Is government debt good or bad for labor productivity? A dynamic panel analysis over 1972-2019

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Abstract

In this paper we provide new insights on the nexus between public debt and economic growth, focusing on the growth of debt rather than its level. By exploiting updated macroeconomic time series for 75 countries (37 OECD and 38 non-OECD) over the period 1972-2019 and using the system-GMM technique, we estimate the impact of the growth of public debt per worker on labor productivity growth. We find evidence of a significant adverse effect of the growth of public debt per worker on labor productivity growth, as proxied by the growth of output per worker. Similar results arise when we consider the growth of public debt per capita and the growth of real GDP per hours worked.

JEL classification

O47, H63, E62, C33

Keywords

Public debt, Labor productivity, Growth.

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1. Introduction

As a result of the Great Recession, public debt has increased considerably, especially in OECD countries. This development prompted several economists to investigate empirically the link between public debt and economic growth.

The seminal paper by Reinhart and Rogoff (2010) attracted the attention of several scholars, who have found a general negative association between debt levels and economic growth (Checherita-Westphal and Rother, 2012; Woo and Kumar, 2015), although findings have so far been very heterogenous (Panizza and Presbitero, 2014) and some studies did not find any significant effect of debt on growth (Lof and Malinen, 2014). Salotti and Trecroci (2016) provide evidence of a negative impact of debt on private investments and productivity, which are among the main drivers of growth. Most of the literature has so far focused on the level of the debt/GDP ratio and little effort has been devoted to consideration of the dynamics of debt (Égert, 2015, Chudik, 2017).

Fig. 1. Annual growth rates of real GDP (blue line) and public debt (red line), both in per worker terms, for 37 OECD and 38 non-OECD countries, 1972-2019.

Figure 1 and Figure 2 show that the contemporaneous correlation between the change in the debt/GDP ratio and that in real GDP per worker is mildly negative on average (and equal to -0.0756), both cross-country and over time.

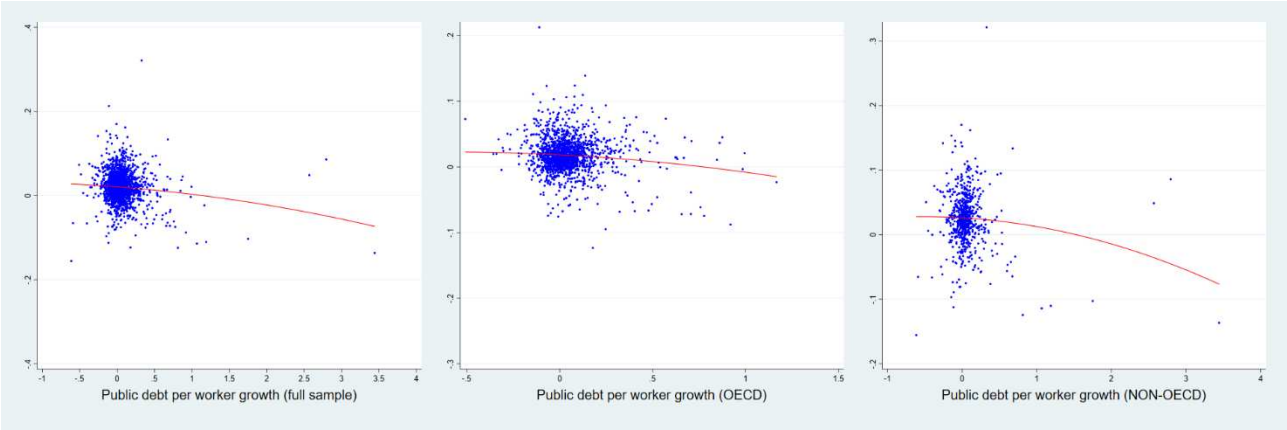

Fig. 2. *Growth of real GDP per worker and public debt for 37 OECD and 38 non-OECD countries, 1972-2019.*

This paper provides new estimates relevant for the growth-debt nexus. We innovate the empirical literature mainly by a) focusing on the growth of public debt rather than its level, and b) exploiting a new, larger panel dataset that yields consistency and efficiency gains for the widely employed system-GMM estimator.

2. Methodology and data

We assume that economy i in year t is characterized by the following Cobb-Douglas production function:

$$y_{it} = d_{it}^{\lambda} k_{it}^{\phi} \tag{1}$$

where y is aggregate output, d is public debt and k is the stock of capital, all in per-worker terms. By applying the logarithmic transformation and taking the first differences, we obtain the following equation:

$$lny_{it} - lny_{it-1} = \lambda lnd_{it} - \lambda lnd_{it-1} + \phi lnk_{it} - \phi lnk_{it-1} \tag{2}$$

Therefore, we have annual growth rates of the observable factors on both sides of the equation. It is convenient to rewrite the equation as follows:

$$\Delta lny_{it} = \lambda \Delta lnd_{it} + \phi \Delta lnk_{it} \tag{3}$$

where Δ denotes first differences. By adding controls and lagging the dependent variable to account for dynamics, we arrive at our empirical model:

$$\Delta lny_{it} = \alpha \Delta lny_{it-1} + \lambda \Delta lnd_{it} + \phi \Delta lnk_{it} + \beta \boldsymbol{X'_{it}} + \mu_{it} \tag{4}$$

$$\mu_{it} = \eta_i + \tau_t + \mathcal{E}_{it} \tag{5}$$

where $\mathbf{X}$ is a vector containing the following covariates: real GDP per capita (log), human capital index, government expenditure as a% of GDP and the real interest rate on 10-year government bond). The component μ includes the time-invariant effects η, the country-invariant factors τ and the idiosyncratic error term $\mathcal{E}$.

The potential endogeneity bias is the main methodological concern. In this paper, we account for this problem in two main ways. First, we measure debt in per-worker terms rather than with the more conventional debt to GDP ratio. Second, we employ the system-GMM technique proposed in Arellano and Bover (1995) and Blundell and Bond (1998), assuming that the lagged first differences of the explanatory variables are orthogonal to the current shocks.

To avoid the proliferation of internal instruments (Roodman, 2009), we limit them up to the

eighth lag. The downward bias of standard errors typical of GMM procedures is corrected by using the Windmeijer standard errors (2005).

Table 1. Descriptive statistics of the variables.

	OECD					NON-OECD				
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
GDP pw growth	2268	.024	.033	-.299	.219	802	.026	.043	-.163	.321
GDP phw growth	2103	.027	.03	-.112	.204	489	.027	.035	-.105	.114
Debt pw growth	2004	.04	.138	-.508	1.167	727	.058	.255	-.614	3.443
Debt pc growth	2004	.042	.133	-.494	1.171	727	.06	.252	-.617	3.405
Capital pw growth	2268	.024	.026	-.061	.166	802	.027	.036	-.129	.271
GDP pc (log)	2305	9.979	.685	7.292	11.481	806	8.798	1.107	6.074	11.333
Human Capital	2305	2.769	.583	1.142	3.892	806	2.199	.661	1.056	4.352
Interest rate	1235	6.454	4.117	-.525	28.758	567	8.988	10.792	.429	209.6
Gov. expenditure	836	42.945	7.853	18.775	65.11	260	31.614	9.381	8.812	59.995
Gov. exp. prod.	795	24.861	3.93	13.754	43.839	189	21.119	6.224	7.917	49.606
Gov. exp. unprod.	795	18.142	4.571	6.704	28.637	192	10.44	4.984	.865	18.531

Following Chu et. al (2020*), productive* government expenditure is the sum of expenditure in education, health, defence, housing & community amenities, economic affairs and general public services whereas *unproductive* government expenditure is the sum of expenditure in culture, social protection and public order and safety.

By exploiting recently updated databases of IMF and Penn World Table (version 10), we build a panel dataset covering the period 1972-2019 for 75 countries (37 OECD and 38 non-OECD). Table 1 shows some descriptive statistics.

3. Estimates

We estimate equation (5) both for the entire set of countries and for the OECD group only. For non-OECD countries, the relatively low number of observations would threaten the consistency of system-GMM estimator.

Table 2. Dependent variable: **Real GDP per worker growth**. System-GMM estimates.

	Full sample			OECD		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable	0.0719	0.1478***	0.1252***	0.1164*	0.1482**	0.1439**
	(0.0469)	(0.0507)	(0.0352)	(0.0585)	(0.0606)	(0.0599)
Debt pw growth	-0.0191**	-0.0423**	-0.0256*	-0.0221**	-0.0325**	-0.0335**
	(0.0081)	(0.0208)	(0.0136)	(0.0107)	(0.0147)	(0.0149)
Capital pw growth	0.5621***	0.4187***	0.3266***	0.5273***	0.4892***	0.5064***
	(0.0601)	(0.1211)	(0.0830)	(0.0607)	(0.0812)	(0.0887)
GDP pc (log)		-0.0102**	-0.0131**		-0.0159**	-0.0158**
		(0.0045)	(0.0057)		(0.0060)	(0.0061)
Human capital		0.0098**	0.0082**		0.0021	0.0027
		(0.0047)	(0.0040)		(0.0055)	(0.0054)
Interest rate		-0.0006	-0.0008		-0.0019*	-0.0020*
		(0.0007)	(0.0009)		(0.0010)	(0.0011)
Gov expenditure		-0.0004***			-0.0004*	
		(0.0001)			(0.0002)	
Gov. exp. prod.			-0.0005*			-0.0001
			(0.0003)			(0.0004)
Gov. exp. unprod.			-0.0003			-0.0006*
			(0.0002)			(0.0003)
Observations	2,712	884	814	1,987	651	639
Groups	75	47	43	37	30	30
AR(2)	0.0178	0.124	0.00797	0.0302	0.0470	0.0631

Hansen *J*-statistics	1.00	1.00	1.00	1.00	1.00	1.00

***, **, * denote significance at 1%, 5%, 10%, respectively. Individual and time effects are included but not reported. *p*-values of the Arellano-Bond test for second order autocorrelation and Hansen-J statistic are reported.

In both groups, the estimated impact of the growth of public debt on the growth of GDP per workers is negative and significant, with the coefficients that increase in absolute value as further conditioning factors are included. The process of conditional convergence – highlighted by the negative coefficient associated to *GDP pc (log)* – is significant across all the specifications and appears to be slightly stronger within the OECD group. Within the OECD group, the real interest rate too has a more significant and adverse effect on labor productivity growth. Furthermore, it is worth highlighting that current government expenditure negatively affects the dependent variable in both groups and that even the subset of *productive* government expenditure is linked negatively and significantly to labor productivity growth when the entire sample is considered.

As a robustness exercise, we consider as dependent variable and key regressor, respectively, two measures that are less sensitive to fluctuations in unemployment: the growth of real GDP per hours worked and that in public debt per capita.

Table 4. Dependent variable: Growth in **real GDP per hours worked**. System-GMM estimates.

	Full sample			OECD		
	(7)	(8)	(9)	(10)	(11)	(12)
Lagged dependent variable	0.0653	0.0560	0.1034*	0.0862	0.1293**	0.1273***
	(0.0450)	(0.0659)	(0.0536)	(0.0567)	(0.0489)	(0.0450)
Debt pc growth	-0.0140	-0.0276*	-0.0262*	-0.0206*	-0.0259*	-0.0259*
	(0.0095)	(0.0154)	(0.0138)	(0.0111)	(0.0146)	(0.0138)
Capital pw growth	0.4913***	0.2894***	0.2565***	0.5498***	0.4580***	0.4702***
	(0.0648)	(0.0680)	(0.0671)	(0.0581)	(0.0802)	(0.0908)
GDP pc (log)		-0.0120*	-0.0126*		-0.0158**	-0.0153**
		(0.0060)	(0.0067)		(0.0063)	(0.0065)
Human Capital		0.0063	0.0055		0.0031	0.0036
		(0.0047)	(0.0045)		(0.0063)	(0.0061)
Interest rate		-0.0014	-0.0016		-0.0019*	-0.0021*
		(0.0010)	(0.0010)		(0.0010)	(0.0011)
Gov expenditure		-0.0004***			-0.0004**	
		(0.0001)			(0.0002)	
Gov. exp. prod.			-0.0001			0.0000
			(0.0003)			(0.0004)
Gov. exp. unprod.			-0.0006**			-0.0007
			(0.0003)			(0.0004)
Observations	2,342	803	765	1,911	651	639
Groups	56	40	39	37	30	30
AR(2)	0.520	0.221	0.289	0.683	0.415	0.571
Hansen *J*-statistics	1.00	1.00	1.00	1.00	1.00	1.00

***, **, * denote significance at 1%, 5%, 10%, respectively. Individual and time effects are included but not reported. *p*-values of the Arellano-Bond test for second order autocorrelation and Hansen-J statistic are reported.

We can notice that the estimated impact of the growth of public debt per capita on the growth of real GDP per hours worked closely aligns to the preceding estimates. However, the estimated coefficient of debt per capita loses some significance

As a further robustness check, we estimate the dynamic models using the FE estimator on the first differences of the variables in order to eliminate potential time-invariant effects (Baltagi (2008), chapter 8). The results (not reported but available upon request) closely follow our baseline estimates.

4. Conclusions

We provide evidence of an adverse effect of the growth of public debt per worker on labor productivity. We cannot directly compare our results with the extant literature, due to the different empirical setup. However, we claim that the growth of public debt is more relevant than its mere level within the debt-growth nexus.

Appendix A

A.1. Countries

OECD countries: Australia, Austria, Belgium, Canada, Chile, Colombia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

NON-OECD countries: Angola, Argentina, Armenia, Bangladesh, Botswana, Brazil, Bulgaria, China, Cyprus, Chana, India, Kyrgyzstan, Malaysia, Maldives, Mauritius, Moldova, Morocco, Myanmar, Nepal, Pakistan, Romania, Russian Federation, South Africa, Sri Lanka, Thailand.

A.2. Data sources (original variables)

International Monetary Fund – Government Finance Statistics: Central government gross debt (% of GDP), government expenditure (% of GDP), real interest rate on 10 years government bonds.

Penny World Table 10 (released on February 18, 2021): Average annual hours worked per worker, population, workers, real GDP (at 2017 US Dollars), physical capital stock (at constant 2017 US Dollars), human capital index (based on years of schooling and returns to education).

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