



# The effects of financial development, economic growth, coal consumption and trade openness on CO<sub>2</sub> emissions in South Africa

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## HIGHLIGHTS

- We found that a rise in economic growth increases energy emissions.
- We found that financial development lowers energy emissions.
- We found that coal consumption significantly deteriorate environment.
- We found that trade openness improves environmental quality.
- Existence of EKC is also found.

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## ABSTRACT

This paper explores the effects of financial development, economic growth, coal consumption and trade openness on environmental performance using time series data over the period 1965–2008 in case of South Africa. The ARDL bounds testing approach to cointegration has been used to test the long run relationship among the variables while short run dynamics have been investigated by applying error correction method (ECM). The unit root properties of the variables are examined by applying Saikkonen and Lütkepohl (2002. *Econometric Theory* 18, 313–348) structural break unit root test. Our findings confirmed long run relationship among the variables. Results showed that a rise in economic growth increases energy emissions, while financial development reduces it. Coal consumption has significant contribution to deteriorate environment in South African economy. Trade openness improves environmental quality by reducing the growth of energy pollutants. Our empirical results also verified the existence of environmental Kuznets curve. This paper opens up new insights for South African economy to sustain economic growth by controlling environment from degradation through efficient use of energy.

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## 1. Introduction

The notion that environmental degradation is the problem of developed and not of developing countries, is no more valid at least in terms of consequences. The accumulation of green house gases (GHGs) in the earth's surface is now adversely affecting the nations across the world, both developing and developed, irrespective of who is responsible for such accumulation. The burn out of fire in Russia, the outburst of flood in Pakistan and Australia, the

earthquake in Haiti, and the tsunami in Japan are some of the major catastrophes observed in the recent past which may be the consequences of environmental dilapidation. These events resulted in damages to infrastructure, natural resources such as forests and resultantly wild life, agriculture land and produce, and most importantly to precious human lives. Events like these have become a major concern, both for environmentalists and economists, for the reason that economic growth has feedback effects from environment. Grossman and Krueger (1991) developed the environmental Kuznets curve hypothesis to demonstrate the relationship between economic growth and environmental degradation.

Although environmental deterioration is a global issue and the entire world is exposed to threats arising from deterioration of environmental quality, yet the responsibility to save the world from such threats falls upon largely on countries who are the

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major emitters of GHGs. One of the most prominent GHG is carbon dioxide and its major emitters include China, USA, India, OECD group, Russia and Brazil (World Bank, 2007). The success of international efforts to reduce world CO<sub>2</sub> emissions heavily depends on the commitment of these major emitters. However, difficulties arise for countries when the CO<sub>2</sub> emissions are related to energy production because energy works as an engine of economic growth. In such cases, curbing carbon dioxide emissions would mean to ultimately retard their economic growth, for which the countries are very reluctant to accomplish. This calls for digging out the ways through which the twin objectives of higher economic growth and lower CO<sub>2</sub> emissions can be achieved. Financial development is one of the ways that could help to accomplish these objectives.

South Africa is a classic case of what has been discussed above. It contains all the contents such as high growth, monstrous energy-related emissions and strong financial base. Soon after the advent of democracy in 1994, the country's economic growth shows an upward trend and remained uninterrupted until the financial crises that hit the country in 2007. The average economic growth rate between 2001 and 2007 was 4.3%. On the other hand, South Africa is one of the major emitter of CO<sub>2</sub> (1% of the world emissions). The obvious reason for this is the use of coal, a major ingredient of CO<sub>2</sub>, in energy production. South Africa had coal reserves of 30408 million tones at the end of 2009 that constitutes 3.68% of the world coal reserves.<sup>3</sup> Almost 77% of the country's primary energy needs are provided by coal whereas 53% of the coal reserves are used in electricity generation, 33% in petrochemical industries, 12% in metallurgical industries, and 2% in domestic heating and cooking. Similarly, financial system in South Africa is highly developed with banking regulations rank outstanding, and the financial sector has long been rated among the top 10 financial sectors of the globe. These characteristics make South Africa a compelling candidate for a separate study to investigate the presence of environmental Kuznets curve (EKC) in the country and to assess the effects economic growth, financial development and coal consumption on the CO<sub>2</sub> emissions in presence of trade openness. Indeed, the study in hands is the first attempt to incorporate coal as separate determinant of CO<sub>2</sub> emissions in the analysis.

Rest of the study is organized as follow: Section 2 gives a brief literature review. The third section talks about data and methodology used in the study. Section 4 discusses the results in detail while Section 5 concludes the study with some policy implications.

## 2. Literature review

After the seminal work of Grossman and Krueger (1991), the environmental Kuznets curve (EKC) hypothesis is tested empirically for many countries and regions using different measures of environmental standards. The studies that examine relationship between economic growth and environmental quality include Shukla and Parikh (1992), Shafik (1994), Selden and Song (1995), Jaeger et al. (1995), Tucker (1995), Jha (1996), Horvath (1997), Barbier (1997), Matyas et al. (1998), Ansuategi et al. (1998), Heil and Selden (1999), List and Gallet (1999), Brandoford et al. (2000), Stern and Common (2001), Roca (2003), Friedl and Getzner (2003), Dinda and Coondoo (2006), Managi and Jena (2008), Coondoo and Dinda (2008), and Akbostanci et al. (2009). Different indicators are used for environmental quality in these studies. For example, CO<sub>2</sub>, SO<sub>2</sub>, NO, etc. are used for air quality, whereas mercury, lead,

cadmium, nickel are utilized for water quality. Similarly, the overall environmental quality is measured by urban sanitation, deforestation, safe drinking water and traffic volumes. Nonetheless, results differ for countries and indicators, confirming the argument that EKC is a country and/or indicator specific phenomenon.

The EKC literature mostly uses energy consumption and trade openness as control variable to omit any specification bias. However, studies using financial development as an important determinant of environmental performance are very rare.<sup>4</sup> The most obvious reason to use financial development in this study is that the existence of a well-developed financial sector attracts foreign direct investment (FDI), which in turns may stimulate economic growth and, hence, affect the environmental quality (Frankel and Romer, 1999). In addition, financial development results in mobilization of financial resources for environment-related projects at reduced financing costs (Tamazian et al., 2009). Regarding the concern that environmental projects are public sector activity, Tamazian and Rao (2010) document that a well-functioning financial sector will especially be helpful for all tiers of government to get finances for such projects. Moreover, financial development may also lead to technological innovations (King and Levine, 1993; Tadesse, 2005) and these technological changes can then contribute significantly to reduction in emissions particularly through energy sector (Kumbaroglu et al., 2008). Likewise, Claessens and Feijen (2007) consider a developed financial sector is essential for carbon trading as environmental regulators may initiate programs that are directly connected with financial markets and frequently make available the information regarding the environmental performances of firms (Dasgupta et al., 2001; Lanoie et al., 1998). Lastly, the announcements of rewards and acknowledgment of superior environmental performance have a positive effect on capital market that is a vital fraction of the financial system [see, for example, Lanoie et al., 1998; Dasgupta et al., 2001, 2004; Tamazian et al., 2009; among others]. Thus, Tamazian et al. (2009) rightly pointed out that CO<sub>2</sub> emission can be lessened by means of a solid financial system.

Trade openness is another vital factor that could influence the environmental quality. The impact of trade liberalization can be decomposed into scale, technique, and composition effects (Antweiler et al., 2001). Nevertheless, contradictory results are established in the empirical literature on the role of trade openness. Some studies such as Lucas et al. (1992), Shafik and Bandyopadhyay (1992), Birdsall and Wheeler (1993), Ferrantino (1997), Grether et al. (2007) and Shahbaz et al. (2012) conclude that trade is beneficial for environment through technique effect. Others, however, consider that trade is harmful for environment by adopting composite effect for production [Suri and Chapman, 1998; Abler et al., 1999; Lopez, 1994; Cole et al., 2000].

Moreover, Dhakal (2009) examines the relationship between urbanization and CO<sub>2</sub> emissions and found that that 40% contribution in CO<sub>2</sub> emissions is by 18% increase in population in large cities of China. Similarly, Sharma (2011) examined the role international trade, income, urbanization and energy consumption using dynamic panel data of countries. Findings explore that international trade, income, urbanisation and energy consumption seem to play their role to increase CO<sub>2</sub> emissions in the panels of high income, middle income, and low income countries. Finally, urbanisation, international trade and electric power consumption per capita have negative impact on energy emissions while GDP per capita and primary energy consumption has positive effect on CO<sub>2</sub>. Martínez-Zarzoso and Maruotti (2011) investigated the effect of urbanization on environmental degradation for developing

<sup>3</sup> For more details ( see BP Statistical Review of World Energy, 2010).

<sup>4</sup> For instance, Tamazian et al. (2009), Halicioglu (2009), Tamazian and Rao (2010) and, Jalil and Feridun (2011).

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