



# Measuring the impact of alternative and nuclear energy consumption, carbon dioxide emissions and oil rents on specific growth factors in the panel of Latin American countries



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## ABSTRACT

This study examines the impact of alternative and nuclear energy consumption (NE), fossil fuel energy consumption (FFUEL), carbon dioxide emissions (CO<sub>2</sub>) and oil rent (OILRENT) on economic growth (GDPPC) and foreign direct investment (FDI) in the panel of nine Latin American countries, for the period of 1975–2013. The result of pooled seemingly unrelated regression (SUR) indicates the importance of NE, FFUEL and CO<sub>2</sub> emissions that positively contributed to increasing GDP per capita, while oil rents fail to promote economic growth in the region. Similar results have been obtained with the FDI in which the role of energy sources amplified the foreign investment on the cost of CO<sub>2</sub> emissions in the region. With respect to individual countries, CO<sub>2</sub> emissions exert the positive association with the GDP per capita of Argentina, Bolivia, Brazil, Chile, Colombia, and Peru, while, NE significantly increases GDP per capita of Colombia, Peru and Venezuela. Fossil fuel energy consumption increases along with the increase in GDP per capita in Bolivia, Chile, Colombia, and Venezuela, however, it decreases the economic growth of Argentina and Peru respectively. Oil rents have a negative relationship with GDP per capita of Argentina, while it possesses significant and positive impact in Ecuador and Venezuela. Finally, the panel causality tests confirmed the following four causality hypothesis in between the different variables i.e., feedback hypothesis, energy conservation hypothesis, growth hypothesis and neutrality hypothesis, both in the short and long-run.

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## 1. Introduction

There are a number of counter arguments exist regarding the safety of nuclear energy consumption. As [Diaz \(2011\)](#) is in the favour of expanding nuclear energy in Latin American countries while [Furtado \(2011\)](#) against it in the favour of nuclear power in Latin American's energy matrix. This debate is not wrapped out here, as in the research arena, this counter argument still alive and the policy makers still strive to hard for managing energy portfolios across their countries.

There is a number of previous literature available on the role of nuclear energy consumption and its impact on growth factors across the globe. [Omri and Chaibi \(2014\)](#) examined the cause-effect relationship between nuclear energy consumption and economic growth in the panel of 17 diversified countries by using a system of equations. The results confirmed the 'growth hypothesis' in

Belgium and Spain, while, 'nuclear energy conservation hypothesis' holds in Bulgaria, Canada, Netherlands, and Sweden. The results further evident of 'feedback hypothesis' in Argentina, Brazil, France, Pakistan, and USA, while 'neutrality hypothesis' holds in Finland, Hungary, India Japan, Switzerland, and the U.K. [Apergis and Payne \(2010\)](#) confirmed the feedback hypothesis between energy consumption and economic growth in the short-run, while in the long-run, this relationship has been shifted from bidirectional to unidirectional in the panel of sixteen developing countries. [Wolde-Rufael \(2010\)](#) found the unidirectional causality running from nuclear energy to economic growth in case of India. [Yoo and Ku \(2009\)](#) confirmed the different causality patterns across the countries including growth hypothesis, energy conservation hypothesis, feedback hypothesis and neutrality hypothesis respectively. [Wolde-Rufael and Menyah \(2010\)](#) found diverse causality patterns in nine developed countries for the period of 1971–2005. Similarly, [Lee and Chiu \(2011\)](#) confirmed different causality patterns between nuclear energy and economic growth in the six highly industrialised countries. [Aslan and Çam \(2013\)](#) employed the bootstrap corrected

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causality between economic growth and nuclear energy consumption in the context of Israel for the period of 1985–2009. The results confirmed the unidirectional causality running from nuclear energy to economic growth but not vice-versa. [Omri et al. \(2015\)](#) established the feedback hypothesis, growth hypothesis, energy conservation hypothesis and neutrality hypothesis in the panel of 17 developed and developing countries of the World.

The nuclear energy consumption literature continues to grow in the following subsequent studies including, [Yoo and Jung \(2005\)](#) examined unidirectional causality running from nuclear energy to Korean economic growth; while [Lee and Chiu \(2008\)](#) using the panel of developed countries and confirmed unidirectional causality running from economic growth to nuclear energy in the long run. [Chu and Chang \(2012\)](#) confirmed unidirectional causality running from nuclear energy to economic growth in Japan, UK and the US, while economic growth Granger cause nuclear energy in the US. [Nazlioglu et al. \(2011\)](#) found no causality relationship between nuclear energy and economic growth in 11 countries out of the panel of 14 OECD countries. [Akhmat et al. \(2014\)](#) focused on the role of energy consumption that contributed environmental pollutants in the context of SAARC region, while [Alam et al. \(2015\)](#) emphasised the positive impact of financial development on SAARC's energy demand in the region. [Chang et al. \(2014\)](#) examined the long-run and causal relationship between economic growth and nuclear energy in the six developed countries for the period of 1971–2011. The results confirmed the conservation hypothesis in the panel of G-6 countries. The results further verified the feedback relationship between economic growth and nuclear energy consumption in the UK, while growth hypothesis is confirmed in Germany, and remaining countries shows the neutrality hypothesis. [Al-Mulali \(2014\)](#) examined the relationship between nuclear energy, economic growth and carbon dioxide emissions in the panel of 30 nuclear energy consuming countries over the period of 1990–2010. The results show that nuclear energy has a positive association with the economic growth, while there is no significant relationship with the carbon dioxide emissions in the panel of countries.

There is growing literature emerged nowadays, in relation with the energy factors and carbon dioxide emissions i.e., [Apergis et al. \(2010\)](#) confirmed the role of nuclear energy in order to lessen carbon dioxide emissions in the panel of 19 developed and developing countries. [Menyah and Wolde-Rufael \(2010\)](#) also confirmed the role of nuclear energy to decrease the carbon dioxide emissions in the context of US. [Vaillancourt et al. \(2008\)](#) suggested that nuclear energy consumption has a better option to reduce greenhouse gas emissions across the globe. [Al-mulali and Sab \(2013\)](#) examined the impact of energy consumption and environmental pollution in 16 emerging countries' economic growth, over the period of 1980–2008. The results show that energy consumption increases economic growth on the cost of air pollution. [Ozturk and Acaravci \(2013\)](#) investigated the long-run relationship between energy consumption, air pollution and growth factors in the context of Turkey, over the period of 1960–2007. The results show that in the long-run, there is a positive relationship between trade and carbon dioxide emissions, while, there is no significant association has been observed between financial development and carbon emissions in a nationwide. [Al Mamun et al. \(2014\)](#) examined the dynamic relationship between economic growth and carbon dioxide emissions across the globe, over the period of 1980–2009. The results confirmed the environmental Kuznets curve across the world except in high-income countries. However, it is evident that air pollution is more pronounced in high-income countries, while there is considerable less pollution in low and middle-income countries. [Yildirim et al. \(2014\)](#) investigated the relationship

between energy consumption and economic growth in 5 Asian countries, over the period of 1971–2009. The results confirmed the unidirectional causality running from economic growth to energy consumption in Indonesia, Malaysia and Philippines, while feedback relationship found in the case of Thailand. In the case of Singapore, both the variables exhibit the casualty independent pattern. [Apergis and Ozturk \(2015\)](#) examined the Environmental Kuznets Curve (EKC) hypothesis in the panel of 14 Asian countries, over the period of 1990–2011. The results confirmed the EKC hypothesis in the Asian region.

Foreign direct investment (FDI) played a vital role to increase energy consumption and growth factors in a number of studies. For example, [Lee \(2013\)](#) examined the relationship between FDI inflows, carbon emissions, energy use and economic growth in G20 nations, over the period of 1971–2009. The results show that along with the increase in FDI inflows, economic growth increases that lessen the carbon emissions in the region. However, the study failed to link any significant association between FDI and energy use. [Mukhtar et al. \(2014\)](#) supported the role of institutional variables that expedite the economic variables in order to reap the benefits of FDI inflows in Pakistan. [Malik et al. \(2014\)](#) investigated the possible impact of different macroeconomic variables on FDI inflows in SAARC countries. The results confirmed that economic variables exerted the positive impact of FDI inflows in the region. [Hassaballa \(2014\)](#) examined the two-way causal relationship between FDI and carbon emissions in the panel of developing countries and found that both the variables jointly connected in the long-run that supports the feedback relationship between them. However, in individual countries case, this relationship has been disappeared. [Tang and Tan \(2015\)](#) examined the linkages among energy consumption, air pollution, FDI inflows, and economic growth in Vietnam using time series data ranging from 1976 to 2009. The results show that both the energy consumption and economic growth have a positive impact on increasing carbon emissions in a country, while the results further verified the existence of environmental Kuznets curve in a country. The study further confirmed the bidirectional causality between i) economic growth and carbon emissions and ii) FDI and carbon emissions respectively. In addition, there is unidirectional causality running from energy to emissions both in the short and long-run.

The overall studies confirmed the strong connection between nuclear energy consumption, carbon dioxide emissions, economic growth and FDI inflows across the globe. This study explores the impact of alternative and nuclear energy consumption, fossil fuel energy consumption, carbon dioxide emissions and oil rent on economic growth and FDI inflows in the panel of 9 Latin American countries for a period of 1975–2013. This research is different from other previous studies in different perspectives i.e., the study used pooled seemingly unrelated regression method that handles the issues of heteroskedasticity, misspecification of the model and aggregation. In addition, the study used bootstrap corrected bias samples for robust analysis. The study substantiates the importance of alternative and nuclear energy consumption and growth-emission nexus in the Latin America region.

## 2. Data source and methodological framework

The data used for panel estimations comprises alternative and nuclear energy (% of total energy use), fossil fuel energy consumption (% of total), CO<sub>2</sub> emissions (metric tons per capita), foreign direct investment (FDI) net inflows (% of GDP); GDP per capita (constant 2005 US\$) and oil rents (% of GDP) taken from World Development Indicators published by [World Bank \(2014\)](#).

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