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Causality for the government budget and economic growth

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We use a panel of 155 countries for the period 1970 to 2010 to study the (two-way) causality between government spending, revenue and growth. Our results suggest the existence of weak evidence supporting causality from expenditures or revenues to GDP per capita and provide evidence supporting Wagner’s law.

**Keywords:** government expenditures; government revenues; panel causality; GMM

**JEL Classification:** C23; E62; H50

I. Introduction

According to conventional wisdom, larger budget deficits have coincided with wasteful government spending, large bureaucracies and other counterproductive economic policies. Seminal earlier work on the impact of government expenditure on long-run growth include studies by Landau (1986), Ram (1986), Grier and Tullock (1989), Romer (1990), Barro (1990, 1991), Devarajan et al. (1996) and Sala-i-Martin (1997), mostly using cross-section data to link measures of government spending with economic growth rates.

On the causality issue, Hakro (2009) finds evidence suggesting that government expenditures are growth inducing. On the same sample, Kumar (2009) using time-series techniques instead infers that Wagner’s law does hold.\textsuperscript{1} Yuk (2005) takes a long-term perspective on UK time series and, although support for Wagner’s law is sensitive to the choice of the sample period, there is evidence that GDP growth Granger causes the share of government spending in GDP.

We use a cross-sectional/time-series panel of 155 developed and developing countries for the period 1970 to 2010. In particular, we assess the (two-way) causality, and also the possibility of the Wagner’s law. Therefore, we run panel Granger-causality tests and assess the existence of cross-sectional dependence amongst homogeneous groups of countries. Our results show the existence of weak evidence supporting causality from expenditures (revenues) to GDP per capita and find supporting evidence for the Wagner’s law.

II. Methodology and Empirical Results

We perform a panel version of a Granger-causality test (Huang and Temple, 2005) between per capita GDP and fiscal variables, namely total government expenditures and revenues retrieved from World Bank’s WDI for 155 countries between 1970 and 2010.

Since causality can run in either direction, one cannot take government expenditures and government revenues as

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The opinions expressed herein are those of the authors and not necessarily those of the ECB, or the Eurosystem, the IMF or its member countries. All remaining errors are the authors’ sole responsibility.

\textsuperscript{1} An often-quoted fact, ‘Wagner’s law’, about the long-run tendency for public expenditure to grow relative to some national income aggregate such as GDP (due to Wagner in 1883).
Causality for the government budget and economic growth

strictly exogenous. Alternatively, we run partial adjustment specifications which allow feedback by means of sequential moment conditions to identify the model (see Arellano, 2003). The standard approach in the literature (Huang and Temple, 2005) would be an AR(1) model as follows:

\[ y_{it} = \alpha_i y_{it-1} + \beta_i x_{it-1} + \eta_i + \varphi_i + \nu_{it}, \]

where in our case \( y_{it} \) is real per capita GDP and \( x_{it} \) will be independent government expenditures and revenues.\(^2\) The reverse relationship is also explored to test notably the hypothesis of the Wagner’s law holding for the full sample and OECD sub-sample.

The model (1) allows for unobserved heterogeneity through the individual effect \( \eta_i \) that captures the joint effect of time-invariant omitted variables. \( \phi_i \) is a common time effect, while \( \nu_{it} \) is the disturbance term. We also assume that \( x_{it} \) is potentially correlated with \( \eta_i \) and may be correlated with \( \nu_{it} \), but is uncorrelated with future shocks \( \nu_{it+1}, \nu_{it+2}, \ldots \). To make use of available moment conditions, we use Arellano and Bond’s (1991) difference-GMM estimator (hereafter DIF-GMM) and use Hansen J’s test to assess the model specification and overidentifying restrictions.

As there are limitations of DIF-GMM estimation, Arellano and Bover (1995) system-GMM estimator can be used to alleviate the weak instrument problem.\(^3\)

In the AR(1) model, one hypothesis of economic interest is the null \( \beta_1 = 0 \) — a panel data test for Granger causality. Even though a Wald-type test of this restriction could be used, we estimate both the unrestricted and the restricted models using the same moment conditions and then compare their (two-step) Hansen J statistics using an incremental Hansen test defined as:

\[ D_{RU} = n(J(\hat{\gamma}) - J(\gamma)) \]

where \( J(\gamma) \) is the minimized GMM criterion for the unrestricted model, \( J(\hat{\gamma}) \) is the minimized GMM criterion for the unrestricted model and \( n \) is the number of observations.\(^4\) The intuition is that, if the parameter restriction \( (\beta_1 = 0) \) is valid, the moment conditions should keep their validity even in the restricted model.\(^5\)

There are some additional issues of interpretation. One may be interested in the stability of the estimated model. If our model is stable, we can compute a point estimate for the long-run effect of \( x_{it} \) on \( y_{it} \):

\[ \beta_{LR} = \beta_1/(1 - \alpha_i) \] \(^3\)

Moreover, we can test for unobserved heterogeneity. In the absence of individual effects, the following additional moment conditions become valid:

\[ E[y_{it-1} (y_{it} - \alpha_i y_{it-1} - \beta_i x_{it-1} - \phi_i)] = 0 \]
\[ E[x_{it-1} (y_{it} - \alpha_i y_{it-1} - \beta_i x_{it-1} - \phi_i)] = 0. \] \(^4\)

The validity of these additional set of moment conditions (tested using an incremental Hansen test relative to difference- or system-GMM) can be evaluated with a test for the presence of unobserved heterogeneity (H0: no heterogeneity). The motivation for using this test is that, if individual effects are absent, the pooled OLS will be a consistent estimator, despite not fully efficient given the presence of heteroscedasticity.

We find little evidence of robust Granger causality from per capita GDP to government expenditure across econometric specifications, with only one model indicating a negative short- and long-run effect of total government expenditure on output growth (Table 1).

However, there is stronger evidence supporting the reverse relationship, i.e. from government expenditures to per capita GDP, therefore favouring the idea of Wagner’s law. There are significant short- and long-run effects and we reject the null of no Granger-causality using our two-step Hansen incremental test, and diagnostics are well behaved (Table 2).

Redoing the OECD sub-sample (not shown), we get slightly stronger results favouring Granger causality from government spending to GDP for a positive short-run effect in three out of six models. Nevertheless, no significant long-run effect emerges. For the OECD, the reverse relationship still holds with evidence of Granger causality from GDP to government spending, as well as positive and significant short- and long-run effects in both the pooled OLS and fixed effects (FE) models.

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\(^2\) Total government expenditures and revenues (% GDP) were converted to nominal levels, deflated using the CPI and scaled by population.

\(^3\) In our setting, the SYS-GMM uses the standard moment conditions, while SYS-GMM-1 (modified 1) only uses the lagged first differences of \( y_{it} \) dated \( t-2 \) (and earlier) as instruments in levels and SYS-GMM-2 (modified 2) only uses lagged first differences of \( x_{it} \) dated \( t-2 \) (and earlier) as instruments in levels.

\(^4\) Under the null, \( D_{RU} \) is asymptotically distributed as \( \chi^2 \) where \( r \) is the number of restrictions.

\(^5\) See Bond and Windmeijer (2005).

\(^6\) Approximate SE estimate for this long-run effect computed using the Delta method.
Table 1. Panel Granger causality – GDP per capita and total government expenditures per capita (full sample)

<table>
<thead>
<tr>
<th>Dep.Var.</th>
<th>real GDPpc</th>
<th>OLS levels</th>
<th>Within group (FE)</th>
<th>DIF-GMM</th>
<th>SYS-GMM</th>
<th>SYS-GMM-1</th>
<th>SYS-GMM-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>Instrument set</td>
<td>None</td>
<td>None</td>
<td>Full</td>
<td>Full</td>
<td>Reduced</td>
<td>Reduced</td>
<td>Reduced</td>
</tr>
<tr>
<td>Lag1 GDPpc</td>
<td>1.02*** (0.005)</td>
<td>0.90*** (0.044)</td>
<td>0.48*** (0.133)</td>
<td>1.07*** (0.020)</td>
<td>1.08*** (0.028)</td>
<td>0.99*** (0.018)</td>
<td></td>
</tr>
<tr>
<td>Lag1 totgovexp</td>
<td>0.00</td>
<td>-0.00</td>
<td>-0.002** (0.000)</td>
<td>-0.00</td>
<td>-0.00</td>
<td>-0.00</td>
<td>-0.00</td>
</tr>
<tr>
<td>Obs.</td>
<td>426</td>
<td>426</td>
<td>320</td>
<td>426</td>
<td>426</td>
<td>426</td>
<td>426</td>
</tr>
<tr>
<td>R²</td>
<td>0.99</td>
<td>0.78</td>
<td>0.37</td>
<td>0.29</td>
<td>0.28</td>
<td>0.40</td>
<td>0.01</td>
</tr>
<tr>
<td>AB AR(1) (p-value)</td>
<td>0.96</td>
<td>0.24</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>Hansen p-value</td>
<td>0.24</td>
<td>0.24</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Granger causality p-value</td>
<td>0.95</td>
<td>0.47</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Unobs. heterogeneity</td>
<td>0.44</td>
<td>0.02</td>
<td>0.44</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>LR effect point estimate</td>
<td>-0.0004 (0.0007)</td>
<td>-0.001 (0.0019)</td>
<td>-0.0004* (0.0002)</td>
<td>0.001</td>
<td>0.003</td>
<td>-0.01</td>
<td>(0.026)</td>
</tr>
</tbody>
</table>

Notes: Our 5-year averages data set was used to assess Granger causality. Year dummies are included in all models (coefficients not reported). Figures in parenthesis below point estimates are SEs. The GMM results reported here are two-step estimates with heteroscedasticity-consistent SEs. The Hansen test is used to assess the overidentifying restrictions; the test uses the minimized value of the corresponding two-step GMM estimator. The difference Hansen test is used to test the additional moment conditions used by the system-GMM estimators in which SYS-GMM uses the standard moment conditions, while SYS-GMM-1 only uses the lagged first differences of GDPpc dated t-2 (and earlier) as instruments in levels and SYS-2 only uses lagged first differences of totgovexp_gdp dated t-2 (and earlier) as instruments in levels. The heterogeneity test is used to test the null that there are no individual effects (see text). The Granger causality test examines the null hypothesis that GDPpc is not Granger caused by totgovexp_gdp; the test statistic is criterion based, using restricted and unrestricted models (see main text for details). The LR effect is the point estimate of the long-run effect of totgovexp_gdp on GDPpc. Its SE is approximated using the delta method. *, **, *** denote significance at 10%, 5% and 1% levels.

Table 2. Panel Granger causality – total government expenditures per capita and GDP per capita (full sample)

<table>
<thead>
<tr>
<th>Dep.Var.</th>
<th>totgovexp</th>
<th>OLS levels</th>
<th>Within group (FE)</th>
<th>DIF-GMM</th>
<th>SYS-GMM</th>
<th>SYS-GMM-1</th>
<th>SYS-GMM-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>Instrument set</td>
<td>None</td>
<td>None</td>
<td>Full</td>
<td>Full</td>
<td>Reduced</td>
<td>Reduced</td>
<td>Reduced</td>
</tr>
<tr>
<td>Lag1 totgovexp</td>
<td>0.04 (0.201)</td>
<td>-0.98** (0.395)</td>
<td>-1.63*** (0.476)</td>
<td>-0.14 (0.127)</td>
<td>-0.12 (0.073)</td>
<td>-1.68*** (0.166)</td>
<td></td>
</tr>
<tr>
<td>Lag1 GDPpc</td>
<td>2.43** (0.950)</td>
<td>32.76*** (8.946)</td>
<td>25.28 (24.939)</td>
<td>6.45* (3.635)</td>
<td>9.49*** (2.941)</td>
<td>12.29** (6.223)</td>
<td></td>
</tr>
<tr>
<td>Obs.</td>
<td>320</td>
<td>320</td>
<td>226</td>
<td>320</td>
<td>320</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td>R²</td>
<td>0.01</td>
<td>0.19</td>
<td>0.26</td>
<td>0.29</td>
<td>0.29</td>
<td>0.25</td>
<td>0.01</td>
</tr>
<tr>
<td>AB AR(1) (p-value)</td>
<td>0.96</td>
<td>0.11</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>AB AR(2) (p-value)</td>
<td>0.65</td>
<td>0.13</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Hansen p-value</td>
<td>0.24</td>
<td>0.24</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Granger causality p-value</td>
<td>0.01</td>
<td>0.00</td>
<td>1.00</td>
<td>0.13</td>
<td>0.00</td>
<td>0.00</td>
<td>2.51* (1.287)</td>
</tr>
<tr>
<td>Unobs. heterogeneity</td>
<td>0.44</td>
<td>0.02</td>
<td>0.44</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>16.54*** (3.053)</td>
</tr>
<tr>
<td>LR effect point estimate</td>
<td>2.51* (1.287)</td>
<td>16.54*** (3.053)</td>
<td>9.62 (10.053)</td>
<td>5.67 (3.649)</td>
<td>8.47*** (2.682)</td>
<td>4.59*** (2.166)</td>
<td></td>
</tr>
</tbody>
</table>

Note: See Table 1, mutatis mutandis.
III. Concluding Remarks

In a context where government spending and revenue have increased throughout time, we use a panel data set of 155 developed and developing countries for the period 1970 to 2010, to assess in which way runs causality and also test for the possibility of the Wagner’s law. We find little evidence of Granger causality from per capita GDP to government expenditure across our econometric specifications. However, there is stronger evidence supporting the reverse relationship, from government expenditures to per capita GDP, therefore favouring the idea of Wagner’s law. In particular, there are also significant short- and long-run effects.

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References


