The Macroeconomic Effects of Energy Purchases

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Abstract Purpose To assess whether the switch in energy source and/or the associated change in trade partners affect the Euro–Dollar exchange rate and how the countries react strategically, adjusting their energy policy.
Approach Dynamic partial equilibrium model.
Findings First, the effect of the energy purchases on the exchange rate dynamics ultimately depends on the preferences over assets and goods of the supplier countries. Second, the import preferences of the energy exporters are what determine the long-run impact of the oil and gas purchases. Therefore, when energy producers have different preferences, switching the supplier or the source can clearly alter the impact on the exchange rate.
Value An analysis of the strategic interaction on the energy markets under the assumption that all assets are not perfect substitutes.

Keywords Euro–Dollar exchange rate • Strategic interaction • Preferences • Trade partners • Energy sources substitutability

Essentially, all models are wrong, but some are useful.
George E. P. Box

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1 Introduction

Historical trends of energy consumption in the European Union clearly show the process of fuel, from crude oil and coal to natural gas, and supplier, from OPEC to Russia, switching (CSI 029/ENER 026). The first objective of this chapter is to provide an answer to the following question: "How does a switch in energy source and/or the associated change in trade partners affect the Euro–Dollar exchange rate?"

The crucial hypothesis is that this shift has an (major) effect on exchange rates, which is arising from the different preferences of the trade partners in term both of savings and consumption, both assets and goods. If asset preferences and spending patterns were identical in the two countries, an increase in disposable income for Russia and a symmetric decrease in Saudi Arabia would exert no pressure on the exchange rate. When preferences are not identical, wealth transfers are equivalent to a shift in the world demand for assets and goods. This shift gives rise to the exchange rate movements.

The role of preferences has been widely investigated in the literature. However, when it comes to asset preferences, authors have mostly preferred to work under the assumption of perfect substitutability. The most notable example of imperfect substitution is Kouri (1983), where he stated:

> In many of the recent models, including Dornbusch (1976), it is assumed that all other assets but monies are perfect substitutes. In such models balance of payments pressures have no effect on the exchange rate, which can deviate from its purchasing power parity, or long run equilibrium, value only to the extent that monetary conditions permit differences in interest rates, as is shown in Kouri and de Macedo (1978). These models cannot, however, explain observed movements in exchange rates in recent years because these movements have been far in excess of differences in inflation rates even if allowance is made for anticipated differences in future inflation rates as reflected in interest rate differentials. The models of perfect substitutability simply assume away market pressures that could account for the observed behaviour.

To cope with this issue, I present a simple dynamic partial equilibrium model to study the theoretical effect on the Euro–Dollar exchange rate of a change in the energy supplier. There is no immediate implication of the shift. Exchange rates could move any way, with the movement eventually being determined by the comparison between the assets and goods preferences of the countries involved.

1.1 Stylized Facts

In the two decades following the 1979 energy crises, oil prices dropped by almost 60 %. There were many reasons for the fall. We essentially observed a decrease in the demand for oil, due to the combination of the following forces: the recession that hit the USA in the early 1980s, the beginning of oil production from the Prudhoe Bay (Alaska) field and from the North Sea, and the greater availability of alternative fuels, such as the nuclear. To sustain the prices, Saudi Arabia cut its own production, but prices kept falling. In a desperate attempt to push out of the market the more expensive production from the USA and UK, Saudi Arabia engaged in a price war, setting the price at the "netback value." The effect was an instantaneous drop of the prices under $8 a barrel, as the strategy failed and the production from the non-OPEC fields continued at the same rate. Saudi Arabia had not considered the effect of the previous increase in oil prices, which allowed the USA and UK to make marketable their own oil. By 1986, the nominal dollar price of oil was back to the precrises level. The never-ending spiral of price drops entailed the infringement of quotas by OPEC members, especially the small ones, more interested in the revenues maximization.

This story is of extremely important for the analysis. Western countries started worrying about the security of energy supply only in the late 1990s because cheap oil was uninterruptedly available for almost 20 years. The strategic selection of energy partners is a recent story, at least for European Union. The USA considered the problem decades before, trying to both ensure the constant flow of desired fuels and to tether moderate oil nations to the US economy. Kissinger wrote in his memories:

> Our primary goal was to create incentives for the producing nations to become responsible participants in the international economy, [. . .] to encourage the use of surplus dollars for development projects, to reduce producers' free funds for waging economic warfare or blackmail against the industrialized democracies, and to return some of the extorted funds to our economy.

American diplomacy was very successful: by 1979, the Saudis were the largest holders of dollars and US Government securities. Moreover, their military purchases from the USA jumped from $305 million in 1972 to $5 billion in 1975.

The turning point is March 1999. After the decision to increase production to sustain the Asian economies in 1997, prices fell to $10/barrel. In the attempt to save the Russian economy from the default, the USA pressured the Saudis and OPEC to cut oil production to drive up the prices. An agreement between OPEC, Norway, Mexico, Oman and Russia was reached shortly after. Prices recovered immediately, but the threat of a new wave of cheating was substantial. OPEC realized that the greatest incentive to cheat was the availability of spare capacity. Therefore, the new production strategy included the control of the production capacity of the members. Since then, prices begun a shocking rise up to the level reached on July 3, 2008: $145.29.

European Union started immediately worrying about the effect of high oil prices on its economy. A defensive strategy needed to be settled. The reality was rather bleak: EU natural resources were almost exhausted and no other source of energy could sustain the whole economic activity. Eventually the European Commission managed to adopt a Green Paper on the security of energy supply by November 2000 (COM 2000, 769). The message was clear:

> The European Union lacks the necessary powers to act on supply conditions to ensure the best possible management of security of supply. Although room for maneuver is limited,

> two avenues can be explored. First of all, if only because it is an attractive market, the European Union can negotiate a strategic partnership with its supplier countries in order to improve security of supply. It has begun to do this with the Russian Federation by offering it aid to improve its transport networks and develop new technologies within a political framework that could stabilize supply and guarantee investment. Secondly, the European Union must focus particular attention on generating financial aid for renewable sources of energy which, in the very long term, are the most promising in terms of diversification of supplies.

In other words, the development of a long-term energy partnership with Russia was considered essential. Talks started between EU and Russia, the latter expressing openness towards the EU problem of security of the supply as long as she was ensured the desired level of revenues.[1] Especially after the EU enlargement, the economic links between Russia and the EU have extremely reinforced. Even if the euro has also gained importance within the Central Bank of Russia, the dollar remains the preferred international currency in Russia, in particular for its strong role in the global oil markets.

We have now on the table all the elements to understand the model, which is presented in the next section.

2 The Model

The major inspiration to this chapter is Krugman (1980), who developed a simple theoretical model of the effect of an oil price increase on the Dollar–Mark exchange rate. His model shows that the direction of the initial effect is opposite to the one in the long run. Krugman argues that the interaction between oil prices and exchange rates is a problem of multilateral economic relations. Therefore, even a minimal model must include at least three countries. Indeed, the common simplification brought by the "small country" assumption is misleading and never justified.

The model is based on three main ideas. First, preferences play an important role in understanding the effect of oil imports. It is not the total oil expenditure that affects the exchange rate; rather, it is the relation between OPEC preferences and the import bill. Second, the fact that OPEC adjusts its expenditure on goods with a lag implies that the dynamics of the exchange rate will be affected by the preferences of OPEC on assets relative to the preferences on goods. Third, the wealth transfer effect is crucial for explaining the exchange rate behavior. As the exchange market clears, the short-run equilibrium is determined as to equilibrate flow demands for and supply of foreign exchange derived from capital flow on one side and the current account on the other for each country. The burden of balance of payments adjustment falls on the exchange rate alone. When the extra demand by the three countries for domestic and foreign assets in excess of the

[1] EU–Russia summit, Paris, October 30, 2000.

existing holdings is balanced, the long-run equilibrium of the exchange rate is determined by the condition that the current accounts are at normal level.

We notice that the effect of the price of oil depends on whether the burden of the balance of payments of one country resulting from higher oil imports is greater or lower than the benefits from the increase in OPEC investments and purchase of goods. In particular, OPEC preferences over the latter are what define the long-run behavior of exchange rates.

2.1 The Features of the Baseline Model

The model of Krugman is extended to include a fourth country, Russia, and a second commodity, Gas. The World is composed by four countries: the USA, EU, Russia, and OPEC. In the following, it is described how this simplified World works:

- Each country produces. OPEC and Russia produce both Oil and Gas, the USA produces Cars, and EU produces Pasta. Each country buys all the other goods, except for OPEC and Russia which do not exchange their respective commodities.
- Only two assets, Dollar and Euro, are available on the market. The four countries allocate their wealth between the two.
- The wealth of both Russia and OPEC is denominated in Dollar.
- Real income and prices are given for the USA and EU, while they are endogenous for Russia and OPEC. Oil and Gas prices are fixed in the baseline model.
- EU trade balance with respect to the USA depends on the exchange rate. The USA and EU import fixed quantities of Oil and Gas. The imports of OPEC and Russia depend on their income. However, their spending does not adjust immediately as their income changes. It is rather a lagged process.
- The USA and EU hold a fixed amount of each other's currency in their portfolio and their wealth is exogenous. Russia and OPEC hold a fixed fraction of their wealth, endogenous, in Euro and the remaining in Dollar.

2.2 The Goods Market

US and EU intertrade is fixed. As prices and incomes are given, the trade balance (from now on, T_t) only depends on the exchange rate, e_t, that is, the dollar ($) price of euro (€). The EU trade balance with respect to the USA, expressed in Dollar,[2] is:

[2] I will express all the values in dollar unless otherwise stated.

$$T_t = T_t(e_t)$$

$$\frac{\partial T_t}{\partial e_t} < 0.$$

The sign of the derivative of the trade balance with respect to the exchange rate implies that the appropriate Marshall–Lerner condition holds. Note that $e_t = \frac{€}{\$}$, so when e_t increases, the Euro appreciates and the trade balance worsens. I am assuming no *J*-curve effect.

The current accounts of EU and the USA include the energy imports too. Total energy production is assumed to be fixed. The structure of the oil and gas markets is similar, as EU and the USA split the imports of the total world energy production. The prices of all the commodities, P_t^i—where i is either o for oil or g for gas and t is the time index—are expressed in Dollars. Therefore, energy prices for EU at time t, $\frac{P_t^{i,\mathrm{E}}}{e_t}$, depend on the exchange rate in the same period. The markets for oil from OPEC and Russia at time t, $O_t^{j,h}$, j being the exporter, R for Russia or O for OPEC, and h being the importer, E for EU or A for the USA, are specified as follows:

$$\frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{O,E}} = \eta P_t^{\mathrm{o}} O_t^{\mathrm{O}}$$

$$P_t^{\mathrm{o}} O_t^{\mathrm{O,A}} = (1-\eta) P_t^{\mathrm{o}} O_t^{\mathrm{O}}$$

$$P_t^{\mathrm{o}} O_t^{\mathrm{O,A}} + \frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{O,E}} = P_t^{\mathrm{o}} O_t^{\mathrm{O}}$$

$$\frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{R,E}} = \phi P_t^{\mathrm{o}} O_t^{\mathrm{R}}$$

$$P_t^{\mathrm{o}} O_t^{\mathrm{R,A}} = (1-\phi) O_t^{\mathrm{R}}$$

$$P_t^{\mathrm{o}} O_t^{\mathrm{R,A}} + \frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{R,E}} = P_t^{\mathrm{o}} O_t^{\mathrm{R}}.$$

The share of EU imports of oil from OPEC is η while the share of EU imports from Russia is ϕ. It follows that the total US import of oil from OPEC at time, $O_t^{\mathrm{O,A}}$, may be higher or lower than those of EU, $O_t^{\mathrm{O,E}}$. The same is true for the imports of Russian oil.

The Gas market works similarly. The total gas exported from each country, G_t^j, is allocated to the consumer countries according to the following rules:

$$\frac{P_t^{g,E}}{e_t} G_t^{O,E} = \psi P_t^g G_t^O$$

$$P_t^g G_t^{O,A} = (1 - \psi) P_t^g G_t^O$$

$$P_t^g G_t^{O,A} + \frac{P_t^{g,E}}{e_t} G_t^{O,E} = P_t^g G_t^O$$

$$\frac{P_t^{g,E}}{e_t} G_t^{R,E} = \omega P_t^g G_t^R$$

$$P_t^g G_t^{R,A} = (1 - \omega) P_t^g G_t^R$$

$$P_t^g G_t^{R,A} + \frac{P_t^{g,E}}{e_t} G_t^{R,E} = P_t^g G_t^R.$$

In the gas market, ψ is the share of gas exported from OPEC to EU and ω is the share of gas that EU imports from Russia. Their value is of fundamental importance for understanding of the exchange rate dynamics.

The imports of OPEC and Russia depend on their incomes: while Oil and Gas constitute almost the entire income of OPEC and Russia, they account only for a minor percentage of US and EU spending. In addition, I also consider the lag in the expenditure and the marginal propensity to consume in goods an extra unit of income.

OPEC has fixed preferences: it spends a portion $\gamma(e_t)$ of its total expenditures at time t, X_t^O, in Pasta from EU and a share $1 - \gamma(e_t)$ in Cars from the USA. I assume that OPEC wealth is held in dollars, so the imports are paid in the same currency. For this reason, the spending in imports from EU, $X_t^{O,E}$ depends on the exchange rate e_t through the parameter γ.

$$X_t^{E,O} = \gamma(e_t) X_t^O$$

$$X_t^{A,O} = [1 - \gamma(e_t)] X_t^O$$

$$X_t^O = X_{t-1}^O + \lambda (P_t^O O_t^O + P_t^g G_t^O - X_{t-1}^O).$$

The parameter λ is the share of the surplus (deficit) of the current account used to finance the consumption of goods (financed via a reduction of the consumption).

Imports from Russia are determined in the same way. Clearly, the Russian propensity to import from EU, $\delta(e_t)$, is different from the one of OPEC. Russian imports from EU need to be paid in Euro. Therefore, $X_t^{R,E}$ equals the share of total Russian imports from EU, $\delta(e_t)\ X_t^R$, converted in Euro.

$$X_t^{\mathrm{E,R}} = \delta(e_t)X_t^{\mathrm{R}}$$

$$X_t^{\mathrm{A,R}} = [1 - \delta(e_t)]X_t^{\mathrm{R}}$$

$$X_t^{\mathrm{R}} = X_{t-1}^{\mathrm{R}} + \rho(P_t^{\mathrm{O}}O_t^{\mathrm{R}} + P_t^{\mathrm{g}}G_t^{\mathrm{R}} - X_{t-1}^{\mathrm{R}}).$$

In this case, the marginal propensity of Russians to consume an extra unite of income is ρ.

2.3 The Capital Market

I assume that the marginal propensity of the USA and EU to hold an extra unit of wealth in the foreign currency is zero. As none of the market considered has an extreme wealth effect on both the USA and EU, the assumption is reasonable. Conversely, the change in wealth is significant for both Russia and OPEC. At each point in time, the holdings of foreign assets by the USA and EU, A_t^j, where j is either A or E, are functions of the exchange rate and of the fixed amount expressed in the home currency allocated to the foreign currency.

$$A_t^{\mathrm{A}} = \frac{€_t^{\mathrm{A}}}{e_t}$$

$$A_t^{\mathrm{E}} = \$_t^{\mathrm{E}} e_t.$$

The asset holding of OPEC and Russia is linked to their wealth. In particular, as I assume away the effect on preferences of the expected rate of returns, the oil and gas producers allocate fixed fractions of their wealth between the two assets.

As both OPEC and Russia are assumed to hold their wealth, Z_t^j, in dollars, their holdings of Euro assets at time t, $A_t^{j,€}$, has to be converted in euro.

$$A_t^{\mathrm{O},€} = \frac{€_t^{\mathrm{O}}}{e_t} = \alpha Z_t^{\mathrm{O}}$$

$$A_t^{\mathrm{O},\$} = \$_t^{\mathrm{O}} = (1 - \alpha)Z_t^{\mathrm{O}}$$

$$A_t^{\mathrm{R},€} = \frac{€_t^{\mathrm{R}}}{e_t} = \beta Z_t^{\mathrm{R}}$$

$$A_t^{\mathrm{R},\$} = \$_t^{\mathrm{R}} = (1 - \beta)Z_t^{\mathrm{R}}.$$

α and β are, respectively, the fractions of the wealth of OPEC and Russia allocated to Euro assets. An appreciation of the Euro will negatively impact on the wealth of OPEC and Russia, which will experience a loss in the share of their Euro holdings, α and β.

The change in wealth is affected by the marginal propensity to save. I previously defined the marginal propensity to consume as ρ for Russia and λ for OPEC. The remaining surplus—or deficit—of the current account is thus transferred to the capital markets for investment purpose.

The change in wealth is thus function of the share of current account surplus invested (deficit financed by liquidating assets) minus the capital loss on Euro holdings (plus capital gains on Euro holdings).

$$\dot{Z}_t^{\mathrm{O}} = (1-\lambda)B_t^{\mathrm{O}} - \alpha Z_t^{\mathrm{O}}\left(\frac{\dot{e}_t}{e_t}\right)$$

$$\dot{Z}_t^{\mathrm{R}} = (1-\rho)B_t^{\mathrm{R}} - \beta Z_t^{\mathrm{R}}\left(\frac{\dot{e}_t}{e_t}\right).$$

The complete model is now specified.

2.4 The Dynamics

Commodity exporters adjust their spending with a lag while no temporal limitation is imposed on the investment decision. The time difference between the allocation on the world markets of financial resources and the spending on goods of extra revenues is what determines the dynamic movements of exchange rates. In the short run, we require the current and the capital account to balance. The exchange rate must move to offset the capital flow generated from OPEC and Russia. In the long run, when the imports of oil and gas producers reach their new level, the new equilibrium of the exchange rate is determined so that the current accounts are at their normal level.

2.4.1 The Short Run

In the short run, the balance of payments must be in equilibrium. In a two-currency world, the equilibrium condition imposed on the EU balance of payments is equivalent to the one imposed on the US balance of payments.

The EU current account, B_t^{E}, equals the sum of the EU net exports to the USA plus exports to OPEC and Russia minus the energy imports.

$$B_t^{\mathrm{E}} = T_t(e_t) + \gamma(e_t)X_t^{\mathrm{O}} + \delta(e_t)X_t^{\mathrm{R}} - \eta P_t^{\mathrm{o}}O_t^{\mathrm{O}} - \phi P_t^{\mathrm{o}}O_t^{\mathrm{R}} - \psi P_t^{\mathrm{g}}G_t^{\mathrm{O}} - \omega P_t^{\mathrm{g}}G_t^{\mathrm{R}}.$$

The EU capital account is given by the net flow of capital into the European Union, which is given by the difference between purchases of Euro assets by the USA, OPEC, and Russia minus purchases of the US assets by EU.

$$K_t^{\mathrm{E}} = \frac{€_t^{\mathrm{A}}}{e_t}\left(\frac{\dot{e}_t}{e_t}\right) + \frac{€_t^{\mathrm{O}}}{e_t}\left(\frac{\dot{e}_t}{e_t}\right) + \frac{€_t^{\mathrm{R}}}{e_t}\left(\frac{\dot{e}_t}{e_t}\right) - \$_t^{\mathrm{E}}\left(\frac{\dot{e}_t}{e_t}\right).$$

When defining the capital markets, I assumed that the flow of capital was function of the change in wealth. Substituting for the wealth of OPEC and Russia in the capital account yields the following equation[3]:

$$\begin{aligned} K_t^{\mathrm{E}} = {} & \frac{€_t^{\mathrm{A}}}{e_t}\left(\frac{\dot{e}_t}{e_t}\right) - \$_t^{\mathrm{E}}\left(\frac{\dot{e}_t}{e_t}\right) + \alpha\left[(1-\lambda)B_t^{\mathrm{O}} - \alpha Z_t^{\mathrm{O}}\left(\frac{\dot{e}_t}{e_t}\right)\right] \\ & + \beta\left[(1-\rho)B_t^{\mathrm{R}} - \beta Z_t^{\mathrm{R}}\left(\frac{\dot{e}_t}{e_t}\right)\right] + \alpha Z_t^{\mathrm{O}}\left(\frac{\dot{e}_t}{e_t}\right) + \beta Z_t^{\mathrm{R}}\left(\frac{\dot{e}_t}{e_t}\right). \end{aligned}$$

The previous condition shows that the capital account is function of net flow of capital from the USA and the change in the wealth of OPEC and Russia.

The balance of payments is then derived setting $K_t^{\mathrm{E}} + B_t^{\mathrm{E}} = 0$. That is,

$$\begin{aligned} & \frac{€_t^{\mathrm{A}}}{e_t}\left(\frac{\dot{e}_t}{e_t}\right) - \$_t^{\mathrm{E}}\left(\frac{\dot{e}_t}{e_t}\right) + \alpha\left[(1-\lambda)B_t^{\mathrm{O}} - \alpha Z_t^{\mathrm{O}}\left(\frac{\dot{e}_t}{e_t}\right)\right] + \beta\left[(1-\rho)B_t^{\mathrm{R}} - \beta Z_t^{\mathrm{R}}\left(\frac{\dot{e}_t}{e_t}\right)\right] \\ & \quad + \alpha Z_t^{\mathrm{O}}\left(\frac{\dot{e}_t}{e_t}\right) + \beta Z_t^{\mathrm{R}}\left(\frac{\dot{e}_t}{e_t}\right) \\ & \quad = -B_t^{\mathrm{E}}. \end{aligned}$$

Solving for the exchange rate, I get the rate of change of the exchange rate:

$$\frac{\dot{e}_t}{e_t} = \frac{B_t^{\mathrm{E}} + \alpha(1-\lambda)B_t^{\mathrm{O}} + \beta(1-\rho)B_t^{\mathrm{R}}}{\frac{€_t^{\mathrm{A}}}{e_t} - \$_t^{\mathrm{E}} + \alpha(1-\alpha)Z_t^{\mathrm{O}} + \beta(1-\beta)Z_t^{\mathrm{R}}}.$$

In the short run, the exchange rate moves according to the ratio of EU combined current account—that is, the EU current account plus the part of the energy exporters' current account recycled into Euro assets—on the size of the international investment pool. Euro will depreciate (appreciate) if the recycling of OPEC and Russia is not enough (enough) to offset the deficit induced by energy purchases and net flow of capital in EU is negative (positive). If α and β are low, this is likely to be the case. The magnitude of the effect is very difficult to detect and depends on a number of factors, including the marginal propensity to save by Russia and OPEC,

[3] The proof of each step from now on is in Appendix.

their total wealth and the share of wealth that they hold in euro. The EU current account deficit or surplus alone does not give any information on the fluctuation of the exchange rate. For the Euro to appreciate, the sum of the planned spending on Pasta from EU—remember that the import decisions are lagged—and of the capital inflow into EU must be such to offset the outflow of money from EU to pay for its energy bill.

2.4.2 The Long Run

From the dynamics outlined in the previous section, after the initial shock to the international payments, the spending of the USA and EU in energy remains constant. The exchange rate is affected by two factors:

- The dynamics of the wealth of OPEC and Russia
- The dynamics of the expenditures of OPEC and Russia

Eventually, when the current accounts of OPEC and Russia are in equilibrium, there will be no other source of fluctuation and the world will reach the new exchange rate. Equally, in the long run all of the equations in the dynamic system are constrained to be zero. The total effect on the exchange rate will then be given by the following:

$$\mathrm{de} = \frac{(\alpha(1-\lambda)-\gamma)dX^{\mathrm{O}} + (\beta(1-\rho)-\delta)dX^{\mathrm{R}}}{(\partial T/\partial e) + (\partial\gamma/\partial e)X^{\mathrm{O}} + (\partial\delta/\partial e)X^{\mathrm{R}}}.$$

The denominator is negative by the Marshall–Lerner condition. This is obvious for the EU–US trade balance, but it is true also for OPEC and Russia spending. The numerator can be either positive or negative, depending on whether the investment propensity of OPEC and Russia is greater or lower than their spending propensity in EU. Under the assumption that both OPEC and Russia spend more on EU products of what they invest in EU, the long-run effect of an increase in energy purchases is an appreciation of the euro. However, a very important role is played by the marginal propensity to save in the two countries. As they do not invest all of their earnings on the capital markets, but just a fraction $(1-\lambda)$ for OPEC and $(1-\rho)$ for Russia, the lower is the propensity to save, the higher is the long-run effect of the import of goods on the exchange rate.

Table 1 summarizes the range of all possible effects and the impact of switch in energy source or partner.

The other four cases follow by induction.

Table 1 The range of all possible effects and the impact of switch in energy source or partner

Preferences	Long-run exchange rate dynamics	Switch	Effect of the switch
1. $\alpha(1-\lambda) > \gamma$ 2. $\beta(1-\rho) > \delta$	The euro depreciates	From OPEC to Russia or vice versa	No effect
1. $\alpha(1-\lambda) < \gamma$ 2. $\beta(1-\rho) < \delta$	The euro appreciates	From OPEC to Russia or vice versa	No effect
1. $\alpha(1-\lambda) > \gamma$ 2. $\beta(1-\rho) < \delta$ $1 > 2$	The euro should depreciate, unless dX^R is high enough	From OPEC to Russia	dX^R increases, the depreciation of the euro is less strong or it is reversed
1. $\alpha(1-\lambda) > \gamma$ 2. $\beta(1-\rho) < \delta$ $1 > 2$	The euro should depreciate, unless dX^R is high enough	From Russia to OPEC	dX^R decreases, the euro depreciates more or appreciates less
1. $\alpha(1-\lambda) > \gamma$ 2. $\beta(1-\rho) < \delta$ $1 < 2$	The euro should appreciate, unless dX^O is high enough	d{{X}^ {R}} ~ beta OPEC to Russia	dX^R increases, the euro appreciates more or depreciates less
1. $\alpha(1-\lambda) > \gamma$ 2. $\beta(1-\rho) < \delta$ $1 < 2$	The euro should appreciate, unless dX^O is high enough	From Russia to OPEC	dX^R decreases, the euro appreciates less or depreciates more

3 Introducing the Strategy

The world is not made of price takers—at least in the long run. Consumers do play a great role in shaping the market. Their strategy is composed of three related goals: diversify the energy suppliers, reduce the imports of energy, and reduce the energy consumption overall. The EU policies contemplate both an increase in the energy efficiency to reduce the energy intensity of the GDP and a series of major investments in the development of renewable backstops. This two combined may be effective in tackling the second and the third issue presented above.

As long as the price of oil and gas were linked, there was not much the consumer countries could do to avoid the burden of the increased energy bill. In the years before the global recession, several actions were taken to mitigate the effect of energy prices, including the creation of new infrastructures—LNG terminals, pipelines, and power plants. Importing countries have now increased flexibility in switching source. While the effect in the switch of the supplier may be determined in the baseline model framework, some extra restrictions will have to be imposed to find the effect on energy purchases of the increase in prices by the energy producers. I will also assume that there is no constraint—both technological and legal—to the amount of energy demand that can be switched.

I partially relax the assumption that oil and gas imports are fixed, and I match this with the hypothesis that total energy imports must be constant. Focusing on EU only, the total energy purchases are given by:

$$\eta \frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{O}} - \phi \frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{R}} - \psi \frac{P_t^{\mathrm{g,E}}}{e_t} G_t^{\mathrm{O}} - \omega \frac{P_t^{\mathrm{g,E}}}{e_t} G_t^{\mathrm{R}} = \bar{E}.$$

$\bar{E}$ is the total of oil and gas imported by EU, which is constant over time.

$$d\bar{E} = 0.$$

As a consequence, any change in the structure of energy imports must be such that total energy imports are held constant.

$$d\left(\eta \frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{O}} - \phi \frac{P_t^{\mathrm{o,E}}}{e_t} O_t^{\mathrm{R}}\right) + d\left(\psi \frac{P_t^{\mathrm{g,E}}}{e_t} G_t^{\mathrm{O}} - \omega \frac{P_t^{\mathrm{g,E}}}{e_t} G_t^{\mathrm{R}}\right) = 0.$$

With G_t^{E} total gas imports and O_t^{E} total oil imports of EU, I derive how oil imports change from time to time:

$$d(O_t^{\mathrm{E}}) = \frac{O_t^{\mathrm{E}}\left(\frac{P_t^{\mathrm{o,E}}}{e_t} de_t - d(P_t^{\mathrm{o,E}})\right) - d(G_t^{\mathrm{E}})}{P_t^{\mathrm{o,E}}}.$$

What do we learn about the EU strategy? When the price of oil increase, EU is interested in buying more gas, if cheaper. However, the appreciation of euro has a positive impact on the purchases of oil. Total changes in oil imports are given by the difference between the effect on the oil and gas markets of the exchange rate and the prices.

What is the effect of this switch on the exchange rate? It depends. The switch affects EU preferences in terms of energy—η, ϕ, ψ, and ω. Should such a change happen, this is going to impact on the exchange rate dynamics. Recalling the long-run effect in the baseline model:

$$\mathrm{de} = \frac{(\alpha(1-\lambda)-\gamma)dX^{\mathrm{O}} + (\beta(1-\rho)-\delta)dX^{\mathrm{R}}}{(\partial T/\partial e) + (\partial\gamma/\partial e)X^{\mathrm{O}} + (\partial\delta/\partial e)X^{\mathrm{R}}}.$$

When the change in the energy source is realized by changing the supplier, the switch is going to affect the exchange rate dynamics if the new supplier has different preferences from the previous. For instance, considering the EU import structure after the recession, the major tool available is the LNG, which is mainly imported from OPEC. As long as new pipelines are not completed, a substitution of oil with gas from OPEC may induce a long-run depreciation of the dollar, given that OPEC buys more EU goods of what it invests in EU assets. Since the shape of energy markets is changing fast, new technologies, the availability of new infrastructures, or simply the discovery of new fields in other regions of the world—like the Marcellus Shale Natural Gas Field in Pennsylvania—might change the picture. This is likely to impact on the exchange rate movements.

4 Conclusions

In this chapter a simple model was presented to study the interactions between energy markets and the Euro–Dollar exchange rate. The hypothesis is that the behavior of energy producers and suppliers is highly strategic and one has to account for it when modelling the energy markets. In particular, I proposed a simple partial equilibrium model where a simple world of four countries, two currencies, two energy sources, and two goods was represented. Although the model is extremely simple and relies heavily on very strong assumptions, it proves to be a useful tool to consider the channels through which a change in the energy source or in the energy supplier can impact on the exchange rate dynamics.

Several considerations arise from the analysis of the model. In particular, two are key to answer to the research question of this chapter. First, the effect of the energy purchases on the exchange rate dynamics ultimately depends on the preferences over assets and goods of the supplier countries. Second, the import preferences of the energy exporters are what determine the long-run impact of the oil and gas purchases. Therefore, when energy producers have different preferences, switching the supplier or the source can clearly alter the impact on exchange rate. In the second part of my analysis, I focused my attention on the strategic actions of the energy market players and their long-term energy policies. Specifically, I assumed that the USA and EU aim at reducing their energy bills—switching source of energy. I found that, *ceteris paribus*, the effect of the switch in energy source might be significant when it is combined with a substitution of the supplier, especially since the link between oil and gas prices is starting to vanish. The impact on the exchange rate dynamics is higher when the new trade partner has different preferences with respect to assets and goods compared to the previous supplier. This is a very powerful strategic tool for importing countries, especially when the infrastructure constrain in the energy markets is reduced.

While my results might be affected by a number of factors, including the effect of speculation and the level of the economic activity, they still deserve attention as a good example of the study of a very strategic, fast-changing market. Future efforts should be devoted to understanding how the interaction between energy players will change when new infrastructure—pipelines, IV generation nuclear plants, and renewable power plants—go into operation. According to my framework, this is likely to have a strong impact on the structure of the market, where there will be room for a flexible energy policy.

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