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Exploring the effects of energy consumption on output per worker: A study of Albania, Bulgaria, Hungary and Romania [☆]



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HIGHLIGHTS

- Energy has a short-run positive effect in Albania, Bulgaria, Hungary and Romania.
- A long-run positive elasticity is noted in Bulgaria and Romania.
- Output per worker cause energy per worker in the four countries.
- A unidirectional causality from capital to energy is noted for Albania and Romania.

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ABSTRACT

In this article, we explore the long-run cointegration between output, capital and energy consumption, in per worker terms, for Albania, Bulgaria, Hungary and Romania. We use the augmented Solow (1956) model and the ARDL bounds procedure (Pesaran et al., 2001) to examine the short-run and long-run effects of energy and capital on output (in per worker terms). We also conduct causality test using the Toda and Yamamoto (1995) non-causality procedure. Our results show the existence of long-run cointegration between output per worker and energy per worker for all the four countries. We find that energy per worker have a dynamic short-run positive effect in Albania (0.37%), Bulgaria (0.25%), Hungary (0.36%) and Romania (0.68%), and a long-run positive effect in Bulgaria (0.32%) and Romania (0.63%) which duly indicate that energy consumption has a momentous long-run effect in these two countries. The causality results indicate a unidirectional causation from output per worker to energy per worker for all the four countries, and from capital per worker to energy per worker for Albania and Romania. Consequently, a balance between effective energy consumption and sound energy conservation policies are likely to support economic growth in the four countries.

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1. Introduction

The nexus between energy and output has been widely explored at country-specific as well as cross-country levels.

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However, the results in many instances remain controversial, largely due to the methods and approaches and the samples used in the analysis. Moreover, given that there is no mutually accepted approach to examining the energy-growth relationship, there is a continual need to revisit the empirical studies concerning energy-growth nexus viz. economic theory and the ensuing econometric approaches. In this paper, we examine the energy-led growth hypothesis within the context of Albania, Bulgaria, Hungary and Romania using the augmented Solow (1956) framework. In a recent study, Ozturk and Acaravci (2010) look at energy-growth nexus in these countries and conclude that a long-run cointegration between energy and output exists for Hungary and not for the other three countries, which means that the long-run results can be estimated for Hungary only. However, our study is different in

the sense that we control for capital and labor stock and treat energy consumption as a shift parameter (Rao, 2010; c.f. Kumar and Kumar, 2013) when reexamining the energy-growth nexus. Moreover, we extend the study to estimate the short-run and long-run elasticity coefficients of energy consumption.

Subsequently, using the Solow framework and the autoregressive distributed lag (ARDL) bounds procedure (Pesaran et al., 2001), we explore the evidence of long-run cointegration, and estimate the short-run and long-run elasticity coefficients of energy per worker. We also investigate the direction of causality using the infamous Toda-Yamamoto (Toda and Yamamoto, 1995) procedure. Briefly, first, we find that cointegration relationship exists for all four countries, and not only for Hungary as posited in Ozturk and Acaravci (2010); second, based on the cointegration outcome, we proceed to estimating the short-run and long-run elasticity coefficients of capital per worker and energy per worker for the four countries which are not done in earlier studies for these countries; and third, in performing the causality assessment, we find a unidirectional relationship from output per worker to energy per worker for all the four countries.

A lot of studies have focused on the relationship between energy and output, income or economic growth. However, there is no definite answer on the direction (unidirectional, bidirectional, or neutrality) of casualty between output and energy. The reasons for the disagreements are often due to the country-specific structural factors, sample size, and variations in the method and approach used in the analysis.

Early studies which explored the nexus between income and energy goes back to Kraft and Kraft (1978) which use the Granger causality test on the US economy data to provide evidence of causality running from income to energy. Following on, a number of studies with different methodologies, countries, time periods and sample sizes were used to explore and extend this relationship. Some of the studies that find evidence of a unidirectional Granger causality running from income to energy consumption include: Abosedra and Baghestani (1989) for the US, Yu and Choi (1985) and Soytaş and Sari (2003) for South Korea, and Italy, Erol and Yu (1987) for West Germany, Masih and Masih (1996) for Indonesia, Oh and Lee (2004a, 2004b) for Korea, Wolde-Rufael (2005) for five African countries, Narayan and Smyth (2005) for Australia, Lee (2006) for France, Italy and Japan, Huang et al. (2008) for middle income groups (lower and upper middle income groups) and high income group countries, and Odhiambo (2009) for Congo (DRC). On the other hand, evidence of a unidirectional causality running from energy consumption to income include: Stern (1993, 2000) for the US, Erol and Yu (1987) for Japan, Yu and Choi (1985) for Philippines, Masih and Masih (1996) for India and Indonesia, Glasure and Lee (1998) for Singapore, Soytaş and Sari (2003) for Turkey, France, Germany and Japan, Wolde-Rufael (2007) for Shanghai, Lee (2005) for eighteen developing countries, Odhiambo (2009) for Tanzania, and Odhiambo (2010) and Kumar and Kumar (2013) for South Africa and Kenya. Furthermore, the consensus on bidirectional causality between energy-income coincides with a number of studies including: Erol and Yu (1987) for Italy, Hwang and Gum (1992) for Taiwan, Masih and Masih (1996) for Pakistan, Glasure and Lee (1998) for South Korea and Singapore, Soytaş and Sari (2003) for Argentina, Ghali and El-Sakka (2004) for Canada, Oh and Lee (2004a, 2004b) for Korea, Wolde-Rufael (2005) for Gabon and Zambia, Lee (2006) for the US, and Mahadevan and Asafu-Adjaye (2007) for energy exporting developed countries. Ozturk and Acaravci (2010) examine the long-run relationships between energy and economic growth using the ARDL bounds approach for Albania, Bulgaria, Hungary and Romania and find that the long-run relationship and bidirectional causality between real GDP and energy use per capita exist only for Hungary.

Nevertheless, there are some studies which find no evidence of causality between energy and income, thus confirming the neutrality of energy hypothesis (energy consumption and income or output are unrelated and evolve independent of each other). These studies include: Akarca and Long (1980), Yu and Hwang (1984), Yu and Choi (1985), Erol and Yu (1987) for the case of the US, Masih and Masih (1996) for Malaysia, Singapore and Philippines, Glasure and Lee (1998) for South Korea (based on the standard Granger causality), Soytaş and Sari (2003) for nine countries including the US, Asafu-Adjaye (2000) for Indonesia and India, Altinay and Karagol (2004) for Turkey, Wolde-Rufael (2005) for 11 African countries (including Kenya and South Africa), Lee (2006) for the UK, Germany and Sweden, Soytaş and Sari (2006) for China; Huang et al. (2008) for low income group countries, and Ozturk and Acaravci (2010) for Albania, Bulgaria and Romania. Other recent studies focusing on the US find absence of causality at disaggregated and sectoral levels. These studies include: Payne and Taylor (2010) which find the absence of causality between nuclear energy consumption and real GDP growth; Bowden and Payne (2010) which find no causality between commercial and industrial renewable energy consumption and real GDP; and Payne (2011b) which find the absence of causality between coal consumption and real GDP. Moreover, in a recent study, Apergis and Tang (2013) re-investigates the validity of the energy-led growth hypothesis using a logit model for a sample of 85 selected countries around the globe including Hungary and find that energy causes economic growth for 46 countries, however not for Hungary.

In what follows, whilst gaining insights from the above studies, we examine the long-run cointegration between the output per worker and the energy per worker and proceed to estimating the short-run and long-run elasticity coefficients and the direction of causality. In Section 2, we discuss the framework, data and method. In Section 3, we discuss the results. Finally, in Section 4, conclusion follows.

2. Materials and method

2.1. Background

Before proceeding to the econometric analysis, a brief background of the four countries is in order. Until 1990, all of the four countries were governed by communist dictatorships and subsequently applied planned economic principles like in the former Soviet Union (SU). However, Albania was an exception in the sense that it had close ties since 1960 with the People's Republic of China instead with the SU and it was a relatively closed economy similar to North Korea today. The other three countries – Bulgaria, Hungary and Romania had mostly international trade relations with The Council for Mutual Economic Assistance (COMECON) countries until 1990. One of the main features of these planned economies then was that the prices were administrated and not governed by relative scarcity of goods and services. Furthermore, industrial production was mostly state-owned. The same held for the agricultural and services sector despite the parallel existence of black market economies. In addition, it must be stated that socialist planned economies prioritized the development of heavy industries at the cost of light industries and services, where the latter was viewed as unproductive and unimportant. With respect to our analysis it must be stated that energy consumption was highly subsidized, partly by the domestic governments and partly, in the case of Bulgaria, Romania and Hungary, by receiving gas and oil from the SU for prices below the world market prices. After the breakdown of socialist planned economies, a massive economic transition took place in the post 1990 era which led to a

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