THE INTERACTIONS BETWEEN CONVENTIONAL AND ALTERNATIVE ENERGY SOURCES IN TRANSPORT SECTOR, ECONOMIC GROWTH AND CO2 EMISSIONS – PANEL VAR APPROACH

Sónia Almeida Neves, University of Beira Interior, Tel. + 351 275 319 600, E-mail sonia.neves@ubi.pt
António Cardoso Marques, NECE-UBI, University of Beira Interior, Tel. + 351 275 19 600, E-mail amarques@ubi.pt
José Alberto Fuinhas, NECE-UBI, University of Beira Interior, Tel. + 351 275 19 600, E-mail fuinhas@ubi.pt

Overview

The transition for a low-carbon Transport Sector (hereafter TS) plays a fundamental role for decarbonization of the economies. In fact, this sector is highly powered by fossil fuels, and consequently extremely harmful for the environment. Accordingly, TS has deserved much attention of the literature, namely on the relationships between TS energy consumption, economic growth and CO_2 emissions (Chandran and Foon 2013; Saboori, Sapri, and bin Baba 2014). However, the analysis of the effects that are resulting from both conventional (fossil fuels) and alternative (renewable fuels and electricity) energy sources on the economic growth and CO_2 emissions remains scarce. Therefore, this paper aim fills this gap, by studying the interactions between TS fossil fuels consumption, TS electricity use and TS renewable fuels consumption[1], CO_2 emissions, and economic growth. Therefore, this paper aims answer the following questions: (i) what are the consequences of the alternative TS energy sources on the TS descabonisation? Moreover (ii) are both the conventional and alternative TS energy sources contributing to the economic growth?The results of this paper could be helpful for the policymakers on the decision-making about the mechanisms effective on the reduction of the TS oil use, and CO_2 emissions without compromising the economic growth.

Methods

This paper uses annual panel data comprising the time span from 1990 to 2014 for 21 high-income OECD (Organization for Economic Co-operation and Development) countries. The variables used include: Gross Domestic Product (*GDP_PC*), TS fossil fuels consumption (*FF_PC*), TS electricity (*ELE_PC*), TS renewable and waste consumption (*RES_PC*), CO_2 emissions (*CO2_PC*), and total energy consumption except in TS (*TOT_PC*). The database sources are: (i) IEA Headline Global Energy Data, (2016 edition), (ii) World Development Indicators, and (iii) BP statistics. All of the variables were converted into their per capita value. Hereafter the prefixes "L" means the natural logarithm and "D" denotes the first differences.

The suspicion that the variables could be endogenous makes it suitable the use of Panel Data Vector Autoregressive (PVAR) proposed by Love and Zicchino, (2006). This methodology supports stationary endogenous variables as well as the unobserved individual heterogeneity. Therefore, the "*Hermelet procedure*" proposed by Arellano and Bover, (1995) was applied to remove the fixed effects, once it causes correlation between the regressors. In this technique, the data loss is minimised, once the mean for the future observations available was removed (Love and Zicchino 2006).

Afterwards of panel VAR estimation, the pairwise Granger causality test, based on the Wald test were performed. One carries out a set of Granger causality for each equation underlying PVAR estimation (Abrigo and Love 2015). The null hypothesis provides the absence of the causality. The Impulse Response Functions are estimated using a Gaussian approximation based on the Monte-Carlo draws. Moreover, the Orthogonalized Impulse Response Functions are based on the Cholesky decomposition. The function shows us the reaction of the one variable to the shock in another variable. The Forecast-Error Variance Decomposition (FEVD) based on a Cholesky decomposition of the residual covariance matrix, was performed using 1000 Monte Carlo simulations and for 15 periods. After analyses the exogeneity blocks, the VAR – Choleski ordering of variables was used, placing the variables in the decreasing order of the exogeneity.

Results

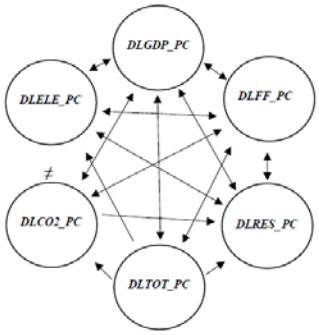
As well known, the TS is highly powered by fossil fuels, namely oil. Consequently, the use of this sources is increasing CO_2 emissions. The TS fossil fuels use are contributing to the economic growth proving the importance

[1] This variable comprises the direct use of renewable fuels, such as biofuels and hydrogen fuel by the transport sector, and it is not accounting the renewable electricity use.

of the TS for the dynamics of the economies. However, the reduction of this sources use is required for the environmental protection.
Coherently, this paper supports that the utilization of the renewable fuels are reducing the fossil fuels use. However, their consumption is hampering the economic growth. This outcome could be explained by the high associated costs of these sources. Indeed, the renewable fuels use must be pursued; however, the policies must be rethinking. On the one hand, the negative effects on the economic growth must be reconsidered. Clearly, from the point of view of economic sustainability, the implementation of these sources should not jeopardise economic growth. On the other hand, although the use of these sources still not contribute to reducing the CO_2 emissions, they are contribute to reduinge the oil use on the TS, and posteriorly could reduce CO_2 emissions.

Regarding the electrification of the TS, this paper indicates that the TS electricity consumption and economic growth affect each other positively. In fact, the electricity use on the TS are not hampering the economic growth; however, there is no evidence that is reducing the CO_2 emissions. Notwithstanding, the electrification of the TS could contribute to reducing the dependence on fossil fuels. In sum, the causalities found are summarised in figure 1.

Figure 1: Main results from the Granger causality test



Source: Own elaboration

Conclusions

The shift pathway for a low-carbon TS is fundamental for the environmental protection. In fact, the harmful effects of the TS on the environment increases when it is considered developed countries. Therefore, the analysis of the high-income OECD countries could be very helpful for the policymakers, providing some policy indications about the pathway for decarbonizing TS that should be followed from the point of view of the economic and environmental sustainability.

The renewable fuels penetration within TS energy mix must be pursued, but the policies must be rethinking. There is evidence that these sources are reducing the fossil fuels use; however, the negative effect on the economic growth must deserve further research, namely on the associated costs for this sources deployment. Although the use of this sources has promoted by the CO_2 emissions, they still not contribute to reducing CO_2 emissions. The electrification of the TS also must be pursued. Indeed, the TS electricity use is boosting the economic growth, and are causing the fossil fuels use . However, the use of this source still not contribute to reducing the CO_2 emissions.

References

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