Is green fiscal policy as a driver for green energy economy: empirical evidence from developing countries

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Ban Ki-moon, United Nations Secretary-General:
“Energy is the golden thread that weaves together economic growth, social equity and environmental sustainability”

1. Introduction

Before the beginning of 2008 Global Financial Crisis, many countries had heavily relied on conventional “black” economic development which required resource depletion and utilization of fossil fuels leading to serious environmental pollution and ecological crisis. Consequently, green economy is now seen as a new vehicle for creating economic, social and environmental benefits. (CCICED, 2011). The phrase “Green Economy”, which means the efficient application of natural resources, has evolved to refer to an economy which has reduced adverse impacts on global environment – air, water, biodiversity and climate (G.Mulgan and O.Salem, 2008). At its most basic level, green economy is the clean energy economy, encouraging dissemination of renewable energy (e.g. solar, wind, geothermal) technologies (K.Gordon and J.Hays, 2008). The pace of green capital accumulation has accelerated in recent years, led by technological progress, economies of scale, strong policy support and favorable public opinion. Green programs had also proven to be important in national fiscal stimulus plans during the 2008/2009 global financial crisis (Luc Eyraud et. al. 2011)

The importance of fiscal policy formulation is for state revenue optimization, controlling budget deficit and reducing debt-to-GDP ratio. Several countries appear to have recycled revenues from environmental taxes in order to reduce overall tax burdens and addressing social concerns. For example, Germany uses eco-tax revenues to reduce labor costs (i.e. pension contributions). And, revenue of environmental taxes are used to support low-income households to lessen social impacts or financing environmental projects (e.g. investment for green technology) (UNEP-IMF-GIZ, 2012). The research paper aims to:

- Provide theoretical and econometric evidence that global ecological problems have a solution with green energy economy and fiscal-financial infrastructure functions to fasten the transition period to green energy economy;
- discuss, analyze successful dissemination of fiscal policies of green economy among developed and emerging countries; lessen the knowledge, experience gap of green economy disseminations between developed and developing economies;
- develop green fiscal policy platform applicable and relevant to all emerging countries; provide recommendation to developing countries which have enormous natural resource to utilize, human resources to lead and society to follow.
Indeed, there is a public perception for accepting sustainable development and each Government possesses capacity to establish, implement efficient public policies, mainly financial mechanisms and environmental policies that direct the economic decisions of each individual in society. Among all industries, finance is considered “blood of all spheres” for providing effective interaction among them. So, the financial mechanism and economic infrastructure of green economy assures complexity and integrity of all industries: agriculture, construction, transportation, energy, etc.

Energy is fundamental to human society, social development and economic growth (WEC, 2013). Global energy demand is projected to grow by around 45 percent by 2030: more than three-quarters of the increased demand will come from developing and transition countries (IEA, 2008). The paper attempts to research the contribution of green investments to electricity generation from renewable sources. Although, RE can bring socio-economic and environmental benefits, its implementation faces a number of obstacles, especially in non-OECD countries (Brunnschweiler, 2009) despite its socio-economic and environmental benefits. One of these obstacles is financing: underdeveloped financial sectors are unable to efficiently channel loans to RE producers. Churchill and Saunders (1989) argues that renewable energy projects have limited access to financing because RE projects compete against fossil fuel projects, which have a longer track record, relatively lower up-front costs and often relatively supported public infrastructure. Brunnschweiler (2010) suggests that a more highly-developed financial sector will have a positive impact on the development of the renewable energy sector. After analyzing 155 non-OECD countries, it is implied that without efficient green fiscal policy resulting to increase FDI, net flows in GDP, renewable energy is unlikely to reach its full potential in developing world.

The paper is organized as follows. Section (2) describes the level of dissemination of green economics in developing countries; ongoing policy framework is discussed in section (3) and the empirical results analyzed in section (4); while section (5) concludes the paper.

As of today, green investment deriving from resource-saving, environmentally-friendly public expenditure management is a significant contributor to energy generation from alternative sources. Renewable energies and nuclear power represent one-third of electricity generation worldwide, and almost one-fourth of total energy consumption (IEA WEO 2010). The pace of green capital accumulation has accelerated in recent years, led by technological progress, economies of scale, strong policy support, and favorable public opinion. Green programs had also proven to be important in national fiscal stimulus plans during the 2008/09 global financial crisis (IMF, 2011).

2. Current status of Green Energy Economy in developing countries
While bankers have been vilified as the cause of one of the largest financial disasters, the renewable sector has been seen as the white horse for many governments looking to emerge stronger. Despite economic downturn, investment continued in the renewable sector largely in part to government stimulus programs that focused on developing green economies. Around the world, governments have allocated more than USD 430bn fiscal stimulus to key climate change investment themes. China and the United States lead the way (KPMG 2011).

According to the African Consensus Statement at RIO+20 (2011), the trigger point for the Green Economy is “The combined stream of economic, social, and environmental crises that have plagued the global economy in recent years to a need to reorient the current development
models towards a more efficient, inclusive and sustainable economy by enhancing the resource efficiency of national economies, and decoupling economic activity from environmental degradation”.

Developing countries cover the majority proportion of the world geography, population and require the application of sustainable development while possessing the highest proportion of natural resources (gas, energy, gold). Evidently, the developed nations proved that green economy is vital in terms of environment and the process should be applied to economies with big territory and population. The fiscal model of green energy economy should be altered to the degree that matches the interest of bigger nation, perception and territories.

The growth of global carbon emissions is nowadays largely driven by the increasing volume coming from within developing countries (IEA 2010). CO2 emissions from economies in transition now exceed those of developed countries (IEA, 2011), but 1.4 billion people lack access to electricity and 2.7 billion depend on traditional biomass for cooking (UNEP, 2011). Since the technical knowledge on the control of pollution or other environmental services mainly exists in multinational enterprises in developed countries, foreign direct investment has the potential to disseminate this knowledge in developing countries (Popp, 2009).

Cumulative investment of US$37 trillion (oil and gas supply account for US$19 trillion and the power sector, including for generation, transmission and distribution accounts for US$17 trillion) is needed in the world’s energy supply system over 2012-2035 while the majority of investment (61%) is needed in non-OECD countries (IEA, 2012).

Many developing countries have unbalanced energy profiles that may be low on all aspects of the energy trilemma or skewed towards one of the three dimensions: energy security, energy equity and environmental sustainability. Yet, they all face similar challenges: how to provide access to the 17% of the world’s population that does not have access to electricity and the 41% that lacks access to clean cooking facilities and how to meet growing energy demand. While least-developing countries must ensure basic energy supply to support economic and social development, some developing and emerging countries are looking to sustain economic growth and to satisfy the aspiration of a growing middle class (WEC, 2013).

These theoretical materials are tested empirically in a series of panel data regressions for 155 non-OECD countries. The empirical findings are fairly encouraging: they confirm the positive effect of green public policies and particularly green fiscal policies resulting to increase the amount of foreign direct investment on the dissemination of RETs in developing and transition countries.

3. Literature review and data collection

To prepare current research paper, many institutional reports and individual studies are referred. Brunnschweiler (2009) focused on financing of renewable energy projects, in particular the relationship between financial sector and RET development in transition and developing countries.

In this paper, we study the relationship between green investments and renewable energy generation across 155 developing countries. Our study is also investigated by Brunnschweiler...
(2010) who presented evidence of financial sector development having a positive effect on renewable energy development, with particular focus on non-OECD countries. Prior that Brunnschweiler (2006) provided metric analysis that renewable energy technologies (RETs) have typically been adopted from developed countries and not been the result of domestic R&D in developing countries. Carley et al. (2011) proposed energy-based economic development (EBED) framework with the most suitable research dimensions, indicators and metrics where energy is referred to advanced, efficient and/or clean energy, which leads to economic development through changes to the energy system that deliver economic, social and environmental benefits.

B.Pohl and P.Mulder (2013) investigated that currently few studies have focused specifically on the diffusion of RET and these studies consider almost exclusively Organisation for Economic Co-operation and Development (OECD) economies. For example, Johnstone et al. (2010) use patent counts in a cross-section of 25 OECD countries to show that public policies encouraging innovation in RET. Also using patent-based data, Popp et al. (2011) find that increased knowledge has a robust, albeit small, effect on renewable energy investments across 26 OECD countries. In contrast, we model and evaluate the adoption of renewable energy sources across 155 developing countries between 1980 and 2012 comparing with foreign direct investment, net flows in GDP of the respective countries:

a) As a measure of electricity generation from renewable resources (i.e. solar, wind, geothermal and biomass), we refer to the data of United States Energy Information Administration (EIA) for the period 1980-2010. Similar to the study of Pohl and Mulder (2013), we exclude hydroelectric power generation from our definition, because large hydropower projects are increasingly viewed as being unsustainable sources of power generation due to their often serious negative environmental and social externalities.

b) World Bank (2003) provided information that large hydro projects in the developing world have been co-financed by multilateral financial institutions and the local governments, with little or no involvement sought of commercial finance. As a second variable, foreign direct investment, net flows are divided by the GDP of 155 developing countries in the period from 1980 till 2012. The data is collected from the World Development Index of World Bank (2015).

On its turn, our research is different from the papers of Brunnschweiler (2010), (B.Pohl and P.Mulder, 2013) and Eyraud et al. (2013) with a parameter that renewable energy generation is regressed against the proportion of foreign direct investments which results from efficient fiscal policy in GDP of 155 developing economies.

Furthermore, we first propose and then apply econometric approach to identify cause-effect relationship between a) renewable energy generation in developing countries and b) proportion of foreign direct investment, net flows in GDP of aforementioned countries. The main problem is the large number of zero-valued parameters surveyed in our dependent variable, because many countries do not yet, or have only recently started the investment on (non-hydro) renewable electricity generation.

Indeed, B.Pohl and P.Mulder (2013) found that a large share of hydropower lowers the probability of NHRE being adopted but nevertheless stimulates the amount of NHRE electricity produced, while the opposite is true when there is a diverse energy mix. Finally,
there is weak support for a positive influence of the Kyoto Protocol on NHRE diffusion and no evidence at all for any influence resulting from financial sector development.

Data was collected from various sources towards providing qualitative and quantitative enrichment. We reviewed and analyzed the academic literature and findings on financing green energy economics in developing countries. As defined by Brunnschweiler (2006), lack of a more systematic empirical analysis of the correlation between financial sector and RE development is also due to the data problem regarding the quantification of the RE sector, especially in the developing world. However, U.S. Energy Information Administration (EIA) provided data on non-hydro renewable energy generation in 155 developing countries in the period from 1980 till 2012. As a first variable, NHRE is chosen to identify the level of green energy dissemination in emerging economies.

The obstacles begin with the definition of RE in official statistics: traditionally, hydropower – mostly provided by large plants – has delivered the lion’s share of renewable energy in countries’ energy generation mix, with other types of RE – when included – making up for barely a few percent of overall energy production. Recently, however, some environmentalists and policymakers have contended that large hydropower projects should not be viewed as viable contributions to sustainable energy production, as they often cause serious negative environmental and social externalities (Brunnschweiler, 2009).

4. Methodology and modeling of fiscal reforms
Green stimulus measures are characteristically short-term, focusing on recovery from the crisis. Green fiscal policies on the other hand are to be understood more generally and often adopt a long-term perspective. In the countries the most common types of stimulus measures have been taxes (tax cuts) and subsidies, infrastructure investment leading to attract more FDI, and special government spending programs, like scrappage payments.

In panel data analysis, the following scenario is obtained:

<table>
<thead>
<tr>
<th>Fixed-effects (within) regression</th>
<th>Number of observations     = 4213</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group variable: Panel</td>
<td>Number of groups                = 152</td>
</tr>
<tr>
<td>R-sq: within = 0.0001</td>
<td>Obs per group: min = 2</td>
</tr>
<tr>
<td></td>
<td>avg = 27.7</td>
</tr>
<tr>
<td></td>
<td>max = 33</td>
</tr>
</tbody>
</table>

The electricity generation data for dependent variable Non-hydro Renewable Energy (NHRE) generation for the period 1980-2010 is freely available from the U.S. Energy Information Administration (EIA) and the variable of green investments is derived from World Development Index. In total, 4213 observations between FDI/GDP and NHRE are identified in the period of 33 years.

| NHRE | Coef.  | Std. Err. | t    | P>|t| | [95% Conf. Interval] |
|------|--------|-----------|------|-------|---------------------|
| FDI  | GDP    | .0045752  | .0067397 | 0.68  | 0.497   | -.0086384  | .0177888  |
Random-effects ML regression

\[ \text{Number of obs} = 4213 \]
\[ \text{Group variable: Panel Number of groups} = 152 \]

Random effects \( u_i \sim \text{Gaussian} \)

\[ \text{Obs per group: min} = 2 \]
\[ \text{avg} = 27.7 \]
\[ \text{max} = 33 \]
\[ \text{LR chi2}(1) = 0.09 \]
\[ \text{Log likelihood} = -10912.995 \]
\[ \text{Prob > chi2} = 0.7625 \]

The hypothesis:

Foreign Direct Investments, net flows in GDP of developing countries = “A”

Non-hydro renewable energy generation (in billion kilowatthours) = “B”

(Positive/negative) relation between two variables: A and B
When the research on investment issues of renewable energy generation is assessed in the case of OECD or developed countries, there is a positive relation between foreign direct investment and non-hydro renewable energy generation.

In our research where focus is oriented to non-OECD countries, these statistical findings are tested in a series of panel data regressions for 155 non-OECD countries. The empirical findings are fairly discouraging: they confirm the negative effect of foreign direct investment on the generation of non-hydro renewable energy in developing countries. The situation can be explained that increase in the FDI in developing countries provide short-term effect on the local economy and poor infrastructure, low level of economic growth and ineffective infrastructure of aforementioned countries does not allow the FDI to generate marginal renewable energy generation.

Referring to the research output of Brunnschweiler (2009), a look at the share of RE in overall electricity generation shows that on average, in non-OECD countries around 34% of electric power was produced by renewable energy resources between 1980-2006, compared with around 32% in OECD countries.

Tax instruments including tax cuts and exemptions, tax credits and subsidies, and new environmental taxes are being employed. However, most of the tax provisions aimed to promote greater fuel efficiency in vehicles, stimulating environmentally-friendly employment and production by SMEs, discouraging large companies causing harm to climate by adopting regulatory and taxation mechanisms. Beyond the stimulus, recent budget plans and long-term strategies for green growth show that countries such as China, the Republic of Korea, Japan, France, Germany, Australia and the U.S. are committed to developing a resource-saving, environmentally friendly green economy.

It is totally wrong to purport the fiscal policy framework of advanced economies to the developing countries, as the following aspects must be analyzed beforehand: political stability index, market development rate, social orientations, infrastructure of governing institutions and economic measurements. However, the cornerstone remains the same:
As part of the expansion of public sector investment, governments have promoted investment in low-carbon energy power – renewable sources, including, geothermal, hydro, wind, solar and nuclear. Countries such as France, the Republic of Korea, and the U.S. along with the EU, have targeted renewable energy, which amounts to USD 43 billion or 8.2 percent of total green package. Confronted with fiscally constrained world, fiscal reforms might appear to be a daunting challenge to a green energy economy transition.

Green fiscal policy reforms could provide multiple benefits. In Barbados, application of environmental taxes contributed to the provision of solar water heaters and in Germany, it contributed to a reduction in labor costs and creation of new jobs. Nevertheless, fiscal measures and reforms can have complex implications in economic and social spheres though. In particular, fiscal reforms tend to have distributional impacts on vulnerable groups (e.g., low-income households, pensioners, single-parent households). Therefore, distributional and social objectives need to be taken into account when formulating and applying fiscal measures, such as tax exemptions, reduced tax rates or other compensation measures that could contribute to the strengthening of social safety nets would not only increase social and political acceptability of fiscal reforms, but could also contribute to an equitable and fair transition to a green economy. The key to a successful green fiscal reform policy is reaching equilibrium between distributional impacts and cost-effectiveness, particularly in the prospective need for fiscal consolidation (UNEP, 2012)

For calculating mathematical outputs, statistical model of Simon and Blume (1994) attempts to identify the variables explaining the variance observed in green tax revenues in developed economies. Accordingly, the dependent variable is total revenue from environmentally related taxes, $R_i$, with adjustments made for fuel taxes to be explained later. The pool of explanatory variables is composed of three vectors: the revenue generating potential of a certain country, $G_i$ (measured by the Gross Domestic Product); the environmental quality vector, $E_i$ (measured by the quality of health, $H_i$, the total quantity of carbon emissions in a given year $C_i$ and its squared form $C_i^2$); the vector of industry pressure $X_i$ (measured by the total goods exported in a given year, $Exp_i$, and the number of exemptions and rebates awarded to energy-intensive sectors, $ExReb_i$). Thus,

$$\begin{align*}
R_i &= \alpha + \beta_1GDP_i + \beta_2H_i + \beta_3C_i + \beta_4C_i^2 + \beta_5Exp_i + \beta_6 ExReb_i + \epsilon_i
\end{align*}\tag{1}$$

Or, more specifically,

$$\begin{align*}
R_i &= \alpha + \beta_1GDP_i + \beta_2H_i + \beta_3C_i + \beta_4C_i^2 + \beta_5Exp_i + \beta_6 ExReb_i + \epsilon_i
\end{align*}\tag{2}$$

where $\epsilon_i$ represents the error term, which is assumed normally distributed.

5. Effective fiscal approaches by countries:

5.1 China

The Government of China has implemented reduced Corporate Income Tax (CIT) rate as 15% for qualified advanced and new technology enterprises operating with solar, wind, biomaterial and geothermal energy. For further encouraging green technologies, ‘Three years’ CIT
exemption followed by another three years’ 50 percent reduction of CIT rate” for income derived from specified Clean Development Mechanism (CDM) projects. Further, 150% of money spent for R&D purposes can be deducted on CIT computation. 50% refund of Value-added Tax (VAT) paid on sale of wind power is refunded while VAT paid on sale of produced from recycled materials or waste residuals is also refundable (KPMG, 2011).

5.2 Uzbekistan

Addressing to Inter-governmental organizations (World Bank, ADB) to fund proposed projects on priority industries brings fruitful results, because long-term credit with low interest rates enhances the development of renewable energy and energy efficiency as a fiscal aspect. For example, Samarqand solar power station with 100 MW electricity generation capacity received long term loan of 300 mln USD which is planned to enlarge to 2 GW station in the future (ADB, 2013). Technical assistance and grants of international financing institutions serve to enlarge stakeholder interests as well as supporting sustainable development of energy industry as a part of green inclusive economics.

5.3 Kenya

Feed-in Tariff (FIT) policy instrument was mandatory for energy companies and utility providers to purchase electricity from renewable energy resources at pre-determined prices in order to stimulate the flow of investments on renewable energy (UNEP, 2010). It is expected that FIT policy would bring extra 1300 MW electricity generation capacity with assurance of energy security by increasing reserve margins. As a result, the mechanism leads “triple-win” concept – enhancing the power of energy economics, green employment opportunities for poverty alleviation in rural areas and green business opportunities to privates sector.

6. Discussion and conclusions

The transition to a low carbon emission model will require large investments in alternative sources, because green technologies, such as wind turbines or solar panels, are capital intensive, especially in the early stages of development (Johnson and Lybecker, 2009).

7. References:


