

# **DOCUMENTOS DE ECONOMÍA Y FINANZAS INTERNACIONALES**

## **Working Papers on International Economics and Finance**

**DEFI 16-06  
February 2016**

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**Asociación Española de Economía y Finanzas Internacionales  
[www.aefi.com](http://www.aefi.com)  
ISSN: 1696-6376**

# **Public debt and economic growth: An empirical evaluation**

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## **Abstract**

Based on a data set of 115 economies, this paper empirically investigates the relation between public debt and economic growth. We find that those countries that present low public debt are characterized by higher economic growth, while the smallest growth rates are associated with high public debt. Nevertheless, this conclusion is tempered when we analyse the countries by income level: low-income countries have a different behaviour with respect to lower-middle, upper-middle and high income countries.

JEL classification numbers: C32, H63, O40, O57.

KEY WORDS: Public debt, economic growth.

## **I. Introduction**

There is a large body of literature investigating the relationship between public debt and economic growth, the results being far from conclusive [see Panizza and Presbitero (2013) for a survey].

The purpose of this paper is to contribute to the literature by performing a fresh and comprehensive assessment of this hypothesis in a large cross-section of countries over a long sample. The key questions that guide our analysis are: (i) is economic growth affected by the level of public debt? and (ii) does it depend upon the income level? Answers to these questions seem relevant as they have direct implications for policy makers and academic researchers.

The paper is organised as follows. Section II briefly reviews the empirical literature on public debt and economic growth. Section III details the data. Section IV describes the empirical strategy and reports the results. The paper ends with some concluding remarks.

## **II. Literature Review**

Economic theory and empirical studies provide mixed results on the relationship between public debt and economic growth. According to the conventional perspective is based on that the increase of public debt to finance government deficit can promote aggregate demand and economic performance in the short-term, nevertheless when there is not a strict control of debt accumulation it can be possible capital outflows and important reduction in output in the long-term (Elmendorf and Mankiw, 1999). In other words, when the government deficit increases, the economic growth can be affected negatively through two different channels: on the one hand, it is related to higher interest rates discouraging investment and on the other hand, the increase in investors' risk aversion favors bonds of countries with low default risk. Therefore, if the economic growth decreases some policymakers consider that it should be implemented expansionary fiscal policies in order to maintain welfare state since the government revenues also decline [see for instance, Krugman (2011) or DeLong and Summers (2012)]. On the contrary, authors as Cochrane (2011) or Reinhart and Rogoff (2010),

among others, indicate that higher levels of public debt reduce significantly the economic performance and for this reason, they justify austerity policies to guarantee the confidence of economic agents and improve their expectations. Most of this literature focuses mainly on the impact of indebtedness on economic growth and only a few studies the other way around.

Modigliani (1961) concludes that the national debt is a burden for next generations due to the lower income generated by a lower stock of private capital. In the same vein, Diamond (1965) argues that both public external and internal debt reduce the available lifetime consumption of economic agents and also affect their savings and the capital stock. Applying endogenous growth models, Aizenman *et al.* (2007) identify a negative relationship between public debt and economic performance.

Analyzing the impact of external debt on the economy authors as Krugman (1988), Aschauer (2000) or Clements *et al.* (2003) suggest that foreign debt is able to stimulate private investment up to certain point and beyond that threshold the debt overhang can generate a negative impact on economic growth because both domestic and foreign investors will not provide more capital. Other channel could be through long-run interest rates (Gale and Orzag, 2003; Baldacci and Kumar, 2010), since if government budget deficits are financed with more debt this will translate in higher long-run interest rates promoting private investment outflows and reducing potential economic growth.

Focusing on empirical studies there is still no consensus on the relationship between these two variables. Using a static linear panel data approach, Tas *et al.* (2013) investigate the impact of eleven macroeconomic indicators on gross domestic product volume. Analyzing 31 EU member and EU candidate countries for the period 2002-2012, they obtain that general government gross debt is not a significant regressor to explain the economic growth. A statistically significant relationship between gross government debt and per capita economic growth is not identified when Schelarek (2005) studies 24 industrial economies during 1970-2002. Similarly, Afonso and Jalles (2013) obtain a similar average economic performance regardless of the level of debt.

Apart from sovereign long-term nominal and real interest rates, Checherita-Westphal and Rother (2012) use private savings, public investments and total factor productivity

as other channels through which it is explained that government debt have influence on the economic growth. They study a non-linear relationship across different models for 12 Euro Area countries over four decades starting in 1970. Given that lower economic performance can be associated with higher level of indebtedness, these authors take into account reverse causation and applying panel fixed-effects techniques corrected for autocorrelation and heteroskedasticity identifying an inverted U-shape (non-linear relationship). They find that between 90 and 100 percent debt to GDP, further increases on debt would reduce economic growth. Although their confidence intervals suggest that the negative impact could start even around 70 or 80 percent of GDP.

Considering different exchange rate arrangement, political systems, institutions and historic contexts Reinhart and Rogoff (2010 and 2011) study one of the most enlarged database including forty-four countries over two hundred years. Focusing directly on total public debt (domestic and external), they identify a weak relationship between gross central government debt and real GDP growth when debt is below 90 percent of GDP, nevertheless once it exceeds this threshold<sup>1</sup> economic growth slows significantly. In fact, above this threshold, the median economic growth decreases by one percent and the average economic growth falls almost four percent with respect to the lower burden groups. When they focus on external debt (public plus private debt), their results suggest that above 60 percent of GDP, annual economic growth reduces almost two percent and for higher levels of debt growth rates diminish approximately in half. In the same vein, Caner *et al.* (2010) obtain a similar non-linearity effect on growth, since they state that above 77 percent of GDP additional debt affects negatively output growth, however for moderate levels of public debt contribute to increase investment and get faster economic growth.

Presbitero (2012) detects a different behavior for developing countries. In this case, higher public debt implies lower economic growth up to a threshold of 90 percent of GDP, however from this magnitude it has not effect on the dependent variable [a similar conclusion arises in Cordella *et al.* (2010) with external debt]. This non-linear effect is explained by the author by country-specific factors, because highest level of debt should be related to sound macroeconomic policies and confident and stable institutional

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<sup>1</sup> The threshold used by them for public debt in advanced and emerging economies is similar.

framework. On contrary, Abbas and Christensen (2010) using a panel data of low-income and emerging countries, describe a positive contribution to economic growth when domestic debt presents moderate levels, nevertheless once represents more than 35 percent of bank deposits has a negative impact on growth due to inflationary pressures and the crowding out of private sector.

Instead of applying a descriptive analysis as in Reinhart and Rogoff (2010 and 2011), Égert (2013) uses nonlinear threshold models based on a similar database to identify the debt threshold beyond which negative effects for economic growth start to appear. This paper highlights that nonlinear effects are very sensitive to data frequency, time and country dimension and other assumptions. The formal econometric test shows that the threshold can be lower than 90 percent, even between 20 and 60 percent of GDP. In fact, these results are maintained when it is used a multivariate model including traditional explanatory factors of long-term economic growth in a context of uncertainty.

Trying to avoid the problem of endogeneity, since it is possible to have a bi-directional causality between these two variables, Kumar and Woo (2010) achieve a linear relationship for 38 advanced and emerging countries for a much shorter time horizon, showing that when public debt increase in a 10 percent the annual per capita real GDP growth experiments a fall of 0.2 percentage points. In the same line, Schclarek (2005) shows no evidence of an inverted U-shape in 59 developing countries for more than 30 years, however finds that foreign debt accumulation decreases per capita output growth in a linear way. Similar results have been reached when a panel of 152 developing economies over the period 1977-2002 is analyzed in Presbitero (2005). Although debt service is not significant across any specification in this paper, debt stock indicators are always significant displaying an adverse impact on economic growth. In fact, the negative effect ranges between 1.02 to 1.50 for the deb-to-GDP ratio using different specifications. On average, an increase of 10 percent of external debt reduces economic growth by 0.11. This effect is stronger in low-income countries. The transmission channels through which this author justify the negative linear relationship between external debt and economic performance is the liquidity constraint, the macroeconomic instability due to uncertainty, lower efficiency of investment and its effect on macroeconomic policies and institutional development. A similar argument is used by

Pattillo *et al.* (2002) to explain how high levels of external debt diminish economic growth along different robust econometric methodologies since instead of reducing the investment volume it goes down the efficiency of it.

Greiner (2011) analyze three different debt policies to evaluate the long-run growth and welfare effects. To that end, this paper uses an endogenous growth model with externalities of capital and elastic labour supply. If the governments apply the balanced budget rule or a rule in which public debt grows less than all other economic variables in the long-run it is able to achieve a higher balanced economic growth. Chudik *et al.* (2013) also examine the long-term effects of public debt on growth employing a cross-sectionally augmented distributed lag methodology. These authors emphasize that the results would depend whether the increase of debt is permanent or temporary (to smooth out business cycle fluctuations), since only if it is permanent it will notice the negative impact on growth in the long-term. They indicate that after periods characterized by high levels of debt, it is possible to implement a fiscal policy compatible with Keynesian deficit spending, but it must be accompanied by credible announcements of reducing the debt burden to levels considered as normal. One of the main limitations of this paper is the absence of a specific estimation of this turning point in which there is no credible expectations of a reversal in the debt pattern.

Most of the authors focus mainly on the impact of indebtedness on economic growth, disregarding the possibility of a reverse causality running from growth to debt. To fill this gap in the literature, some papers have studied the causal relationship between these two variables. However, there is currently no consensus among economist in this area. For instance, Ferreira (2009) find a bi-directional causal relationship between public debt and growth when analyze 20 OECD countries during thirteen years. Applying a different methodology (instrumental approach), Panizza and Presbitero (2014) do not detect a causal connection. In the same line, Puente-Ajovín and Sanso-Navarro (2015) show that government debt does not cause real GDP growth using a panel bootstrap Granger causality test in 16 OECD countries from 1980 to 2009. In contrast, their paper supports the idea that non-financial private debt affect to real economic performance. More recently, examining eleven peripheral and central EMU countries, Gómez-Puig and Sosvilla-Rivero (2015) confirm that there is not a negative causation between sovereign debt and economic growth when they consider the whole sample period

(1980-2013). Nevertheless, they find an inverse Granger-causality relationship from 2007 or 2009<sup>2</sup> to the end of the period above a debt threshold that ranges from 56 to 103%. This paper suggests that an increase in public indebtedness would reduce economic growth.

### **III. Data**

We employ data for a total of 115 countries, both developed and developing countries over an extended period of time (1970-2013). The 115 countries are: Algeria, Argentina, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Bhutan, Bolivia, Brazil, Bulgaria, Burundi, Cameroon, Canada, Central African Republic, Chile, China, Colombia, Congo Democratic Republic, Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt Arab Republic, El Salvador, Estonia, Ethiopia, Fiji, Finland, France, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Honduras, Hong Kong SAR, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea Democratic Republic, Kyrgyz Republic, Latvia, Lesotho, Lithuania, Luxembourg, Malaysia, Maldives, Malta, Mauritius, Mexico, Moldova, Mongolia, Morocco, Myanmar, Nepal, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Portugal, Romania, Russian Federation, San Marino, Senegal, Seychelles, Sierra Leone, Singapore, Slovak Republic, South Africa, Spain, Sri Lanka, St. Vincent and the Grenadines, Sweden, Switzerland, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United States, Uruguay, Vanuatu, Venezuela, Zambia and Zimbabwe.

To assess real economic growth, we use the annual percentage change rate of the GDP at market prices expressed in constant US\$2005 taking from the World Bank National Accounts and OECD National Accounts data.

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<sup>2</sup> These breakpoints are identified endogenously.



## **IV. Empirical Strategy and Results**

### *IV.1 Empirical strategy*

We form groups of countries at the end of each year based on total (domestic plus external) gross central government debt as a share of GDP taking from Reinhart and Rogoff (2011) and from Datastream.

In order to create our debt classification we adopt the following procedure. First, we calculate the percentiles 25, 50 and 75 for our distribution. Then we apply the following criteria: if the total gross central government debt is less or equal than percentile 25 we categorize this country as low debt group, if the total of indebtedness is between percentile 25 and percentile 50 will be consider as lower-middle debt group, if the central debt is between percentile 50 and percentile 75 is upper-middle debt group and finally if it exceeds percentile 75 we assign it on high debt group.

Following Sarno and Schmeling (2014), and starting in 1970, we recursively form groups of countries based on the debt classification and we track their growth performance. The dynamic rebalancing of country groups enables us to look at the average growth performance of groups of countries with similar level of indebtedness.

This procedure circumvents the need to assume a specific channel through which public debt might influence growth. Additionally, this approach produces results which are readily interpretable in terms of economic significance, since the difference in growth differentials between groups directly yields an estimate of how much higher the rate of growth is in countries with a given level of indebtedness versus countries with an alternative one.

### *IV.II Empirical results*

We considered four statistics to evaluate the economic growth performance of each group of countries: the mean, the median, the 20% trimmed mean and the 20% winsorized mean.

Table 1 (Panel A) presents the results. As can be seen, those countries that present low public debt are characterized by higher economic growth, while the smallest growth

rates are associated with high public debt. In order to investigate the existence of means equality between different debt groups, first it has been implemented several variance equality test in which the null hypothesis contrast what is called homogeneity of variance (see for instance, Levene, Brown-Forsythe, Bartlett test, among others). Depending on whether we reject or accept the null hypothesis of variance equality, Table 1 presents the results of Welch F-test or ANOVA F-test, respectively. These formal tests of mean equality indicate that there are indeed significant differences between low and high debt groups in terms of economic growth. Regardless of the method used, those countries with the highest level of debt show almost one percent less in its economic growth rate.

To assess the robustness of our results, we divide economies under study in four income groups using the World Bank's classification: low income, lower middle income, upper middle income and high income. Given that income classifications are set each year based on their per capita income data, we recursively formed groups of countries based on the public debt and income classifications, tracking their growth performance. In this case, we need to clarify that we calculate different percentiles 25, 50 and 75 for each income countries groups in order to get a more accurate debt classification<sup>3</sup>. Panels B to E in Table 1 report the results. It can be seen that low-income countries have a different behaviour with respect to lower-middle, upper-middle and high income countries. Except for the case of upper middle versus high debt, clearly we can reject the null hypothesis of formal mean equality tests regardless of whether we use mean, median, winsorized mean or trimmed mean. As the level of debt increases the economic growth experiences a progressively decrease. Comparing our four statistics we can say that the highest debt group is associated with the lowest economic growth (around 3% of the GDP), while the upper-middle debt group almost reaches a 4%. It is possible to obtain a higher level of output for lower-middle debt group and even higher for countries that try to avoid excessive budget deficits. Analyzing lower-middle-income countries, there are only significant statistical differences between low and high debt indicating that austerity policies suppose higher output. Nevertheless, for upper-middle-income and high-income countries it cannot be appreciated any differences in terms of growth studying different level of indebtedness.

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<sup>3</sup> We have also used for the debt classification the 25, 50 and 75 percentiles for all the countries in the sample. The results (not shown here to save space but available from the authors upon request) render the same qualitative conclusions as when the 25, 50 and 75 percentiles for each income countries groups were used.

Our results suggest that the level of debt accumulation specially matters for low and lower-middle-income countries due to the fact that higher levels of debt imply lower economic growth. For this reason, it must have a very strict control of indebtedness since there are significant differences between low and high debt groups. However, for upper-middle-income and high-income countries it seems that economic growth is not affected by the level of debt.

#### **IV. Concluding remarks**

We empirically investigate the relation between public debt and economic growth using annual data for 115 economies covering the 1970-2013 period.

Our results indicate that those countries that present low public debt are characterized by higher economic growth, while the smallest growth rates are associated with high public debt. Nevertheless, this conclusion is tempered when we analyse the countries by income level: low-income countries have a different behaviour with respect to lower-middle, upper-middle and high income countries.

#### **Funding**

This work is supported by the Government of Spain under Grant ECO2011-23189.

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**Table 1: Empirical results**

	Mean	Median	Winsorised mean	Trimmed mean
Panel A: All countries				
Low debt	4.0617 (15.9072)	3.9340 (16.7370)	4.0040 (16.1417)	3.9684 (16.4490)
Lower middle debt	3.7831 (12.7679)	3.9852 (13.8740)	3.9337 (14.7046)	3.9384 (14.4672)
Upper middle debt	3.6669 (15.0041)	3.6103 (17.7815)	3.6700 (17.8155)	3.6842 (18.6549)
High debt	2.8717 (9.2848)	3.0970 (10.0438)	3.0387 (10.9862)	3.0623 (10.7929)
Low vs Lower middle debt	0.5072 [0.4783]	0.0190 [0.8906]	0.0371 [0.8477]	0.0068 [0.9345]
Low vs Upper middle debt	1.2478 [0.2672]	1.0859 [0.3004]	1.0727 [0.3033]	0.8311 [0.3646]
Low vs High debt	8.8030 [0.0039]	4.6605 [0.0337]	6.7504 [0.0111]	5.9189 [0.0171]
Lower middle vs Upper middle debt	0.0916 [0.7629]	1.1356 [0.2896]	0.6099 [0.4370]	0.5714 [0.4518]
Lower middle vs High debt	4.5278 [0.0363]	4.4423 [0.0380]	5.4102 [0.0224]	4.9642 [0.0285]
Upper middle vs High debt	4.0690 [0.0469]	1.9334 [0.1686]	3.3511 [0.0710]	3.2359 [0.0761]

**Table 1 (continued)**

	Mean	Median	Winsorised mean	Trimmed mean
Panel B: Low-income countries				
Low debt	6.2576 (10.3822)	6.3390 (10.4411)	6.3487 (10.4939)	6.3471 (10.4871)
Lower middle debt	5.0251 (10.6811)	4.9141 (14.1079)	4.9509 (13.7923)	4.9463 (13.9260)
Upper middle debt	3.3178 (7.8511)	3.8450 (9.9427)	3.7390 (9.3380)	3.7572 (9.4617)
High debt	2.6122 (5.6908)	3.1638 (7.4990)	2.9775 (6.5574)	3.0113 (7.1739)
Low vs Lower middle debt	2.5819 [0.1121]	4.1447 [0.0465]	3.9485 [0.0511]	3.9845 [0.0501]
Low vs Upper middle debt	15.9494 [0.0001]	12.0050 [0.0009]	12.9397 [0.0006]	12.8012 [0.0006]
Low vs High debt	23.4250 [0.0000]	18.7384 [0.0000]	21.2355 [0.0000]	20.8397 [0.0000]
Lower middle vs Upper middle debt	7.3058 [0.0084]	4.2071 [0.0436]	5.0634 [0.0272]	4.9665 [0.0287]
Lower middle vs High debt	13.4638 [0.0004]	10.0675 [0.0021]	12.5258 [0.0007]	12.2034 [0.0008]
Upper middle vs High debt	1.2723 [0.2626]	1.4089 [0.2387]	1.7142 [0.1941]	1.6599 [0.2012]



**Table 1 (continued)**

	Mean	Median	Winsorised mean	Trimmed mean
Panel C: Lower-middle-income countries				
Low debt	4.4990 (11.8179)	4.8496 (14.0197)	4.5375 (12.3577)	4.5948 (12.9212)
Lower middle debt	4.1543 (9.6880)	4.2840 (11.0099)	4.3496 (11.2192)	4.3477 (11.3688)
Upper middle debt	4.0078 (13.0037)	3.9830 (14.4720)	3.9924 (14.2144)	4.0131 (14.6345)
High debt	3.3051 (7.7630)	3.6240 (10.9768)	3.3843 (9.3771)	3.4387 (9.7707)
Low vs Lower middle debt	0.3604 [0.5499]	1.1764 [0.2812]	0.1235 [0.7261]	0.2235 [0.6376]
Low vs Upper middle debt	1.0103 [0.3178]	3.8627 [0.0527]	1.3983 [0.2404]	1.6876 [0.1975]
Low vs High debt	4.3572 [0.0399]	6.5750 [0.0121]	4.9901 [0.0282]	5.3392 [0.0233]
Lower middle vs Upper middle debt	0.0769 [0.7823]	0.3989 [0.5294]	0.5567 [0.4579]	0.5054 [0.4793]
Lower middle vs High debt	1.9753 [0.1636]	1.6732 [0.1994]	3.3048 [0.0726]	3.0587 [0.0840]
Upper middle vs High debt	1.7877 [0.1852]	0.6978 [0.4059]	1.7564 [0.1887]	1.6575 [0.2015]

**Table 1 (continued)**

	Mean	Median	Winsorised mean	Trimmed mean
Panel D: Upper-middle-income countries				
Low debt	3.3495 (8.8814)	3.4235 (8.8633)	3.4260 (8.7585)	3.4266 (8.7801)
Lower middle debt	3.5622 (6.7276)	3.6840 (7.3535)	3.6656 (7.3170)	3.6691 (7.3328)
Upper middle debt	4.0046 (7.6995)	4.0141 (7.7654)	4.0371 (7.7877)	4.0348 (7.7975)
High debt	3.3774 (5.7529)	3.3504 (5.7303)	3.3679 (5.7387)	3.3651 (5.7385)
Low vs Lower middle debt	0.1079 [0.7434]	0.1705 [0.6807]	0.1428 [0.7064]	0.1469 [0.7025]
Low vs Upper middle debt	1.0397 [0.3108]	0.8374 [0.3628]	0.8854 [0.3494]	0.8807 [0.3507]
Low vs High debt	0.0016 [0.9682]	0.01088 [0.9172]	0.0068 [0.9345]	0.0076 [0.9307]
Lower middle vs Upper middle debt	0.3553 [0.5527]	0.2100 [0.6480]	0.2653 [0.6079]	0.2578 [0.6130]
Lower middle vs High debt	0.0545 [0.8160]	0.1870 [0.6666]	0.1483 [0.7012]	0.1549 [0.6949]
Upper middle vs High debt	0.6394 [0.4262]	0.7231 [0.3976]	0.7305 [0.3952]	0.7332 [0.3943]

**Table 1 (continued)**

	Mean	Median	Winsorised mean	Trimmed mean
Panel E: High-income countries				
Low debt	2.8562 (12.1182)	2.7196 (11.9641)	2.7343 (12.5503)	2.7333 (12.5634)
Lower middle debt	3.0625 (7.5634)	2.9433 (8.3672)	3.0962 (8.4797)	3.0599 (8.4628)
Upper middle debt	3.0457 (9.6128)	2.8831 (10.8494)	2.8902 (10.5921)	2.8879 (10.6575)
High debt	3.5444 (8.5501)	3.0287 (7.4922)	3.1855 (7.8805)	3.1533 (7.8365)
Low vs Lower middle debt	0.1939 [0.6611]	0.2853 [0.5946]	0.7242 [0.3972]	0.5988 [0.4412]
Low vs Upper middle debt	0.2303 [0.6325]	0.2187 [0.6412]	0.1992 [0.6565]	0.1978 [0.6577]
Low vs High debt	2.0832 [0.1536]	0.4444 [0.5069]	0.9651 [0.3296]	0.8428 [0.3620]
Lower middle vs Upper middle debt	0.0011 [0.9740]	0.0186 [0.8917]	0.2042 [0.6525]	0.1449 [0.7044]
Lower middle vs High debt	0.6918 [0.4079]	0.0254 [0.8737]	0.0269 [0.8702]	0.0298 [0.8633]
Upper middle vs High debt	0.9138 [0.3418]	0.0906 [0.7642]	0.3666 [0.5465]	0.2993 [0.5858]

Notes:

In the ordinary brackets below the parameter estimates are the corresponding  $t$ -statistics based on Newey and West (1987) standard errors.

XX vs. XX are equality tests. In the square brackets we report the associated  $p$ -values are given.