THE TEMPORAL RELATIONSHIP BETWEEN INVESTMENT AND SAVING IN IRAN

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Abstract

This paper examines causal relationships between gross domestic investmentrate and national saving rate for Iran using annual data over the period 1970-2010. 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 these variables. The results suggest that there is a long-run relationship between these variables. The Granger Causality test indicates strong unidirectional effects from saving to investment. But there is no evidence that investment promotes domestic saving.Moreover, the main results in this paperconfirm that there is an instantaneous as well as unidirectional causal link running from saving to investment.The results also support the Feldstein-Horioka (1980) hypothesis implying internationallow capital mobility in Iran.

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1. Introduction

Feldstein and Horioka (1980) found ahigh correlation between domestic investment and saving in OECD countries during the period1960-74. Theyindicated that the estimatedregression coefficient, or thesaving-retention coefficient, were near to unity, indicating that most of theincremental saving remain in the country of origin.Their result was a dilemma in a world of increasing capital mobilityand persistent current account imbalances.

The subject of causaldirection is important in the developing countries regarding the aim of discreet fiscal policies.Nowadays, the usualunderstandingis that government fiscal imbalances deficits are not desirable due to theirundesirable macroeconomic effects. At the backof this view of government fiscal imbalances is the idea that saving causesinvestment, and because government deficits is considered as negative government saving, this decreases the amount ofsaving available for investment and thereby hinders economic growth.

So, the examination of the causality between saving and investment is useful for choosing the most efficient approach to decreasebudget deficit. For example, if causality runs fromsaving to investment, then the reduction of the deficits by cutting government expenditure rather than by increasing tax is essential. This is a more cautious policy because increasing taxes decreases disposable income and saving, reducing the impact of lower deficits onnational saving. On the other hand, if investment causes saving, then there are no merits of cutting government spending or the budget deficit. Indeed, if the causalityruns from investment to saving,policy measures should shift away from saving-promoting policies and be employed to achieve sustainable growth through more productivity.On the other hand, the neoclassical Solow (1956) model argues that the increase in the savingrate raises steady-state output and investment.

There is a large part of economic empirical literature analyzing the causal relationship between gross domestic investment and savingfollowing the pioneering work of Feldstein and Horioka (1980). Arginon and Roldan (1994) studied the saving-investment relationship in EU countries during theperiod 1960-1988, and indicated unidirectional causality running from saving to investment. Apergis andTsoulfidis (1997) used the ARDL bounds testing approach to cointegration to 14 EU countries. They found a cointegrating relationship between saving and investment, and that saving Granger causes investment.De and Eyden (2005) applying panel data for 36 sub Saharan African countries including Ethiopia found an evidence ofhigh capital mobility. They concluded that the foreign aid and FDI flows (and not the domestic saving)determine investment ratio in thesecountries. In most of the studies, the saving retention coefficient was found to behigh for developed countries while, the low coefficient for developing countries has been interpreted as highcapital mobility in these countries. Afzal (2007) studied relationship between savings and investment in developing countries using cointegration techniques. He indicates there is no long-run relationship between savings and investment in seven countries of the sample, implying high degree of capital mobility and failing of savings and investment relationship. He find evidence of bidirectional causality between savings and investment in South Africa, and unidirectional causality from savings to investment in Pakistan and Sri Lanka, with no causality in India, Philippines, Malaysia, and Iran. However, he says the strong correlation between savings and investment does not rule outcapital mobility across these countries.Esso and Keho (2010) have found some evidence of the absence of causalitybetween savings and investment for West African Economic and Monetary Union (UEMOA) countries that has been attributed to capital mobility.On the other hand, Onafowara et al. (2011) investigated the relationship between savings and investment in eightadvanced economies of the

European Union and found evidence of cointegration for sixcountries.Sanjib and Joice (2012) examined the relationship between savings and investment in three economies, namely, US, UK, China andIndia. They showed a cointegrating relationship between savings and investment in thesecountries.

So with regard to the literature on the causal relationship between investment and national saving rates, we cannot achieve a common result, because results differ in different countries and using different methods. This paper investigates the causality between investment and savingrates in Iran during 1970-2010.Section 2 discusses the methodology and data. We also present the empirical results of the paper in section 2, and section 3 concludes.

2.Methodology and Empirical Results

In this section we use the Granger causality to study the causal relationship between investment rateand saving rate in Iran. The macroeconomic variables used in the model are (logarithm of) grossdomestic investmentrate (INV) and national saving rate (SAVING).The data series are obtained from Central Bank of Iran (CBI). The data are annual from 1970-2010, 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 investment and saving rates.

2.1. 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 investmentrate and national saving rate, 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)

Gross Domestic Investment rate(INV)		National saving(SAVING)	
PP	ZA	PP	ZA
-2.11	-2.14(1979)	-2.41	-2.53(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 ( )

2.2 The Gregory-Hansen Cointegration Analysis

Cointegrationtest 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 Jeslius (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 investment rate, 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. 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:

$$INV = 0.01 + 1.42 SAVING - 0.10 D - 0.96 D(SAVING) - 0.006 trend$$

$$t \quad (2.35) \quad (4.81) \qquad (5.73) \quad (6.39) \qquad\qquad (3.61)$$

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 coefficient of investmentor thesaving-retention coefficientbefore the regime shift and at the time of regime shift is significant. The elasticity before the regime shift is 1.42. It decreases by0.96 with regime shift. Therefore, we can see that the elasticity has decreased after regime shift and took a different path, may be thanks toincreasing capital mobility before the revolution. So, the elasticity of investment in Iran, at least after the Islamic revolution declinesto 0.46much less than unity, implyinghigher cost of current account imbalance after regime shift.

Table 2: Gregory-Hansen cointegration tests

Dependent Variable	Model	Test Statistic	Break Point
INV			
	C	-4.82*	1979
	C/T	-5.12*	1979
	C/S	-5.01*	1979
SAVING			
	C	-4.35	1979
	C/T	-5.02	1979
	C/S	-4.23	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).

2.3. Granger Causality Tests

The existence of cointegrating relationship between INV and SAVING 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 gross domestic investmentrate(INV) and log of saving rate(SAVING). 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 cointegratingrelationship (Granger 1988). Engle and Granger (1987) showed that if the two series are cointegrated, the vector-error correction model for the INV and SAVING series can be written as follows:

$$\Delta INV_t = \alpha_I + \beta_I ECT_{t-1} + \sum_{i=1}^{n} \gamma_{Ii} \Delta SAVING_{t-i} + \sum_{i=1}^{n} \delta_{Ii} \Delta INV_{t-i} + \varepsilon_{It} \quad (1)$$

$$\Delta SAVING_t = \alpha_S + \beta_S ECT_{t-1} + \sum_{i=1}^{n} \gamma_{Si} \Delta SAVING_{t-i} + \sum_{i=1}^{n} \delta_{Si} \Delta INV_{t-i} + \varepsilon_{St} \quad (2)$$

$$ECT = INV - 0.01 - 1.42 SAVING + 0.10 D + 0.96 D(SAVING) + 0.006 trend \quad (3)$$

where Δ is a difference operator; ECT is the lagged error-correction term derived from the long-run cointegrating relationship; The β_i $(i = I, S)$ are adjustment coefficientsand the $\varepsilon_{it}s$ 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 $H_0 : \gamma_{Ii} = 0$ for all i in Eq. (1) or $H_0 : \delta_{Si} = 0$ 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_I is zero, then INV does not respond to a deviation from the long run equilibrium in the previous period. Indeed $\beta_I = 0$ or $\beta_s = 0$ 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 $H_0 : \beta_I = 0$ and $\gamma_{Ii} = 0$ for all i in Eq. (1) or $H_0 : \beta_S = 0$ and $\delta_{Si} = 0$ 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 INV is said to be instantaneously causal foranother time series variable SAVING if knowing the value of INV in the forecast periodhelps to improve the forecasts of SAVING. It turns out, however, that in a bivariate VAR process, this concept reduces to a property of the model residuals. More precisely, let $\varepsilon_t = (\varepsilon_{It}, \varepsilon_{St})$ be the residual vector of $y_t = (\Delta INV, \Delta SAVING)$; then, ΔINV is not instantaneously causal for $\Delta SAVING$ if and only if ε_{It} and u ε_{St} are uncorrelated. In turn, ΔINV is instantaneouslycausal for $\Delta SAVING$ if and only if ε_{It} and ε_{St} are correlated. Consequently, the concept is fully symmetric. If $\Delta SAVING$ is instantaneously causal for ΔINV, then ΔINV is also instantaneouslycausal for $\Delta SAVING$. Hence, the concept as such does not specify a causaldirection. The causal direction must be known from other sources. Still, if it is known from other sources that there can only be acausal link between two variables in one direction, it may be useful to check thispossibility 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 SAVINGGranger-causes INV. The coefficient of the ECT and lagged explanatory variables are significant in the INVequation which indicates that long-run as well as short run causalities run from SAVING to INV. The adjustment coefficient in INV equation (2) is estimated about -0.65. It means thatINV adjusts at a reasonable speed to the long-run equilibrium, where almost two-thirdof the disequilibrium is corrected in the first period. Moreover, the interaction term (ECT and SAVING) in the investment equation is significant at 5% level. The results for the other equation suggest that INV has no effect on SAVING in short- and long-run. Therefore, there is unidirectional Granger causality running from SAVING to INV.

Table 3:Result of causality tests

	Source of causation				
	Short-run		Long-run	Joint(short-run/long-run)	
	ΔINV	$\Delta SAVING$	$ECT(-1)$	ΔINV, $ECT(-1)$	$\Delta SAVING$, $ECT(-1)$
Null hypothjesis	F-statistics		t-statistics	F-statistics	

INV does not cause SAVING	0.73	-	-1.46	1.78	-
p-value	(0.56)		(0.32)	(0.29)	
SAVING does not cause INV	-	5.61	-6.82	-	7.29
p-value		(0.00)	(0.00)		(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 absenceof 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 12.61, being highly significant.

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

3. Conclusion

This paper applies Gregory-Hansen (1996) cointegration and error correction modeling techniques in order to test causal relationship between gross domestic investmentrate(INV) and national saving rate(SAVING) 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 stationarityof 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 INV and SAVING.The value of the elasticity og investment before the regime shift is 1.42, more than unity, while it comes to 0.46, much less than unity, after the Islamic revolution recognized as the second regime.It means more loose current account in the first regime or less capital mobility after the Islamic revolution.

We also find strong support for the exogeneity of SAVING. The main results in this paper confirm that there is an instantaneous and unidirectional causal link running from SAVING to INV.So, investment and economic growth is driven by the national savings particularly after the revolution.In terms of fiscal consolidation strategiesand growth-promoting policies, Iran should reduce fiscal imbalance that have positive effects on private investment.

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