



THE CAUSALITY BETWEEN SAVINGS AND GDP IN IRAN

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Abstract: *This paper examines causal relationships between gross domestic savings (GDS) and GDP for Iran using annual data over the period 1970-2008. The Gregory-Hansen (1996) cointegration technique, allowing for the presence of potential structural breaks in data, is applied to empirically examine the long-run co-movement between GDS and GDP. The results suggest that there is a long-run relationship between these variables. The evidence also indicates that the value of the income elasticity of saving before the regime shift is 1.32, amounting to 0.51, much less than unity, after the regime shift happening with Islamic revolution (1979-2008). It means that savings rate decreases when income increases during the second regime. The Granger Causality test indicates strong unidirectional effects from GDP to GDS. But there is no evidence that GDS promotes long-term economic growth. Moreover, the main results in this paper confirm that there is an instantaneous as well as unidirectional causal link running from GDP to GDS. So the findings of this paper support the consumption theories such as Keynesian point of view that it is higher economic growth that leads to higher saving growth. According to the results, it seems that oil revenues have mostly contributed to investment and economic growth during the sample period.*

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1. INTRODUCTION

The relationship between savings and economic growth is an important as well as controversial issue for economists and policy makers. The empirical evidence indicates that there exists a robust positive correlation between the saving rates and GDP growth. In addition to examining the relationship between them, it is also important to investigate the causal relationship between savings and economic growth, because it can provide useful information on the variables which should be controlled in order to obtain the desired level of the targeted variable(s). It can also be useful for policy makers designing policies. If the causality is from savings to economic growth, then savings should increase in order to achieve a higher economic growth. If the results imply that the economic growth causes savings, then the Keynesian point of view that savings depend on income is dominating. So decision makings will emphasize the demand side of the economy in order to increase economic growth.

There are, however, disagreements about the direction of the correlation. Some researchers have analyzed this linkage as cause and effect relationship. Another group of economists believe in capital fundamentalists' point of view that savings cause growth (e.g. Bacha, 1990; DeGregorio, 1992; Jappelli and Pagano, 1994). Lewis's (1955) in his traditional development theory has stated that increasing savings would accelerate growth. Kaldor (1956) and Samuelson and Modigliani (1966) studied how different savings behaviors induced growth. There is a third group of economists who have confirmed Keynesian theory that savings depend upon the level of output (e.g. Sinha and Sinha, 1998; Salz, 1999; Anoruo and Ahmad, 2001). Edwards (1995) found that per capita growth is one of the most important determinants of both private and public savings. (Mohan, 2006)

So with regard to the literature on the causal relationship between savings and economic growth, we cannot achieve a common result, because results differ in different countries and using different methods. This paper investigates the causality between savings and economic growth in Iran during 1970-2008 brief study of previous empirical studies is presented in section 2. Section 3 discusses the methodology and data. We also present the empirical results of the paper in section 3, and section 4 concludes.



2. EMPIRICAL LITERATURE

Taking a long-run view, Sinha (1996) studied the relationship between GDP and saving in India for the period 1950-1993. In doing so, he distinguished between gross domestic saving and gross domestic private saving and found that gross domestic private saving rather than gross domestic saving is more important in determining GDP. He also explored that both gross domestic saving and gross domestic private saving are cointegrated with GDP. The results of causality tests between growth of gross domestic saving/private domestic saving and the growth of GDP in Sinha's study indicated that the causality does not run in any direction.

Using VAR model, Agrawal (2001) investigated the relationship between savings, investment, and growth in South Asia for the period of 1950-1998. He found a unidirectional causality from savings to economic growth in Bangladesh and Pakistan, and a unidirectional causality from economic growth to savings in India, Sri Lanka, and Nepal.

Nwachukwu and Egwaikhide (2007) examined the determinants of private saving in Nigeria or the period 1970-2005. They compared the estimation results of the Error-Correction Model with those of three conventional models: Partial-Adjustment, Growth Rate and Static Models. The conclusion was that the ECM performed much better than the other models. The estimation results for the error-correction model pointed to the level of per capita income, terms of trade changes, public saving rate, external debt service ratio, and the inflation rate as having statistically positive influences on domestic saving. The real interest rate and growth rate of income had a negative impact on the saving rate. They also found a clear role for fiscal policy in increasing total saving in the economy, with the private sector considering public saving as a complement for its own saving.

In their study, Agrawal and Sahoo (2009) investigated the long-run determinants of total and private savings and the direction of causality between savings and growth in Bangladesh over 1975-2004. The evidence indicated that total savings rate is determined by GDP growth rate, dependency ratio, interest rates and bank density. It is also revealed that private savings rate is affected by the public savings rate. In addition, using the Granger Causality tests, the results suggested a bi-directional causality between savings and growth. Agrawal and Sahoo also applied the Forecast Error Variance Decomposition (FEVD) analysis using the



VAR framework. The causality results obtained using the Granger causality tests and the estimated savings functions are confirmed using FEVD analysis.

Ogoe (2009) tried to find the direction of causality between gross domestic savings and economic growth (using real per capita GDP as a measure of growth) of Ghana using annual time series data over 1961-2008. In his study, Ogoe carried out three analyses. First, the time series properties of growth rate of gross domestic savings and the growth rate of real per capita GDP were ascertained using the ADF unit root test procedure. The estimated results indicated one order of integration or $I(1)$ for the series. Second, the long-run relationship between the series was explored utilizing Engel–Granger Cointegration Test procedure. The result of the test indicated that the series were not cointegrated. Finally, the causal relationship between growth rate of gross domestic savings and the growth rate of real per capita GDP was performed using the Vector Autoregressive (VAR) model and Pairwise Granger Causality Test. The results showed that there was bi-directional causal relationship between growth rate of gross domestic savings and growth rate of real per capita GDP in Ghana. Based on the findings of the study, certain monetary and fiscal policies as well as legislation and other measures have been recommended to boost gross domestic savings mobilisation and to increase growth.

Abu Al-Foul (2010) examined the long-run relationship between real gross domestic product (GDP) and real gross domestic saving (GDS) for Morocco during the period 1965-2007 and Tunisia over 1961-2007 using a developed approach to cointegration by Pesaran et al. (2001) that. The empirical results of his study revealed that in the case of Morocco a long-run relationship exists between the variables, but they found no evidence indicating a long-run relationship in the case of Tunisia. The results of the Granger causality test supported bidirectional causality between economic growth and saving growth in Morocco. However, in the case of Tunisia, it is found the there is a unidirectional Granger causality from saving growth to economic growth.

3. METHODOLOGY AND EMPIRICAL RESULTS

In this section we use the Granger causality to study the causal relationship between savings and economic growth in Iran. The macroeconomic variables used in the model are (logarithm of) gross domestic savings (GDS) and real GDP (GDP). The data series are obtained from Central Bank of Iran (CBI). The data are annual from 1970-2008, reflecting



data availability. Considering the short sample period, a bivariate model is used to empirically examine the long-run co-movement and the causal relationship between savings and real GDP.

3.1. Zivot and Andrews Unit Root Test

Conventional tests for identifying the existence of unit roots in a data series include that of the Augmented Dickey Fuller (ADF) (1979, 1981) or Phillips-Perron(1988). So in the first step of the empirical analysis, the Phillips - Perron unit-root tests have been carried out for the both variables: gross domestic savings and GDP per capita, both in logarithm. The results reported in Table 1, indicate that both of the variables are nonstationary. However, recent contributions to the literature suggest that such tests may incorrectly indicate the existence of a unit root, when in actual fact the series is stationary around a one-time structural break (Zivot and Andrews, 1992; Pahlavani, et al, 2006). Zivot and Andrews (ZA) (1992) argue that the results of the conventional unit root tests may be reversed by endogenously determining the time of structural breaks. The null hypothesis in the Zivot and Andrews test is a unit root without any exogenous structural change. The alternative hypothesis is a stationary process that allows for a one-time unknown break in intercept and/or slope. Following Zivot and Andrews, we test for a unit root against the alternative of trend stationary process with a structural break both in slope and intercept. Table 1 provides the results. As in the Phillips-Perron case, the estimation results fail to reject the null hypothesis of a unit root for both variables. The same unit root tests have been applied to the first difference of the variables and in all cases we rejected the null hypothesis of unit root. Hence, we maintain the null hypothesis that each variable is integrated of order one or $I(1)$.

Table 1: Unit-root tests of Phillips-Perron(PP) and Zivot and Andrews (ZA)

Real Gross Domestic Savings(GDS)		Real GDP	
PP	ZA	PP	ZA
-0.81	-1.25(1979)	-1.69	-2.39(1979)

Note: The break point in ZA unit root test is presented in brackets. Empirical results fail to reject the null hypothesis of unit-root in all cases. The lag lengths for the ZA and PP tests are chosen by using SC's information criterion and Newey and West (1987) method respectively. Critical values for ZA tests were obtained from Zivot and Andrews (1992). Break points are reported in ()



3.2 The Gregory-Hansen Cointegration Analysis

Cointegration test means looking for a stationary long-run relationship between non-stationary variables. It has been introduced for the first time in 1980's by Engle and Granger (1987), Johansen (1988, 1991), Johansen and Juselius (1990, 1992) and the others. There are some methods for testing for cointegration the most well-known of which is Johansen test. However, as noted by Perron (1989), ignoring the issue of potential structural breaks can render invalid the statistical results not only of unit root tests but also of cointegration tests. Kunitomo (1996) argues that in the presence of a structural change, traditional cointegration tests, which do not allow for this, may produce spurious cointegration. Therefore one has to be aware of the potential effects of structural effects on the results a cointegration test, as they usually occur because of major policy changes or external shocks in the economy.

The Gregory-Hansen approach (1996) (hereafter, GH) addressed the problem of estimating cointegration relationships in the presence of a potential structural break by introducing a residual-based technique so as to test the null hypothesis (no cointegration) against the alternative of cointegration in the presence of the break (such as a regime shift). In this approach the break point is unknown, and is determined by finding the minimum values for the ADF t-statistic.

By taking into account the existence of a potential unknown and endogenously determined one-time break in the system, GH introduced three alternative models. The first model includes intercept or constant (C) and a level shift dummy. The second alternative model (C/T) contains an intercept and trend with a level shift dummy. The third model is the full break model (C/S), which includes two dummy variables, one for the intercept and one for the slope, without including trend in model. This model allows for change in both the intercept and slope.

These tests detect the stability of cointegrating vectors over time in the presence of structural breaks in the form of level shift, level shift with trend, and regime shift. Table 2 reports all cases. when dependent variable is gross domestic savings, the null hypothesis of no cointegration relationships is rejected in favor of the existence of one cointegrating relationship, allowing for a one time structural break (although not rejected when GDP is



dependent variable). The results show that the variables under examination do not drift apart for Iran. The estimated long run relationship using the C/S is of the form:

$$GDS = 2.42 + 1.32GDP - 1.3D - 0.81D(GDP) - 0.002trend$$

$$t \quad (4.67) \quad (5.89) \quad (3.33) \quad (6.82) \quad (3.78)$$

where dummy $D = 0$ if $t \leq 1979$ and $D = 1$ if $t > 1979$. Both the intercept and the intercept at the time of regime shift (Islamic Revolution in Iran) are significant. Moreover, the income elasticity of saving before the regime shift and at the time of regime shift is significant. The income elasticity before the regime shift is 1.32, more than unity. It decreases by 0.81 with regime shift. Therefore, we can see that income elasticity has decreased after regime shift and took a different path, may be thanks to more inclination to consumption after the revolution. So, the income elasticity of savings in Iran, at least after the Islamic revolution amount to 0.51 much less than unity, implying that savings regressively increase when income increase.

Table 2: Gregory-Hansen cointegration tests

Dependent Variable	Model	Test Statistic	Break Point
GDS	C	-6.29*	1979
	C/T	-5.11*	1980
	C/S	-4.98*	1979
GDP	C	-1.22	1979
	C/T	-0.57	1979
	C/S	-1.27	1980

Notes: C denotes level shift, C/T denotes level shift with trend, and C/S denotes regime shift. The lag length is chosen based on minimum SC.* denotes significant at the 5% level. Critical values were obtained from Gregory and Hansen (1996).

3.3. Granger Causality Tests

The existence of cointegrating relationship between GDS and GDP for Iran suggests that there must be long run Granger causality in at least one direction (Hatanaka, 1996). In this section, we test for Granger Causality between log of real gross domestic savings (GDS) and log of real GDG per capita (GDP). Cointegration implies that causality exists between the two series but it does not indicate the direction of the causal relationship. The dynamic Granger causality can be captured from the vector error correction model (VECM) derived



from the long-run cointegrating relationship (Granger 1988). Engle and Granger (1987) showed that if the two series are cointegrated, the vector-error correction model for the GDS and GDP series can be written as follows:

$$\Delta GDS = \alpha_y + \beta_R ECT_{t-1} + \sum_{i=1}^n \gamma_{Ri} \Delta GDP_{t-i} + \sum_{i=1}^n \delta_{Ri} \Delta GDS_{t-i} + \varepsilon_{Rt} \quad (1)$$

$$\Delta GDP = \alpha_e + \beta_E ECT_{t-1} + \sum_{i=1}^n \gamma_{Ei} \Delta GDP_{t-i} + \sum_{i=1}^n \delta_{Ei} \Delta GDS_{t-i} + \varepsilon_{Et} \quad (2)$$

$$ECT = GDS - 2.42 - 1.32GDP + 1.3D + 0.81D(GDP) + 0.002trend \quad (3)$$

where Δ is a difference operator; ECT is the lagged error-correction term derived from the long-run cointegrating relationship; The β_i ($i = y, e$) are adjustment coefficients; α is long run coefficient or elasticity and the ε_{it} s are disturbance terms assumed to be uncorrelated and random with mean zero.

Sources of causation can be identified by testing for significance of the coefficients on the lagged variables in Eqs. (1) and (2). First, by testing $H_0 : \gamma_{Ri} = 0$ for all i in Eq. (1) or $H_0 : \delta_{Ei} = 0$ for all i in Eq. (2), we evaluate Granger weak causality. This can be implemented using a standard F-test. Masih and Masih (1996) and Asafu-Adjaye (2000) interpreted the weak Granger causality as 'short run' causality in the sense that the dependent variable responds only to short-term shocks to the stochastic environment.

Another possible source of causation is the ECT in Eqs. (1) and (2). In other words, through the ECT, an error correction model offers an alternative test of causality (or weak exogeneity of the dependent variable). The coefficients on the ECTs represent how fast deviations from the long run equilibrium are eliminated following changes in each variable. If, for example, β_R is zero, then GDS does not respond to a deviation from the long run equilibrium in the previous period. Indeed $\beta_R = 0$ or $\beta_E = 0$ is equivalent to both the Granger non-causality in the long run and the weak exogeneity (Hatanaka, 1996). This can be tested using a simple t-test.

It is also desirable to check whether the two sources of causation are jointly significant, in order to test Granger causality. This can be done by testing the joint hypotheses $H_0 : \beta_R = 0$ and $\gamma_{Ri} = 0$ for all i in Eq. (1) or $H_0 : \beta_E = 0$ and $\delta_{Ei} = 0$ for all i in Eq.(2). This is referred to as a strong Granger causality test. The joint test indicates which variable(s) bear



the burden of short run adjustment to re-establish long run equilibrium, following a shock to the system (Asafu-Adjaye, 2000). A test of these restrictions can be done using F-tests.

Another concept related to Granger-causality is that of instantaneous causality. Roughly speaking, a variable GDS is said to be instantaneously causal for another time series variable GDP if knowing the value of GDS in the forecast period helps to improve the forecasts of GDP. It turns out, however, that in a bivariate VAR process, this concept reduces to a property of the model residuals. More precisely, let $\varepsilon_t = (\varepsilon_{Rt}, \varepsilon_{Et})$ be the residual vector of $y_t = (\Delta GDS, \Delta GDP)$; then, ΔGDS is not instantaneously causal for ΔGDP if and only if ε_{Et} and ε_{Rt} are uncorrelated. In turn, ΔGDS is instantaneously causal for ΔGDP if and only if ε_{Rt} and ε_{Et} are correlated. Consequently, the concept is fully symmetric. If ΔGDP is instantaneously causal for ΔGDS , then ΔGDS is also instantaneously causal for ΔGDP . Hence, the concept as such does not specify a causal direction. The causal direction must be known from other sources. Still, if it is known from other sources that there can only be a causal link between two variables in one direction, it may be useful to check this possibility by considering the correlation between the residuals (Lutkepohl, 2004).

The results of the tests on causality are presented in Table 3. The evidence strongly indicates that GDP Granger-causes GDS. The coefficient of the ECT and lagged explanatory variables are significant in the GDS equation (GDS) which indicates that long-run as well as short run causalities run from GDP to GDS. The adjustment coefficient in GDS equation (2) is estimated about -0.83. It means that GDS adjusts at a reasonable speed to the long-run equilibrium, where almost four-fifth of the disequilibrium is corrected in the first period. Moreover, the interaction term (ECT and GDP) in the spending equation is significant at 5% level. The results for the other equation suggest that GDS has no effect on GDP in short- and long-run. Therefore, there is unidirectional Granger causality running from GDP to GDS.



Table 3: Result of causality tests

	Source of causation					
	Short-run		Long-run	Joint(short-run/long-run)		
	ΔEX	ΔGDP	$ECT(-1)$	$\Delta EX,$ $ECT(-1)$	$\Delta GDP,$ $ECT(-1)$	
Null hypothesis	F-statistics		t-statistics	F-statistics		
GDS does not cause GDP p-value	1.03 (0.71)	-	-0.56 (0.63)	1.32 (0.42)	-	
GDP does not cause GDS p-value	-	5.39 (0.00)	-6.10 (0.00)	-	7.19 (0.00)	

Notes: the lag length has been chosen based on minimum SC. Δ denotes series in first difference.

Testing for instantaneous causality can be done by determining the absence of instantaneous residual correlation. Because only one correlation coefficient is tested to be zero, the number of degrees of freedom of the approximating chi-square distribution is one. Clearly, it is sufficient to report the test result for only one instantaneous causal direction because the test value for the other direction is identical given that it tests the very same correlation coefficient. The test statistics based on the residuals of the VECM is 12.90, being highly significant.

These results imply that, there is instantaneous as well as unidirectional Granger causality running from GDP to GDS, while savings has an insignificant effect on GDP in both the short- and long-run. In other words, GDS is strongly exogenous and whenever a shock occurs in the system, GDS must be reduced to maintain the long run relationship.

4. CONCLUSION

This paper applies Gregory-Hansen (1996) cointegration and error correction modeling techniques in order to test causal relationship between gross domestic savings and real GDP in Iran based on annual data from 1970 to 2008. Prior to cointegration analysis, the Zivot and Andrews unit root test has been applied to test the stationarity of the variables. The empirical results indicate that we cannot find enough evidence against the null hypothesis of unit root. However, for the first difference of the variables, we rejected the null hypothesis of unit root. It means that the variables are $I(1)$. The results show that there is a long-run relationship between GDS and GDP. The value of the income elasticity before the



regime shift is 1.32, more than unity, while it comes to 0.51, much less than unity, after the Islamic revolution recognized as the second regime. It means that savings progressively increase with income in the first regime and regressively in the second one.

We also find strong support for the exogeneity of GDP. The main results in this paper confirm that there is an instantaneous and unidirectional causal link running from GDP to GDS. The findings of this paper support the consumption theories such as Keynesian point of view that saving growth depends on income. It seems that oil revenues have been responsible for financing investment and economic growth during the sample period. Therefore, policy measures should be employed to achieve sustainable growth through more productivity and substantially enlarging and diversify their economic base diversification in the future.

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