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An Empirical Analysis of Imports of Iran: Are Imports, Exchange Rate and Gdp Cointegrated?

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Abstract
This paper investigates the effect of exchange rate and other variables such as world GDP, domestic GDP and Inflation on Iran's Imports using cointegration method suggested by Gregory and Hansen. The empirical analysis indicates that there is a long run relationship between imports and these variables as they are cointegrated and there is an evidence of a structural shift during 1995. The empirical results indicate that the variables have expected signs. In view of these findings some policy suggestions have been made.

I. Introduction

Since the advent of the floating exchange rate system in the early 1970s, and the trade liberalization during 1990s, there has been an extensive debate about the impact of exchange rate and other macro variables on imports of a country. Despite the availability of vast literature, only a few papers provide statistically convincing evidence on this relationship. Iran has been experiencing deterioration in its exchange rate coupled with volatility, and lesser economic performance due to structural problems and exogenous factors such as economic sanctions, in spite of being oil rich. Starting from the late 1950s to the mid 1970s the country has been experiencing a rise in its imports. During this period and particularly after 1973, the oil prices have risen resulting in an increase in national income. During this period imports also have risen due to the removal of several restrictions. However, during war period, due to the problem relating petroleum exports foreign exchange has dwindled and also the import capacity. Shortly afterwards, imports have increased as the reconstruction of the economy has started and due to the trade liberalization policies. But during the years, 1993 and 1994, the imports have decreased due to restrictive atmosphere. During 1995-1996, government set the limits on imports with less intensity; furthermore, it increased oil price and foreign exchange incomes, consequently the amount of imports have risen again. In 1997 along with decreasing the global oil price, the value of imports decreased by 6.1% and mounted to 13633 million dollars. This trend continued up to the year 1999, but since 2000 the global oil price along with redemption and decrease of the restriction of import policies, imports have continued to increase. In brief, the imports of Iran were experiencing a rise with fluctuations due to internal and external factors.

The present study is pursued with the objective of studying the impact of real effective exchange rate (REER), Domestic GDP, World GDP and Domestic Inflation on the Imports of Iran. The paper is structured into five sections. A brief review of the earlier studies has been presented in the section two and the third section presents the data and empirical model used in the study. Empirical findings are presented in section four and the final section deals with conclusions and policy suggestions.

II. Brief Review of the Earlier Studies

A review of empirical works on effects of changes in real exchange rate and world GDP and other domestic factors can answer the question that whether the policies relating these variables have helped the growth of the economy or not. For example, a group of economists believe that devaluation can reduce the imports resulting in an increased domestic production in the country. But a group of empirical studies have confirmed the effects of Shrinkage devaluations of national economy. On the other hand effects of changing the official exchange rate on imports, although it can provide information to analysts but cannot represent all the facts[1].

Alam and Ahmad (2010) have estimated the import demand function for Pakistan using quarterly data for the period 1982-2008 in an ARDL framework. They suggest that there exists a long run relationship among, import demand, real economic growth, and relative price of imports, real effective exchange rate and volatility of real effective exchange rate. The study also suggests that in the short run, the real economic growth, relative price of imports, real effective exchange rate and real effective exchange rate volatility Granger cause import demand. Samimi, Adibpour et al (2012) have studied the effect of real exchange rate uncertainty on import demand of Iran for the period 1979-2007 and have concluded that the real exchange rate uncertainty had negative impact and , the GDP had a positive impact on imports. However, despite the large number of studies conducted, no real consensus has emerged regarding the impact of exchange rate volatility on trade flows. The empirical evidence and results depends on the choice of sample period, model specification, proxies for exchange rate volatility, and countries considered (Chongcheul et al., 2004). There are only a few studies on effect of exchange rate volatility on Iran's import, for example Mohammadi and Taheri (2008), and Mohammadi and Mohammad zadeh (2007) investigate the influence of exchange rate volatility on Iran's trade and found a significant and positive effect. The review of the literature suggests that the studies on imports of Iran and its various determinants are limited and there are not many studies on cointegration involving these variables particularly using Gregory – Hansen method. The present study tries to fill this gap.

III. Data and the Econometric Model

The present study exclusively depends on secondary sources of data collected from various sources. The data on exchange ratse, and the GDP of Iran's major trade partners have been collected from various issues of International financial statistics (IFS) published by IMF. The data on value of imports have been collected from the annual reports and balance sheets of the Central bank of Iran. The study period chosen for the empirical analysis is 1962-2011. All the variables are in real terms and have been transformed in to their natural logarithms. In computing foreign economic growth (the growth of GDP of the major trading partners of Iran) and the real effective exchange rate (REER) , the macro economic data of the countries such as India, Japan, united Arabic emirates (UAE), France, Canada, Italy, Turkey, Denmark, Switzerland, Belgium, Germany, Britain, Austria, Pakistan, China and Korea have been used as these countries constitute the major share of Iran's foreign trade (56%). Using the following methods both REER and world GDP have been computed:

$$\mathrm{REER_j} = \frac{\sum_{t=1}^{11} w_t * E_t * P_t}{P_j} (1)$$

Where:
-$REER_j$ is real effective exchange rate in year(j)
-W_i is share of country (i) in Iran's foreign tread in year(j)
-E_i is official exchange rate of country (i) in year (j)
P_i is The consumer price index in the country(i) In the year (j)
-P_j is The consumer price index of Iran in the year(j)

To compute the World GDP variable, we have used the GDP of Iran's major trade partners. We have collected the data on GDP of each country in terms of their domestic currency and converted it into the dollar terms based on the official exchange rates, and computed the total world GDP. This has been again converted in to Iran's domestic currency, Rial, using the official exchange rate and finally it is deflated by using CPI index.
To verify the determinants of imports, we have used time series methodology which includes two stages:
As most of the time series economic relationships present spurious relations among the variables, testing for the presence of unit root in the variables is a must. In stage one,all the variables are tested for the presence of unit roots in the variables using Augmented Dickey Fuller (ADF) test as it is a popular method of testing unit roots in variables. In the second stage, if the variables are found to be I(1), i.e. is integrated of order one, then they are tested for the cointegration among the variables using Gregory and Hansen cointegration methods.

Unit root test with structural changes

In cases where structural change is not only a quantity of intercept of function is changes but it also affects the slope. For the unit root test, the null hypothesis can be written in the following pattern:

$$H_0: y_t = \mu_1 + dDTB + (\mu_2 - \mu_1)Du + y_{t-1} + u_t$$

Where, (DTB) and (DU) are virtual variables

Alternative Hypothesis is written as a following pattern, in which the time series y_t, is a stationary time series, around a deterministic time trend.
But after structural break not only intercept the function of time trend will be change, but also changes its slope.

$$H_1: y_t = \mu_1 + (\mu_2 - \mu_1)Du + Bt + (B_2 - B_1)DT_t + u_t \quad (2)$$

DT_t is a dummy variable that quantity for the years of t> TB is
$DT_t = t$ and is zero for other years.
Now to test the null hypothesis against the alternative hypothesis both the null hypothesis and alternative hypothesis brought together and estimated.

$$y_t = \alpha_0 + \alpha_1 \mathrm{Du} + dDTB + Bt + \gamma DT_t + \rho y_{t-1} + \sum_{i=1}^{p} \theta \Delta y_{t-1} + e_i \quad (3)$$

Assuming the validity of the hypothesis "unit roots exist" are expected to:

$$d \neq 0 , B = 0 , \gamma = 0 , \rho = 1$$

But if the alternative hypothesis is correct, we would expect the following parameters:

$$\alpha_1 \neq 0 , d = 0 , b \neq 0 , \gamma \neq 0 , \rho < 1$$

With the estimated regression equation and according to this issue that the validity of the hypothesis H_0, statistic test t is related to coefficient

y_{t-1}has a partially distributed time series can be a test of instability of time series y_t in the presence of a structural break.

Testing for cointegration: Gregory – Hansen Method

In this case a general form of cointegration,, and the existence of only one structural break in the vector cointegration has been considered . The null hypothesis of this is same as the other tests but the alternative hypothesis is different. In this method, a cointegration test based on residual sentences is considered and the method estimates shift points.

Gregory - Hansen test statistic to extract themselves from the usual convergence regressions have the following:

$$Y_{1t} = \alpha + \beta y_{2t} + e_t \ , \qquad t = 1, \ldots, T \ (4)$$

Where (y_{2t}) is a vector (m) variable and I(1), and (e_t) is a variable I(0) is assumed. In this tests, different shapes is considered for patterning the structural change, which are as follows:

$$y_{1t} = \alpha_0 + \alpha_1 D_{tb} + \beta y_{2t} + e_t, \qquad t = 1, \ldots, T \quad (5)$$

$$y_{1t} = \alpha_0 + \alpha_1 D_{tb} + \gamma t + \alpha_1^T y_{2t} + \beta y_{2t} + e_t, \qquad t = 1, \ldots, T \ (6)$$

$$y_{1t} = \alpha_0 + \alpha_1 D_{tb} + \beta_1 y_{2t} + \beta_2 y_{2t} D_{tb} + e_t, \qquad t = 1, \ldots, T (7)$$

Equation No. (5),represents the level shift ,the equation number (6)represents level shift with trend and the equation number (7) represents the regime shift (structural change) .

(D) Is a dummy variable and if $(t > TB)$ its value is one and otherwise it is zero.

Gregory - Hansen method , in order to trace the cointegrating relation in the presence of probable structural changes, also estimates the break point , residual sentences for each of the equations 5 to 7 (depending on the alternative hypotheses) and also estimates its residual sentences $(\hat{e}_{tb})$. Based on these residual sentences, the First order successive correlation coefficient is as follows:

$$\hat{\rho}_b = \sum_{t=1}^{n-1} \hat{e}_{tb} \hat{e}_{(t+1)b} \Big/ \sum_{t=1}^{T-1} \hat{e}_{tb}^2 \qquad (8)$$

With the correction of skewed of this coefficient, Phillips test statistic will be changed. Now, residual sentences are calculated as follows:

$$\hat{v}_{tb} = \hat{e}_{tb} - \hat{\rho}_b \hat{e}_{(t-1)b} \ (9)$$

This correction also includes , the estimate of the total harmonic of auto covariance.

$$\hat{\lambda}_t = \sum_{j=1}^{M} w\left(\frac{j}{M}\right) \hat{\gamma}_b(j), \qquad (10)$$

In which the (M=M (T)) the optimal value of the parameter, Bandwidth (or the lag shear parameter) and (W (0)) functions weighted corners, and each, in a certain manner, to be determined.

To determine the optimal lag shear parameter or Bandwidth parameter, the following is recommend:

$$\widehat{M}_b = 1.3221[\hat{\alpha}(2)T]^{\frac{1}{5}} (11)$$

In this equation, $(\hat{\alpha}(2))$ function, the unknown spectrum density function of (e_t) and based on this , the following can be calculated:

$$\hat{\alpha}(2) = \sum_{\alpha=1}^{p} wa \left[\frac{4\hat{\rho}_a^2 \hat{\delta}_a^4}{[1-\hat{\rho}]^8}\right] \Big/ \sum_{a=1}^{p} wa \left[\frac{\hat{\delta}_a^4}{[1-\hat{\rho}_a]^4}\right] (12)$$

In the above equation, $(\hat{p}_a)$ and $(\hat{\delta}_\alpha)$ respectively are autoregressive parameters and innovation variances, and (w_α) is the weight.

Innovation variance parameter $(\hat{\delta}_\alpha^2)$, Sum of squares, regression error sentences is as follows:

$$\Delta y_t = \alpha + \delta t + \beta y_{t-1} + \varepsilon_1 (13)$$

In calculating the kernel function normal Kerenls are used as following:

$$w\left[\frac{j}{M}\right] = (2\prod)^{-\frac{1}{2}} exp\left[\left[-\frac{1}{2}\right]\left[\frac{j}{M}\right]^2\right] \quad J = 1,2,\ldots\ldots, M (14)$$

in Equation 47 quantity of $\hat{\gamma}_b(j)$ to be calculated as follows:

$$\hat{\gamma}_b(j) = \frac{1}{T}\sum_{t=j+1}^{T} \hat{v}_{(t-j)b}\hat{v}_{tb}, \quad (15)$$

Based on the above description, the first-order serial correlation coefficient with Skew corrections, such would be:

$$\hat{\rho}_b^* = \sum_{t=1}^{T-1}(\hat{e}_{tb}\hat{e}_{(t+1)b} - \hat{\lambda}_b) \Big/ \sum_{t=1}^{T-1}\hat{e}_{tb}^2 \quad (16)$$

Philips test statistic can be summarized as follows:

$$Z_\alpha(b) = T(\hat{\rho}_b^* - 1), \quad (17)$$

$$Z_t(b) = (\hat{\rho}_b^* - 1)/\hat{s}_b, \quad (18)$$

Where:

$$\hat{s}_b^2 = \hat{e}_b^2 \Big/ \sum_{1}^{T-1}\hat{e}_{tb}^2, \quad (19)$$

And $(\hat{\delta}_\alpha^2)$ is the long-term variance of $\hat{V}_b$and it is calculated as follows:

$$\delta_b^2 = \hat{\gamma}_b(0) + 2\hat{\lambda}_b, \quad (20)$$

other Statistic, the(t) statistic is the coefficient $(\hat{e}_{(t-1)b})$ in the following regression equation that is shown (ADF(b)).

$$\Delta\hat{e}_{tb} = \alpha + \beta\hat{e}_{(t-1)b} + \gamma_1\Delta\hat{e}_{(t-1)b} + \cdots + \gamma_1\Delta\hat{e}_{(t-M)b} + \varepsilon_t (21)$$

And thus

$$ADF(b) = tsat(\hat{e}_{(t-1)b}), \quad (22)$$

According to Gregory - Hansen, the test statistic s, 17, 18 and 22 are conventional tools for analyzing relationships, co-integration, without the presence the structural change (regime change). They proposed test statistics in the presence of this change in direction as follows:

$$Z_t^* = \inf_{b\in T} Z_t(b), \quad (24)$$

$$ADF^*(b) = \inf_{b\in T} ADF(b) \quad (25)$$

Breaking point (Date of shift) is also specified by the years of related to statistics.

In order to estimate the impact of exchange rate and other macro economic variables we have specified the following model based on Gregory- Hansen method:

$$\left(\frac{C}{S}\right): ML_{1t} = \alpha_0 + \alpha_1(D) + \alpha_2 REERL + \alpha_3 WDGPL + \alpha_4 INFL + \alpha_5 IGDPL + \alpha_6 REERL(D) + \alpha_7 WGDPL(D) + \alpha_8 INFL(D) + \alpha_9 IGDPL(D) + e_t, \quad t = 1,2,3,\ldots,T \quad (26)$$

Where the variables are as shown in the table below:

Table 1: Description of the variables

VARIABALE	DISCRIPTION
ML	Logarithm of real imports
REERL	Logarithm of real effective exchange rate
WGDPL	Logarithm of world GDP
INFL	Logarithm of Iran's inflation(CPI)
IGDPL	Logarithm of Iran's GDP
DIVL	first difference of Logarithm of real imports
DREERL	first difference of Logarithm of real effective exchange rate
DWGDPL	first difference of Logarithm of world GDP
DINFL	first difference of Logarithm of Iran' inflation
DIGDPL	first difference of Logarithm of Iran's GDP

Tests to estimate the break point Gregory - Hansen according to the level shift model (C)

According to the regression model (C), this is given below;

$$ML_{1t} = \alpha_0 + \alpha_1(D) + \alpha_2 REERL + \alpha_3 WGDPL + \alpha_4 INFL + \alpha_5 IGDPL + e_t \,, t = 1,2,3,\dots,T \qquad (27)$$

We do the tests, and we check the results. Test results in Table (2) are given. According to the obtained results, the year as year, structural failure, form endogenous, has been achieved, the year is 1374. This year is the year, which has the lowest value of (RSS).

test estimation, break point of Gregory - Hansen, according to the model level shift with trend(C/T)

The results of this test, the regression model

$$ML_{1t} = \alpha_0 + \alpha_1(D) + \alpha_2 REERL + \alpha_3 WGDPL + \alpha_4 INFL + \alpha_5 IGDPL + \gamma.t + e_t \,, t = 1,2,3,\dots,T \qquad (28)$$

In Table (2), are presented. According to the results, the year-as-year structural break, as endogenous, have been obtained, the year is 1995. This year is the year, that have the lowest value of (RSS2) .

break point of Gregory - Hansen according to the regime shift model (structural change) (C/S)

The regression results

$$\left(\frac{C}{S}\right): ML_{1t} = \alpha_0 + \alpha_1(D) + \alpha_2 REERL + \alpha_3 WDGPL + \alpha_4 INFL + \alpha_5 IGDPL + \alpha_6 REERL(D) + \alpha_7 WGDPL(D) + \alpha_8 INFL(D) + \alpha_9 IGDPL(D) + e_t \,, \quad t = 1,2,3,\dots,T \qquad (29)$$

Its results also are presented as well as the two previous models, and figure (1) and Table (2).

IV Empirical Findings of the Study

In this section we present the results based on unit root tests and the structural break points

Unit root tests and structural break

Unit root test has been conducted using ADF and Peron statistics and the calculated values indicate that (H_0) is not rejected. This means ($\rho < 1$), so, the time series discussed, has a unit root. The results are presented in the following table:

Table 2: Unit root tests of the variables

variables	ADF	Ta(b1)	Ta(b2)	Ta(b3)
IVL	-1.8457	-2.47006	-2.46879	-2.33531
REERL	-1.6995	-0.56075	-0.5851	-0.59566
WGDPL	-0.45719	-1.20465	-2.08375	-2.02096
INFL	-1.5941	-4.23526	-4.32841	-4.1798
IGDPL	-1.7944	-2.55216	-2.96016	-2.7041
DIVL	-3.8605	-3.7862	-4.03781	-3.81778
DREERL	-5.1153	-4.06699	-4.23678	-4.08793
DWGDPL	-4.1871	-4.656	-5.20068	-5.22271
DINFL	-10.8048	-6.91741	-7.34539	-7.02676
DIGDPL	-3.3134	-3.19432	-3.46964	-3.40132
Critical values at 5% level	-2.9241	-3.80	-3.85	-4.18

Source: Research findings

Co-integration test of Gregory - Hansen

Cointegration test based on f Gregory – Hansen method has been used, for all possible break points (1969-2004) which include Z_a ,Z_t and $ADF(b)$. Table 3 presents these results:

Table 3: Test results for all the break points

years	Z_a	Z_t	$ADF(b)$
1969	-19.77686	-4.283992	-4.0298
1970	-19.78545	-4.417521	-4.1207
1971	-20.92836	-4.350809	-3.9927
1972	-21.28308	-4.224622	-3.4821
1973	-19.87039	-3.546833	-3.9552
1974	-21.08171	-4.39211	-3.3851
1975	-24.77215	-5.068498	-3.6613
1976	-23.12886	-5.019328	-4.4804
1977	-25.42349	-4.928527	-4.3041
1978	-26.96561	-4.887809	-3.9092
1979	-23.64632	-4.058688	-3.9585
1980	-23.89866	-4.27921	-3.8129
1981	-23.71401	-4.476167	-4.0061
1982	-23.98947	-4.308894	-3.7365
1983	-23.45217	-4.293124	-3.719
1984	-24.12557	-4.266227	-3.8865
1985	-26.89989	-4.455681	-4.3266
1986	-26.6066	-4.413878	-4.2604
1987	-24.46212	-4.242089	-4.0339
1988	-24.26956	-4.102517	-4.0425
1989	-23.5333	-4.014264	-4.0598
1990	-22.34784	-4.092979	-3.6993
1991	-20.30772	-3.835204	-3.9393
1992	-20.10318	-3.802649	-3.8291
1993	-25.9515	-4.421499	-4.0226
1994	-24.25292	-5.03875	-4.2072
1995	-27.0564	-5.483688	-4.9854
1996	-22.45035	-4.852088	-4.7521
1997	-21.08213	-4.472494	-4.2651
1998	-20.01271	-4.544073	-4.0931
1999	-19.14051	-4.219912	-3.9648
2000	-18.33955	-4.224618	-3.9063
2001	-18.00403	-4.214121	-3.9234
2002	-17.92981	-4.164107	-3.8861
2003	-17.91981	-4.162004	-3.8834
2004	-17.92208	-4.15279	-3.8542

Source: Research findings

Based on all three statistics the year 1995 as the year of structural break has been identified.

We present the results of cointegration test based on Gregory- Hansen method as follows (Table 4):

Table 4: The results of co-integration test

$$\left(\frac{C}{S}\right): ML_{1t} = \alpha_0 + \alpha_1(D) + \alpha_2 REERL + \alpha_3 WDGPL + \alpha_4 INFL + \alpha_5 IGDPL + \alpha_6 REERL(D) + \alpha_7 WGDPL(D) + \alpha_8 INFL(D) + \alpha_9 IGDPL(D) + e_t , \quad t = 1,2,3,\dots,T$$

	Z_a^*	Z_t^*	ADF^*
	-24.25292	-5.483688	-4.9854
critical values at the level 5%	-78.52	-6.41	-6.41

Coefficient estimates based on DOLS

α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8	α_9	R^2
−15.9988	− 32.3558	− 1.27767	− 1.6730	1.15258	2.9099	− 1.2004	5.0683	1.0765	− 3.4802	0.9443
−7.2384	− 1.0929	4.2323	− 1.01057	2.8905	8.2771	− 1.0629	1.16026	1.10799	− 1.49877	$= t$

References: Research findings

The empirical findings indicate that there exists co-integrating relationship between imports and other macro variables. The coefficients of (α) which are significant at 5% level indicate that there is structural change.

V Conclusions and Recommendations

As per the empirical findings, there exists a cointegrated relationship between imports and other variables considered in the model. As expected, the real exchange rate has a negative relationship and inflation and domestic GDP have a positive relationship with imports. However, the global economic growth has an inverse long-term relationship. Based on these empirical findings the following suggestions may be made:

1 - Considering the inverse relationship between the global economic growth and the imports , it is suggested that Iran should confine only to the imports of capital goods so that the production capability in the domestic economy is increased. In addition, Iran should pusue the policies of export promotion and import containment in the priority sectos.

2 –Exchange rate is an important variable influencing Iran's imports. Iran should integrate its exchange rate with the global rates and at the same follow the policies of minimizing exchange rate fluctuations.

3 – Iran should contain the domestic inflation using appropriate fiscal and monetary policies.

Notes

1. See, Ahammadi, et al (2011), The Effect of exchange Rate uncertainty on Import : a TARCH Approach, International Journal of Management and Business Research, 1 (4), 211-220, Autumn.

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Appendix

Figure (1) : The results of RSS1, RSS2, RSS3.

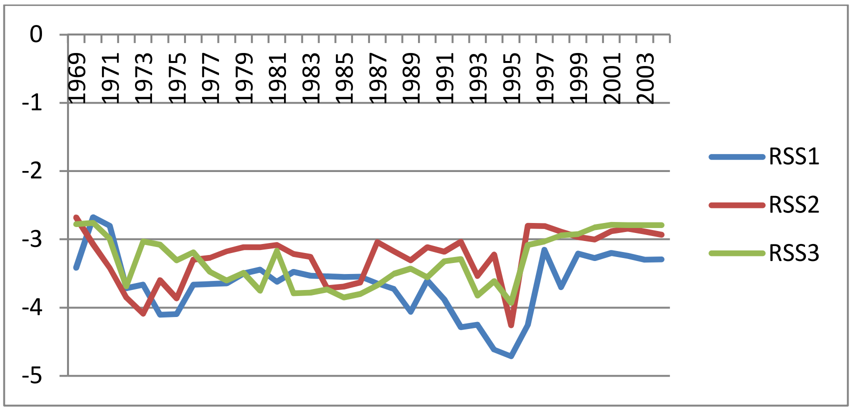

Table (2) Estimation results, point of breaking, Gregory - Hansen

years	RSS1	RSS2	RSS3
1969	-3.4167	-2.6801	-2.7791
1970	-2.6757	-3.0724	-2.7587
1971	-2.8030	-3.4186	-2.9948
1972	-3.7136	-3.8538	-3.6871
1973	-3.6622	-4.0926	-3.0329
1974	-4.1044	-3.5960	-3.0760
1975	-4.0954	-3.8669	-3.3066
1976	-3.6632	-3.2991	-3.1920
1977	-3.6529	-3.2719	-3.4748
1978	-3.6465	-3.1745	-3.6031
1979	-3.4986	-3.1175	-3.4921
1980	-3.4417	-3.1153	-3.7517
1981	-3.6225	-3.0846	-3.1662
1982	-3.4773	-3.2157	-3.7911
1983	-3.5309	-3.2566	-3.7817
1984	-3.5425	-3.7141	-3.7324
1985	-3.5534	-3.6927	-3.8511
1986	-3.5445	-3.6315	-3.8005
1987	-3.6471	-3.0393	-3.6741
1988	-3.7316	-3.1742	-3.5057
1989	-4.0607	-3.3059	-3.4288
1990	-3.6042	-3.1146	-3.5556
1991	-3.8814	-3.1825	-3.3201
1992	-4.2884	-3.0343	-3.2906
1993	-4.2485	-3.5358	-3.8249
1994	-4.6163	-3.2242	-3.6107
1995	-4.7157	-4.2597	-3.9296
1996	-4.2531	-2.8013	-3.0833
1997	-3.1505	-2.8074	-3.0292
1998	-3.7025	-2.8915	-2.9408
1999	-3.2084	-2.9671	-2.9239
2000	-3.2931	-3.0030	-2.8264
2001	-3.1993	-2.8790	-2.7850
2002	-3.2429	-2.8435	-2.7902
2003	-3.2974	-2.8852	-2.7895
2004	-3.2954	-2.9336	-2.7921

Sources: research finding