greece, Italy, Portugal, USA.

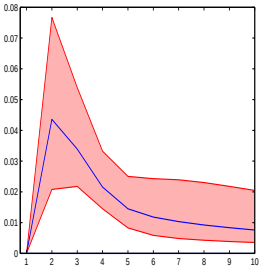
Figure 8: Responses to 1% Shock to Non-Financial Corporate Debt



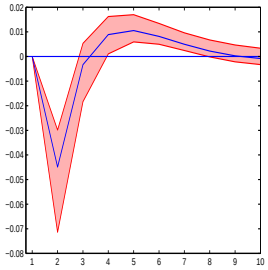
(a) Response of income (high)



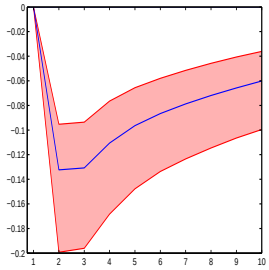
(b) Response of income (low)



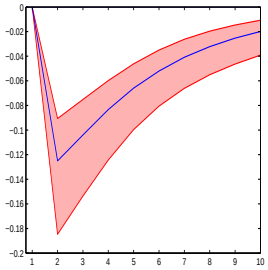
(c) Response of government debt (high)



(d) Response of government debt (low)



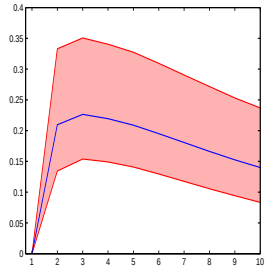
(e) Response of household debt (high)



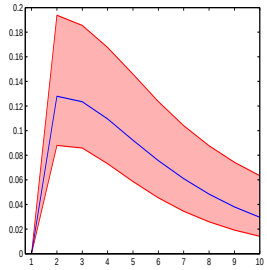
(f) Response of household debt (low)

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

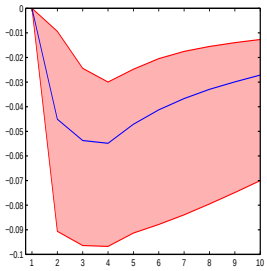
Figure 9: Responses to 1% Shock to Household Debt



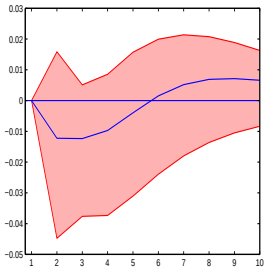
(a) Response of income (high)



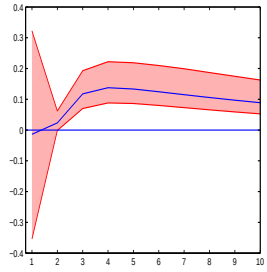
(b) Response of income (low)



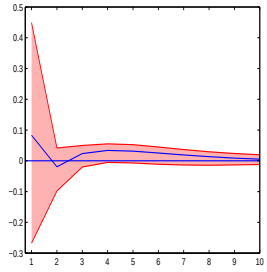
(c) Response of government debt (high)



(d) Response of government debt (low)



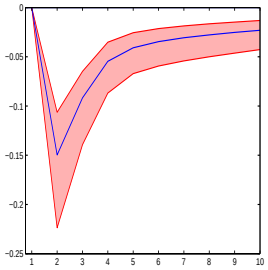
(e) Response of nf corporate debt (high)



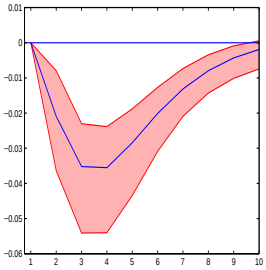
(f) Response of nf corporate debt (low)

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

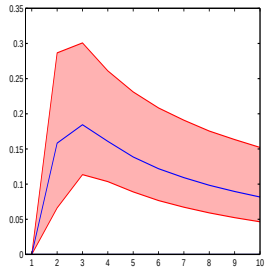
Figure 10: Growth Responses



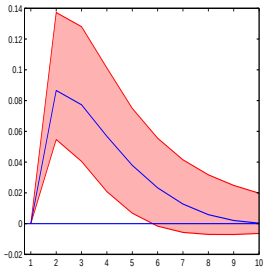
(a) to nf corparate debt shock (high)



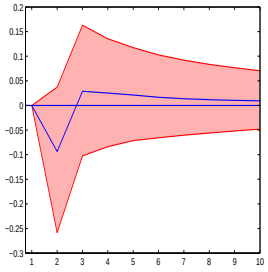
(b) to nf corparate debt shock (low)



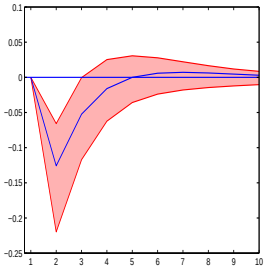
(c) to household debt shock (high)



(d) household debt shock (low)



(e) to government debt shock (high)



(f) to government debt shock (low)

Notes: Solid line plots mean response and shaded area depicts the 95 per cent confidence intervals.

Furthermore, positive innovations to household debt tend to lower government debt in the high debt group (figure 9c). The latter equally implies that a deleveraging process in the household sector will tend on average to increase sovereign borrowing in economies where public debt is already high. Debt contagion from the household to the government sector is insignificant in the low debt group (figure 9d). Third, debt spillovers from the household to the non-financial corporate sector are strong and statistically significant when the public sector is highly indebted (figures 9e-f). Finally, the increased real incomes due to increased household sector indebtedness continues to be quite robust for both groups (figures 9a-b).

Moreover, the growth effects of private debt shocks are more pronounced in countries with higher government debt. In particular, an increase in non-financial corporate debt seems to have a more detrimental impact on economic growth in the high debt group (figures 10a-b). Also, household deleveraging will have a stronger, negative effect on growth (figures 10c-d). Contrariwise, we find that in economies facing high levels of government indebtedness, a further public debt build-up does not have a statistically significant impact on economic activity (figures 10e-f). This finding lends some support to the view that there is no universally applicable threshold effect in the relationship between public debt and economic growth (see, e.g. Chudik et al., 2017).

6. Conclusions

This paper investigated the propagation of debt shocks across sectors of the economy in OECD countries that work through the "savings or income channel". The latter operates through the impacts of a debt shock on disposable incomes and agents' spending decisions. Given the notable implications of sectoral indebtedness for the macroeconomy, we also discussed the dynamic response of output growth to stochastic shocks in sectoral debt.

Based on a Bayesian panel VAR estimation approach, our analysis provided evidence of debt contagion effects among sectors of the economy, notably between the household and the non-financial corporate sector. First, run-ups in non-financial corporate debt and an ensuing decline in household disposable incomes amid cuts in the wage bill are associated with lower

household leverage. By contrast, a household debt shock seems to raise corporate sector indebtedness due to increases in real incomes that signal favourable demand prospects and higher corporate profitability.

Second, when controlling for country heterogeneity, debt shocks are also propagated from the private to the government sector. Higher non-financial sector debt drives down disposable incomes and weighs on public finances. Also, debt contagion effects from the household to the public sector in OECD countries over the reference period are on average negative, albeit weak. In countries with excessive government debt, the impact of private debt shocks on government debt stemming from the income channel is stronger compared to countries with lower public debt. Finally, we do not find strong evidence on the transmission of debt shocks from the public to the private sector.

With regards to the growth effects of sectoral debt shocks, these vary and largely depend on country idiosyncrasies. An increase in non-financial corporate leverage dampens output growth. When accounting for country heterogeneity, a higher sovereign debt also detrimental to growth, while output growth seems to moderate in light of household deleveraging. Interestingly, the effects of household and non-financial corporate debt shocks on economic activity are stronger for economies with a highly leveraged public sector.

From a policy perspective, our analysis suggests that policy efforts pertaining to the timely balance sheet repair are crucial for sustaining economic growth and mitigating debt contagion effects across sectors. Also, strengthening institutions related to private sector bankruptcies could accelerate clearance procedures, drive a more gradual deleveraging process and lessen negative feedback loops within the macroeconomy.

Acknowledgements

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affiliated.

Appendix

Data definition and sources

We employ an annual balanced panel dataset for 19 OECD countries over the 1996 to 2014 period. The countries are: Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Portugal, Spain, Sweden, UK, and the US. The variables are drawn from the OECD Database on Financial Accounts (on a national-accounts basis), the OECD Economic Outlook and the OECD National Accounts at a Glance.

The debt series employed refer to financial balance sheets' gross liabilities at current prices and on a non-consolidated basis for the following sectors; a) non-financial corporations (code: S11), b) general government (code: S13), c) households and non-profit institutions serving households (code: S14+S15). For households and non-financial corporations, debt is calculated as total financial liabilities, excluding shares and other equity (see, also, Cecchetti et al., 2011). For the general government, total financial liabilities are included. The private sector debt is the aggregate of the debt series for non-financial corporations and households. Household disposable income is proxied by real household net adjusted disposable income, deflated by individual consumption (see also, OECD national accounts at a glance). HICP and CPI are used for euro area and non-euro area countries respectively, to deflate nominal wage series.

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