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« Hypothesis of Currency Basket Pricing of Crude Oil: An Iranian Perspective »

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Hypothesis of Currency Basket Pricing of Crude Oil: An Iranian Perspective

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Abstract

The decline in the value of US dollar and the emergence of other currencies has opened the debate within OPEC, of whether it is possible to resort to the pricing of crude oil in alternative currencies. The debate was limited because of the inadequate liquidity of most other currencies. In this paper, we focus on the implications of the shift in the pricing of Iran's crude oil to other currencies than the US dollar. The results demonstrated that the pricing for Iranian oil in US dollar had high reaction potential and responded moderately to the change in the exchange rate, when compared to the pricing in Euro and in Yen. Consequently, it appeared that stability on the financial market led to partial stability in the oil market.

Keywords: *Crude Oil Pricing, Currency Basket, OPEC, Exchange Rate of Dollar, Euros, Yen.*

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1- Introduction

Since oil prices are contracted in US dollars and oil-exporting nations also imported their goods from other countries in addition to the United States, a strong dollar will therefore increase the real oil price and a weak dollar will decrease it. A decline in the value of the dollar will weaken an oil exporter's purchasing power (Evans 1986) since it effectively makes imports originating from outside the US more expensive, which will lead to oil being cheaper outside of United States.

Several studies have empirically examined the impact of a decline in the value of the dollar on the purchasing power of oil exporting countries. Dailami (1982), Massood, Arul and Mohana (2003) showed that when oil exporting nations purchased a large share of their import needs from outside USA, as well as for those that invested a large share of their reserves in US dollar and dollar denominated assets, they experienced losses in purchase power. On one hand, Houghton (1991) argued that a declining dollar was not a factor in the reduction of purchasing power of OPEC revenues because prices reflected demand and supply and therefore tended to be at an equilibrium state after time. While on the other hand, Evans (1986) focused on the issue of oil price stability and its role in maintaining the purchasing power of OPEC's oil revenues.

It has become of general preoccupation within OPEC members to determine whether to continue the pricing of crude oil in US dollar or to shift to an alternative currency, in respect of their oil income volatility and uncertainty, as well as their import expenses. Despite a slight leniency of OPEC members in believing that a currency basket would help maintain their purchasing power[4], this debate has indeed not led to any definite results yet. Many countries have expressed various reasons for pricing crude oil in an alternative currency; Europeans for instance adopted their own currency, the chinese, Japanese and Arab oil exporting countries aim to protect themselves from the depreciation of the US dollar and Russians base their reasons on trade relationships. Only the British find themselves somewhat pulled apart by their strategic partnership with the US and their

[4] The currency basket pricing for oil remained unenforceable because Saudi Arabia is still refusing the pricing in currencies other than the dollar in regards to the agreement with the U.S. in 1971.

natural pull from Europe. However, how solid will their century old partnership stand against frictions induced by an unstable dollar?

Despite voluminous studies on this subject, the question of whether and how an oil currency basket would affect the oil market volatility appears to not have been studied much. Hence, the main objectives of this paper[5]: first, identify the volatility of the oil reference prices and analyze the impact of dollar fluctuations on the purchasing power of Iran. Second, propose a currency basket for Iranian oil and analyze its impact on the oil market volatility.

The remainder of the paper is organized as follows. Section 2 presents the oil currency basket model. Section 3 describes the data. Section 4 presents the empirical results and section 5 concludes.

2- Currency dilemma and oil currencies basket policy

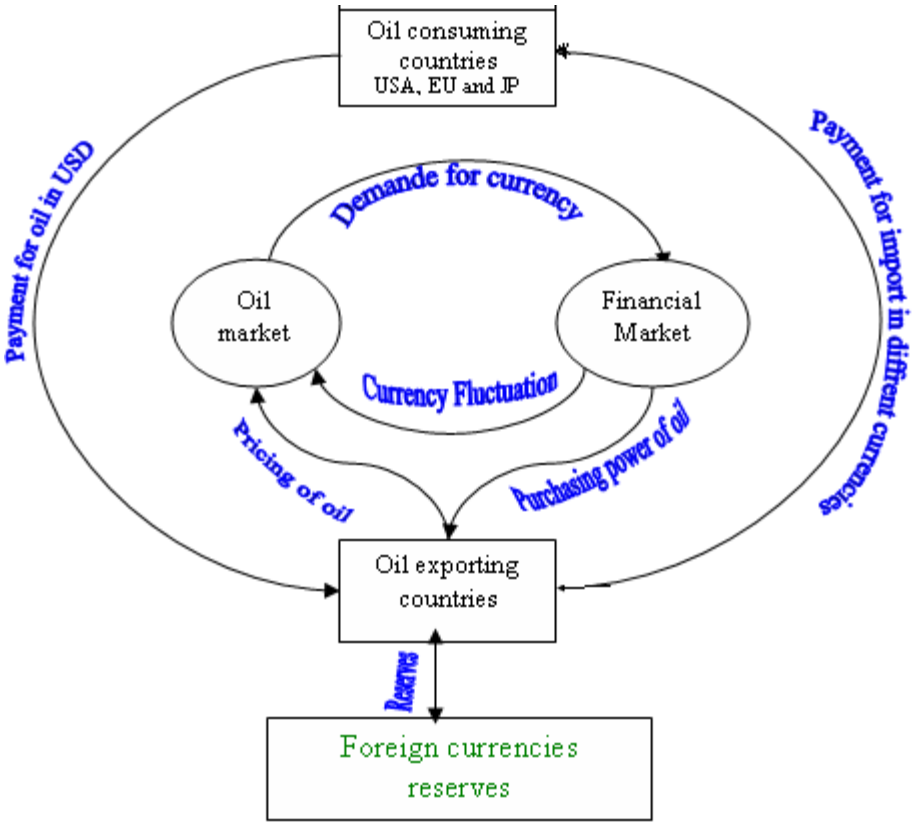
Analysis of the shift in the pricing of oil would require focusing on two groups of countries and two different markets (Samii, Rajamanikam and Thirunavukkarasu 2005). As shown in figure1 below, changes arising in any of the five components making up the two-country-group market system would impact on other components, so would any new external shock.

Different levels of interaction are identified as illustrated in Figure1. In the innermost level, fluctuations of US exchange rate affect oil prices. A decrease in the value of the dollar will weaken an oil exporter's purchasing power since it effectively makes imports originating from outside the US more expensive, hence rendering oil cheaper outside US and initiating an increased demand in those countries (Allen 1979)[6]. This instability in the oil market is transferred to the financial market through the means of fluctuating demand and supply of dollar, which would again feed into the dynamics of the oil market. In the

[5] Liquidity not being our interest in this paper, we nevertheless consider it as a hypothesis.
[6] Verleger (2003) showed that even in the case of a stable nominal price, a decrease in the dollar value would worsen the situation for OPEC because they buy a large share of their goods and services from non US suppliers that deal in euro or yen.

middle level, oil exporting countries are added to the oil market-Financial market loop, since they react to the fluctuations of the US dollar in the financial market which alters the price of oil. In the outermost level, the reserves composition of almost all of OPEC is expressed in US dollar, and yet, losses resulting from the dollar movements would not be equal from one group of country to the other (Dailami 1982). For those members who purchase a large share of their import needs from outside the USA as well as for those that invest a large share of their reserves in US dollar, this loss is more flagrant. Finally, number of OPEC members have large debts. Fluctuations in exchange rates strongly influence each country's life standards.

Figure 1: model of two groups of countries and two different markets



Hence, the most favourable choice of currency in regards to oil pricing would be one that takes into account the following condition: minimize the currency exposure losses, which translates to minimizing the gap between oil revenues and import expenses.

In order to determine oil prices reactions, we extend this definition of exposure to OPEC, where exports and imports are unequal. For simplicity purpose, we consider the case of one member country trading (Iran)[7] with three partners United States, European Union and Japan. If X_O^{US}, X_O^{EU} and X_O^{JP} represent the oil exported to the USA, EU, and Japan respectively, then the foreign currency revenue to the exporting country can be expressed as R_O^{US}. If M_g^{US}, M_g^{EU} and M_g^{JP} represent the goods imported from USA, EU and Japan respectively then the foreign currency payment to the importing country can be expressed as P_g^{US}. The currency exposure for the OPEC country (Iran) under dollar pricing of crude oil is derived as follows:

$$\text{Currency Exposure} = \text{Foreign currency revenue} - \text{Foreign currency expense}$$

$$= \left[R_O^{US} - P_g^{US}\right] \qquad (1)$$

We first considered the existing scenario where oil is priced in US dollar. If $\delta\left(\frac{e_t^{us} P_t}{P_t^{us}}\right)$ represent the variations of exchange rate, $e_{us,t}$ is the effective exchange rate of the dollar in terms of other major currencies, p_t is the domestic price index pertaining to the importing countries, then the actual loss related to currency exposure for the exporting country (Iran) in its local currency is given as:

$$\text{Actual loss} = \left[R_O^{US} - P_g^{US}\right] * \delta\left(\frac{e_t^{us} P_t}{P_t^{us}}\right) \qquad (2)$$

The alternative scenario proposed was that of oil being priced in a currency basket. In this case, the actual loss depends on the nature of each currency: a) the external balance: deficit in USA, quite equilibrium in Europe and excess in Japan. b) The nature of the exchange rate regime for each of these currencies. c) The distance and the national border. For these reasons, many countries diversified their foreign reserve holdings in order to

[7] Iran happens to be the only oil exporting country where oil trade is expressed in many currencies: 65% in Euro, 20% in dollar and 15% in Yen.

protect themselves against the depreciation of the dollar[8]. This diversification step is hence accompanied by a shift in the oil payment system, as was announced by Iran in 2003, which also implied the payment for oil in Euro[9] (Venezuela accepted the contracting of oil in euro, *Ramirez R*. (2007)) [10].

Therefore, the actual loss to the OPEC member (Iran) in terms of local currency against the proposed currency basket is:

$$\text{Currency basket exposure} = \left[(R_O^{US} - P_g^{US}), (R_O^{EU} - P_g^{EU}), (R_O^{JP} - P_g^{JP})\right] \quad (3)$$

$$\text{Actual loss of dollar} = \left[R_O^{US} - P_g^{US}\right] * \delta\left(\frac{e_t^{us} P_t}{P_t^{us}}\right) \quad (4)$$

$$\text{Actual loss of euro} = \left[R_O^{EU} - P_g^{EU}\right] * \delta\left(\frac{e_t^{eu} P_t}{P_t^{eu}}\right) \quad (5)$$

$$\text{Actual loss of Yen} = \left[R_O^{JP} - P_g^{JP}\right] * \delta\left(\frac{e_t^{JP} P_t}{P_t^{JP}}\right) \quad (6)$$

Where $\delta\left(\frac{e_t^{us} P_t}{P_t^{us}}\right)$, $\delta\left(\frac{e_t^{eu} P_t}{P_t^{eu}}\right)$ and $\delta\left(\frac{e_t^{JP} P_t}{P_t^{JP}}\right)$ represent the variations in the exchange rate of each currency. The OPEC member (Iran) would then have to choose the currencies such that the loss to currency exposure is minimized, that is:

$$Min\left\{\left(\left[R_O^{US} - P_g^{US}\right] * \delta\left(\frac{e_t^{us} P_t}{P_t^{us}}\right)\right), \left(\left[R_O^{EU} - P_g^{EU}\right] * \delta\left(\frac{e_t^{eu} P_t}{P_t^{eu}}\right)\right), \left(\left[R_O^{JP} - P_g^{JP}\right] * \delta\left(\frac{e_t^{JP} P_t}{P_t^{JP}}\right)\right)\right\} \quad 7)$$

[8] the central banks reduced the dollar share of their reserves. For instance, 70% of china's reserves are made up of dollar and the rest of Euro and Yen, For India it's a share of 65% in dollar, 13% in euro and the rest in Sterling and Yen, the Japanese foreign reserves surpassed 1 trillion $ blend of dollar and of euro.

[9] Iran is cutting its US dollar reserves to less than 20% of total foreign currencies holdings, and will buy more euros and yen as tensions with the US increase, Central Bank Governor Ebrahim Said, March 2007.

[10] Recently at a summit of OPEC heads of state in Riyad in Nov 2007, Iran and Venezuela suggested a basket of currencies including with the dollar, the Euro, the Yen and the Yuan, but the failed to win over the remaining member states. (Altman D. 2007)

3- Data description

Before undertaking a statistical analysis, we shall describe the data used in this paper. Our dataset consists of daily observations over the time period of January 1st 1999 to end of December 2007, of real effective exchange rate of the dollar index (EERD), real effective exchange rate of the Euro index (EERE) as well as that of the Japanese Yen (EERY). The real index of effective exchange rate is the price adjusted major currencies indices of Dollar, Euro and Yen, respectively. The oil price series is the US dollar daily spot price of Iranian oil reference (Iran light) deflated by the US consumer price index. The variables are used in logarithmic form. The data employed are taken from Federal Reserves, European Central Bank, OPEC organization, Bank of Japan, Energy Information Administration (EIA), World Trade Organization (WTO), Organization for Economic co-operation and Development –World Statistical Resources- (OECD).

4- Empirical results

We start our empirical examination by investigating for presence of unit roots in our series, by employing the Augmented Dickey-Fuller test (1981). The results are presented in table 1. Akaike's information criterion is used to select the appropriate lag lengths. For all series, we are unable to reject the unit root null hypothesis in level.

Table 1: unit root test of ADF (1981)

	Dollar	*euro*	*yen*	*Iran*
Level	*-1.37*	*0.39*	*-1.19*	*1.82*
Frst diff	*-48.35**	*-48.78**	*-47.28**	*-47.07**

* Rejection the null hypothesis of test at 5% significant level.

The correlation coefficients between the three currencies are also computed and reported in table 2. We observe that there is high correlation amongst effective exchange rate series over the sample period, the smallest value being a 0.65 coefficient value between yen and dollar. Table 3 shows that oil price series appear to be perfectly correlated. It also shows that despite the higher correlation between euro and dollar exchange rates, Yen

based oil pricing exhibits higher correlation with dollar oil pricing (0.99) than that of the euro pricing (0.98).

Table 2: Effective Exchange rate correlations

	EERD	*EERE*	*EERY*
EERD	***1***		
EERE	*-0.92*	***1***	
EERY	*0.65*	*-0.71*	***1***

Table 3: Correlations of oil prices

	IranC$	*Iran€*	*Iran¥*
Iran$	***1***		
Iran€	*0.96*	***1***	
Iran ¥	*0.99*	*0.96*	***1***

We used Iran price reference of crude oil priced in the three currencies. Table 4 and 5 compute the volatility of Iran's reference priced in different currencies and that of exchange rate of Dollar, Euro and Yen. One can see that the exchange rate of the dollar and the yen appears to be more volatile than the exchange rate of the euro by *27.9%* and *29.1%* respectively over sample period; hence, it is only natural that euro priced oil be less volatile than those in Dollar and Japanese Yen.

Table 4: volatility of Iran reference pricing in 3 currencies

	Iran $	*Iran €*	*Iran ¥*
Volty[*]	*0.5*	*0.38*	*0.51*

Table 5: Volatility of Exchange rate

	Dollar	*Euro*	*Yen*
Volty	*0.118*	*0.085*	*0.12*

** Volatility=Standard Deviation/Mean*

Consequently, from this analysis, euro pricing appears to be less volatile and suitable against the Japanese yen and the dollar. At its' birth in 2000, clear evidence of the euro standing out as a competitive currency was not available, but over time, it has definitely been able to prove itself as being strong and disposing of it's own force as indicated by various important signs relevant to the hard European economic indices. The stability of these economic indices reflects through an equilibrium state of the currency level.

In order to verify outcomes of the scenario pertaining to the proposed hypothesis of oil pricing based on a currency basket, we proceed to the examination of trade relationships between two groups of countries: the importers and exporters of oil.

For this reason, we consider a sample of trade relationships between Iran, United States, European Union and Japan. The statistics show that trade flows or business relationships are more important between Iran and Japan or the European Union, compared to that of trade with the US. This is reflected through the important volumes of trade relationship between the tree countries, with the EU, Iran's main trading partner, holding 27.8% of total market share, followed by china at 15.6% and Japan holding 9.8% of total market share. On another hand, there appears to be a wide discrepancy in oil exports from Iran to the world, with higher shares to EU and Japan as compared to USA as well as larger imports from EU and Japan. In 2006, Iran exports to EU totaled up to 14.12 billion € (88% energy) and those to Japan totaled more than $15.109 billion (90% energy), whereas the value of Iranian imports from EU was more than 11.19 billion euro and imports from Japan were more than 1.045 billion dollar. Consequently, trade balance between Iran and EU resulted in a €2.935 billion surplus as well as a $14.064 billion surplus in the relationship with Japan[11].

Given these circumstances, the issue that one must address is knowing whether the revenue from oil exports to USA, EU and Japan adequately compensates for the goods and services imports from these regions respectively. We first considered the existing scenario of oil being priced in US dollars. If Iran imports a major share of its needs from the USA, then the dollar revenue from oil export could be employed to pay for these imports.

Table 6: Iran currency exposure and reserves in 2006

	CE (Billion)	*Loss (Million)*	*Reserves (Billion)*	*Loss (Million)*
US dollar	*23*	*361*	*52*	*832*

If, on the contrary, Iran import needs originate from non-dollar areas, then it becomes necessary to convert this revenue to cover for import costs. As the value of the dollar is subject to uncertainty, the purchasing power of dollar revenues also becomes unstable.

[11] The statistics are from the United Nations Commodity Trade Statistics Database and from worldwide statistical resources of OECD.

Table 6 shows that Iran's losses in currency exposure mounts up to 361 million dollars, while losses in the Iranian foreign reserves are of 832 million dollars due to the decline of the value of US dollar currency in 2006. Therefore, a decrease in the dollar value would worsen the situation since Iran buys a large share of its goods and services from outside USA.

As for the alternative scenario of oil being priced in other currency than the dollar, and also with diversified Iranian foreign reserves, every thing else being equal, what would be the impact on oil market volatility?

Table 7: Currencies Exposure of Iranian trade

	Currency Exposure	*balance (Million)*
Dollar (Million)	*77*	*1,232 Loss*
Euro (Billion)	*2,929*	*22 Wins*
Yen (Billion)	*797332*	*73354 Loss*

We suppose that Iran implements a new payment system for oil – meaning that it negotiates oil sales in currencies other than the US dollar (as it was the case with Venezuela in 2008 for instance). In counter part, import bills are covered in the currency of each country. We observe from table 7 that the Iranian currency exposure benefits from the appreciation of the euro, which partially covers losses resulting from the depreciation of the Dollar and the Yen in 2006. This equilibrium in the purchasing power would be able to stand out as a partial stability of the oil market.

Table 8: Iranian reserves depend on the oil trade in strange currencies in 2006

	Reserves (Billion)	*Results (Million)*
Dollar (20%)	*10.4*	*166 Loss*
Euro (60%)	*24*	*185 Wins*
Yen (15%)	*709218*	*83464 Loss*

Another possibility of addressing the question would be by computing the influence of the devaluation of exchange rate on the purchasing power of Iran. The Iranian reserve of foreign currencies was of 52.3 billion dollar in 2006[12]. Currency exposure of reserves is determined by working out the percentage of Iranian oil sales in the various currencies. It appears that 60% sales were made in Euro, 20% in dollar and 15% in Japanese Yen. Inference arising form results enclosed in table 8 is that the reason that pushed many countries to diversify their foreign reserves holdings is primarily to protect themselves against the decline in the value of the US dollar.

Hence, using equation (7), losses due to currency exposure is computed under the alternative of dollar, euro and yen pricing. It appears that when oil is priced in dollars, Iran's loss in the purchasing power is of -1.6% of the dollar exports share for the year 2006 and when priced in yen the loss is of -9.2% of the yen exports share. However, the pricing in euro leads to surplus in purchasing power of 0.75% of the euro exports share in the same year. Hence, it appears wise to choose the pricing currency such that the loss to currency exposure is minimized.

In order to verifying the above results, we estimate the reactions of oil prices subsequent to changes in exchange rate as well as to changes in price levels in different currencies. Table 9 presents estimation results of exchange rate mark-up elasticities and the reaction of price elasticities in various currency pricing. The results reveal that the statistics are significant at a 10% significance level and carry the expected negative signs for exchange rate of the dollar and for yen, while carrying a positive sign for euro. The export price mark-up elasticity estimates range from -0.17 for dollar pricing to 0.02 for euro pricing. For a 10% depreciation of the effective exchange rate of the US dollar during the sample period, export prices have been leveled by 1.7% to partially recoup the decline in the purchasing power of oil revenues while the Iranian export prices of oil in Japanese yen have been marked-up by 0.56%. On the other hand, for a 10% appreciation of the effective exchange rate of the euro, export prices exhibit a surplus of 0.2%, we notice that dollar and Yen pricing for oil have a negative impact and appear to be more volatile than

[12] Iranian Central Bank report, Oct 2006.

the euro pricing. Despite higher volatility of dollar pricing compared to that of euro pricing, we observe from table 9 that the potential reaction of Iranian oil priced in US dollar responds moderately to changes in exchange rate, whereas it is not case for Euro and Yen pricing. This result may be due to the strong confidence in the US economy and global trust in the US currency.

Table 9: the OLS estimation for Iranian oil is priced by Dollar, Euro and Yen.

$$\Delta P_{i,t} = \alpha_i + \beta_i \Delta VOL_t^i + \gamma_i \Delta P_t + \varepsilon_{i,t}$$

	Constant	β^*	$\gamma_{oildollar}$	$\gamma_{oileuro}$	γ_{oilyen}	R^2
Iran Oil $	*0.003*	*-0.17*		*0.49*	*0.46*	*0.96*
(P-value)	*(0.46)*	*(0.00)*		*(0.00)*	*(0.00)*	
Iran Oil €	*- 0.007*	*0.02*	*0.96*		*0.03*	*0.93*
(P-value)	*(0.50)*	*(0.09)*	*(0.10)*		*(0.07)*	
Iran Oil ¥	*0.176*	*-0.056*	*0.97*	*0.02*		*0.93*
(P-value)	*(0.89)*	*(0.98)*	*(0.00)*	*(0.10)*		

* β *is the mark-up of effective exchange rate of dollar, Euro and Yen. The results are significant at 10% levels*

5- Conclusion

Confronted to the fluctuations of oil revenues purchasing power of OPEC members, induced by the variability of the value of the US dollar, we are led to believe that taking on a different pricing scheme would yield a more stable market circumstance and trade outcomes. Hence, focusing on the two alternate pricing methods of crude oil for export purpose, we compared dollar based oil pricing to a currency-basket pricing scenario and reached two main interesting conclusions:

First, the decline in the value of US dollar leads to losses in the purchasing power of a barrel of oil of exporting countries (Iran). Our measures led to determine that when priced in dollar the loss for Iran as a whole is -1.6% of dollar export shares, and when priced in yen the loss is -9.5% of Yen export shares, whereas benefits from euro pricing is 0.75% of the euro export shares. Hence, it would result in a disadvantage for countries whose major trading partner is the USA.

Second, the results of the currency basket-pricing hypothesis suggest that dollar pricing and Yen pricing are more volatile than euro pricing for Iranian oil. Despite that US dollar

price of oil appears more volatile and more uncertain, its potential reaction to changes of other price references included in the currency basket, is of more moderate temperament, whereas Euro and Yen pricing exhibit large responses.

We conclude that the price calculated in currency basket would display more stability in terms of economic development and oil markets conjuncture. However, few drawbacks arose from these observations. Namely, how realistic is the implementation of this currency-basket pricing? Is there proper and adequate liquidity supply of currencies in the financial market? Would Europeans and the Japanese be willing to accept the pricing of oil in their currencies and what impact would it have on their economies? To respond to these questions, one must carry out more investigations on monetary situations of Europe and Japan.

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