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Abstract

This paper examines the impact of macroeconomic policies in the era of sanctions on the Iranian economy. The results illustrate the role of the money supply and government spending in supporting growth, but contributing to inflationary pressures in the long-run, attesting to supply-side constraints. In the short-run, policies have aimed to provide support to the economy in the face of continued fluctuations with the oil price and spillovers from the geopolitical tensions attributed to sanctions. The exchange rate has played a key role in absorbing, but at times magnifying the adverse effects of these tensions. Continued deterioration of the fundamentals of the Iranian economy forced an official devaluation as the exchange rate proved to be misaligned with the fundamentals of the economy against the backdrop of the limited capacity of the Central Bank to continue to intervene to defend it. In the meantime, a parallel exchange rate market has been flourishing to satisfy the market's needs for foreign exchange as culminated in the spread between the market exchange rate and the official exchange rate. A wider spread between the parallel market rate and the official rate has signified overvaluation of the rial and proved to be a major source of inflationary expectations and pressures. Wider spread has demanded frequent interventions by the Central Bank to defend the official rate and ultimately has forced an official devaluation of the exchange rate, further increasing inflationary pressures with negative effects on the output supply given high dependency on imports for consumption and investment. As the Iranian economy continues to be challenged by the effects of the unfolding sanctions, policy priorities should be focused on easing structural bottlenecks and enhancing domestic production capacity to reduce the adverse effects of the exchange rate devaluation on output supply and inflationary pressures.

Keywords: inflation, output growth, exchange rate, sanctions.

JEL Classifications: E61, E62, E63, E32, E21

1. Introduction

The Iranian economy has suffered from a series of economic sanctions since 1978. However, the impacts of the sanctions increased drastically in 2012, as the U.S. led a coalition to impose sanctions on Iran in connection to the nuclear program. The sanctions embraced measures to limit the access of the Iranian central bank to the payments system to settle transactions in US dollar and the European Union banned imports of Iranian oil, and tightened sanctions on banking, trade and energy sectors. As a result of the financial sanctions of 2012, the Iranian rial fell to a record low, see Graph 1. Historically, the depreciation of the rial has fueled price inflation and stagnation in Iran as illustrated in Graph 2. For example, more recently in 2018, the severe depreciation of the rial in anticipation of another round of sanctions increased dollarization and resulted in more than 30 percent inflation rate. Absent policies to arrest continued depreciation of the rial, more inflationary pressures could be in the pipelines at a much higher rate with further stagnation in economic conditions.

In normal circumstances, the depreciation of the rial could have been welcome news to boost the competitiveness of Iran's non-oil export sector at least in the short run and reduce the country's increased reliance on oil exports. Ideally, improved competitiveness could help Iran to diversify the export structure, which could ease the effects of the sanctions on the Iranian economy. More importantly, such diversification would circumvent the effects of the sanctions on the payments systems in US dollar denomination which are most applicable to oil exports, allowing the country to diversify the payments structure and currency denomination for other non-energy exports, thereby reducing the impact of the failure to sell oil in the international market.

However, depreciation is a double edge sword in a country that has high dependency on imports for consumption and intermediate goods. Given this high dependency, the benefits of cheaper exports as a result of nominal depreciation could be easily eroded by the higher cost of imports that could fuel price inflation and appreciate the real effective exchange rate despite nominal depreciation. Depreciation increases the cost of imported goods for consumption and production and, therefore, it fuels inflationary expectations and increases the cost of the output produced eroding competitiveness and shrinking the output supply. Given the limited capacity of the Central Bank to defend the exchange rate through proper interventions, depreciation could start a wave of dollarization, magnifying the adverse effects of depreciation on the economy and economic activity. As illustrated in Graphs 3 and 4, while Iran's non-oil output and non-oil exports have increased over the years, the increases have not been large enough to reduce Iran's economic dependency on oil.

Against this backdrop and the most recent wave of economic sanctions imposed by the US Administration on the Iranian economy, this paper aims to investigate the current economic conditions in Iran and the impact of the currency depreciation on real growth and price inflation. Given the lagged effect of the sanctions on the Central Bank's decision to devalue the official exchange rate following multiple attempts to defend its value, the analysis captures the impact of

the parallel market rate and the official exchange rate, on growth and inflation. To capture the channels through which fluctuations in the exchange rate determine the economy, the analysis captures the impacts of the exchange rate fluctuations, both official and the spread of the parallel market rate relative to the official rate, on non-oil exports, imports, and investment. In all empirical models, the analysis includes real government spending and the money supply, as domestic policy variables, and the oil price, as the major source of foreign income receipts for the Iranian economy. The aim is to study the role of macroeconomic policies in sheltering the economy from potential exogenous shocks that may include additional sanctions and further depreciation of the exchange rate, triggering further price inflation and output contraction. The results will be timely for the Iranian economy as it continues to struggle with a challenging external environment that has been inflamed recently by growing geopolitical tensions that could prove to be formidable for the prospects of the Iranian economy under additional sanctions.

2.Methodology and Analysis

Building on the study by Kandil and Mirzaie (2017), domestic macroeconomic policies should be tailored to mitigate the effects of a challenging external environment on the Iranian economy. This paper aims to investigate the effects of the sanctions on exchange rate depreciation in Iran, both the official rate and the spread of the parallel market rate relative to the official rate, and the prospects of monetary and fiscal policies to contain the risks of further capital outflows, increased dollarization and loss of investors' confidence that would collectively further widen the spread between the official and black market exchange rates in Iran.

The choices are limited in such a challenging environment. Imposing capital controls[3] could also work to increase speculation and dollarization, widening the spread between the official and black market exchange rates and fueling further speculative attacks. Hence, domestic policies should aim to foster confidence in the capacity of the economy to weather the shocks in order to ease structural bottlenecks and increase investors' confidence by controlling inflation and reducing dependency on hot capital inflows as a major source of financing domestic credit and infrastructure projects.

To that end, the analysis employs annual data from 1978–2017 to examine the impact of the official and non-official currency (market rate) exchange rates, along with macroeconomic policies, on price inflation, output growth, non-oil export growth, import growth, and investment growth. The analysis will establish the relationships between the domestic and external macroeconomic environment and supporting macroeconomic policies, fiscal and monetary, on the official and black market exchange rates. The impact of the latter on the macroeconomic environment will also be studied to assess bilateral causality and the role of pro-active macroeconomic policy management to arrest the risks of the vicious cycles of depreciation and inflation.

[3] Since 2018, Iran has imposed capital controls by limiting capital outflow, but it has not been able to eliminate the downward pressure on the value of rial.

First, we use an empirical model that includes domestic and external factors that combines the determinants of inflation and economic growth in the long-run with short-term dynamics. Endogeneity is a common concern when analyzing policy implications. Hence, variables in the estimated error correction model are predetermined (entered with a lag) and as such are assumed "weakly" exogenous.

An error correction model is specified as follows:

$$\Delta p_t = c + \delta(p_{t-1} - \alpha_1 m_{t-1} - \alpha_2 g_{t-1} - \alpha_3 exch_{t-1} - \alpha_4 spread_{t-1}) + \sum_{i=1}^{k} b_{1i}\Delta p_{t-i} + \sum_{i=1}^{k} b_{2i}\Delta exch_{t-i} + \sum_{i=1}^{k} b_{3i}\Delta m_{t-i} + \sum_{i=1}^{k} b_{4i}\Delta spread_{t-i} + \sum_{i=1}^{k} b_{5i}\Delta g_{t-i} + \sum_{i=1}^{k} b_{6i}\Delta oilp_{t-i}$$

where P is the domestic price level, *exch*[4] is the value of the US dollar in terms of rial, *Spread* is the difference between the non-official exchange rate (black market parallel rate) and the official rate, *M* is broad money, *G* is real government spending, and *oilp* is oil price. Oil price enters the model as an exogenous variable[5]. When testing, all variables are introduced in log forms. Finally, *k* is the number of lags defining short-run dynamics. Then we estimate the empirical model substituting real growth for price inflation as the dependent variable to determine the real effect of the explanatory variables in the model. To test the success of the Iranian economy to diversify away from oil dependency we zero in the analysis to explain the determinants of the growth in the non-energy real output, non-energy exports, imports and investment.

The empirical model will be augmented with dummy variables to capture the end of the Iran-Iraq war in 1988 and subsequent spending on reconstruction, a 2012[6] dummy, marking the start of financial sanctions against Iran's central bank and its banking system imposed by the international community, and finally a dummy variable in 2015 to capture the nuclear agreement between Iran and the Group of 7, China, France, Germany, the European Union, Russia, the United Kingdom, and the United States.

Then, we repeat the above model to examine the factors determining decisions by the Iranian Central Bank regarding the official exchange rate. That is, we estimate an empirical model that explains movement in the official exchange rate. Finally, we estimate the model to investigate the determinants of the spread, i.e., the gap between the parallel black market rate and the official

[4] An Increase in the exchange rate indicates depreciation of the rial against the U.S. dollar.
[5] Mohaddes and Pesaran (2016) conclude that the international oil price is weakly exogenous for Iran. They provide evidence that negative shocks to the Iranian oil production are neutralized by the increase in Saudi Arabia's oil production.
[6] In 2012, the International Community, led by the US, tightened sanctions on the banking and energy sectors of Iran. As a result, the Iranian rial fell by 80 percent from its 2011 value.

exchange rate of the rial as posted by the Central Bank. Accordingly, the following empirical model is estimated:

$$\Delta exch_t = c + \delta(exch_{t-1} - \alpha_1 m_{t-1} - \alpha_2 g_{t-1} - \alpha_3 spread_{t-1}) + \sum_{i=1}^{k} b_{1i}\Delta exch_{t-i} + \sum_{i=1}^{k} b_{2i}\Delta spread_{t-i} + \sum_{i=1}^{k} b_{3i}\Delta m_{t-i} + \sum_{i=1}^{k} b_{4t}\Delta g_{t-i} + \sum_{i=1}^{k} b_{5t}\Delta oilp_{t-i}$$

The results of the estimations are reported in Tables 1, and 2 and discussed in the next section.

3. Data and Estimation

The details of the data and their sources are reported in Appendix A. Our empirical tests confirm the existence of unit roots in variables while the first difference of variables is stationary, see the test result in Appendix Table A1.

We use a Vector Autoregressive (VAR) lag order selection criteria to select the lag length for each model. Following evidence of non-stationarity, using the number of lags from VAR, we run the Johnsen co-integration tests[7]. The tests confirm at least one co-integration vector for each model. Then, we run vector error correction models and the estimation results identify determinants of inflation, real growth, real non-oil output growth, non-oil export growth, import growth, investment growth, the rate of change in the official exchange rate, and the rate of change in the spread between the parallel black market rate and the official rate, both in the long-run as well as the short-run dynamics.

The long-run specification in the models includes the money supply and government spending, the official value of the US dollar in terms of rial[8], and the spread between the non-official and the official exchange rates. The short-run dynamics also includes the oil price, a major source of determining foreign exchange receipts and economic conditions in Iran, and dummy variables to mark the end of the 1988 Iran-Iraq war, imposing sanctions in 2012 and easing these sanctions in 2015. Tables 1 and 2 report the results.

3.1. Inflation

The price level increases in the long run with the money supply, depreciation of the official exchange rate, and a wider spread, i.e., a higher market exchange rate relative to the official exchange rate of the US dollar in terms of rial. Government spending decreases inflation in the

[7] The results for both the lag structure and co-integration are available upon request.

[8] The exchange rate is defined as the number of rials per US dollar. A higher exchange rate represents devaluation of the rial. An increase in the spread also captures the depreciation of the rial in the unofficial exchange rate market relative to the official exchange rate posted by the Central Bank.

long-run, signifying the importance of government spending to capacity building and easing supply-side constraints. Monetary growth increases inflation in the long run, signifying capacity constraints that force higher inflation with continued increase in domestic liquidity over time.

Depreciation of the official exchange rate fuels price inflation in the long run, attesting to higher cost of imports and limited domestic capacity to compensate for imported inflation. Similarly, an increase in the spread, i.e., depreciation of the market rate relative to the official exchange rate, has fueled price inflation over time, attesting to limited supply of foreign exchange at the official exchange rate, resulting in higher cost of imports at the market exchange rate and tighter domestic supply constraints.

Monetary growth increases price inflation in the short run, solidifying the evidence regarding capacity constraints in the face of higher domestic liquidity. An increase in government spending has some negative impact on inflation in the short run, signifying efforts to ease capacity constraints via higher government spending. An increase in the oil price also has a negative effect on price inflation in the short run, signifying the role of oil revenues in supporting government spending on capacity building.

The end of the Iran-Iraq war, captured by the dummy 88, led to a higher inflation in the short run as it magnified the economy's tight capacity constraints. The 2015 nuclear agreement, captured by the dummy15, signifies that the agreement helped to reduce inflationary expectations and thereby the rate of inflation in anticipation of easing constraints on foreign exchange and tight production capacity.

3.2. Output Growth

In the long-run, output growth increases with the money supply and government spending. The evidence attests to the importance of government spending and supporting domestic liquidity to ease capacity constraints and contribute to long-term growth of the economy. However, Iran's government faces restrictions in its access to the global financial market because of sanctions; Graph 5 illustrates the amount of Iranian government's external debt for more than two decades. As it is shown, the level of external borrowing has declined in recent years because of the financial sanctions that have restricted Iran's government ability to borrow on the international market.

In the short-run, monetary growth has a negative significant impact on growth while the increase in government spending has no significant effect on growth. The former channel signifies tight capacity constraints with the increase in the money supply that depreciates the value of the Iranian rial and increases the cost of the output produced.

Further, depreciation of the official exchange rate or a wider spread of the black market parallel exchange rate relative to the official rate do not have any significant impact on output growth,

indicating binding supply-side constraints that limit the scope of mobilizing non-energy output growth capitalizing on nominal depreciation to enhance competitiveness. The end of Iran-Iraq war in 1988 led to higher economic growth as it helped to ease capacity constraints. None of the other structural break dummies in the empirical model has a significant impact on output growth in Table 1.

3.3. Non-oil Output Growth

For an economy that is positioning itself towards further diversification given the high share of oil in the economy, the analysis should consider the determinants of non-energy growth, in the long and short-term to establish determinants of competitiveness and the role of stabilization policies to counter the adverse effects of external shocks on the economy.

In the long-run, non-oil growth is not affected by expansionary monetary or fiscal policy while depreciation of the rial does has a significant positive effect on non-oil output growth. The evidence stablishes the importance of nominal depreciation to boost competitiveness of the non-energy activity and expand non-energy growth.

In the short-run, neither monetary growth nor government spending stimulate non-oil growth. The evidence signifies limitations on policies to boost competitiveness and further diversification of the economy. In contrast to the long-run evidence, depreciation of the official exchange rate and the market parallel exchange rate of the rial affect non-oil growth negatively in the short run. The evidence attests to binding supply side constraints and failure to mobilize currency depreciation towards boosting competitiveness and mobilizing non-energy growth in the short-run. Given capacity constraints, depreciation increases the cost of intermediate goods with a negative effect on the output supply and non-energy growth.

Higher oil price has a positive significant impact on non-oil real growth in the short-run. The evidence attests to the supporting role of energy price and higher oil receipts to domestic resources, which helps relax constraints on financing and eases constraints on capacity building and non-energy growth.

3.4. Non-Energy Export Growth

In the long-run, non-energy export growth increases with the money supply and government spending. Higher monetary growth eases liquidity constraints in support of non-energy export growth. Higher government spending contributes to capacity building and higher non-energy export growth.

Depreciation of both the official rate and the market exchange rate (a wider spread) of the rial has no impact on non-energy export growth in the long-run. In fact, nominal depreciation, alone, cannot boost competitiveness to mobilize non-energy export growth given binding supply-side

constraints and high dependency on intermediate imported goods. Further, nominal depreciation is inflationary, as discussed above, appreciating the real exchange rate and eroding competitiveness, notwithstanding nominal depreciation.

In the short-run, growth in the money supply and government spending do not provide significant support towards mobilizing non-energy export growth, signifying failure to prioritize government spending, capitalizing on available liquidity, towards supporting further diversification of the economy.

Depreciation of the market parallel exchange rate relative to the official exchange rate (a wider spread) has a positive but not significant effect on non-energy export growth. However, an increase in the oil price has a negative significant effect on non-energy export growth, providing evidence of the Dutch disease phenomenon. Higher oil exports reduce incentives to mobilize non-energy growth and appreciate the exchange rate, eroding competitiveness. None of the structural break dummies in the empirical model has any significant effect on non-energy export growth in the short-run.

3.5. Import Growth

In the long-run, import growth increases with the money supply and higher government spending. As domestic demand increases in response to higher money supply and government spending, imports grow over time, signifying the dependency of the economy on imports. However, devaluation of the rial increases the cost of imports and decreases imports significantly in the long-run.

In the short-run, higher government spending has a negative effect on import growth. By targeting capacity building, higher government spending decreases imports in the short-run. Depreciation of the market exchange rate relative to the official exchange rate, i.e., a wider spread, decreases imports in the short-run. Depreciation of the exchange rate, as evident by a higher spread, increases the cost of imports and curbs demand. Higher oil price has a negative and significant effect on imports. Higher oil price decreases incentives for diversification of the economy and investing in the non-energy sector. Hence, the demand for imported intermediate goods decreases.

The end of the Iran-Iraq war mobilized demand for imports to build the economy and replace depleted capacity, as evident by the significant positive coefficient on the Dummy88 in the empirical model. In contrast, imposing sanctions by the international community in 2012 had a negative significant impact on import growth as Iran was cut out of the international payments system.

3.6. Investment Growth

In the long-run, depreciation of the rial increases investment growth. Depreciation increases the prospects of boosting competitiveness and reduces the cost of foreign direct investment. Neither the increase in the money supply nor higher Government spending stimulate investment growth in the Long run, signifying failure to mobilize investment decisions via domestic policies over time. In the short run, depreciation decreases investment growth as it renders the costs of imported intermediate goods more expensive. In contrast, higher oil price stimulates investment growth, which could be targeting the energy sector.

3.7. Analysis of Developments in the Exchange Rate

We extend the analysis to investigate the long run and short run drivers of fluctuations in the official exchange rate and the spread between the black market parallel rate and the official exchange rate. The long-run specification in this model includes the money supply and government spending, the official exchange rate, and the spread between the parallel black market and official exchange rates. The short-run dynamics also includes the oil price and the three dummy variables for possible structural breaks. The test results are shown in Table 2.

3.8. Official Exchange Rate

The exchange rate depreciates in the long-run with an increase in the money supply. Higher monetary growth increases domestic liquidity, forcing depreciation of the official exchange rate over time. Moreover, higher government spending depreciates the official exchange in the long-run, signifying the high import content of government spending and related domestic demand.

In the short run, neither money supply growth nor the growth in government spending has any significant effect on the official exchange rate. On the other hand, an increase in the oil price leads to appreciation of the official exchange rate. Higher oil price translates to higher foreign exchange receipts in support of exchange rate appreciation. The nuclear agreement of 2015 also boosted confidence in the capacity of the Iranian economy to mobilize further foreign exchange receipts, resulting in an appreciation of official exchange rate of the rial.

3.9. Spread between Market and Official Exchange Rates

In the long-run, an increase in the money supply decreases the spread. Higher money supply growth increases the downward pressure on the official exchange rate, narrowing the spread, relative the market parallel rate.

Similarly, higher government spending decreases the spread in the long run. Higher government spending increases depreciation pressures relative to the black market parallel rate, narrowing the spread over time. Devaluation of the official exchange rate of the rial has a positive significant impact on the spread. Devaluation may increase speculative attacks and erode confidence in the

central bank's ability to defend the rial. As a result, official devaluation of the exchange rate leads to a wider spread.

In the short-run, higher oil price has a positive and significant effect on the spread of the market parallel exchange rate relative to the official exchange rate. Higher oil price shores up the international reserves position of the central bank, providing support for the official exchange rate, mitigating depreciation pressures on the official exchange rate. Hence, the spread appears to be wider between the market and the official exchange rates in response to solidifying the official exchange rate of the rial because of higher oil price in the short-run.

4. Autoregressive Distributed Lag Model

In order to check for the robustness of the results, we run all the models above using Auto Regressive Distributed Lag (ARDL) model. The advantage of the model is that it includes contemporaneous values of the variables, both stationary and non-stationary, fitting the model to the optimal lag length. The results are presented in Tables 3 and 4.

According to the results, inflation is persistent as evident by the statistically significant lag. Higher money supply increases inflation due to the increase in domestic liquidity. Government spending decreases inflation in further evidence of targeting capacity building. Depreciation of the official exchange rate increases inflation as it increases the cost of imports. The end of the Iran-Iraq war resulted in higher inflation while the nuclear agreement of 2015 decreased inflationary pressures. Real GDP growth is persistent as the coefficient on the one-year lagged dependent variable is positive and significant. The transmission mechanism from monetary growth to the real economy appears to be slow over time. Higher monetary growth increases real growth although with a-three-year lag as the effect of easing constraints on domestic liquidity is mobilized fully towards supporting real growth.

Higher government spending increases real GDP growth, which signifies the importance of the fiscal stimulus in mobilizing capacity building. Depreciation of the official exchange rate increases real GDP growth as it supports competitiveness and fosters investment confidence. The end of Iran-Iraq war in 1988 led to higher economic growth mainly by increasing oil production, fostering confidence and diverting resources towards capacity building of the domestic economy.

None of the coefficients on the lagged dependent variable is positive and significant ruling out high degree of persistence in non-oil GDP growth. Higher monetary growth avails liquidity in support of higher non-energy growth, albeit with a 3-year lag. Higher growth of government spending also helps stimulate non-energy growth, albeit with a 1-year lag. Higher oil price inflation stimulates non-energy growth in the current period. The nuclear agreement of 2015 has a negative significant impact on non-oil GDP growth. The agreement eased sanctions and access to the international payments system for dollar clearance. Subsequently, priorities were focused on

ramping up oil production, which was mostly affected by the sanctions, rather than increasing non-energy growth.

Non-oil export growth appears to be somewhat persistent as evident by the statistically significant coefficient on its first lag. Higher monetary growth is significant in promoting non-oil export growth as it avails necessary liquidity. Depreciation of the official exchange rate has a positive significant impact on non-oil export growth in the current period. However, the signs of the coefficients on the lags indicate negative effects of the official devaluation of the exchange rate on competitiveness and the growth of non-oil exports in the following periods. Over the longer period, depreciation increases inflationary pressures, as evident form the results in the price model, appreciating the real exchange rate and eroding competitiveness for non-oil exports. Similarly, a wider spread signifies higher cost of imports, which erodes competitiveness for non-energy exports, as evident by the negative and statistically significant coefficient in the current period. Higher oil price decreases non-oil export growth, providing further evidence of the Dutch disease phenomenon as oil resources reduce incentives for diversification of the economy.

Import growth is persistent as evident by the positive and significant coefficient on its first lagged value. Higher monetary growth decreases imports with a 2-year lag before increasing it in the third year. The reduction is attributed to the effect of monetary growth in depreciating the rial and increasing the cost of imports. Subsequently, higher liquidity and economic growth help revive the demand for imports over time. Higher growth of government spending increases imports attesting to the high import content of government spending. Official devaluation has a negative significant effect on import growth. Wider spread between the black market parallel rate, compared to the official exchange rate, increases the cost of imports with a negative effect on import growth. Imports increased after the Iran-Iraq war as domestic demand recovered in support of mobilizing the domestic economy. However, imposing sanctions by the international community in 2012 increased the cost of imports and disrupted access to the international payments system with a negative effect on import growth.

Investment growth is persistent as evident by the positive and significant coefficient of adjustment to its first lag. Monetary growth initially depresses investment demand due to depreciation and higher inflationary pressures. Subsequently, investment growth recovers with a lag as liquidity support helps stimulate investment demand. Higher government spending is targeting capacity building, stimulating investment growth in the current period. Depreciation of the rial has a negative significant effect on investment growth, although with a lag. Depreciation increases the cost of imports and decreases the return on investment. Imposing financial sanctions in 2012 had a negative significant effect on investment growth as it increased uncertainty and discouraged commitments by investors. The nuclear agreement of 2015 also had an inverse effect on investment growth in Iran. Despite easing sanctions, investors did not rush to commit to long-term investment decisions awaiting more evidence of confidence concerning the outlook.

In Table 4, movement in the depreciation of the official exchange rate appears persistent, as evident by the positive and significant response to its first lag. A wider spread between the black market and the official rate has a positive significant effect on the latter. Wider spread forces an official devaluation, although with a 1-year lag.

The spread between the official and black market exchange rates decreases with the depreciation of the official exchange rate as evident by the negative and significant coefficient in the current period. Subsequently, failure to adjust the official exchange rate (an overvaluation) increases the spread relative to the black market parallel exchange rate, as evident by the positive and significant response to the lagged values of the official exchange rate. The spread between the black market and the official exchange rates appears to be persistent as evident by the positive and significant response to its first lag. An increase in the growth of government spending has a negative effect on the spread, as it forces a depreciation of the official exchange rate in response to higher demand for imports.

5. Conclusion and Policy Implications

The exchange rate of the Iranian rial reflects the demand for the rial relative to foreign currencies that are needed for imports and settling external debt services and other foreign liabilities. On the other hand, the available supply of foreign exchange increases with higher demand for the rial by foreigners through higher Iranian exports and more financial inflows to Iran's economy for investments. Building the capacity of the central bank through higher international reserves and fostering confidence in the stability of the exchange rate will stabilize the demand to hold rial by the citizens of Iran, compared to alternative instruments to store wealth, and stem the risks of dollarization.

Against this backdrop, Iran has been facing mounting challenges to external stability that have been more formidable under the sanctions imposed by the International Community on the country. In the wake of these sanctions, the natural inflows of foreign income receipts have considerably declined, while the demand for foreign currency by locals has increased to keep up with the need to import and service the outstanding external debt. The situation has become worse due to loss of confidence in the stability of the exchange rate that increased speculative demand and dollarization given further expectations of depreciating rial and additional sanctions. Many agents have opted to hoard dollar savings in anticipation of further depreciation of the rial against the backdrop of lingering shortages of foreign exchange that could become even worse under renewed waves of sanctions, restrictions to sell Iranian oil exports on the international market and loss of access to the US dollar clearing system for settlements of payments for international transactions through correspondent banks.[9]

[9] Recently, swift has announced cutting Iranian banks from the swift system to avoid sanctions by the U.S.

For policy implications, priorities should be in place to reach an agreement with the international community to ease sanctions and resume natural inflows of trade and investment to the Iranian economy. In parallel, and given the prospects of more challenging and continued volatility of the external environment, both public and private resources should be focused on relaxing binding domestic capacity constraints, capitalizing on oil resources in Iran (assuming resumption of oil exports on the international market) towards further diversification of the economy and less dependency on oil resources and continued fluctuations in the oil price that have proven to be a difficult political weapon.[10]

Faced with the continued prospects of a challenging environment, aligning the official exchange rate with the underlying fundamentals will help boost the competitiveness of non-energy exports, as the evidence attests. Blocking the channel from exchange rate depreciation to inflation would be facilitated by easing capacity constraints to reduce dependency on imported inflation. Higher inflation in response to exchange rate depreciation has fueled inflationary expectations and eroded the public's confidence in the capacity of the Central Bank to intervene in the foreign exchange rate market, fueling expectations of further monetization of higher government spending and hence further higher inflation.

Inflationary pressures, as the evidence attests, could prove detrimental to the non-energy export competitiveness, hampering efforts to diversify resources and expanding capacity to sustain non-energy output growth. Diversification of the economy will also help shore up non-oil revenues in the government budget, reducing increased reliance on government spending against the backdrop of continued fluctuations in budgetary oil revenues with the oil price that has been made more volatile by the international sanctions on Iran's oil exports.

Switching to a transparent exchange rate management regime would help. Among the options is to employ a basket peg with weights that reflect the shares of major trading partners in Iran's total trade of non-oil exports and imports. A more diversified structure of trading partners on the Import side or for non-oil exports could help ease the impact of economic sanctions as some major partners may be willing to swap rial directly in exchange for their currencies. Alternatively, the exchange rate could be aligned with the price of oil, although at a higher risk of continuing to settle oil receipts in dollar denomination, which could be targeted for further international sanctions if Iranian banks continue to face restrictions on dollar clearance for international settlements.

Regardless of the exchange rate system, closing the gap between the official and the market exchange rates, and more transparency in managing the exchange rate would anchor expectations and solidify external stability. Such transparency would also foster confidence to stem continued

[10] Despite recent evidence of significant drop in Iranian exports in anticipation of the new wave of sanctions, the US Administration granted a temporary waiver to eight countries to continue to import oil from Iran, which led to an increase in the supply of oil in the international market and the recent reduction in the oil price. Recently, this waiver has been suspended, increasing constraints on Iranian oil exports to the international markets.

speculative pressures on the rial and increase agents' confidence in rial holdings. Boosting confidence in the exchange rate and its alignment with the underlying fundamentals of the economy would reduce the need for trading in the parallel black market.

Priorities of the Central Bank should be focused on containing the risks of abrupt discretionary devaluation of the rial in response to long episodes of pronounced over-valuation and foreign exchange shortages that may not be sustained against the backdrop of increasingly challenging external environment and finite holdings of international reserves. Arresting exchange rate risks and boosting confidence in the management and transparency of the exchange rate system would pave the way for macroeconomic stabilization, focusing domestic policy priorities on hedging against global spillovers in the short-term and building capacity in the long-term for sustainable growth and more diversified structure of the Iranian economy.

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Figure 1. The Official and Non-official Exchange Rates and the Spread, 1978-2018

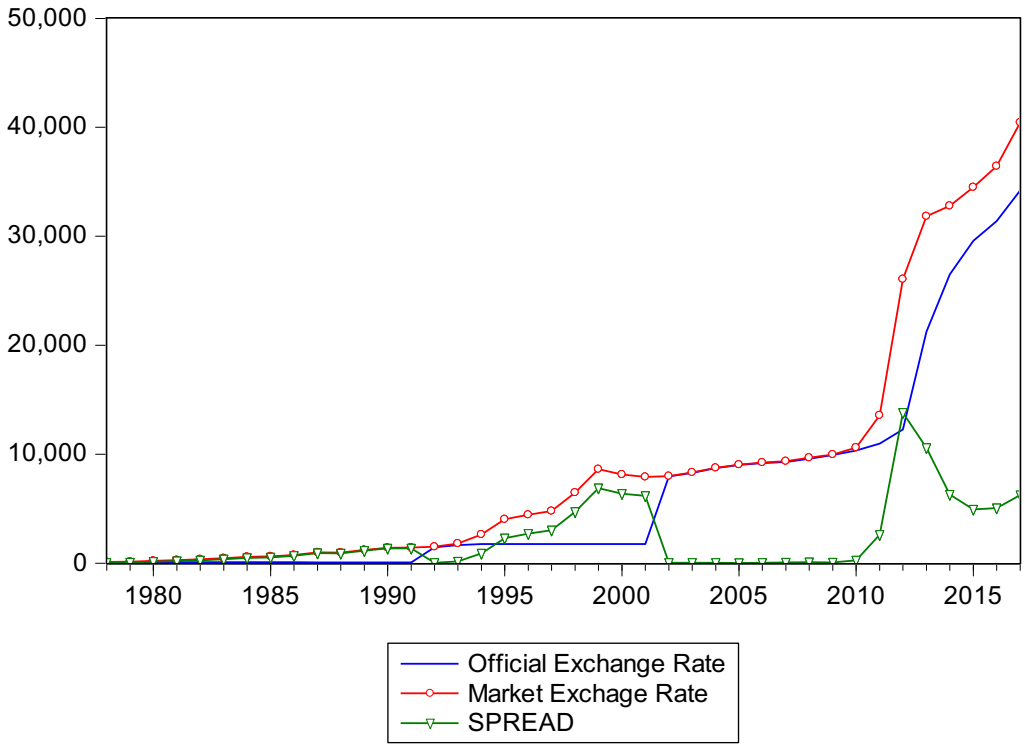

Figure 2. Market Exchange rate depreciation, Inflation & Non-oil GDP Growth, 1978 - 2017

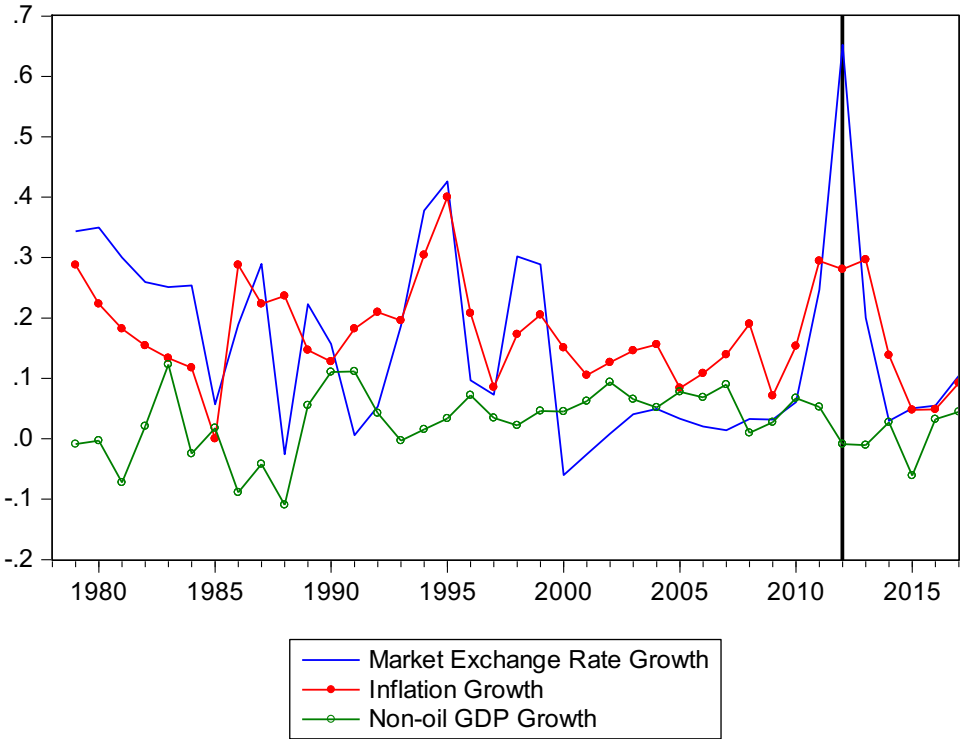

Figure 3. Oil and Non-oil Export Ratios to Total Export, 1978 - 2017

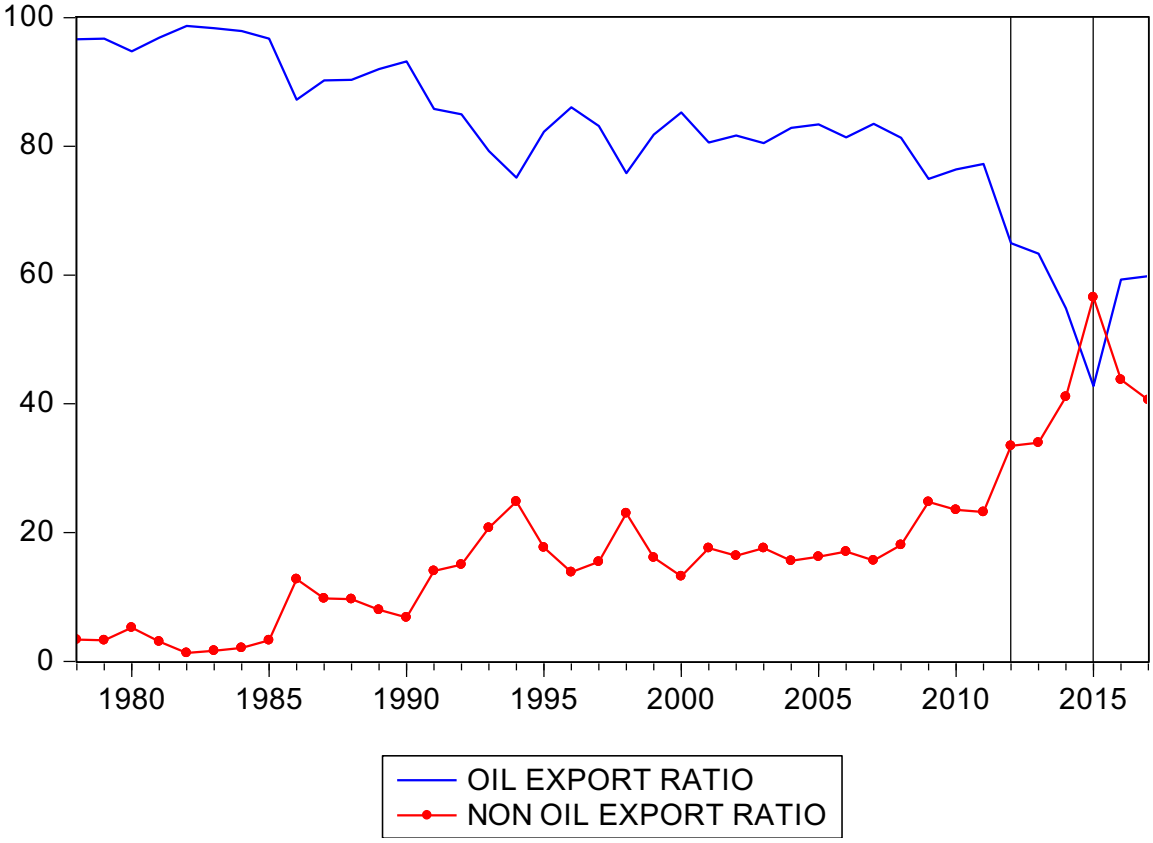

Figure 4. Ratio of Non-oil Output to Total Output, 1978 - 2017

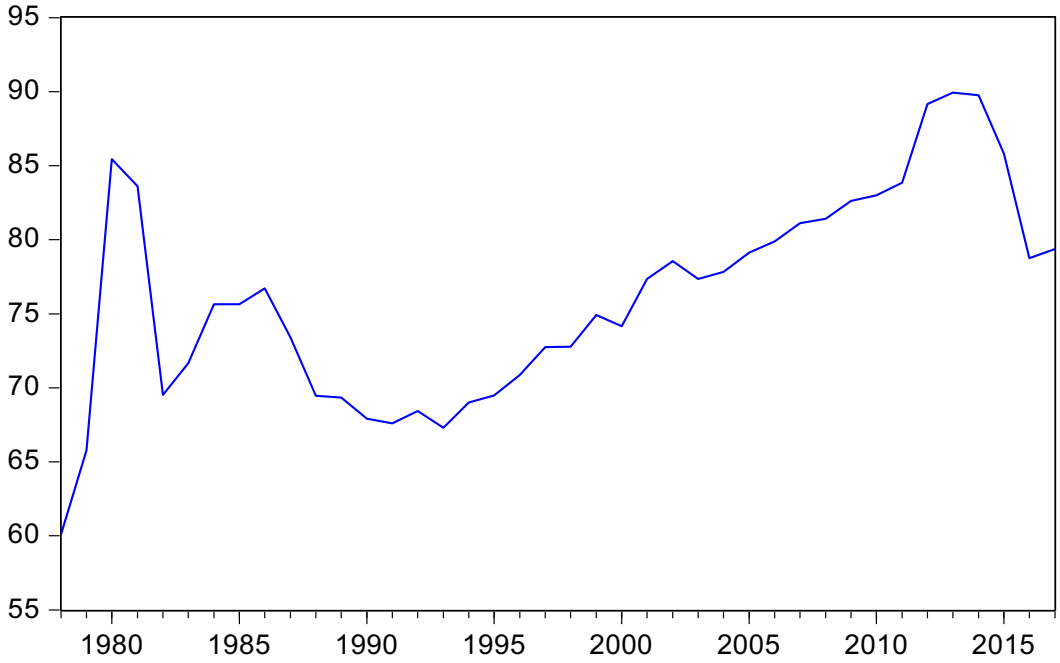

Figure 5. Iran's Government Total External Debt (million dollars), 1993-2017

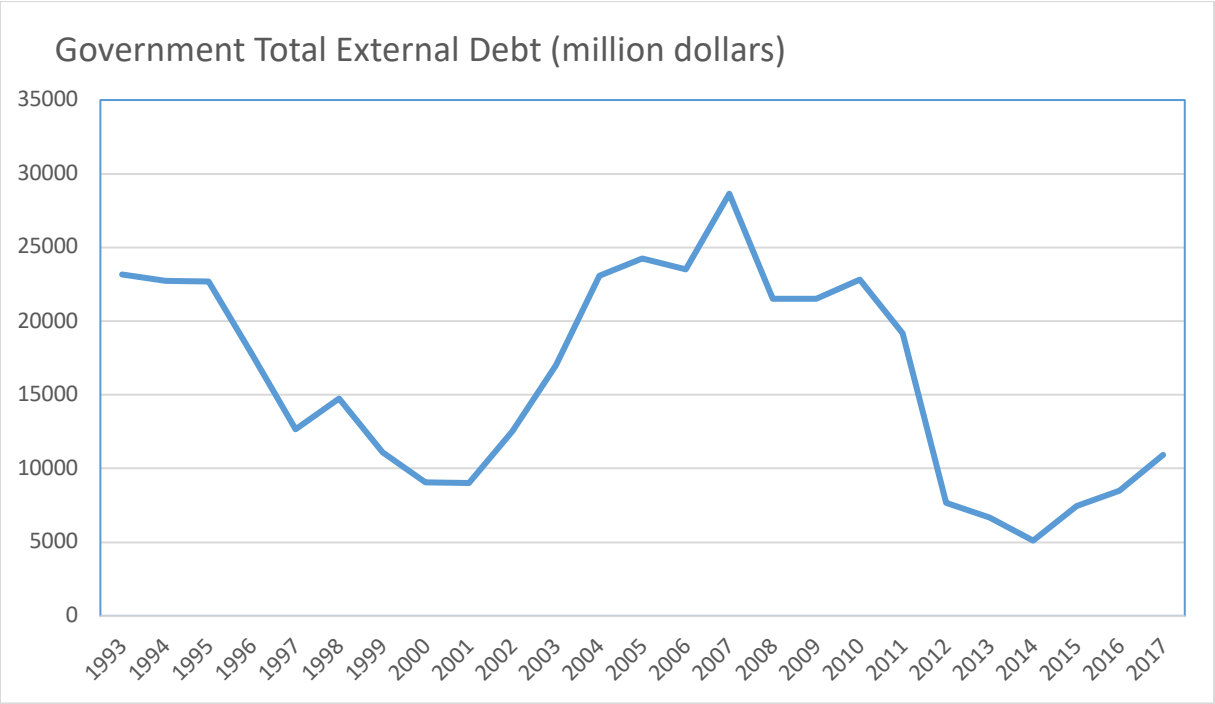

Table 1. Vector Error Correction Estimates[11]

	Model 1 PRICE	Model 2 REAL GDP	Model 3 Non-oil GDP	Model 4 Non-oil EXPORT	Model 5 IMPORT	Model 6 INVEST
Long Run Equation						
Log(M (-1))	0.56**	0.11**	0.01	1.01**	0.78**	-0.02
	(34.22)	(6.71)	(0.27)	(3.61)	(5.38)	(-0.19)
Log(G (-1))	-0.82**	0.27**	-0.40	6.27**	5.35**	-0.98
	(-3.79)	(2.54)	(-1.61)	(4.07)	(5.49)	(1.32)
Log(exch(-1))	0.28**	0.02	0.14**	0.37	-1.01**	0.26**
	(13.03)	(1.08)	(4.07)	(1.48)	(-7.45)	(3.43)
Log(spread(-1))	0.04**	-0.01	-0.01	-0.06	-0.004	-0.02
	(6.59)	(-1.14)	(-0.58)	(-0.75)	(-0.09)	(-0.70)
C	-3.44	-9.40	-17.51	73.57	53.79	21.92
Adjustment Coefficient						
	-0.43*	-1.07**	-0.26**	-0.64**	-0.15*	-0.66**
	(-2.03)	(-8.80)	(-2.63)	(-3.14)	(-2.03)	(-2.80)
Short Run Dynamic						
D(Log((P(-1)))	-0.18					
	(-0.97)					
D(Log((P (-2)))	-0.67**					
	(-4.41)					
D(Log((P (-3)))	-0.19					
	(-1.34)					
D(Log(((Y(-1))		0.53**				
		(4.57)				
D(Log((NON-OIL GDP(-1)))			0.16			
			(0.94)			
D(Log((EXPORT(-1)))				0.83**		
				(2.76)		
D(Log((IMPORT(-1)))					-0.08	
					(-0.51)	
D(Log((INVESTMENT(-1)))						0.68**
						(2.58)
D(Log((INVESTMENT(-2)))						0.31
						(1.32)
D(Log((M(-1)))	0.41**	-0.31**	-0.04	1.98	0.64	1.57
	(2.10)	(-2.57)	(-0.32)	(1.03)	(1.42)	(1.62)
D(Log((M (-2)))	0.02					-1.16
	(0.19)					(-1.29)

[11] The signs of long run equation has been reversed to reflect the actual impact.

Table 1. Vector Error Correction Estimates, continued

	Model 1 PRICE	Model 2 Real GDP	Model 3 Non-oil Y	Model 4 Export	Model 5 Import	Model 6 Investment
D(Log((M (-3)))	0.28					
	(1.24)					
D(Log((G(-1)))	-0.21	-0.10	0.61	0.20	-1.30**	-0.36
	(-0.90)	(-0.80)	(1.23)	(0.12)	(-2.95)	(-0.37)
D(Log((G(-2)))	-0.38**					0.03
	(-2.56)					(0.03)
D(Log((G(-3)))	-0.19					
	(-1.48)					
D(log((exch(-1)))	-0.05	0.01	-0.05**	-0.05	-0.12	-0.28**
	(-0.87)	(0.68)	(-2.37)	(-0.10)	(-1.24)	(-2.55)
D(log((exch(-2)))	-0.05					-0.08
	(-0.13)					(-0.54)
D(Log((exch(-3)))	0.05					
	(1.44)					
D(log((spread(-1)))	0.01	0.002	-0.01*	0.24	-0.09**	-0.07
	(0.79)	(0.27)	(-1.69)	(1.58)	(-2.68)	(-1.28)
D(log((spread(-2)))	0.01					-0.03
	(0.91)					(-0.60)
D(log((spread(-3)))	0.05					
	(1.12)					
Constant	0.40**	-0.23**	-0.27**	1.99**	0.08	-0.62**
	(5.20)	(4.65)	(-3.04)	(2.70)	(0.45)	(-2.18)
Log(oilprice)	-0.08**	0.07**	0.08**	-0.78*	-0.11*	0.22*
	(-4.71)	(5.09)	(2.76)	(-2.66)	(-1.72)	(1.76)
DUMMY88	0.14**	0.08**	0.33	0.36	0.25**	-0.17
	(2.61)	(4.12)	(1.46)	(1.47)	(2.97)	(-1.07)
DUMMY12	0.01	-0.02	-0.04	0.29	-0.24**	-0,14
	(0.33)	(-0.69)	(-1.30)	(0.86)	(-2.23)	(-0.83)
DUMMY15	-0.15**	0.03	0.06	-0.77	0.11	-0.07
	(-2.57)	(0.93)	(1.44)	(-1.58)	(0.78)	(-0.29)
R-squared	0.89	0.81	0.57	0.49	0.52	0.62
Adj. R-squared	0.75	0.74	0.40	0.30	0.35	0.34
Log Likelihood	83.83	75.87	73.35	-21.04	26.03	16.26
Akaike AIC	-3.49	-3.41	-3.28	1.68	-0.79	-0.14

t-statistics are in brackets

** 5 percent significant, * 10 percent significant.

Table 2. Vector Error Correction Estimates[12]

	Model 7 Exchange Rate	Model 8 Spread
Long Run Equation		
Log(M (-1))	0.89**	-11.32
	(9.48)	(-4.91)
Log(G (-1))	6.03**	-76.04**
	(5.91)	(-4.56)
Log(SPREAD (-1))	0.08	
	(1.38)	
Log(exch(-1))		12.62**
		(5.66)
C	76.46	-964.65
Adjustment Coefficient	-0.73**	-0.11**
	(-3.20)	(-2.60)
Short Run Dynamic		
D(Log((EXCH (-1)))	0.54*	0.13
	(1.74)	(0.19)
D(Log((SPRED (-1)))	0.10	0.27
	(0.87)	(1.09)
D(Log((M (-1)))	1.92	-3.60
	(1.16)	(-0.98)
D(Log((G (-1)))	-0.91	3.14
	(-0.53)	(0.84)
Constant	3.07**	-6.28**
	(3.06)	(-2.81)
Log(Oil Price)	-1.05**	2.20**
	(-3.14)	(2.96)
DUMMY88	0.37	-0.71
	(1.47)	(-1.23)
DUMMY12	-0.10	-0.57
	(-0.29)	(-0.71)
DUMMY15	-0.95*	2.27**
	(1.81)	(1.95)
R-squared	0.32	0.37
Adj. R-squared	0.10	0.16
Log Likelihood	-23.30	-53.27
Akaike AIC	1.75	3.35

[12] The signs of long run equation have been reversed to reflect the actual impact. t-statistics are in brackets
** 5 percent significant, * 10 percent significant.

Table 3. ARDL Test Results

Models: Investment	PRICE	Real GDP	Non-oil GDP	Non-Oil Export	Import	
Log (p(-1))	-0.06					
	(-0.19)					
Log (p(-2))	-0.35					
	(-1.44)					
Log (p(-3))	0.44**					
	(3.30)					
Log (y(-1))		0.40**				
		(2.88)				
Log (y(-2))		-0.48**				
		(-4.26)				
Log(nonoily(-1))			0.13			
			(0.59)			
Log (non-oil y(-2))			-0.13			
			(-0.79)			
Log (non-oil y(-3))			-0.30*			
			(-1.82)			
Log (export(-1))				0.57**		
				(2.82)		
Log (export(-2))				-0.38**		
				(-2.63)		
Log (import(-1))					0..44**	
					(2.36)	
Log (import(-2))					-0.19	
					(-1.29)	
Log (investment(-1))						0.70**
						(3.04)
Log (investment(-2)						-0.50**
						(-2.91)
Log (M)	0.04	-0.03	-0.08	0.34**	0.10	-1.37**
	(0.23)	(-0.24)	(-0.74)	(2.93)	(0.25)	(-2.21)
Log (M(-1))	0.60**	0.03	0.25		0.86	3.59**
	(2.11)	(0.13)	(1.41)		(1.19)	(4.00)
Log (M(-2))	-0.39	-0.20	-0.36*		-1.60**	-4.13**
	(-1.62)	(-0.86)	(-1.89)		(-2.32)	(-4.17)
Log (M(-3))	0.29*	0.32**	0.40**		0.83*	2.20**
	(1.73)	(2.31)	(3.64)		(2.01)	(3.21)
Log (G)	0.04	0.34**	0.22	0.05	1.38**	3.40**
	(0.19)	(2.19)	(1.63)	(0.09)	(3.01)	(5.33)
Log (G(-1))	-0.92**	-0.09	0.31*		-0.72	-1.82**
	(-3.64)	(-0.61)	(1.87)		(-1.45)	(-3.03)
Log (G(-2))	-0.51**	0.30*	0.29*		1.10**	0.88
	(-2.15)	(1.77)	(1.85)		(2.13)	(1.23)
Log (G(-3))	0.30*					

	(1.94)					
Log (EXCH)	0.05**	0.04*	0.01	0.96**	-0.10**	-0.08
	(2.45)	(1.79)	(0.64)	(9.09)	(-2.33)	(-1.05)
Log (EXCH(-1))	0.07*	-0.04	-0.01	-0.58**	-0.09	-0.15*
	1.88)	(-1.40)	(-0.94)	(-2.83)	(-1.69)	(-1.74)
Log (EXCH(-2))	0.08**		-0.02	0.39*	-0.10*	
	(2.39)		(-1.24)	(1.84)	(-2.03)	
Log (EXCH(-3))	0.08**		-0.01	-0.43**		
	(3.73)		(0.98)	(-3.73)		
Log (SPREAD)	-0.01	0.01	0.004	0.02	-0.04**	-0.001
	(-0.56)	(1.04)	(0.83)	(0.50)	(-2.60)	(-0.05)
Log (SPREAD(-1))	0.02	-0.02		-0.05		
	(1.61)	(-1.52)		(-0.74)		
Log (SPREAD(-2))	0.01			0.04		
	(0.96)			(0.51)		
Log (SPREAD(-3))				-0.17**		
				(-3.30)		
Log (OILP)	-0.03	0.04	0.08**	-0.31*	-0.02	-0.19
	(-0.70)	(1.14)	(2.35)	(-1.82)	(-0.16)	(-1.48)
Dummy 88	0.18**	0.11**	0.03	-0.03	0.38**	0.25
	(2.89)	(2.46)	(0.05)	(-0.19)	(2.73)	(1.40)
Dummy 12	-0.26	-0.0004	0.01	0.002	-0.22*	-0.30*
	(-0.78)	(-0.01)	(0.19)	(0.01)	(-1.71)	(-1.71)
Dummy 15	-0.19**	0.01	-0.11**	0.05	-0.90	-0.45**
	(-3.42)	(0.12)	(-2.45)	(0.23)	(-0.72)	(-2.64)
C	7.10**	6.97**	5.53*	3.36	-11.78*	-20.84**
	(2.94)	(2.78)	(2.04)	(0.48)	(-1.70)	(-2.78)
R-square	0.99	0.99	0.99	0.99	0.94	0.96
Adj-R-square	0.99	0.99	0.99	0.99	0.89	0.94
Akakie	-3.74	-3.60	-4.08	-0.53	-1.43	-0.87
Log likelihood	91.16	84.60	95.52	26.83	44.48	33.03

** 5 percent significant, * 10 percent significant.

Table 4. ARDL Test Results

	Model 7	Model 8
	Exchange Rate	Spread
Log(EXCH)		-1.47**
		(-5.19)
D(Log((EXCH (-1)))	1.92**	2.55**
	(5.85)	(6.20)
D(Log((EXCH (-2)))	-0.55**	2.55*
	(5.85)	(6.20)
Log((SPREAD)	-0.34**	
	(-5.20)	
D(Log((SPREAD (-1)))	0.47**	1.18**
	(4.42)	(6.27)
D(Log((SPREAD (-2)))	-0.18*	-0.40**
	(-1.98)	(-2.07)
Log((M)	o.24	-0.24
	(1.23)	(-0.57)
Log(G)	-0.91	-4.89*
	(-0.66)	(-1.88)
D(Log((G (-1)))	2.04	
	(1.62)	
Log(Oil Price)	-0.15	0.78
	(-0.49)	(1.23)
DUMMY88	0.51	0.18
	(1.63)	(0.30)
DUMMY12	0.06	-0.04
	(0.18)	(-0.06)
DUMMY15	-0.05	1.61
	(-0.11)	(1.35)
C	-13.36	53.26*
	(-0.85)	(1.89)
R-squared	0.98	0.90
Adj. R-squared	0.98	0.85
Log Likelihood	-6.36	-35.82
Akaike AIC	1.01	2.52

** 5 percent significant, * 10 percent significant.

Data Appendix

Data Span: 1978– 2017

Sources:

Central Bank of Iran:

Historical values of most of the variables are taken from Iran's Central Bank's *Economic Time Series Database*. For the recent numbers, different issues of *Economic Trends and Annual Review* published by Iran's Central Bank are used.

Investment includes real gross national expenditure on machinery in billions of rials.

Export included non-oil export, mainly industrial production.

OPEC, IEA:

OPEC price of Crude, U.S. Dollars per Barrel, Annual, Not Seasonally Adjusted

International Financial Statistics:

Consumer price index

Table A1: The Augmented Dicky Fuller Test Results (The 5% critical value is -2.94)

	Level	1st difference
Price	-0.78	-3.99**
Output	-0.29	-4.51**
Non-oil Output	0.04	-4.19**
Exchange rate	-0.59	-6.14**
Spread	-2.11	-5.44**
Money *Sup*ply	1.52	-3.86**
Government Spending	-1.42	-5.39**
Export	-0.03	-5.44**
Import	-1.38	-5.15**
Investment	-1.35	-5.12**

** 5 percent significant, * 10 percent significant.