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Trade Openness and Real Investment in Jordan An ARDL Bound Testing Approach

Alaaeddin A. Al-Tarawneh[1] and Ghazi I. Al-Assaf [1]

ABSTRACT

This paper investigates the relationship between trade openness and real investment in Jordan, over the period 1976-2010. An Autoregressive Distributed Lag (ARDL) approach is employed in order to explore the association between investment and trade openness by estimating an investment function for the Jordanian economy and incorporating trade openness as a determinant of investment. The Empirical results provide strong evidence on the presence of a long-run stable investment function. In the short-run, trade openness has a positive and significant effect on real investment; a consistent result with the literature. Therefore, the results confirm the significant impact of trade openness on real investment found in the previous literature using a cointegration technique. This finding emphasises the importance of the trade liberalisation effects on real investment especially in the case of Jordan.

Keywords: Trade Openness, Investment, Cointegration, ARDL, Jordan.

INTRODUCTION

Economic theory stresses the importance of investment for economic growth, development, and economic stability. As a result, a number of reasons may be proposed to justify a study of investment. Firstly, investment is highly volatile; thus, investment movements have important effects on the short-run fluctuations of employment, income, and productivity. Secondly, it is important in determining how much an economy's output is invested to increase future capacity. In the long run, investment demand is considered to be one of the important determinants affecting the future of living standards of the population. Thirdly, investment establishes some important issues relating to the financial markets, and it has important feedback effects on these markets. On the other hand, a few studies have investigated the impact of investment on trade openness especially in the case on developing economy.

Jordan has a strategic location. It is located at the crossroads between Europe, Asia and Africa, and is attached to the Red Sea through the Gulf of Aqaba port and other ports via neighbouring countries. These features make Jordan attractive for investors. However, since the mid 1990's, the Jordanian authorities passed encouraging legislations in an attempt to create a proper investment environment that attracts investors to invest in Jordan, in addition to holding several bilateral and multi-trade agreements with neighbouring and other countries, and formatting appropriate infrastructure needed for investment.

Among these agreements is the Free Trade

[1]Assistant Professors of Economics, Department of Business Economics, The University of Jordan .
✉a.altarawneh@ju.edu.jo
g.alassaf@ju.edu.jo
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Agreement (FTA) between Jordan and the United States. It was the first convention of its kind to be signed with an Arab country. The agreement provides for an ending of all types of tariffs on industrial goods and farm products. As the convention on the Euro-Jordanian partnership, which plays an important role in encouraging investment in Jordan, Jordan signed the Euro-Mediterranean Association Agreement, which has the status under which there is free trade with European countries, as well as the free trade agreement with Arab countries to facilitate and develop trade exchange between Arab countries.

Investment in Jordan, defined in this study as the change in the level of the fixed capital stock, has fluctuated over time. This study attempts to investigate whether there is a stable investment function for the Jordanian economy. Determining the key features of investment, with concern on the trade openness, enables policy makers to identify the effect of trade policies on real investment in Jordan.

The rest of this paper is structured as follows: Section 2 reviews some of the literature in this field. Section 3 discusses the main model used in the analysis. Section 4 presents data and methodology adopted in this paper. The empirical results are reported in Section 5, while Section 6 is the conclusion.

2. Previous Empirical Work

Many empirical studies have used a number of variables, suggested by the theory, in an attempt to describe the determinants of investment in both developed and developing countries. Shafik (1992) provided a comprehensive survey of the empirical work on estimating investment function before 1990s on developing countries. She used an error-correction model and co-integration to test Egyptian data for a private investment function that takes into account some features of developing countries. She found that a number of variables, including mark ups, internal financing, demand and the cost of investment, are the main determinants of the private investment in Egypt. Sun (1998), using data on China for the period 1953 to 1995, found that the long-run investment function can be characterised by co-movements of real fixed investment, grain output per capita, and energy supply per capita.

In their article, du Toit and Moolman (2004) found that, in South Africa, investment depends on the interest rate (the user cost of capital), international position, and domestic and foreign financial constraints. Ismihan et al. (2005) used data from Turkey covering the period 1963 to 1999. The main findings they made were that capital formation and growth are seriously affected by the macroeconomic instability of the Turkish economy. Anoruo et al. (2007) estimated a neoclassical model of investment for Bangladesh covering the time period 1973 to 2004. They found that there is an equilibrium relationship between the investment-output ratio, real output, and real interest rate.

Heim (2008) identified seven major variables that have a significant effect on the investment demand in the US economy for the period 1960 to 2000. These variables are the crowd out problem, depreciation, growth rate of GDP, interest rate, growth in stock values, exchange rate changes, and company profitability.

Moore (2010), using panel data for 107 developing countries over the period 1970 to 2006, tested McKinnon's hypothesis that the rate of return on money does matter for investment in developing countries. His findings appear to support this hypothesis under a number of conditions.

The linkage of trade openness and investment has traditionally been an important topic in developing countries. It attracted attention due to the vital role of trade openness in the development in many economies.

A number of recent papers have empirically examined the relationship between trade, economic growth, and Foreign Direct Investment (FDI), using a wide variety of econometric techniques. Only very few studies have focused on the linkage between trade openness and level of investment.

One of the very beginning efforts to explore the impact of trade openness on investment is done by Baldwin and Seghezza, (1996). This study is one of the first to discuss the role of trade liberalization in fostering the capital accumulation and affecting domestic investment. They employed a model using the Three Stages Least Squares and found that trade barriers depresses investment and thereby slows economic growth. Trade openness was found to have a positive impact on the level of investment by allowing domestic agents to import relatively cheaper capital goods from foreign countries.

Harrison (1996) also investigated the association between trade openness and growth, and extended the analysis to examine the relationship between openness and investment. He found, using a panel data, trade openness affects domestic investment positively. Another panel data study was conducted by Salahuddin and Islam (2008) who found a positive relationship between trade openness and investment. They have extended the investigation pertaining determinants of gross investment in developing countries by including investment.

A very recent study by Oladipo (2011) employed cointegration techniques to examine the impact of trade liberalization (openness) on long run economic growth. The empirical results, obtained from a quarterly data on Mexico, showed that investment play a significant role in determining the economic growth along with the trade openness in Mexico. The study has highlighted the interrelationship between trade liberalization, investment, human capital, and growth. The researcher found all these variables are statistically cointegrated.

As can be noticed from the previous review of the main literature on the relationship between trade openness and investment, there have been a few studies connecting trade openness to the level of investment, and there is no research exclusively devoted to the case of Jordan. In the present paper, we intend to fill in this gap in the literature concerning the links between trade openness and real investment by employing a long span of data in the case of a small developing country (Jordan) and using a cointegration analysis based on the ARDL approach.

3. Model of Investment

Net investment can be defined as the net change in the capital stock (K) since the previous time period (K_t - K_{t-1}) and equals total investment (I_t) minus replacement investment (δK_{t-1}),

$$K_t - K_{t-1} = I_t - \delta K_{t-1} \tag{1}$$

where (δ) is the capital stock depreciation rate and is measured to be constant.

The next short sub-sections will discuss a number of different theories of investment behaviour, starting with the Keynesian theory and the accelerator models, followed by the neoclassical model of investment, and Tobin's q model.

Keynesians and the Accelerator Model

Keynesians consider investment as one of the key determinants of macroeconomics activity. Keynes (1936) emphasised the essentially unstable nature of investment, because investment is based on expectations. However, he derived an investment demand function which was inversely linked to the interest rate, which then formed a key transmission mechanism between monetary policy and the real side of the economy.

The Keynesian theory assumed that firms would implement an investment project only if the discounted flow of expected future revenue from that project (*ER*) exceeded the total cost (*C*). Thus the firm invests if the net return (NR) is positive.

$$NR = \sum_{t=1}^{n} \frac{ER_t}{(1-r)^t} - C_t > 0 \qquad (2)$$

The rate of return, *r*, required to equate total revenue with total cost (or *NR*=0) was termed the marginal efficiency of capital by Keynes. When this rate exceeds the market interest rate, which represents the opportunity cost, the investment project would be undertaken. A decrease in the market interest rate would result in the marginal investment of projects becoming more profitable, thus the total demand for capital in the economy would increase. However, Keynes argued that the supply of capital would be unable to meet these increases in demand caused by changes in the interest rate, and from this he constructed an investment marginal efficiency curve that was inversely connected with the market interest rate.

Changes in monetary policy, that caused interest rate to change, would affect the investment volume in the economy, Keynes argued. Thus, he emphasised that interest rate is the main transmission mechanism between monetary policy and investment. However, his theory did not ignore the importance of other factors, such as prices and wages, in determining the demand for investment.

The naive accelerator model, elaborated by Clark (1917), is based on the assumption of a fixed capital-output ratio. This implies that prices, wages, interest rates, and taxes may have indirect impacts on the capital stock. The naive accelerator model defines the optimal capital stock (K^*_t) as a constant proportion of output (Y_t):

$$K_t^* = \mu Y_t \qquad (3)$$

where μ represents the capital-output ratio. Furthermore, while the capital stock is always optimally adjusted in each period (i.e. $K^*_t = K_t$) net investment (NI_t) will be equal to:

$$NI_t = K_t - K_{t-1} = \mu(Y_t - Y_{t-1}) \qquad (4)$$

The flexible accelerator model, derived by Chenery (1952) and Koyck (1954), which is a more general form of the naive accelerator models, is based on the gap between the existing capital stock level (K_{t-1}) and the desired capital stock (K^*_t). λ is a constant proportion and lies ($0< \lambda <1$), then net investment is:

$$NI_t = \lambda(K_t^* - K_{t-1}) \qquad (5)$$

Output, funds, costs and other variables may be included in the model as determinants of the desired capital stock, proportional to output.

Neoclassical Model

The neoclassical approach has gained importance in the investment literature following the work of Jorgenson, who presented a 'neoclassical theory of optimal accumulation of capital'. The main assumptions behind the neoclassical approach are that there is perfect certainty. In other words, all agents in the market perform with the same certain expectations about the future, and there is a perfect capital market, though all agents in the capital market are price takers (Jorgenson, 1971).

The main feature of the neoclassical theory of investment is that it is based on a model of optimisation, in which the desired capital stock is determined by interest rates, output, capital prices and tax policies. Assuming a firm produces output, *Y*, by using two inputs, *K* and *L*. Jorgenson's approach modelled the firm's net worth maximisation objective as its optimal objective, which equals the sum of the discounted value of the cash flow of profits from time zero, subject to a neoclassical production function: $Y_t = f(K_t, L_t)$. Then the optimisation problem is:

$$max_{K,L,I}V = \int_0^{\infty} \exp(-R_t)\,[p_t f(K_t, L_t) - w_t L_t - q_t I_t]dt \qquad (6)$$

where $R_t = \int_0^t i_s\, ds$, and i_s is the interest rate at time s, I_t is gross investment at time t, the output is sold at price p_t and the inputs are bought at the prices w_t and q_t respectively. Under a perfectly competitive market, the firm is a price taker, therefore the firm has to choose L_t, K_t and I_t to maximise the discounted value of cash flow of the firm.

The Lagrangian multiplier yields the conditions for solving the optimisation problem, for capital and labour:

$$p_t \frac{\partial Y_t}{\partial K_t} = r_t \equiv MP_{K,t} = \frac{r_t}{p_t} \qquad (7)$$

$$p_t \frac{\partial Y_t}{\partial L_t} = w_t \equiv MP_{L,t} = \frac{w_t}{p_t} \qquad (8)$$

where $MP_{K,t}$ and $MP_{L,t}$ represented the marginal products of K and L, respectively.

Under the theoretical conditions for profit maximisation, firms will employ a set of inputs; for each input the marginal product of employing another unit of the input should equal the marginal cost of employing that additional input, thus the additional real user-cost of capital or real wage.

The user-cost of capital, r_t, represents the true cost to the firm of holding its assets in the form of capital stock. It is composed of three elements. The first is the cost taking place from the interest rate foregone from not investing elsewhere, the opportunity cost. The second element is a cost caused by the depreciation of the capital stock. The third is the possible capital gain (loss) occurred as a result of a change in the market value of the capital over the period.

Tobin's *q* Investment Theory

Tobin (1969) generalised a cash-flow model and presented a framework for an investment model where net investment depends on the ratio of the market value of additional capital stock to its replacement costs. This ratio is known as *marginal q*. The naive form of the Tobin's q model is specified by:

$$q - 1 = C'(I) \qquad (9)$$

It implies that whenever *marginal q* deviates from unity, this indicates that there are incentives to investment or disinvestment the capital by the firm. The marginal valuation approach is therefore basically a predictor of investment, the underlying principle of this theory is to provide a link between monetary policy and the real side of the economy. For this purpose, the market interest rate, which measures the opportunity cost of investment, is seen as a crucial determinant of investment, without, of course, ignoring the importance of other factors.

4. Data and Methodology

4.1. Data

This section analyses the empirical effects of the economic fundamentals on aggregate investment in Jordan, using annual observations over the period 1976-2010. The objective here is to investigate whether a stable investment function exists, with concern on the role played by the trade openness in such functions. The variables included are the natural logarithm of real investment, LRI_t; the natural logarithm of real Gross Domestic Product (GDP), LRY_t; the Natural Logarithm of Real Credit, $LRCR_t$; the user cost of capital, UCC_t; and natural logarithm of trade-to-GDP ratio, $LOpen_t$.

Real investment is approximated by using gross fixed capital formation in constant prices. Real GDP is calculated as nominal GDP deflated by the GDP deflator. A positive growth rate represents an increase in aggregate demand, which in turn increases investment, and then we expect a positive sign with investment.

Real credit is measured by the domestic credit provided to the private sector deflated by the GDP deflator. An increase in credit increases investment, and then we expect a positive sign with investment.

The user cost of capital can be constructed as follows:

$$UCC_t = \frac{P_t^K(i_t + \delta_t)}{P_t} \qquad (10)$$

where P_t^K is the price of capital measured by the gross capital formation deflator, i_t is the average of interest rate on loans and advances, δ_t is the depreciation rate, and P_t is the GDP deflator. We assume a negative relation between user cost of capital and investment.

Trade liberalisation or the degree of economy openness, represented as trade-to-GDP ratio, is calculated as the sum of exports and imports divided by GDP. An increase in trade liberalisation expressed by decreasing barriers gives incentives for investment and may affect their expectations about the new markets available. We expect a positive sign with investment.

Most of the data are obtained directly from the World Development Indicators of the World Bank and International Financial Statistic of the IMF.

Figure (1) represents plots of the variables. Table (1) shows descriptive statistics and Table (2) summaries the expected signs and the theoretical reference.

Gross fixed capital formation in real term had a positive trend during 1976-1981, from JD 512.8 millions in 1976 to JD 1328.0 millions in 1981 or an annual average growth of 21.7 percent, which is the case for GDP and credit, these upward being the result of the expansion that occurred in the economy. The increasing demand for Jordanian products came from the neighbouring oil exporting countries, which were affected by the oil price shock in the late 1970s. Investment started to decrease sharply, about 14.6 percent, because of the recession in the economy until the mid-1980s, followed by an increase until 1989. Then it decreased again reflecting the increase in the price level in the late 1980s. During 1991-1994 investment started to follow a positive trend, from JD 755.8 millions in 1991 to JD 1391.6 millions in 1994 or on annual average growth of 23.8 percent, reflecting the improvements in the economy during the second reform programme, which started in 1992. These improvements did not last long because of the recession in the mid 1990's. During the 2000s, investment followed an upward trend reflecting the openness that occurred in the economy after Jordan became a member in the World Trade Organisation (WTO) in 2000. Investment increased from JD 1059.6 millions in 2001 to JD 2140.6 millions in 2008, an annual average of 11.2 percent.

In addition, the figure shows the general trend in trade openness indicator for Jordan over the period 1976-2010. It can be clearly seen that Jordan had experienced a spectacular increase in the volume of both exports and imports over that period. This led to increase the level of international trade transactions with foreign world due to the expansion of establishing international trade agreements with various partners especially during the last two decades. It is also noticed that trade openness indicator in Jordan is fluctuating over time and influenced by various exogenous factors.

During the oil boom in the Gulf Countries over the 1970s, trade openness indicator had experienced a clear increase. However, over the first half of 1980s, this indicator had dropped gradually as a result of the rapid growth in the Jordanian GDP compared to the growth in exports and imports during that period. After that, Jordanian exports and imports had experienced rapid growth rates, particularly over the years 1987 and 1988.

This increase had continued steadily over the period 1989-1990.

The consequences of the 1989-economic crisis had badly affected the level of trade openness in Jordan during the period 1991-1999, and caused trade openness to decrease in Jordan during that period. After that, trade openness indicator had experienced a tremendous increase. This is arising from implementing different trade agreements, where many of these agreements came into enforce in 2001, 2002, and after, such as Jordan-US FTA and Jordan- EU Association Agreements and other trade agreements.

The global financial crisis and the US recession, during the year 2008 and after, caused the Jordanian international trade level to decreased, affecting the level of trade openness in the years 2008 and 2009. However, both exports and imports have gradually increased compared to the GDP, and as a results trade openness indicator improved again in the year 2010 and after.

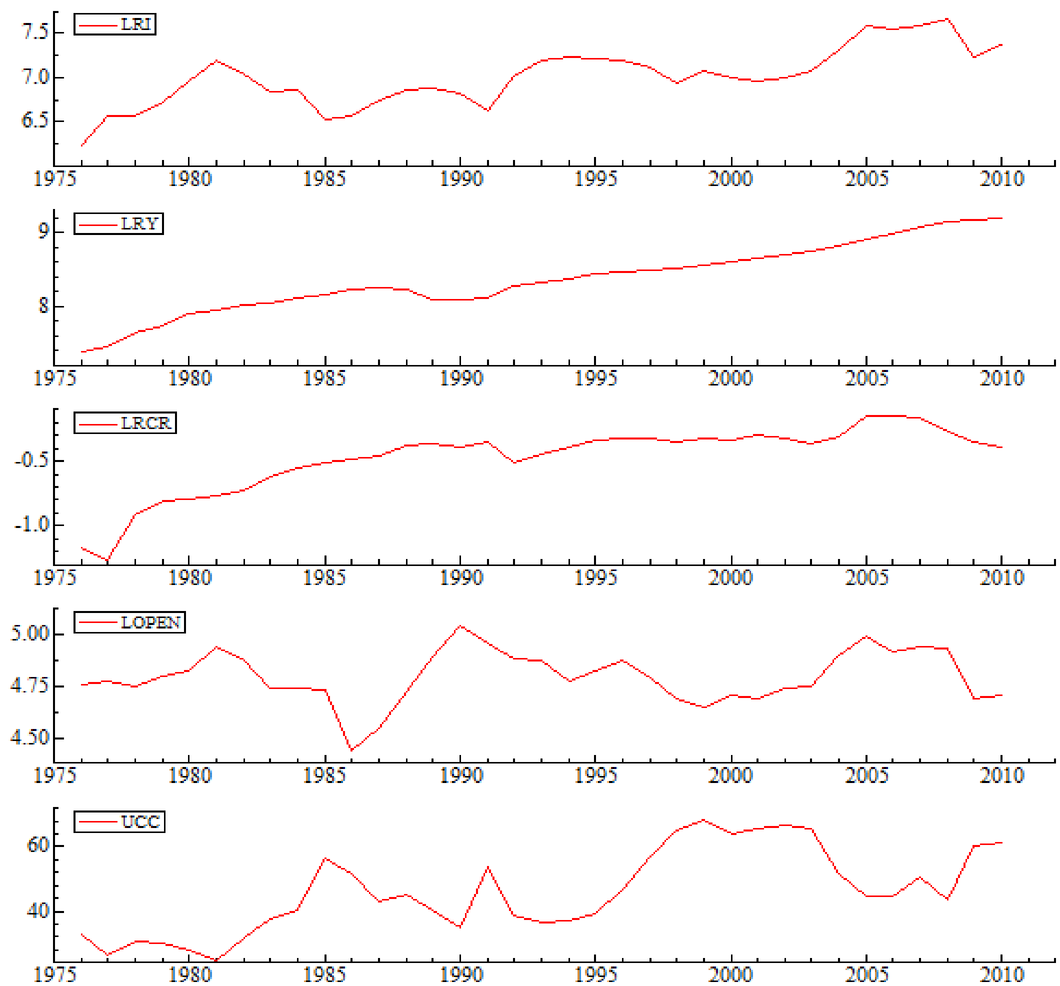


Figure 1. Data plots (1976-2010)

Table 1. Descriptive statistics

	LRI	***LRY***	***LRCR***	***UCC***	***LOPEN***
Mean	7.009	8.366	-0.476	45.288	4.796
Standard Deviation	0.330	0.470	0.261	12.822	0.126
Sample Variance	0.109	0.221	0.068	164.401	0.016
Count	35	35	35	33	35

Table 2. Expected signs of the model

	Expected sign	**Theoretical reference**
LRY	Positive	Anoruo et al. (2007), Heim (2008)
LRCR	Positive	Shafik (1992)
UCC	Negative	du Toit and Moolman (2004), Anoruo et al. (2007)
LOPEN	Positive	Baldwin & Seghezza (1996), Harrison (1996), Salahuddin and Islam (2008)

4.2. Methodology

Following the literature on investment, a general model is considered to formulate empirically the investment function in Jordan, which could be expressed as:

$$LRI_t = f(LRY_t, LRCR_t, UCC_t, LOpen_t) \quad (11)$$

Using the technique of 'General-to-Specific' it will estimate a number of models and then choose the most accurate one, which represented the investment function in Jordan.

These models are estimated depending on an Autoregressive Distributed Lag (ARDL) approach by Pesaran and Shin (1999), where this procedure allows us to apply the model regardless of the stationarity of the variables. The results of this approach are equivalent to the results of the Error-Correction Models (ECM) (Hassler and Wolters, 2006). ARDL is adopted for a mixture of stationary and non-stationary variables, the advantage of ARDL over the ECM is that it can be applied irrespective of whether the regressors are $I(0)$ or $I(1)$.

The autoregressive distributed lag (ARDL) approach, developed by Pesaran and Shin (1999) and Pesaran *et al.* (2001), is also known as the ARDL bounds test. The ARDL approach has numerous advantages which make it preferable over other methods in estimating the long-run co-integration relationships. The main advantage is that it is not necessary for testing the unit root of the variables, where the ARDL can be applied irrespective whether regressors are $I(0)$ or $I(1)$.

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \varphi_i y_{t-i} + \acute{\beta} x_t + \sum_{i=0}^{q-1} \acute{\beta}_i^* \Delta x_{t-i} + u_t \quad (12)$$

Following Pesaran and Shin (1997) and Pesaran *et al.* (2001), a general ARDL (p,q) model can be presented as follows:

$$\Delta x_t = P_1 \Delta x_{t-1} + P_2 \Delta x_{t-2} + \cdots + P_s \Delta x_{t-s} + \varepsilon_t \quad (13)$$

where y_t represents the dependent variable, x_t is a vector of explanatory variables and u_t, ε_t are uncorrelated error terms with zero mean and constant variance.

$$\varphi(L)y_t = \alpha_0 + \alpha_1 t + \sum_{i=0}^{k} \acute{\beta_\iota}(L)x_t + u_t \quad (14)$$

The model can be rewritten as:

Where$\varphi(L) = 1 - \varphi_1 L - \varphi_2 L^2 \ldots - \varphi_p L^p$, $\acute{\beta}(L) = \beta_0 - \beta_1 L - \beta_2 L^2 \ldots - \beta_q L^q$, and L is the lag operator. For simplicity define:

$$\delta = \frac{\alpha_1}{1-\varphi} \; and \; \theta = \frac{\beta}{1-\varphi} \quad (15)$$

Then y_t can be expressed as:

$$y_t = \mu + \delta t + \sum_{i=0}^{k} \acute{\theta_\iota}(L)x_t + v_t \quad (16)$$

Where $\mu = \frac{\alpha_0}{1-\varphi} - (\frac{\varphi}{1-\varphi})\delta$, and $v_t$represents the error term.

The long-run co-integrating vector can be expressed as:

$$y_t - \hat{\theta}_0 - \hat{\theta}_1 x_{1t} - \hat{\theta}_2 x_{2t} - \cdots - \hat{\theta}_k x_{kt} = v_t \quad (17)$$

Using the lag and first differences of y and x, we obtain:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{r} \beta_i y_{t-i} + \sum_{j=i}^{k} \sum_{i=1}^{r} \delta_{ji} x_{j,t-i} + \sum_{i=1}^{r} \pi_i \Delta y_{t-i} + \sum_{j=1}^{k} \sum_{i=1}^{r} \gamma_{ji} \Delta x_{j,t-i} + u_t \quad (18)$$

Where β_0 is a deterministic variable, j is the number of explanatory variables, r is the number of lags selected based on the information criteria, and u_t is a white noise disturbances.

The implementation of this technique involves two stages. First one, test for the existence of co-integration relationship among y_t and x_{jt} variables by the bounds test, using a Wald-test (F-test). The test null hypothesis that there is no co-integration relationship among the variables, and can be conducted as a joint significance test on lagged level variable's coefficients as follows:

$$H_0: \beta_i = \delta_{ji} = 0 \qquad \forall\, i = 1,2,\ldots r \; and \; j = 1,2,\ldots k$$

The computed Wald test gives two sets of critical values, bounds, one set based on the assumption that all variables in the ARDL model are *I*(1), and the other set assumes that all variables are *I*(0). If the calculated F is higher than the upper critical bound, then the null hypothesis is rejected, therefore a co-integration relationship between the variables exists. If the test statistic is below the lower critical bound, then the null hypothesis cannot be rejected. And if the calculated F-test is between the bounds, then the test cannot give a conclusive inference.

In the second stage, if the long-run relationship exists, then the long-run and short-run coefficients of the equation (18) can be estimated.

The investment function can be presented as follows:

$$\Delta LRI_t = \alpha_0 + \alpha_1 LRI_{t-1} + \sum_{i=1}^{p} \beta_i \, \Delta LRI_{t-i} + \sum_{i=0}^{p} \sum_{j=1}^{k} \gamma_{ji} \, \Delta DEP_{j,t-i} + \sum_{j=1}^{k} \delta_j \, DEP_{j,t-1} + \varepsilon_t \quad (19)$$

Where Δ denotes the first difference, and p=1,2 is the number of lags determined by information criteria, and k is the number of independent variables, and DEP_t represented a vector of the explanatory variables of the real investment.

5. Empirical Results

5.1. Unit Root Tests

According to figure (1), most variables have a trend over the sample period. Therefore, a constant and trend have been included in the unit root test.

A visual inspections of the data confirmed that all variables were *I*(1), except for *LRCR* and *LOpen* which are *I*(0). The Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowiski-Phillips-Schmidt-Shin

(KPSS) unit root tests confirmed the stationary hypothesis for the first difference. Table (3) summarises unit root tests results.

Table 3. Unit root tests results

	ADF		PP		KPSS	
	Level	**1st Difference**	**Level**	**1st Difference**	**Level**	**1st Difference**
LRI	-2.906	-4.525*	-2.906	-4.456*	0.061	
LRY	-3.097	-3.666**	-2.403	-4.089**	0.093	
LRCR	-4.289**		-1.962	-6.672*	0.242	0.075
LOpen	-3.309***		-2.667	-3.932**	0.050	
UCC	-2.486	-5.804*	-2.598	-5.805*	0.075	

-ADF, Augmented Dickey-Fuller; PP, Phillips-Perron; KPSS, Kwiatkowiski-Phillips-Schmidt-Shin. For ADF Schwarz information criterion used to select the lag length and the maximum number of lags was set to be 8. For PP and KPSS Barlett-Kernel was used as the spectral estimation method and Newey-West used to select the bandwidth.

-ADF & PP critical values: 1% -4.263, 5% -3.558, 10% -3.212, KPSS critical values: 1% 0.216, 5% 0.146, 10% 0.119.

-*Significant at 1%, **significant at 5%, and ***significant at 10%.

For the level variables, under ADF and PP the null hypothesis of a unit root cannot be rejected at the 5% significance level, except for *LRCR* and *LOpen* which can be rejected at level 5% and 10%. However, the null that the first difference of the variables has unit root is rejected at the 5% level. While according to the KPSS test, the null hypothesis of stationarity can be rejected at level 5% significant, except for *LRCR* which cannot be rejected at level 5%. However, the null that the first difference of the variables is stationary cannot be rejected at the 5% significance level.

5.2. Co-integration Tests

In order to check the existence of a co-integration relationship among the variables, the bounds test, Pesaran *et al.* (2001), is implemented, which is based on testing the null hypothesis of no co-integration relationship among the variables. The test uses the F-statistic depend on Wald test on equation (19):

$$\Delta LRI_t = \alpha_0 + \alpha_1 LRI_{t-1} + \beta_1 \Delta LRI_{t-1} + \beta_2 \Delta LRI_{t-2} + \gamma_{11}\Delta LRY_{t-1} + \gamma_{12}\Delta LRY_{t-2} + \gamma_{21}\Delta LRCR_{t-1} + \gamma_{22}\Delta LRCR_{t-2} + \gamma_{31}\Delta LOpen_{t-1} + \gamma_{32}\Delta LOpen_{t-2} + \gamma_{41}\Delta UCC_{t-1} + \gamma_{42}\Delta UCC_{t-2} + \delta_1 LRY_{t-1} + \delta_2 LRCR_{t-1} + \delta_3 LOpen_{t-1} + \delta_4 UCC_{t-1} + \varepsilon_t$$

Where the null and the alternative hypotheses are constructed as follows:

$H_0: \alpha_0 = \alpha_1 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$

H_1: At least one is not zero

Table 4. Bound test results

F statistic	Critical values*		
	Sig level	**Lower bound**	**Upper bound**
3.87	5%	2.69	3.83
	10%	2.38	3.45

* The critical values are obtained from Pesaran *et al.* (2001), table CI(v).

From Table (4), the calculated F-statistics for all models are exceeding the upper critical bound at the 5% level of significance. Thus the null hypothesis of no co-integration can be rejected, so only one co-integration relationship exists in these models.

The long-run relationship can be estimated as:

$$LRI_t = 3.349 + 0.817LRY_t + 0.246LRCR_t - 0.806LUCC_t$$

R^2= 0.883, *RSS*= 0.322, *F*(Prob.)= 70.74 (0.00)

The above estimation represents the long-run relationship between investment and its determinants. Real investment depends positively on real income and real credit, and negatively on the user cost of capital. All signs and coefficients magnitude seem to be consistent with the economic theory. One can notice that the coefficient of trade openness is not shown in the long-run relationship as it has not a significant effect.

5.3. Estimation Results

Table 5. Short run results of investment equations

	Dependent variable: Δ*LRI*	
	Model 1	Model 2
LRI_{t-1}	-0.365 (0.099)	-0.379 (0.092)
$\Delta_3 LRY_t$	0.715 (0.176)	0.844 (0.171)
$\Delta LRCR_{t-1}$	0.485 (0.314)	
$\Delta\Delta LRCR_t$	0.771 (0.281)	0.409 (0.167)
$\Delta LUCC_t$	-0.759 (0.106)	-0.598 (0.114)
$\Delta LOpen_t$		0.394 (0.151)
$LRCR_{t-1}$	0.692 (0.215)	0.641 (0.190)

	Dependent variable: Δ*LRI*	
	Model 1	Model 2
$LUCC_{t-1}$	-0.260 (0.102)	-0.228 (0.095)
Constant	3.777 (1.040)	3.714 (0.958)
SE	0.155	0.132
R^2	0.840	0.864
$\bar{R}^2$	0.791	0.882
F-statistic	17.21	20.81
Prob(F-statistic)	0.000	0.000

Table (5) represents the results of the ARDL estimation of the short run for two suggested models (just significant variables included which driven from a general model). The results of these models appear to be similar. Nonetheless, the explanatory variable added in the model 2, trade-to-GDP ratio ($\Delta Lopen_t$), increases the explanatory power; as adjusted R^2 increased from 79 percent to 88 percent.

The coefficient of LRI_{t-1}, that measures the speed of adjustment, appears to be negative and less than 1 in magnitude, about -37 and -38 percent, and they are statistically significant at 1% level. Thus, it seems that the model takes about three years to be adjusted.

The real income and real credit have a positive effect on real investment. The real income does not vary among the models, and it is less than unity; however the real credit has also a stable effect among the models.

A more trade 90iberalization, positively affect the real investment, about 40 percent. In other words, any 1 percent increase in the trade-to-GDP ratio, increases the real investment by about 40 percent. This result confirms the finding at the previous empirical literature.

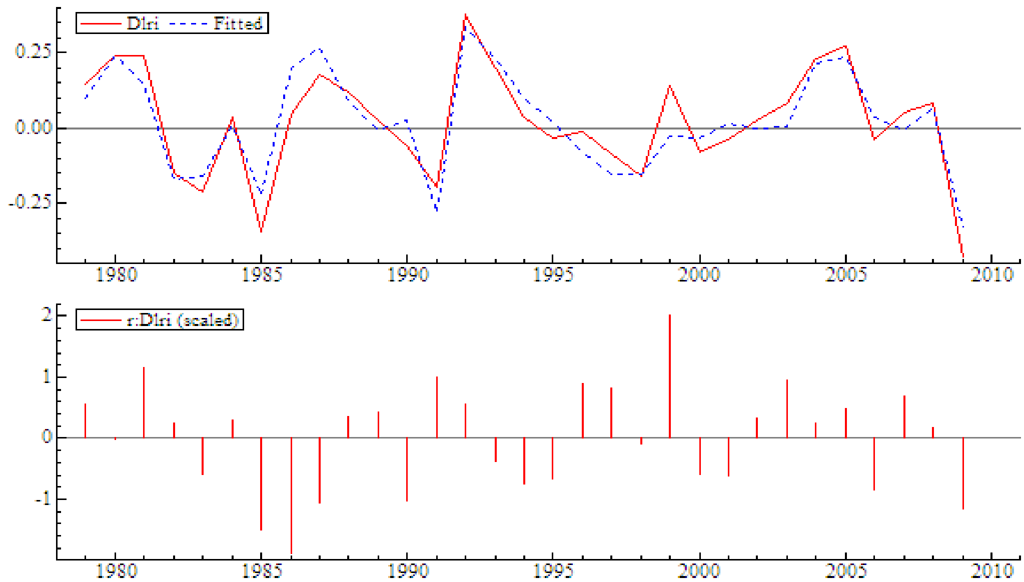
The log of the user cost of capital lagged one period appears to be consistent with the theory in both models; it has a magnitude between -23 percent and -26 percent. Thus any increase in interest rate by 1 percent, may decrease investment by about 23 and 26 percent.

The goodness of fit of these models is relatively high, and the overall models are significant. The regression specifications fit well and pass all diagnostic tests against serial correlation, autoregressive conditional heterosedasticity, non-normal residual, heterosedasticity, and incorrect functional form. Table (6) reports the diagnostic tests. Figure (2) shows residuals, actual, and fitted lines.

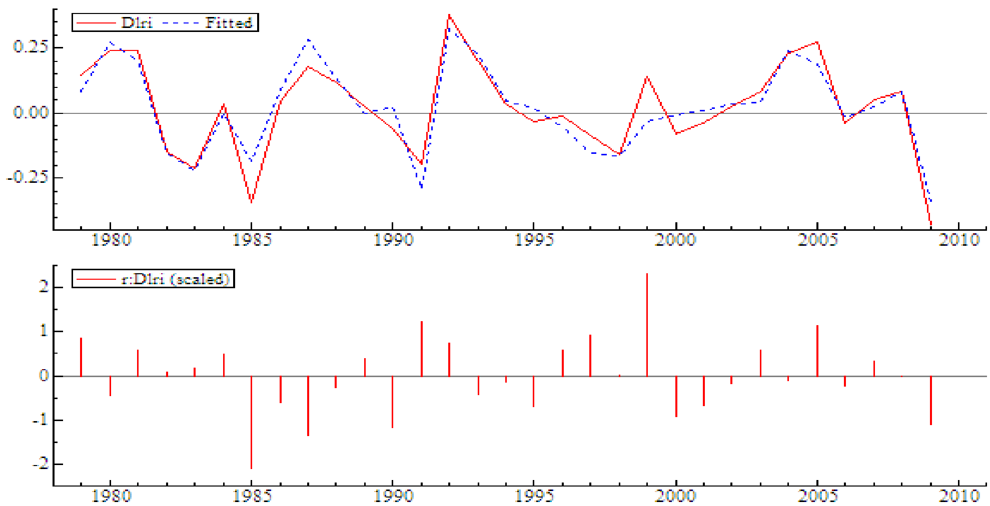
Table 6. Diagnostic tests

	Model (1)	**Model (2)**
ARCH 1-1 test	F(1,21)= 0.342 [0.714]	F(1,21)= 0.120 [0.668]
Normality test	χ^2 (2)= 0.167 [0.920]	χ^2 (2)= 3.283 [0.194]

	Model (1)	**Model (2)**
Hetero. Test	F(14,8)= 0.275 [0.983]	F(14,8)= 0.356 [0.956]
RESET test	F(1,22)= 1.071 [0.311]	F(1,22)= 0.278 [0.604]



Model (1)



Model (2)

Figure 2. Actual, Fitted and Residuals lines

6. Conclusion

As investment theories emphasise the importance of investment for economic growth, development, and economic stability, this research looks at the potential determinants of investment for Jordan, trying to formulate an investment function and attempting to capture the role played by trade openness in the real economy. It employs a number of variables depending on the theory in an attempt to capture their effect on investment in Jordan covering the time period 1976 to 2010, using the Autoregressive Distributed Lag (ARDL) model, by Pesaran and Shin (1999), which is the procedure used when some of the variables, being used in the analysis, are *I(1)* and others are *I(0)*. In order to check for the existence of a long run relationship among the variables exists in the model, the bounds test is implemented, and it is found that there is strong evidence that at least one co-integration relationship exists.

The OLS estimation is used to estimate the long-run relationship between investment and its determinants including trade openness. In the long-run, real investment depends positively on real income and real credit, and negatively on the user cost of capital.

The speed of adjustment appears to be negative and less than 1, about -37 percent and -38 percent for both models, respectively, and they are statistically significant at 1% level. This speed of adjustment coefficients is considered to have about three years to adjust.

The coefficient of the trade-to-GDP ratio, that represents the trade openness, is found positive and significant; a consistent result with the literature. This finding emphasise the importance of the trade liberalisation effects on the real investment in Jordan. Trade openness has a relatively important role in stimulating capital formation and increasing the level of investment in the case of a small economy as in Jordan. Giving the positive impact of trade openness on the level of investment in Jordan, policies should be aimed at enhancing trade liberalisation and focusing on implementing bilateral trade agreement with the foreign world in order to increase investment, where cointegration analysis employed in this paper shows that trade liberalisation is accompanied by a large change in the composition of investment in the case of Jordan.

It is also shown that a strong cointegration relationship exists among trade openness and real investment. This fact highlights the broadly ignored effects of trade liberalisation when formulating the determinants of investment equation in many countries. Therefore, international trade variables should be considered when investigating the behaviour of investment especially in developing countries.

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الانفتاح التجاري والاستثمار الحقيقي في الأردن باستخدام نموذج ARDL

علاء الدين عوض الطراونه[1] وغازي ابراهيم العساف[1]

ملخص

يهدف هذا البحث إلى دراسة العلاقة بين الانفتاح التجاري ومستوى الاستثمار الحقيقي في الأردن باستخدام تحليل اقتصادي قياسي. وتسعى هذه الدراسة إلى قياس هذه العلاقة من خلال تقدير دالة الاستثمار للاقتصاد الأردني باستخدام نموذج (*ARDL*) لتحليل السلاسل الزمنية لبيانات الاقتصاد الأردني التي تغطي الفترة 1976–2010، بإدخال مؤشر الانفتاح التجاري في هذا النموذج القياسي. تُشير نتائج التقدير إلى وجود علاقة تكامل مشترك بين المتغيرات، ومن ثمّ فإن دالة الاستثمار في الاقتصاد الأردني تعكس علاقة اقتصادية مستقرة، وطويلة الأجل بين مستوى الاستثمار الحقيقي ومؤشر الانفتاح التجاري ومحددات الاستثمار الأخرى. كما تؤكّد نتائج هذه الدراسة ما خلصت إليه دراسات سابقة، حيث تظهر النتائج أيضا وجود تأثير إيجابي قوي للانفتاح التجاري في مستوى الاستثمار الحقيقي في الأردن. إنّ هذه النتائج تؤكّد أهمية السعي قدما في تحرير التبادل التجاري مع العالم الخارجي لرفع مستوى الانفتاح التجاري، الأمر الذي سيُساعد في تعزيز الاستثمار الحقيقي ودعمه في الاقتصاد الأردني.

الكلمات الدالة: الانفتاح التجاري، الاستثمار، التكامل المشترك، ARDL، الاردن.

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[1] استاذ مساعد، قسم اقتصاد الاعمال، كلية الاعمال، الجامعة الاردنية.

✉ a.altarawneh@ju.edu.jo
g.alassaf@ju.edu.jo

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