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The Effects of Openness and Globalization on Inflation: An ARDL Bounds Test Approach

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Abstract

The purpose of this paper is to test the hypothesis first proposed by Romer (1993); suggesting that inflation is lower in more open economies. According to this hypothesis, central banks have a lower incentive to engineer surprise inflations in more-open economies because the Phillips curve is steeper. Furthermore, Comparing with other empirical studies, this paper has used the new KOF globalization index to estimate the relationship between economic globalization and inflation. We utilized the ARDL Bounds test approach to level relationship proposed by Pesaran et al. (2001) for Iranian annual data during 1970-2009. The results from Bounds test approach confirm the existence of the long-run relationship among the variables for both spesification. The results show that openness has a negative and significant effect on inflation in short-run but its effect on inflation in long-run is positive. Globalization has a negative and significant effect on inflation in short-run and long-run. Thus, it seems that the new economic globalization (KOF index) which is a broader comprehensive index is a better proxy of openness.

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1. Introduction

One of the most striking events of the past two decades has been the remarkable decline in inflation around the world. Inflation has always been a concern for the policy makers as it creates uncertainty in the economy that may adversely affect economic growth. Therefore, maintaining noninflationary stable economic growth has been at the core of macroeconomic policies in developing countries.

Romer (1993) argues that more-open economies will have steeper Phillips curves. The reason for this is that a monetary expansion in an open economy will be accompanied by a real depreciation of the currency, raising costs for households and businesses. The larger share of imported goods, the greater the increase in inflation. Romer also argues that the relative weight on stabilizing output is smaller in more-open economies, again because of the real depreciation induced by the monetary shock (Wynne and Kersting, 2007).

This study tests the negative openness vs. inflation hypothesis for the years 1990s and 2000s. Using not only the traditional trade openness measure (exports plus imports as a ratio of GDP) but also a broader measure of economic globalization (KOF index), we try to accomplish two things. We believe that the paper results provide a more complete picture of the relationship between openness and inflation as compared to empirical studies that used a subset of economic globalization as openness measures.

Most studies have employed exports plus imports to GDP as the traditional trade openness measure that is sub-index of economic globalization. The traditional trade openness share in KOF is only 19 percent and the remaining 81 percent deals with other factors of openness such as Foreign Direct Investment, flows and stocks (percent of GDP), Income Payments to Foreign Nationals (percent of GDP) and Restrictions that itself includ Hidden Import Barriers, Mean Tariff Rate, Taxes on International Trade (percent of current revenue) and Capital Account Restrictions ignored by the traditional index.

The present study, estimates two models: model I investigates the effects of openness on inflation and model II investigates the effects of globalization on inflation for Iran's economy during 1970-2009. This paper is organized in five sections. After the introduction in the first section, section 2 provides a theoretical background and reviews empirical research. Section 3 presents model specification and data description. Section 4 considers the empirical results, and finally, a conclusion will be provided in section 5.

2. Review of Literatures and Empirical Research

The theoretical reasoning for why more open economies tend to have less inflation follows Rogoff's (1985) model, which shows that such economies gain less from surprise inflation. Surprise monetary expansions cause the real exchange rate to depreciate, leading to a negative terms-of-trade effect. The more open the economy the more the real exchange depreciates, thus reducing incentives to undertake expansion (Alfaro, 2005).

Romer (1993) proposes an explanation of this relationship. Because unanticipated monetary expansion causes real exchange rate depreciation, and because the harms of real depreciation are greater in more open economies, the benefits of surprise expansion are a decreasing function of the degree of openness. Thus, if the monetary authorities' temptation to expand is an important determinant of inflation, that is, if the absence of binding pre-commitment is important to monetary policy, monetary authorities in more open economies will on average expand less, and the result will be lower average rates of inflation (Romer, 1993)

The relationship between inflation and openness has been analysed from theoretical as well as empirical frameworks. According to 'new growth theory', openness is likely to affect inflation through its likely effect on output (Jin, 2000). This link could be operating through: a) increased efficiency which is likely to reduce cost through changes in composition of inputs procured domestically and internationally, b) better allocation of resources, c) increased capacity utilization, d) rise in foreign investment which can stimulate output growth and ease pressures on prices (Ashra, 2002). Okun (1981) postulates that the shocks to the domestic price level due to domestic output fluctuation are likely to ease as the economy opens up.

Cukierman, et al. (1992) state that in small open countries prices of traded goods converge across countries because of free trade; therefore, theory suggests a lower degree of price distortions in outward-looking countries. Moreover, in highly open countries conversion of domestic currency into foreign currency is very easy. Therefore, the inflation rate – a kind of tax on domestic currency –will be low in more open countries (Zakaria, 2010).

In early empirical literature Triffin and Grudel (1962) tested the hypothesis that openness leads to cheaper availability of goods that are costly in the country otherwise and confirmed that more open economies tended to experience lower inflation in 5 countries in the European Economic Community.

Iyoha (1973) used a sample of 33 less developed countries and analysed the relationship for both yearly and 5 year average data from 1960-61 to 1964-65. A negative relationship between openness and inflation emerged when Iyoha related inflation and openness in a bivariate framework using method of ordinary least squares. However, when the analysis was extended to a multivariate exercise, the results were not unambiguous. Though the openness variable was not always significant, it always had a negative sign.

Kirkpatrick and Nixon (1977) while commenting on Iyoha (1973) argued that imports restrictions could worsen the inflation situation.

Romer (1993) used a Barro-Gorden type of model for a cross section of 114 countries and argued that inflation is lower in small and open economies even in the absence of an independent central bank with pre-commitment to price stability.

Lane (1997) proposed that it is existence of imperfect competition and the presence of rigid nominal prices in the non-tradable sector that leads inverse relationship between openness and inflation. According to new growth theory, openness reduces inflation through its positive influence on output, mainly through increased efficiency, better allocation of resources, improved capacity utilization, and increased foreign investment (Jin, 2000).

Alfaro (2002) using panel of 148 countries found that openness does not seem to play a role in the short run in restricting inflation, but a fixed exchange-rate regime plays a significant role.

Hanif and Batool (2006) tested the hypothesis that inflation is lower in small and open economies for Pakistan economy using annual time series data for the period 1973-2005.They found that the openness variable such as growth in 'overall trade to GDP ratio' also has a significant negative impact on the domestic price growth in Pakistan.

Wynne and Kersting (2007) showed that there is a robust negative relationship across countries between a country's openness to trade and its long-run inflation rate in the United States. Also, Granato et al. (2007) found support for Romer's (1993) argument concerning the relation between monetary policy and economic openness. Their study links economic openness to the slopes of aggregate supply and aggregate demand to explain why the openness-inflation relation can be ambiguous. Their empirical results from 15 developed countries support the recent empirical failure in finding the negative openness-inflation relation. Al Nasser et al. (2009) checked the validity of Romer's (1993) main result and also tested the Terra's (1998) criticism that the negative relationship between openness and inflation is due to severely indebted countries in the debt crisis period. Their analysis showed that the principal result of Romer still holds in the 1990s; however, Terra's criticism fails to hold in the 1990s as the negative relationship between inflation and openness remains unrestrictive to a subset of countries or specific time period.

Taiebnia and Zandiyeh (2009) have pointed four main channels that globalization affects inflation; first is globalization's effect on monetary authorities' incentives for resorting to money expansion and thereby affecting long-run inflation. Second is globalization's effect on relative prices which is embodied in import prices.Third is its effect on the slope of Philips' curve; theories suggest that economy's openness to trade will reduce this slope; hence inflation impression from domestic output fluctuations will diminish. The fourth is foreign output effect on domestic inflation through trade. They have used the traditional measure of openness and a VAR model to test globalization effect on inflation through channel two to four in Iran during 1988-2005. Results are as follows: 1- The more Iran's economy opens to trade, the less domestic business cycles affect inflation and it will have a smoother path. 2- Import relative price increase acts as a supply shock in economy and increases inflation. 3- Iran's trade partner's booms and slumps transmit to Iran through trade and affect domestic inflation.

Mukhtar (2010) has used a multivariate cointegration and a vector error correction model in Pakistan during 1960 to 2007. The empirical findings under the cointegration test show that there is a significant negative long-run relationship between inflation and trade openness, which confirms the existence of Romer's hypothesis in Pakistan.

In turn, opponents (cost push hypothesis) argue that trade openness does not necessarily reduce inflation; rather it increases inflation. Bellow are researches that have shown that openness increases inflation:

Evans (2007) argues that the positive effect of openness on inflation is driven by the fact that the monetary authority enjoys a degree of monopoly power in international markets as foreign consumers have some degree of inelasticity in their demand for goods produced in the home country. The decision of the monetary authority is then to balance the benefits of increased money growth that come from the open economy setting with the well-known consumption tax costs of inflation. Further, it is also possible for an open economy to import inflation from the rest of the world via the prices of manufactured imports or raw material imports. Moreover, as the economy opens up, the fiscal and monetary authorities tend to lose their ability to control inflation through fiscal and monetary policies (Evans, 2007).

Salmanpour, et al. (2009) investigate the Consequences of Economic Globalization on Iran's Domestic Inflation. The results show that domestic inflation is affected by expected inflation, imported inflation, domestic and foreign output gap.

Cooke (2010) developed a two-country general equilibrium model to analyze the optimal rate of inflation under discretion. He shows that when agents' welfare is the sole policy objective, it is possible to show that openness and inflation no longer have a simple inverse relationship. Because the terms of trade are related to monopoly markups, a greater degree of openness may lead the policymaker to exploit the short-run Phillips curve more aggressively, even if it involves a smaller short-run benefit. Then inflation can be higher in a more open economy (Cooke, 2010).

Zakaria (2010) examined the relationship between trade openness and inflation in Pakistan using annual time-series data for the period 1947 to 2007. The empirical analysis showed that a positive relation holds between trade openness and inflation in Pakistan.

3. Model Specification and Data Description

Inflation is an important and complicated concept especially with respect to its causes as well its economic impacts. Therefore, it is always a tough job for any researcher to construct an empirical model for a country. However, it is possible to find the key macroeconomic variables impacting the inflation process in a country like Iran. Monetarists argued that inflation is always and everywhere a monetary phenomenon. Jafari

Samimi and Erfani (2004) tested the neutrality and super-neutrality of money in Iran during 1959-2002. They have shown that money is neutral but the results of the super-neutrality tests suggest that inflation is driven by money growth. So, the first determinant of inflation as mentioned in the present paper is the rate money growth.

Following Ramsey (1927) and Phelps (1973), since government revenue from money creation or the so-called seigniorage is a source of government revenue, especially in developing countries, the marginal deadweight loss of inflation should be equal to the marginal deadweight loss of other taxes. Presumably the marginal deadweight loss of other taxes is greater when the government need to raise more revenue. Becker and Mulligan (2003) and most studies conclude a positive correlation between inflation and the size of government.

There is a vast literature on inflation and growth. Clearly, availability of goods and services in the economy eases pressure on the domestic price growth. We included the GDP per capita variable in the inflation equation expecting negative sign.

So ‘model I’ for inflation in order to investigate the effect of openness on inflation:

$$INF_t = \delta_1 M_t + \delta_2 GS_t + \delta_3 OPN_t + \delta_4 Y_t + \varepsilon_t \tag{1}$$

And we have used ‘model II’ to the investigation the effect of globalization on inflation:

$$INF_t = \delta_1 M_t + \delta_2 GS_t + \delta_3 KOF_t + \delta_4 Y_t + \varepsilon_t \tag{2}$$

WhereINF_t is the inflation rate calculated by CPI, M_t is the money growth, GS_t is the government size that is represented by the share (percent) of government consumption in GDP, OPN_t is ratio (percent) of trade (imports+exports) to GDP as the traditional trade openness measure, $KOF_t$is the globalization index, Y_t is the GDP per capita and ε_t is the error term.

Empirical studies have shown that money is neutral in the long-run, so that the level of the money supply at any time has no influence on real magnitudes, money could still be non-superneutral: the growth rate of the money supply could affect real variables. A rise in the monetary growth rate leads to a new dynamic equilibrium with an equally increased inflation rate.

3.1 Data and Econometric Methodology

3.1.1 Data

This paper uses annual data of the Iranian economy during 1970-2009. Data for economic globalization is taken from the KOF index of globalization. Other data are obtained from WDI for Iranian economy 1970-2009. Descriptive statistics and time series plots are given in Table 1and Fig 1 respectively.

Table 1: Descriptive statistics for variables

	OPEN	**M**	**Y**	**INF**	**KOF**	**GS**
Mean	43.14994	27.23741	1641.826	17.45585	23.62175	16.46612
Median	42.35375	25.22003	1534.049	16.79829	23.57500	15.74371
Maximum	76.77430	153.6837	2303.845	49.65599	36.77000	25.77113
Minimum	13.77244	-57.23533	1123.955	1.666871	13.68000	11.01334
Std. Dev.	13.80636	25.33130	308.8686	8.958410	7.387272	4.256185
Skewness	0.201773	2.263301	0.466163	1.089418	0.087170	0.623285
Kurtosis	3.094979	19.60123	2.210048	5.481472	1.566150	2.240409
Jarque-Bera	0.286452	493.4851	2.488758	18.17505	3.477202	3.551529
Probability	0.866558	0.000000	0.288120	0.000113	0.175766	0.169354
Sum	1725.997	1089.496	65673.06	698.2341	944.8700	658.6447
Sum Sq. Dev.	7434.002	25025.31	3720592.	3129.871	2128.300	706.4894

Before talking about the series, we have to pay attention to the fact that the Iranian economy has been subjected to numerous shocks as, the 1979 Islamic Revolution victory and the eight-year (1980-1988) war against Iraq; these two events seem to have a significant impact on the economy and therefore should not be ignored. The following facts can be observed from Table 1 and Fig.1. The maximum point of real GDP per capita is about 2270 million dollars in 1976 before the Islamic Revolution. After that time, the series came down every year and they came to about 1161 million dollars in 1989. After that time the economy slowly started to improve until 2009 that GDP per capita was 2161 million dollars. The mean of globalization index (KOF) and openness (OPN) are 23.62175 and 43.14994 percent respectively. As it is clear from the Fig.1 GDP per capita, Globalization and economic openness are at least after the revolution and during the war.

As it can be seen the mean of the inflation rate is 17.45585 percent and the maximum point is about 50 percent, hence Iranian had the inflationary condition over the period 1970-2009. Finally, the government size has been decreasing over the study period.

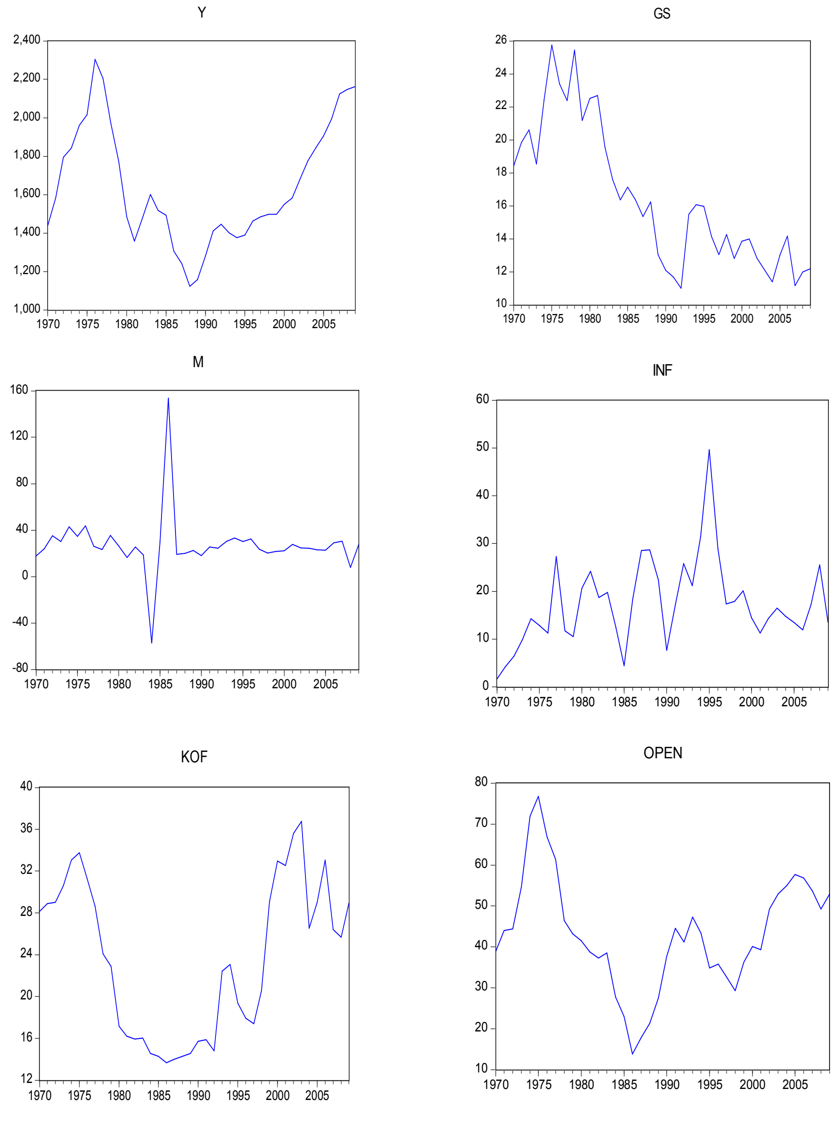

Figure 1: Time series plots

3.1.2 The KOF Index of Globalization

The KOF Index of Globalization was introduced in 2002 (Dreher, 2006) and is updated and described in detail in Dreher, Gaston and Martens (2008). The overall index covers the economic, social and political dimensions of globalization. Following Clark (2000), Norris (2000) and Keohane and Nye (2000), it defines globalization to be the process of creating networks of connections among actors at multi-continental distances, mediated through a variety of flows, including people, information and ideas, capital and goods. Globalization is conceptualized as a process that erodes national boundaries, integrates national economies, cultures, technologies and governance and produces complex relations of mutual interdependence.

More specifically, the three dimensions of the KOF index are defined as:

- *Economic globalization*, characterized as long distance flows of goods, capital and services as well as information and perceptions that accompany market exchanges;
- *Political globalization*, characterized by a diffusion of government policies; and
- *Social globalization*, expressed as the spread of ideas, information, images and people.

3.1.3 Economic Globalization

Broadly speaking, economic globalization has two dimensions. First, actual economic flows are usually taken to be measures of globalization. Second, the previous literature employs proxies for restrictions to trade and capital. Consequently, two indices are constructed that include individual components suggested as proxies for globalization in the previous literature.

Table 2: KOF Index of Globalization

Indices and Variables	Weights
A. Economic Globalization	**[37%]**
i) Actual Flows	(50%)
Trade (percent of GDP)	(19%)
Foreign Direct Investment, flows (percent of GDP)	(20%)
Foreign Direct Investment, stocks (percent of GDP)	(24%)
Portfolio Investment (percent of GDP)	(17%)
Income Payments to Foreign Nationals (percent of GDP)	(20%)
ii) Restrictions	(50%)
Hidden Import Barriers	(22%)
Mean Tariff Rate	(28%)
Taxes on International Trade (percent of current revenue)	(27%)
Capital Account Restrictions	(22%)
B. Social Globalization	**[39%]**
i) Data on Personal Contact	(33%)
Telephone Traffic	(26%)
Transfers (percent of GDP)	(3%)
International Tourism	(26%)
Foreign Population (percent of total population)	(20%)
International letters (per capita)	(25%)
ii) Data on Information Flows	(36%)
Internet Users (per 1000 people)	(36%)
Television (per 1000 people)	(36%)
Trade in Newspapers (percent of GDP)	(28%)
iii) Data on Cultural Proximity	(31%)
Number of McDonald's Restaurants (per capita)	(43%)
Number of Ikea (per capita)	(44%)
Trade in books (percent of GDP)	(12%)
C. Political Globalization	**[25%]**
Embassies in Country	(25%)
Membership in International Organizations	(28%)
Participation in U.N. Security Council Missions	(22%)
International Treaties	(25%)

3.2 **Unit root tests**

Table 3 presents the Augmented Dickey Fuller (ADF), Philips-Perron(PP), Zivot and Andrews (ZA), and Lumsdaine and Papell (LP) unit root test results[1]. As can be seen from the table the results of all four tests are the same for variables. Inflation (INF) and money growth (M) are stationary and other variables are unit root at the level of 5%

significance level.

Table 3. Unit root test results

	ADF	**PP**	TB_{ZA}	**ZA**	TB_{1LP}	TB_{2LP}	**LP**
INF	I(0)	I(0)	1994	I(0)	1980	1994	I(0)
M	I(0)	I(0)	1986	I(0)	1986	1989	I(0)
GS	I(1)	I(1)	1982	I(1)	1982	1994	I(1)
OPN	I(1)	I(1)	1981	I(1)	1981	1984	I(1)
KOF	I(1)	I(1)	1986	I(1)	1986	1999	I(1)
Y	I(1)	I(1)	1986	I(1)	1986	1988	I(1)

The critical values for ADF and PP identified by MacKinnon (1996), also The critical values for ZA and LP identified by Zivot and Andrews (1992) and Lumsdain and Papell (1997) respectively.

3.3 Econometric methodology

In the previous section, we concluded that the series under consideration are not in the same order of integration. As most of the cointegration tests such as Engel-Granger, and Johansen and Joselius (1990), are confident when the series are in the same order of integration, these tests cannot be suitable for our study. Thus, we use the Bounds test approach to level relationship, which can be applied irrespective of the order of integration of the variables.

3.3.1 ARDL model specification

This paper applies the Bounds test approach to level relationship and Autoregressive Distributed Lag (ARDL) model proposed by Pesaran et al. (2001).This method has several advantages in comparison to other cointegration procedures: First, this approach yields consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I(1) or I(0) or fractionally integrated. Thus, the Bounds test eliminates the volatility associated with pre-testing the order of integration. Second, this technique generally provides unbiased estimates of the long-run model and valid t-statistics even when some of the regressors are endogenous. Third, it can be used in small sample sizes, whereas the Engle–Granger and the Johansen procedures are not reliable for relatively small samples (Pesaran et al, 2001). We apply the Bounds test procedure by modeling our regression (equation 3) as a general vector autoregressive (VAR) model of order p, in z:

$$z_t = c_0 + \beta_t + \sum_{i=1}^{p} \phi_i \, z_{t-i} + \varepsilon_t, \;\; t = 1, 2, 3, \dots, T \qquad (7)$$

Where c_0 is a (k+1) vector of intercepts and βdenoting a (k+1)-vector of trend coefficients. Similar to Pesaran, et al. (2001) our Vector Error Correction Model (VECM) is as follows:

$$\Delta z_t = c_0 + \beta_t + \pi z_{t-i} + \sum_{i=1}^{t} \Gamma_i \, i\Delta z_{t-i} + \varepsilon_t, \;\; t = 1,2, \dots., T \qquad (8)$$

Where the (k+1) x (k+1) – matrices,$\pi = I_{k+1} \sum_{i=1}^{p} \Psi_i$ and $\Gamma_i = -\sum_{j=i+1}^{p} \Psi_j$, $i = 1,2, \dots, p-1$, contain the long-run multipliers and short-run dynamic coefficients of the VECM. $z_t$is the vector of variables $y_t$and $x_t$respectively. y_t is an I(1) dependent variable defined as INF_t and INF_t=$[M, OPN_t, GS_t, Y_t]$ for model I(INF_t=$[M, KOF_t, GS_t, Y_t]$ for model II) is a vector of I(0) and I(1) regressors with a multivariate identically independently distributed zero mean error vector $\varepsilon_t = (\varepsilon_{1t}, \varepsilon'_{2t})'$, and a homoscedastic process. We consider two cases for VECM with regard to intercept and trends; case III and case V.

Case III: unrestricted intercepts; no trends and the ECM for the model I is:

$$\begin{aligned} \Delta INF_t = c_0 &+ \delta_1 INF_{t-1} + \delta_2 M_{t-1} + \delta_3 OPN_{t-1} + \delta_4 GS_{t-1} \\ &+ \delta_5 Y_{t-1} + \sum_{i=1}^{p} \phi_i \, \Delta INF_{t-i} + \sum_{l=1}^{q} \varphi_l \, \Delta M_{t-l} \\ &+ \sum_{m=1}^{q} \eta_m \Delta OPN_{t-m} + \sum_{n=1}^{q} \theta_n \, GS_{t-n} + \sum_{s=1}^{q} \zeta_s \, Y_{t-s} \\ &+ \Psi D_t + \varepsilon_t \end{aligned} \qquad (9)$$

Case III: unrestricted intercepts; no trends and the ECM for model II is:

$$\Delta INF_t = c_0 + \delta_1 INF_{t-1} + \delta_2 M_{t-1} + \delta_3 KOF_{t-1} + \delta_4 GS_{t-1} + \delta_5 Y_{t-1} + \sum_{i=1}^{p} \phi_i \, \Delta INF_{t-i} + \sum_{l=1}^{q} \varphi_l \, \Delta M_{t-l} + \sum_{m=1}^{q} \eta_m \Delta KOF_{t-m} + \sum_{n=1}^{q} \Theta_n \, GS_{t-n} + \sum_{s=1}^{q} \zeta_s \, Y_{t-s} + \Psi D_t + \varepsilon_t \quad (10)$$

Case V: unrestricted intercepts; unrestricted trends and the ECM for model I is:

$$\Delta INF_t = c_0 + \beta t + \delta_1 INF_{t-1} + \delta_2 M_{t-1} + \delta_3 OPN_{t-1} + \delta_4 GS_{t-1} + \delta_5 Y_{t-1} + \sum_{i=1}^{p} \phi_i \, \Delta INF_{t-i} + \sum_{l=1}^{q} \varphi_l \, \Delta M_{t-l} + \sum_{m=1}^{q} \eta_m \Delta OPN_{t-m} + \sum_{n=1}^{q} \Theta_n \, GS_{t-n} + \sum_{s=1}^{q} \zeta_s \, Y_{t-s} + \Psi D_t + \varepsilon_t \quad (11)$$

Case V: unrestricted intercepts; unrestricted trends and the ECM for model II is:

$$\Delta INF_t = c_0 + \beta t + \delta_1 INF_{t-1} + \delta_2 M_{t-1} + \delta_3 KOF_{t-1} + \delta_4 GS_{t-1} + \delta_5 Y_{t-1} + \sum_{i=1}^{p} \phi_i \, \Delta INF_{t-i} + \sum_{l=1}^{q} \varphi_l \, \Delta M_{t-l} + \sum_{m=1}^{q} \eta_m \Delta KOF_{t-m} + \sum_{n=1}^{q} \Theta_n \, GS_{t-n} + \sum_{s=1}^{q} \zeta_s \, Y_{t-s} + \Psi D_t + \varepsilon_t \quad (12)$$

Where δ_i are the long-run multipliers, c_0 is the intercept, t is time trend and ε_t are white noise errors.

3.3.2 Bounds testing Procedure

The first step in the ARDL Bounds testing approach is estimated of models, I and II by ordinary least squares (OLS) in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables, i.e.,$H_N: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ against the alternative $H_A: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$.We denote the test which normalized on INF by $F_{INF}(INF|G, M, OPN, Y)$for model I ($F_{INF}(INF|G, M, KOF, Y)$ for model II).Two asymptotic critical values bounds provide a test for cointegration when the independent variables are I(d) (where 0≤d≤1): a lower value assuming the regressors are I(0), and an upper value assuming purely I(1) regressors. If the F-statistic is above the upper critical value, the null hypothesis of no long-run relationship can be rejected irrespective of the orders of integration for the time series. Conversely, if the test statistic falls below the lower critical value, the null hypothesis cannot be rejected. Finally, if the statistic falls between the lower and upper critical values, the result is inconclusive. The approximate critical values for the F and t-tests were obtained from Pesaran et al. (2001).

In the next step, once cointegration is established, the conditional$ARDL(p_1, q_1, q_2, q_3, q_4)$ Long-run model derives from following equation:

$$INF_t = c_0 + \beta t + \sum_{i=1}^{p} \delta_1 INF_{t-i} + \sum_{i=0}^{q_2} \delta_2 M_{t-i} + \sum_{i=0}^{q_3} \delta_3 OPN_{t-i} + \sum_{i=0}^{q_4} \delta_4 GS_{t-i} + \sum_{i=0}^{q_5} \delta_5 Y_{t-i} + \varepsilon_t \qquad (13)$$

Also the conditional $ARDL(p_1, q_1, q_2, q_3, q_4)$Long-run model for the model II derives from following equation:

$$INF_t = c_0 + \beta t + \sum_{i=1}^{p} \delta_1 INF_{t-i} + \sum_{i=0}^{q_2} \delta_2 M_{t-i} + \sum_{i=0}^{q_3} \delta_3 KOF_{t-i} + \sum_{i=0}^{q_4} \delta_4 GS_{t-i} + \sum_{i=0}^{q_5} \delta_5 Y_{t-i} + \varepsilon_t \qquad (14)$$

This involves selecting the orders of the $ARDL(p_1, q_1, q_2, q_3, q_4)$ model in the four variables using Schwarz information criteria.

In the final step, we obtain the short-run dynamic parameters by estimating an ECM associated with the long-run estimates. This is for the model I specified as follows:

$$\Delta INF_t = c_0 + \beta t + \sum_{i=1}^{p} \phi_i \, \Delta INF + \sum_{l=1}^{q} \varphi_l \, \Delta M_{t-l} + \sum_{p=1}^{q} \eta_p \Delta OPN_{t-p} + \sum_{n=1}^{q} \Theta_n \, GS_{t-n} + \sum_{s=1}^{q} \zeta_s \, Y_{t-s} + \vartheta ecm_{t-1} + \varepsilon_t \quad (15)$$

ECM for model II is:

$$\Delta INF_t = c_0 + \beta t + \sum_{i=1}^{p} \phi_i \, \Delta INF + \sum_{l=1}^{q} \varphi_l \, \Delta M_{t-l} + \sum_{p=1}^{q} \eta_p \Delta KOF_{t-p} + \sum_{n=1}^{q} \Theta_n \, GS_{t-n} + \sum_{s=1}^{q} \zeta_s \, Y_{t-s} + \vartheta ecm_{t-1} + \varepsilon_t \quad (16)$$

Where ϕ, and $\zeta$are the short-run dynamic coefficients of the models, and ϑ is the speed of adjustment.

4. Empirical Results

In order to test for the existence of a long-run relationship between series under consideration, the Bounds test approach to level relationship is used. Table 5 gives the results of the Bounds test under two different scenarios as suggested by Pesaran et al. (2001) with an unrestricted deterministic trend(F_V) and without deterministic trend (F_{III}). Intercepts in these scenarios are all unrestricted. The critical values for F-statistics are taken from Narayan (2005) and t-statistic from Pesaran et al. (2001), and presented in Table 4. The lag length p for this test is based on Schwarz-Bayessian criterion (SBC). As it can be seen from Table 5, F-statistic value confirms cointegration among series in F_{III} and $F_V$for both models of this article.

Table 4: Critical values for ARDL modeling approach

K=5	**0.10**		**0.05**		**0.01**	
	I(0)	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
F_{III}	2.50	3.76	3.03	4.44	4.25	6.04
F_V	3.08	4.27	3.67	5.00	5.09	6.77
t_{III}	-1.62	-3.49	-1.95	-3.83	-2.58	-4.44

t_V	-2.57	-3.86	-2.86	-4.19	-3.43	-4.79

Source: Narayan (2005): pp. 1988 to1990 for F-statistics and Pesaran et al. (2001): pp. 300-301 for *t* ratio.

Note: F_{III}represents the F statistic of the model with unrestricted intercept and no trend and restricted trend, F_V represents the F statistic of the model with unrestricted intercept and trend. t_V and t_{III} are the *t* ratios for testing $\delta_1 = 0$ in equation 6 to 9 with and without deterministic linear trend.

Table 5: Bounds F- and t-statistics for the Existence of a Levels Relationship

		With Determintic Trends		Without Determintic Trends	
	Lag	F_V	t_V	F_{III}	t_{III}
$F_Y(INF_t \mid M_t, OPN_t, GS_t, Y_t)$	1	6.322**	-3.871*	6.498***	-4.229**
$F_Y(INF_t \mid M_t, KOF_t, GS_t, Y_t)$	2	6.344**	-4.729***	5.076**	-4.393**

Note: significance levels are: * 10 percent, ** 5 percent, ***1 percent respectively.

To investigate the long-run effect of openness on inflation (model I)table 6 presents the long-run coefficients of ARDL(0,2,2,0,0). As can be seen from the table effect of money growth (M) on inflation is positive and significant at the5% level; also the effect of GDP per capita (Y) is unable to be rejected at the1% significance level and its coefficientis positive.The coefficient of GS is positive and significant at the 5% level; therefore as inflation increases the government size grows in the long-run. As it can be seen from Table 6 the coefficient of OPN is significant at the 1% level. This means that the effect of openness on inflation is positive in the long-run.

Table 6: Estimated long run coefficients using the ARDL (2,2,0,1,2)

approach

The Regressors	Coefficient	Std. Error	t-Statistic	Prob.
M	0.274238	0.101946	2.690024	0.0109
OPN	0.828484	0.274229	3.021144	0.0047
GS	-0.800018	0.702659	-1.138559	0.2626
Y	-0.041325	0.011583	-3.567802	0.0011
C	56.51182	19.30208	2.927757	0.0060

To investigate the long-run effect of globalization on inflation (model II) Table 7 presents the long-run coefficients of ARDL(2,2,0,1,2). The coefficients of GS and Y can not be rejected at the 1% significance level and their coefficients are positive and negative respectively. The effect of money growth on inflation is positive and significant at the 5% level. According to the table the effect of the KOF globalization index on inflation is negative and significant at the 1% level.

Table 7: Estimated long run coefficients using the ARDL (2,2,0,1,2) approach

The Regressors	Coefficient	Std. Error	t-Statistic	Prob.
M	0.193416	0.092609	2.088528	0.0441
KOF	-0.612773	0.209714	-2.921948	0.0061
GS	2.888372	0.712637	4.053074	0.0003
Y	-0.017263	0.006166	-2.799577	0.0083
C	-15.50146	15.10789	-1.026051	0.3119

Table 8 presents ECM results for model I. The most important among others is the negative impact of openness on inflation. The coefficient of ECMT(-1), is 0.903, significant at the 1% level, and negative as be expected, thus approximately all of disequilibrium from the previous year's shocks in equation (15) converge back to the long-run equilibrium in the a little more than a year.

Table 8: Error correction representation for the selected ARDL (0,2,2,0,0) model

The Regressors	Coefficient	Std. Error	t-Statistic	Prob.
DM	0.052887	0.029146	1.814578	0.0803
DM(-1)	-0.084869	0.041132	-2.063311	0.0485
DOPEN	-0.007519	0.170673	-0.044053	0.9652

DOPEN(-1)	-0.587505	0.246971	-2.378839	0.0244
DG	-1.030621	0.652944	-1.578421	0.1257
DY	-0.041176	0.011936	-3.449825	0.0018
DW	1.373728	4.509564	0.304625	0.7629
DR	-14.98850	7.513042	-1.994997	0.0559
C	0.476785	1.006511	0.473701	0.6394
ECMT(-1)	-0.903458	0.150615	-5.998461	0.0000

$R^2 = 0.645$ $S.E.R = 6.012$ $F.St = 5.674(0.000)$ $Schwarz.C = 7.077$
$\bar{R}^2 = 0.532$ $RSS = 1012.218$ $D.W = 1.998$ $Akaike.C = 6.646$

DW is the Iraq-Iran War (1980-1988) Dummy variable
DR is the Islamic Revolution (1979) Dummy variable

Table 9 presents ECM results for model II. The short-run effect of globalization index on inflation is negative and significant at the 5% level. The coefficient of ECMT (-1), is 1.24, significant at the 1% level and negative as be expected, thus approximately all of the disequilibrium from the previous year's shocks in equation (16) converge back to the long-run equilibrium in less than a year.

Table 9: Error correction representation for the selected ARDL (2,2,0,1,2) model

Regressor	Coefficient	Std. Error	t-Statistic	Prob.
DINF(-1)	0.545755	0.160158	3.407599	0.0021
DM	0.072204	0.029498	2.447764	0.0212
DM(-1)	-0.079460	0.036342	-2.186464	0.0376
DKOF	-0.649025	0.290365	-2.235202	0.0339
DG	1.830353	0.649850	2.816577	0.0090
DY	-0.015795	0.009838	-1.605484	0.1200
DY(-1)	0.054147	0.011022	4.912782	0.0000
DW	-10.47274	4.771490	-2.194857	0.0370
DR	10.08442	7.324488	1.376808	0.1799
C	1.056391	0.968495	1.090756	0.2850
ECMT(-1)	-1.240182	0.184692	-6.714862	0.0000

$R^2 = 0.707$ $S.E.R = 5.563$ $F.St = 6.536(0.000)$ $Schwarz.C = 6.981$
$\bar{R}^2 = 0.599$ $RSS = 835.570$ $D.W = 2.294$ $Akaike.C = 6.507$

Table 10 shows diagnostic tests for ARDL(0,2,2,0,0) model that used to investigate the effect of openness on inflation (modelI). In this manner

Breusch-Godfrey serial correlation LM test and Heteroskedasticity ARCH test are used. The LM test indicates that the residuals are not serially correlated, and ARCH test shows that the residuals have not Heteroskedasticity problem. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) plots (Fig. 2) from a recursive estimation of the model also indicate stability in the coefficients over the sample period.

Table 10: ARDL (0,2,2,0,0) model diagnostic tests

Breusch-Godfrey Serial Correlation LM Test:			**Heteroskedasticity Test: ARCH**		
		probe			probe
F-statistic	0.158820	0.6936	F-statistic	0.681958	0.4145
Obs*R-squared	0.239882	0.6243	Obs*R-squared	0.707149	0.4004

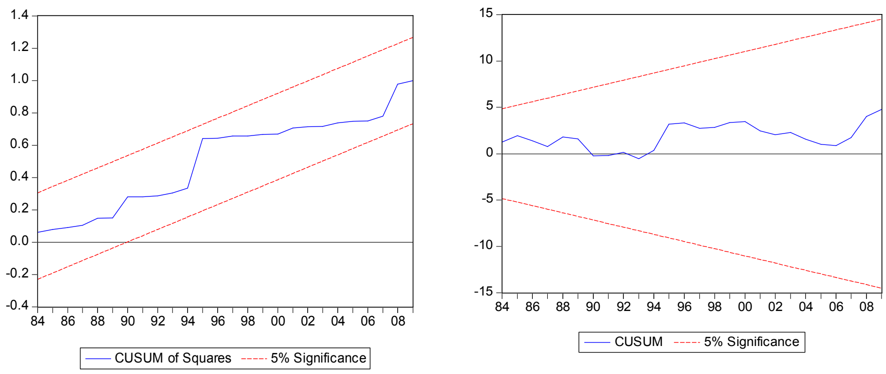

Figure 2: CUSUM and CUSUMQ tests for coefficients stability of ARDL (0,2,2,0,0) model

Table 11 shows diagnostic tests for ARDL (2,2,0,1,2) model that is relevant to the study of globalization on inflation (model II). Breusch-Godfrey serial correlation LM test indicates that the residuals are not serially correlated, and the Heteroskedasticity ARCH test shows that the residuals have not Heteroskedasticity problem. The CUSUM and CUSUMQ plots (Fig. 3) from a recursive estimation of the model also indicate stability in the coefficients over the sample period.

Table 11. ARDL (2,2,0,1,2) model diagnostic tests

Breusch-Godfrey Serial Correlation LM Test:			Heteroskedasticity Test: ARCH		
		probe			probe
F-statistic	2.124114	0.1591	F-statistic	0.945005	0.3377
Obs*R-squared	3.345877	0.0674	Obs*R-squared	0.972741	0.3240

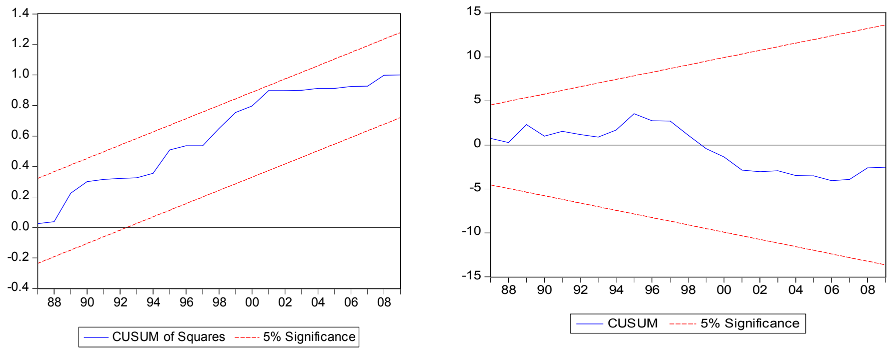

Figure 3: CUSUM and CUSUMQ tests for coefficients stability of ARDL(2,2,0,1,2) model

5. Conclusion

This paper provides evidence on the impact of openness and globalization on the inflation in Iran. We estimate two models; model I to investigate the effects of openness on inflation and model II to investigate the effects of openness on inflation. We apply the Bounds test approach to level relationship and Autoregressive Distributed Lag (ARDL) model proposed by Pesaran et al. (2001).The Results from the Bounds test approach confirm the existence of long-run relationships among the variables under consideration in both models. The results show that openness has a negative and significant effect on inflation in short-run but its effect on inflation in the long-run is positive and significant at the 1% level. The results confirm that globalization has a negative and significant effect on inflation in the short-run at the 5% significance level and in the long-run at the 1% significance level. The coefficient of ECMT(-1) for the model I is 0.903, for model II is 1.240, both significant at the 1% level and negative as expected; thus approximately all of disequilibrium from the previous year's shocks in the model I converge back to the long-run equilibrium in more than a year and in the model II in less than a year. Therefore, the speed of convergence in model II is greater than the model I. Diagnostic tests for both ARDL models indicate stability in the coefficients over the sample period.

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Notes:

1. Zivot and Andrews (1992) propose a unit root test with one possible endogenous structural break and Lumsdaine and Papell (1997)

propose LM unit root test that allows for two unknown structural breaks under both the null and alternative hypotheses.