Portfolio Risk Management in Iran: With an Special Emphasize on Oil Price

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Abstract

The purpose of this article is to investigate the impact of oil price on the asset portfolio in order to choose an efficient portfolio by investors in Iran by using daily data from 15th December 2012 to 17th December 2013. The considered portfolio in this study consists of gold, silver, platinum, stock market and foreign currency. The results of ARDL Bounds test shows that the series are co-integrated. Also, Toda–Yamamoto version of Granger causality has been employed to establish the causation amongst the variables. Furthermore, the study examines error variance decomposition of variables thanks to various shocks in the system and indicates that price fluctuations of other commodities have the least impact on stock price changes, meanwhile pointing the most importance on stock bonds in asset portfolio would be a proper decision for investors. Such information provides insight into the transmission links between the global oil market and the Iranian precious metals, foreign exchange and capital markets. These results may be helpful for investors to manage asset portfolio.

Keywords: Oil Price, Asset Portfolio, Bounds Test, Variance Decomposition

Introduction

Iran is one of the world’s biggest oil exporting countries. The most important problem in oil exporting countries is that their economy is dependent on a single product and the export of raw materials, which leaves negative effects on their economies and policies. Some of the negative effects that dependency on oil exports can have on the economy are as follows: a) since oil is traded in dollars, the exchange rate fluctuation will affect oil revenues and economic growth in these countries. b) Oil price fluctuations lead to a change in the price of goods which may cause
a government budget deficit and result in national currency depreciation. c) The import of capital goods is largely dependent on oil revenues and the exchange rate; therefore oil price shocks will deeply affect the investment structure in the country. d) Oil price fluctuations can affect stock market return through various transmission channels. Indeed the value of stock depends on future cash-flows. The Expected cash-flows depend on economic conditions and macroeconomic events (i.e. inflation rate, production costs, interest rates and income) which are widely influenced by oil price. So oil price may change stock returns. e) The most important factors affecting oil price are political issues within the oil producing countries and the demand of big oil consumers such as Japan, The United States of America and China. Therefore oil revenues depend on world shocks which can threaten economic growth of oil exporting countries. Considering these negative effects of oil, studying the oil price effect on other macroeconomic variables is an essential issue in oil exporting countries.

As the oil prices rise, global inflation increases and investors prefer to invest in markets which have maximum resistance against inflation so they transfer their assets from the oil market into the precious metal market. Hence the increase in the demand for precious metals ends in inCreasing in their prices. This impact of oil price on precious metals causes oil to indirectly affect many other commodities, such as the auto industry, currencies and stock markets. On account of deep correlation between the price of oil and the price of other assets, oil price shocks are always drawn into the investment market. In addition to precious metal markets, investors flock to stock markets to hedge their portfolios against uncertainty. After the 2008 financial crisis, investors placed great importance on precious metals (e.g. gold, silver and platinum) in their portfolio. So there is a price co-movement among oil price, precious metals price and stock price.

In Iran, gold, silver and platinum are not only used in the jewelry industry but are also widely used in the chemistry and auto industries. Gold is used as an alternative for common currencies in order to save values in the event of a political and/or economic crisis. Besides, holding gold is the best policy for investors during a war, revolution or economic turmoil to reserve assets values. If the financial markets work effectively and efficiently, people will hold their assets as financial assets but in the event of inflationary conditions they save assets as real assets (non-productive assets) to avoid losses stem from inflation. War, revolution and economic turmoil have historically encouraged Iranian people to hold precious metals. Therefore, understanding the effect of oil price on the price of precious metals, the exchange rate and stock prices will help investors know how to manage their portfolio and diversify their assets.

A brief picture of Iranian oil economy outlines that, Iran is the 3th largest oil producer in the world. Iranian economy is largely dependent on oil revenues. According to the reports of the central bank of Iran, Iran’s oil revenues have grown by 427 percent after the Islamic revolution. Iran reached its maximum oil revenue in 2011 (113 billion $). Furthermore, a report on the value added in the gross domestic production of the 4 main economic sectors \(^1\) in Iran shows that the oil sector is the second large sector of the Iranian economy after the service sector. Government incomes are strongly dependent on oil exports to the point that 53% of government income came from oil revenues in the year 2010. The value of oil exports is 16 times the value of non-oil exports. This shows that oil has de-industrialized the Iranian economy and stickered its economy to Dutch-disease.

Considering the importance of oil, precious metals, stock price and foreign currency in an investor's portfolio, the objective of this paper is to assess the effects of oil price on the asset portfolio of Iran. The portfolio considered in this study consists of gold, silver, platinum, stock market and foreign currency. The sample period is 2012-2013 and data are collected daily. The following four sections of this article are organized as follows: Section 2 lays out the theoretical framework. Section 3 provides data description and methodology. Results are presented in section 4 and finally section 5 sums up the conclusion.

\(^1\) agriculture, industry, oil and service sector.
Literature Review

1. **Effect of oil price on precious metals:**

   Historically, gold is the best choice to preserve purchasing power. Gold is one of the precious metals that investors use as an asset in their portfolio. In risky conditions, gold can be used as a hedge against inflation and currency depreciations (Sujit, Kumar, 2011). Investors always choose oil or gold or a combination of them in order to diversify their assets. Moreover, oil is the most traded raw material which plays an important role in the economic growth of countries. Co-movement between oil price and gold price historically began when Middle East oil exporters required gold in exchange for oil and Saudi Arabia set her oil concession in exchange for gold in 1933. These events caused co-movements between oil and gold. Melvin and Sultan (1990) explain the oil and gold relationship through the channel of export revenues channel in oil exporting countries. Regarding their theory, whenever oil price rise so does the revenues in exporting countries. Since gold is an international reserve portfolio, international increase in the demand for gold caused by oil exporting countries increases the price of gold. Oil price expansion enhances the investment in gold and this causes co-movement between the price of oil and gold. Hooker (2002), and Le and Chang (2011) investigate the oil-gold relationship through the inflation channel. They believe that when oil prices rise, almost all commodity prices increase including gold. On the other hand investors demand gold to hedge assets against inflation. Gold is considered the leader of other precious metals; therefore, gold price increase seems to lead to an increase in other precious metal prices. Ewing et al (2006), Fattouh (2010) and Hunt (2006) investigate the relationship between oil price and other precious metals in oil exporting countries and they find a positive effect of oil price on gold price.

2. **Effect of oil price on stock market:**

   The extent to which oil price shocks impact on stock market returns varies among countries depending on whether the country is a net oil exporter or oil importer. According to Asteriou et al (2013) oil price increase will boost the cost of production in oil importing countries and shifts the stock prices downward. But it will have positive effect on stock revenues in oil exporting countries, due to profit increases. According to Famma efficient stock market theory, companies in which oil is an essential input or output, would incept new information (for example oil price changes) and quickly consider it in stock prices (Famma, 1970). Therefore oil price changes will affect stock prices by changing the value of the future earnings of firms (Bjørnland, 2008). The negative or positive effects of oil price changes on stock price depend on whether the firm or company is a net oil consumer or an oil producer. It is obvious that higher oil prices is bad news for stock returns in oil consuming industries, the same is not true for companies producing oil and its derivatives because the revenues are expected to rise by oil price increase. El-Sharif et al (2005) examined the effect of oil price on stock prices in the oil and gas sector in the UK and they observed a positive relationship between oil price and asset values in the above mentioned industries. Similarly Nadha and Faff (2008) and Cong et al (2008) reached a same results examining the oil and gas industries in several countries.

   But according to Bashra and Sadorsky (2006) oil importing countries face higher risks and costs because of oil price fluctuations, which affects stock prices and reduces both wealth values and investment rates.

   Another indirect channel in which oil price affects stock market returns is via discount rates. In other words, an increase in oil prices will cause inflation and in return it will cause higher discount rates and hence lower stock returns. Huang, Masulis and Stoll (1996) and Cologni and Manera (2008) show that oil price shocks increase inflation rates and decrease stock returns. In addition Park and Ratti (2008), Sadorsky (1999) and Papapetrou (2001) showed that higher oil prices increase production costs and cause inflation which in turn increases interest rates and decreases the stock returns.
On the other hand, oil price increment will set the stage for higher incomes and boost aggregate wealth and stock returns in oil exporting countries (Le & Chang, 2011). In Bjørnland (2008) point of view if oil exporting countries spend oil revenues to purchase goods and services in the domestic economy, then it would increase domestic demand and cause higher level of activity domestically and it will improve economy and have a positive effect on stock market revenues. Many studies have examined the relationship between oil prices and stock market returns. Basher & Sadorsky(2006), Hammoudeh & Eleiza(2004) and Papapetrou(2001) conclude that oil prices have positive effects on stock returns via the channel mentioned above.

3. Effect of oil price on exchange rates:

Empirically, real exchange rates co-move with oil price fluctuations in oil exporting countries. In the case which oil price increases, the exchange rate appreciates and this leads domestic companies to lose competitiveness against foreign companies. Hence the country will lose its non-resource industry base and will involve Dutch Disease (Torvik, 2001, Rickne, 2009). Korhonen and juurikkala(2009), Koranchelian et al(2005) Zalduendo(2006) and Olomoa & Adejumo(2006) find that oil price increment cause exchange rate appreciations in oil exporting countries. Another channel in which oil prices affect exchange rate is as follows: when oil prices increase it causes financial surpluses in oil exporting countries and changes the pattern of their spending and investment. The oil revenues will lead to increase asset prices and cause inflation which in turn weakens the real value of domestic currency (AL-mulali,2010). Rautava (2004), Adeniyi et al(2012), Abdelaziz(2008) investigate the effect of oil price on exchange rate through this channel in oil exporting countries and they show the negative and significant effect of oil price on domestic currency. Also, they argue that the final effect of oil price on exchange rates depends on political and legal institutions spending which do control the effect of oil price shocks on exchange rates.

Some of the literature that emphasizes on the effect of oil price on macroeconomic variables are presented here. Using a structural VAR model for the time series data, Bjornland investigates the effect of oil price on stock returns in Norway. The results show that a 10 percent increase in oil prices, increased stock returns by 2.5 percent. But its effect on other variables was modest because Norwegian economy increased wealth and demand as oil price increased. Imarhiagbe (2010) analyzed the impact of oil price on stock prices in major oil producing and consuming countries. The results confirm the existence of an influence of oil prices and exchange rates over stock prices. Narayan (2010) carried out a study on the effect of oil price and nominal exchange rates on Vietnam’s stock price. The results showed that stock prices, oil prices and nominal exchange rates are co-integrated and oil prices have a positive and significant impact on stock prices. Thai and Youngho (2011) examined the relationships among oil price, gold and financial variables in Japan using a bound testing approach. They show that just the price of gold and stock can cause higher expectations for inflation over time in Japan. Also in the short run, only the price of gold will affect interest rates. Lizardo and Mollick(2010) showed a significant negative relationship between oil price and the value of the US dollar against the currencies of oil exporting countries, but a positive relationship in oil importer countries.

Data Description and Methology

The sample data consists of the daily prices for oil, precious metals (gold, silver and platinum), stock prices and exchange rates in Iran, during the period of 2012-2013. The present study uses nominal data because of the unavailability of the daily consumer price index. According to Narayan et al. (2008), tracking the daily behavior of oil price, exchange rate and stock market does not require knowledge of real values. The descriptive statistics of all the raw variables is reported in Table 1.
According to Jain & Ghosh (2013), this study uses ARDL bound tests approach for testing co-integration among the 4 mentioned macroeconomic variables. A systematic co-movement among economic variables is known as co-integration. Generally a co-integration shows the presence of spurious correlation among variables. An ARDL methodology is a general dynamic approach through which the short run effects can be directly estimated. It uses the lags of dependent variables and the lagged and present values of independent variables in the estimation process. An important benefit of the ARDL bound test is that it can be used regardless of whether the variables are stationary or integrated of order one or more. Pesaran & Shin (2001). The ARDL approach starts with estimating below unrestricted error correction models:

\[ \Delta \text{Oil}_{t} = a_{\text{Oil}} + \sum_{i=1}^{k} b_{\text{Oil},i} \Delta \text{Oil}_{t-i} + \sum_{i=0}^{m} c_{\text{Oil},i} \text{Lev}_{t-i} + \sum_{i=0}^{n} d_{\text{Oil},i} \Delta \text{Gold}_{t-i} + \sum_{i=0}^{p} e_{\text{Oil},i} \text{Es}_{t-i} + \sum_{i=0}^{q} f_{\text{Oil},i} \Delta \text{Plat}_{t-i} + \varepsilon_{\text{Oil},t} \]

(1)

\[ \Delta \text{Lev}_{t} = a_{\text{Lev}} + \sum_{i=1}^{k} b_{\text{Lev},i} \Delta \text{Lev}_{t-i} + \sum_{i=0}^{m} c_{\text{Lev},i} \Delta \text{Oil}_{t-i} + \sum_{i=0}^{n} d_{\text{Lev},i} \Delta \text{Gold}_{t-i} + \sum_{i=0}^{p} e_{\text{Lev},i} \text{Es}_{t-i} + \sum_{i=0}^{q} f_{\text{Lev},i} \Delta \text{Plat}_{t-i} + \varepsilon_{\text{Lev},t} \]

(2)

\[ \Delta \text{Gold}_{t} = a_{\text{Gold}} + \sum_{i=1}^{k} b_{\text{Gold},i} \Delta \text{Gold}_{t-i} + \sum_{i=0}^{m} c_{\text{Gold},i} \text{Lev}_{t-i} + \sum_{i=0}^{n} d_{\text{Gold},i} \Delta \text{Oil}_{t-i} + \sum_{i=0}^{p} e_{\text{Gold},i} \text{Es}_{t-i} + \sum_{i=0}^{q} f_{\text{Gold},i} \Delta \text{Plat}_{t-i} + \varepsilon_{\text{Gold},t} \]

(3)

\[ \Delta \text{Es}_{t} = a_{\text{Es}} + \sum_{i=1}^{k} b_{\text{Es},i} \Delta \text{Es}_{t-i} + \sum_{i=0}^{m} c_{\text{Es},i} \text{Lev}_{t-i} + \sum_{i=0}^{n} d_{\text{Es},i} \Delta \text{Oil}_{t-i} + \sum_{i=0}^{p} e_{\text{Es},i} \text{Es}_{t-i} + \sum_{i=0}^{q} f_{\text{Es},i} \Delta \text{Plat}_{t-i} + \varepsilon_{\text{Es},t} \]

(4)
The equations for silver and platinum are written as the above equations. Also the $\Delta$ operator indicates the first difference of variables. Null hypothesis of bound test is no co-integration among variables. For example the null hypothesis for equation 1 is as follow:

$$H_0: \sigma_{t_{1-0}} = \sigma_{t_{1-1}} = \sigma_{t_{1-2}} = \sigma_{t_{1-3}} = 0$$

$$H_1: \sigma_{t_{1-0}} \neq \sigma_{t_{1-1}} \neq \sigma_{t_{1-2}} \neq \sigma_{t_{1-3}} \neq 0$$

Write null hypothesis for equations 2 and 3 and 4 as for equation 1. The F-test uses to test the mentioned hypothesis. After testing for existing co-integration among variables by Bound test, the causality among variables is tested via the Toda-Yamamoto (TY) non-causality test. Granger-causality test is a traditional way of testing the causality between variables. But currently Toda and Yamamoto (1995) present a new form of granger causality test of Toda-Yamamoto which is used regardless of whether a series is I(0), I(1) or I(2), not co-integrated or co-integrated in any order. TY procedure employs a modified Wald test for restriction on the parameters of the vector auto-regression (VAR) $(k)$ $(k$ is the lag length). This study uses the below model in order to do the TY test:

$$\begin{bmatrix}
  \text{Loil}_t \\
  \text{Lena}_t \\
  \text{Lstock}_t \\
  \text{Lgold}_t \\
  \text{Lsilv}_t \\
  \text{Lplat}_t \\
  \text{Loil}_{t-1} \\
  \text{Lena}_{t-1} \\
  \text{Lstock}_{t-1} \\
  \text{Lgold}_{t-1} \\
  \text{Lsilv}_{t-1} \\
  \text{Lplat}_{t-1}
\end{bmatrix} = \begin{bmatrix}
  \alpha_0 \\
  \alpha_1 \\
  \alpha_2 \\
  \alpha_3 \\
  \alpha_4 \\
  \alpha_5 \\
  \alpha_6 \\
  \alpha_7 \\
  \alpha_8 \\
  \alpha_9 \\
  \alpha_{10}
\end{bmatrix} + \begin{bmatrix}
  \bar{A}_{1,0} & \bar{A}_{1,1} & \bar{A}_{1,2} & \bar{A}_{1,3} & \bar{A}_{1,4} & \bar{A}_{1,5} & \bar{A}_{1,6} & \bar{A}_{1,7} & \bar{A}_{1,8} & \bar{A}_{1,9}
\end{bmatrix} \cdot \begin{bmatrix}
  \text{Loil}_{t-1} \\
  \text{Lena}_{t-1} \\
  \text{Lstock}_{t-1} \\
  \text{Lgold}_{t-1} \\
  \text{Lsilv}_{t-1} \\
  \text{Lplat}_{t-1}
\end{bmatrix} + \begin{bmatrix}
  \varepsilon_{t-1} \\
  \varepsilon_{t-2} \\
  \varepsilon_{t-3} \\
  \varepsilon_{t-4} \\
  \varepsilon_{t-5} \\
  \varepsilon_{t-6}
\end{bmatrix}$$

(5)

Finally, in order to decompose error variances, this study uses a Variance decomposition method in a VAR model. A reduced form of VAR expressed each variable as a linear function of its own past values and the past values of all other variables being considered and a serially uncorrelated error term. In practice, Akaike (AIC) or Bayes(BIC) information criteria is used in order to define the lag length in VAR system equations. In this notation, Forecast error variance decompositions show the contribution of each shock to the movements in other variables. In other words, it indicates which shock is more predominant in the variability of variables.

## Results and Discussion

In order to test the stability of variables, the Augmented Dickey Fuller test (Dickey and Fuller, 1979) along with Phillips & Perron(1988), KPSS (Kwiatkowski et al, 1992) has been performed. Although checking variables for stationary isn't necessary to do the bounds tests of co-integration, but it is necessary for the Toda-Yamamoto causality test. Table 2 presents the results of the unit root tests on the natural logarithms of the levels and the first differences of the variables. The results show that all variables are stationary in their first differences. In the level analysis, all the tests are unable to reject the null hypothesis of the presence of a unit root at the 1%, 5% and 10% levels of significance. In the first differences form, all the tests reject the null hypothesis. Hence the results of unit root tests reveal that all series are I (1) in nature.
In the next stage, one can proceed to the ARDL bound tests. Before that it is important to ascertain the optimal lag order. The optimal order of lags for co-integration tests are selected based on Schwarz-Bayesian (SBC) information criteria and Akaike Information Criteria (AIC) as suggested by Pesaran et al (2001). It has been found that the maximum optimal lag length is two for oil and stock price and one for other variables. The results of the ARDL bound test for co-integration are reported in Table 3. The bound test indicates that a co-integration relationship exists among the variables when exchange rate and gold price are the dependent variables. These are because \( F_{gold}(lgold|loil, lsilver, lplat, lex, lsp) \) and \( F_{lex}(lex|loil, lgold, lsilver, lplat, lsp) \) are higher than the upper bound critical values at the 1%, 5% and 10% levels of significance. However, no co-integration exists when other variables (as \( F_{loil}, F_{lsilver}, F_{lplatinum} \) and \( F_{lstockprice} \)) have been taken as the dependent variables and the statistical f values are lower than the upper bound critical value at the 5% level.

### Table 3: Bounds Testing Or Cointegration

<table>
<thead>
<tr>
<th>F-statistics</th>
<th>Without a time trend</th>
<th>With a time trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F_{loil}(loil, lgold, lsilver, lplat, lex, lsp) )</td>
<td>2.05</td>
<td>2.42</td>
</tr>
<tr>
<td>( F_{gold}(lgold</td>
<td>loil, lsilver, lplat, lex, lsp) )</td>
<td>7.04</td>
</tr>
<tr>
<td>( F_{lsilver}(lsilver</td>
<td>loil, lgold, lplat, lex, lsp) )</td>
<td>2.88</td>
</tr>
<tr>
<td>( F_{lplatinum}(lplatinum</td>
<td>loil, lgold, lsilver, lex) )</td>
<td>2.80</td>
</tr>
<tr>
<td>( F_{lex}(lex</td>
<td>loil, lgold, lsilver, lplat, lsp) )</td>
<td>5</td>
</tr>
<tr>
<td>( F_{lstockprice}(lstockprice</td>
<td>loil, lgold, lsilver, lplat) )</td>
<td>1.97</td>
</tr>
</tbody>
</table>

**F-Critical at 5%**

<table>
<thead>
<tr>
<th></th>
<th>I(0)</th>
<th>I(1)</th>
<th>I(0)</th>
<th>I(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F_{loil} )</td>
<td>3.010</td>
<td>4.216</td>
<td>2.688</td>
<td>3.698</td>
</tr>
</tbody>
</table>
In regard to estimated models, the exchange rate, silver and platinum prices have positive effects on gold price and the link between gold and oil prices is not confirmed in short run. In addition, results show that increase in oil and gold prices lead to an increase in the exchange rates in the short run.

Table 4 presents the results of the TY$^2$ version of the Granger causality tests. The results indicate that there is causality from gold and silver to stock price and from exchange rate to silver, platinum and stock price. Also a change in stock price can cause changes in oil, silver and platinum prices. But the null hypothesis of non-causality between other variables cannot be rejected at 1% and 5% levels of significance. The explanation for the locally traded precious metals is implicit because of the high export and import consumption of these metals. The causation of the internationally traded oil price is difficult to explain theoretically, as it implies that the Rial–Dollar exchange rate along with locally traded gold, silver and platinum prices, as shown in Table 3, have predictive powers for international oil prices. It is also clear from Table 5 that there is a bi-directional causality between precious metals, which indicate that they can be alternative substitutes of each other to invest.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Loil</th>
<th>Lgold</th>
<th>Lsilver</th>
<th>Lplatin</th>
<th>Lexrate</th>
<th>Lstockprice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loil</td>
<td>-</td>
<td>26.07</td>
<td>20.51</td>
<td>27.82</td>
<td>14.58</td>
<td>7.20</td>
</tr>
<tr>
<td>Lgold</td>
<td>31.03</td>
<td>-</td>
<td>47.43</td>
<td>38.03</td>
<td>357.12</td>
<td>7.42</td>
</tr>
<tr>
<td>Lsilver</td>
<td>12.83</td>
<td>37.63</td>
<td>-</td>
<td>100.99</td>
<td>8.94</td>
<td>8.90</td>
</tr>
<tr>
<td>Lplatin</td>
<td>30.83</td>
<td>36.85</td>
<td>103.21</td>
<td>-</td>
<td>7.08</td>
<td>12.67</td>
</tr>
<tr>
<td>Lexrate</td>
<td>19.41</td>
<td>324.79</td>
<td>2.28</td>
<td>1.74</td>
<td>-</td>
<td>2.71</td>
</tr>
<tr>
<td>Lstockprice</td>
<td>2.88</td>
<td>12.32</td>
<td>1.58</td>
<td>3.24</td>
<td>17.87</td>
<td>-</td>
</tr>
</tbody>
</table>

*, ** and *** indicate significance at the 1%, 5% and 10% levels respectively.

2 Toda-Yamamoto
Table 5: Variance Decomposition Results

<table>
<thead>
<tr>
<th>Time Horizon</th>
<th>Lexrate</th>
<th>Loil</th>
<th>Lgold</th>
<th>lsilver</th>
<th>lplatinum</th>
<th>lstockprice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance decomposition of exchange rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>100.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>96.45</td>
<td>0.24</td>
<td>2.09</td>
<td>0.04</td>
<td>0.26</td>
<td>0.89</td>
</tr>
<tr>
<td>10</td>
<td>90.77</td>
<td>1.70</td>
<td>2.28</td>
<td>0.40</td>
<td>2.51</td>
<td>2.30</td>
</tr>
<tr>
<td>15</td>
<td>83.85</td>
<td>3.34</td>
<td>2.74</td>
<td>0.79</td>
<td>5.55</td>
<td>3.70</td>
</tr>
<tr>
<td>20</td>
<td>77.77</td>
<td>4.51</td>
<td>3.39</td>
<td>1.07</td>
<td>8.17</td>
<td>5.06</td>
</tr>
<tr>
<td>Variance decomposition of oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3.40</td>
<td>96.60</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>3.13</td>
<td>96.28</td>
<td>0.30</td>
<td>0.17</td>
<td>0.07</td>
<td>0.02</td>
</tr>
<tr>
<td>10</td>
<td>2.49</td>
<td>93.95</td>
<td>1.03</td>
<td>1.16</td>
<td>1.25</td>
<td>0.09</td>
</tr>
<tr>
<td>15</td>
<td>2.01</td>
<td>90.71</td>
<td>1.50</td>
<td>2.24</td>
<td>3.36</td>
<td>0.14</td>
</tr>
<tr>
<td>20</td>
<td>1.70</td>
<td>87.82</td>
<td>1.69</td>
<td>3.07</td>
<td>5.53</td>
<td>0.16</td>
</tr>
<tr>
<td>Variance decomposition of gold</td>
<td></td>
<td></td>
<td></td>
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The results of the variance decomposition are presented in Table 5 over a horizon of 20 days. It is clear that a large amount of variability in variables is due to their own shocks. The shares of platinum and stock prices on the variability of the exchange rate are 8.17 and 5.06 percent respectively by the 20th day, which are higher than the effects of other variables in the system. Oil and gold explain 4.51 and 3.39 percent of the variability in exchange rates at the end of the horizon. Likewise, the 5.53% and 3.07% of variance in oil price is explained by platinum and silver by the 20th day respectively, but oil does not significantly explain the variance in any variable other than silver (24.18%) and platinum (21.41%). Oil, silver and platinum have major industrial uses, which can have high impacts on each other. Gold error variance is significantly explained by the exchange rate variances (27.26) and silver and platinum variances are the second and third source of exchange rate variability. This indicates that the price of gold is strongly linked to other precious metals in comparison to oil prices. Also this result indicates that Iranians can use gold and foreign currencies as substitution assets in their portfolio. Platinum and gold error variances are significant sources of stock price variances. Moreover, the exchange rate has the least impact on the variance of stock price over a horizon of 20 days.

**Conclusions**

This study investigates the relationship among international oil prices, Rial–Dollar exchange rates, prices of precious metals traded in the local markets and the Iranian stock price. The ARDL bounds test shows a co-integration relationship among the variables when exchange rate and gold are dependent variables. Iran produces a substantial fraction of its crude oil but imports a huge amount of needed precious metals from foreign countries. The import of precious metals affects the exchange rate since these commodities are traded in US-dollar internationally. The co-integration relationship indicates that the demand for precious metals’ imports and the demand for oil exports are important factors which affect exchange rates. From the variance decomposition view, international oil price and precious metals prices shocks are transmitted to the Iranian economy through fluctuations in the exchange
rate. The dependency of the mentioned metals on imports can be a detriment in the exchange rate and inflation management by the central bank. The promotion of recycling precious metals and the exploitation of the intact domestic metal mines and the enrichment of them might reduce the dependency of Iranian economy to the price of precious metals. A reduction in the dependency of the economy to the price of precious metals and oil incomes might free the exchange rate from global commodity price shocks and allow for a better foreign exchange rate and reserve managements. The co-integration relationship among gold and other variables indicates the positive relationships among all precious metals. On account of the precious metals that are being used in diversifying investment portfolios, long term dependence amongst the prices can be expected. Toda–Yamamoto’s version of Granger’s causality tests indicates that the oil price is the cause of all other variables and there are the bilateral relationships among the precious metals.

In general, since price fluctuations of other commodities have the least impact on stock price changes, then pointing the most importance on stock bonds in asset portfolio would be a proper decision for investors. Following stock bonds, foreign currency is the next asset which should devote an important share of portfolio because foreign currency gets little influence from asset price fluctuations. Also, owning to the high impacts of oil and foreign currency shocks on precious metals, devoting the least share of asset portfolio to precious metals would be a good strategy. These efficient portfolios, which diversify risk, can provide superior risk adjusted returns.

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