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Exploring the Impact of the Greening of the Agri-Food Sector on Economic Growth: An Empirical Approach in the BVAR Framework for the EU †

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Abstract: The Greening in agro—food sector has become within the last decade a high priority issue given the 17 Sustainable targets set by OECD. More specifically, the Sustainable Development Goals (SDGs) by 2030, intend to promote using environmental resources in close correlation with measures to reduce non-environmental human pressure on the planet as well as in agro-food sector. The present work studies the greening of agro-food sector as synopsized in emissions per capita by agro-food sector for the EU and its relation to economic growth per capita with the assistance of a BVAR framework. Our findings do not validate success in greening of agro—food sector since the emissions reduction is not accompanied by economic growth a result that rejects the hypothesis of eco efficiency. Future research could involve the construction of an index that should incorporate more variables that will reflect more accurately the greening efforts in agro—food sector.

Keywords: ecoefficiency; farm to fork strategy; BVAR; impulse response; agro-food industry

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1. Introduction

Modern lifestyles worldwide are constantly putting pressure on natural resources that are increasingly at risk of depletion. The vertical growth of the population and the continuous strengthening of industrial and agricultural production have for years created concerns about the ability of future societies to cover their basic needs. More specifically, food production must double by 2050 to meet the world's growing population's expected demand and that the global population will number approximately 9.8 billion by 2050 and 11.2 billion by 2100 [1,2].

Therefore, an organized and gradual shift towards green production processes that can ensure the sustainability of the future is an option. At the same time, those methods are identified that can adapt green entrepreneurship to the requirements of the necessary economic development. The agri-food sector is decisive for the survival of the people and through it the largest volume of food is produced. Therefore, applying green practices in this area as well can ensure sustainable economic growth.

Well-organized and resilient agro-food systems can ensure the survival of societies in the future [1]. Agenda 2030, namely ESG of the United Nations, with 17 complex and interrelated objectives, provides a useful tool for sustainability. The European Union makes a great effort to cope with this new reality and therefore, in this direction, governments have promoted policies for a green transition through which ecoefficiency may be a feasible result satisfying societal demand [2–6].

Having in mind all the above, the present work makes an effort to analyse the impact of utilizing green entrepreneurship (as synopsized in emissions per capita in tonnes generated by the agrifood system for EU as an entity) and its linkage to economic development (as reflected to GDP per capita generated by agriculture Forestry and Fishing).

2. Materials and Methods

The data of the present work are annual for the time period 1990–2020. As mentioned above, we selected the emissions per capita to be represented by the agri-food sector's intensity (as proxy for environmental degradation) and GDP per capita (to describe EU economic growth).

The data employed in our Model are illustrated in the next Figure 1.

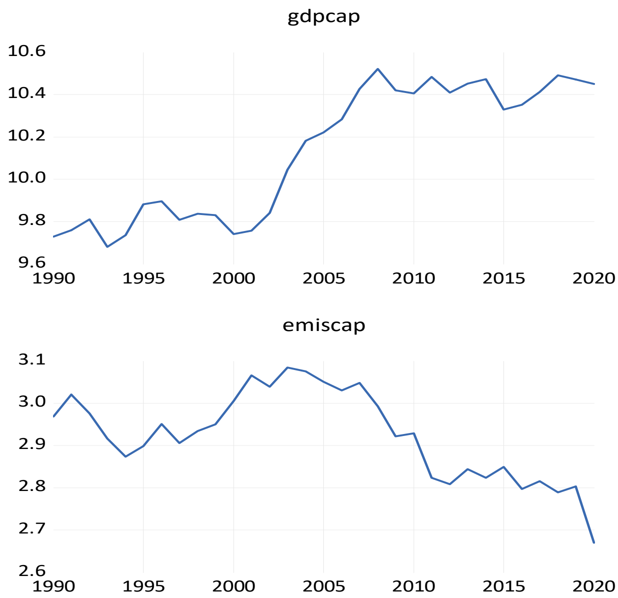

Figure 1. Evolution of the model variables employed (1990–2020).

The break unit root test is the first analysis employed for our data [7]. Then, we employed the BVAR methodology in order to detect the interlinkages among green energy and economic growth in agriculture [8–14]. The mathematical form of a BVAR model is the same though the parameters' estimation and interpretation do not coincide. Actually, the BVAR models, by incorporating prior information about model parameters, secure reliable results since the particular process stabilizes parameter estimation. BVAR model estimation is based on the Minnesota prior specification, while all the information is incorporated in the parameters' estimations. Based on the maximum likelihood function, we estimate the posteriors [15,16].

Based on the BVAR estimation model, we generate a tractable posterior density function that is similar to that of the prior. The prior selected is the Litterman/Minnesota algorithm for the target parameter. The next step in our BVAR analysis involves the specification of the prior covariance or the target parameter, having incorporated a set of hyperparameters [14–17].

The last step in our analysis involves impulse response function estimation (IRF) for each variable as well as forecast error variance decomposition analysis (FEVD). Impulse response analysis is a significant tool in econometric analysis, since it may well describe the evolution of the estimated VAR model's variables as a response to a shock in one or more variables. In other words, this step allows the analyst to trace the transmission of a single shock within the noisy system of equations and therefore we can make an assessment of the economic policy impacts on the model variables' evolution within a period that may be 10 or 20 years in the case the data employed are annual [6,7]. In a similar vein, variance decomposition or in other words 'forecast error variance decomposition is a specific tool that may adequately and precisely interpret the relations between variables described by the model estimated. This methodology will amplify impulse response analysis since it further quantifies the contribution rates of all variables to the impact on the dependent variable [18,19].

The model's evaluation was based on forecast accuracy performance for the classic VAR and BVAR specifications, respectively, with the assistance of the following indices, the root mean square error (RMSE) and the mean absolute error (MAE) [17]. The forecast accuracy measures were selected on the basis of sensitivity extending to the deviations from the true values.

3. Results

The break unit root test provided the results illustrated in Table 1.

Table 1. ADF break unit root results.

Variables	ADF Break Unit Root	Break Date
CEM	−3.33 (0.778)	1999
ΔCEM	−5.5 *** (0.00)	2001
GDP	−3.8 (0.48)	2002
ΔGDP	4.82 *** (0.0)	2003

*** Reject unit root test for 1%level of significance with critical values −4.94, −4.44, and −4.19 for 1, 5 and 10% levels of significance. CEM denotes carbon emissions per capita for the agri-food system for the EU; GDP is denoted as GDP per capita; ΔCEM ΔGDP denotes the first differences of the variables.

Based on the aforementioned findings for the EU, all the respective variables are found to be I(1) with the years 1999 and 2002 being identified as structural breaks. The Kyoto Protocol (1996–1999 signing period) as well as the different financial crises may well explain the breakpoints identified. Impulse response analysis was also employed to detect and identify the interlinkages among the variables employed, as illustrated in Figure 2.

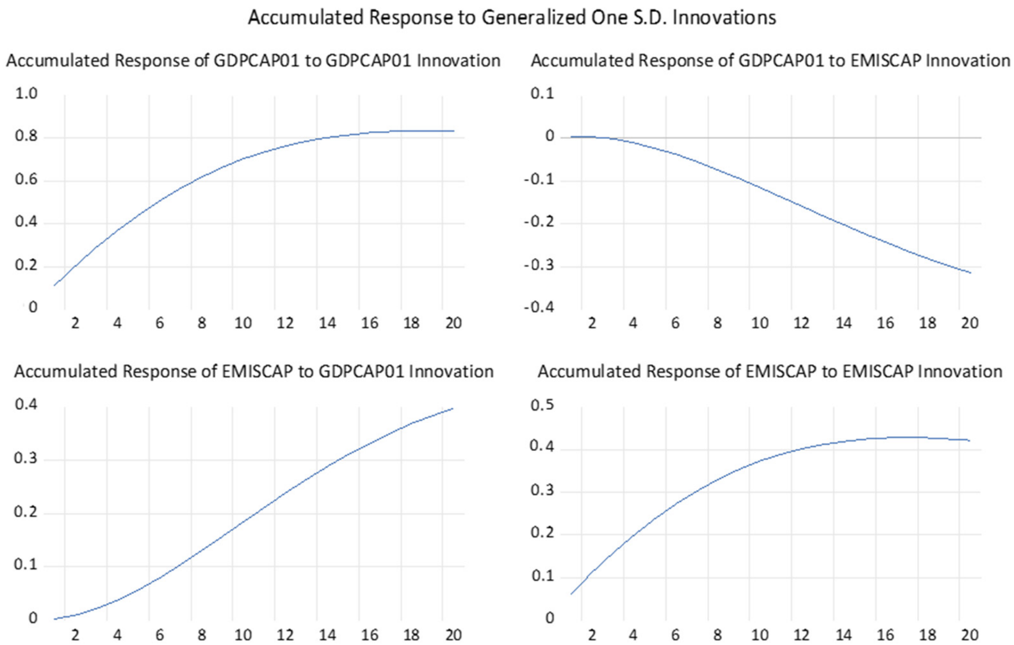

Figure 2. Impulse response analysis of the variables employed.

The figures constructed were based on the Bayesian methodology of Gibbs sampling while 1000 iterations were implemented to acquire the results [18]. GDP is increasing with a declining trend for a time period of twenty years while emissions are increasing with a declining trend in the first decade, though then the slope of the curve begins to change and increases. This means that the greening of the agri-food sector cannot provide steadily increasing growth and therefore that more steps need to be taken for ecoefficiency to become an achievable objective in EU in Figure 3.

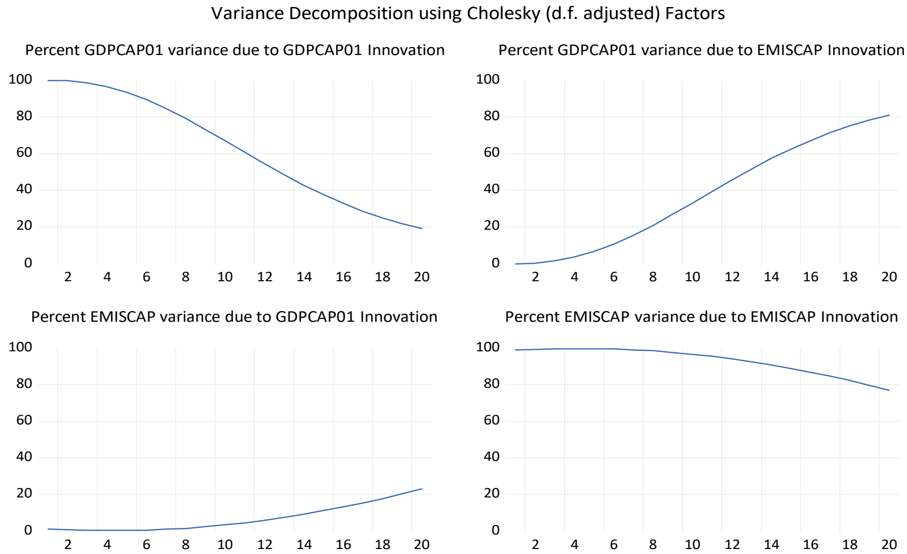

Figure 3. Variance Decomposition Analysis analysis of the variables employed.

Based on our findings an innovation on greening interprets the income variability with an increasing rate and reaches 80% after of 20 periods validating the slow process through which greening entrepreneurship may affect income volatility. On the other hand the rate is even slower to interpret the greening variance attributed to income innovation reaching 20% of the total variance. This result is indicative that other than income motivation could promote the adoption of greening practices. Last but not least the MAE = 0.098 and RMSE = 0.118 validating a good forecast ability.

4. Conclusions

Green or sustainable practices in the agro-food sector have become common in modern societies. Especially in the EU, this trend has been imposed on different stages of the agro-food industry including the farm-to-fork strategy in line with the SDG strategy, which aims to deliver nutritious and affordable food for a growing world. Actually, in EU, the particular strategy aims' to make food systems fair, healthy and environmentally friendly. The present work has employed the BVAR methodology to identify the interlinkage among emissions per capita generated by the agro-food sector as a proxy for the greening of the agro-food sector and GDP per capita. Our findings confirm that greening is far from being successful since the effort to reduce carbon emissions is not accompanied by economic efficiency. To synopsize, more steps should be taken in order for ecoefficiency to become an achievable objective in the agro-food sector.

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