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The impact of government expenditure on environmental degradation in MENA countries: an empirical investigation

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Abstract: This paper examines the impact of government expenditure on environmental degradation using panel data for 14 MENA countries over the period 2000–2018. We estimate the total effect of government expenditure on CO_2 emissions by examining the different channels through which government spending may influence the environmental quality, namely the GDP per capita and the institutional quality. Our findings show that the marginal direct effect of government expenditure on CO_2 emissions is negative and significant. In contrary, the effect of government spending conditional on GDP per capita is found to be positive, offsetting a part of the negative direct effect. Moreover, the effect conditional on democracy level, which is a proxy for institutional quality, is found to be negative. This negative effect reinforces the initial direct effect. Hence, the total effect of government expenditure on CO_2 emissions is revealed to be negative. This indicates that government spending can contribute to the reduction of air pollution and the improvement of environmental quality.

Keywords: government expenditure; environment; MENA region; economic growth; democracy.

JEL codes: E60, F64, H50, O44, Q53, Q58.

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1 Introduction

With the advent of various environmental concerns such as air pollution, climate change, and natural resource depletion, environmental sustainability has lately been recognised as a critical objective in many countries. For instance, the Sustainable Development Goals (SDGs) agenda of the United Nations encompasses different environmental goals aimed at alleviating environmental degradation caused mostly by increased economic activity and its harmful effects on the environment.

Since government spending plays an important role in different social and economic activities, many studies argue that government spending could exert an impact on environmental quality (Bernauer and Koubi, 2006; Yuxiang and Chen, 2010; Halkos and Paizanos, 2013, 2016, 2017; Islam and Lopez, 2015; Zhang et al., 2017). On the one hand, more government expenditure may have a positive environmental impact as long as the government is directing its efforts towards the reduction of environmental damages. For instance, this could be achieved by increasing spending on the establishment of higher-quality institutions that help in enforcing the imposed environmental regulations. On the other hand, increased government expenditure may lead to more environmental damage. This negative impact is more likely to occur when the government fails to include environmental sustainability goals into the formulation of its fiscal policies.

In this regard, the main objective of this paper is to study the impact of government spending on environmental quality in the Middle East and North Africa (MENA) countries. The MENA region has been regarded as a region with low levels of environmental quality for decades. For instance, pollution records in the region have shown levels exceeding the world average level of pollution since 1995 (Farzanegan and Markwardt, 2018). This could be attributed to the long history of energy subsidies in the region, which may encourage the inefficient use of fossil fuel and decrease environmental quality, especially if those subsidies are not accompanied by other policies that offset the environmental damages. Therefore, assessing the environmental impact of fiscal spending in MENA countries is critical for driving fiscal policy decisions towards the environmental sustainability goals.

To the best of our knowledge, there has been little research in this area of study in the context of the MENA region, hence further research is needed to get better insights into this region. This study tries to fill this gap in the literature by using data on 14 MENA countries, covering the period between 2000 and 2018.

The study also analyses the different channels through which government spending may affect the environment, namely income per capita and institutional quality. We utilise the overall government expenditure rather than a subset of government spending, such as government expenditure on environmental protection (GEEP), or government expenditure on investment. The overall expenditure will allow us to study the suggested channels since it covers the various aspects affecting the different economic activities that lead to GDP growth and better quality of institutions.

The rest of the paper is organised as follows: Section 2 reviews the literature on the effect of government expenditure on environmental quality. Section 3 describes the model specification, the data, and the estimation methodology used in the analysis. Section 4 presents and analyses the empirical findings of the paper. Finally, Section 5 incorporates the conclusions of our paper and provides some relevant policy recommendations.

2 Literature review

This section examines the theoretical and empirical literature on the effect of government spending on environmental quality. The section begins by introducing the channels that explain the relationship between government expenditure and the environment, starting with the direct channel, moving to the income channel, and lastly to the democracy and the institutional quality channel. Then, the section presents different empirical studies tackling the effect of government expenditure on the environment. Empirical evidence is divided into studies focusing on the direct and indirect effects of overall expenditure on environmental quality, and then studies exploring the composition of government expenditure and its influence on the environment.

2.1 Government expenditure and environmental impact channels: theoretical background

Government spending may have a direct impact on the environment since improved environmental quality can be viewed as a public good. To begin with, the quality of the environment is non-excludable. Clean air and water, for example, may be enjoyed – to a large extent – by everyone. Second, environmental quality is non-rival as one person's usage has little or no influence on the availability of this good to other individuals (Bernauer and Koubi, 2006). Since the government is the main provider of public goods, increased government spending might have a direct effect on environmental quality. Furthermore, the government could play a role in achieving environmental sustainability through allocations towards campaigns that urge individuals to be environmentally responsible (Cristóbal et al., 2021). For instance, Shao et al. (2021) showed that government allocations in the cultural industry boost environmental performance.

In addition to the direct effect that government spending might have on the environment, other channels could enhance or alleviate this impact. Those channels are mainly the country's level of income, as well as the degree of political freedom and institutional quality.

The income level is considered to be one of the determinants of both the extent and the direction of the impact of fiscal expenditure on the environment. This channel is also related to the environmental Kuznets curve (EKC), which hypothesises that environmental degradation increases with the country's income up to a certain level beyond which pollution begins to decrease and environmental quality improves. This suggests the presence of an inverted U-shaped relationship between income level and pollution (Selden and Song, 1994; Shafik, 1994; Grossman and Krueger, 1995). Nonetheless, some other studies have argued that the presence of the EKC and its shape varies depending on the country and/or the econometric model used in the analysis (Holtz-Eakin and Selden, 1995; Stern et al., 1996).

The 'scale effect' and 'income effect' are two main explanations of how income could impact the environment (Lopez et al., 2011). The 'scale effect' indicates that higher economic growth generates more pollution as economic activities put more strain on the environment. For instance, Sharmin and Tareque (2018) concluded that economic growth increases energy consumption, which leads to higher carbon dioxide (CO_2) emissions in the long run. The results also suggested that energy intensity, urbanisation, industrialisation, and growth are the main factors contributing to pollution in Bangladesh since they account for more than 60% of CO_2 emissions.

As for the 'income effect', it poses an argument that as income increases, the demand for better environmental quality increases. This happens as the result of better education and greater awareness of environmental problems in countries with higher development levels. For example, Kim et al. (2020) confirmed that higher air pollution leads to more awareness and reduces public satisfaction with government policies. They also emphasised that higher education levels lead to more public opposition to coal-fired power plants. Similarly, Li et al. (2022) concluded that government expenditure increases the resident's well-being, while higher environmental pollution affects it negatively. Consequently, this emphasises the importance of considering environmental quality while formulating public policies to increase the positive effects of government's efforts on social well-being.

According to the assumptions of the EKC, the income effect dominates the scale effect in developed economies. This goes in line with the assumptions mentioned by Islam and Lopez (2015). They argued that the positive effect of fiscal spending on environmental quality is expected to be more pronounced in developed economies, since the income effect is more likely to be greater than the scale effect at higher levels of development. On the other hand, government spending in developing economies may increase environmental degradation due to significant market failures, favouring the scale effect over the income effect.

Positive environmental consequences of fiscal spending in developed economies occur as a result of government expenditure being more focused towards sectors and activities that enhance environmental quality. This is what Lopez et al. (2011) referred to as the 'composition effect'. They introduced a theoretical model depicting the relationship between government spending and the environment. Their main argument is that increased government expenditure could lead to a reduction in production-generated pollution only when it is reallocated to social and public goods rather than private ones.

On the one hand, spending on public goods helps in alleviating market failures. Additionally, increased public spending in the knowledge sector would stimulate research and development (R&D) activities as well as technological diffusion, resulting in a lower pollution-to-output ratio, which is known as the 'technique effect'. On the other hand, spending on private goods is likely to be focused towards the industrial 'dirty' sector, which is usually more capital and fossil-fuel intensive than both the services sector 'clean sector' and the human capital-producing sector 'knowledge sector'. Therefore, increasing government spending without changing its composition may not lead to an improvement in environmental quality.

Moreover, the IS-LM model can explain the theoretical relationship between income, the environment, and both monetary and fiscal policies. Heyes (2000) proposed an argument that an EE line that depicts the environmental equilibrium steady state should be added to the analysis of the IS-LM model. This is to reach the IS-LM-EE model, which can describe the impacts of different monetary and fiscal policies on the environment. The author argued that an environmentally sustainable level of output could be reached using a mix of both economic activities and adequate policies. Similarly, using the IS-LM-EE model, Sim (2006) stated that sustainable economic growth requires continuous improvement in environmental quality.

In addition, Arrow et al. (1995) argued that although policies aiming at higher growth rates and more economic liberalisation could be beneficial for the environment, they cannot replace direct environmental policies. Besides, the establishment of adequate institutions capable of comprehending and properly identifying the dynamics of environmental change is critical to the success of environmental policy.

Therefore, institutional quality is another main channel through which public spending might affect the environment. In democratic regimes, citizens' demands for services are often focused towards those that promote social welfare, which means reduced externalities and better environmental quality. In contrast, elites in non-democratic regimes demand services that primarily benefit their own interests and wealth. These interests are usually tied to the industrial sector, which is capital and fossil fuel-intensive and may cause greater environmental harm. This could be explained by the 'citizen-over-state' theories, which assume that government size is demand-driven and reflects citizens' need for government services.

On the other hand, the 'state-over-citizen' theories refer to the supply-side determinants of government size. According to these theories, the quantity and type of public services are mostly determined by the government's preferences and objectives, since it holds a monopoly position. For instance, in less democratic regimes, government spending on public goods may be viewed as a side issue, which results in higher market failures and lower environmental quality. Besides, elites in non-democratic regimes are likely to oppose to any kind of environmental regulations that may harm their own interests. In contrast, environmental regulations have less impact on the median voter in democratic regimes. As a result, stricter environmental regulations are expected to be implemented in those regimes (Niskanen, 1997; Bernauer and Koubi, 2006; Farzin and Bond, 2006; Halkos and Paizanos, 2017).

Furthermore, Congleton (1992) argued that democratic regimes tend to have long-term planning, which implies better environmental regulations and helps in achieving more sustainable levels of development. This is in contrast to less democratic regimes that tend to formulate short-term plans, demonstraining lower interests in environmental sustainability. Moreover, Farzin and Bond (2006) posited a theory in which environment-related expenditure and environmental quality can be modelled as a function of citizens' preferences. In this case, political decisions, particularly in democratic regimes, are more likely to take citizens' preferences for better environmental quality into consideration. Finally, it is envisaged that as political institutions improve, government spending will play a larger role in enhancing environmental quality, with a greater ability to enforce environmental regulations (Fullerton and Kim, 2008).

According to the afore-mentioned theoretical background, our research hypotheses are as follows. First, it is predicted that government spending will have a direct positive impact on environmental quality. Second, when considering the income level channel, we anticipate a negative effect of government expenditure on the environment, since all of the countries in our sample are developing economies. As previously mentioned, government spending in developing countries tends to result in higher levels of environmental degradation, with the scale effect dominating the income effect. Third, the higher the democracy level, the higher the possibility that government expenditure will result in lower environmental degradation. In other words, while both the direct effect of government expenditure on environmental degradation and the effect conditional on institutional quality are expected to be negative, the effect conditional on economic growth is expected to be positive.

2.2 Empirical evidence

2.2.1 Direct and indirect effects of government spending on the environment

The empirical literature examining the relationship between fiscal spending and environmental quality usually divides the impact into direct effect and indirect effect. The indirect effect is generated by the impact of government expenditure on the income level, and then the consequential effect of the change in income on the environment.

Bernauer and Koubi (2006) tested the relationship between government size, measured by government expenditure, and environmental quality, measured by sulphur dioxide 'SO_2' concentrations. They used a panel of 42 countries over the period 1971–1996, employing a standard OLS regression that accounts for heteroscedasticity. The authors found a negative relationship between government expenditure and environmental quality, which provides an argument against the theories that link increased government size to better environmental quality.

Similarly, Yuxiang and Chen (2010) concluded that increasing government expenditure in China, between 1996 and 2006, led to an increase in energy intensity. The variable used for energy intensity was energy consumption (standard coal equivalent) per unit of real GDP. The study was based on province-level panel data and utilised a generalised method of moments (GMM) model. Moreover, they introduced individual province fixed effects in their analysis to capture time-invariant characteristics.

In a different study on Chinese cities, Zhang et al. (2017) examined both the direct and indirect effects of government spending on environmental pollution between 2004 and 2014. They used city-level data on a panel of 106 Chinese cities and applied the GMM technique. The results reveal that the total environmental effect of fiscal spending differs according to the proxy used for environmental degradation. Yet, the authors noticed that in all cases, the indirect effect of government spending on the environment, through income, dominates the direct effect.

A similar conclusion was reached by Halkos and Paizanos (2013) on a panel of 77 countries for the period 1980–2000. In their study, they also confirmed the dominant role of the indirect effect over the direct one. Furthermore, they added a distinction between low and high-income countries in their analysis. The results reveal a direct negative effect of government spending on SO_2 emissions and an insignificant direct effect on CO_2 emissions. However, the indirect effect of government spending on CO_2 emissions appeared to be negative and significant for most countries in the sample. This indicates that more government spending leads to better environmental quality. Regarding the indirect effect on SO_2 emissions, it is found to be negative for low-income countries and becomes positive as the income level increases. This means that cutting government spending in developed countries leads to better effects on the environment. It also implies that developed countries already have well established environmental regulations. Hence, they are more likely to face diminishing returns from increased government spending on environmental quality.

Adewuyi (2016) introduced the short-term and long-term dimensions to the analysis. The author found that, contrary to Halkos and Paizanos (2013) and Zhang et al. (2017), the negative direct impact of government spending dominates the positive indirect impact in the long run, leading to a negative total effect on aggregate carbon emissions. However, in the short run, both direct and indirect effects are negative. The study was based on a panel of 40 countries over the period 1990–2015. It also incorporated a sectoral analysis according to which government spending led to a small negative impact on the transport and manufacturing carbon emissions in the short run. It is found that while the negative impact on carbon emissions in the transport sector holds in the long run, the negative effect on the manufacturing sector emissions becomes positive in the long run.

In a different study, Halkos and Paizanos (2017) examined the channels through which government expenditure affects the environment for a panel of 94 countries from 1970 to 2008. They mainly focused on the income and institutional quality channels, as well as the direct marginal effect of fiscal spending on the environment. Results showed a significant negative total effect of government spending on sulphur dioxide (SO_2) and nitrogen oxide (NO_x) emissions, but an insignificant effect on nitrous oxide (N_2O) and carbon dioxide (CO_2) emissions. Furthermore, their results confirm the two proposed channels, since the pollution-alleviating impact of government expenditure increases with more income growth and with higher democracy levels. Similar results were found by Farzanegan and Markwardt (2018). Their study concluded that institutional and democratic improvements lessen environmental problems in MENA region countries.

Using time series analysis, Tariq and Jehan (2020) studied both the direct and indirect relationship between government consumption and environmental degradation, measured by carbon emissions. The study examined data on Pakistan for the period between 1960 and 2013. The authors used a fully modified ordinary least squares model to examine the relationship. Results showed that there is a negative direct effect and a positive indirect effect of government spending on environmental degradation. Furthermore, the negative direct relationship dominates the positive indirect one, similar to the conclusion of Adewuyi (2016). Hence, the total effect of government expenditure on environmental degradation is found to be negative. Besides, the authors found evidence that supports the existence of EKC in Pakistan.

Similarly, Saud et al. (2019) confirmed the presence of an EKC in Venezuela during the period 1971–2013. They used the autoregressive distributed lag (ARDL) approach for cointegration to test for both the short-run and long-run relationship. Results showed that increasing government expenditure worsens environmental degradation, measured by CO_2 emissions.

2.2.2 Composition of government spending and its impact on the environment

Another strand of literature focuses on testing how the composition of government spending could affect the environment. Lopez et al. (2011) tested the 'composition effect' of the reallocation of public spending towards more public goods. They used panel data for 38 countries between 1986 and 1999 when examining air pollution, and data for 47 countries between 1980 and 2005 when examining water pollution. The results indicate that a reallocation of government spending towards social and public goods tends to alleviate environmental pollution.

Similarly, Islam and Lopez (2015) examined the impact of federal and state government spending composition on air pollutants, namely SO_2, $PM_{2.5}$, and O_3, in the USA. They used a state panel dataset covering the period between 1983 and 2008. The results indicate that reallocating public spending of state and local governments from private to social and public goods reduces air pollution, while the reallocation of federal government spending is found to be neutral.

Furthermore, Galinato and Islam (2017) introduced the type of political regime in their econometric analysis. They used data on a panel of 33 countries from 1986 to 1999. Results showed that as the share of government spending allocated to public goods and correcting market failure increases, air pollutant emissions in the form of CO_2 and NO_2 decrease. They emphasised that this conclusion only holds in democratic countries, where stricter environmental regulations outweigh the increase in pollution consumption resulting from more government expenditure.

Moreover, a study by Hua et al. (2018) examined both the composition and the technique effects of government spending in China on different air pollutants, using government spending on education and spending on R&D. They used city-level data for 284 Chinese cities between 2003 and 2012. The authors argued that although the composition effect is stronger than the technique effect, both effects are found to be weak, which contradicts the theoretical predictions. The authors explained the weak composition effect by the fact that government spending on education in China is mainly directed towards primary education rather than higher education. They added that the fragile technique effect might be a result of multiple obstacles (i.e., increased input costs, high tax burden, and inappropriate administrative procedures that face new knowledge-based firms).

In addition, the importance of the environmental effect of fiscal spending on public goods has been confirmed by Lopez and Palacios (2010). The authors based their analysis on a comparison between the effect of government expenditure and that of environmental taxes on environmental quality. They used data for a panel of 21 countries in Europe over the period 1995–2006. They found that environmental taxes are found to be effective in reducing nitrogen dioxide concentrations that mainly stem from the combustion of oil and coal in generating energy. On the other hand, increasing the share of government spending and shifting the emphasis towards spending on public goods is found to be more effective than imposing environmental taxes, in terms of reducing sulphur dioxide and ozone concentrations.

Gholipour and Farzanegan (2018) analysed the impact of the GEEP as well as the quality of governance on environmental quality in the MENA region. Results show that, in the period between 1996 and 2015, GEEP alone does not have a significant impact on environmental quality. However, having a high quality of governance in the MENA region can significantly lead to a decrease in the level of environmental degradation as the GEEP increases.

Finally, as shown in this section, the empirical literature on the impact of government expenditure is inconclusive and shows different results according to the dataset under study and the employed proxy for environmental degradation. To the best of our knowledge, little research has been conducted in this field of study on the MENA region. Therefore, the main objective of our analysis is to examine the direct impact as well as the main channels through which government expenditure may influence environmental quality in the MENA region. We also test for the existence of the EKC in the MENA countries.

3 Methods, model specification and data

This section discusses the model specification adopted in our empirical analysis, the variables used and their data sources, as well as the utilised estimation methodology.

3.1 Model specification and estimation methodology

To estimate the effect of government expenditure on environmental quality, we use a model that is mainly adapted from Halkos and Paizanos (2017). We introduce a new variable to the model, which is the household consumption per capita, since private consumption has been linked to increased CO_2 emissions (Lopez et al., 2011). Table A1 in Appendix provides a description for all of the included variables, with a model's specification of the following form:

$$\begin{aligned}\text{Ln}(P/c)_{it} &= \beta_1 \ln Govshare_{i,t-1} + \beta_2 \left(\ln Govshare_{i,t-1} \times \ln GDPc_{it}\right) \\ &+ \beta_3 \left(\ln Govshare_{i,t-1} \times polity_{it}\right) + \beta_4 \ln(GDPc)_{it} + \beta_5 \ln(GDPc)_{it}^2 \\ &+ \beta_6 polity_{it} + \beta_7 \ln investment_{it} + \beta_8 \ln HC_{it} + \beta_9 \ln trade_{it} \\ &+ \beta_{10} population_{it} + \varepsilon_{it}\end{aligned} \tag{1}$$

where subscripts i and t denote country and time dimensions, respectively. The dependent variable P / c measures environmental degradation per capita, which is proxied by per capita carbon dioxide (CO_2) emissions. This type of air pollutant mainly stems from the burning of fossil fuels and cement manufacturing.[1] As per Halkos and Paizanos (2013), CO_2 emissions can be considered as a mix between both production and consumption-generated pollution. According to the World Bank, CO_2 accounts for the largest share of greenhouse gas emissions (GHG), which represent a major driver of global warming and climate change. The choice of CO_2 is also based on the fact that it is the most commonly used pollutant in the relevant literature to depict environmental degradation.

Regarding the explanatory variables included in the model, *Govshare* represents the share of government consumption expenditure in GDP. We use the lagged share of government expenditure for two main reasons. First, there may be an endogeneity problem stemming from the potential reverse causality between government spending and CO_2 emissions. That is, an increase in air pollution can lead to an increase in government spending if the government decides to implement environmental taxes or other regulations to curb such pollution. Hence, introducing the government share variable in the lag form will help mitigate the bias resulting from the reverse causality problem, as current pollutant emissions are unlikely to affect the past share of government spending. Second, the effect of government expenditure on CO_2 emissions is unlikely to occur instantaneously. For instance, firms may take time to adjust to new technologies supported by public spending, and consumers may not necessarily alter their consumption behaviour immediately in response to a change in fiscal spending (Halkos and Paizanos, 2017).

GDPc is GDP per capita, measured at constant 2015 US$. Squared GDP per capita $(GDPc)^2$ is also introduced to examine the presence of a nonlinear relationship between pollutant emissions and income, as predicted by the EKC. The two variables of GDP per capita and its squared form are expected to account for the scale and income effects that government spending exerts on pollutant emissions. Following the same technique as Halkos and Paizanos (2017), we rely on the Akaike and Bayesian information criteria (AIC/BIC) in deciding whether to use a quadratic or a cubic specification of the EKC.[2] Both criteria confirm that the quadratic form is a better fit in the case of CO_2 emissions. As for the coefficient of the interaction between the lagged share of government expenditure and GDP per capita, it is expected to capture the effect of government spending on the environment through the income channel.

Moreover, following the previous studies of Lopez et al. (2011), Halkos and Paizanos (2013, 2017) and Galinato and Islam (2017), we account for the potential effect of institutional quality on the environment by including an index of the degree of democracy, denoted by the variable *polity*. This variable ranges from –10, which indicates full autocracy, to +10, which indicates full democracy. An interaction term between the lagged share of government expenditure and democracy is also included to capture how the effect of government expenditure on environmental degradation is influenced by the quality of the established political institutions in the economy. According to Galinato and Islam (2017), it is important to account for the two channels of income level and institutional quality through which government spending may affect pollutant emissions in order to avoid an omitted variable bias.

Since investment activities, particularly those in polluting sectors, may be a source of pollutant emissions, we include the variable *investment* which is the share of total investment, measured by gross capital formation, in GDP. Furthermore, following Lopez et al. (2011) and Halkos and Paizanos (2013), we introduce the *HC* variable into our model. *HC* measures the household final consumption expenditure per capita. The inclusion of this variable is also supported by the AIC/BIC, which indicates that private consumption provides important information to the model and helps in explaining changes in CO_2 emissions.

Trade openness, measured by the share of exports and imports as a percentage of GDP, is represented by the variable *trade*. This variable helps in examining if a country's participation in international trade affects environmental quality as detected in the trade literature, such as in Cole (2004). According to the pollution haven hypothesis (PHH), trade may be a means of displacement of pollution-intensive industries from developed countries with strict environmental regulations to developing countries with lax environmental controls. Hence, international trade might lead to an increase in pollution in developing countries, such as the countries covered by our sample.

In addition, a variable measuring population growth (*population*) is included in the model, which helps in capturing a part of the scale effect of government spending. According to Shi (2003), the increase in population is associated with higher carbon dioxide emissions. The author also stated that the positive impact of population growth on emissions is greater in developing countries than in developed countries. Moreover, Sahin and Yilmazer (2021) argued that the increase in urban population has a negative effect on renewable energy consumption. They reached this conclusion in a study on seven emerging and growth-leading countries in the period 2001–2015.

Finally, it is important to note that all of the model's variables are expressed in natural logarithms except for democracy and population growth variables. Based on the abovementioned specification of the model, the total effect of government spending on pollution can be calculated by combining the following:

$$\frac{\partial \ln(P/c)}{\partial \ln(Govshare)} = \beta_1 + \beta_2(\ln GDPc) + \beta_3(polity) \tag{2}$$

The total effect will depend then on the magnitude and signs of the coefficients β_1, β_2 and β_3. If an increase in the income level and the institutional quality enhance the effectiveness of government spending on environmental issues, implying a negative β_2 and β_3, the total effect could be negative. This means that government expenditure will be enhancing environmental quality. For this to take place, the marginal direct effect of *Govshare* on pollution (β_1) needs to be either negative as well, or it should be compensated by the negative signs of the other two coefficients if it is positive.

As for the employed estimation methodology, equation (1) is estimated using the fixed effects technique. This methodology allows us to account for unobserved heterogeneity across the countries of the sample. Since country unobserved characteristics may be correlated with the explanatory variables of the model, fixed effects seem to be more appropriate than random effects. We conducted a Hausman test to verify this assumption and the results confirm that the fixed effects formulation is more suitable for our case than the random effects (see Table A2 in Appendix). We have also conducted a Wald test to determine whether time-fixed effects will be needed in the estimation. The Wald test works by testing that the parameters of interest are simultaneously equal to zero. We did not reject the null hypothesis that the coefficients for all years are jointly equal to zero, therefore time fixed effects are not needed in our model.

3.2 Data sources and description

Our sample comprises data on 14 countries of the MENA region, including Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Tunisia, and the United Arab Emirates. The sample covers the period from 2000 to 2018. Countries and time-period are selected based on the availability of data for the different variables included in the model.

Data on CO_2 emissions, GDP per capita, household consumption[3], trade openness, and population growth are obtained from the World Development Indicators (WDI) database. In addition, data on government expenditure and investment are obtained from the Penn World Table (version 10.0) that relies on the United Nations Main Aggregates Database (Feenstra et al., 2015). According to the United Nations definition, "Government final consumption expenditure consists of expenditure, including imputed expenditure, incurred by the general government on both individual consumption goods and services and collective consumption services."[4] Regarding the degree of democracy variable, it is obtained from the Polity5 dataset of the Polity IV Project. Table 1 provides some descriptive statistics for the model's variables.

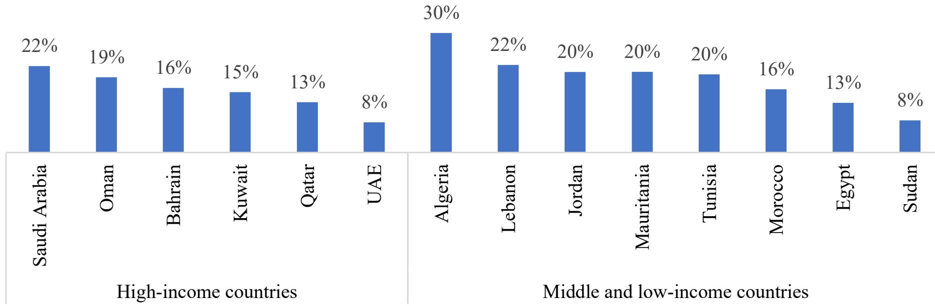
Table 1 Descriptive statistics of the variables of the model

Variable name	*Variable abbreviation*	*Obs.*	*Mean*	*Std. dev.*	*Min.*	*Max.*
CO_2 emissions per capita	*P/c*	266	10.93	11.51	0.20	47.70
Government share	*Govshare*	266	0.17	0.07	0.03	0.34
GDP per capita	*GDPc*	266	16,062.53	18,101.02	1,017.29	65,129.38
Polity	*polity*	254	–4.72	4.66	–10.00	7.00
Investment share	*investment*	266	0.27	0.09	0.07	0.58
Household consumption per capita	*HC*	239	10,720.90	10,051.73	1,419.11	57,567.02
Trade openness (% of GDP)	*trade*	265	88.44	34.95	1.30	191.87
Population growth (%)	*population*	266	3.42	2.93	–0.05	17.51

Moreover, Figure 1 illustrates the share of government expenditure in GDP for the countries included in our sample. For each country, we use the average share of government expenditure over the studied time period 2000–2018. We also distinguish between 'high-income' and 'middle- and low-income' countries in the MENA region.[5] It is important to note that Sudan is the only country in our sample that is classified as a low-income country, while the remaining countries are classified as either middle- or high-income countries. We can observe that the share of government expenditure in high-income countries ranges from 22% (in Saudi Arabia) to 8% (in the UAE), whereas the government's expenditure share in middle- and low-income countries ranges from 30% (in Algeria) to 8% (in Sudan). Hence, we can say that the share of government expenditure tends to be higher, on average, in the MENA middle- and low-income countries, with an average share of 19%, compared to the MENA high-income countries, with an average share of 15%.

Figure 2 presents the average value of CO_2 emissions in thousand kilotonnes (kt) by country. Figure 2 shows that CO_2 emissions in MENA high-income countries vary from 405 thousand kt (in Saudi Arabia) to 24 thousand kt (in Bahrain). In the MENA middle- and low-income countries, the average level of CO_2 emissions ranges between 185 thousand kt (in Egypt) and 2 thousand kt (in Mauritania). Hence, Figure 2 indicates that the average level of CO_2 emissions in MENA high-income countries, estimated at 126 thousand kt, is higher than the average of 35 thousand kt that is observed in MENA middle- and low-income countries.

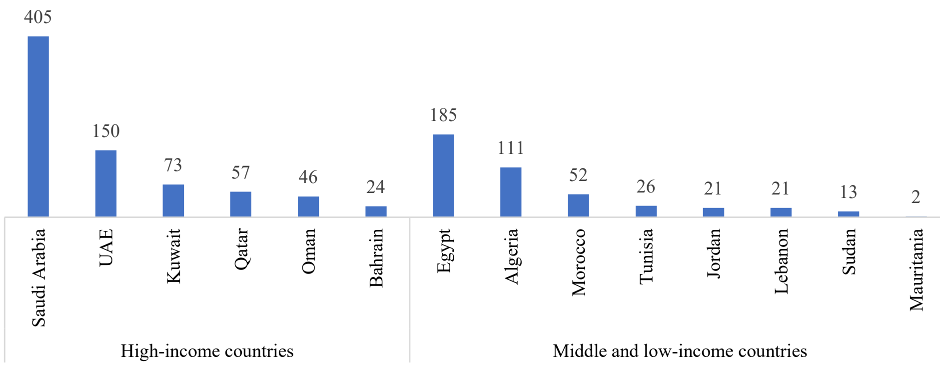
Figure 1 Average share of government consumption expenditure in GDP by country (see online version for colours)



Note: Figures represent averages taken over the period 2000–2018.

Source: Constructed by the authors using data from the Penn World Table version 10.0

Figure 2 Average value of CO_2 emissions (in thousand kt) by country (see online version for colours)



Note: Figures represent averages taken over the period 2000–2018.

Source: Constructed by the authors using data from the WDI

4 Findings and discussion

In this section, we present and discuss the findings of our empirical analysis regarding the impact of government expenditure on environmental quality.

4.1 Estimation results of the environmental effect of government expenditure

The estimation results of equation (1) are illustrated in Table 2. Variables of interest were included gradually. First, we run the regression without the inclusion of the interaction variables, the square of the GDP per capita, and the household consumption per capita, as shown in column (1). Then, column (2) presents the results after the inclusion of the squared GDP per capita. In both cases, the effect of government spending on per capita

CO_2 emissions is insignificant. Yet, the included GDP per capita in squared form appears to be negative and statistically significant. However, as mentioned earlier, neglecting how income and institutional quality may influence the effect of government expenditure on CO_2 emissions can lead to an omitted variable bias, which risks invalidating the reported results.

Table 2 Estimates of the impact of government expenditure on CO_2 emissions

	CO_2 emissions per capita			
	(1)	*(2)*	*(3)*	*(4)*
Ln($Govshare_{t-1}$)	0.0293	0.0153	–0.895***	–0.762***
	(0.0320)	(0.0320)	(0.171)	(0.188)
Ln($Govshare_{t-1}$) × ln(*GDPc*)			0.0862***	0.0666***
			(0.0205)	(0.0227)
Ln($Govshare_{t-1}$) × *polity*			–0.0278***	–0.0311***
			(0.00763)	(0.00739)
Ln(*GDPc*)	0.712***	2.067***	1.673***	1.752***
	(0.0659)	(0.490)	(0.456)	(0.457)
Ln($GDPc)^2$		–0.0737***	–0.0429*	–0.0676***
		(0.0264)	(0.0246)	(0.0259)
polity	0.0114***	0.00713	–0.0359***	–0.0462***
	(0.00418)	(0.00440)	(0.0122)	(0.0120)
Ln(*investment*)	0.0824**	0.0735**	0.0425	0.0753**
	(0.0329)	(0.0326)	(0.0303)	(0.0318)
Ln(*HC*)				0.286***
				(0.0530)
Ln(*trade*)	0.106**	0.0503	0.0244	0.0244
	(0.0506)	(0.0537)	(0.0503)	(0.0492)
population	0.00712**	0.00783**	0.0134***	0.00181
	(0.00314)	(0.00310)	(0.00301)	(0.00420)
Constant	–5.029***	–10.96***	–10.08***	–11.47***
	(0.665)	(2.225)	(2.083)	(2.090)
Observations	252	252	252	226
R-squared	0.499	0.515	0.596	0.656
Number of countries	14	14	14	14

Notes: Standard errors are reported in parentheses.
*Significant at 10%, **significant at 5% and ***significant at 1%.

Therefore, the interaction variables of government expenditure with income and democracy level are added in column (3). Interestingly, the marginal effect of the share of government expenditure on per capita emissions becomes negative and statistically significant at 1% significance level when the interaction terms are added. Both interactions are statistically significant, which indicates the importance of the channels through which government spending may affect air pollution. However, the interaction terms appear to have contradicting effects. While government spending tends to enhance environmental quality in countries with better institutions, it is less effective in improving environmental quality at higher levels of GDP per capita. This might explain why, when the two channels are excluded in columns (1) and (2), the overall impact of government expenditure is insignificant.

Finally, column (4) illustrates the final form of the estimation results, after the inclusion of the private consumption per capita. It shows that the share of government expenditure in GDP has a significant negative effect on CO_2 emissions per capita. At a 1% significance level, an increase in the lagged share of government consumption by 1% reduces the CO_2 emissions per capita by 0.76%. This result is consistent with the effect detected in the literature. For instance, Halkos and Paizanos (2013), Zhang et al. (2017), and Tariq and Jehan (2020) have all reported a negative effect of government expenditure on CO_2 emissions. The inclusion of 'household consumption' and 'investment' variables in the estimated equation helps in justifying the negative partial effect of the share of government expenditure. One could argue that government spending in the MENA countries is likely to be harmful to the environment since it is dominated by energy subsidies that encourage polluting consumption and production activities. However, when we account for this harmful effect by including household consumption and investment, which appear to have a significant positive effect on CO_2 emissions, the coefficient of government share will reflect then the pure effect of government spending on environmental quality.

We can also attribute the negative sign of the coefficient of the government share to the composition of government expenditure, following the justification provided by Lopez et al. (2011). If the increase in public spending is mainly oriented towards public goods, particularly education, health, environmental initiatives, and R&D; this could lead to an improvement in environmental quality. This type of spending tends to favour human capital intensive activities instead of the physical capital intensive activities that have higher pollution intensity. Besides, investing in human capital may lead to increased labour efficiency and more usage of green technology, resulting in a cleaner production process and lower emissions. This is what Lopez et al. (2011) called a positive technique effect.

In contrast, the results show that the effect of government spending on air pollution conditional on the GDP per capita is positive and significant, reflecting an increase of 0.07% in CO_2 emissions. This means that an increase in GDP per capita offsets a part of the reduction in the CO_2 emissions induced by the marginal direct effect of government spending in our sample. The increase in economic activity creates more pressure on the environment, which explains the increase in air pollutant emissions. Hence, this indicates that the scale effect is dominating the income effect generated by the increase in GDP per capita. Tariq and Jehan (2020) reported similar findings for the coefficient of the interaction term between government spending and income in the case of Pakistan.

Moreover, the coefficients of GDP per capita and its squared form validate the EKC in the case of our sample. They show that, at first, an increase in income per capita implies more environmental pressure and increased environmental degradation. The findings show that a 1.75% increase in CO_2 emissions is associated with a 1% increase in GDP per capita, at a significance level of 1%. However, after reaching a certain level of income per capita, the effect of income on air pollution reverses and becomes negative. As shown by the coefficient of the squared GDP per capita, an increase in this term by 1% decreases the per capita CO_2 emissions by 0.07% at a significance level of 1%.

As for the democracy level, measured by the variable *polity*, its coefficient is negative and significant. This indicates that a higher democracy level reduces the per capita CO_2 emissions. The coefficient of the interaction of government spending with democracy is negative and statistically significant as well. Hence, we can deduce that better institutional quality reinforces the effectiveness of government spending in reducing air pollutant emissions. The high institutional quality allows government spending to be more efficient and effective in establishing as well as enforcing environmental regulations, which generates a positive impact on environmental quality as argued by Fullerton and Kim (2008). The air pollution alleviating role of the democracy level was also confirmed by Lopez et al. (2011) and Halkos and Paizanos (2017).

Furthermore, both the investment share in GDP and the household consumption per capita have a positive and significant effect on CO_2 emissions, at 5% and 1% significance levels, respectively. This is consistent with the idea that production and consumption activities are expected to contribute to air pollution. An increase in the investment share by 1% increases per capita CO_2 emissions by 0.08%. This also comes in line with the results reported by Halkos and Paizanos (2013, 2017). Both studies detected that a higher share of investment in GDP implies higher CO_2 emissions. Similarly, an increase in private consumption per capita by 1% leads to an increase in CO_2 emissions by 0.29%, which is consistent with the findings of Lopez et al. (2011) regarding the effect of household final consumption expenditure on air pollution, particularly the lead pollutant.

Regarding trade openness and population growth, they both have a positive but insignificant effect on CO_2 emissions. The same results were detected by Halkos and Paizanos (2017) for the coefficients of trade and population when CO_2 emissions were used as a proxy for environmental degradation.

Finally, we compute the total effect of the share of government expenditure on CO_2 emissions per capita. This is done by combining the marginal direct effect of government spending, the effect of government spending conditional on GDP per capita, and the effect conditional on democracy level, as follows:

$$\textit{Total effect} = -0.76 + 0.07 - 0.03 = -0.72$$

Hence, we can conclude that the total impact of fiscal spending on carbon emissions is negative. A negative overall impact of government spending on environmental degradation has been also reported by studies like Halkos and Paizanos (2013, 2017) and Tariq and Jehan (2020). That is, an increase in the share of government expenditure in GDP reduces CO_2 emissions per capita.

4.2 Robustness checks

To test the robustness of our results, we conducted dominance tests for extreme observations. We examine the change in the effect of government spending when extreme observations are dropped from the analysis. To do so, we re-estimate equation (1) first, without the top 1% of government expenditure share. Second, without the bottom 1%, and third, without both the top 1% and bottom 1% of the government expenditure share. Then, we apply the same approach to CO_2 emissions. This analysis was used by other relevant studies such as Lopez et al. (2011) and Halkos and Paizanos (2013, 2017).

The results of the dominance tests are reported in Table 3. We can observe that both the sign and significance of the different components of the total effect remain unchanged even after dropping the extreme observations. Moreover, the magnitude of the total effect of government spending on CO_2 emissions is similar across the different regressions. This proves that the results of our model are robust and that government spending is environmentally friendly.

Table 3 Robustness checks of the estimates of the effect of government expenditure share on CO_2 emissions per capita

	Marginal effect	*Through GDP per capita*	*Through democracy*	*Total effect*
Bottom 1% of government share dropped	–0.823***	0.0728***	–0.0310***	–0.7812
Top 1% of government share dropped	–0.762***	0.0660***	–0.0319***	–0.7279
Bottom and top 1% of gov. share dropped	–0.829***	0.0727***	–0.0319***	–0.7882
Bottom 1% of pollutant dropped	–0.735***	0.0633***	–0.0321***	–0.7038
Top 1% of pollutant dropped	–0.758***	0.0662***	–0.0310***	–0.7228
Bottom and top 1% of pollutant dropped	–0.732***	0.0629***	–0.0321***	–0.7012

Note: ***Significant at 1%.

Moreover, multiple regressions were conducted replacing CO_2 emissions with other possible proxies for environmental degradation, including the total GHG, sulphur dioxide (SO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x), and fine particulate matter (PM_{10} and $PM_{2.5}$). Data for GHG, CH_4 and N_2O emissions were obtained from the WDI database, whereas data for SO_2, NO_x, PM_{10} and $PM_{2.5}$ were obtained from the Emissions Database for Global Atmospheric Research (EDGAR v5.0) (European Commission, 2020). Results as reported in Table A3 in Appendix show that for four of the eight employed pollutants, the effect of government spending on the emissions per capita is negative and significant. However, as reported in the previous relevant literature such as Halkos and Paizanos (2013, 2017), results vary when changing the employed proxy for environmental degradation. This could be explained by the idea that pollutants differ in terms of their atmospheric life characteristics, the geographical range of their impact, as well as their main sources of emission.

5 Conclusions and policy implications

The main objective of this paper is to examine the impact of fiscal spending on environmental degradation using panel data for 14 MENA region countries. The literature has shown that the effect of government spending on the environment can be influenced by two main factors, namely the country's income level and institutional quality. Empirical studies provide a mixed evidence regarding the final effect of government expenditure as well as its interaction with other factors that may determine environmental quality. The reported results in the literature differ based on the type of pollutant used as a proxy for environmental degradation, the countries considered in the sample, and the time period that is being studied.

Using a panel fixed effects estimation technique, this study estimates the total effect of fiscal spending on the environment in MENA region countries during the period 2000–2018. We have utilised the share of government consumption expenditure in GDP as a measure of fiscal spending and CO_2 emissions per capita as a proxy for environmental degradation. The total effect of government expenditure comprises the following: the effect conditional on income level, the effect conditional on institutional quality, and the direct marginal effect of government spending on environmental quality.

The results have identified a negative marginal effect of government spending on CO_2 emissions. The environmental deteriorating effect of government spending through GDP per capita is revealed to be positive, offsetting a part of the negative direct effect. However, the effect conditional on the democracy level (the proxy for institutional quality) is negative, which reinforces the initial direct effect. Finally, the total effect of the share of government expenditure on CO_2 emissions is found to be negative, despite being alleviated by the GDP per capita channel. This indicates that increasing government expenditure is not environmentally damaging. In contrast, government spending can contribute to the reduction of air pollution and the improvement of environmental quality. In addition, our findings have confirmed the existence of the EKC in the case of MENA region countries.

In recent years, many countries in the MENA region, such as Jordan, United Arab Emirates, Egypt, and Tunisia have initiated several reforms to shift government expenditure towards more environmentally friendly services. These strategies may explain the increase in environmental quality as a result of government expenditure.

Having said that, the empirical findings in this paper introduce other policy implications. First, the results reassure policymakers regarding the environmental effects of fiscal spending. In particular, the results show that government expenditure can serve as a means of alleviation of air pollution and that it is not detrimental to environmental quality in MENA region countries. Second, the results suggest that a higher democracy level and better institutional quality help reinforce the positive environmental effect of government spending. Hence, enhancing the quality of available institutions is important to strengthen the effectiveness of environmental regulations in monitoring and reducing environmental pollution. Third, the alleviating effect of government spending on CO_2 emissions could also be strengthened by directing public investment towards renewable energy sources and the use of greener technologies. Fourth, correcting market failures through the internalisation of environmental costs could also strengthen the effect of fiscal spending on environmental quality. For example, this could be done through the enforcement of property rights to hold producers accountable and create incentives to reduce environmental degradation.

Finally, limitations of this study include the unavailability of large time series data for some variables in the MENA region case, particularly the government spending variable. In addition, there is a lack of more recent data on CO_2 emissions as well as on other pollutants. Besides, it is important to highlight that the results of this study are considered to be valid mainly for the MENA countries.

Therefore, future studies may consider adding more countries to the sample to examine any potential changes in the empirical findings. Another recommendation for future studies is to perform a time series analysis by country to test for any structural breaks in the relationship between government spending and the environment before and after the implementation of new environmental policies, as well as the subsidy reforms in the region. Additionally, studying the impact of taxation along with government spending on the quality of the environment would help in providing more policy insights. Moreover, further research is needed to investigate the mechanisms underlying the change in the effect of government expenditure on the environment when the pollutant utilised in the study is replaced by another indicator of environmental quality.

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Notes

1 World Bank, *World Development Indicators (WDI)* [online] https://data.worldbank.org/indicator/EN.ATM.CO2E.PC (accessed 4 January 2022).

2 AIC/BIC are methods used to compare different possible models and determine which one is the best fit for the data. The model with the lower AIC and BIC values is the better-fit model.

3 Household consumption expenditure data, as reported by the World Bank, includes also the expenditures of non-profit institutions serving households.

4 The definition is extracted from https://unstats.un.org/unsd/snaama/Metadata/Glossary#.

5 We use the World Bank classification that is based on the gross national income (GNI) per capita for 2020 of each country (https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html).

Appendix

Table A1 Variables' abbreviations and descriptions

Variable's abbreviation	*Variable's description*
P/c	CO_2 emissions per capita, in metric tons
Govshare	Share of government consumption expenditures in GDP
GDPc	GDP per capita (constant 2015 US$)
polity	Index of the degree of democracy, scaled from –10 to 10
investment	Share of gross capital formation expenditures in GDP
HC	Household final consumption expenditure per capita
trade	Sum of exports and imports as % of GDP
population	Annual population growth rate (%)

Table A2 Results of the Hausman test as reported by STATA

	(b)	*(B)*	*(b-B)*	*sqrt(diag(V_b – V_B))*
	Fixed effects	*Random effects*	*Difference*	*Standard error*
Ln($Govshare_{t-1}$)	–0.762	–0.648	–0.114	0.085
Ln ($Govshare_{t-1}$) × ln(*GDPc*)	0.067	0.074	–0.007	0.009
Ln($Govshare_{t-1}$) × *polity*	–0.031	–0.008	–0.023	0.003
Ln(*GDPc*)	1.752	2.998	–1.247	0.361
Ln$(GDPc)^2$	–0.068	–0.107	0.039	0.021

Notes: *b* = consistent under H0 and Ha.
B = inconsistent under Ha, efficient under H0.

Table A2 Results of the Hausman test as reported by STATA (continued)

	(b)	*(B)*	*(b-B)*	*sqrt(diag(V_b – V_B))*
	Fixed effects	*Random effects*	*Difference*	*Standard error*
polity	–0.046	–0.023	–0.023	0.005
Ln(*investment*)	0.075	0.050	0.025	0.013
Ln(*HC*)	0.286	0.172	0.114	0.035
Ln(*trade*)	0.024	0.100	–0.076	0.026
population	0.002	0.003	–0.002	0.001

Notes: *b* = consistent under H0 and Ha.
B = inconsistent under Ha, efficient under H0.

Test of H0: difference in coefficients not systematic

$$chi2(10) = (b-B)'\left[(V_b - V_B)^{(-1)}\right](b-B)$$
$$= 72.28$$

$$Prob > chi2 = 0.0000.$$

Table A3 Estimates of the effect of government expenditure on per capita emissions of different pollutants

	(1)	*(2)*	*(3)*	*(4)*
	CO_2	*GHG*	CH_4	N_2O
Ln($Govshare_{t-1}$)	–0.762***	–0.267**	0.607***	0.420**
	(0.188)	(0.126)	(0.124)	(0.196)
Ln($Govshare_{t-1}$) × ln(*GDPc*)	0.0666***	0.0424***	–0.0761***	–0.0373
	(0.0227)	(0.0152)	(0.0150)	(0.0236)
Ln($Govshare_{t-1}$) × *polity*	–0.0311***	–0.00370	–0.000365	0.0136*
	(0.00739)	(0.00493)	(0.00489)	(0.00769)
Ln(*GDPc*)	1.752***	–0.793**	–3.383***	–2.757***
	(0.457)	(0.305)	(0.302)	(0.476)
Ln(*GDPc*)^2	–0.0676***	0.0610***	0.214***	0.180***
	(0.0259)	(0.0173)	(0.0171)	(0.0270)
polity	–0.0462***	–0.00983	–0.00152	0.0233*
	(0.0120)	(0.00803)	(0.00796)	(0.0125)
Ln(*investment*)	0.0753**	0.0305	0.0317	0.0895***
	(0.0318)	(0.0213)	(0.0211)	(0.0332)
Ln(*HC*)	0.286***	0.253***	–0.250***	–0.200***
	(0.0530)	(0.0354)	(0.0351)	(0.0552)
Ln(*trade*)	0.0244	0.0601*	0.0733**	–0.0251
	(0.0492)	(0.0329)	(0.0326)	(0.0512)

Notes: Standard errors in parentheses.
***p < 0.01, **p < 0.05 and *p < 0.1.

Table A3 Estimates of the effect of government expenditure on per capita emissions of different pollutants (continued)

	(1)	*(2)*	*(3)*	*(4)*
	CO_2	*GHG*	*CH_4*	*N_2O*
population	0.00181	0.00306	–0.00619**	0.00448
	(0.00420)	(0.00281)	(0.00278)	(0.00437)
Constant	–11.47***	–5.070***	8.159***	3.967*
	(2.090)	(1.396)	(1.383)	(2.176)
Observations	226	226	226	226
R-squared	0.656	0.638	0.619	0.354
Number of countries	14	14	14	14
	(5)	*(6)*	*(7)*	*(8)*
	SO_2	*NO_x*	*PM_{10}*	*$PM_{2.5}$*
Ln($Govshare_{t–1}$)	0.201	–0.426	–0.506***	–0.489**
	(0.490)	(0.262)	(0.193)	(0.214)
Ln($Govshare_{t–1}$) × ln(*GDPc*)	–0.0561	0.0442	0.0777***	0.0669**
	(0.0602)	(0.0322)	(0.0237)	(0.0263)
Ln($Govshare_{t–1}$) × *polity*	–0.0597***	–0.0314***	0.0105	–0.00291
	(0.0206)	(0.0110)	(0.00811)	(0.00899)
Ln(*GDPc*)	–3.260***	–1.987***	–2.464***	–2.872***
	(1.224)	(0.655)	(0.482)	(0.534)
Ln($GDPc)^2$	0.232***	0.130***	0.137***	0.156***
	(0.0697)	(0.0373)	(0.0275)	(0.0304)
polity	–0.0930***	–0.0441**	0.0222*	0.00286
	(0.0336)	(0.0180)	(0.0132)	(0.0146)
Ln(*investment*)	0.0334	0.0660	0.0798**	0.0950**
	(0.0924)	(0.0494)	(0.0364)	(0.0403)
Ln(*HC*)	–0.587***	0.109	0.153**	0.175**
	(0.156)	(0.0832)	(0.0613)	(0.0679)
Ln(*trade*)	–0.305**	–0.196***	0.0710	0.0329
	(0.138)	(0.0740)	(0.0545)	(0.0604)
population	–0.0132	0.0119**	–0.00648	–0.00867*
	(0.0105)	(0.00563)	(0.00415)	(0.00460)
Constant	5.279	–3.733	–3.050	–1.636
	(5.637)	(3.015)	(2.220)	(2.460)
Observations	187	187	187	187
R-squared	0.273	0.390	0.284	0.274
Number of countries	13	13	13	13

Notes: Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$ and *$p < 0.1$.