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CONSIDERATION THE EFFECTS OF WATER SECTOR INVESTMENT ON ECONOMIC GROWTH IN IRAN

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ABSTRACT

This paper studies the causality relationship between water sector investment and economic growth and other sector such as agriculture, industry and mine, services, and petroleum sectors in Iran, using panel data approach, from annual data covering the period of 1980 to 2010. The short-run cointegration estimation support the relationship between our variables. In this paper we show the effects of water sector investment on production function of Solow growth model for this purpose we use econometric method based on Panel Data.The results show low efficiency in water industry. Solow Growth Model for different sectors (agriculture, industry and mine, services, and petroleum sectors) in Iranian economy implies that the elasticity of water investment in agricultural sector is significant, and positive, with the amount of 1.3%. Also results show that the investment effect of water sector for groundwater discharge is about 2.4 percent which is significant. Finally the results show that conversely relationship for surface waters with the amount of about -2.7%.

Keywords: Water investment, Economic growth, Investment elasticity, Solow growth model, Panel data, Agricultural sector.

JEL Classification: Q40, O40, C33, Q43, N50.

1. INTRODUCTION

Progress of technology is the main base of economic growth and efficiency in every country and especially in developing countries to ensure people's access to higher and more standard living. So, progress of technology at the national level will be raised for the purposes of macroeconomic and in organizations and companies level technology to achieve greater benefits is spend minimum of resources and competitions for survival. Economic growth when is possible that national production increases. For production also, main factors of production system namely labor and capital fused together in a hardware and software called technology and with changing data create service or product higher output value. There is now a large body of theoretical and empirical studies on the determinants of economic growth. Much of the early work emphasized

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that growth in labor and the stock of physical capital are the key determinants of economic growth. However, early empirical works were unable to explain a significant portion of the growth in GDP and GDP per capita, by the growth in labor and capital alone, and so attention turned to other factors-most human capital and institutions. However, to attain a sustainable, high economic growth we should answer to the question that what factors determine the rate of economic growth? The whole renewable, available waters (130 billion m^3) approximately 105 billion m^3 are surface flows, and the rest (25 billion m^3) penetrating flows as groundwater. There are 130 billion m^3 of water which can be extracted, however only 84% of it is used for agricultural applications in about 30% efficiency and the rest of the allocated water (70%) is wasted during transportation and consumption stages (Ettehad, 2002). This paper is organized as follows: In Section 2 we provide a brief discussion of theoretical bases. Section 3, covers the review of literature, the relationship between water sector investment and economic growth. Section 4, covers the panel unit root test and the panel cointegration procedure. Section 5, the details of the data and research methodology employed in this study and reports the findings and discussions. The final section contains the conclusions.

2. THEORETICAL BASES

To represent a clearer picture from the position of water sector in national economy, one part of this research devoted to water sector portion in national production and investment, and in order to estimate the coefficient of economic growth elasticity in proportion to water sector production, we will suggest a regression model. In the West development debates are focused on economic development and most important development problems focused on discussions about quantity of economic growth. In these theories it has been already assumed that quantity changes will be led to quality and organizational changes of the society. So, all efforts for dealing with development problems are focused on analyzing capital changes during a certain period of a time.

The reason for studying growth models in capital topic is that crucial variables in analyzing these models are capital and investment and the related issues. However theories and models in these fields are so widespread that hardly can we categorize them in a concise sector to explain them. The generalization of these theories is based on formulating the rules which in long term are predominant over economic variables and parameters.

By constructing mathematical model, these theories try to anticipate changes in variables to study economic equilibrium conditions. What is an accepted premise in all these theories is the considerable importance of capital as development and growth factor. Therefore, the models employed in growth theories are rather seek for inventory changes in capital during a certain period of time and what factors really resulted in increase or decrease in investment are out of their economic analyses reach. The model used in this study is a production function of Solow growth (neo- classic) which is based on neo-classic basis.

3. METHODOLOGY

3.1. The Panel Unit Roots Test

In order to investigate the possibility of panel cointegration, it is first necessary to determine the existence of unit roots in the data series. For this study we have chosen the Im, Pesaran and Shin (IPS), which is based on the well-known Dickey-Fuller procedure. Levine and Lin (1993) proposes a panel-based ADF test that restricts parameters γ_i by keeping them identical across cross-sectional regions. LL tests the null hypothesis of $\gamma_i = \gamma$ =0 for all i, against the alternate of $\gamma_1 = \gamma_2 ... = \gamma < 0$ for all i, with the test based on statistics $t_\gamma = \hat{\gamma}/s.e.(\hat{\gamma})$. One drawback is that c is restricted by being keptidentical across regions under both the null and alternative hypotheses (see e.g. (Lee, 2005)). For the above reason, Im, Pesaran and Shin (1997) relax the assumption of the identical first-order autoregressive coefficients of the LL test and allow γ varying across regions under thealternative hypothesis. IPS test the null hypothesis of $\gamma_i = 0$ for all i, against the alternate of$\gamma_i < 0$ for all i. The IPS test is based on the mean-group approach, which uses the averageof the t_{γ_i}statistics to perform the following $\bar{Z}$ statistic:

$$\bar{Z} = \sqrt{N}(\bar{t} - E(\bar{t}))/\sqrt{Var(\bar{t})} \quad (2)$$

Where$\bar{t} = (\frac{1}{N}) \sum_{i=1}^{N} t_{\gamma_i}$, the terms E($\bar{t}$) and Var($\bar{t}$) are, respectively, the mean and variance ofeach t_{γ_i}statistic, and they are generated by simulations and are tabulated in Im *et al.* (1997).

The next step is to test for the existence of a long-run cointegration among our variables using panel cointegration tests suggested by (Pedroni, 1999) Pedroni (2004). In this paper we use two types of tests are suggested by Pedroni.

4. EMPIRICAL RESULTS AND DISCUSSION

According to table 2 all statistic of the level model confirm that three series have a panel unit root. Using these results, we proceed to test water sector investment economic growth and other sector such as agriculture, industry and mine, services, and petroleum sectors for cointegration in order to determine if there is a long-run relationship to control for in the econometric specification. Table 1, presents the results of the panel unit root test at level indicating that all variables are *I*(1) in the constant plus time trend of the panel unit root regression.

Table-1. Panel unit root tests

Variable	LL		IPS	
	No time effects	Time fixed effects	No time effects	Time fixed effects
Economic growth	-2.69	0.90	-1.32	-1.41
water sector investment	-2.29	-2.50	-2.29	-2.48
agriculture	0.61	2.87	0.87	-1.29
industry and mine	0.56	1.74	0.68	1.12
petroleum sectors	-0.21	-1.03	-0.35	-1.19

All variables are in natural logarithms.

We can conclude that the results of panel unit root tests reported in Table1 support the hypothesis of a unit root in all variables across sectors, as well as the hypothesis of zero order integration in first differences. Since the variables are found to be integrated in the same order I(1), we continue with the panel cointegration tests proposed by Pedroni (1999), Pedroni (2001; 2004). Cointegration are carried out for constant and constant plus time trend and the summary of the results of cointegration analyses are presented in Table 2 .In constant level, we found that 5 out of 7 statistics reject null by hypothesis of no cointegration at the 5 percent level of significance for the adf-statistic and group ρ–Statistic, while the group-adf is significant at 1 percent level. The results of the panel cointegration tests in the model with constant level show that independent variables do hold cointegration in the long run for Iran sectors with respect to economic growth.

Table-2. Panel cointegration tests

	No time effects	**Time fixed effects**
Panel variance	1.23	1.21
Panelρ	-1.13	0.98
Panel PP	-1.45	-1.37
Panel ADF	-2.13	-2.25
Groupρ	-0.87	1.65
Group PP	-1.48	-1.55
Group ADF	-2.24	-2.45

In this part, the effect of water investment on different economic sectors in the form of a full logarithmic equation for years 1980 to 2010 is explored. The effect of investment in water sector on various sectors of agriculture, industry, service, and petroleum has different results as showed in the table below:

Table-3. Exploring investment effect of water sector on various economic sectors

Coefficients impacts of water investment on each sector	**Various economic sectors**
1.30*	Agriculture
0.11	Industry
0.60	Service
2.40	Petroleum

Source: calculations of the researcher
*indicates significance coefficients in 90% confidence level

In this part investment effect in water sector, total investment (without considering investment on water sector) and labor force of Iran economic growth in a full logarithmic equation for years 1980 to 2010 is explored. Before testing for stability of the variable, unit root test is done for variables. As it was said before, unit root test based on Panel data is stronger than unit root test of time series. The model employed here is Panel data model which is assessed by using Fixed Effects method. The reason why we use Fixed Effects method is that the number of cross sections (economic sectors) of the model is less than assessed coefficients. As expected, the effect of water investment on agriculture is positive and significant and its elasticity is more than 1 which indicates the high sensitivity of agricultural products to investment in water sector. Investment effect coefficients in water sector on industry, service, and petroleum are non-significant. The calculated result of elasticity is almost consistent with Demetri is and Mines' long term supply production elasticity infrastructures in national level. As the estimated model is full logarithmic, it is expected that this model is static and the graph of correlation test related to residual model confirms it.

Table-4. The amount of water investment (public and private sector) in 1980-2010(figures in billions of Rails)

Shares (%)	Annual investment mean	The amount invested	Sectors
62	12015	372468	Public
38	7457	231165	Private
100	19472	603633	Total

Source: researcher's calculations

Total amount of investment in Iran economy during 31 years under study was 2,925,649 billion Rails from which the share of water was about 21% i.e. 603,363 billion Rails and the share of public sector investment was around 12.7% of total investment. The investment indicates that most of the investments are made in dams and there is no logical relationship between dams and the sub-networks. The amount of investment in sub-networks is about 15,737 billion Rails during these 31 years which is around 0.026% of total investment in water sector and shows the important issue that there is no a reasonable priority in water sector investment.

6. CONCLUSION

The purpose of this study was to explore the effects of water sector investment on economic development in Iran. According to the results we can show despite inherent limitations and inappropriate distribution of water in Iran, utilization of this worthy and non-renewable and expensive resource in terms of investment, is in a very low efficiency. The justified Solow growth model for different economic sectors of Iran indicates that the elasticity of water investment on agriculture sector is less than 1, 0.02%, with confidence coefficient level of 66% and is negative for the rest of the other sectors. The volume of water sector investment in 31 years mounted to 603,633 billion Rails, from which public share was 62% and that of private sector was 38%. The amount of physical capital in constant prices of the period under study was 603,633 billion Rails from which the share of water sector investment on base price of year 2006 amounted to about 21% and portion of public sector was 12.73%. To reduce and compensate the costs due to water crisis, here we offer some solutions and suggestions which may be useful: Pay more attention to the effects of global climate changes and its impact on reducing rainfalls and surface flows during ten-year drought in Iran. Pay more attention to increase in population growth rate during recent three decades in respect to developing countries, and more demand for drinking water, hygiene, services, and water demand in sectors such as agriculture, and industry, and growth in welfare and hygiene and increase in consumption per capita. Pay more attention to limitations of water harvesting from underground resources. The consumption share of the whole country in this part is 70% and this requires to pay attention to the effects of land subsidence, reducing underground water reservoirs and pollution increase, influx of salt water and substitution of it in underground water so that major plains of the country faced to negative balance in water potential.

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