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Clean manufacturing industries and environmental quality: The case of Egypt

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ABSTRACT

The present paper investigates the relationship between the quality of the environment and clean manufacturing industries in Egypt over the period 1990–2013. The chosen estimation technique is the error correction model. For that purpose, the effect of clean manufacturing industries, per capita income and technology on the quality of the environment are examined. Clean manufacturing industries are defined as industries that have low actual emissions per unit of output. This is usually attained as a result of using technologies that reduce waste(s) and minimize the use of non-renewable sources of energy. The results indicate that clean manufacturing industries are a determinant of environmental quality as indicated through CO_2 emissions per capita, change in forest area, consumption of ozone depleting substances, and lack of access to improved sources of water. However, it was found to be insignificant for the case of lack of access to sanitation facilities. Policy implications to promote clean industries are given.

1. Introduction

Manufacturing has always been believed to be the engine of growth. Since the 1950's, Egypt has focused on promoting its manufacturing industries especially in chemicals, textiles and metals (Egypt State of Environment, 2010). Nevertheless, these industries have tended to cluster in heavily populated cities such as Cairo, Giza, Helwan and Alexandria creating considerable environmental damage (Egypt State of Environment, 2010). The manufacturing share of GDP in Egypt averaged around 17.5% over the period 1990–2013 (World Bank "World Development Indicators" (WDI)) albeit at a cost to the environment. For perspective, environmental damage is estimated to range from 3.4% to 6.4% of GDP yearly. Among the types of pollution, air pollution costs are estimated to range from 1.1% to 3.2% of GDP, while water pollution costs (including sanitation, lack of safe water and hygiene) are estimated to range from 0.7% to 1.2% (World Bank, 2002). Finally, ozone depletion costs range from 0.2% to 0.4% of GDP every year (World Bank, 2002).

That is not to undermine the potential of Egypt's manufacturing industries to create jobs, to act as a catalyst of technology transfer, to attract foreign direct investment and to foster greater integration in the global economy (UNIDO, 2014). However, Egypt, like many other developing countries, faces rising risks of global warming, climate change and environmental degradation. Hence, shifting to clean manufacturing industries, or heightening the reliance on it, is one way to avoid environmental pitfalls which result in energy, water, and also food shortages in Egypt. It is also a means to preempt rapid resource depletion, excessive pollution, and loss of biodiversity (UNIDO, 2011a). Given the above scenario this paper sets the following research question: What is the effect of clean manufacturing industries on the quality of the environment in Egypt?

Abbreviations: ECM, Error Correction Model; EKC, Environmental Kuznets Curve

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In an attempt to answer the above question, the paper examines the effect of clean manufacturing industries on five indicators of environmental quality; carbon dioxide (CO_2) emissions per capita; annual change in forest area; consumption of ozone depleting substances; the lack of access to improved sources of potable water; and the lack of access to improved sanitation facilities. The main hypothesis tests whether there is a positive correlation between the quality of the environment and clean manufacturing industries.

Clean manufacturing industries are defined as those industries which use clean technology, clean energy and improved resource efficiency. They ultimately reduce air and water pollution, manage waste and reduce its generation, as well as minimize chemical risks. Clean manufacturing can be achieved on both the product and process levels. There is increased consumer demand and awareness not only for clean products that constitute minimal or no harm to the environment, but also for production processes that use energy and resource efficient techniques. Manufacturing industries are classified/ranked based on their pollution intensity (namely, actual emissions per unit of output). The emissions-intense manufacturing industries are generally identified as the "dirty ones" (iron and steel, non-ferrous metals, industrial chemicals, pulp and paper and non-metallic mineral products).[1] By analogy, textiles, non-electrical machinery, transport equipment, and instruments are examples of clean industries.

Although there are several empirical contributions that investigate the relationship between economic growth and the quality of the environment, there remains a research gap especially with relevance to developing countries in general and Egypt in particular. It is this gap that motivates the present paper. Using an error correction model, it examines the long-term relationship between the value-added of the clean manufacturing industries and environmental quality. It further examines whether or not the EKC hypothesis holds for Egypt. To the authors' knowledge, this is the first contribution to use clean manufacturing industries instead of dirty industries in determining the quality of the environment in Egypt.

The analysis is focused on Egypt because Egypt's rank is 104 out of 180 countries in the Environmental Performance Index (EPI)[2] in 2016 and its performance is below its peer Middle East North African countries. For perspective, the EPIs for Tunisia, Morocco, Jordan and Algeria are 53, 64, 74, and 83, respectively (Environmental Performance Index Report, 2016). In addition, some of the recommended policies of this research can be replicated in other developing countries depending on the degree of similarity to the Egyptian case. As clean manufacturing industries rely heavily on technologies that reduce waste(s) and minimize the use of non-renewable sources of energy, the paper also attempts to capture the role played by technological change over time.

The paper is structured as follows: Section 2 reviews the relevant literature; Section 3 explains the empirical model and the results; Section 4 concludes and presents some policy recommendations.

2. Review of literature

There are three strands of literature with relevance to environmental quality. The first is the EKC hypothesis, the second is structural change that includes both scale and composition effects of economic activity, and the third is technological change.

First, the EKC hypothesis is the most common approach in the theoretical and empirical literature that examines the linkage between economic growth and environmental quality. The hypothesis states that environmental quality deteriorates faster than income at early stages of economic growth and then improves after reaching a certain threshold of per capita income. Following are a number of studies that investigate the economic growth-environmental quality relation (their support, or otherwise of the hypothesis shown between parentheses): Grossman and Krueger (1995), Panayotou (1993), Selden and Song, (1994), Shafik, (1994) (support the existence of the EKC); Cole et al. (1997), Stern (2004) (reject the existence of the inverted U shape relationship), and Cialani (2007) (finds no evidence).

Second, structural change includes both scale and composition effects[3] of economic activity. Han and Chatterjiee (1997) and Dinda (2004) argue that the sectors generating high value-added in developing countries tend to be the ones which are more energy intensive and which generate high CO_2 emissions compared to developed countries.

Vukina et al. (1999) examined the relation between the level of value-added generated by energy intensive industries in a group of transition economies and their respective pollution emissions. They found that the overall emissions associated with aggregate manufacturing have declined due to the near collapse of manufacturing production in those countries. In the same vein, Lucas et al. (1992) find that shifts in industrial composition have been associated with faster growth in manufacturing emissions relative to GDP at lower levels of per capita income and have been associated with slower growth at higher levels. This is not due to the use of cleaner technology, but to manufacturing taking a declining share of GDP at higher income levels.

Third, technological progress is found to be a principal factor in environmental quality. Zhou et al. (2013) revealed that structural adjustments are considered an effective of way to reduce China's CO_2 emissions, and that much of that reduction is attributed to technological progress. Lindmark (2002) uses stochastic trend as a proxy of technological progress and argues that it affects the EKC patterns. The study also finds that one of the aspects of progress is introducing new industrial output which takes environmental

[1] The paper has adopted the definition of Mani and Wheeler (1998) of dirty industries to be able to extract the value added of the clean industry.

[2] The index comprises nine issues that measure environmental performance (health impact, air quality, water and sanitation, water resources, agriculture, forests, fisheries, biodiversity and habitat, climate and energy). A host of indicators lie under each issue. For example, air quality issue includes: 'household air quality'; 'air pollution – average exposure to fine particulate matter'; 'air pollution- fine particulate matter exceedance'; 'air pollution- average exposure to NO_2. In total, 20 indicators fall under the 9 issues comprising the index.

[3] Under the scale effect, and given constant technology, a large scales rise in economic growth results in a proportional increase in levels of pollution emissions and environmental degradation (Dinda, 2004), and more extensive use of natural resources. The composition effect relates to a growth in income, and in per capita income, which are associated with a change in the structure of the economy towards information-based industries and services which tend to shift to clean production (Cialani. 2007).