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## Abstract

Does the public debt improve production capacities and long-term growth, or are its effects limited to the short run? This study assesses how public debt influences economic growth by distinguishing between the effect on the output gap and the effect on the potential output, which were given little interest in the literature despite the divergent ways they react to public indebtedness. Our analysis covers an unbalanced panel of 21 Arab countries between 1990 and 2021 and shows that the public debt helps improve long-term potential growth with a very limited impact on the short term. This conclusion is valid mainly for middle and high-income Arab countries, while there is no evidence that public indebtedness helps low-income Arab countries to improve their economic growth, either in the short or long term.

**Keywords:** Public debt, potential growth, output gap, Arab countries, panel data.

**JEL Classification:** H63, O40, C23.

## ملخص:

هل يحسن الدين العام القدرات الإنتاجية والنمو على المدى الطويل، أم تقتصر آثاره على المدى القصير؟ تقيم هذه الدراسة الطريقة التي يؤثر بها الدين العام على النمو الاقتصادي من خلال التمييز بين التأثير على فجوة الإنتاج والتأثير على الناتج المحتمل، وللذان لم يحظيا باهتمام كبير من طرف الباحثين على الرغم من تباين طرق تفاعلهما مع المديونية العامة. يغطي التحليل الذي تقرره الدراسة 21 دولة عربية بين عامي 1990 و2021، ويظهر أن الدين العام يساعد في تعزيز النمو المحتمل على المدى الطويل مع تأثير محدود للغاية على المدى القصير. يبقى هذا الاستنتاج صالحًا بشكل رئيسي للدول العربية ذات الدخل المتوسط والمرتفع، في حين لا يوجد دليل على أن المديونية العامة تساعد الدول العربية ذات الدخل المنخفض على تحسين نموها الاقتصادي، سواء على المدى القصير أو الطويل.

**الكلمات المفتاحية:** الدين العام، النمو المحتمل، فجوة الإنتاج، الدول العربية، البيانات المقطعة الزمانية.

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## 1. Introduction

Public debt may have a significant role in supporting development and improving countries economic growth, by financing infrastructure, health care, and education investments. These investments are necessary to enhance the economy productivity, but they require large budgets that are difficult to finance relying on tax resources only. Public debt is also an effective tool for government to temporary boost the economy during recession periods by supporting the overall demand, backing vulnerable groups, and providing safe assets - government bonds - to financial markets, helping thus to achieve greater economic stability. However, public debt can also raise serious risks, as it makes countries more vulnerable to external shocks. High government debt levels may also limit the effectiveness of fiscal policy during recessions. This is on top of the negative impact on private investment and, consequently, on economic growth<sup>1</sup>.

According to some research<sup>2</sup>, the world is experiencing a fourth global debt wave since 2010, after the 1970, 1990 and 2000 waves. Even before the Covid-19 pandemic crisis, this fourth wave was considered as the largest, the broadest, and the fastest growing wave<sup>3</sup>. Still, the economic growth rates remain below the countries ambitions, with a persistent set of challenges, especially in developing countries, mainly linked to the increasing public and current account deficits, and high levels of short-term external debt<sup>4</sup>.

For Arab countries, a large difference is observed between economic growth rates and government debt growth rates, which were respectively 2% and 15.3% yearly between 2010 and 2021 for the Arab region, resulting thus on a difference of 13 percentage points in average. Some Arab economies exceeded this level and show almost 20 percentage points difference between the economic growth rates and government debt growth rates.

With this situation, understanding the impact of public indebtedness on economic growth in Arab countries is a priority. Did the public debt pin down the growth, or did it help Arab countries avoid weaker economic growth levels, considering the global economy slowdown? To what

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<sup>1</sup>Alcidi and Gros (2019), Eichengreen (2019), Rogoff (2019)

<sup>2</sup> Kose *et al* (2021)

<sup>3</sup> Malpass (2021)

<sup>4</sup> Kose & Ohnsorge (2019)



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extend the public debt helped the Arab economies to improve their production capacities? Did the public indebtedness improve the potential growth of the Arab countries, or its effects were limited to the short run? And how the Arab countries income level influences this relationship?

This paper seeks to answer these questions through three main sections. The first section sheds light on the economic literature about the link between public indebtedness and economic growth. The second section presents the methodology used to answer our research questions. The last section focuses on the results analysis and discussion.

## 2. Public indebtedness and economic growth

The relationship between public debt and economic growth is one of the most discussed topics in economic research. First, understanding this relationship is a priority for policy makers at national and international levels to guide their decisions. Second, this relationship is not static. The economic literature review shows that there is no consensus about the impact of debt on growth, whether for developed or developing economies, or even for the same economy over different time periods. This impact is linked to countries' economic characteristics and circumstances, public policies, and private sector behavior, in addition to the financial market conditions domestically and globally. These factors vary, which explains the large difference in methodologies used to study the effect of public debt on growth and the resulting impact (cf. Table 1).

**Table 1: Literature review summary**

Author	Country and period	Methodology	Resulting impact
Reinhart and Rogoff (2010)	20 developed and emerging economies 1946-2009	Survey	<ul style="list-style-type: none"><li>Negative above debt-to-GDP ratios of 90% for developed countries and 60% for emerging economies.</li><li>Non-significant otherwise.</li></ul>
Baum, Checherita-Westphal, and Rother (2013)	12 advanced European countries 1990-2010	Dynamic threshold panel model	<ul style="list-style-type: none"><li>Positive bellow debt-to-GDP ratios of 67%.</li><li>Negative above 95%.</li><li>Non-significant otherwise.</li></ul>

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Lof and Malinen (2013)	20 developed countries 1954-2008	GMM, panel VAR model	<ul style="list-style-type: none"> <li>No evidence for a robust effect on debt to growth, even for higher levels debt-to-GDP ratios.</li> <li>Growth rate has a negative impact on debt, which explains the negative correlation in other studies.</li> </ul>
Herndon, Ash and Pollin (2014)	20 developed and emerging economies 1946-2009	Survey	<ul style="list-style-type: none"> <li>Positive even above debt-to-GDP ratios of 90%.</li> </ul>
Panizza and Presbitero (2014)	OECD countries 1946-2009	Instrumental variable approach	<ul style="list-style-type: none"> <li>There is no evidence that public debt has a causal effect on economic growth, either negative or positive.</li> </ul>
Blake (2015)	Jamaica 1990-2014	ARDL model	<ul style="list-style-type: none"> <li>Negative above debt-to-GDP ratios of 100% for total public debt.</li> <li>Negative above debt-to-GDP ratios of 55% for external debt.</li> </ul>
Owusu-Nantwi and Erickson (2016)	Ghana 1970-2012	VECM approach	<ul style="list-style-type: none"> <li>Positive and statistically significant long-run relationship.</li> </ul>
Chudik, Mohaddes, Pesaran and Raissi (2017)	40 countries 1965-2010	dynamic heterogeneous panel data models	<ul style="list-style-type: none"> <li>No evidence for a universally applicable threshold effect in the relationship between public debt and economic growth.</li> </ul>
Fernando and Serafim (2018)	Angola 2004-2015	Spatial autocorrelation model	<ul style="list-style-type: none"> <li>Public debt has negative impact on growth.</li> </ul>
Guei (2019)	13 emerging countries. 1990-2016	ARDL model	<ul style="list-style-type: none"> <li>No robust effect of external debt on economic growth in the long run.</li> <li>Significant negative effect in the short run.</li> </ul>
Law, Ng, Kutan, Law (2021)	71 developing countries. 1984-2015	Dynamic panel threshold model	<ul style="list-style-type: none"> <li>Negative above debt-to-GDP ratios of 51%.</li> <li>Non-significant bellow.</li> </ul>
D'Andrea (2022)	Meta analysis of 422 estimates	Average estimated effect	<ul style="list-style-type: none"> <li>Negative effect of public-debt on growth.</li> </ul>



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Heimberger (2023)	Meta analysis of 816 estimates primary studies	Meta-regression methods	<ul style="list-style-type: none"><li>• Lack of evidence of a consistently negative growth effect of higher public-debt-to-GDP.</li></ul>
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As shown by Table 1, the impact of public debt on economic growth is a controversial topic. One possible explanation for this divergence is the channels through which public debt can affect growth. In fact, depending on how the public debt is used, its impact on GDP growth may differ. On one hand, public debt can improve structural long-term growth, by financing structural investments. On the other hand, public debt can also support short-term growth, for example by enabling governments to increase their consumption to support demand during recession periods. In the first case, the impact of public debt on growth is initially limited, and a negative impact may be recorded in the short-term due to the investments and structural projects expensive imports needs. The positive impact of public debt in this case appears after the completion of these projects. For the second case, the effect of public debt on growth is more important in the beginning when it is used for consumption, but in the medium/long-term this effect reverses.

Many studies already highlight this point, and particularly by researchers from the IMF and the ECB which published early studies in 2010<sup>5</sup> warning that there is little interest on the extent to which large debts are likely to reduce potential growth, that represents the structural long-term growth of the economy. Some studies tried to fill this gap, as Chudik *et al.* (2015), Owusu-Nantwi and Erickson (2016) and Guei (2019), still none of these studies gave interest to the channels specified above and focused more on the threshold on which the public debt's impact reverse. Also, these studies didn't explicitly use the potential growth as the dependent variable; they tried to assess the long-term impact of public debt on real GDP growth using statistical frameworks such as ARDL or VECM. Those approaches assess the long-term relationship between two variables and use them with the real GDP growth as the dependent variable instead of potential growth, assuming that the impact of public debt on these two variables is similar in the long run. This assumption may not always be true as the real GDP also considers the output gap in addition to the potential output.

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<sup>5</sup> Manmohan, Kumar and Woo (2010) and Checherita-Westphal and Rother (2010).

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Our study contributes to the literature on public debt impact on economic growth by clearly differentiating between the impact on potential output, which represents the structural improvement of production capacities (long-term), and the impact on the output gap, capturing the demand driven growth (short-term). Another key contribution of our study to the literature on public debt impact on economic growth is our interest on Arab economies that were not given enough attention.

### 3. Methodology and data

As discussed in the previous section, when assessing the impact of public debt on economic growth directly, the results can be ambiguous due to the consideration of two opposite effects: the impact on potential output and the impact on the output gap.

In fact, the GDP is the sum of these two components and the potential output is an indicator of the supply capacity of an economy: more this indicator is high, more the production capacities of the economy are important, and the economy has a greater ability to provide goods and services. Assessing the public indebtedness impact on the potential output will show to what extend the public debt helped improving the production capacities of the economy and its structural long-term growth.

In the opposite, the output gap, which is the difference between the GDP and the potential output, is an indicator of the demand side of the economy: more this indicator is high more the demand is important. When the output gap is positive this means that the demand of the economy is above its supply, meaning that the economy is consuming more than it can produce. This situation leads to higher GDP growth rates, but it comes with the price of higher inflation and threats of external imbalances. Assessing the impact of indebtedness on the output gap will show to what extent the public debt helped improve the short-run growth and allow a comparison with its impact on the production capacities of the economy and its structural long-term growth.

Our methodology is therefore built on two different models, one for the short-term growth effect with the output gap as dependent variable (1), and the other for the long-run growth with potential output as dependent variable (2):

$$\text{Output\_gap}_{it} = \alpha^{OG} + \delta^{OG} * \text{Debt}_{it} + \beta^{OG} * X_{it}^{OG} + \varepsilon_{it}^{OG} \quad (1)$$

$$\text{Potential\_output}_{it} = \alpha^{PG} + \delta^{PG} * \text{Debt}_{it} + \beta^{PG} * X_{it}^{PG} + \varepsilon_{it}^{PG} \quad (2)$$



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Where  $Debt_{it}$  is the public indebtedness, and  $X_{it}^j$  are vectors of control variables.

For the potential output model, it relies on the growth theories where the long-run growth is a result of capital, labor, and total factor productivity. Therefore, we use as control variables the labor force to population ratio, the gross fixed capital formation to GDP ratio, and the export to GDP ratio respectively as proxies of labor force, capital, and productivity gains. We also assume a log-linearised Cobb–Douglas production function where the dependent variable is the potential GDP logarithm. For the output gap model, the control variables are the world GDP growth to account for the external economic conditions effect<sup>6</sup>, and the unemployment rate to consider the domestic demand effect. In both models, the dependent variables, the potential GDP and the output gap, are used in logarithm to directly obtain semi-elasticities to the debt-to-GDP ratio and facilitate the interpretation. In fact, this choice makes the interpretation of the coefficients ( $\delta^{PG}$ ) and ( $\delta^{OG}$ ) straightforward: what is the percentage increase of the potential GDP and the output gap in reaction to a one percentage point increase of the public debt-to-GDP ratio.

The output gap and the potential output are estimated for each Arab country using the Hodrick-Prescott approach based on the real GDP dynamic. The data used to estimate the models is collected from the IMF Global Debt Database (GDD), for the public debt data, and from the World Bank World Development Indicators (WDI), for the other variables<sup>7</sup>. The panel datasets used for estimation contains 21 Arab countries for the output gap model and 19 Arab countries for potential output model, both datasets are unbalanced<sup>8</sup>. As showed by Table 13 in Appendix 2, our datasets show significant individual and time effects. Therefore, we consider countries and time fixed effects in the models and use the Beck and Katz (1995) panel-corrected standard errors estimator to account for cross-sectional heteroskedasticity and serial correlation<sup>9</sup>. We also suggest an analysis by country's income level in line with the World Bank country classification<sup>10</sup>.

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<sup>6</sup> Exports can also be used as a proxy for external economic conditions, however the exports capture also the competitiveness component which depend on internal and external factors and may result on a less accurate description of the global economic situation.

<sup>7</sup> Please see Appendix 1 Table 6 for more details about data definitions and sources.

<sup>8</sup> Please see Appendix 1 Table 7 and Table 8 for more details about the data coverage.

<sup>9</sup> Please see Appendix 2 for more details about models' validation.

<sup>10</sup> We use the 2022-20233 World Bank country classifications by income level.

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## 4. Results and discussion

The first question of the study aimed to address the effect of public debt in Arab countries on the short-term component of the GDP, i.e. the output gap. Table 2 summarises the analysis results and stands out the dominance of a negative and significant relationship between the public debt and the output gap. In other words, with the increase of public debt as a percentage of GDP, the output gap moves to the opposite direction. Still, this relationship is limited in amplitude: a 1-percentage point (pp) increase in the debt-to-GDP ratio leads to an average 0.01 percent decline in the output gap. Therefore, despite the significant negative relationship between the debt and the output gap, the effect of the former on the latter is weak. The analysis by country income level classification supports this result, with coefficients almost equal to zero and only significant for the middle-income Arab countries group (Table 3).

**Table 2: Estimation results – Output gap model**

Independent variables	Dependent variable Output Gap		
	(1)	(2)	(3)
Debt ratio	-0.011* (0.006)	-0.011* (0.006)	-0.011* (0.006)
Unemployment rate	-0.086** (0.043)	-0.086** (0.043)	
World GDP growth	0.641 (0.555)		
Observations	583	583	583

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Table 3: Estimation results by income classification – Output gap model<sup>11,12</sup>**

	High-income	Middle-income	Low-income
Output Gap	-0.0004 (0.007)	-0.018** (0.008)	-0.002 (0.011)
Observations	181	285	79
Note:	*p<0.1; **p<0.05; ***p<0.01		

<sup>11</sup> In line with the 2022-2023 World Bank country classifications, Bahrain, Emirates, Kuwait, Oman, Qatar, Saudi Arabia are in the High-Income group, Algeria, Comoros, Djibouti, Egypt, Jordan, Lebanon, Mauritania, Morocco, Palestine, Tunisia are in the Middle-Income group, and Sudan, Syria and Yemen are in the Low-Income group.

<sup>12</sup> For each group, the estimation is done separately. Reported results correspond to specification (1) in Table 2, detailed results are in Appendix 3.



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The second question of this study aimed to examine the role played by public indebtedness in improving the long-term component of the GDP in Arab countries. The objective is to assess the effect of public debt on potential output, which reflects an economy's structural production capacity. The results obtained from the panel data analysis for all Arab countries are summarised in Table 4, while Table 5 reports the results by country income level classification.

**Table 4: Estimation results – Potential output model**

Independent variables	Dependent variable		
	Potential output		
	(1)	(2)	(3)
Debt ratio	-0.003 (0.019)	-0.003 (0.018)	-0.001 (0.019)
Labor force ratio	0.300** (0.137)	0.301** (0.137)	
Investment ratio	0.149* (0.078)	0.149* (0.077)	
Export ratio	0.005 (0.048)		
Observations	460	460	460
Note:	*p<0.1; **p<0.05; ***p<0.01		

**Table 5: Estimation results by income classification – Potential output model<sup>13</sup>**

	High-income	Middle-income	Low-income
Potential output	0.122*** (0.026)	0.097*** (0.026)	-0.0004 (0.016)
Observations	120	288	52
Note:	*p<0.1; **p<0.05; ***p<0.01		

Based on these results, the way the public indebtedness affects the potential output is heterogeneous and depends on the country income level group. This relationship is non-significant when considering all Arab countries in one regression, yet it becomes significant for the middle-income and high-income Arab countries groups when they are considered separately. Additionally, the positive effect of the public debt on potential output is higher for the high-

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<sup>13</sup> For each group, the estimation is done separately. Reported results correspond to specification (1) in Table 4, detailed results are in Appendix 3.

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income Arab countries group compared to the middle-income Arab countries group: a 1-pp increase of the debt-to-GDP ratio leads to a 0.12 percent improvement of the potential output for the former group against 0.09 percent for the later, on average.

As discussed in the second section, public debt can improve structural long-term growth when it is used to finance structural investments. In that case, the impact of public debt on growth is initially limited, and a negative impact may be recorded in the short-term due to the investments and structural projects expensive imports needs. The positive impact of public debt in this case appears after the completion of these projects. Public debt can also support short-term growth when used by governments to increase their consumption. In this case, the effect of public debt on growth is more important in the beginning, but it reverses in the long-term.

From this perspective, the review of our results suggests that Arab countries are typically experiencing a situation where the public debt is likely oriented to finance structural investments, which help improve long-term potential growth. This conclusion is valid mainly for the middle and high-income Arab countries and supported by the positive impact of public indebtedness on the potential output. In addition, middle and high-income Arab countries succeeded to fully benefit from public indebtedness in the long run by surpassing its negative implications in the short-term, as showed by the feeble relationship between the public debt and the output gap.

For low-income Arab countries, results didn't show any significant relationship either between the public debt and the output gap or the public debt and the potential output. In other words, there is no evidence that public indebtedness helps low-income Arab countries to improve their economic growth, either in the short term or the long term. As for any regression analysis, limited availability of data may play a role in obtaining non-significant relationships. Still, it is worth mentioning that beyond the limited data challenge, such a situation may also be a result of structural challenges related to debt allocation and management.

Related to the last point, it is important to note that more the outcome of a debt is higher than its cost, more that debt will have positive impact on economic growth. For the public debt, the main cost component is the debt burden paid by governments, and, despite its exogenous nature, which is mostly linked to domestic and external financial conditions, adopting a clear debt management framework may help reduce that burden. A starting point for this is a strong government commitment for a regular communication about the public indebtedness situation and perspectives. On the one hand, this will encourage public debt planification and on the other



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hand, it will send positive signals to debtors, which may help reduce the country's risk premium and increase its access to the debt markets, especially for low-income Arab countries.

The public debt planification may also improve the public debt outcome dimension and for all countries despite their level of income. In fact, debt planification may be a key element to reduce the inefficiencies related to public investment. According to the IMF, emerging countries lose 33 per cent of potential benefits from infrastructure investment because of those inefficiencies, this rate increases to 53 per cent for low-income countries<sup>14</sup>.

Another element which may be significantly improved if Arab countries opt for a public debt planification steaming from a bigger development strategy is the crowding out effect that public debt has on investment. Many studies point out that rising public sector spending, mainly when debt financed, drives down private sector investment and sometimes even more than the public sector spending rise<sup>15</sup>. For Arab countries, this effect is reported by Table 6 which shows the impact of public indebtedness on investment.

**Table 6: Impact of public indebtedness on investment by income classification<sup>16</sup>**

	Dependent variable		
	Investment-to-GDP ratio		
	High-income	Middle-income	Low-income
Public debt-to-GDP ratio	0.021*** (0.012)	-0.062*** (0.012)	-0.057*** (0.016)
Observations	120	288	52

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Results reported in Table 6 show a negative impact of public debt on investment for middle and low-income Arab countries and a positive impact for high-income Arab countries. In all cases, the impact is significant, however it is limited with much less than 0.1 pp variation of the

<sup>14</sup> According to the IMF infrastructure governance initiative estimates: Importance of infrastructure governance at [<https://infrastructuregovern.imf.org/content/PIMA/Home/IMFs-Role.html>].

<sup>15</sup> Cevik (2019), Mao and Yang (2020), Bahal, Raissi and Tulin (2018).

<sup>16</sup> For each group, the estimation is done separately. Reported results correspond to a specification where the Investment-to-GDP ratio is the dependent variable, and the public debt-to-GDP ratio is the independent variable. Estimations are obtained using a panel regression with country and year fixed effects.

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investment ratio for each 1 pp variation of the public debt ratio. In other words, the net outcome of a public indebtedness increase in term of total investment is negative in all cases. Therefore, a public debt planification steaming from a bigger development strategy may be useful for Arab countries, offering a clear roadmap for public and private sectors to coordinate and set partnerships.

## **5. Conclusion**

The aim of this study is to assess how public debt influences economic growth in Arab economies by examining its effects on the output gap and potential output over the period of 1990 and 2021. The investigation has shown two key results. First, despite the negative relationship between the debt and the output gap, the effect of the former on the latter is weak, with coefficients almost equal to zero and only significant for the middle-income Arab countries group. Second, the way the public indebtedness affects the potential output is heterogeneous and depends on the country income level group. This relationship is non-significant when considering all Arab countries in one regression, yet it becomes significant for the middle-income and high-income Arab countries groups when they are considered separately. For low-income Arab countries, results didn't show any significant relationship between the public debt and the potential output.

The review of these results suggests that middle and high-income Arab countries succeed to use the public debt to improve the long-term potential growth while surpassing its negative implications in the short-term. For low-income Arab countries, there is no evidence that the public indebtedness helps improving either short or long-terms economic growth. The factors that may explain this situation might be diverse and different from a country to another, however, a proper starting point to increase the growth efficiency of public indebtedness is strengthening the public debt planification and management. First, this will help Policymakers steering debt toward investments in sectors that promote long-term growth and productivity. Second, it will provide a framework to set a consistent development strategy and ensure its coherence with fiscal policy.

Strengthening the public debt planification and management framework can be useful for middle and high-income Arab countries too. Despite the positive impact of the public debt on the potential growth, the analysis shows a lack of efficiency of the Arab countries' public indebtedness in term of investment, with a much smaller total investment improvement



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compared to the debt increase. Strengthening the public debt planification and management framework can help improving the investment outcomes of public debt by reducing the crowding-out effect and providing a clear roadmap for public and private sectors to coordinate and set partnerships.

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## Appendix 1: Used Data

**Table 7: Data definitions and sources**

<b>Indicator</b>	<b>Definition</b>	<b>Technical notes</b>	<b>Used data sources</b>
Output gap	Difference between real GDP and Potential output.	Estimated by country using HP filter based on real GDP (constant 2015 USD), transformed to hundred logarithm (100*log) unit.	World bank - World Development Indicator database
Potential Output	Level of output reflecting the highest sustainable level of production without stoking inflation (Mitra <i>et al</i> , 2015).	Estimated by country using HP filter based on real GDP (constant 2015 USD), transformed to hundred logarithm (100*log) unit.	World bank - World Development Indicator database
Debt ratio	Government Debt-to-GDP ratio.	No data available for Somalia. General Government debt for Egypt and UAE, and Central Government debt for the rest.	IMF Global Debt Database
Unemployment rate	The share of unemployed labor force seeking employment as percent of total labor force.	Reported by World Bank from the International Labour Organization database ILOSTAT.	World bank - World Development Indicator database
World GDP growth	Yearly growth rate of World GDP.	Real GDP (constant 2015 USD)	World bank - World Development Indicator database
Investment ratio	Gross fixed capital formation as percent of GDP.	Data from the expenditure side recording purchaser prices.	World bank - World Development Indicator database
Labor force ratio	Total labor force as percent of total population.	The midyear values estimates are used.	World bank - World Development Indicator database
Export ratio	Exports of goods and services as percent of GDP.	Data from the expenditure side recording purchaser prices.	World bank - World Development Indicator database



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**Table 8: Data coverage for the Output gap model**

Country	Start year	End year	Available observations
Algeria	1991	2022	32
Bahrain	1991	2022	32
Comoros	1991	2022	32
Djibouti	2013	2022	10
Egypt	1991	2021	31
Emirates	1991	2021	31
Iraq	2004	2022	19
Jordan	1991	2022	32
Kuwait	1992	2022	31
Lebanon	1991	2020	30
Libya	1999	2017	19
Mauritania	1991	2022	31
Morocco	1991	2022	32
Oman	1991	2022	32
Palestine	2000	2022	23
Qatar	2000	2022	23
Saudi Arabia	1991	2022	32
Sudan	1992	2022	31
Syria	1991	2010	20
Tunisia	1991	2022	32
Yemen	1991	2018	28
<b>Total</b>			<b>583</b>

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**Table 9: Data coverage for the Potential output model**

Country	Start year	End year	Available observations
Algeria	1990	2022	33
Bahrain	1990	2021	32
Comoros	1990	2022	33
Djibouti	2013	2020	8
Egypt	1990	2021	32
Emirates	2001	2020	20
Jordan	1990	2019	30
Kuwait	1992	1994	3
Lebanon	1990	2020	31
Mauritania	1990	2022	32
Morocco	1990	2022	33
Oman	1990	2021	32
Palestine	2000	2022	23
Saudi Arabia	1990	2022	33
Sudan	1992	2022	31
Syria	1990	2010	21
Tunisia	1990	2022	33
<b>Total</b>			<b>460</b>

# Public debt and economic growth in Arab countries: structural or short-term benefits?

## Appendix 2: Models' validation

**Table 10: Data descriptive statistics**

	<b>Indicator</b>	<b>Minimum</b>	<b>1st Quantile</b>	<b>Median</b>	<b>Mean</b>	<b>3rd Quantile</b>	<b>Maximum</b>
<i><b>Output gap model</b></i>	Output gap	-44.75	-1.06	-0.03	0.04	1.40	23.34
	Debt ratio	1.19	25.23	52.07	62.44	81.43	495.20
	Unemployment rate	0.10	4.21	9.46	9.95	13.87	31.84
	World GDP growth	-3.07	2.60	3.08	2.92	3.89	6.02
<i><b>Potential output model</b></i>	Potential Output	2,007	2,354	2,455	2429	2536	2,733
	Debt ratio	0.98	28.20	57.00	67.69	88.59	495.20
	Investment ratio	2.18	18.75	23.10	23.60	27.25	93.55
	Export ratio	1.57	18.50	34.37	38.20	47.38	166.72
	Labor force ratio	19.05	26.19	29.90	33.02	35.08	70.34

**Table 11: Independent variables correlation matrix - Output gap model**

	<b>Debt ratio</b>	<b>Unemployment rate</b>	<b>World GDP growth</b>
<b>Debt ratio</b>	1.000	0.232	-0.038
<b>Unemployment rate</b>	0.232	1.000	-0.015
<b>World GDP growth</b>	-0.038	-0.015	1.000

**Table 12: Independent variables correlation matrix – Potential output model**

	<b>Debt ratio</b>	<b>Investment ratio</b>	<b>Export ratio</b>	<b>Labor force ratio</b>
<b>Debt ratio</b>	1.000	-0.195	-0.344	-0.295
<b>Investment ratio</b>	-0.195	1.000	0.157	-0.044
<b>Export ratio</b>	-0.344	0.157	1.000	0.551
<b>Labor force ratio</b>	-0.295	-0.044	0.551	1.000

# Public debt and economic growth in Arab countries: structural or short-term benefits?

**Table 13: Models validation tests p-values**

	Output gap model	Potential output model
<b>F test for country effects</b> <b>(Alternative: significant individual effects)</b>	0.982	<0.01
<b>Lagrange Multiplier Test - time effects (Breusch-Pagan)</b> <b>(Alternative: significant time effects)</b>	<0.01	0.0008
<b>F test for country effects (with time effects)</b> <b>(Alternative: significant individual effects)</b>	<0.01	<0.01
<b>Hausman Test</b> <b>(Alternative: one model is inconsistent)</b>	0.0464	<0.01
<b>Pesaran CD test for cross-sectional dependence in panels</b> <b>(Alternative: cross-sectional dependence)</b>	0.573	0.0195
<b>Breusch-Godfrey/Wooldridge test for serial correlation in panel models</b> <b>(Alternative: serial correlation in idiosyncratic errors)</b>	<0.01	<0.01
<b>Breusch-Pagan test for Heteroskedasticity</b> <b>(Alternative: Heteroskedasticity)</b>	<0.01	<0.01



# Public debt and economic growth in Arab countries: structural or short-term benefits?

## Appendix 3: Detailed estimation results by income classification

**Table 14: Estimation results for High income Arab countries – Output gap model**

Independent variables	Dependent variable		
	Output Gap		
	(1)	(2)	(3)
Debt ratio	-0.0004 (0.007)	-0.0004 (0.007)	-0.003 (0.008)
Unemployment rate	0.296 (0.374)	0.296 (0.374)	
World GDP growth	0.303 (0.441)		
Observations	181	181	181
Note:	*p<0.1; **p<0.05; ***p<0.01		

**Table 15: Estimation results for Middle income Arab countries – Output gap model**

Independent variables	Dependent variable		
	Output Gap		
	(1)	(2)	(3)
Debt ratio	-0.018** (0.008)	-0.018** (0.008)	-0.020** (0.007)
Unemployment rate	-0.054 (0.044)	-0.054 (0.044)	
World GDP growth	0.385 (0.323)		
Observations	285	285	285
Note:	*p<0.1; **p<0.05; ***p<0.01		

# Public debt and economic growth in Arab countries: structural or short-term benefits?

**Table 16: Estimation results for low-income Arab countries – Output gap model**

Independent variables	Dependent variable		
	(1)	(2)	(3)
Debt ratio	-0.002 (0.011)	-0.002 (0.014)	-0.009 (0.011)
Unemployment rate	-0.473 (0.617)	-0.473 (0.617)	
World GDP growth	2.613 (3.210)		
Observations	79	285	285
Note:	*p<0.1; **p<0.05; ***p<0.01		

**Table 17: Estimation results for High income Arab countries – Potential output model**

Independent variables	Dependent variable		
	(1)	(2)	(3)
Debt ratio	0.122*** (0.026)	0.111*** (0.028)	-0.117*** (0.029)
Labor force ratio	0.187 (0.321)	0.342 (0.328)	
Investment ratio	-0.093 (0.193)	0.013 (0.199)	
Export ratio	-0.180*** (0.051)		
Observations	120	120	120
Note:	*p<0.1; **p<0.05; ***p<0.01		

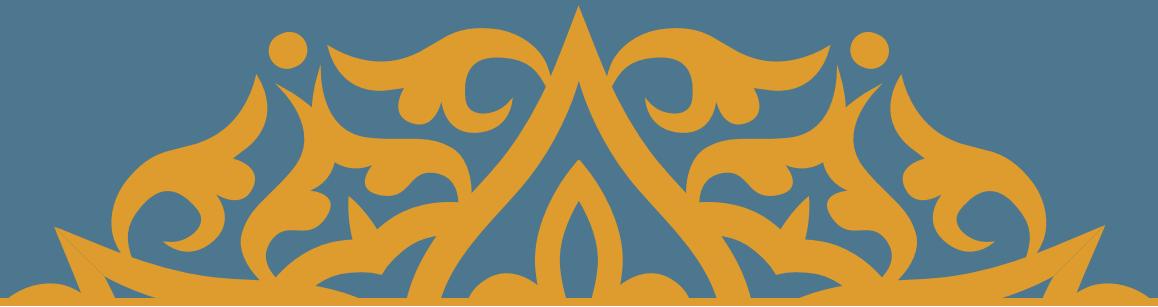
## Public debt and economic growth in Arab countries: structural or short-term benefits?

**Table 18: Estimation results for Middle-income Arab countries – Potential output model**

Independent variables	Dependent variable		
	Potential output		
	(1)	(2)	(3)
Debt ratio	0.097*** (0.026)	0.087*** (0.025)	-0.082*** (0.026)
Labor force ratio	0.614* (0.342)	0.617* (0.337)	0.603* (0.340)
Investment ratio	0.099 (0.080)	0.093 (0.080)	
Export ratio	-0.124 (0.078)		
Observations	288	288	288
Note:	*p<0.1; **p<0.05; ***p<0.01		

**Table 19: Estimation results for Low-income Arab countries – Potential output model**

Independent variables	Dependent variable		
	Potential output		
	(1)	(2)	(3)
Debt ratio	-0.0004 (0.016)	-0.010 (0.012)	-0.011 (0.012)
Labor force ratio	0.822 (0.964)	-0.481 (0.848)	
Investment ratio	0.939*** (0.145)	0.761*** (0.135)	0.740*** (0.130)
Export ratio	-0.621** (0.279)		
Observations	52	52	52
Note:	*p<0.1; **p<0.05; ***p<0.01		



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