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Research article

Economic growth, CO_2 emissions, renewable waste and FDI relation in Pakistan: New evidences from 3SLS

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ABSTRACT

First attempt has been made to find the effects of foreign direct investment on environmental pollution and economic growth, in addition to finding the determinants of foreign direct investment inflows in Pakistan using the annual data set for the period of 1980–2014. Simultaneous equation model has been used to find relation between the variables of concern. Results from technique and composition effects show that increase in economic growth leads towards more pollution emissions. Scale effect shows stock of capital and labor have positive effect on the economic growth of Pakistan while pollution has negative effect on growth. In case of capital accumulation effect, economic growth and foreign direct investment have positive and significant effect on stock of capital. Although increase in economic growth increases pollution, however, economic growth declines as pollution crosses a certain limit. Foreign direct investment is also found positively related with pollution.

1. Introduction

The industrial sector in Pakistan is one of the major contributors to economic growth i.e. 25.5 percent of GDP (GOP, 2014). Raising industrial production requires increased mobilization of foreign resources, being the most important determinant for progress in this sector (Khan and Kim, 1999). Pakistan is undertaking sound macroeconomic policies along with a wide range of structural reforms and incentives for being congenial for both foreign investors and local industries (Khan, 2007, 2011; Hussain, 2009; Desbordes, 2010). Recent studies have explored the relationship between FDI inflows and its determinants [see Akhtar (2000); Afza and Khan (2009); Khan and Samad (2010); Hakro and Ghumro (2011)]. However, the relationship between pollution emissions and FDI is limited in previous work. The importance of FDI in economic growth process is increasing gradually and increasing concern regarding environmental problems. Thus, FDI role has become controversial and debatable.

FDI contributes into host economy via three folds: (i) FDI stimulates hence economic development process in host economy (Alfaro et al., 2010). (ii) FDI is source of external finance (Bustos, 2007). (iii) FDI reduces the bridge between domestic savings and target investment (Ndikumana and Verick, 2008). Moreover, FDI stimulates economic activity by providing direct access to capital financing, generating positive externalities, transferring advanced technology, increasing productivity gains, etc. (Lee, 2013; Shahbaz et al., 2015). FDI helps in developing local enterprise development which further encourages employment opportunities for skilled and unskilled labor in host country. It is affirmed that FDI promotes economic growth but not free from environment cost (Shahbaz et al., 2015). The fact is that developing economies undermine environmental apprehensions via relaxed environmental regulation is named as *pollution haven hypothesis* (Cole and Elliott, 2003). In such circumstances, multinationals are encouraged to

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make investment in those countries which have relaxed environmental policies to enhance their production. This scenario provides opportunities to multinationals for reaping full advantage of reduced cost of production and it is termed as *industrial flight hypothesis* (Asghari, 2013). Anyhow, relaxed environmental policies as well as reduced cost of production are sources of environmental degradation in host country. Contrarily, FDI comes with advanced and energy efficient technology and works under better management practices that leads to improve environmental quality in host country. This is termed as *pollution halo hypothesis*. FDI affects economic growth which affects energy consumption and hence carbon emissions in host country (Shahbaz et al., 2015). If multinationals or foreign investors employ advanced technologies for production process then FDI declines energy intensity and lowers CO_2 emissions otherwise FDI impedes environmental quality by increasing carbon emissions due to use of energy intensive technology. The relationship between FDI and carbon emissions via income or energy consumption is discussed and empirically investigated in various studies in existing literature but results are inconclusive (Omri and Kahouli, 2014; Shahbaz et al., 2015).

This ambiguity in empirical evidence on FDI-emissions nexus provides rational for reinvestigating association between FDI and carbon emissions for reliable and consistent empirical analysis. In doing so, this study fills the gap by investigating the relation between FDI, CO_2 emissions by incorporating role of economic growth for Pakistan. Industrial sector is a major contributor in GDP of Pakistan. The expansion in industrial sector leads energy demand which is major source of CO_2 emissions (Shahbaz et al., 2015). Pollution emissions is mainly associated with industrial sector. Further, FDI inflow to Pakistan is increasing may also be a source of CO_2 emissions. FDI may affect CO_2 emissions via scale, technique and composition effects.

Thus, this study offers the solution to check all possible channels to overcome environmental pollution for Pakistan. Beauty of the study is to decompose the total environmental effect of FDI into three techniques, namely technique, scale and composition effects. FDI affects carbon emission via income is termed as income or scale effect. FDI may affects carbon emissions via changing structure of an economy i.e. shift of economy from agriculture to industry and then industry to services is called composition effect. FDI helps host country in adopting advanced technology which may affect carbon emissions is termed as technique effect. This study is inspired by recent studies (for example, Zhang and Zhou, 2016; Shahbaz et al., 2015) to investigate the relation between CO_2 emissions, economic growth and FDI for Pakistan. The spurious problem may be found due to omission of relevant variables. This issue is covered by adding additional independent variables such as stock of capital, renewable waste and labor force. For empirical analysis, we have employed three stage least square (3SLS) to solve a simultaneous equations system. The 3SLS is more efficient as compared to 2SLS as 3SLS allows correlation between unobserved disturbances across various equations to be used in the analysis. Thus, 3SLS has been used because of its advantages. Rest of the paper is structured in different sections as: Section 2 is for brief literature review, section 3 for data and method, section 4 is for results and discussion while section 5 concludes the paper policy.

2. Brief literature review

There are two different arguments regarding effect of FDI on environmental quality of the host country. At one side, it is considered to have positive effect on the host country environment (Liang, 2006) on the other side, it is argued that although FDI accelerates the process of economic growth but it may also generate a negative spillover effects on environment of the host countries (Xing and Kolstad, 2002; He, 2006; Tang and Tan, 2014). Similarly, Kivyiro and Arminen (2014) find that CO_2 emissions, FDI, economic development and energy consumption move in the same direction in the long run in Sub-Sahara Africa. Omri et al. (2014) also find bidirectional causality between economic growth and FDI flows and CO_2 emissions and FDI, indicating that FDI may exert adverse effect on the host economy. The studies focusing on Gulf Cooperating Council and five ASEAN countries reveal that economic growth and energy consumption are the sources of pollution emission whereas FDI flows have no role in pollution emission (Almulali and Tang, 2013; Chandran and Tang, 2013). Therefore, the effect of FDI inflows on the host country's environmental pollution has always been one of the most controversial issues till date and there is little to focus for Pakistan's economy.

Developing countries deliberately underrate the environmental standards to attract foreign investors. Therefore, generally, to get benefit of the few stringent environmental policies, foreign investors shift their operations to the less developed countries (Mabey and McNally, 1999). On other hand, it is also possible that multinational corporations (MNC) use more environment friendly and advanced technologies along with better management and operational practices in the production process. Hence, FDI contributes positively in reducing the host country environmental pollution intensities (Zarsky, 1999). Existing energy economics literature discusses the relationship between environmental pollution and FDI both in cross-country and inter-country framework (Porter and Van der Linde, 1995; Eskeland and Harrison, 2003; Henderson and Millimet, 2007; Lee, 2013; Shahbaz et al., 2015). However, results remain controversial.

Literature shows relationship between all these variables like a study conducted by Cole et al. (2011) in China report that there is a U-shaped relationship between per capita pollution emissions and income, economic development also lead to an increase in industrial emissions. He (2006) used panel data to test economic growth-environment relationship by employing simultaneous equation approach by constructing five equations in a system of equations to find out the effect of FDI on pollution emissions. The decision of FDI entry depends on the economic growth of last period and stringency of the environmental regulations. The results in this study support the pollution haven hypothesis while the effect of environmental stringency affects the FDI inflows modestly. The nexus between pollution and FDI becomes more complicated when theoretical considerations are related to three economic considerations namely the scale effect, technique effect and composition effect. Basically the entry decision is mostly based on the scale of economic growth in the host country. On other hand, pollution halos hypothesis exists in the case when domestic firms are more pollution intensive as compared to multinational firms because these multinational firms use more environmental friendly technologies and cleaner and advanced production methods which result in an improved environmental management systems (Cole et al., 2008; Eskeland and Harrison, 2003).

3. Material and methods

Annual data has been used for the period of 1980–2014 in the present study. Data on real GDP (US million dollar), per capita GDP (Us dollar), population density (number of persons per square km) and foreign direct investment (US million dollars) are taken from different issues of Economic Survey of Pakistan. We used two indicators of pollution due to data availability on these variables. They include CO_2 emissions and renewable waste. Renewable waste comprises waste (metric tons) from energy consumption in industrial sector. Data on CO_2 emissions (metric tons), renewable waste (metric tons), road and railway lengths (km) are taken from