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Determinants of energy production from biomass: Multivariate Panel Data Evidence for IEA-30 Countries

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The contemporary increase in worldwide population drives the generation of energy from conventional and unconventional sources. Energy generated from exhaustible resources endanger the environment and imperils economic development. However, production of energy from naturally replenished resources add-in to economic development and helps address issues of global warming and further grants energy security. This study seeks to investigate the determinants of biomass energy production for International Energy Administration (IEA)-30 countries for the period covering 2000-2015. In our analysis, Gross Domestic Product (GDP) per capita is used as a proxy for economic growth and energy imports is deemed as the main controlling factor. Our panel fully modified and dynamic ordinary least squares regression shows a significant positive influence of total biomass energy production on economic growth. Thus, a percentage increase in primary biomass energy production increase GDP per capita by 0.04%-0.05%. For our panel vector error correction model based causality nexus, we notice that in both the short and long-run, there exist unidirectional causality running from economic growth and energy imports to total biomass energy production which supports the conservation hypothesis. The findings from the study indicates that economic growth and energy imports significantly influences total biomass energy production. This study guides policymakers in formulating a conclusive biomass energy and trade policies for sustainable economic growth.

Synopsis of our Econometric Model Formulation: Our primary focus is to investigate the nexus between biomass energy production, energy imports and economic growth with a panel data fixed-effects regression model specified as follows: $Z_{it} = \alpha_0 + \beta_1 Y_{it} + \beta_2 C_{it} + \varepsilon_{it}$ (1) Where denotes the dependent variable gross domestic product per capita (GDPC) ; represents total biomass energy produced; represents each IEA member country-level control variables; is the intercept or constant and and are the parameters; is the stochastic error term; is the subscript of each IEA member states where , and is the subscript of each IEA member state time dimensions where .

More specifically, we explore the relationship between biomass energy production (TBEP), energy imports (EI) and GDPC by employing Granger causality test based on panel vector error correction model (PVECM). For our stationarity analysis, we first employ Im, Pesaran and Shin (IPS) test developed by Im et al. which allows for heterogeneous autoregressive coefficients. We formulate our mathematical model as: $z_{it} = v_i z_{it-1} + \delta_i Y_{it} + \varepsilon_{it}$ (2) Where Y_{it} represents our predictor variables comprising individual time trend; autoregressive coefficients is represented by v_i ; and ε_{it} represent the stationary stochastic error terms. As the IPS ensures various orders of serial correlation by averaging the augmented Dickey-Fuller (ADF) unit root test, we formulate our stochastic stationary error term as:

$$\varepsilon_{it} = \sum_{x=1}^{v_i} \phi_{ix} \varepsilon_{it-x} + \mu_{it}$$

(3) Therefore, by substituting (3) into (2), our mathematical formulation becomes: $z_{it} = v_i z_{it-1} + \sum_{x=1}^{v_i} \phi_{ix} \varepsilon_{it-x} + \delta_i Y_{it} + \mu_{it}$

(4) Where the number of lags in ADF regression is represented by. We propose our null hypothesis to be a case where there exists a unit root in each series of our panel data sets whereas alternative hypothesis supposes that at least one individual series in the panel data is stationary. Besides Phillips-Perron (PP), Augmented Dickey-Fuller and Levin, Lin & Chu (LLC) stationarity test are executed.

After our stationarity analysis, Pedroni heterogeneous panel cointegration test is employed to check the cross-section interdependence with different individual effects between our variables under consideration. Our cointegration test becomes: $GDPC_{it} = \alpha_i + \delta_{it} + \lambda_{1i} TBEP_{it} + \lambda_{2i} EI_{it} + \varepsilon_{it}$

(5) Where and represents each country deterministic trends; represents the residuals as a result of deviations from the long-run relationships. We propose our null hypothesis as there is no cointegration between our variables under study. We perform the fully modified Ordinary Least Squares (FMOLS) and dynamic OLS (DOLS) by estimating PVECM in order to perform the Granger-causality analysis. We present our dynamic error correction model as: (6)

$$\Delta GDPC_{it} = \alpha_{1x} + \sum_{k=1}^{r} \phi_{11ik} \Delta GDPC_{it-k} + \sum_{k=1}^{r} \phi_{12ik} \Delta TBEP_{it-k} + \sum_{k=1}^{r} \phi_{13ik} \Delta EI_{it-k} + \gamma_{1i} \varepsilon_{it-1} + \mu_{1it}$$

(7) $$\Delta TBEP_{it} = \alpha_{2x} + \sum_{k=1}^{r} \phi_{21ik} \Delta GDPC_{it-k} + \sum_{k=1}^{r} \phi_{22ik} \Delta TBEP_{it-k} + \sum_{k=1}^{r} \phi_{23ik} \Delta EI_{it-k} + \gamma_{2i} \varepsilon_{it-1} + \mu_{2it}$$

(8) $$\Delta EI_{it} = \alpha_{3x} + \sum_{k=1}^{r} \phi_{31ik} \Delta GDPC_{it-k} + \sum_{k=1}^{r} \phi_{32ik} \Delta TBEP_{it-k} + \sum_{k=1}^{r} \phi_{33ik} \Delta EI_{it-k} + \gamma_{3i} \varepsilon_{it-1} + \mu_{3it}$$

Where and represents the first difference and the lag length according to likelihood ratio test whereas denotes the serially uncorrelated error term.

Recent Publications

1. Ameyaw, B.; Yao, L. Analyzing the Impact of GDP on CO_2 Emissions and Forecasting Africa's Total CO_2 Emissions with Non-Assumption Driven Bidirectional Long Short-Term Memory. Sustainability 2018, 10, 3110. (SSCI).
2. Ameyaw, B.; Yao, L. Sectoral Energy Demand Forecasting under an Assumption-Free Data-Driven Technique. Sustainability 2018, 10, 2348. (SCSCI).
3. Ameyaw, B. , Oppong, A. , Abruquah, L. and Ashalley, E. (2017) Causality Nexus of Electricity Consumption and Economic Growth: An Empirical Evidence from Ghana. Open Journal of Business and Management, 5, 1-10. doi: 10.4236/ojbm.2017.51001.
4. Ameyaw, B. , Oppong, A. , Aba Abruquah, L. and Ashalley, E. (2016) Informal Sector Tax Compliance Issues and the Causality Nexus between Taxation and Economic Growth: Empirical Evidence from Ghana. Modern Economy, 7, 1478-1497. doi: 10.4236/me.2016.712134.
5. Ameyaw, B. and Dzaka, D. (2016) Determinants of Tax Evasion: Empirical Evidence from Ghana. Modern Economy, 7, 1653-1664. doi: 10.4236/me.2016.714145.

Biography

Bismark Ameyaw is a Doctoral Researcher at University of Electronic Science and Technology of China and a referee to a number of prestigious peer-review journals. He specializes in modelling and forecasting the dynamic links in energy policies. He writes, teaches and consult on energy-related issues. He serves as an editorial board member and a reviewer for a number of prestigious international journals.

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