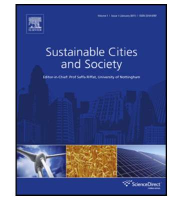
Sustainable Cities and Society xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Sustainable Cities and Society

journal homepage: www.elsevier.com/locate/scs



The close relationship between informal economic growth and carbon emissions in Tunisia since 1980: The (ir)relevance of structural breaks

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ARTICLE INFO

Article history:
Available online xxx

Keywords:
CO_2 emissions
Informal economy
Johansen et al. cointegration
Structural breaks
Tunisia

ABSTRACT

The informal economy is considered among the most important factors because of its direct relationship with environmental degradation. The main contribution of the paper is to investigate empirically the causal relationship between economic growth and CO_2 emissions in the presence of the informal economy for Tunisia, during the period 1980–2009. This study is conducted on the basis of the Environmental Kuznets Curve hypothesis (EKC). We found a monotonically increasing relationship between total GDP (the sum of the formal and informal economy) and CO_2 emissions as well as between formal GDP and CO_2 emissions. Thus there is no evidence that supports the EKC hypothesis for greenhouse gas (GHG) emissions. By employing a cointegrated VECM model specification and accounting for structural breaks, we found that there exist co-integration relationships between the variables. Applying the technique to Granger causality, in both short and long-run, unidirectional causality from formal economic growth to CO_2 emissions, while demonstrating bidirectional causality between CO_2 emissions and TGDP. This implies that informal economy can be boosted at the cost of the environment. Thus, we propose policy recommendations directed at reducing the size of the informal sector and GHG emissions without affecting economic growth. Such suggestions consist chiefly in: implementing regulatory policy instruments to reduce CO_2 emissions, increasing the probability of tax audits, compelling informal firms, and finally, applying a minimum of regulations in the formal sector, instead of multiplying them.

1. Introduction

What is the causal relationship between CO_2 emissions and economic growth in the presence of informal economy? It is the central question of the CO_2-economic growth nexus, which has been left unanswered univocally after more than six decades of empirical research. The major increase in GHG emissions is attributed largely to CO_2 as the principal gas leading to global warming and climate change (World Bank, 2007), formal economy has become a major contributor of CO_2 emissions. Similarly, informal economy has also been found to be affecting environmental quality. Indeed, by allowing polluting small and medium enterprises to evade environmental regulations, production in the informal economy is likely to increase pollution levels and induce environmental degradation (Biller, 1994; Blackman & Bannister, 1998; Blackman, 2000; Lahiri-Dutt, 2004). In Tunisia, as in many developing countries, small-scale traditional brick kilns are a notorious informal sector source of urban air pollution. Many large cities support several hundred of them. These kilns are fired with a variety of cheap, highly polluting fuels such as used motor oil, wood scrap, used tires, manure, and plastic refuse. As a result, in some cities they are a leading citywide source of air pollution. Here one question crops up: how will the expansion of an informal economy over time affect the quality of the environment? The answer is obvious. On the one hand a richer informal firm consumes more resources, requires more energy and produces more waste and pollution. On the other hand, a richer informal firm systematically refuses to install the most technologically advanced pollution control equipment, and to implement effective environmental policies. As distinct from the formal economy, the answer is not obvious. A richer formal firm has the resources to invest in renewable energy, to install pollution control equipment, and to implement effective environmental policy, at both administrative and judicial levels.

The first empirical studies were stimulated by Kuznets (1971). The latter received the Nobel Prize in economics for his works on the relationship between the formal economy and inequality which tend to take the form of an inverted U-shaped curve. In other words, income inequality tends to worsen when a country tends to

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http://dx.doi.org/10.1016/j.scs.2014.11.001
2210-6707/© 2014 Published by Elsevier Ltd.

undergo economic takeoff, to stabilize at a level of average revenue, then to gradually decrease (Kuznets, 1955). This relationship between income per capita and income inequality can be represented by a bell-shaped curve. This phenomenon is described as the Kuznet Curve (KC). The inverted U-shaped relationship between economic growth and measured pollution indicators is known as the Environmental Kuznet Curve (EKC). The EKC hypothesis states that pollution levels increase as a country develops, but begin to decrease as rising incomes pass beyond a turning point. This hypothesis is illustrated first by Grossman and Krueger (1991). These authors studied two groups of 29 and 42 countries on the basis of cross-sectional data relative to suspended particulate materials and to sulfur dioxide. They estimated that these two indicators of pollution reach the EKC turning point when GDP per capita is $5000 (in 1985).

In the national literature, only two studies put the accent on the causal relationship between income and CO_2 in the case of Tunisia. In a first work, Fodha and Zaghdoud (2010) studied the relationship between economic growth and gas emissions over the period 1961–2004. Their study is based on the EKC hypothesis and uses the time series technique. Particularly, they treat the relationship between CO_2 and SO_2, as environmental indicators, and economic growth. The relationship between SO_2 emission and GDP per capita has taken the form of an inverted U, with the income turning point approximately equal to $1200 (constant 2000 prices) or to $3700 (in PPP, constant 2000 prices). However, a monotonically increasing relationship with GDP is found appropriate for more CO_2 emissions. In a second work, Ben Abdallah, Belloumi, and De Wolf (2013) examined the relationship between value added transportation, road transportation-related energy consumption, road infrastructure, fuel price and CO_2 emissions from the Tunisian transportation sector during period of 1980–2010. They found a long-run co-integration relationship between CO_2 emissions and GDP per capita in the transportation sector. Relations between the value-added transportation and transport CO_2 emissions per capita have taken the form of an inverse N-shaped, with the income turning point respectively equal to 75 and 579 (2000 TND constant prices).

In the international literature, there exist numerous studies on the relationship between environmental degradation and economic growth. This relationship is examined by Adom, Bekoe, Mensah, Mensah, and Botchway (2012), Grossman and Krueger (1994), Harbaugh, Levinson, and Wilson (2002), Holtz-Eakin & Selden, 1995, Itkonen (2012), List and Gallet (1999), McPherson & Nieswiadomy, 2000, Nasir and Rehman (2011), Pallab, Berrens, and Bohara (2004), Saboori, Sulaiman, and Mohd (2012), Shafik (1994), Shahbaz, Ozturk, Afza, and Ali (2013), Sharma (2011), Song, Hang, and Wang (2013) and Stern and Common (2001). These studies use different indicators for environmental quality such as suspended particulate materials (SPM), nitrogen oxide (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), smoke (for air quality), and CO_2 (for atmospheric changes), dissolved oxygen, fecal nutrients, heavy metals, access to water (for water quality), a number of threatened bird species, many threatened species of mammals, national risk indicator (for threats to biodiversity), biodiversity and annual deforestation (for deforestation), and for solid waste. These empirical studies allow us to distinguish between three results of empirical testing: positive results, negative or controversial and non-significant results in the EKC. The above mentioned studies, however, conclude that EKC is a country and/or indicator specific phenomenon, as the results vary both across countries and across different measures of environmental standards.

However, environmental problems like air pollution are due to the increase and concentration of GHG emissions in the atmosphere. GHGs such as CO_2, methane and NO_x usually originate from agro-food processing and agro-industrial activities such as informal processing industries with high energy, thermal power plants and road transport intensity. These problems are more severe when accompanied by demographic growth. The more the population increases the greater will be the atmospheric pollution.

Some researchers have recently considered demographic factors in order to explain the sources of air pollution. The first studies were based on cross-sectional data for only one time period. In this line, Cramer (1998, 2002) and Cramer and Cheney (2000) evaluated the effects of population growth on air pollution in California and found a positive relation only for some sources of emissions but not for others. Dietz and Rosa (1997) and York, Rosa, and Dietz (2003) studied the impact of population on carbon dioxide emissions and energy use within the framework of the Impact-Population-Affluence-Technology model (IPAT). The results in these studies indicate that the elasticity of CO_2 emissions and energy use with respect to population are close to unity.

In many countries, especially developing countries like Tunisia, the more the population and its needs increase, the more it will be difficult to respect biological standards. Tunisia is not able to acquire new technologies, cleaner production techniques and equipment to fight against pollution. Thus, environmental and fiscal policies in Tunisia are not yet rigorous. The number of employers in the informal economic activities is increasing to the extent that the survival of about 31.4% of the active non-agricultural labor force depends on this sector, which plays a key social role the formal sector is unable to play (Abid & Ben Salha, 2013). Such irregular activities may be responsible for the increase in CO_2 emissions in Tunisia and the aggravation of the phenomenon of global warming or climate change. Therefore, it is obvious that, in the long-term, informal economic growth will be dangerous to the environment if we do not take the necessary precautions. Similarly, informal economy has been found to have a great effect on environmental quality.

Although this study focuses chiefly on EKC, the size of the informal sector is included in the calculation of GDP and in our analysis in order to capture the true significance of EKC for Tunisia's economy. Surprisingly, the literature studying the relationship between informal economic growth and environmental degradation in Tunisia is conspicuously absent. Also, there is no published research investigating this relationship in the presence of the informal sector. So this paper is one of the first to attempt to fill the gap in this field. The principal objective here is to examine the relationship between carbon dioxide emissions and economic growth in the presence of the informal economy. Hence, the main contribution to the literature is to conduct an empirical analysis so as to find out whether the informal economy is the main source of environmental degradation. It is also important to note that this study attempts to enrich the literature in question and make a contribution to quality-related studies.

The paper is organized as follows. The next section gives an overview of the informal economic and environmental situation in Tunisia. Section 3 provides data information and clarifies the methodology and the modeling strategy. Result interpretations are presented in Section 4. Finally, Section 5 presents the conclusion and deals with policy implications.

2. An overview of Tunisia's informal economic and environmental situation

Emissions from all fuel sources have grown in the African region over time with liquid and solid fuels now each accounting for approximately 35% and gas fuels accounting for 16.9% of the regional total. A small number of nations are largely responsible for the African emissions from fossil fuels and cement production. South Africa accounts for 38% of the continental total, and