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The Role of Human Capital in Economic Growth, Energy Consumption and Environmental Pollution in Line with Sustainable Development in Iran

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Abstract

In this study, the role of human capital in sustainable development was analyzed through simultaneous equations models (economic growth, energy consumption and CO2 emissions) using (GMM) over the period of 1971-2017. For this purpose, with the aim of improving the concept of human capital, average years of schooling and returns to education were used as human capital index in the model. The results show that due to the lack of attention to applied educations, the quality of education and mismatch between employment and education, human capital in Iran not only has not led to increased economic growth but caused economic growth slowdown through disruption of optimal resource allocation and waste of resources. The results also confirm the role of human capital in reducing energy consumption and, thereby, CO2 emission through the development of energy efficient technologies. The results also show that environmental considerations have not been taken into account in the process of economic growth and energy consumption. Finally, the results show that oil rents in Iran have reduced economic growth leading to the "oil curse phenomenon".

Keywords: Human Capital, Sustainable Development, Economic Growth, Energy Consumption, CO2 Emission.

JEL classification: Q01, Q41, Q56, Q44.

1. Introduction

According to the World Bank, per capita real GDP in Iran since 1988 has experienced an almost upward trend with a slight slope, while its growth has been very volatile. Also, the energy intensity in Iran has fluctuated over time. This means that energy efficiency has decreased over time. On the other hand, according to the World Bank, the trend of per capita CO2 emissions in Iran has been upward. But the key question is what variables have contributed to this trend. One of the variables that can affect this trend is human capital because human capital has an impact on economic growth through the channel of factors accumulation, as well as through the channel of productivity consequently, affecting energy consumption. According to FRED, human capital has reached

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from 1.05 in 1955 to 2.4 in 2017 with an upward trend. Accordingly, , this upward trend has been accompanied by an increase in per capita energy consumption, per capita CO2 emissions and per capita real GDP. But what role human capital has played in shaping these trends needs further investigation. The purpose of this paper is to investigate the role of human capital in achieving the goals of sustainable development by examining its impact on economic growth, energy consumption and environmental degradation in Iran during the period 1971-2014. In fact, in addition to examining the role of variables affecting economic growth, energy consumption, and CO2 emissions, this study focuses specifically on the role of human capital in achieving the goals of sustainable development. Thus, this study specifically seeks to understand how human capital has contributed to economic growth, energy consumption, and emissions. In this regard, to quantify the concept of human capital, the human capital index based on the average years of schooling and returns to education was used.

2. Background

According to Li and Wang (2018), human capital can also influence economic growth through the factors accumulation channel and can act as a separate factor in production (Mankiw et al.,1992; Barro et al., 1995) It can also play a role in economic growth through the productivity channel (Nelson & Phelps, 1996). Human capital, on the one hand, provides the innovation in the production process, and on the other hand, increases the speed of adaptation to existing technologies, thereby, increasing the total factor productivity, creating added value and economic growth (Kumar & Kober, 2012; Li & Wang, 2018; Conti & Sulis, 2016). On the other hand, Lucas (1988) and Romer (1986; 1989; 1994) theoretically implied the role of human capital in economic growth in the form of endogenous growth models. Human capital can also play a role in energy consumption, according to Salim et al. (2017), Adewuyi and Awodumi (2017), and Bashir et al. (2019). For example, based on Salim et al. (2017), human capital can influence energy consumption through the income effect and technology effect; accumulation of human capital may lead to increased economic growth, followed by an increase in real per capita income and, as a result, an increase in the level of aggregate demand, which, in turn, can lead to an increase in energy consumption (income effect). In addition, the accumulation of human capital reduces energy consumption in the production process by changing technology into efficient technology (Adewuyi & Awodumi, 2017).

3. Model and method

Achieving sustainable economic development requires continued economic growth in all sectors of the economy, taking into account environmental considerations and optimal use of resources. In the first step, in order to achieve

sustainable economic growth, it is necessary to combine factors such as capital, labor, and energy in an environmentally friendly way to create sustainable growth. Based on studies such as Bashir et al. (2019), Adewuyi and Awodumi (2017), Omri (2013) and Jian et al. (2019), it is possible to study the factors affecting sustainable development by combining a growth model, the energy demand function and the pollution production function. Therefore, the role of factors affecting sustainable development can be examined by investigating the factors affecting economic growth, energy demand and environmental pollution separately, and, finally, combining them in the form of a simultaneous equation model as follows.

$$Ln(GDPPC_t) = \alpha_0 + \alpha_1 Ln(E_t) + \alpha_2 Ln(CO2PC_t) + \alpha_3 Ln(K_t) + \alpha_4 Ln(HC_t) + a_5 Ln(Oil_t) + \pi_t \quad (1)$$

$$Ln(E_t) = \beta_0 + \beta_1 Ln(GDPPC_t) + \beta_2 Ln(CO2PC_t) + \beta_3 Ln(K_t) + \beta_4 Ln(HC_t) + \beta_5 Ln(FD_t) + \beta_4 Ln(URB_t) + \varepsilon_t \quad (2)$$

$$Ln(CO2PC_t) = \lambda_0 + \lambda_1 Ln(GDPPC_t) + \lambda_2 Ln(E_t) + \lambda_3 Ln(URB_t) + \lambda_4 Ln(TR_t) + \theta_t \quad (3)$$

In this model, $GDPPC_t$is per capita GDP, E_t is per capita energy consumption, $CO2PC_t$ represents per capita carbon dioxide emissions, K_t denotes per capita physical capital stock, Oil_t shows oil rents (%GDP), HC_t is per capita human capital, FD_t is financial development, URB_t is urbanization rate and TR_t is trade openness. In the present study, this equation was estimated and analyzed simultaneously using the generalized moment method (GMM). The reason for using this approach is the endogeneity in the simultaneous equation model and avoid the problems of violations of classical assumptions. For this purpose, the lags and difference of variables as well as the interaction effect of variables were used as instrumental variables.

4. Findings

The results of estimating the growth equation indicate that the variables of energy consumption and CO2 emissions have a positive and significant effect and the variable of human capital has a negative and significant effect on economic growth. However, capital stock did not have an impact on economic growth, while its changes (investment) in the second model had a positive and significant impact on growth. Also, based on the findings, the nonlinear relationship between oil rents and economic growth was confirmed. According to the findings, per capita human capital in Iran had a negative and significant effect on per capita income growth. This is in line with the results of Adewuyi and Awodumi (2017) in some West African countries. The findings also suggest that oil rents in Iran are linked to economic growth. In fact, low oil rents in Iran -

due to low oil prices - slowed economic growth. But with rising oil prices and, as a result, rising oil rents, economic growth has gradually increased. This means that economic growth in Iran is highly dependent on the increase and decrease of oil rents; Therefore, it can be stated that over-reliance on oil revenues in Iran will jeopardize economic growth due to high fluctuations in oil prices. According to the energy demand equation, the variables of GDP, urbanization and capital stock have a positive and significant effect and the variable of human capital has a negative and significant effect on energy demand in Iran. Also, financial development and CO2 emissions have not affected energy consumption in Iran. The findings also show that the increase in per capita human capital has led to a decrease in per capita energy consumption. This finding is consistent with the findings of Salim et al. (2017) on China. Similarly, the results of estimating the pollution equation pointed to the positive and significant effect of economic growth, energy consumption, urbanization and the trade openness on the pollution emission in Iran. But human capital has indirectly contributed to the pollution emissions through its impact on energy consumption. According to the results, energy consumption in Iran has been expected to have a positive and significant effect on CO2 emissions.

5. Conclusion

In the present study, the role of human capital in sustainable economic development has been studied and analyzed through the simultaneous study of three equations of economic growth, energy consumption and CO2 emission using GMM during the period of 1971-2017. As the trend of total factor productivity (TFP) in Iran versus the trend of human capital shows, the increase in human capital has been accompanied by a decrease in TFP over time. On the other hand, the small share of people with a university degree in the labor market means a reduction in the workforce that specializes in the production process of goods and services, which limits innovation in the production process. Also, the mismatch of education with the job position of the workforce, the lack of attention to applied training and the quality of training, and, finally, lack of attention to training efficiency have disrupted the optimal allocation of resources and the process of using factors involved in production. The results also show that human capital has reduced energy consumption and pollution through the creation and use of energy-efficient technologies in Iran.

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