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Research Article

The study of the effective factors on investment in private sector in Iran (With emphasis on uncertainty)

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Abstract

Making capital and investment is the main driving forces of economic development. Based on the investment sensitivity to the changes of some of macro-economic variables and risk and uncertainty, the present study evaluated the effective factors on investment in private sector in Iran during 1980-2007. At first, the uncertainty variables of real informal exchange rate, nominal interest rate and inflation rate were calculated by GARCH model. Then, by ARDL model, the effect of calculated uncertainty indices besides the main values of the variables and some of the other control variables on investment in private sector in Iran was investigated. The estimation results showed the negative uncertainty effect of the real exchange rate, inflation rate and nominal interest rate on investment in private sector in short-term and long-term. Also, the gross domestic production and inflation rate had significant and positive and negative effect, respectively on investment in private sector in Iran. In this model, there was no relationship between the size of civil expenditures of the government and real exchange rate with the private sector investment in our country. The error correction term coefficient showed that moderation to balance is done during more than 3 years.

Keywords : Investment in private sector; Uncertainty of real exchange rate; Uncertainty of nominal interest rate; uncertainty of inflation rate; GARCH; ARDL.

1 Literature review

The experience of the developed countries showed that the main factor of their economic development is investment [18]. The investment was sensitive to the change of policies and reacted rapidly [1, 5]. Various factors including monetary and financial, political and structural variables affect the investment process and finally economic growth of the country [8]. Various researches are conducted regarding the theories and models of investment from the researchers and economic experts in Iran. Generally, it is in an ideal condition without any uncertainty to future, uncertainty is one of the important effective factors in this regard. Uncertainty by deviating the saving decisions and investment of economic enterprises and households is one of the important costs of effective variables on investment. By increasing uncertainty, costs estimation and future incomes of activities are not transparent and this has unsuitable effects on allocating the resources and efficiency of economic activities. The high uncertainty degree in economy leads to the increase of opportunity costs and good private investment is reduced [12]. Based on

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the lack of studies conducted about the simultaneous effect of uncertainty of some variables on investment in private sector in Iran, we investigated this issue in the present study. The present study is organized as followings: At first theoretical basics and the studies are expressed, then the uncertainty model of the variables is estimated by Generalized AutoRegressive Conditional Heteroskedasticity (GARCH). In the next stage, the relationship between variables uncertainty and investment of private sector were estimated by autoregressive distributed lag (ARDL). Finally, the data analysis and conclusion were discussed.

Flexible Acceleration Theory

After Keynes (1936) considered investment as the direct function of market interest rate, investment function was investigated from the view of various effective factors on it. The acceleration theory considers investment a linear ratio of the production changes. The simple acceleration model assumes that the ratio of capital to product is constant value as net investment is the ratio of product growth, $\Delta K_t = \alpha \Delta Q_t$. This simple form of acceleration theory showed the weak results. As the ratio of capital to product is different in different economic systems or inside a system from time to time or in various regions. Based on the mentioned problems, flexible acceleration principle is presented with the inventory moderating theory in which real net investment is considered ratio of required investment to achieve the inventory of good capital, K_t^*. Thus: $K_t - K_{t-1} = \beta(K_t^* - k_{t-1})^{(*)}$ Where, β is adjustment coefficient. If it is assumed the capital to product determines the good volume of capital, we have : $K_t^* = \alpha\varphi_t$. Thus: $K_t = \beta K_t^* + (1-\beta)K_{t-1}$ By repeated placing for the values or lag K_{t-1} , a term for K_t is obtained as followings:

$$K_t = \alpha\beta \sum (1-\beta^i) Q_{t-j}$$

gross investment It is equal to the net investment plus the capital inventory depreciation in the previous period, it means that $I_t = \Delta K_t + D_t$, on the other hand, capital volume at the end of period is equal to capital volume at the beginning of period plus gross investment minus depreciation. It means that : $K_t = K_{t-1} + I_t - D_t$. Thus, it can be said that depreciation is consistent with the present capital inventory. It means that : $D_t = \delta K_{t-1}$, thus, we have: $I_t = K_t - (1-\delta)K_{t-1}$ The latter equation with the partial adjustment capital (equation *) shows gross investment as followings [25]:

$$I_t = \beta K_t^* - (\delta - \beta)K_{t-1}.$$

In the developing countries including Iran with its different cultural, social, economic and environment, major part of investment is not explained by investment behavior model. Thus, in identification of the effective factors on private investment, two variables, one with theoretical basics and another is empirical study in the third world countries with emphasis on the special features of Iran. Most of the researches conducted regarding the private sector investment function in developing countries as Green and Villanueva [10] and Dehn [7] is adjusted form of flexible acceleration model and sometimes is called partial adjustment model. Thus, by considering the flexible acceleration function and adding some other variables, we investigated the private investment function [13].

Uncertainty of exchange rate, interest and inflation

The effective factors on investment are divided into known and unknown and the known factors sometimes are not measured [11]. The present study attempted to evaluate the factors that are measurable and have the greatest effect on investment and is significant in applied model. Instability of exchange rate leads to the increase of uncertainty and it leads to the increase of commercial activities risk and finally the reduction of trading volume and Clark and Baron in their study referred to the negative relation [6]. If exchange rate has more fluctuations, the exporters and importers during the contract conclusion has no exact image of the revenue of export and import costs to the domestic money. The exchange value of export and import goods are known during the contract conclusion and as there is a distance between receiving export revenue or to selling the importing goods, the exchange rate fluctuations can affect the value of export goods and import goods costs (to national money) and the revenues and expenditures can easily have considerable and unexpected difference with the trading time. The wide real exchange fluctuations

as the features of the developing countries created uncertain environment for decision makings of private investment. As profitability prediction in commercial and non-commercial sectors and the costs of new capital goods due to high volume of its import are problematic. Indeed, stability of exchange rate leads to the trust in domestic economy environment and the investors easily take decision about investment [13]. High inflation with increase of production has negative effect on private investment. High inflation rate increases the production activities risk and economy trade is with considerable profit and guides the resources from manufacturing activities and investment to the false services, hoarding and early-return commercial activities and private investment is reduced. The most important economic loss of inflation is uncertainty of its value in future periods. Inflation uncertainty is the space in which the decision of economic activists including households, enterprises or state sectors in various fields is with future inflation uncertainty. Uncertainty about future inflation rate creates uncertainty and instability in prices and through this channel can make some changes in economic decisions. In uncertainty space, the economic activists take decisions that are inconsistent with their expectations. Obviously, by the increase of inflation uncertainty, costs estimation and future revenues of activities are not transparent and this can bring adverse effects on allocating the resources and efficiency of economic activities. By the increase of uncertainty of inflation, efficiency of price mechanism in optimal allocation of resources is disturbed and finally will have negative effect on production. Inflation uncertainty by affecting the interest rates , inter time decisions of resources allocation are changed. In a world with nominal stickiness, uncertainty of inflation changes real costs of production and relative price of the final goods and inter-time allocation of the resources is affected. Thus, the costs of inflation uncertainty affect the inter-time and intra-time allocation of the resources [20] .It is expected that investment to the changes of interest rate shows reaction inversely. It should be considered that interest rate relation and investment demand in Iran economy has more uncertainty compared to the developed economies. The uncertainty is mostly due to the unreal and imbalanced nature of formal earnings rates and their more difference with the informal interest rates and credits rationing. Although, high profit rate means high rent cost of capital, in Iran, this rate doesn't show the real cost of capital. Namely, in most years, the real profit rate is negative [15].

2 Literature review

In a study done by Green, Villanueva [10] titled "Private investment in developing countries", effective factors on private investment are investigated in 22 countries and it is shown that inflation rate had negative association with investment of private sector. Serven [22] in a paper titled "Uncertainty of macro economy and investors in private sector in LDCs (applied study)" "investigated the relationship between investment and macro economy uncertainty by the set of time series data including 94 developing countries. The results showed negative relation between uncertainty of 5 variables (inflation, commercial periods, real exchange rate, growth and capital goods price) with private sector investment. Serven [23] in a paper titled "uncertainty of real exchange rate and investment of private sector in developing countries" showed that uncertainty of real exchange rate had negative and strong effect on private sector investment. Badawi [3] in a paper "form of private sector investment and uncertainty policies in Sudan: by VAR model" emphasized on state investment, credits, reduction of money and interest rate policies. The results showed that increasing real interest rate had negative effect on private sector investment. Serven and Naxey [24] in a study empirically investigated the relationship between real exchange rate uncertainty and private investment in developing countries. The results showed the negative and severe effect of real exchange rate uncertainty on private investment. Ahmad and Qayyum [2] in a paper " the effect of uncertainty of macro-economic variables on private sector investment in Pakistan "investigated the uncertainty effect of macro-economy variables in investment in private sector in Pakistan. The estimation results showed the negative effect of uncertainty of macro-economic variables including real interest rate and their instability on investment in private sector. Escaleras and Thomakos [9] in a paper" uncertainty of real exchange rate, social and political instability on private sector

investment: Latin America" found that the effect of uncertainty of real exchange rate on private sector investment is negative.
Kazeruni and Dolati [13] in a paper "the effect of uncertainty of real exchange rate on private sector investment" investigated the relationship between uncertainty of real exchange rate and investment in private sector in Iran during 1962-2003. The estimation results showed the negative effect of uncertainty of real exchange rate on investment in private sector in short-term and long-term. Moradpour Oladi, Ebrahim and Abasion [16] in a paper "study of the effect of uncertainty of real exchange rate on investment in private sector" investigated the fluctuations of real exchange rate and uncertainty of it on private sector investment. The results showed that uncertainty of real exchange rate had negatively considerable effect on private sector investment. Also, interest rate and inflation rate had negative effect on investment in private sector. Safdari and Purshahabi [21] in a paper" the effect of uncertainty of inflation on economic growth of Iran" investigated the relationship between inflation and economic growth of Iran by considering the uncertainty of inflation. The results of the study showed that by the increase of inflation, inflation uncertainty is increased and leads to the reduction of investment in private sector in Iran economy and this issue had long-term negative effect on economic growth rate of the country. Karshenasan [14] in a paper "the study of uncertainty of macro economy and its effect on private investment in OPEC countries" The effect of uncertainty on macro economy on investment decisions of private sector was investigated in a selection of the state's member of OPEC (e.g. Aljazeera, Indonesia, Iran, Nigeria and Venezuela) during 1970-2001. For indexing uncertainty of macro economy, five key economic variables including inflation, real exchange rate, exchange relation, relative price of capital goods and gross domestic product development were applied. Of the designed uncertainty indices, uncertainty index of real exchange rate had negatively significant effect on private investment and uncertainty index of inflation had no significant effect on private investment.

According to the researches done in Iran, uncertainty of macro-economic variables was investigated one by one. These variables are uncertain at the same time. The present study evaluated the relationship between uncertainty variables with investment in private sector by time series of the variables in Iran.

3 Presenting the model

For the first time in Iran, Hadian and Samadpour [11] in a paper "effective factors on investment in private sector in Iran" investigated the effect of uncertainty of exchange rate on investment in private sector and various researches were conducted later in this regard. There is no study regarding the simultaneous effect of uncertainty of exchange rate, interest rate and inflation rate on investment in private sector in Iran. In this study, it is attempted to estimate adjusted form of flexible acceleration model of investment and besides the common variables of the model, include some other variables as uncertainty of exchange rate, uncertainty of inflation rate and uncertainty of interest rate. The investment function of private sector in the study was as:

$$PI = F(RER, IR, INF, GDP, \frac{G}{GDP}, RERU, IRU, INFU)$$

In the above function, the variables from the left to right show the investment expenditures of private sector, real exchange rate, interest rate, inflation rate, gross domestic product, ratio of civil expenditures on gross domestic product, uncertainty of real exchange rate, uncertainty of interest rate and uncertainty of inflation rate.
The data of the study were collected by library method, statistics and information of central bank of Islamic Republic of Iran. In this study, the variables were real and the basic year was 2005. Some of the variables were as growth rate. To calculate the real exchange rate (RER), nominal exchange rate of informal market was used. The calculation of the variable is as:

$$Real\ Exchange\ Rate = Nominal\ Exchange\ Rate \times \frac{CPIAmerica}{CPIIran}$$

(Price index of consumer =CPI)

To calculate inflation rate variable (INF),

consumer price index is used as:

$$INF = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} \times 100$$

Although using real interest rate is correct, due to using inflation rate variable, nominal interest rate is used.

3.1 Unit roots

In time series analyses, before anything we should investigate the stationary or non-stationary time series. If the time series is not stationary, the regression is spurious. Unit root tests are the most important tests to estimate a regression with reliability coefficient. In this study, to evaluate the stationary and reliability of time series, unit root test, Augmented Dickey-Fuller test, Perron and KPSS are used and the results are shown in the Table 1.

According to Perron (1989), the results of the above tests can be biased in case of structural break in data, in the Table 2 by unit root tests of Zivot & Andrews (with the ability of considering endogenous structural break) and Lumsdaine -papell (with ability of two structural endogenous break), the collective degree of the variables is investigated. The results of Zivot & Andrews test showed that INF,GDP variables by considering endogenous structural break at the level 99,95% are reliable. The results of Lumsdaine -papell test showed that the variables had no endogenous structural break.

3.2 The introduction of uncertainty model of real exchange rate, nominal interest rate and inflation rate

In this Section, to obtain the most suitable model of ARCH or GARCH, Akaike criteria (AIC) and Schwarz-Bayes Criterion (SBC) were used. To estimate the uncertainty model of three variables, Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) is used. Before estimation of uncertainty model, at first the initial model of the variables is presented. According to Box-Jenkins method, the best model that is obtained to describe the variables behavior is as followings:

$$D(RER) = 10.02212 + 1.097601AR(1) -$$

$$0.454981AR(2) - 0.872276MA(1) + 0.57043MA(3)$$

$$(0.032788)(7.218702)(-3.061699)$$

$$(-15.58454)(12.19524)$$

$$D(IR) = 0.211905 - 0.782687AR(1) +$$

$$0.203889AR(5) + 0.629020MA(6) +$$

$$1.530225MA(3)(0.457267)$$

$$(-2.789974)(0.873537)(5.153419)(9.684018)$$

$$INF =$$

$$15.24223 + 0.404058AR(1) + 0.318018MA(5)$$

$$(4.814901)(2.952270)(2.298621)$$

The reported numbers in the parenthesis is t-statistics.

After showing sequential non-autocorrelation in standardized residuals of three variables and Arch effects test and Heteroskedasticity, the best model in terms of selective criteria of Box-Jenkins GARCH (0,1) for each three variables is obtained. All the estimated coefficients in the model are significant. The results of model estimation GARCH (0,1) are shown in Appendix 4. To apply the fluctuation data of the variables of the model in future estimations, the root unit test is performed on the obtained series. Table 3 shows the results of reliability test of unit root KPSS of uncertainty variables for the model with intercept and without trend.

3.3 The estimation of the coefficients by ARDL method

3.3.1 Estimation of the coefficients in short-term

By selecting lag one, the best selected model is obtained as to the variables of investment expenditures of private sector, nominal interest rate and domestic gross product, one lag and to the rest of variables, no lag is dedicated. In Appendix 4, estimation of short-term coefficients is presented. Based on statistics , explanatory variables explain 97% of the changes of dependent variable. F statistics showed the significance of total regression. The results of diagnosis test, residuals serial auto-correlation, error in specification of function form of the model, normality of residuals and Heteroskedasticity variance showed the suitable studied model to investigate the relations in the variables and none of the assumptions were violated.

Table 1: The results of the reliability of the model with intercept and without trend. $I(0)$ Variable at reliable level, $I(1)$ Variable with once reliable differentiation.

variables	5%*adf*	*Tstati*	*result*	5%*pp*	*Tstati*	*result*	5%*kpss*	*LMstati*	*result*
PI	−2.89	−5.15	$I(1)$	−2.89	−4.68	$I(1)$	0.46	0.16	$I(1)$
RER	-2.89	-3.90	I(1)	-2.89	-4.19	I(1)	0.46	0.16	I(0)
IR	-2.89	-4.75	I(1)	-2.89	-4.72	I(1)	0.46	0.33	I(1)
INF	-2.89	-3.09	I(0)	-2.89	-3.16	I(0)	0.46	0.12	I(0)
GDP	-2.89	-3.94	I(0)	-2.89	-3.82	I(0)	0.46	0.40	I(0)
G/GDP	-2.89	-3.39	I(0)	-2.89	-5.27	I(1)	0.46	0.12	I(0)

Table 2: Results of Zivot Andrews (ZA) unit root tests and Lumsdaine Papell (LP). Critical values of Zivot & Andrews at the level 90,95,99% were determined by Zivot & Andrews as -4.82, -5.08, -5.57, respectively. The critical values of Lumsdaine -papell at the level 90,95,99% were determined by Lumsdaine -papell as -6.49, -6.82, -7.34, respectively.

variables	TB_{ZA}	τ_{ZA}	TB_{1LP}	TB_{2LP}	τ_{LP}
PI	1363	−4.67	1362	1370	−3.92
RER	1378	−3.04	1363	1378	−4.84
IR	1372	−3.96	1369	1373	−2.84
INF	1373	-5.81^{***}	1373	1381	−4.91
GDP	1363	-5.14^{**}	1369	1378	−6.24
G/GDP	1372	−4.38	1363	1379	−3.16

Table 3: The results of KPSS test. Resource: Authors findings.

Variables	Test critical value at 1% level	LM-statistic	Results
RERU	0.73	0.67	$I(0)$
IRU	0.73	0.60	$I(0)$
INFU	0.73	0.66	$I(0)$

The results of dynamic presented model showed that in short-term:
Investment in private sector is affected by itself with one lag and this effect is positively significant. The nominal interest rate in the same period had negative effect and in lag one had positively significant effect on investment in private sector. Inflation rate in the same period had negatively significant on investment in private sector. In the same period, there was no significant relation between real exchange rate and investment in private sector. The gross domestic product in the same period and with one lag had positively significant effect on investment in private sector. In the same period, there was no significant association between the government civil expenditures to gross domestic product (size of government civil expenditures) and investment in private sector. Uncertainty of real exchange rate, nominal interest, and inflation had negatively significant effect on investment in private sector. Based on the trend variable coefficient, the investment in private sector in our country is increasing over time. On the other hand, based on the positive and significant intercept, it can be said that other factors except the factors that are studied in this study affect investment in private sector in Iran.

3.3.2 The estimation of coefficients in long-term

As the collective degree of data is not consistent, to be sure the long-term relation of this method is not spurious, the method of Bannerjee,.Dolado and Mestre [4] is used to show this relation.

$$t = \frac{\sum_{i=1}^{p}(\hat{a})_i - 1}{\sum_{i=1}^{p} S_{(}\hat{a})_i} = \frac{0.700 - 1}{0.064} = -4.68$$

The absolute value of t calculation statistics is more than the absolute value of critical value presented by Bannerjee,.Dolado and Mestre [4], -4.05 at confidence interval 95%. The null hypothesis

regarding the lack of long-term relationship is rejected and its presence is supported [17]. As by ARDL long-term model, the long-term results are extracted, later the long-term coefficients are estimated by ARDL method. In Appendix 4, the estimation of long-term coefficients is presented. All the long-term results supported the short-term results and have the same interpretations.

3.3.3 The estimation of error correction model

Error correction model associates short-term fluctuations of the variables to the balanced long-term values. To determine the error correction model, the error terms of co-integration regression with time lag is put as explanatory variable beside the first rank difference of other model variables and then by OLS method, the model coefficients are estimated. The estimation of error correlation model is shown in Appendix 4. The coefficient of error correction term is significant and -0.29 and it shows each year, 0.3 of imbalance of one period is adjusted in private investment function of the next period. Thus, adjustment is to the balance during 3 years. The estimation results showed that all the variables except real exchange rate and government expenditures rate to gross domestic product is significant and were obtained based on the expectations.

4 Conclusion

In this study, the effect of macro-economic variables including uncertainty of real exchange rate, inflation rate, nominal interest rate on investment in private sector in Iran during 1980-2007 were investigated by ARDL model. According to the results, uncertainty index of real exchange rate, inflation rate and nominal interest rate are consistent with the results of the study of Serven and Naxey [24] Escaleras and Thomakos [9], Ahmad and Qayyum [2] had negatively significant effect on investment in private sector. All the long-term results supported the short-term results. The error correction term coefficient showed that adjustment to balance is done during more than 3 years. Despite the uncertainty of investors due to the risk aversion, nothing is done about investment and the government by taking required policies, secure business space is provided to improve the motivations of investment in private sector and investors by reducing risk start investment.

Appendix 1. Real exchange rate (Estimates of two other variables are available and be provided if need), The absence of serial autocorrelation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.022040	Prob. F(2,40)	0.9782
Obs*R-squared	0.045695	Prob. Chi-Square(2)	0.9774

Arch effects test

Heteroskedasticity Test: ARCH

F-statistic	3.867545	Prob. F(1,44)	0.0556
Obs*R-squared	3.716653	Prob. Chi-Square(1)	0.0539

Estimation of GARCH (0,1)

Dependent Variable: D(RER)
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 08/04/13 Time: 16:43
Sample (adjusted): 1341 1387
Included observations: 47 after adjustments
Convergence achieved after 91 iterations
MA Backcast: 1338 1340
Presample variance: backcast (parameter = 0.7)
GARCH = C(6) + C(7)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	189.9389	353.2355	0.537712	0.5908
AR(1)	1.095394	0.154897	7.071754	0.0000
AR(2)	-0.408103	0.209811	-1.945098	0.0518
MA(1)	-0.868905	0.066751	-13.01706	0.0000
MA(3)	0.558604	0.045434	12.29490	0.0000
	Variance Equation			
C	21426.47	32354.54	0.662240	0.5078
GARCH(-1)	1.026901	0.065340	15.71617	0.0000

R-squared	0.243167	Mean dependent var	10.06455
Adjusted R-squared	0.129642	S.D. dependent var	1182.928
S.E. of regression	1103.589	Akaike info criterion	16.72488
Sum squared resid	48716309	Schwarz criterion	17.00043
Log likelihood	-386.0347	Hannan-Quinn criter.	16.82857
F-statistic	2.141970	Durbin-Watson stat	1.937435
Prob(F-statistic)	0.069501		

Inverted AR Roots	.55-.33i	.55+.33i	
Inverted MA Roots	.74-.60i	.74+.60i	-.61

Appendix 2. The results of short-term estimation

Autoregressive Distributed Lag Estimates
ARDL(1,1,0,0,1,0) selected based on Schwarz Bayesian Criterion

Dependent variable is PI
22 observations used for estimation from 1364 to 1385

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
PI(-1)	.70096	.064876	10.8047[.000]
IR	-.023856	.0059577	-4.0042[.003]
IR(-1)	.068752	.0097046	7.0845[.000]
INF	-.0046191	.6980E-3	-6.6172[.000]
RER	.2979E-5	.5076E-5	.58685[.572]
GDP	.0031923	.6932E-3	4.6049[.001]
GDP(-1)	.0048143	.7080E-3	6.8002[.000]
GI	-.21852	.17706	-1.2341[.248]
IRU	-5.6398	.81033	-6.9599[.000]
RERU	-.3849E-3	.5883E-4	-6.5420[.000]
INFU	-7.2469	1.1014	-6.5799[.000]
C	888.1230	135.1100	6.5733[.000]
T	7.0830	1.0917	6.4881[.000]

R-Squared	.98938	R-Bar-Squared	.97522
S.E. of Regression	.019278	F-stat. F(12, 9)	69.8605[.000]
Mean of Dependent Variable	.46099	S.D. of Dependent Variable	.12245
Residual Sum of Squares	.0033446	Equation Log-likelihood	65.4892
Akaike Info. Criterion	52.4892	Schwarz Bayesian Criterion	45.3974
DW-statistic	1.8125	Durbin's h-statistic	.46162[.644]

Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1)= .37970[.538]	F(1, 8)= .14050[.718]
B:Functional Form	CHSQ(1)= .31751[.573]	F(1, 8)= .11715[.741]
C:Normality	CHSQ(2)= .84263[.656]	Not applicable
D:Heteroscedasticity	CHSQ(1)= 1.1583[.282]	F(1, 20)= 1.1115[.304]

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

Appendix 3. The results of long-term estimation

Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,1,0,0,1,0) selected based on Schwarz Bayesian Criterion

Dependent variable is PI
22 observations used for estimation from 1364 to 1385

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
IR	.15014	.056970	2.6354[.027]
INF	-.015447	.0041614	-3.7119[.005]
RER	.9962E-5	.1790E-4	.55662[.591]
GDP	.026775	.0069698	3.8415[.004]
GI	-.73074	.60980	-1.1983[.261]
IRU	-18.8599	5.5944	-3.3712[.008]
RERU	-.0012870	.3977E-3	-3.2361[.010]
INFU	-24.2339	7.4574	-3.2497[.010]
C	2969.9	914.6233	3.2472[.010]
T	23.6861	7.3670	3.2151[.011]

Appendix 4. The results of ECM

Error Correction Representation for the Selected ARDL Model
ARDL(1,1,0,0,1,0) selected based on Schwarz Bayesian Criterion

Dependent variable is dPI
22 observations used for estimation from 1364 to 1385

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
dIR	-.023856	.0059577	-4.0042[.002]
dINF	-.0046191	.6980E-3	-6.6172[.000]
dRER	.2979E-5	.5076E-5	.58685[.569]
dGDP	.0031923	.6932E-3	4.6049[.001]
dGI	-.21852	.17706	-1.2341[.243]
dIRU	-5.6398	.81033	-6.9599[.000]
dRERU	-.3849E-3	.5883E-4	-6.5420[.000]
dINFU	-7.2469	1.1014	-6.5799[.000]
dC	888.1230	135.1100	6.5733[.000]
dT	7.0830	1.0917	6.4881[.000]
ecm(-1)	-.29904	.064876	-4.6094[.001]

List of additional temporary variables created:
dPI = PI-PI(-1)
dIR = IR-IR(-1)
dINF = INF-INF(-1)
dRER = RER-RER(-1)
dGDP = GDP-GDP(-1)
dGI = GI-GI(-1)
dIRU = IRU-IRU(-1)
dRERU = RERU-RERU(-1)
dINFU = INFU-INFU(-1)

dC = C-C(-1)
dT = T-T(-1)
ecm = PI -.15014*IR + .015447*INF -.9962E-5*RER -.026775*GDP + .73074*GI + 18.8599*IRU + .0012870*RERU + 24.2339*INFU -2969.9*C -23.6861*T

R-Squared	.97561	R-Bar-Squared	.94308
S.E. of Regression	.019278	F-stat. F(10, 11)	35.9969[.000]
Mean of Dependent Variable	-.1582E-3	S.D. of Dependent Variable	.080805
Residual Sum of Squares	.0033446	Equation Log-likelihood	65.4892
Akaike Info. Criterion	52.4892	Schwarz Bayesian Criterion	45.3974
DW-statistic	1.8125		

R-Squared and R-Bar-Squared measures refer to the dependent variable dPI and in cases where the error correction model is highly restricted, these measures could become negative.

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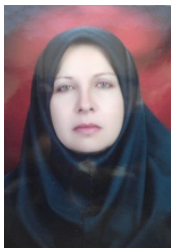

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