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Oil market structure, network effects and the choice of currency for oil invoicing[☆]

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ABSTRACT

Crude oil is a homogeneous good traded on specialised exchanges and quoted and invoiced predominantly in US dollars. Despite the strong case for the use of the US dollar as a vehicle currency in the oil trade, we provide an alternative view. We develop a simple network effects model to identify the conditions under which either a complete switch in the oil invoicing currency or parallel invoicing in different currencies is possible and economically sensible. We calibrate the model using low actual values for the transaction costs of using euro and/or US dollars, as well as a proxy for information costs, which decline with the increase in the use of the new currency. The results show that there will be a switch to parallel invoicing in both currencies when two conditions are met: first, oil exporters expect that a certain minimum number of other oil exporters will also start using the new currency; and second, the information costs associated with quoting oil contracts in two currencies are low.

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1. Introduction

Why is oil priced, invoiced and settled in US dollars? The surge in oil prices from USD 10 per barrel in 1998 to USD 145 in July 2008, combined with the rise of the US dollar/euro exchange rate from a low of USD 0.83 in 2000 to a high of USD 1.60 in July 2008, encouraged discussions in various circles—from the media (Islam, 2003) and academia (Alhajji, 2005) to the European Parliament (2004) and OPEC (Koch, 2004)—about the possibility of pricing oil in euro or using a basket of currencies. In the recent environment of increasingly heated debates about currency wars, trade sanctions, global imbalances and national interests, this discussion about alternatives to invoicing crude oil contracts in US dollars may gain prominence again.

The literature on trade invoicing suggests that primary commodities, such as crude oil, tend to be priced in vehicle currencies, because they are homogeneous and prices are easily comparable. Physical crude oil is not a homogenous commodity: Platts, the world's leading pricing service, provides daily price quotes for 62 grades of crude oil.¹ However, standardised grades, such as Brent and West Texas Intermediate (WTI), have been developed to

create homogeneity which allows the trading of “paper” oil contracts on commodity exchanges.

Historically, petroleum has mostly been traded in US dollars since the Seneca Oil Company drilled the first oil well in Pennsylvania in 1859. But there are some notable exceptions to this statement. In the 1940s Anglo-Iranian (now BP) concluded some large crude oil contracts with Standard Oil of New Jersey and Standard Oil of New York (now ExxonMobil) in pounds sterling (Bamberg, 2000). Another case is the 1950s sterling-dollar oil controversy, in which the British government established exchange controls on oil imports and required the pricing of petroleum in pounds sterling in order to stop a short-term dollar drain (Schenk, 1996). A third example is the practices of the countries of the Persian Gulf which were part of the sterling area, which quoted their oil prices in US dollars but accepted payment in pounds sterling (McKinnon, 1979, p. 77). Fourth, in 1972 and 1973 OPEC signed two agreements, known as Geneva I and Geneva II, which attempted to price oil in a basket of currencies. The agreements aimed to protect the price of oil against fluctuations in the value of the US dollar against other major currencies (Al-Chalabi, 1980).

More recently, in October 2000 the Iraqi government demanded the settlement of its petroleum exports in euro under the UN Oil-for-Food Programme (CNN, 2000), and in April 2008 Iran stopped conducting oil transactions in US dollar (CBS, 2008). In addition to these instances, when actual settlement of the international oil trade occurred in pounds sterling or euro, there is also the case of crude oil exports to the United States being priced in Canadian dollars but settled in US dollars, so that the producers bear the exchange rate risk. Finally, Chinese oil companies—such as the two largest, CNOOC

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¹ By way of example, in 2011 European refineries experienced difficulties in replacing Libyan light, sweet crude, the production of which came to halt in 2011, with similar quality crude from other producers.

Ltd. and Petrochina Company Ltd.—price their locally produced crude oil in US dollars on the basis of international benchmark grades, but settle domestic contracts (the majority of their crude oil sales) entirely in renminbi. While several of these cases are reflections of political intentions rather than economic considerations, the present study considers the economic setting of the oil market and the arguments that may support or argue against the case for invoicing and settling oil trades in a currency other than the US dollar.

After a review of the literature this paper examines in detail the characteristics of the crude oil market and current oil invoicing/settling practices (Section 3) and develops a network effects-based model defining the conditions under which a complete switch in the oil invoicing currency or parallel invoicing in different currencies would be possible (Section 4).

2. Theoretical literature on the use of currencies in international trade

This section provides an overview of the theoretical explanations for the choice of invoicing currency in trade, reflecting the three functions of money: medium of exchange, unit of account and store of value.² Most theoretical literature on trade invoicing focuses on money as a *medium of exchange* and discusses the role of vehicle currencies in the trading of goods or the exchange of currencies. Swoboda (1968) argues that if residents of a country may only hold non-interest bearing foreign currency assets, and their revenues or expenditures are at least partly denominated in a foreign currency, it is, transaction costs (e.g. brokers' fees, bookkeeping, and psychological inconvenience) make it profitable for them to hold foreign currency cash balances. Krugman (1980) develops a formal three-country, three-currency model, in which transaction costs as a proportion of the transaction size decline as the size of the exchange market increases. He shows that only the currency of an economically dominant country can serve as a vehicle currency. Moreover, once a currency is established as an international medium of exchange, its vehicle role becomes self-reinforcing and may persist even if the country's economic power diminishes. Krugman's static analysis also allows for multiple equilibria with more than one vehicle currency in international payments at any one time. Extending Krugman's model, Rey (2001) integrates international goods and currency exchange and suggests that the "thick market" externality (i.e. economies of scale in foreign exchange markets) and trade parameters, such as the degree of openness, the level of integration between the countries or transportation technologies, are the key variables which characterise these multiple steady state equilibria and have an impact on the choice of vehicle currency. Section 4.1 of this paper deals in greater detail with the theory of network effects in the use of currencies.

Invoicing decisions in international trade are also modelled and tested empirically by Goldberg and Tille (2005). They contrast factors that influence the choice of currency and find that industry characteristics, such as the degree of product differentiation, are more important than macroeconomic factors such as exchange rate volatility. Their analysis presents evidence that the vehicle role of the US dollar is explained by both the importance

of transactions in goods traded in organised exchanges and the significant role played by the United States as an international trade partner.

The theoretical literature on the second role of money, as a *unit of account*, is not well developed. It is often assumed that the quotation currency is the same as the invoicing or settlement currency and the theory of vehicle currencies is applied. McKinnon (1979) treats money as a medium of exchange but reaches an important conclusion regarding the unit of account function. McKinnon suggests that the use of vehicle currencies in the trading of homogeneous goods such as primary commodities is dictated by the need for price transparency. He also argued that trade on Britain's commodity exchanges had continued to be conducted in pounds sterling, despite sterling's relative decline (at that time) as a vehicle currency, because of the long history of such currency use and the familiarity with the pound of merchants involved in these exchanges.

Thirdly, investment currencies fulfil the purpose of international money as a *store of value*. The general result of international asset pricing models is that efficient portfolios are usually well diversified across many currencies because of risk-reducing considerations, which is in contrast to the predictions of the medium of exchange theory that there may be only a limited number of vehicle currencies. However, considerable currency diversification in financial portfolios is not actually observed. This may occur, because the store of value and medium of exchange functions of money are interrelated. On the one hand, countries important in international trade tend to have deep financial markets and no capital controls, and therefore they attract foreign investors. On the other hand, countries with large and sophisticated financial markets experience high demand for their currencies for international trade payments (Hartmann, 1998, p. 28).

To explain the role of money as a store of value, Giovannini and Turtelboom (1994) use a cash-in-advance-constrained model and incorporate the costs incurred in instantly transforming financial assets into cash for use in purchasing goods. The demand for domestic or foreign currencies is determined by their expected "liquidity services". Thus, in countries with underdeveloped financial markets (i.e. financial assets are illiquid), the liquidity services of money are significant and, if the domestic currency provides low expected returns (as is the case in high inflation countries), the foreign currency becomes an attractive liquid investment.

The analyses in many of the studies reviewed above apply to the trading of crude oil as a homogeneous good traded in organised exchanges and denominated in the currency of the country which dominates international trade. However, as the discussion of the oil market in the following section suggests, multiple currency invoicing in this particular industry might prove to be more likely than has previously been assumed.

3. Overview of the oil market

The most widely accepted theoretical approach to the economics of oil focuses on the prevailing oligopolistic market. According to Adelman (1993), the long-term marginal cost is a small fraction of the price of oil, even when making considerable allowances for the future values of the resources used up today ("user costs"). To support high price levels, the excess supply is restricted by a cartel. Higher-cost producers sell all they can produce, while low-cost producers satisfy the remainder of the demand at current prices and cut back production if needed. Econometric evidence on Saudi Arabia confirms the asymmetric behaviour of the low-cost petroleum suppliers: the country restricts production in reaction to negative demand shocks but

² For a detailed survey of the literature, see Hartmann (1998, pp. 11–29). Note that the terms invoicing and settlement are used throughout this paper in relation to the medium of exchange function of money, as is standard practice in the literature. The important issue here is who bears the exchange rate risk—the buyer or the seller. A distinction is made, however, between the medium of exchange function and the unit of account function, with the term quotation used in this paper in relation to the latter.

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