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Full Length Research Paper

External debt and economic growth in Iran

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In this paper, balance relation and the long term of five variables (gross domestic product, private investment, public investment, external debt and imports) and also their influences on each other in Iran for the period of 1974 to 2007, were analyzed. As such, the vector autoregressive model (var) was used. First, stability of variables by the use of dickey-fuller test was examined, after which analysis of Johnson test for considering the convergence among five variables was used. The results of this research showed that the external debt had a negative effect on gross domestic product and private investment. Also, public investment had a positive relation with private investment.

Key words: External debt, private investment, government investment, growth economy, vector autoregressive model (VAR).

INTRODUCTION

External debt has increased steadily in developing countries in recent decades. The analysis of the role of external debt in financing the development process is important. Avramovic (1964) proposed a thesis, which was called the debt cycle thesis. In it, he confirmed that for an economy, characterized by low domestic savings, external debt was considered as an important funding source. Based on predictions of the debt cycle, domestic savings should increase to be able to finance a higher investment proportion in the long run. Also, it should be able to repay the external debt in its first stage of development. However, it seemed that many of the developing countries stopped in the first stage of this debt cycle as the stock of external debt increased and the domestic saving was still low.

New studies, done by Krugman (1988), Sachs (1989) and Cohen (1992), led to the development of the theory of excessive debt (debt overhang). This theory is beyond a certain threshold, in that external debt could decrease consumption and investment, and therefore confine economic growth.

There is a complicated relation between external debt and economic growth. To show whether external debt has a good or bad effect on economic growth, depends greatly on how we make use of it. External debt has played a great role in the promotion of economic development during the last 30 years; for instance, many East Asian economies have benefited from external debt greatly. The external debt has been used in many articles. Anyangah (2009), in his article, titled "Financing investment in environmentally sound technologies: Foreign direct investment versus foreign debt finance", develops a screening model to examine the relationship between alternative sources of private capital and investment in environmentally sound technologies (ESTs). In the model, a polluter (agent) must secure investment funds from the international financial markets in order to upgrade its production and abatement technology. The requisite capital can be obtained via either market loans (debt finance) or foreign direct investment (FDI). Under debt finance, the foreign financier supplies only capital and the relationship between the two parties is more in 'arms-length'. By contrast, under FDI, the investor delivers both capital and managerial skills. They use the model to derive the implications of debt finance for optimal investment decisions and compare them to those obtained under FDI. Investment incentives are more pronounced under debt finance.

Michael et al. (2010), in their article titled "Foreign currency debt, financial crises and economic growth: A long-run view", studied the effects of foreign currency debt on currency and debt crises, its indirect effects on

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short-term growth and its long-run output effects in both the periods of 1880 to 1913 and 1973 to 2003 for 45 countries. Greater ratios of foreign currency debt to total debt are associated with increased risks of currency and debt crises, although the strength of the association depends crucially on the size of a country's reserve base and its policy credibility. They found that financial crises, driven by exposure to foreign currency, resulted in significant permanent output losses. They estimate some implications of their findings for the risks posed by currently high levels of foreign currency liabilities in Eastern Europe.

Hoa and Robert (2006) investigated the role of foreign currency denominated debt (FCDD) as a natural hedging instrument, using a sample of Australian firms. Their results show that the incidence of foreign debt use among industrial sector firms is associated with a lower level of exchange rate exposure. The practice of issuing foreign debt within the industrial sector also conforms better to the hypothesis that firms do so to satisfy a demand for hedging. In contrast, although the incidence of foreign debt issues is higher in the resource/mining sector, the underlying motive for such arises from a demand for financing.

Keunsuk et al. (2010) investigated the determinants of foreign borrowing costs in a stochastically growing economy. They found that these increase with the debt-wealth ratio, depending on the volatilities of domestic and foreign origin, and the length of debt contract. In addition, the sensitivity of the short-term debt supply to the debt wealth ratio exceeds that of the long-term debt, and the effects of volatility on the borrowing premium, growth of wealth, and its volatility, depending on the relative size of a direct effect and a secondary portfolio-adjustment effect of the initial shock, as well as the length of the debt contract. Panel regressions suggest that the empirical evidence generally support the theoretical predictions.

Karin (2009) derives optimal public spending and the resulting optimal deficit and debt in an optimal control framework when the government seeks to maximize the utility of constituents in the presence of the external revenue that cannot be influenced by the government directly, but is contingent on public revenue and debt. He found that in this context, a policy of running budget deficits and accumulating debt becomes optimal. In simulations, he characterizes the size and the path dependency of the optimal deficit and debt.

Michael and Christopher (2006), in their article titled "The role of foreign currency debt in financial crises: 1880 to 1913 versus 1972 to 1997" show that exposure to foreign currency debt does not necessarily increase the risk of having a financial crisis. Some countries do not suffer from financial fragility despite original sin. Before 1913, the British offshoots and Scandinavia, afflicted with it, avoided financial meltdowns. Today, many advanced countries have original sin, but few have had crises. In both periods, aggregate balance sheet mismatches are associated with a greater likelihood of a crisis. The evidence suggests that foreign currency debt is dangerous when miss-managed. This is part of the difference between developed countries and emerging markets both of which borrow in foreign currency.

Hing-Man (1999) studies foreign debts of newly industrializing countries (NICs). These countries develop by imitating foreign technology and exporting goods that are lower than the 'quality ladder'. Differentiated by quality differences, such goods are often substitutes to those exported by advanced countries in the west. As NIC incomes increase, their consumers seek to smooth their consumption over time. The novelty of this study's finding is that NICs borrow from abroad only when these goods are substitutes, but they would not have done so had the goods been complements. The intuition, obviously yet ignored in the literature, is the opposite terms of trade effects arising from substitutes and complements in consumption. Most papers in the 'growth debt' literature adopted the Romer and Lucas steady-state framework. They concentrated on issues, such as population growth and foreign debt, but neglected the imitation-growth debt relation. A simple theoretical model is devised to fill this gap in the literature.

DATA AND METHODOLOGY

We used the data collected from Iran in the period of 1999 to 2006. These data were found in the Central Bank of Iran. One vector autoregressive (VAR) model, which possesses k as an exogenous variable and p as the inhibition of time for each variable in the shape matrix, is shown as follows:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + U_t,\ U_t \sim IN(0,\Sigma)$$

In this relation, Y_t and its lags, k×1 vectors, are related to the model's variables. A_i , I = 1, 2 ,..., p are the coefficients of the model for k × k matrix, and U_t, k × 1 vector is related to the terms of the model's error.

At this point, in linking the short term behavior of Y_t to the long term balance values, we can bring the aforementioned relation as the vector error correction model as follows:

$$\Delta y_t = \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \cdots + \beta_{p-1} \Delta y_{t-p-1} + \pi y_{t-p} + u_t$$

where:

$$B_i = -(I - A_1 - A_2 - \cdots - A_p)\ ,\ I = 1,2,\ldots,p\text{-}1$$

and

$$\pi = -(I - A_1 - A_2 - \cdots - A_p)$$

However, matrix π contains information of the long term balance variables.

We follow the Johansen approach in determining the long-run relationships. Patterson (2000) and Doornik and Hendry (2001)

Table 1. Variable definitions and descriptions.

Variable	Description
Yp	Real per capita GDP
IMPO	Nominal imports of goods and services. No distinction is made between imports for consumption and imports for industrial use. Imports are used as a proxy for trade openness
DEBT	Net external loans to the government
PINV	Private investment, obtained by deducting government investment (GINV) from gross fixed capital investment
GINV	Government investment proxied by total capital or development expenditure of the central government

Table 2. ADF tests for unit roots**.**

Variable	ADF	Critical value (%)			Lag
		1	5	10	
PINV	-0.65	-3.62	-2.95	-2.61	0
GDP	-2.03	-3.62	-2.95	-2.61	1
GINV	-1.33	3.62	-2.95	-2.61	0
IMPO	-0.96	3.62	-2.95	-2.61	0
DEBT	-1.77	3.62	-2.95	-2.61	4

provide a full treatment of the issues involved in this method. The first step is to estimate the VAR in levels with an appropriate lag structure, while the next stage involves determining the cointegrating rank, that is, the number of long-run equilibrium relationships or cointegration vectors among the variables. Finally, to allow a reasonable interpretation of the results, cointegration vectors are identified.

Theoretical principles

The model which is used for investigating the effect of external debt on economic growth is inspired from the propounded model in Amanja D and Morrissey O(2005)'s paper. This model is defined as:

$$Y_p = \beta_0 PINV + \beta_1 GINV + \beta_2 DEBT + \beta_3 IMPO$$

where: Y_p is the real per capita GDP; PINV is private investment; GINV is government investment; DEBT is the external debt; and IMPO is the nominal imports of goods and services.

FINDINGS AND DISCUSSION

The previous formulation is used to estimate a VAR model containing five variables (Table 1). In order for it to fit into the VAR pattern, first, it is necessary to investigate the persistency of variables. One of the common examinations which are nowadays used for recognition of the persistency of the one time series process is the unit root test. This examination can be done in two ways: Dickey fuller's test and Dickey fuller's generalized test.

The results of the test for the variables in levels are presented in Table 2. The results show that all the variables have a unit root in their levels and are stationary in their first differences, implying that they are integrated into order one, that is, I (1).

After the investigation of the persistency of variables, one of the important stages in the evaluation of the vector regression model is choosing the rank of pattern (magnitude of lag should be inserted in equations). For choosing the optimum rank of pattern, the criterion of Akaike or Schwarz can be used. The lag which is mostly given to the model is 2, and considering Table 3, the least quantity of Schwarz or Akaike statistic is prepared in the first lag. As such, we can indicate that the optimum lag of the VAR model is equal to 1 in Table 4.

Now, the VAR model is evaluated with one lag for each variable, and a step is taken towards improving the estimated equations, since adding the lag of variables usually did not improve the removal of problems like: Serial auto correction, abnormal deranging sentences, non homoscedasticity or specification of the function's shape. Particularly, the higher lag of variables is meaningless from the statistical perspective. So, the figurative variables can be used for improving the model. Therefore, the livestock's variables of the revolution process and petrol crisis of 1973 were added to the model. However, entering these variables into the model did not create problems of auto correction and co-linearity In this article, vectors and accumulated vectors among variables of gross domestic product, import, public investment, private investment and external debt were followed by the use of Johansson's method. Considering the stationary test, variables which are under consideration are I (1). In Johnson's method, after doing necessary calculations for studying the existence of

Table 3. ADF tests for unit roots.

Variable	ADF	Critical value (%)			Lag
		1	5	10	
DPINV	-2.88	-3.62	-2.95	-2.61	0
DGDP	-3.91	-3.62	-2.95	-2.61	2
DGINV	-3.11	3.62	-2.95	-2.61	0
DIMPO	-4.03	3.62	-2.95	-2.61	0
DDEBT	-4.68	3.62	-2.95	-2.61	0

Table 4. Determination of the magnitude of lag for the VAR model.

Schwarz information	Akaike information	Lag
145.5	144.70	0
142.38	138.34	1
143.36	140.94	2

Table 5. Test statistics for cointegration of ranks (Trace tests).

Null	Alt	Critical value	λ_{trace}	Probe
r=0	r≥ 1	69.82	107.06	0.000
r≤ 1	r ≥2	47.86	47.68	0.052
r≤ 2	r≥ 3	29.80	18.12	0.56
r≤ 3	r≥ 4	15.49	7.62	0.51
r≤ 4	r≥ 5	3.84	0.02	0.88

Table 6. Test statistics for cointegration of ranks (Max tests).

Null	Alt	Critical value	λ_{max}	Probe
r=0	r ≥ 1	33.88	59.38	0.000
r ≤1	r ≥ 2	27.58	29.56	0.0275
r ≤ 2	r ≥ 3	21.13	10.49	0.697
r ≤ 3	r ≥ 4	14.26	7.61	0.42
r ≤4	r ≥ 5	3.84	0.02	0.88

convergence, we use two criteria consisting of λ_{max} and λ_{trace}. If the existence of convergence among variables is verified, then it can be said that balance and long term relation among variable is established.

The results which are concluded from the examination of the effect and the maximum specific values for determination of accumulated vectors among the model's variables are presented in Tables 5 and 6. Likewise, the results of the maximum specific values for determination of the magnitude of accumulated vectors are reported in Table 5.

The magnitudes of vectors which are prepared by the statistics of the examination effect matrix are equal to 1, while the vectors and magnitudes of vectors which are prepared by the statistic of the maximum specific values are equal to 2. Considering that the examination of the maximum specific values is stronger than the examination of the effect matrix and the determination of the magnitude of accumulated vectors, the examination of the maximum specific values is used. Considering the results of Tables 5 and 6, in the level of 90% probability, the magnitude of the long term relations among the compatible patterns of variables with the economic theory is determined as equal to 2 (r = 2).

As Harris (1995) indicates, the estimated vectors, which present the accumulated space, have no information about the economic long term relations. So finding a collection of unique vectors in this space limitation should be exerted because of the economic

Table 7. Cointegration of vectors.

Variable	Vector 1	Vector 2
GDP(-1)	1.0000	0.0000
PINV(-1)	-2.42 (-14.3)	1.0000
IMPO(-1)	0.58(2.33)	0.458(2.72)
GINV(-1)	-2.98(-4.1)	4.004(8.35)
DEBT(-1)	0.25(2.03)	-0.44(-5.48)
DUM3(-1)	0.000	0.21(11.31)
C	-0.92	

analysis. In other words, Johnson's method determines only the rank of the matrix effect of $\beta\alpha$, but for examining the existence of specific elements in α, an exertion of limitation is required (Dickey et al., 1995). Therefore, it is necessary to exert limitation based on the economical theoretical principles or any kind of previous information out of the pattern of coefficient of cointegration vectors, in order to present a balance in the long term of relations to be recognized.

Under this circumstance (existence of 2 accumulated vectors), we require two independent limitations for the exact recognition of each of these relations. The exerted limitation, according to theoretical principles, consists of an estimation of the accumulated equations:

B (1, 1) = 1, B (2, 1) = 0
B (2, 2) = 1, B (1, 6) = 0

In Table 7, the number inside parentheses is the statistic of accounting for the estimated coefficients of all variables in a meaningful level. Thus, 5% is significant from the statistical aspect.

Considering the prepared results within the investigated period, the variables of private and public investments had a positive effect on growth rate, while the variables of import and external debt had a negative effect on growth rate. Also, the variable of public investment had a positive effect on private investment, while the variables of import and external debt had a negative effect on private investment.

According to results, with an augmentation of one percent in the ratio of private investment to GDP and public investment to GDP, the growth rate will increase by 2.98 and 2.42%, while with an augmentation of one percent in the rate of import and foreign loan, the growth rate will decrease by 0.25 and 0.58%, respectively. Also, with 1% augmentation, and with 0.44% augmentation in one percent import growth and ratio of public investment to GDP, the ratio of private investment to GDP decreased by 4.004 and 0.458%. In the estimated marginal model of growth, coefficients of investment for the private and government sector GDP ratio, which present the marginal productivity of investment in these two sectors, are in the order of 1.19 and 4.93. When considering the statistics of t in the level of 5%, these values are significant from the statistical perspective. Therefore, investments of these two sectors have influenced the per capita rate growth of GDP. This shows that investment and activities of the private sector, in spite of some problems, had an effect on the economic growth of the country.

Conclusion

This paper analyzes the effects of external debt on the economic growth in Iran. These effects were analyzed using the vector autoregressive model (VAR). This study focused on the period of 1974 to 2007. The results showed that external debt and imports have a negative effect on economic growth. Also, variables of private and public investments had a positive effect on economic growth.

Furthermore, the variable of public investment had a positive effect on private investment, while the variables of imports and external debt had a negative effect on private investment.

Foreign loans had a negative effect on economic growth and a positive effect on the investment of the private sector. This can be as a result of the optimum volume in using loans that were not based on the absorptive capacity of the country because these extra resources have entered the speculation channels. So, with an augmentation in loans, investment is accomplished more. Also, extra resources can enter the speculation channels. For this, it can have an inverse effect on economic growth. Another reason is that loans must be invested in economics parts, which have a higher efficiency than loan interest rate. Moreover, these loans should be able to supply enough exchange to repay debt. So, if the interest rate of the loans is more than the efficiency of investment, investment will be accomplished but in an unsuccessful way.

Also, public investment has a negative relation with private investment. Consequently, in the economy of Iran, public investment could not make the private sector increase its activity. This can be as a result of lack of necessary infrastructure in developing an efficient activity for the private sector.

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