

The Impact of Interest Rate on Investment in Jordan: A Cointegration Analysis

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Abstract. The main aim of this study is to investigate the impact of real interest rate on investment level in Jordan over the period (1990-2005). A cointegration analysis with three variables (investment level, real interest rate, and income level) is employed.

Two unit root tests (Phillips-Perron test and Augmented Dickey-Fuller test) have been exploited to check the integration order of the variables. The Johansen Cointegration test is mainly used. And for the purpose of supporting the results, the dynamic relationships among the variables are explained through presenting variance decomposition and impulse responses.

The results were found to be in line with the economic theory and some other studies in the sense that real interest rate has a negative impact on investment, where it is found that an increase in the real interest rate by 1% reduces the investment level by 44%. On the other hand, the income level has a positive impact.

Introduction

Investment is considered to be an important factor in economic growth (Al-Tarawneh, 2004). So, economists and policy makers have been interested in studying the major determinants of the investment level. One of the prospective determinants is the real interest rate.

In the Jordanian economy, during the 1970s and 1980s, the interest rate was completely determined by the Central Bank of Jordan. Since the beginning of

the 1990s, interest rates have become almost floated and commercial banks are competing with each other in determining the level of interest rate.

Objective of the Study

This study aims at investigating the impact of the real interest rate on the investment level in Jordan over the 1990-2005 period. The central hypothesis of this study is that the real interest rate has a negative impact on the investment level.

Economic Literature and Previous Studies

There are two conflicting views of the effect of the real interest rate on the level of private investment. A high interest rate level raises the real cost of capital and therefore dampens the private investment level. On the other side, poorly developed financial markets in less developing countries (LDCs) and inadequate access to foreign financing for most private projects, both imply that private investment is constrained largely by domestic savings. These, in theory, are expected to respond positively to higher real interest rates. For this reason, private investment could, on balance, be positively related to interest rates in developing countries (Greene and Villanueva, 1990).

As for previous empirical studies, because of the huge number of these studies, five of them were chosen. The first study is conducted by Greene and Villanueva (1990). They explored the determinants of private investment in less developing countries for 23 countries over the 1975-1987 period, and found that the real deposit interest rate has a negative impact on private investment. The second study by Hyder and Ahmad (2003) was about the slowdown in private investment in Pakistan. They found that higher real interest rates reduce private investment. Larsen (2004), in the third study about the United States, has found that low mortgage interest rates make direct real estate investments attractive to suppliers of the real estate units. Aysan and others (2005), in the fourth study, analyzed the determinants of unsatisfying private investment growth in the Middle East and North Africa (MENA) throughout the 1980s and 1990s. Their findings have shown that the real interest rate appears to exert a negative effect on a firm investment projects. And in the last study, Wang and Yu (2007) examined the role of interest rate in investment decisions for firms in Taiwan. Their results reveal that the interest rate plays an important role in investment decisions.

The Model and Data

The standard economic theory proposes that the investment level depends mainly on two major factors: the real interest rate and the level of income. Accordingly, the variables of this study are as follows:

The dependent variable is the investment level, which is proxied by the Gross Fixed Capital Formation (GFCF), since data on yearly investment levels are not available for Jordan. The independent variables are: the real interest rate (R), which is calculated according to the Fisher equation, i.e. by subtracting the inflation rate from the lending nominal interest rate, and the level of income which is proxied by the Gross Domestic Product (GDP).

This study covers the (1990-2005) time period for the following two reasons:

First, the nominal interest rate in Jordan was determined by the monetary authority represented by the Central Bank of Jordan before 1990, and this rate has been floating since 1990.

Second, categorization of the interest rate into lending rate and deposit rate by the Central Bank of Jordan is published in its statistical bulletins since 1990.

Unfortunately monthly or quarterly data are not available in Jordan, so this study is based on annual data.

All the data are obtained from the annual and monthly statistical bulletins of the Jordanian Central Bank and from the International Financial Statistics Yearbook.

During the period of study, the three variables have behaved in the following manner:

- The real interest rate was estimated to be around (-5.89%) in 1990, which was a result of the high inflation rate that Jordan witnessed during that year. Since 1991, this rate has reversed from a negative value to a positive one hovering between 2.17% in 1991 and 11.73% in 1999. This may be due to two factors; the first one is that the Jordanian monetary authority was able to keep low rates of inflation since 1992 till the end of the study period, and secondly the nominal interest rate has become floated since 1990.

- The gross domestic product at market prices was estimated to be JD 2668.3 millions in 1990 and persistently kept going up until it reached about JD 9118.1 millions in 2005 with estimated 7.98% annual growth rate.

- The gross fixed capital formation started to be around JD 694 million at the beginning of the study period and has fluctuated up and down ranging from JD 678 millions in 1991 to JD 1445.3 millions in 1996 with an averaged 5.4% annual growth rate.

The time series analysis, particularly the cointegration analysis, is employed for achieving the goal of the study.

The suggested econometrical model will take the form:

$$\text{GFCF}_t = \beta_0 + \beta_1 R_t + \beta_2 \text{GDP}_t + U_t$$

where;

GFCF : the investment level, proxied by gross fixed capital formation.

R : the real interest rate.

GDP : the income level, proxied by Gross Domestic Product.

U : error term

t: time.

Real interest rate is used in this context because borrowers and lenders, in their investment decisions, care about the real interest rate rather than the nominal one.

Empirical Results

A. The Integration Order of the Variables

The integration order of the variables specifies the suitable method of estimation. If all of the variables are integrated of the same order, then the Ordinary Least Squares (OLS) method can be utilized. If not, the results of the OLS could be misleading and other methods of estimation should be examined.

To specify the order of integration of the variables and for the sake of comparison, two tests have been exploited as follows:

First: The Phillips-Person unit root test. This test is basically a test of the hypothesis $\rho=1$ in the equation:

$$\Delta X_t = \mu + \rho X_{t-1} + \varepsilon_t \quad (1)$$

the equation is estimated by the OLS method and then the t-statistic of the ρ coefficient is corrected for serial correlation in ε_t .

The results in Table (1), show that R is integrated of order zero, *i.e.* I(0), since the calculated absolute value is greater than the critical absolute values at 1% and 5% significance levels. By the same token, GDP is I(1), and GFCF is I(2).

Table 1. Phillips-Perron Test.

Variable	Calculated Value	1%Critical Value	5%Critical Value
GFCF	- 2.85	- 4.07	- 3.12
Δ (GFCF)	- 2.62	- 4.14	- 3.15
Δ (GFCF,2)	- 6.29	- 4.22	- 3.18
R	- 5.27	- 4.07	- 3.12
Δ (R)	- 4.17	- 4.14	- 3.15
Δ (R,2)	- 6.49	- 4.22	- 3.18
GDP	- 1.32	- 4.07	- 3.12
Δ (GDP)	- 4.68	- 4.14	- 3.15
Δ (GDP,2)	- 13.29	- 4.22	- 3.18

Notes: Δ (X) : The first difference of the variable X.

Δ (X,2): The second difference of the variable X.

Second: The Augmented Dickey-Fuller test. This test is basically a test of the hypothesis $\rho = 0$ against the hypothesis $\rho < 0$ in the equation:

$$\Delta X_t = \mu + \rho X_{t-1} + \alpha_i \sum_{i=1}^m \Delta X_{t-i} + \varepsilon_t \quad (2)$$

where the lagged difference terms are included. The number of these terms to be included is often determined empirically, *i.e.* we could include enough terms to get a serially independent error term. The results of this test in Table (2) show that GFCF is I(0), R is I(1), and GDP is I(2).

The results of both tests show that the three variables are integrated to different orders, which implies that the application of the OLS method could lead to spurious results and some other estimation methods should be considered, so the researchers have resorted to the cointegration analysis.

Table 2. Augmented Dickey-Fuller Test.

Variable	Calculated Value	1%Critical Value	5%Critical Value
GFCF	- 5.61	- 4.14	- 3.15
Δ (GFCF)	- 2.51	- 4.22	- 3.17
Δ (GFCF,2)	- 3.90	- 4.33	- 3.22
R	- 2.78	- 4.14	- 3.15
Δ (R)	- 3.17	- 4.22	- 3.17
Δ (R,2)	- 3.05	- 4.33	- 3.22
GDP	- 2.89	- 4.14	- 3.15
Δ (GDP)	- 2.20	- 4.22	- 3.17
Δ (GDP,2)	- 3.26	- 4.33	- 3.22

Notes: Δ (X) : The first difference of the variable X.

Δ (X,2): The second difference of the variable X.

B. The Cointegration Analysis

In general, in this analysis we need to check if the variables are cointegrated, *i.e.* if a linear combination of these variables is stationary. If that is the case, the regression on the levels of these variables would be meaningful and we do not lose any valuable long-term information (Gujarati, 1995, 726).

One of the most powerful tests for cointegration is Johansen Cointegration test, which tests the assumption of linear deterministic trend in the data. The likelihood ratio is used for testing the number of cointegrating vectors. The likelihood ratio statistic for the trace test is:

$$\text{LHR} = -T \sum_{i=r+1}^{p-r} \ln(1-g_i)$$

where g_{r+1}, \dots, g_p are the estimated $p-r$ eigenvalues. The null hypothesis to be tested is that there are at most r cointegrating vectors, *i.e.* the number of cointegrating vectors is less than or equal to r , where r is 0, 1, or 2. In this case, the null hypothesis is tested against the general alternative of $r+1$ cointegrating vectors. So, the null hypothesis $r=0$ is treated against the alternative $r=1$, $r=1$ against the alternative $r=2$ and so forth (Alkhatib, 2005).

The implementation of the Johansen Cointegration test gives the results in Table (3).

Table 3. Johansen Cointegration Test.

Eigenvalue	Likelihood Ratio (L.R.)	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
0.94	43.32	29.68	35.65	None
0.55	9.48	15.41	20.04	At most 1
5.16E-05	0.0006	3.76	6.65	At most 2

L.R. test indicates 1 cointegrating equation at 5% significance level.

Table (3) shows the rejection of the null hypothesis of no cointegration at 1% significance level, and the likelihood ratio test indicates the existence of one cointegrating equation at 5% level of significance. These results suggest that we could use the variables in their levels instead of using any order of differencing.

The resulting cointegrating equation from the Johansen Cointegration test is written as follows:

$$\text{GFCF} = 1672.315 - 44.04R + 17.01 \text{ GDP} \quad (3)$$

(15.75) (0.03)

where the standard errors are in brackets. The above equation produces the equilibrium relationship among the variables and shows that the real interest rate (R) has a negative impact on Gross Fixed Capital Formation (GFCF), and is highly significant, where it is found that an increase in (R) by 1% reduces (GFCF) by 44%. On the other hand, the impact of income (GDP) on (GFCF) is positive, where it is found that an increase in (GDP) by 1% raises (GFCF) by 17%, but this effect is insignificant. The variance-covariance matrix is found to be as follows:

	GFCF	R	GDP
GFCF	132444.8	427.6	531652.2
R	427.6	16.17	2430.6
GDP	531652.2	2430.6	2952996

For the purpose of checking if there is any structural change in the data, two stability tests were implemented for the Ordinary Least Squares (OLS) method, where the dependent variable is GFCF and the independent variables are R and GDP. These two tests are CUSUM test and CUSUM of Squares test (CUSUMQ). The results of these two tests have shown that the parameters of the equation are stable, which in turn implies that we cannot reject the null hypothesis of constant parameters for the whole period of study at 5% level of significance.

To make the results more concrete, the researchers have tried to investigate the dynamic short-term relationship among the variables through decomposing the variance of GFCF and showing the impulse responses of GFCF to shocks in R and GDP.

First: Variance Decomposition. Table (4) reports the decomposition of variance of the variable GFCF for various time periods:

Table 4. Decomposition of Variance of GFCF.

Period	GFCF	R	GDP
1	100.00	0.00	0.00
3	82.93	6.50	10.56
6	57.15	35.84	7.00
9	51.67	41.16	7.17

The results show that the real interest rate is responsible for explaining 6.5% of the variation of GFCF after three time periods, this percentage reaches 35.8% after six time periods and goes up to 41.2% after nine time periods. On the other hand, variations of the income level (GDP) were found to explain about 10.6% of the forecast error of GFCF after three time periods, and 7% after six time periods. It seems that the real interest rate has a greater impact, compared to GDP, on the Gross Fixed Capital Formation. These results support the results of the cointegrating equation above.

Second: Impulse Response Function. The second technique for investigating the dynamic relationship among the variables is the impulse responses. Figure (1) shows the response of GFCF to a one standard deviation (S.D.) shock in R (the upper part of the figure) and to a one standard deviation shock in GDP (the lower part of the figure) with two standard error bands. It is very clear from the upper part that GFCF responds negatively to a positive shock in R and this response lasts for a few periods of time. On the other hand, the lower part shows that the response of GFCF to a shock to GDP is positive and is highly significant, which means that an increase in the income level raises the level of investment. Greene and Villanueva (1990) reached similar results in studying the determinants of private investment in less developing countries, where they found that the real deposit interest rate and per capita gross domestic product have, respectively, negative and positive effects on private investment.

All of the above results point to two major conclusions. First, the impact of the real interest rate on investment is negative, which is completely consistent with the economic theory. Second, the effect of the real interest rate is stronger than the effect of the income on investment in Jordan. The second conclusion is in line with the behavior of the three variables during the period of study, where both the real interest rate (R) and gross fixed capital formation (GFCF) were fluctuating, whereas the income level (GDP) was persistently increasing.

Conclusions

The focal aim of this study is to test the hypothesis that the real interest rate has a negative impact on investment in the Jordanian economy. This hypothesis is tested by utilizing a time series analysis in general, and cointegration analysis in particular. The results are found to support this hypothesis. The results also show that the influence of the real interest rate on investment is higher than the influence of the income.

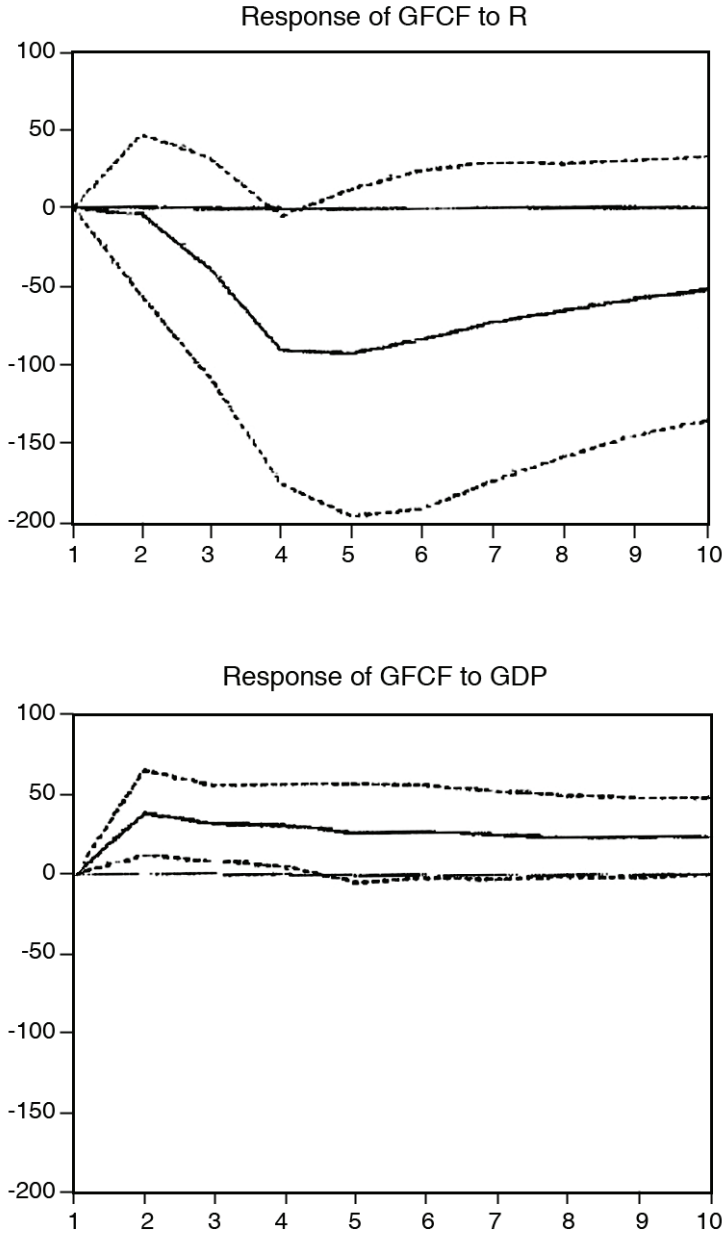


Fig. 1. Response to one S.D. Innovations \pm 2 S.E.

Notes

- 1) The dotted lines in the response chart refer to two-standard error bands.
- 2) Error bands are evaluated by using Monte Carlo procedure.

In our minds, there is an avenue for future research. It would be done by including some other variables in the model. Foreign aid may be considered as an important variable in investment decisions in the Jordanian economy since Jordan heavily depends on external financing.

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تأثير سعر الفائدة على الاستثمار في الأردن: تحليل تكامل مشترك

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المستخلص. تهدف هذه الدراسة بشكل أساسي إلى استقصاء أثر سعر الفائدة الحقيقي على حجم الاستثمار في الأردن خلال الفترة الزمنية (١٩٩٠-٢٠٠٥م). وبهدف تحقيق ذلك تم استخدام طريقة تحليل التكامل المشترك بثلاثة متغيرات هي: حجم الاستثمار، وسعر الفائدة الحقيقي، وحجم الدخل.

تم استخدام أسلوبين لاختبار جذر الوحدة: اختبار فيليبس-بيرون واختبار ديكي-فولر الموسع، وذلك بهدف اختبار درجة تكاملية المتغيرات المستخدمة في الدراسة. كما تم استخدام طريقة جوهانسن للتكامل المشترك في التحليل. وبغرض دعم نتائج الدراسة تم تحليل التفاعل الديناميكي بين المتغيرات باستخدام تحليل مكونات التباين ودالة الاستجابة لردة الفعل.

وقد جاءت نتائج الدراسة منسجمة مع النظرية الاقتصادية ومع بعض نتائج الدراسات السابقة، من حيث إن سعر الفائدة الحقيقي يؤثر بشكل سلبي على حجم الاستثمار، حيث إن زيادة سعر الفائدة بمعدل (١٪) يقلل حجم الاستثمار بمعدل (٤٤٪)، بينما كان تأثير مستوى الدخل على الاستثمار إيجابياً.