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NETWORK EFFECTS, HOMOGENEOUS GOODS AND INTERNATIONAL CURRENCY CHOICE

NEW EVIDENCE ON OIL MARKETS FROM AN OLDER ERA

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In 2014 all ECB publications feature a motif taken from the €20 banknote.

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Abstract

Conventional wisdom has it that network effects are strong in markets for homogenous goods, leading to the dominance of one settlement currency in such markets. The alleged dominance of the dollar in global oil markets is said to epitomize this phenomenon. We question this presumption with evidence for earlier periods showing that several national currencies have simultaneously played substantial roles in global oil markets. European oil import payments before and after World War II were split between the dollar and non-dollar currencies, mainly sterling. Differences in use of the dollar across countries were associated with trade linkages with the United States and the size of the importing country. That several national currencies could simultaneously play a role in international oil settlements suggests that a shift from the current dollar-based system toward a multipolar system in the period ahead is not impossible.

Key words: network effects, homogeneous goods, international invoicing currency, oil markets, US dollar role

JEL classification: F30, N20

Non-technical summary

One of the clearest signs of the US dollar's dominant international role is its status as the all but exclusive currency used for pricing and settling transactions in global oil markets. The prices of West Texas Intermediate, Brent and Dubai crude are all expressed in dollars. The dollar is used as the unit of account for virtually all benchmark prices. NYMEX, the world's largest oil futures market, provides quotes exclusively in dollars. In the global oil market, whether for spot, term or future contracts and irrespective of country, the dollar reigns supreme.

The dominance of the dollar in global oil markets is relevant for several key international economic issues. It is essential to the understanding of the dollar's international status and international currency choice. It has major implications for the degree of exchange rate pass-through of oil and commodity price shocks and for forecasting of domestic inflation. Many models used for policy simulations assume that oil prices are set in dollars.

The dollar's dominance as unit of account and means of payment in global oil markets is said to rest on two pillars. One, as with all facets of international currency status, are network effects. In other words, oil prices tend to be expressed and transactions to be settled in dollars because the US remained the largest global oil producer for fully a century, until it was overtaken by the Middle East in the 1950s. Once the practice of expressing oil prices in dollars and settling transactions in that unit became so widespread, and a critical mass of transactions was reached, it was costly for individual buyers and sellers to do otherwise. The second pillar is homogeneity of the product. Because oil is a relatively homogenous commodity, there is substantial convenience in quoting prices in just one currency to facilitate comparisons.

The literature on the use of the dollar as the currency of denomination, invoicing and settlement in oil-market transactions is pitched at a high level of generality, however. It tends to be based on stylised rather than closely-observed facts. A major constraint facing empirical work on currency choice in international trade in oil, as in other commodities, goods and services, has been lack of detailed data. Moreover, there has been no meaningful empirical work on choice of currency in the oil market because it is presumed that there is no variation in currency usage in the recent data, if any, given that virtually all recent transactions are widely believed to be denominated, invoiced and settled in dollars.

In this paper we present evidence showing that the effects of network increasing returns and product homogeneity on the currency used as means of payment in the global oil market are not as strong as conventionally supposed. In earlier periods, oil transactions were in fact undertaken in a number of different currencies. This suggests that there is room for more than one national currency as means of payment even for a good as homogenous as oil. This conclusion is consistent with what we have called elsewhere the "new view" of international currency markets (Chițu, Eichengreen and Mehl, forthcoming), according to which network increasing returns are not as strong as commonly supposed, first-mover

advantage is not everything, incumbency is no guarantee of success, and several national currencies can play consequential roles in international transactions.

Specifically, we show here that European oil import payments both before and after World War II were split almost evenly between the dollar and non-dollar currencies, mainly sterling. Limited data suggest that what was true of European oil markets was also true of the global oil market, consistently with the fact that Europe accounted for a substantial share of global oil imports then.

Use of the dollar and other currencies in international petroleum transactions varied across countries, however. These differences in dollar usage are associated with the extent of trade linkages with the US and the size of the importing country. There is also evidence that countries with more stable currencies used the dollar less; that strategic motives (i.e. government influence in the oil sector) made countries less inclined to use the dollar; and that countries that were constrained by capital controls in their ability to pay freely with sterling used the dollar more. In contrast, we find little evidence in favour of liquidity effects or international political considerations in explaining currency choice.

These findings suggest that there is room for more than one international currency as means of payment even for a good as homogenous as oil. They suggest that network increasing returns are not as strong as sometimes supposed, that first-mover advantage is not everything, and that incumbency is no guarantee of continued dominance. They therefore suggest that a shift from the current dollar-based system to a multipolar system is not impossible.

1. Introduction

One of the clearest signs of the US dollar's dominant international role is its status as the all but exclusive currency used for pricing and settling transactions in global oil markets. The prices of West Texas Intermediate, Brent and Dubai crude are all expressed in dollars.[1] The dollar is used as the unit of account for virtually all benchmark prices.[2] NYMEX, the world's largest oil futures market, provides quotes exclusively in dollars. In the global oil market, whether for spot, term or future contracts and irrespective of country, the dollar reigns supreme.

The dominance of the dollar in global oil markets is relevant for several key international economic issues. It is essential to the understanding of the dollar's international status and international currency choice.[3] It has major implications for the degree of exchange rate pass-through of oil and commodity price shocks and for forecasting of domestic inflation. Many models used for policy simulations –including by the IMF or the Federal Reserve Board– assume that oil prices are set in dollars (see e.g. Backus and Crucini, 2000; Kumhof et al., 2010; Bodenstein, Erceg and Guerrieri, 2011).

There have been periodic attempts to change this state of affairs, from OPEC's "Geneva I and II" conventions in 1972-73, whose participants vowed to quote oil prices in a basket of currencies, to Iraq's attempt to settle its oil exports in euros in the early 2000s using a European bank as conduit. In each case these efforts failed immediately or were short-lived (see e.g. Al-Chalabi, 1980; Mileva and Siegfried, 2012). Recent efforts by the Chinese authorities to strengthen the role of the renminbi in China's external trade, particularly for oil and other commodity imports from e.g. African countries, have similarly had little impact (Eichengreen, 2013).

The dollar's dominance as unit of account and means of payment in global oil markets is said to rest on two pillars. One, as with all facets of international currency status, are network effects (Krugman, 1980). Oil prices tend to be expressed and transactions to be settled in dollars because, as it is argued, the US was the first oil producer and remained the largest global oil producer for fully a century, until it was overtaken by the Middle East in the 1950s. Once the practice of expressing oil prices in dollars and settling transactions in that unit became so widespread, and a critical

[1] West Texas Intermediate (WTI) oil is also known as "Texas light sweet" crude; Brent is a heavier source of crude from the North Sea; and Dubai a variety used to benchmark Persian Gulf exports to Asia.

[2] There are a few exceptions, however. For instance, some Canadian grades are quoted in Canadian dollars; Chinese oil companies price domestically produced oil in dollars but settle domestic contracts in renminbi; the Tokyo Commodity Exchange lists an array of oil future contracts based on Asian grades of petroleum, all quoted in yen (see ECB, 2005).

[3] For recent contributions on the implications for the degree of exchange rate pass-through for prices and quantities of international invoicing currency choice, see e.g. Gopinath, Itskhoki and Rigobon (2010), who find large differences in the extent of exchange rate pass-through to US import prices between dollar-priced goods (25%) and non-dollar-priced goods (95%) or Berman, Martin and Mayer (2012), who point to the key role played by differences in productivity across exporting firms in their ability to absorb exchange rate movements in their mark-ups.

mass of transactions was reached, it was costly for individual buyers and sellers to do otherwise.

The first oil well successfully drilled was in Titusville, Pennsylvania, in 1859 (Yergin, 2008). The US is still home to five of the "Seven Sisters," the oil multinationals that have dominated global oil markets since the early 20th century.[4] Yergin reports that, as early as 1928, the "traditional formula" to calculate the price of crude oil for sale in international markets ("traditional" implying that it was most likely used even earlier) was the US Gulf Coast price plus the going freight rate from that coast to market, even if the oil was supplied by a non-US source (Yergin, 2008, p. 247). It is this reference price that the "Seven Sisters" used in 1928 to divide global oil markets among themselves under the so-called "As-Is" agreement. The US Gulf Coast price of earlier periods bears more than passing resemblance to today's West Texas Intermediate (WTI) benchmark. All this would appear to testify to the importance of first-mover advantage, incumbency and network increasing returns.

The second pillar is homogeneity of the product.[5] Oil is neither firm- nor country-specific. Producers are price takers. Their identity is unimportant. Oil prices fluctuate according to global supply and demand, with deviations from world prices disappearing quickly through arbitrage.[6] This has two implications for the choice of invoicing and settlement currency according to McKinnon (1979, pp. 72-77). Producers, as price takers, have no market power to set prices in their own currency. And because oil is relatively homogenous, there is substantial convenience in quoting prices in just one currency to facilitate comparisons.[7] In practice, McKinnon further observes, the currency of choice will be sterling or the dollar insofar as it is in London, New York and Chicago that centralised commodity exchanges emerged as clearinghouses for supply and demand.[8]

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[4] The five US "Sisters" include the four Aramco partners (i.e. which joined forces to produce oil in Saudi Arabia), namely: Standard Oil of New Jersey (now Exxon); Standard Oil of New York/ "Socony-Vacuum" (Mobil); Standard Oil of California/"SoCal" (Chevron); Texaco; the fifth US "Sister" is Gulf.

[5] This is not to deny the existence of variations in the quality of crude oil (sweet, sour, mazut), which in turn depend on an array of factors (such as geographical origin and sulphur content). Virtually all crude needs to be refined (heated) in order to be converted into gasoline, jet fuel, home heating oil, industrial oil, etc. Those products differ in terms of value added. That oil is traded in three contracts, namely term (often used by Gulf countries), spot (often confidential, and without central clearing) and futures (which account for the majority of global oil trading today) further adds to observed price variations. Still, oil is still relatively homogeneous compared to many other goods – relative to most manufactured goods, for example. It is sufficiently homogeneous to be traded on organized exchanges. If every barrel differed significantly in quality and characteristics, the standard contracts that exchanges require would not be feasible, and oil would have to be traded "over the counter." Oil is not branded; that is to say, prices can be quoted without mentioning the name of the producer (see Rauch, 1999). Again, this is in contrast to goods which have a reference price but are not traded on organized exchanges (such as highly specialised chemical products like polymerization and copolymerization substances), and goods where the name of the producer is an important guide to quality and other characteristics.

[6] As McKinnon puts it, oil is what Hicks (1974) would call a "flexprice" good.

[7] Goldberg and Tille (2008) provide evidence of a "coalescing" effect, according to which exporters use the same invoicing currency as their competitors in order to limit movements in their relative price. They find that this tendency is especially strong for homogenous goods like oil.

[8] At the same time, he notes that petroleum and gasoline products have long been traded throughout the world at fairly uniform prices without such geographically centralised exchanges. He also notes that

Hartmann (1998) and Friberg and Wilander (2008) conclude that one of the main stylised facts emerging from the literature on currency choice in international trade is that commodities are generally invoiced in one currency, typically the dollar. The literature on the use of the dollar as the currency of denomination, invoicing and settlement in oil-market transactions is pitched at a high level of generality, however. It tends to be based on stylized rather than closely-observed facts.

A major constraint facing empirical work on currency choice in international trade in oil, as in other commodities, goods and services, has been lack of detailed data. Friberg and Wilander (2008) note that investigators have mainly relied on snippets of aggregate data, surveys of selected firms, and casual empiricism (e.g. "for instance noting that oil is traded in US dollars," as they put it).[9] Another way of putting the point is that there is no meaningful empirical work on choice of currency in the oil market because it is presumed that there is no variation in currency usage in the recent data, given that virtually all recent transactions are widely believed to be denominated, invoiced and settled in dollars.[10]

In this paper we present evidence showing that the effects of network increasing returns and product homogeneity on the currency used as means of payment in the global oil market are not as strong as conventionally supposed. In earlier periods, oil transactions were in fact undertaken in a number of different currencies. This suggests that there is room for more than one national currency as means of payment even for a good as homogenous as oil. This conclusion is consistent with what we have called elsewhere the "new view" of international currency markets (Chițu, Eichengreen and Mehl, forthcoming), according to which network increasing returns are not as strong as commonly supposed, first-mover advantage is not everything, incumbency is no guarantee of success, and several national currencies can play consequential roles in international transactions.

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before 1974, in "a rather charming anachronism", several oil-producing countries in the Persian Gulf demanded payment in sterling because they had been previously part of the sterling area (although they quoted prices and paid taxes in US dollars).

[9]They point to an array of "stylized facts", including that primary products are generally priced in dollars; that manufactured goods traded between advanced economies are invoiced in the exporter's currency (a finding from Grassman's seminal 1973 study), although Asian economies and the US use dollars for both imports and exports; and that emerging market currencies are typically not used in North-South trade.

[10] Recently investigators have looked more closely at trade invoicing and settlement decisions by currency. In analysing export invoicing data for 24 advanced and emerging economies over 1997-2004, Goldberg and Tille (2008) find empirical support of their "coalescing effect" favouring the dollar. Kamps (2006) considers similar data and highlights the growing role of the euro in the trade of regions neighbouring the euro area. Other studies have used firm-level data for individual countries (see e.g. Donnenfeld and Haug, 2003; Oi et al., 2004; Wilander, 2006; Ligthart and da Silva, 2007). Friberg and Wilander (2008) report on the results of a survey conducted in 2006 on the currency choice of Swedish exporters, finding inter alia that price, invoicing and settlement currencies tend to be one and the same (i.e. 85% of the exporters surveyed used the same currency for 90% or more of their export revenues); they also report that currency choice is occasionally set through bargaining between exporters and importers. Goldberg and Tille (2011) test for such bargaining and strategic interactions in Canadian import data in the period 2002-2009, while Goldberg and Tille (2013) provide a bargaining theory for international trade invoicing and pricing.

Specifically, we show here that European oil import payments both before and after World War II were split almost evenly between the dollar and non-dollar currencies, mainly sterling. Limited data suggest that what was true of European oil markets was also true of the global oil market, consistently with the fact that Europe accounted for a substantial share of global oil imports then.[11]

Use of the dollar and other currencies in international petroleum transactions varied across countries, however. These differences in dollar usage are associated with the extent of trade linkages with the US and the size of the importing country. There is also evidence that countries with more stable currencies used the dollar less; that strategic motives (i.e. government influence in the oil sector) made countries less inclined to use the dollar; and that countries that were constrained by capital controls in their ability to pay freely with sterling used the dollar more. In contrast, we find little evidence in favour of liquidity effects or international political considerations in explaining currency choice.

Our data on the use of the dollar and other currencies for oil import payments are for the period from the late 1930s to the early 1950s, i.e. the period when the dollar was dethroning sterling as the main international currency. They are, to the best of our knowledge, unique. That they focus on oil is one of their strengths, given the allegedly dominant role of the dollar in global oil markets today. A case study of this well-defined, relatively homogenous commodity allows us to approach the problem of international currency use at a more granular level than previous studies.

Section 2 presents the data used in our empirical analysis. Section 3 describes the key stylised facts, while Sections 4 sets out the methodology. Section 5 and Section 6 present baseline estimates and robustness check results, after which Section 7 concludes.

2. Data

Our data on the currency composition of oil import payments are from Economic Cooperation Administration (ECA, 1949). They were gathered by statisticians employed by the Organization for European Economic Cooperation (OEEC, the predecessor of today's OECD) based on submissions by 16 European countries eligible to the European Recovery Program (the Marshall Plan): Austria, Belgium-Luxembourg, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, the Netherlands, Norway, Portugal, Sweden, Switzerland, Turkey, and the United Kingdom.[12]

[11] We estimate that the share of the dollar in global oil import payments reached at least 31% and that of non-dollar currencies at least 23% (these are lower bounds insofar as there is no information on currency denomination for the remainder of global oil imports).

[12] Germany is the sum of the Bizone and the French Zone; Italy includes Trieste.

The ECA volume was meant to inform decisions taken by US authorities on how to finance European oil imports. This was no small matter. In all, more than 10% of total aid under the Marshall Plan was spent on oil. Plan administrators sought to estimate how many dollars the recipients would require to meet their oil import needs. Ensuring that the provision of dollars through the Marshall Plan would suffice for this purpose would help Western Europe to secure the energy it needed for recovery. Providing adequate dollars for European petroleum imports would also help to maintain markets for US oil companies when their potential customers would otherwise have been unable to obtain dollars (Painter, 1984). This was no small consideration for a US-dominated Marshall Plan administration.

The ECA volume contains detailed data on the currency composition of oil imports by the 16 participating countries. Data are broken down not just by country and currency (dollar vs. non-dollar) but also by product (crude, refined products, petroleum equipment). They are available for different fiscal years (pre-war, 1947, 1949, 1950 along with projections for 1953).[13] Both quantities (i.e. in thousands of metric tonnes) and values (i.e. in thousands of dollars) are reported.

The authors use the term "dollar oil" for oil that "the importing country must pay [for in] dollars" (ECA, 1949, p. 1 footnote 3). "Dollar oil is in general – but not always – sourced in the "continental United States or by American-owned companies from offshore sources" (ibid.). "All other oil," they continue, "is, in general, classified as non-dollar oil." Thus, these data provide information on the use of the dollar and other units as settlement currencies for oil imports (i.e. not as the currency of denomination of prices or of invoicing).

"Non-dollar oil" was mostly sterling oil insofar as two of the Seven Sisters (Royal Dutch-Shell and the Anglo-Iranian Oil Company, now known as British Petroleum) were of British origin. While only sterling is explicitly mentioned in the volume, other currencies might have played a role; as noted by the authors: "there is likely to be continued pressure to replace some additional dollar oil with oil from sterling or other non-dollar sources" (ECA, 1949, p. 11).

Attention was paid to this question because oil was the largest single item in the dollar budget of most Marshall Plan countries. Oil purchased from US companies required dollar reserves, since US companies preferred payment in that form. US companies demanded dollars to pay salaries and purchase supplies that were themselves dollar-denominated. They were not interested in accumulating inconvertible blocked currencies that could be used to pay salaries and purchase supplies only in the oil-importing country itself. UK companies, in contrast, may have been willing to take sterling and dollars insofar as they had sterling-denominated costs but also sought to purchase US oil equipment, technology and tankers, again typically using dollars (Painter, 1984).

Sceptical readers may object that the same factors responsible for the existence of the data make them less than representative. Given the dollar shortage following

[13] The data for our independent variables were available for calendar years, by contrast.

World War II, countries might have used other currencies in extremis only in this period. Oil companies thus may have accepted payment in sterling where, under other circumstances, they would have demanded dollars. The pattern in these years was idiosyncratic, such sceptics would insist. And once the dollar shortage ended, so did the use of other currencies for payments, they would suggest.

Reassuringly, the ECA volume also provides estimates of oil imports in quantity terms for the pre-war period when there was no comparable dollar shortage.[14] In that earlier period, some 41% of the oil imports of European countries were paid in dollars, while fully 59% were paid for using other currencies. This is similar to the post-World War II pattern.[15] Moreover, complementary evidence for the modern era (which we provide in Section 3 below) suggests that oil companies still used sterling in oil payments to a considerable extent in the 1970s. Even today, they still use other units than the dollar to invoice international transactions in the European oil market. Again, this suggests that the pattern before and after World War II was not an anomaly.[16] It suggests further that the assertion that the dollar has always dominated payments in the market for global oil transactions is overdrawn.

Sceptics may further contend that use of the dollar in oil settlements was heavily a function of how many dollars were made available to European countries by the United States through the Marshall Plan, rather than the result of any economic calculus on the part of the recipients. But the provision by the US of dollars to European countries, through its foreign aid program to finance their oil imports, would have worked against our finding that sterling and other currencies also played a consequential role in oil payments in this period. Moreover, as we will show below, when we control for Marshall aid received each year by the countries in our sample, we find that it had no significant bearing on the heterogeneity over time and countries in dollar usage.

Still others will question whether the data are accurate. Reporting biases there may be, but European countries had every incentive to overestimate – not underestimate – the share of dollar settlements in order to maximise their Marshall aid. The ECA was aware of these incentives and insisted on checking data provided by participating countries against its own estimates. Where it detected discrepancies, it generally found that dollar oil needs had been too "ambitiously estimated" (ECA, 1949, p. 4) and reduced them by some 15% in value terms. This suggests that our data are not biased towards underestimating the role played by the dollar in the international oil markets.

Finally one could also argue that because a large share of oil trade was intra-firm, due to the fact that the Seven Sisters were vertically integrated, there might have

[14] There were various restraints on long-term foreign lending, but this is a different matter (see Capie, 2002 for details).

[15] See Section 3 for details. A caveat is that the classification between dollar and non-dollar sources was not necessarily made on "exactly the same bases" for the pre-war period as it had been for the post-war period (ECA, 1949, p. footnote 6). But the overall picture is broadly the same.

[16] We provide additional evidence for periods before and after the years 1938-53 on which our formal analysis focuses in Section 3 below.

been a close correspondence between nationality of companies and nationality of the currency used for invoicing in international oil transactions. European countries would pay their oil imports in dollar or sterling, depending on whether they would purchase oil from US or British companies. It is not clear theoretically that intra-firm trade necessarily implies that the exporter's currency is used for invoicing, however. Currency choice in intra-firm trade depends also on the degree of homogeneity of the product traded.[17] For the contemporaneous period, Ito et al. (2010 and 2013) find a tendency for the importer's (not the exporter's) currency to be used for invoicing in a sample of intra-Japanese firm transactions, especially for non-differentiated products. Thus, Japanese firms invoice in dollars – not in yen – when they export to their US subsidiaries. Hence there is here no correspondence between nationality of companies and nationality of the currency used. The reason is that exports are destined for local subsidiaries that face competition in local markets. In this case, Japanese parent firms tend to price-to-market and to take exchange rate risk by invoicing in the importing country's currency. Similar patterns might have well characterised the period before and after World War II insofar as oil is a non-differentiated product.

3. Overview

A first observation is that, even for a good as homogenous as oil there is room for more than one currency of payment in the global market, contrary to the presumption in recent theoretical models and related empirical studies. Figure 1a shows the breakdown by currency of denomination of oil imports (crude and refined products) in thousands of metric tonnes for the 16 countries participating in the European Recovery Program. Each bar splits the quantity of oil imports into the share of dollar and non-dollar payments in each of the fiscal year for which data is available: pre-war (usually 1938), 1947, 1949, 1950 and 1953.[18] While the dollar is clearly an important currency for payments, with an average share of 43% of total oil imports, it is by no means the only one or, for that matter, overwhelmingly dominant. The majority (57%) of European oil imports were paid in non-dollar currencies, presumably mainly sterling.

Importantly (as noted before), the picture was essentially the same before World War II, when patterns cannot be ascribed to the postwar dollar shortage. The share of the dollar in Europe's oil imports was 41%, while that of non-dollar currencies was 59%.[19] Both before and after World War II world oil markets were

[17] In addition, in the absence of detailed data, it is difficult to assess how important this phenomenon really was (see FTC (1952, chapter 2, fn 22): "only limited data on marketing operations of the major oil companies in the post-World War period are available".

[18] Where, repeating what we said above, the data for 1953 are projections. As for the prewar year, the ECA volume notes that country officials provided data for "1938 or another representative prewar year" (see footnote 2 to Tables 3 and 4, pp. 33-34, ECA, 1949).

[19] The share of the dollar actually declined between 1947 and 1953, from 48% to 38%. This likely reflects efforts by US oil companies to "sterlingize" their oil exports to Europe to address the dollar shortage in the run-up to the so-called "New Look" agreements of 1953 (see Painter, 1984; Schenk, 1996; Galpern, 2009). In addition, European countries might have tried to shift their imports away from the US members of the Seven Sisters and toward the British members in response to the postwar dollar shortage.

multi-polar in the sense that international transactions were settled using several currencies.

Figure 1b shows similar breakdowns in value terms (thousands of dollars). The share of the dollar here is a few percentage points higher, at about 50%. This reflects the fact that a larger proportion of high-value added products, including practically all lubricating oils, were purchased from the US (ECA, 1949, p. 14). Still, the fairly equal split between dollar and non-dollar currencies again points to the use of multiple international currencies.

To what extent do these findings for European markets extend to global markets? Europe accounted for a substantial share of global oil imports (about 40% in 1948). As a matter of definition, then, what was true for European oil markets was to some extent also true for global oil markets.

Figure 2 provides one estimate of the currency breakdown of global oil imports in quantity terms in 1948-49. In constructing this estimate we augmented the information available from ECA (1949) with that from US Federal Trade Commission (1952). FTC provides data on oil imports by source and destination country in North America, South America, Europe, Asia and Africa in 1948 in thousands of barrels.[20] The estimated share of the dollar in global oil imports is the sum of oil imports paid in dollars by European countries (from ECA, 1949), oil imports by the US (from Federal Trade Commission, 1952), which were assumed to be all paid in dollars, and 30% of sterling area imports (30% being the estimate of the dollar content of oil sales to the sterling area from Schenk, 1996, p. 29). The estimated share of non-dollar currencies in global oil imports is then the sum of two components: oil imports paid in non-dollar currencies by European countries and 70% of the sterling area's imports. The remainder are oil imports from other countries for which information on currency denomination is not available.

Figure 2 again suggests that there was room for more than one national currency in global oil market settlements. The dollar was the main currency of payment of global oil imports in 1948/9, with an estimated share of 31%. But the share of non-dollar currencies was also large, at 23%. Although there is no information on currency denomination for the residual (46%), it is likely that at least some of these imports were paid in currencies other than the dollar. For instance, Royal Dutch Shell had been active in Asian markets since its creation in the late 19th century.

There is also variation across countries in the intensity of use of the dollar and other currencies as means of payment for oil imports. This is apparent in Figure 3a, which breaks down by currency of denomination the oil imports of the 16 European countries (here we again consider imports by volume). The data are averages over the 1938-50 period (we excluded projections for fiscal year 1953).[21] Use of the dollar

[20] We converted barrels to metric tonnes in order to compare these data with those of the ECA, using a conversion factor of 0.1364 for crude oil and 0.1228 for refined products (for more details see http://www.bp.com/conversionfactors.jsp).

[21] Although including them would change little in terms of the results.

varied greatly. Some countries, such as the Netherlands, Ireland, Norway and the UK, did not use the dollar much; there the average share was barely a third of oil import payments. In the case of the Netherlands and the UK, this might reflect the fact they were home to two of the Seven Sisters, i.e. Royal Dutch-Shell and AIOC (now known as BP). For the other countries we will have to look for another explanation.

The dollar was the dominant currency of payment of oil imports for Portugal, Germany, Turkey and Sweden, in each of which its share was close or in excess of 60%. Similar patterns are evident when considering currency shares for oil imports in value terms, as in Figure 2b (differences with Figure 2a mirror price differences in the basket of oil products imported).

The state of affairs is further illustrated in Figure 3a, which plots the share of dollar payments in oil imports in quantity terms of each country (on the horizontal axis) against the share of the United States as a source of the country's oil imports (on the vertical axis) in 1948-49. Under the extreme assumption of full dollar payment of oil purchases from the US and no vehicle role for the dollar, all points would lie along the 45-degree line. In practice, the use of the dollar in oil import payment is greater than what would be expected on the basis of oil trade with the US. This is especially true for France, Belgium-Luxembourg, Portugal, Turkey and Italy. Similar patterns emerge from Figure 3b which shows oil imports in value terms. Admittedly, that the share of dollar payments exceeds the share of the US as an oil supplier to Europe in part reflects the role of US multinationals which sold to the continent oil sourced from offshore (i.e. from sources such as Saudi Arabia or Venezuela) and not just from the United States (an aspect which we will need to take into account in the empirical estimates below).

The importance of the dollar also varies across products. Table A1 of the appendix provides a currency breakdown of European countries' oil imports by product category in 1949. As noted above, the share of the dollar is slightly higher for higher-valued products.[22] However, it is lower, at about one-third, for oil equipment, e.g. refining equipment, storage equipment, casing or pipelines. This reflects the fact that a large portion of imports thereof were produced by European countries themselves and consequently settled in their own currencies.

Against the objection that the period surrounding World War II was exceptional and unrepresentative, we can provide additional evidence, albeit of a more fragmentary nature, for both earlier and later years. As noted previously, Yergin (2008, p. 247) emphasises that the "traditional formula" to calculate the price of crude oil for sale in international markets in the 1920s was based on the dollar, reflecting the position of the United States as the leading global petroleum producer. At the same time, firm-level evidence suggests that sterling was also widely used for international oil payments in this period. The general sales ledgers of the Anglo-Persian Oil

[22] Also consistently with this, the implied dollar price of a dollar oil barrel relative to that of a non-dollar oil barrel (both obtained by dividing prices by quantities for 1949 and 1950, i.e. the two years for which such data are available) was higher for some country-year observations (see Figure A1 in the appendix). This again reflects the fact that a large proportion of high-value added products, including practically all lubricating oils, were purchased from US companies.

Company (APOC, now known as BP) in the BP archives contain detailed information on each transaction between 1926 and 1930.[23] They show that sterling was used when APOC was selling oil in this period. No other currency is mentioned. Some of these ledgers breakdown various charges (e.g. insurance costs) and proceeds (e.g. including or excluding custom duties), all in sterling.

Schenk (2010) provides some complementary evidence for the 1970s. As she notes (p. 360), oil producing states in this period received royalty payments both in sterling and dollars. Circa 1974, 19 per cent of royalty payments were denominated in sterling, 81 per cent in dollars. Over time, contracts expired and tended to be replaced by new ones in which royalty payments denominated in sterling were replaced by royalty payments denominated in dollars, giving rise to the situation in the final quarter of the 20th century where the dollar was dominant to an unusual degree.

Another complementary perspective is for the current period, as provided by recent Eurostat data. This also suggests that there is room for more than one currency in international oil transactions.[24] While the dollar accounts for over three-quarters of import invoicing in a majority of countries, some countries use other currencies to a non-negligible extent, including Germany, Sweden, Luxembourg and Austria, which all use the euro – and, in the case of Sweden, the kronor – as invoicing unit for over half of their imports. The use of multiple international currencies is still more evident on the export side. No fewer than 12 countries use the euro and other currencies as invoicing units for the majority (i.e. over half) of their exports.[25] However, insofar as Europe accounted for about 20% of global oil imports in 2010 (against 40% after World War II), it is unclear that what is true for Europe is true for global oil markets now, unlike then.

4. Empirical framework

What explains the heterogeneity across countries and time in the use of dollar and non-dollar currencies as units of payment for oil imports before and after World War II? To get at this question, we use an empirical framework based on Goldberg and Tille (2008). Our general specification is of the form:

$$\beta_{\$,i,t}^{m} = \alpha_i + \alpha_1 X_{US,i,t}^{m} + \alpha_2 X_{US,i,t}^{m} \frac{Y_{i,t}}{Y_{US,t}} + \alpha_3 \frac{Y_{i,t}}{Y_{US,t}} + \alpha_4 fxvol + \boldsymbol{\alpha}' \mathbf{fxcontrols} + \boldsymbol{\gamma}' \mathbf{Z_{i,t}} + \varphi' \boldsymbol{\Theta}_{\mathbf{t}} + \mu_{i,t} \quad (1)$$

[23] See BP Archive, ARC 93666, 93704, 93690, 93686 and 93689.

[24] The data pertain to extra-EU imports and exports in value terms.

[25] An average 65% of UK extra-EU oil exports were invoiced in domestic currency, against 35% for Sweden. A caveat is that the value of EU oil exports is markedly lower than that of their imports (i.e. the former accounts for about one-third of the latter).

where the dependent variable is the share of a country's imports of crude and refined oil that was paid for in dollars, $\beta^m_{\$}$ in country i (with i = 1, … 16) and fiscal year t (with t = 1938, 1947, 1949, 1950, 1953). In the baseline specification we express imports in quantity terms.[26] We also consider imports of crude and refined oil separately in robustness checks, along with imports of petroleum equipment. In estimating Eq. (1) we control for unobserved country effects, denoted α_i, and for time effects $\boldsymbol{\Theta}$.

A first potential determinant is import penetration of US firms, denoted X^m_{US}. To measure this, we include the share of the US in country i's total imports, using data from Mitchell (1998) for 1938 and 1947 and the IMF's *Direction of Trade Statistics* for 1949, 1950 and 1953. Denomination tends to be tilted towards the currency of the country that accounts for the largest share of the market, since exporting firms prefer being paid in their own currency to minimise exchange rate exposure (Bacchetta and van Wincoop, 2005). Higher US import penetration should thus be associated with high producer currency pricing (PCP; i.e. dollar payments) and lower local currency pricing (LCP; i.e. payment in European currencies). Theory is quieter when the choice is between local currency, producer currency and a vehicle (i.e. third) currency, like sterling, although intuition suggests that the expected impact of higher US import penetration on the share of dollar payments is here likely to be the same.

We consider in robustness checks two alternative measures. First, the share of the US in country i's oil imports in 1948 (using data from FTD, 1952; data for other years were not readily available). Second, time-varying guesstimates of the share of the US an oil supplier, which we obtain by supplementing the latter (time-invariant) observations with US production of oil relative to total world production.[27] A limitation of these alternative metrics (as previously mentioned) is that they capture only direct European purchases from the US and not those from US companies offshore, for which no data appear to be readily available. This means that these measures underestimate the size of the US relative to its competitors.

A second potential determinant is relative market size, which we measure as the ratio of country i's GDP relative to that of the US, denoted Y_i/Y_{US} in Eq. (1) (data from Maddison, 2010). Relative market size matters insofar as exporters in small countries are less likely to play a significant role in destination markets and to be able to use their own currency as a means of payment (Goldberg and Tille, 2008). They are also more likely to use imported inputs and less likely to use their own currency in international transactions (Campa and Goldberg, 2007).[28] When choice is restricted to

[26] We leave imports in value terms for the robustness checks (as values are available for 1949 and 1950 only).

[27] We could produce such guesstimates for 1949, 1950 and 1953 (the years for which data on US production of oil relative to total world production could be gathered from American Petroleum Institute, 1959).

[28] The dollar, in contrast, benefits from the fact that exporters selling to the US may strive to stabilise their prices relative to those of US producers of comparable goods. Theory is less explicit when it comes to the size of importers relative to one large exporter (i.e. our sample of small European economies relative to the US).

only two currencies (i.e. producer vs. local currency pricing), Goldberg and Tille (2013) show that the bargaining weight of importers decreases when they are fragmented relative to exporters and that, as a result, they are charged relatively high prices. They are then also less willing to be exposed to exchange rate risk, which increases the extent of local currency pricing (i.e. non-dollar payments).[29] Conversely, Goldberg and Tille's model suggests that importers are ready to take on *more* exchange rate risk exposure when they are less fragmented –and hence more powerful– because they can also benefit from low prices and receive more of the joint surplus from trade contract negotiations. This increases the extent of producer currency pricing (i.e. dollar payments).[30]

We also include in the baseline specification the interaction between X^m_{US} and $Y_i/Y_{US.}$ This is designed to account for the possibility that the impact on currency choice of import penetration from US firms depends on relative market size, and vice-versa.[31]

In addition, we consider a proxy for currency stability, following Goldberg and Tille (2011). This is the coefficient of variation of country's *i* exchange rate relative to the dollar (calculated as annual averages from monthly data taken from *Global Financial Data*), denoted *fxvol*. Theory suggests that firms prefer to invoice trade in a stable currency so as to minimize disturbances to demand and profits (see e.g. Baron, 1976; Giovannini, 1988; Devereux et al., 2004; Bacchetta and van Wincoop, 2005; Wilander, 2006).[32] The role of exchange rate volatility is likely more limited for differentiated products for which demand is relatively insensitive to prices (Goldberg and Tille, 2008). Hence, stable currencies are likely to be preferred as units of payments for relatively homogeneous good, such as oil, for which demand is price elastic. In robustness checks, we use as alternative metrics of currency stability the relative volatility of exchange rates vis-à-vis the dollar, compared to volatility vis-à-vis sterling, as well as the volatility of exchange rates vis-à-vis sterling.

An important feature of international financial markets in the 1940s is their segmentation by exchange restrictions. One segment consisted of the US and other countries with trade surpluses and "hard" currencies fully convertible into dollars. The other segment was composed of countries with "soft" currencies and short of dollars, namely a large part of Western Europe, South America and the sterling area (i.e. either British colonies and protectorates or members of the Commonwealth). This pattern was not without implications for the currency denomination of oil imports (see Menderhausen, 1950; Painter, 1984; Schenk, 1996; and Galpern, 2009).

[29] Goldberg and Tille define fragmentation as the absolute number of importers (or exporters).

[30] There is no theory when currency choice is between three or more units, i.e. dollar, sterling, local or still other currencies. The impact of relative market size on currency denomination of oil import payments is here an empirical question, in other words.

[31] This continuous interaction is calculated with centred variables to ensure that estimates remain economically interpretable and efficient, should the constant term fall outside the range of observable data (see Simpson and Lewis, 2001, for further details).

[32] In addition, exporters may also choose to invoice in a currency that help them hedge against volatility in input costs (Novy, 2006).

Up to 1953, British treasury regulations prohibited US companies from selling oil for sterling outside the sterling area since Britain would have been obliged to convert sterling acquired in this way into dollars on demand (as per the Anglo-US Financial agreement of 1945). They were allowed to sell oil for sterling or dollars to the sterling area, in contrast.[33] And they could sell oil for dollars outside the sterling area. British companies, on the other hand, could sell oil for sterling wherever the latter was accepted as a means of international payment, i.e. both inside and outside the sterling area. They could also sell for dollars and, under certain conditions, for other European currencies, such as the Dutch gulden or the French Franc (Shannon, 1949). All this put US multinationals at a competitive disadvantage, particularly in continental Europe.[34]

Sceptical readers could argue that sterling played a prominent role in international oil markets at this time only because of such capital controls. However, that US oil companies wishing to sell oil outside the sterling area (i.e. mainly to continental European countries, which account for 13 out of the 16 countries we consider in this paper) were largely limited to doing so for dollars works against our main conclusion. This would have heightened the importance of the dollar in global oil settlements, other things equal. In other words, it works against the presumption that the role of sterling and other currencies was artificially inflated by UK capital controls. This suggests that our conclusion is not simply a figment of postwar capital controls. Finally, it is worth emphasising that Ireland and the UK itself are the only sterling area countries in the sample. This makes it hard to argue that what we are picking up is entirely a sterling-area story.

All this notwithstanding, we control explicitly for the potential effects of this segmentation in the estimates by introducing three time-varying dummy variables designed to capture the main institutional features of UK exchange control regulations post-World War II, denoted *fxcontrols*. These dummy variables equal one when a country is in a given year, respectively: a member of the sterling area (and zero otherwise); a so-called "bilateral account" country (and zero otherwise); and a so-

[33] Shannon notes that "all business [under the Anglo-American Loan Agreement with the US and Western Hemisphere countries of 1945] must be conducted on a dollar or near dollar basis… the main imports involved are … oil from Mexico and Venezuela", which – needless to say – largely came from US multinationals (Shannon, 1949, p. 226). This said, US oil companies committed in the early 1950s to gradually reduce the dollar content of their oil exports to a level matching that of British companies, which was estimated at 30% at that time (see Schenk, 1996). The Economic Cooperation Administration, the body administering Marshall aid, sought to actively fight against such "currency discrimination or other undesirable trade practices" by refusing to finance with dollar aid purchases by British-controlled companies of oil facilities whose operations depended on such practices (Painter, 1984; Schenk, 1996). The need to save dollars as rationale for capital controls became less pressing in the second part of the 1950s as the dollar shortage ended and UK current account convertibility was re-established in 1955.

[34] Concerns from US companies about what they considered to be discriminatory exchange controls led to intense negotiations to put an end to the so-called "sterling-dollar oil controversy" in 1950-3. These negotiations culminated with the so-called "New Look" agreements, the essence of which was to encourage the US Sisters to "sterlingize" (i.e. increase the sterling content) of their oil sales while allowing them to sell oil for sterling outside the sterling area (i.e. mainly Western Europe) as a quid pro quo.

called "transferrable account" country (and zero otherwise).[35] Values are taken from BIS (various issues).

We will show that British exchange controls are not the entire story. Other economic and structural characteristics of economies explain a significant portion of the variation across countries and time in dollar and sterling usage, even after "controlling for controls." The economic importance of these factors is in fact even greater than that of exchange controls, again suggesting that observed patterns were not only due to the latter.

5. Baseline results

We estimate Eq. (1) using a linear country-effect estimator with standard errors robust to heteroskedasticity and clustered heterogeneity to control for residual correlation between country observations in each year. The share of payments in dollars is the dependent variable.[36]

Table 1 reports baseline estimates of Eq. (1) for the share of dollar payments in oil imports in quantity terms for our sample of 15 European countries in 1938, 1947, 1949, 1950 and 1953. Columns 1-2 and 3-4 report those obtained with a random effect and a fixed effect estimator, respectively. We control for time effects in columns 2 and 4.[37]

A first finding is that differences in dollar usage are affected by trade linkages with the United States. The coefficient on US import penetration is positive, large, and statistically significant in columns 2 and 4.[38] This suggests that producer currency pricing (i.e. dollar payments) increases with penetration of US firms, in other words that denomination tends to be tilted towards the currency of US exporters where they account for the largest share of the market, insofar as they prefer being paid in their own currency to minimise exchange rate exposure (as in Bacchetta and van Wincoop, 2005). According to our estimates, a 1% increase in the share of the US in European oil imports is associated with a ½% increase in the share of dollar payments.

[35] Sterling of "bilateral account" countries could be automatically transferred to accounts in the sterling area, while those held in "transferrable account" countries could be automatically transferred to accounts in both the sterling area and in other "transferrable account countries" (see BIS, various issues). Goldberg and Tille (2008) similarly test for whether the fact that a country is in a de jure or de facto euro or dollar bloc matters for currency invoicing.

[36]. We consider the share of oil import payments in non-dollar currencies in robustness checks (below) only, owing to the absence of a currency breakdown of the data on non-dollar oil import payments (assuming in the former case that the only unit used is sterling). We also experiment with a variety of other estimation techniques than linear fixed or random effect estimators, including panel tobit, difference GMM and system GMM. For the estimates using crude oil as dependent variable, we explicitly control for the fact that some countries imported no crude at all (i.e. neither from dollar nor from non-dollar sources) due to lack of refining facilities.

[37] Iceland drops out from the sample because the size variable was not available. We also dummy out Austria in 1947, where the share of the dollar in its oil import payments reached 100% (i.e. four times the average in other years).

[38] But not when we do not control for time effects, as in columns 1 and 3.

In addition, the impact of US import penetration is greater in larger countries, as suggested by its significant interaction coefficient with size. For a given level of import penetration from US firms, larger European oil importers (especially e.g. Germany, France, Italy and Belgium-Luxembourg) tend to use the dollar disproportionately more for import payments.[39] This finding might be interpreted as reflecting the fact that larger and more powerful European importers are ready to take on more exchange rate risk exposure because they can also negotiate lower prices, as suggested in Goldberg and Tille (2013). Figure 5 provides an intuitive sense of this effect by plotting the estimated share of the US dollar in oil import payments (on the *y*-axis) against the share of US imports in total imports (on the *x*-axis) using the baseline model estimates in column (2) of Table 1. The effect is large. Assuming that the US is the source of 16% of total imports, the sample average, and that the economy is the size of Austria or Denmark (e.g. 2% of US GDP), the dollar would be used for 43% of oil import payments. Assuming that import penetration remains unchanged but that the economy is larger (e.g. about 20% of US GDP, a size roughly equivalent to that of France or Germany), our estimates indicate that the dollar would be used for 63% of oil import payments, a 20 percentage point increase.

We find no evidence that currency stability mattered for currency choice of oil import payments over the full estimation period. The estimated parameter for the coefficient of variation of the local currency's exchange rate relative to the dollar is insignificant. The dummies for foreign exchange controls are mostly insignificant (we return to this finding below).[40] If we exclude the foreign exchange controls from the specification (as in columns 5 and 6), we find again strong evidence that import penetration and its interaction with size both affect the dollar share. The two coefficients are positive, significant and of a similar economic magnitude as before.

Table 2 reports similar estimates with the share of dollar payments in oil imports in value terms as the dependent variable (note that the results are based here on less than half of our original sample, due to limited availability of the dependent variable). The coefficient on US import penetration is again positive. It is significant in the estimations of columns 4, 5 and 6. When it is significant, the magnitude of the effect is also somewhat smaller. The estimates suggest that a 1% increase in the share of the US in European imports is associated with a roughly 0.3-0.4% increase in the dollar share of oil import payments. The interaction of import penetration and size is positive, mostly significant and somewhat smaller in size than the estimates in Table 1.

One noteworthy difference is that the coefficient on the variability of the local currency against the dollar is positive and significant. A possible explanation for why exchange rate volatility against the dollar shows up with the expected sign in the estimates for oil imports in value, but not quantity terms, is the difference in samples.

[39] In contrast, size alone is insignificant, except in column 2 (at the 10% level of confidence).

[40] Except the sterling area member dummy in the specification of column 3 (which is found to have a counterintuitive positive sign and to be statistically significant at the 10% level of confidence; more on this below).

Recall that we have data for only 1949 and 1950 for oil in value terms but data for 1938, 1947, 1949, 1950 and 1953 for oil in quantity terms. When we restrict the sample for the quantity equations to 1949 and 1950, volatility against the dollar sometimes shows up significantly as well.[41] One interpretation of this result could be that currency instability mattered for the choice of a currency of oil import payments especially in the immediate aftermath of World War II, but not much before or thereafter.

Another difference is the impact of UK foreign exchange controls, which is significant in the random effect estimates of columns 1 and 2. The share of the dollar in the oil import payments of sterling area members (the UK, Ireland and Iceland) is estimated to be about 17 percentage points lower than that of the remaining countries, other things equal. This may reflect, as noted, the fact that US oil companies were pressured to sell an ever increasing share of their exports for sterling to the sterling area, particularly during the "dollar-sterling oil controversy" of the early 1950s.

In contrast, the share of the dollar in the oil import payments of bilateral account countries (mainly European continental countries) is estimated to be 9 percentage points higher than that of other countries, ceteris paribus. UK regulations made cross-border payments in sterling especially difficult for bilateral account countries (compared to sterling area and transferrable account countries). These countries were those whose international payment positions were so imbalanced among themselves, and with the UK, that unrestricted transferability of sterling could not "be allowed without too great danger of a one-sided development" (BIS, 1948, p. 151).[42] Sterling from bilateral account countries could be transferred freely only to and from the sterling area; sterling transfers were not allowed among bilateral countries themselves, and they were not allowed with third countries outside the sterling area (such as the United States) without the authorisation of UK Control. That the use of sterling was costly and inconvenient for the bilateral account countries helps to explain why they were keen to use the dollar instead to pay for oil imports.

Overall, capital controls undoubtedly played a role in shaping currency use in this period. But other variables, like country size and trade linkages, had an even greater economic impact on the share of the dollar in oil import payments.[43]

[41] Although only if one does not include the foreign exchange control dummies in the regression. If one keeps the foreign exchange control dummies, the effect then becomes insignificant.

[42] Several of these countries were located in continental Europe, including Austria, Belgium, France or Italy.

[43] Assuming again that import penetration from US firms is 16% of total imports and that the economy is the size of Austria or Denmark (e.g. 2% of US GDP), the estimates of column 2 of Table 2 suggest that the dollar would be used for 42% of oil import payments. Assuming again that import penetration remains unchanged but that the economy is larger (e.g. about 20% of US GDP, a size roughly equivalent to that of France or Germany), our estimates indicate that the dollar would be used for 68% of oil import payments, a 26 percentage points increase, one which is well above the estimated impact of foreign exchange controls in absolute value.

6. Robustness

In robustness checks, we explore the importance of other variables considered in the literature on international currency invoicing but for which data are more limited, along with a range of institutional and political factors and alternative variable definitions.[44]

As an alternative measure of currency stability, we consider the premium between the free market rate in Basle for foreign banknotes and the official exchange rate.[45] This can be thought of as the black market rate and as a measure of expected devaluation of the currency in question. An alternative interpretation is that the black market rate measures distortions and frictions in local currency markets relative to the dollar. Data are available for 11 of our 16 countries from BIS (various issues).

The literature suggests that a currency is more likely to be used for invoicing and settlement purposes if it is liquid and benefits from low transaction costs (Swoboda, 1968 and 1969; Portes and Rey, 1998; Devereux and Shi, 2008). Rey (2001) points to "thick market externalities" when a unit has a large presence in global international trade and low transaction costs of exchange. We proxy liquidity with the bid-ask spread of country *i*'s currency vis-à-vis the US dollar, following Goldberg and Tille (2008). We use London quotations in December of year *t* to that end, taken from archived issues of the *Financial Times* (data were available for the entire period for nine of the countries of our sample).

We also control for the fact that some countries were oil producers. We add a dummy variable which equals one for the three countries which were home to one of the European "Sisters", i.e. the UK (Anglo-Iranian Oil Company, now BP, and Royal Dutch-Shell); France (Compagnie Française des Pétroles, CFP, which was sometimes considered as the "Eighth Sister"; see Yergin, 2008); and the Netherlands (Royal Dutch-Shell).

Friberg and Wilander (2008), Goldberg and Tille (2011) and (2013) highlight the role of strategic interactions – of bargaining between exporters and importers – as a potential determinant of currency choice. In Goldberg and Tille (2013)'s two-currency model, the impact of bargaining power on invoicing currency choice crucially depends on whether exporters and importers bargain over both the price of a transaction and currency of invoicing or only over the latter.[46] In addition, Goldberg and Tille (2011) consider the share of foreign or government ownership in an industry as a measure of related-party effects and constraints on pricing behaviour that might

[44] Unless stated otherwise, in all robustness checks we use a linear random-effects estimator, given that the Hausman test did not reject the null that the parameters estimated with an (efficient) random effect estimator were the same as those using a (consistent but less efficient) fixed-effects estimator.

[45] There was an active and legal market for such banknotes in Switzerland in the immediate aftermath of World War II.

[46] For instance, if bargaining concerns both aspects, importers with higher bargaining power negotiate lower prices but are also readier to accept higher exchange rate exposure, which leads to lower local currency pricing. In contrast, if bargaining takes place only over invoicing currency choice, higher bargaining power on the part of importers – expectedly – leads to higher local currency pricing.

be associated with government influence. To capture potential government influence, we include in Eq. (1) a dummy variable that equals one for the two countries in our sample which have a multinational oil company partly (or wholly) owned by government, namely: the UK (AIOC); and France (Compagnie Française des Pétroles, CFP).

To capture other potential political motives (for instance, that US allies might have had a stronger preference for the US dollar) we include a dummy variable that equals one for countries that were part of the Axis during World War II (Austria, Germany and Italy) and a dummy that equals one for the founding members of the North Atlantic Treaty Organization in April 1949 (Belgium, Denmark, France, Iceland, Italy, Netherlands, Norway, Portugal and the UK).

Finally, we control for Marshall aid received each year by each country, since it could be argued that use of the dollar in oil settlements was heavily a function of how many dollars were made available to European countries by the United States through the European Recovery Program.

As Table 3 shows, the coefficients on import penetration and its interaction with size for the most part remain significantly positive.[47] Size alone has a significant effect in only two specifications, exchange rate volatility in just one. The dummies for UK foreign exchange controls are insignificant. Neither our measure of local currency market frictions or distortions (the premium between the free market rate in Basle for foreign banknotes and the official exchange rate) nor our measure of foreign exchange market liquidity (the bid-ask spread of the local currency vis-à-vis the US dollar quoted in London) has a statistically significant effect. This may reflect the limited availability of data for both variables (note that the results for liquidity are in line with those of Goldberg and Tille (2008) for the modern period, however). Moreover, if we substitute exchange rate volatility vis-à-vis sterling for exchange rate volatility vis-à-vis the dollar, this alternative measure of volatility is also found to have an insignificant effect. We obtain similar results if we use as yet another alternative measure exchange rates volatility vis-à-vis the dollar, compared to exchange rate volatility vis-à-vis sterling. [48] If currency instability mattered, it is evidently currency instability against the dollar.

Oil producers (i.e. the UK, the Netherlands and France) are found to use the dollar significantly less. By our estimates, the share of dollar payments in these countries was about 13 percentage points lower, ceteris paribus.[49]

[47] With the exception of the specification using the black market rate reported in column 1 and that of liquidity reported in column 2; readers should note the smaller number of observations left for these two specifications, however, due to limited data availability.

[48] Both sets of estimates are not reported here for the sake of brevity but are available from the authors upon request.

[49] They likely used their own currency as a unit of international settlement (i.e. sterling, the Dutch Guilder and the French franc, respectively) or sterling (for the Netherlands and France), albeit in proportions that are difficult to ascertain given the absence of a currency breakdown of the data on the share of non-dollar oil import payments.

The coefficient on government influence is also statistically significant. The two countries with a multinational oil company partly (or wholly) owned by government (the UK and France) have dollar shares 8 percentage points lower than other countries, ceteris paribus. This might reflect the role of related party-effects and constraints on pricing behaviour associated with government influence, consistently with Goldberg and Tille (2011). The Axis power and NATO founding member dummies are insignificant, in contrast. This suggests that economic – more than political – factors drove currency choice in oil markets before and after World War II.

Table 4 reports estimates based on our baseline sample using the share of dollar payments in oil imports in quantity terms as dependent variable, obtained using panel tobit, difference GMM and system GMM estimation techniques (also controlling for instrument proliferation bias as regards the latter two techniques, as suggested by Roodman, 2009). The main results remain unaltered to a large extent. The coefficient on import penetration is significantly positive (with a similar economic magnitude) in three specifications, while the coefficient of its interaction with size is positive and significant (and somewhat higher than in the baseline estimates, in some instances).[50] Size alone, along with exchange rate volatility, again have little effect. Among UK foreign exchange controls, only the transferable account dummy is significant in one specification.

The inertia variable included in columns 3 to 5 is the coefficient on the lagged dependent variable estimated using difference GMM and system GMM methods. Inertia, as opposed to "coalescing effects" (see Goldberg and Tille, 2008, 2011) does not appear to have been systematically considered in previous work on currency invoicing. There are signs that inertia effects are there, according to the estimates in columns 3 and 4.[51] At 0.3-0.5, they are smaller than those found in studies of currency choice in international bond markets (see e.g. Chitu, Eichengreen and Mehl, forthcoming) or on the currency composition of reserves with modern data (see e.g. Chinn and Frankel, 2007 and 2008), which typically find that the coefficient on the lagged dependent variable is on the order of 0.9. These inertia effects are found not to be statistically significant, however (a pattern which is underscored by the lack of significant first-order serial correlation in the first-differenced disturbances of the estimated models).[52]

In Table 5 we first use as an alternative dependent variable the share of dollar payments in imports of crude oil, refined oil and oil-related equipment (in columns 1, 2 and 3, respectively). For refined oil the estimates are fairly close to those obtained under the baseline specification (for which the dependent variable is the share of

[50] Except in column 4.

[51] In constructing the instrument matrix, we treat dollar share, import penetration, size and stability as endogenous variables and treat the foreign exchange controls and year dummies as exogenous variables. We endeavour to control for instrument bias proliferation by collapsing the set of instruments, as suggested by Roodman (2009), in columns (3) and (5). The results obtained using system GMM methods are reported *pro memoria* only, given dollar share's limited estimated persistence.

[52] This also suggests that a static specification is more appropriate for modelling currency payment patterns in our sample.

dollar payments in imports of crude *and* refined oil) for import penetration and its interaction with size; and the coefficient on the size variable is significant and positive.

The estimates using crude oil and oil-related equipment are different. None of the baseline explanatory variables has a significant effect in the former case, in particular (except the dummies for transferable and bilateral account countries). This suggests that the share of the dollar in crude oil imports was determined by different factors, such as the existence of refining capacities in the importing country. As yet another measure of the dependent variable we used the share of the dollar in crude and refined oil as estimated by the ECA, which also restricts the sample to observations for 1949 and 1950.[53] We find again that the interaction between import penetration from US firms and size is significantly positive, with the magnitude of the effect being somewhat higher (readers should note the small number of available observations, however).

We also dropped the observations for 1953, since they were based on projections, not actual data, as well as those for 1938, since the methodology followed by the OEEC to compile the data was not necessarily identical to the one used for post-war years. We again obtained results pointing to the key role of import penetration, its interaction with size, along with that of the exchange controls for bilateral account countries.[54]

As an alternative measure of import penetration, we used the share of the United States in the oil imports of each country of our sample in 1948 (the only year for which data were available). We found again that the coefficient of import penetration was positive and on the order of ½ percent, albeit statistically insignificant (which is unsurprising given that the estimation makes use here of a sample of 14 observations only).[55] In addition to this, we used time-varying guesstimates of the share of the US an oil supplier as yet another alternative measure of US import penetration, which we obtain by supplementing the latter (time-invariant) observations with US production of oil relative to total world production.[56] We found again that the coefficient on import penetration remained significant, positive and statistically significant at the 10% or 12% level when we use a random effect estimator.[57]

Finally, we used the share of oil import payments in non-dollar currencies as the dependent variable, effectively assuming that 100% of these payments were in

[53] Which, as readers will recall, tended to be lower than that estimated by the OEEC.

[54] Only when excluding observations for 1938, however, which makes economic sense insofar as these controls were only in place after World War II.

[55] The estimates are not reported here for sake of brevity but are available from the authors upon request.

[56] As aforementioned, we could produce such guesstimates for 1949, 1950 and 1953 (the years for which data on US production of oil relative to total world production could be gathered from American Petroleum Institute, 1959).

[57] But not when we use a fixed effect estimator. These estimates are not reported here for sake of brevity but are available from the authors upon request.

sterling (along with the corresponding UK explanatory variables).[58] The latter were found mostly not to matter, presumably because sterling was not in fact the only non-dollar currency used as a unit of payment of oil import.[59]

7. Conclusions

It is widely argued that network increasing returns are strong in markets for homogenous goods, in global oil markets for example, leading to the dominance of one currency of settlement. We have challenged this presumption by showing that several national currencies simultaneously played substantial roles in global oil markets in earlier periods. European oil import payments before and after World War II were almost evenly split between the dollar and non-dollar currencies. And what was true of European oil markets, more limited data suggest, was also true of the global oil markets, insofar as Europe accounted for a large share of global oil markets then. Evidence for the modern era substantiates the point and suggests that European countries still use other currencies than the dollar in their international oil transactions to a non-negligible extent.

Differences in dollar usage across countries in the earlier era were associated with the extent of trade linkages with the US and the size of the importing country. In addition, countries with more stable currencies used the dollar less in oil import payments; strategic motives (i.e. government influence in the oil sector) also made countries less inclined to use the dollar; and other countries that were constrained by capital controls in their ability to pay freely with sterling used the dollar more. We find little evidence that liquidity effects and international political considerations further influenced this choice.

These findings suggest that there is room for more than one international currency as means of payment even for a good as homogenous as oil. They suggest that network increasing returns are not as strong as sometimes supposed, that first-mover advantage is not everything, and that incumbency is no guarantee of continued dominance. They therefore suggest that a shift from the current dollar-based system to a multipolar system is not impossible.

[58] Although part could have been in e.g. local currency.

[59] The estimates are again not reported here for the sake of brevity but are available from the authors upon request. We also estimated the determinants of the share of dollar invoicing in imports and exports of petroleum, petroleum products and related materials of EU countries in 2010 and 2012. There is some evidence that higher exchange rate volatility vis-à-vis the US dollar was associated with significantly higher dollar invoicing, for both imports and exports, and thereby that currency instability matters. None of the other standard explanatory variables were found to be statistically significant, however.

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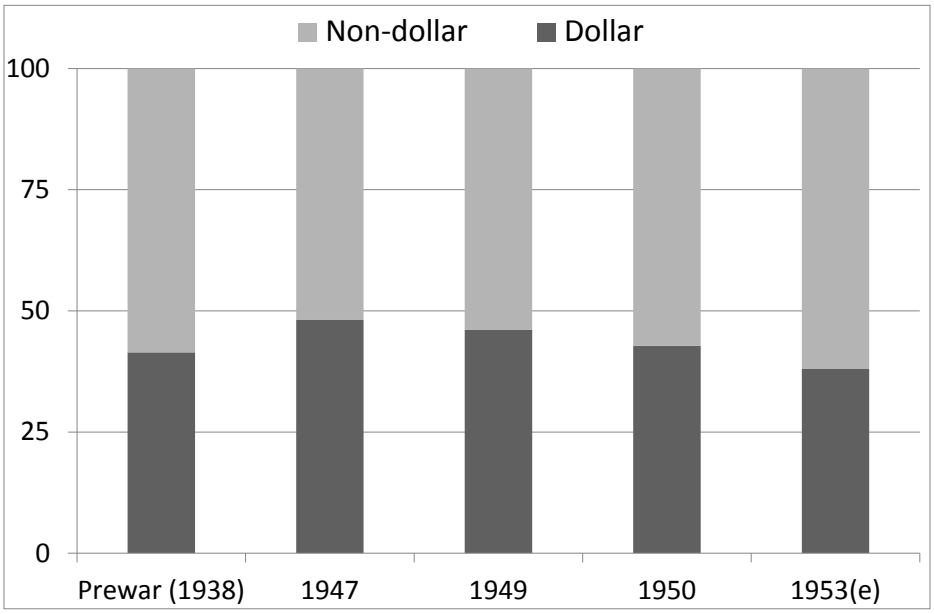
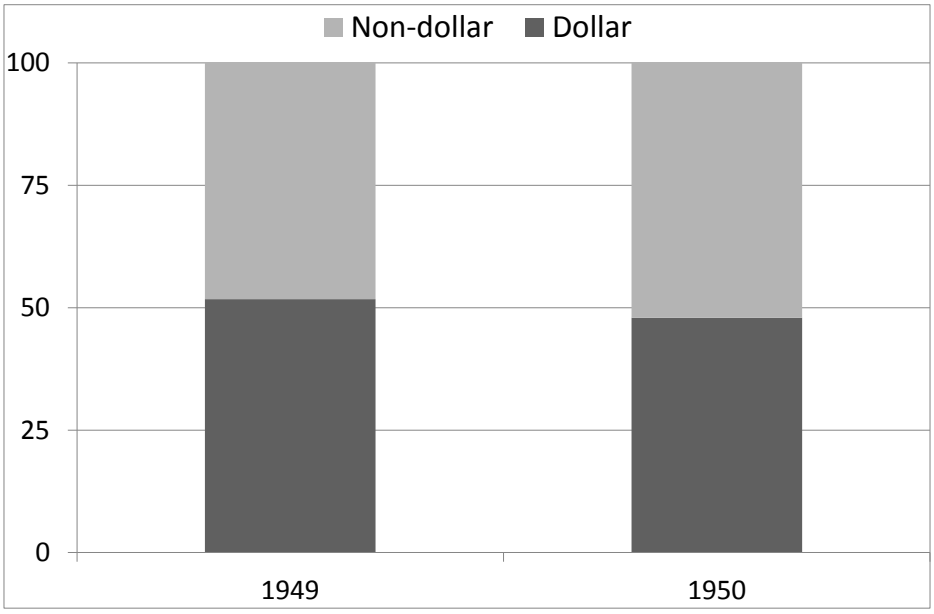
Figure 1a: Currency denomination of European oil imports
(*Oil imports in quantity terms, %*)



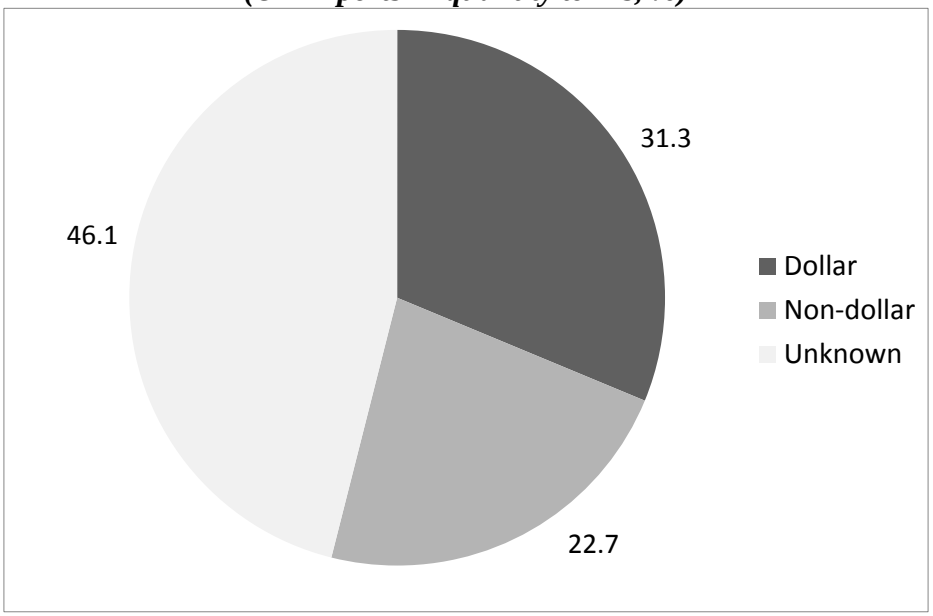
Note: The figure shows the breakdown by currency of denomination of the oil imports (crude and refined products) of our sample's 16 European countries as a whole in each fiscal year for which the countries reported data in quantity terms (i.e. oil imports in thousands of metric tonnes) to the OEEC (estimates based on ECA, 1949, Tables 5-6, pp. 35-36). Pre-war data are for 1938 or another "representative" pre-war year (ibid., p. 33). Data for fiscal 1953 were projections by the time participating countries were submitting data to the OEEC.

Figure 1b: Currency denomination of European oil imports
(*Oil imports in value terms, %*)



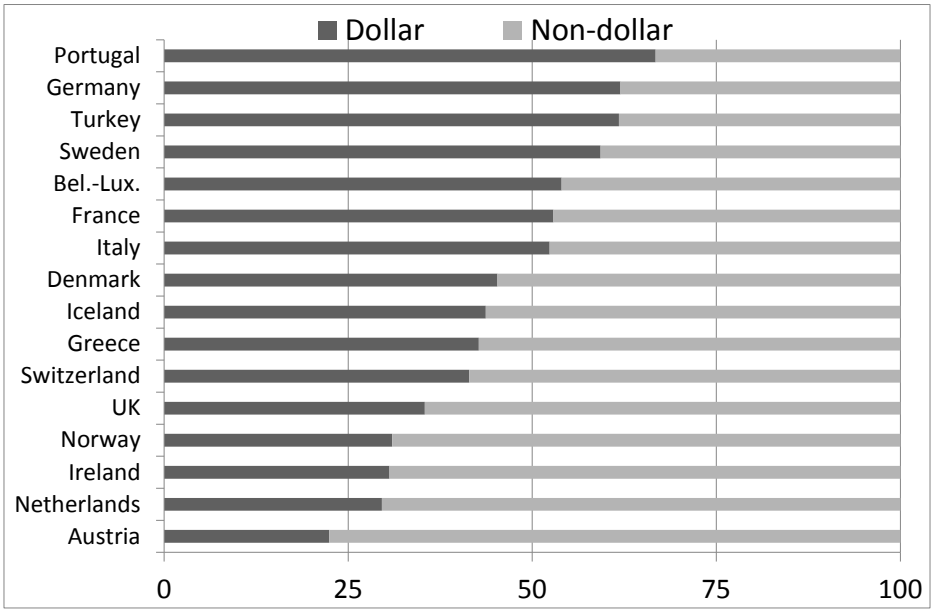
Note: The figure shows the breakdown by currency of denomination of the oil imports (crude and refined products) of our sample's 16 European countries as a whole in each fiscal year for which the countries reported data in value terms (i.e. oil imports in thousands of dollars) to the OEEC (estimates based on ECA, 1949, Table 9, p. 38).

Figure 2: Currency denomination of global oil imports after World War II
(Oil imports in quantity terms, %)



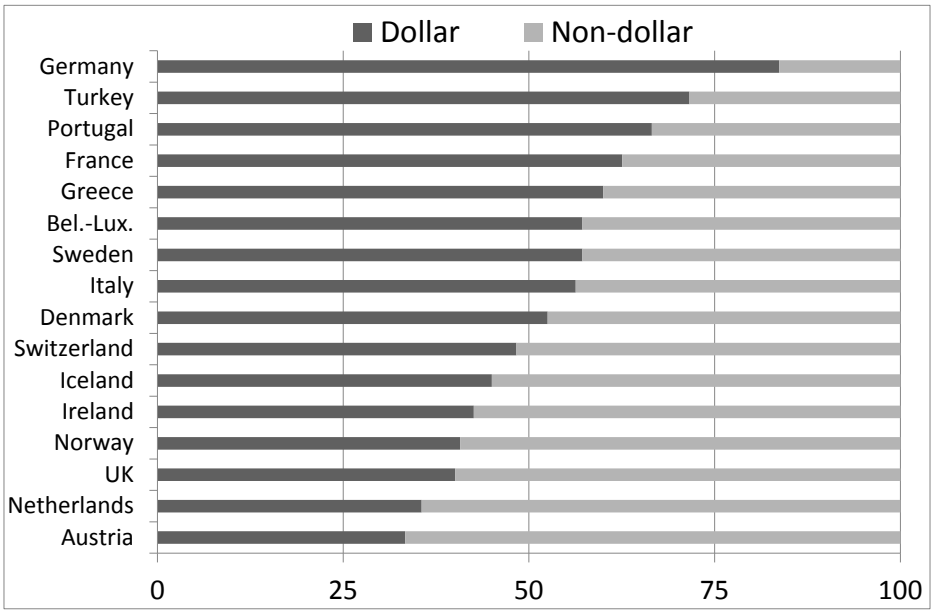
Note: The figure shows the estimated currency breakdown of global oil imports (crude and refined products) in quantity terms (i.e. imports in thousands of metric tonnes) in 1948-49. "Dollar" = imports paid in dollars by European countries (ECA, 1949, Tables 5, p. 35) + US imports (Federal Trade Commission, 1952, Chapter 1, Tables 6-7) + 30% of sterling area imports (Schenk, 1996). "Non-dollar" = imports paid in sterling by European countries + 70% of sterling area's imports. "Unknown" = imports for which no information is available. Barrels are converted to metric tonnes using a factor of 0.1364 for crude oil and 0.1228 for refined products when needed.

Figure 3a: Currency denomination of European countries' oil imports
(*Oil imports in quantity terms, %*)



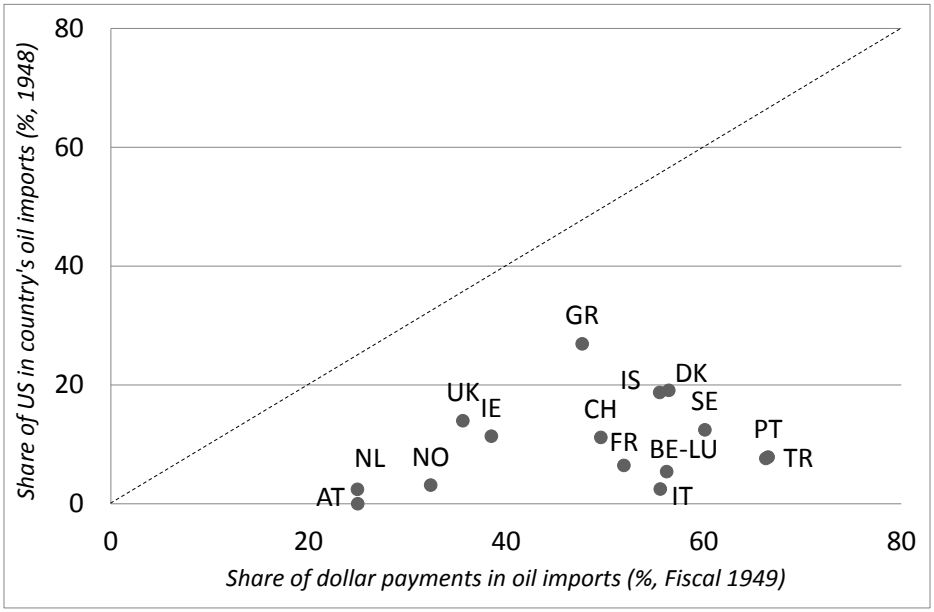
Note: The figure shows the breakdown by currency of denomination of the oil imports (crude and refined products) of our sample's 16 European countries in quantity terms (i.e. oil imports in thousands of metric tonnes). Data are reported by country and as pre-war-1950 period averages (estimates based on ECA, 1949, Tables 5, p. 35).

Figure 3b: Currency denomination of European countries' oil imports (*Oil imports in value terms, %*)



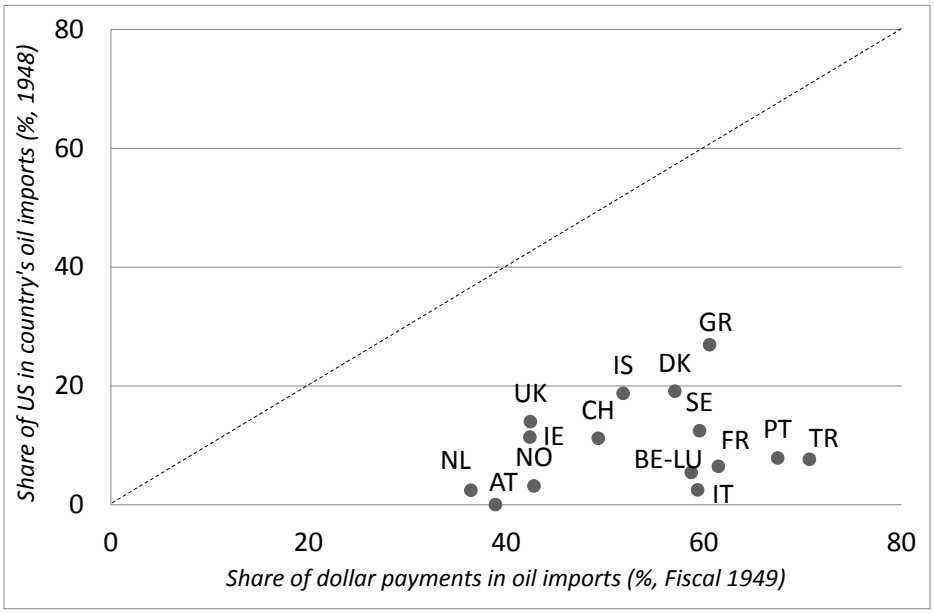
Note: The figure shows the breakdown by currency of denomination of the oil imports (crude and refined products) of our sample's 16 European countries in value terms (i.e. oil imports in thousands of dollars). Data are reported by country and as 1949-1950 period averages (estimates based on ECA, 1949, Tables 9, p. 38).

Figure 4a: Role of the US dollar as vehicle currency in oil import payments (*Oil imports in quantity terms*)



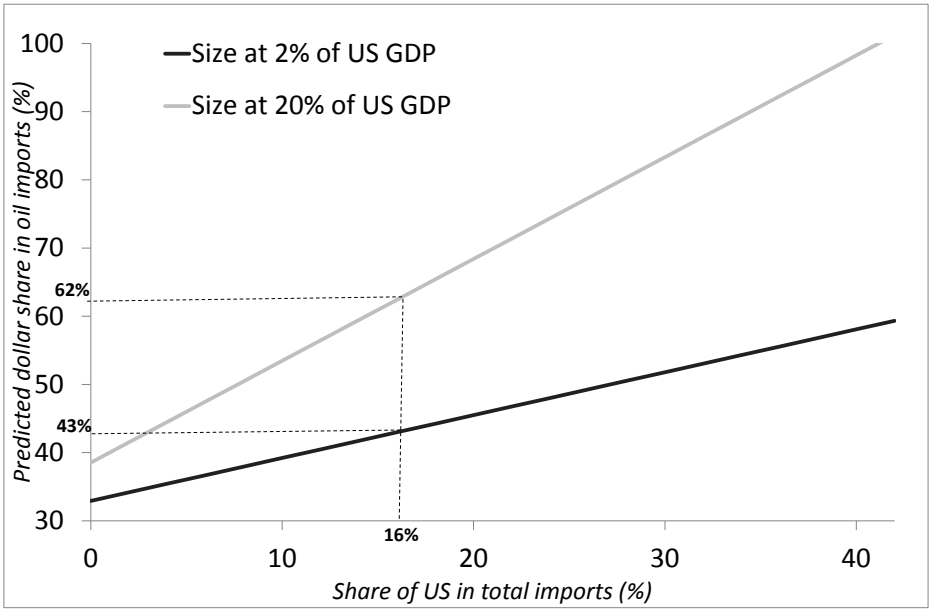
Note: The figure plots the share of dollar payments in the oil imports (crude and refined products) of our sample's 16 European countries in quantity terms (i.e. oil imports in thousands of metric tonnes) for fiscal year 1949 against the share of the US in their respective oil imports in 1948 (as available from Federal Trade Commission, 1952, Chapter 1, Tables 6-7). The dotted line is the 45-degree line.

Figure 4b: Role of the US dollar as vehicle currency in oil import payments (*Oil imports in value terms*)



Note: The figure plots the share of dollar payments in the oil imports (crude and refined products) of our sample's 16 European countries in quantity terms (i.e. oil imports in thousands of metric tonnes) for fiscal year 1949 against the share of the US in their respective oil imports in 1948 (as available from Federal Trade Commission, 1952, Chapter 1, Tables 6-7). The dotted line is the 45-degree line.

Figure 5: Estimated dollar share in oil import payments as a function of US import penetration and size



Note: the figure plots the estimated share of the US dollar in oil import payments (in the *y*-axis) as a function of the share of US imports in total imports (in the *x*-axis) and two possible assumptions regarding GDP size, using the baseline model estimates reported in column (2) of Table 1.

Table 1: Baseline estimates

	(1) Random effects	(2) Random effects	(3) Fixed effects	(4) Fixed effects	(5) Random effects	(6) Fixed effects
Import penetration	0.252	0.533**	0.256	0.562**	0.587***	0.530**
	(0.254)	(0.219)	(0.253)	(0.242)	(0.178)	(0.209)
Country size	0.281	0.312*	0.316	0.647	0.331	0.459
	(0.207)	(0.186)	(0.622)	(0.810)	(0.223)	(0.587)
Import penetration × size	0.049**	0.048***	0.049*	0.057**	0.055**	0.057**
	(0.022)	(0.017)	(0.025)	(0.027)	(0.022)	(0.026)
FX volatility	-4.537	-14.170	2.078	-3.331	-13.914	-0.782
	(18.121)	(26.054)	(15.610)	(23.767)	(20.641)	(18.964)
Sterling area member	3.140	0.410	8.127*	2.880		
	(2.512)	(3.869)	(4.260)	(5.832)		
Transferable account	1.319	-3.464	1.841	-9.355		
	(3.809)	(4.913)	(4.646)	(6.536)		
Bilateral account	11.342	8.369	9.778	0.907		
	(6.913)	(5.603)	(7.658)	(7.569)		
Constant	35.616***	32.293***	35.213***	28.528***	31.620***	30.468***
	(6.153)	(6.104)	(6.833)	(9.470)	(6.484)	(8.472)
Time effects	NO	YES	NO	YES	YES	YES
Observations	69	69	69	69	71	71
R^2 (overall)	0.324	0.367	0.278	0.268	0.263	0.239
R^2 (within)	0.448	0.482	0.455	0.494	0.440	0.446
R^2 (between)	0.169	0.227	0.0784	0.0766	0.0712	0.0453
ρ	0.498	0.483	0.489	0.510	0.430	0.518
σ^{α}	11.93	11.69	11.73	12.33	10.63	12.68
σ^{u}	11.99	12.09	11.99	12.09	12.24	12.24
log likelihood	.	.	-255.3	-252.7	.	-263.9
# countries	15	15	15	15	15	15

Note: The table reports estimates of Eq. (1) based on our baseline sample for fiscal years 1938, 1947, 1949, 1950 and 1953 using the share of dollar payments in oil imports in quantity terms as dependant variable. The foreign exchange controls are excluded from specifications (5) and (6). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Estimates with oil import payments in value terms

	(1) Random effects	(2) Random effects	(3) Fixed effects	(4) Fixed effects	(5) Random effects	(6) Fixed effects
Import penetration	0.187	0.196	0.209	0.274*	0.378***	0.327*
	(0.121)	(0.142)	(0.149)	(0.148)	(0.134)	(0.187)
Country size	0.841**	0.857**	-0.089	0.082	0.393	-0.043
	(0.416)	(0.414)	(0.869)	(0.717)	(0.539)	(0.614)
Import penetration × size	0.039***	0.039**	0.028*	0.026	0.022*	0.019
	(0.014)	(0.015)	(0.016)	(0.017)	(0.014)	(0.019)
FX volatility	13.515**	13.488*	17.411**	20.527**	19.247***	22.646***
	(5.305)	(7.951)	(6.735)	(8.559)	(5.532)	(5.280)
Sterling area member	-17.742**	-18.019**				
	(8.998)	(9.078)				
Transferable account	5.214	5.073				
	(5.542)	(5.633)				
Bilateral account	9.533**	9.536**	1.959	1.362		
	(4.085)	(4.187)	(3.121)	(3.519)		
Constant	38.909***	38.775***	48.339***	46.503***	43.422***	46.876***
	(1.576)	(1.795)	(7.331)	(6.145)	(5.537)	(5.546)
Time effects	NO	YES	NO	YES	YES	YES
Observations	29	29	30	30	30	30
R^2 (overall)	0.427	0.431	0.146	0.154	0.135	0.0482
R^2 (within)	0.820	0.818	0.817	0.822	0.811	0.820
R^2 (between)	0.423	0.427	0.126	0.135	0.104	0.0168
ρ	0.965	0.961	0.974	0.972	0.962	0.977
σ^{α}	10.75	10.74	13.19	13.15	10.69	13.88
σ^{u}	2.049	2.159	2.139	2.224	2.126	2.126
	.	.	-48.91	-48.48	.	-48.72
# countries	15	15	15	15	15	15

Note: The table reports estimates of Eq. (1) based on our baseline sample for fiscal years 1949 and 1950 using the share of dollar payments in oil imports in value terms as dependant variable. The sterling area member and transferable account dummies dropped out because of multicolinearity in specifications (3) and (4). The foreign exchange controls are excluded from specifications (5) and (6). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p≤0.1.

Table 3: Estimates with additional controls

	(1)	(2)	(3)	(4)	(5)	(6)
Import penetration	0.163	1.000	0.536**	0.528**	0.537**	0.535**
	(0.711)	(0.803)	(0.234)	(0.230)	(0.238)	(0.223)
Country size	0.424	0.235	0.541**	0.369	0.363	0.330*
	(0.674)	(0.248)	(0.261)	(0.233)	(0.309)	(0.199)
Import penetration × size	0.095*	0.045	0.054***	0.050***	0.050**	0.050***
	(0.054)	(0.032)	(0.018)	(0.018)	(0.020)	(0.017)
FX volatility	7.490	34.318*	-11.441	-12.215	-11.893	-11.969
	(49.079)	(19.273)	(25.811)	(25.640)	(23.945)	(28.066)
Sterling area member	-13.708	5.955	2.880	0.632	0.907	2.804
	(17.866)	(10.142)	(4.430)	(4.012)	(4.696)	(8.668)
Transferable account	-9.233	2.386	-4.573	-3.675	-3.869	-1.823
	(10.500)	(7.031)	(4.951)	(5.008)	(6.217)	(7.983)
Bilateral account		12.425	6.837	7.763	7.502	9.936
		(10.544)	(5.764)	(5.857)	(6.094)	(8.322)
Black market	0.099					
	(0.371)					
Liquidity		0.017				
		(0.032)				
Oil producer			-12.594***			
			(4.793)			
Government influence				-8.277**		
				(3.503)		
Axis power					-1.688	
					(11.075)	
NATO founding member					-1.519	
					(6.992)	
Marshall aid						-0.397
						(1.019)
Constant	52.157***	28.134**	32.382***	32.790***	32.753***	32.034***
	(10.515)	(12.522)	(6.247)	(6.342)	(6.213)	(6.198)
Time effects	YES	YES	YES	YES	YES	YES
Observations	36	48	69	69	69	69
# countries	11	12	15	15	15	15
R^2 (overall)	0.449	0.237	0.413	0.384	0.361	0.367
R^2 (within)	0.548	0.188	0.489	0.485	0.486	0.483
R^2 (between)	0.403	0.141	0.329	0.266	0.205	0.224
ρ	0	0.440	0.568	0.568	0.568	0.515
σ^{α}	0	10.91	13.86	13.86	13.87	12.60
σ^{u}	11.13	12.31	12.09	12.09	12.09	12.24

Note: The table reports estimates of Eq. (1) based on our baseline sample for fiscal years 1938, 1947, 1949, 1950 and 1953 using the share of dollar payments in oil imports in quantity terms as dependant variable as well as an array of additional control variables (for which data availability is poorer or that aims to capture institutional and political determinants of currency choice). Estimates are obtained with a linear random effects estimator. The bilateral account dummy dropped out because of multicolinearity in specification (1). The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Estimates with alternative estimation methods

	(1) Panel tobit	(2) Difference GMM	(3) Difference GMM	(4) System GMM	(5) System GMM
Import penetration	0.539**	0.977***	-0.140	0.591**	-0.203
	(0.236)	(0.307)	(0.798)	(0.203)	(0.280)
Country size	0.301	5.259**	6.828	-0.157	0.417
	(0.305)	(1.825)	(5.310)	(0.370)	(0.297)
Import penetration × size	0.048*	0.070**	0.090*	0.019	0.085**
	(0.026)	(0.028)	(0.049)	(0.020)	(0.032)
FX volatility	-16.714	-20.815	-85.282*	-90.373*	-40.985
	(21.510)	(36.698)	(45.405)	(44.307)	(44.527)
Sterling area member	0.183	-0.738	-3.373	4.117	-5.023
	(13.753)	(7.149)	(6.805)	(9.744)	(6.371)
Transferable account	-2.641	-12.461	-16.040*	-0.799	-0.328
	(13.250)	(8.097)	(7.527)	(3.117)	(4.791)
Bilateral account	9.557			5.407	11.443
	(13.338)			(5.454)	(7.736)
Inertia		0.020	0.320*	0.572**	0.304
		(0.198)	(0.185)	(0.209)	(0.205)
Constant	32.498***			17.289*	31.381***
	(5.599)			(8.306)	(9.265)
Time effects	YES	YES	YES	YES	YES
Observations	69	40	40	55	55
R^2 (pseudo)	.	.	.	.	.
log likelihood	-272.6	.	.	.	.
# countries	15	15	15	15	15
# instruments	.	33	21	51	28
p-value of AR(1)	.	0.231	0.585	0.483	0.715
p-value of AR(2)	.	0.139	0.451	0.164	0.842
p-value of Hansen stat.	.	1.000	1.000	1.000	1.000

Note: The table reports estimates of Eq. (1) based on our baseline sample for fiscal years 1938, 1947, 1949, 1950 and 1953 using the share of dollar payments in oil imports in quantity terms as dependant variable and alternative estimation methods to those used in Table 1. The bilateral account dummy dropped out because of multicolinearity in specifications (2) and (3). The estimation results in specifications (3) and (5) are obtained with a collapsed set of instruments, as suggested in Roodman (2009). The standard errors reported in parentheses are robust to heteroskedasticity; *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Other sensitivity checks

	(1) Only crude oil	(2) Only refined oil	(3) Oil equipment	(4) ECA estimates	(5) Excl. 1953	(6) Excl. 1938
Import penetration	0.192	0.680***	0.221	0.059	0.551***	0.640***
	(0.255)	(0.256)	(0.425)	(0.213)	(0.199)	(0.211)
Country size	-0.829	0.661***	-3.694***	0.411	0.188	0.416
	(0.626)	(0.226)	(1.157)	(0.554)	(0.200)	(0.349)
Import penetration × size	-0.032	0.085***	-0.070	0.063***	0.032	0.052**
	(0.027)	(0.028)	(0.051)	(0.021)	(0.023)	(0.025)
FX volatility	-30.036	-30.396	41.089	-28.585**	-34.031	-20.263
	(25.633)	(24.185)	(29.639)	(12.597)	(21.090)	(24.759)
Sterling area member	-19.431	-0.896	82.418***	-7.157	3.863	-0.891
	(15.045)	(6.085)	(29.017)	(14.578)	(3.649)	(6.000)
Transferable account	-32.558***	0.845	62.056***	0.950	-3.756	2.109
	(10.213)	(6.250)	(16.339)	(6.168)	(5.326)	(5.619)
Bilateral account	-22.723**	14.444**	49.922***	13.953**	6.992	14.586***
	(10.956)	(6.582)	(10.034)	(6.261)	(4.888)	(5.385)
Constant	60.949***	27.882***	30.368***	36.945***	33.355***	0.000
	(19.288)	(5.669)	(5.349)	(2.713)	(6.257)	(0.000)
Time effects	YES	YES	YES	YES	YES	YES
Observations	69	69	22	29	55	55
# countries	15	15	14	15	15	15
R^2 (overall)	0.501	0.438	0.714	0.607	0.431	0.419
R^2 (within)	0.592	0.501	0.368	0.251	0.621	0.556
R^2 (between)	0.448	0.309	0.678	0.637	0.201	0.331
ρ	0.535	0.197	0.905	0.823	0.556	0.563
σ^{α}	17.45	6.790	26.81	10.64	11.92	12.77
σ^{u}	16.27	13.69	8.677	4.936	10.65	11.25

Note: The table reports estimates of Eq. (1) based on our baseline sample for fiscal years 1938, 1947, 1949, 1950 and 1953 using alternative dependant variables i.e. the share of dollar payments for (1) crude oil only; (2) refined oil only; (3) oil-related equipment only; (4) crude and refined oil as estimated by the ECA, rather than the OEEC as well as the share of dollar payments in oil imports in quantity terms as dependant variable, but excluding (5) fiscal year 1953 (projections) and (6) fiscal year 1938 (methodology not necessarily identical to the one used for post-war years). Estimates are obtained with a linear random effects estimator. The standard errors reported in parentheses are robust to heteroskedasticity and clustered heterogeneity; *** p<0.01, ** p<0.05, * p<0.1

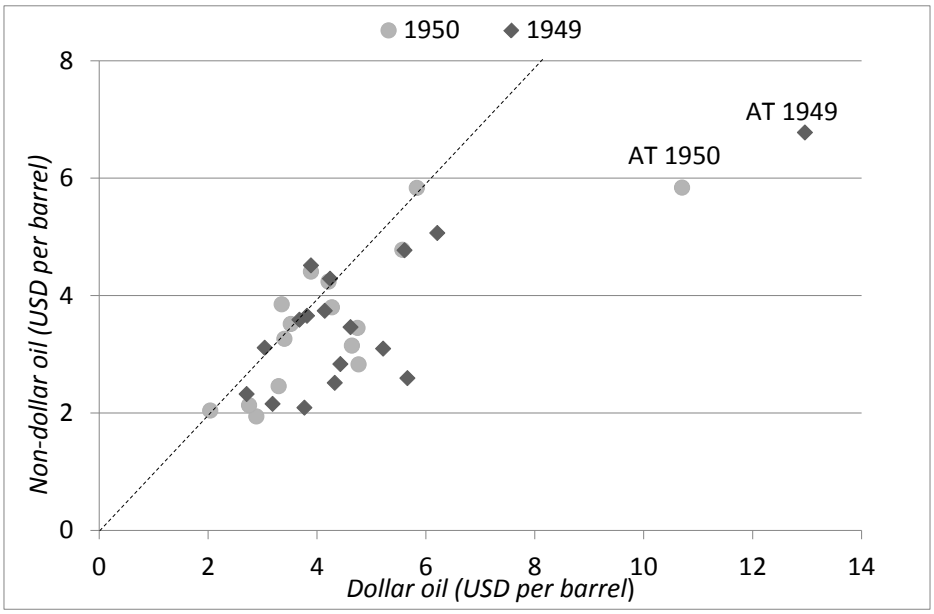
Appendix: Additional evidence for the post-World War II period

Table A1: Currency denomination of European oil imports by product (%)

	Oil imports in quantity terms		*Oil imports in value terms*	
	Dollar	Non-dollar	Dollar	Non-dollar
Crude oil	43.4	56.6	45.7	54.3
Refined products	47.9	52.1	53.9	46.1
Crude oil and refined products	46.1	53.9	51.8	48.2
Petroleum equipment	…	…	33.6	66.4

Note: The table shows the oil imports of our sample's 16 European countries as a whole in fiscal year 1949 broken down by currency of denomination and main categories of oil and oil-related products (estimates based on ECA, 1949, Tables 3 to 9 and 17 to 19, pp. 33-47). Oil equipment under the heading "Dollar" must be obtained almost entirely from the US whereas equipment under the heading "Non-dollar" is in general produced by the European countries.

Figure A1: Dollar vs. non-dollar oil price per barrel



Note: The figure plots the implied dollar price of a dollar oil barrel against that of a non-dollar oil barrel obtained by dividing prices by quantities for 1949 and 1950 (the two years for which such data are available). Metric tonnes are converted to barrels using a factor of 0.1296 (i.e. the arithmetic average of the corresponding factors for crude oil and refined products).