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On the Determinants of International Currency Choice: Will the Euro Dominate the World?

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Abstract[1]

Money is used as a store of value, a medium of exchange and a unit of account. Most recent analyses of currency choice in an international setting have focused on the denomination of reserves—the store of value role. However, public data are only aggregate and exclude several countries. This paper focuses on currency choice for the unit of account role, employing a detailed database on security issuance across countries, time and currencies. The paper finds a stable relation between currency choice and specific real and financial variables with different specifications for developed and developing countries, as well as evidence for persistence and network externalities. Exploiting the creation of the Euro, the paper finds a large and significant Euro liquidity effect at the cost of the dollar, especially in the early years of the life of the new currency. The estimates suggest that the Euro is making significant progress toward threatening the role of the dollar as *the* dominant international currency.

Keywords: currency composition, dominant international currency, liquidity effect
JELCodes: F02, F31, F33

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1. Introduction

After the demise of the British pound as the dominant international currency and after the two world wars of the last century, the dollar has been the currency of choice for international use including reserve holdings, trade invoicing, security denomination, and for currency trading in both spot and derivative markets. However, with the creation of the Euro in 1999 and the first Euro notes appearing in 2000, there has been rising interest in whether the supremacy of the dollar may come under threat.[2]

A small literature suggests several determinants of currency choice in an international setting.[3] Some, such as trade patterns, imply stability, while others, particularly liquidity effects, suggest the possibility of a self-fulfilling equilibrium in the currency determination decision. The introduction of the Euro provides an excellent natural experiment to consider the importance of liquidity effects in currency use. The Euro replaced 12 currencies and so garnered substantial additional liquidity.[4] If liquidity is an important factor we should expect to find that this boosted the use of the Euro as an international currency over and above the use of the 12 pre-Euro currencies, controlling for other determinants.

This is not just an interesting theoretical debate. As suggested by previous authors, the dominance of the dollar as an international currency may allow the United States to finance its current account deficit more easily and may reduce the cost of issuance in dollars for the private and public sector alike, depending on the importance of the liquidity premium. This is likely to favor the United States more than other countries that may also take advantage of this premium, but at the cost of increased currency risk. There is also a more practical dimension. U.S. authorities are used to thinking of the dollar as an international currency, and this obviously holds major implications. Many developing countries have dollarized their financial systems, and some have explicitly

[2] Eichengreen (2000) states "With so much economic activity taking place in Europe and so much of it denominated in euros, the euro should become increasingly convenient for use in international transactions by governments, banks and traders in other parts of the world." His prediction turned out to be close to the mark, as the *Financial Times* (January 14, 2007) reports,"The Euro displaces the Dollar in bond markets."

[3] Krugman (1980) and (1984), Eichengreen and Mathieson (2000), Chinn and Frankel (2005), and Papaioannu et al. (2006).

[4] In January 2000, 11 currencies were replaced by the Euro. Greece joined in January 2001.

adopted the dollar as official currency, while others have come quite close to doing so.[5] To the extent that the Euro threatens the dollar's supremacy, more countries may de facto Euroize or even adopt the Euro as official currency, and European authorities will have to consider the potential implications.[6,7]

Money is normally considered to have three complementary roles a) as a store of value b) as a medium of exchange and c) as a unit of account. Previous analyses of the choice of an international currency have tended to focus on the role of money as a store of value, especially in reserve holdings. While this is appealing, as it appears to be closer to the benefits to the United States in terms of financing its current account, there are drawbacks. Specifically, the only publicly available dataset on the currency composition of reserve holdings is aggregate across countries and excludes certain key countries.[8] Moreover, the world's largest economy, the United States, has rather low holdings of international reserves.[9] This approach then essentially ignores how U.S. firms use other currencies. In this paper we choose to consider the unit of account role of currency and specifically currency choice for security denomination. This role is closer to the potential benefit to the United States, as US firms may be able to issue at less cost in their own

[5] A monetary agreement was discussed between Argentina and the United States after the Brazilian devaluation in 1999. This was one of the motivations for the International Monetary Stability Act (S.1879), also known as the Mack Bill, that proposed that the US support countries that dollarized by sharing seigniorage income. In the end the bill did not get to a full debate in Congress, and Argentina decided not to dollarize. Euroland does have rules to share seignorage among its members and South Africa has a monetary agreement with neighbors that use the Rand as currency. Guidotti and Powell (2003) provides details of the official Argentine documents and discusses these issues.

[6] A small but increasing set of countries issue more international securities in Euros than in dollars. Extreme cases are Estonia, French Polynesia, Iran, Latvia, Morocco and Slovenia, which in 2004 issued more then 90 percent of their international securities in Euros.

[7] The Mack Bill generated several hearings in Congress; for a fuller account see http://banking.senate.gov/docs/reports/dollar.htm.

[8] The IMF has recently revised its methodology in compiling data on the currency composition of foreign reserves. Consequently the data are not fully comparable across years, since country coverage changes. In previously reported data, the IMF resorted to its own estimates, when countries were not reporting to its confidential database. The revised IMF data reflect a considerably smaller sample, since they are based only on reported data. Most importantly, since "reporting compliance" has traditionally been low in Asia, the recent estimates do not include several East Asian economies with very large reserves. A 2005 European Central Bank (ECB) report, *Review of the International Role of the Euro*, provides details on the problems of the IMF data, and Truman and Wong (2006) present data on reserve composition for 14 countries. Most show significant shifts from dollar and yen to Euro from 2000 to 2004 in line with the BIS data on security issuance.

[9] The stated U.S. international reserve position is US$66.6bn as of April 13, 2007, with US$25bn denominated in Euros, US$15.9bn in yen and some US$11.0bn of gold. The total includes the Treasury's Exchange Rate Stabilization Fund and the United States' IMF reserve position and special drawing rights (SDRs). See http://www.treas.gov/press/releases/200741615285918278.htm.

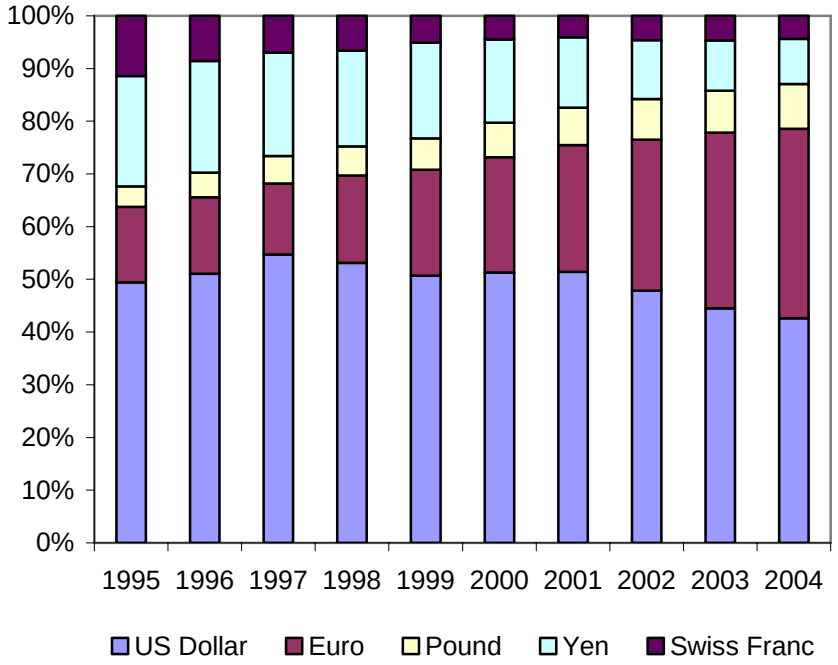
currency. Moreover, this allows us to employ a detailed Bank for International Settlements (BIS) dataset that identifies currencies and countries (including both developed and developing countries) over time.

We note that the correlation at the aggregate level for available data between currency choice for reserve holdings and currency choice for security denomination is very high. The correlation between the shares of the top five currencies across 10 years of data is 0.95 across the whole sample. The correlation taking into account fixed effects (i.e., the within correlation) is 0.55, and the rank correlation coefficient across currencies is 0.91 over the sample period 1995-2004. These correlations should not come as any great surprise as the roles of money (store of value and unit of account in this case) are highly complementary.[10] We suggest that our results are then likely to be highly relevant for reserve holdings and other uses of international currency.

Figure 1 illustrates the share of currencies employed in international security issuance over time. The figures suggest that the Euro has made a substantial dent in this dominance. The losers appear to have been the US$ and to a lesser extent the yen. As the Euro takes substantial market share from the dollar in security issuance, the historical correlations and complementarities between the different roles of money suggest that the dollar as *the* dominant world currency in general may start to fade.

[10] Indeed, for something to be thought of as money it is generally considered that it *must* perform the three functions of a) medium of exchange b) store of value and c) unit of account.

Figure 1. Currency Denomination in International Security Issuance



Source: BIS data and authors' calculations. Data aggregated across issuers and across countries. Domestic issues in domestic currency excluded. Euroland is treated as one country. Euro issues for the pre-Euro period include issues in all 12 countries replaced by the Euro.

There are several advantages of using this disaggregated data. First, we can employ panel techniques across countries and hence control for unobservable fixed effects to analyze more closely the determinants of changes in currency use. Second, we introduce variables that capture links between countries and currency use. One such link is trade, and hence we employ bilateral trade data. This captures more precisely economic connections between countries than simply openness of the issuer country. A second is whether the currency of the country is pegged and, if so, to which currency. Third, we analyze whether there are differences in the determinants of currency use between countries; in the end we show results for developed and developing countries. Fourth, we can attempt to estimate network externalities between countries' currency choice (i.e., issuers in country *x* decide to use currency *j* as issuers in country *y* also use *j*. Finally, the dataset simply has many more observations, as we can exploit the time variation over many units and hence our regressions may find statistically significant results not found in aggregate data as significance tests may lack power.

The paper is organized as follows. In the next section we describe the data and descriptive trends. In Section 3, we develop our econometric methodology, and in Section 4 we discuss the results. Section 5 concludes.

2. Data and Trends

We employ a database on international debt securities statistics from the Bank for International Settlements (BIS) that covers long-term bonds, notes and short-term money instruments issued in international markets. The BIS aggregates the detailed information on individual securities according to certain standard criteria, including currency, type of issue, sector of the immediate borrower, the country of residence, and the nationality of borrowers.

In this paper we are concerned with the use of currencies as a unit of account in international markets, and for this purpose we considered the residence criterion the most natural means of defining international issues. Accordingly, in this paper we consider issues in foreign currency (by residents and non-residents) in a given country and issues by non-residents of that country in that country's currency. As an example, consider the United States. U.S. residents' issues in currencies other than the dollar and non-U.S. residents' dollar issues are included in our database, but our database does not include a dollar issue by a company residing in the United States. We employ issues by all types of issuers (public, private and banks), but we exclude the issues of International Financial Institutions (IFIs). While IFIs are located in particular countries, they are really residents of none. We therefore decided to exclude them from the database entirely.

We have grouped international debt security issues into annual observations for each borrower country and for the five major denominating currencies, namely the U.S. Dollar, the Euro, the Pound, the Yen and the Swiss Franc. Our data cover the pre and the post-Euro period, and indeed we specifically wish to exploit the introduction of the Euro as a test of whether liquidity effects are important in currency trading. To do this, for the pre-Euro period we assigned to the Euro all the securities issued in the national currencies of the twelve countries that created the European Monetary Union (EMU), and we thus effectively Euroland as one country before and after the introduction of the single currency. Hence in the pre-Euro era we exclude the issues of all the various pre-Euro

currency issues in any country now part of Euroland country (e.g., we exclude deutschmark issues in Italy). Naturally, we also exclude any Euro issue in any Euroland country in the post-Euro era.

We use the same criteria for bilateral trade data, disregarding all trade between the countries of Euroland and aggregating trade between each Euroland country and the rest of the world. Considering Euroland as one country and the 12 currencies that were replaced by the Euro as one, we can then consider if the introduction of the Euro had significant liquidity effects.[11]

We have assembled an annual database for the amount outstanding of international securities spanning the period 1995-2004 for 64 developing countries and 42 developed countries according to the World Bank definition;[12] a full list of the countries included in our database is provided in Appendix 1. As mentioned above, these data suggest that the Euro has gained significant market share. In quantitative terms, issuance in pre-Euro currencies amounted to around 14 percent of the total. This jumped to about 20 percent in 1999, steadily increasing to reach 36 percent in 2004. This market share was gained at the expense of the dollar and the yen, with an erosion of market share of 12 percent and 10 percent, respectively, over the same period. The market share of the pound has risen, while that of the Swiss Franc has gradually declined.

Given that we have disaggregate data, we can also analyze how the distribution of currency use across countries has changed over time. In Figure 2 we plot the cumulative distribution for the Euro and for the dollar across countries for 1998 and for 2004. Consider the dollar in 1998. There were very few countries that had no dollar issues, and only 21 percent of countries issued less than 44 percent in dollars. In other words, almost 80 percent of countries issued at least 56 percent of their total issues in dollars. As can be

[11] One issue here is the role of London as a financial center. London was important as a location for the issuance of the pre-Euro currencies, as it is today for Euro issues. As the 12 countries coordinated on the Euro, London may also have become the coordinating location for Euro issuance. Our view is that, if this is the case, then there is a strong liquidity effect at work and we should include this in our data. A second view, however ,is that London is somehow special. In our regressions we introduce a UK Euro dummy, and we do find this to be significant in some specifications. However, the other results remain the same. In our view this simply separates out a London-Euro liquidity effect from the more general liquidity effect of currency denomination.

[12] The World Development Indicators (WDI) database groups countries into five categories according to the level of GNI per capita. We have grouped low and middle-income countries into the category developing countries and high-income countries (both OECD and non-OECD) into the category developed countries.

seen, this curve has shifted such that there is now more weight at lower dollar shares in international issues. In 2006, 36 percent of countries issued less than 44 percent of their total issues in dollars, as opposed to 21 percent in 1998. On the other hand, the cumulative distribution for the Euro has shifted in the opposite direction. In 1998 very few countries had large shares of Euro issuance, and for 96 percent of countries the share of Euro issuance was less than 56 percent. However, in 2004 the curve had shifted down such that only 78 percent of countries had Euro issuance equal to or lower than 56 percent of total issuance, implying that now 22 percent of countries issued at least 44 percent of their international issues in Euros.

Figure 2. Cumulative Frequencies for Share Issued in Dollars and Euros

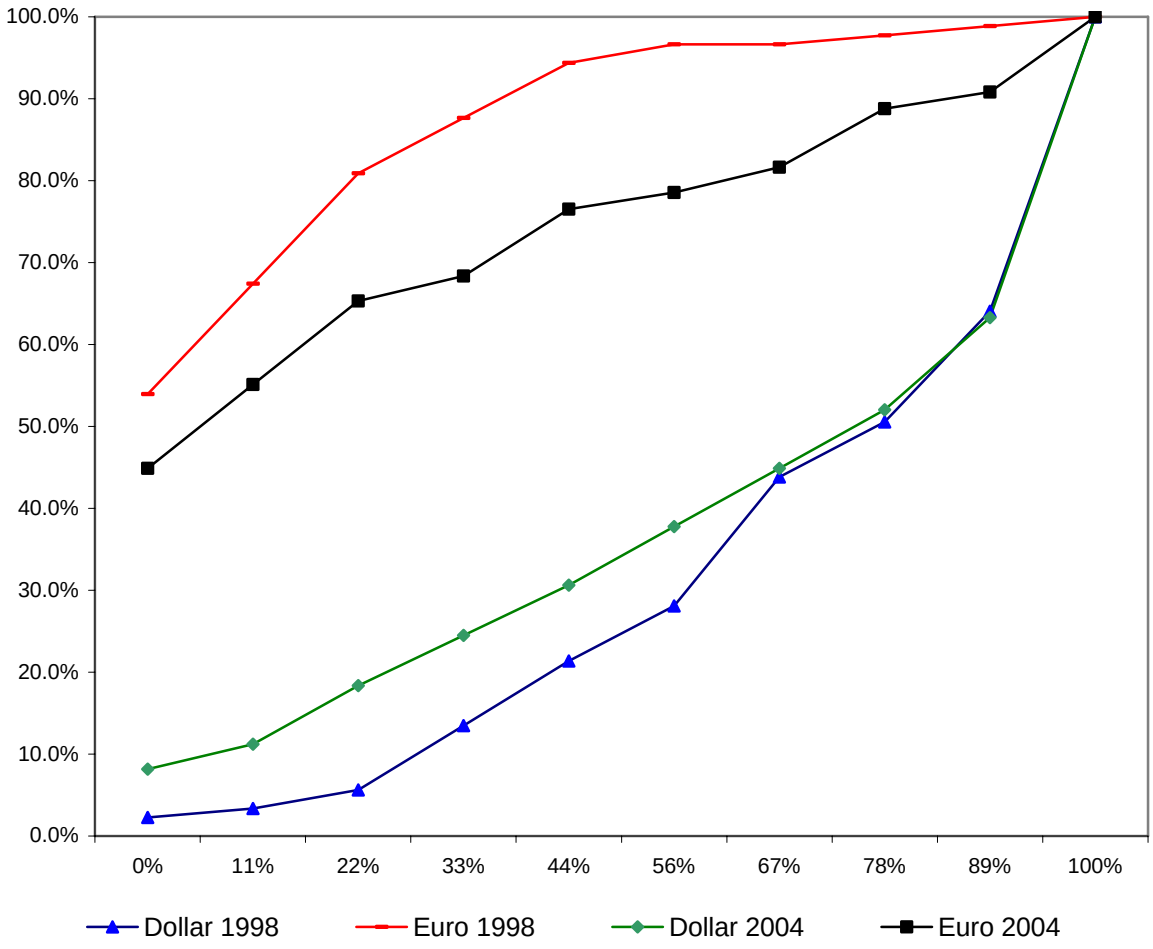
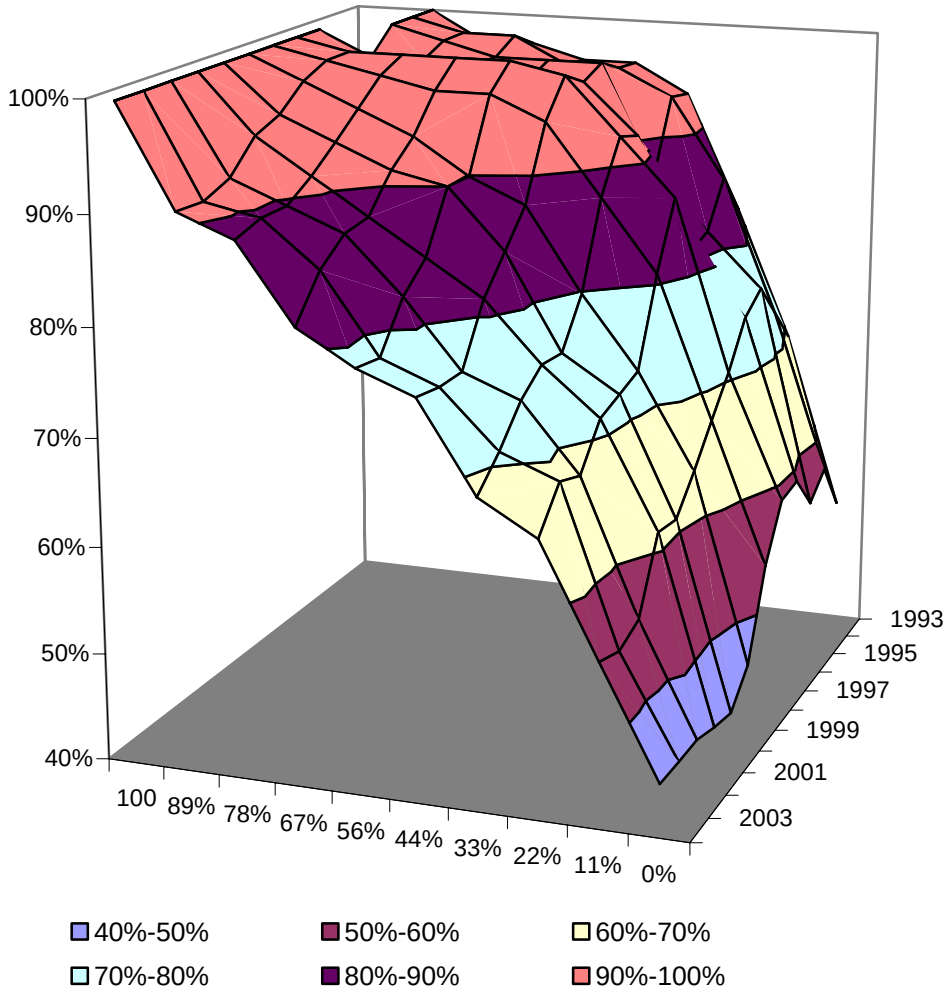


Figure 3 shows how the cumulative distribution for the Euro has been shifting over time. The figure illustrates the flattening of the cumulative distribution, implying that more countries are issuing more securities denominated in Euros. If this trend continues, at some point the curve may "tip" in the opposite direction. The movement of this curve is somewhat suggestive of the tipping phenomenon in currency choice.

Figure 3. Cumulative Distribution of Share of Issues in Euros Over Time



In addition to these aggregate trends, we also note that there are considerable differences between developed and developing countries. Since the creation of the European currency, in developed countries the Euro has gained market share in relation to the dollar, reaching rough parity in 2004. For developing countries the picture is different: the average Euro share in 2004 is roughly 26 percent, and the dollar still

maintains a dominant position, with almost 70 percent of international issues. Nevertheless, beside Eastern Europeans countries, which represent the most natural candidates for adopting the European currency, many large emerging countries are gradually shifting the composition of their liabilities towards the euro. In 2004 Tunisia, South Africa and Argentina issued around 40 percent of their liabilities in Euros, followed by Turkey and Jamaica with about 35 percent, and Peru, China, Colombia and Brazil with roughly 20 percent.

However, while descriptive statistics are of interest to consider the main trends in the data, they do not give us a clear idea of the underlying determinants of currency choice or why currency composition may be changing over time. In the next section we present an econometric analysis.

3. The Determinants of Currency Choice: An Overview of the Empirical Model

The previous literature has suggested a variety of determinants of currency use in an international setting. As the majority of this literature has used aggregate data, some variables have been used that do not completely accord with the underlying economic intuition. Our disaggregated data allow us to match several variables more precisely to the economics. In this section we discuss the underlying reasoning for the variables included in the empirical model to follow.

- ***Patterns of Output: Economic Size Matters***

As outlined in Chinn and Frankel (2005), the currency of a country that has a large share in international output has a significant natural advantage in terms of economy of scale to further the use of its currency in an international setting. We therefore employ the GDP of the country pertaining to each of the five currencies as a measure of economic size. At constant prices, the United States remains the largest economy in terms of output and trade even when Euroland is considered as one nation. In fact, even though Euroland is likely to grow in the future as the new EU members fulfill the necessary conditions for membership, and there is a possibility that the three opt-outs (the UK, Sweden and Denmark) will join, at constant prices the United States would still be the larger

economy. At current prices, however, this is not the case, and if the three opt-outs join Euroland, then Euroland would indeed surpass the size of the US.

- *Economic Ties: Trade*

If the economic ties between two countries are very significant, then it is likely that the currency of each will be well-known in the second. If a country then trades a great deal with a country that has a currency which is a candidate for a leading international currency, then it will be more likely that the first country will use the currency of the second for international security issuance and other purposes in the international sphere. Trade theory suggests that countries that are economically close to each other will trade more. Hence trade is also a good measure of economic distance. Trade may also matter for security denomination from a risk-sharing perspective. If a country's exports are to a particular destination country and denominated in that country's currency, then it may make sense to issue securities in the currency of the second currency such that if the currency in question falls in value and exports fall in value then liabilities will also fall. Consider the case of a country whose exports are to the United States and are denominated in dollars. It would then be preferable to issue securities in dollars in order to hedge an increase in the value of the liabilities with an increase in the value of exports given a dollar appreciation. We therefore believe trade captures economic ties and hence knowledge regarding the other country, economic distance may also reflect risk sharing. The variable we adopt in the regression is the share of bilateral trade between the two countries as a percentage of total trade of the issuer. Note that it is only possible to employ this variable because we have a disaggregated (ijt) database. In order to minimize reverse-causality problems we have lagged this variable by one time period.

- ***Currency Regime, Currency Anchor***

If a country pegs its exchange rate to a leading currency then that currency may also be favored for international securities issued by residents of the country. Here again, as we have disaggregated data, we can identify whether the currency is pegged to the dollar or another leading currency. It is likely that there is a dual causality here. Indeed, the fear of floating literature suggests that dollarized countries may tend to have de facto pegged currencies. More sophisticated models suggest a self-fulfilling type of equilibrium where

a monetary policy that favor currency stability against a particular currency may provoke issuance in that currency and, given substantial issuance in that currency, this may influence the monetary authorities to seek further currency stability.[13] In the simple panel regressions we use a dummy which takes a value of one if the currency is pegged to the leading currency and a zero other, so that if a currency is pegged to the Euro it is a 1 in the Euro dimension but zero for other leading currencies. We also conduct a 2SLS analysis and treat this variable as endogenous in a GMM estimation to take into account the potential endogeneity.[14] The anchor variable is essentially relevant only for developing countries, and indeed the variable is dropped for a sample of industrialized countries. This is one reason why we wish to investigate whether the specification for developed and developing countries should be different and, if so, how.

- ***Financial Variables***

A property favored by the literature on international currency choice is confidence or, perhaps more concretely, stability. While this is perhaps more obvious for asset denomination, considering both sides of the transaction, it will be difficult and certainly more expensive to issue securities in a currency that is unstable and where there is very large uncertainty regarding future valuations. Hence we suspect that this may also be important for debt denomination. To capture this effect we include inflation in our model. However, as we are analyzing the currency choice of issuing debt, we also include variables that capture the real cost of interest rate payments in the relevant currency. We use the one-year interest rate differential between the dollar and the other currencies to capture the role played by nominal cost. This is often referred to as the cost of carry. Finally, the literature on currency choice for reserves find evidence for the current value of the currency as being important. It appears countries wish to hold reserves in a "high value" currency. While we are unsure of the specific rationale for this result, nor whether it would carry over to issuance rather than reserves, we include a variable to summarize the value of each of the major currencies—namely the price of gold in that currency. We remain agnostic as to the expected sign of the coefficient.

[13] See Jeanne (2002), Chamon and Hausmann (2002) and Ize and Powell (2005).

- ***The Euro-Liquidity Effect***

Our dataset encompasses the creation of the Euro in 1999 and the first Euro notes and coins issued in 2000. We argue that the creation of the Euro was driven by wide political and economic considerations to further the project of an integrated Europe and can be considered exogenous to the currency choice of an agent outside the Eurozone. The creation of the Euro then provides an excellent natural experiment of whether liquidity effects are important for currency choice. We aggregate all the data on the currencies of the pre-Euro period that came to form the Euro and aggregate the economic data on the countries, such that Euroland is considered as one country. Therefore our data also allow us to consider directly whether the liquidity effect of merging the 12 currencies into one had a direct impact on the choice of the Euro for agents outside of the Eurozone for security denomination. We also hope our results will shed light on the potential future of the Euro as an international currency more generally.

We include individual currency dummies for each currency to pick up liquidity effects throughout the sample period. On top of these time-invariant dummies, we incorporate in our model a set of year-currency dummies. The first takes the value of one in 1999 for the Euro and zero otherwise, and the second takes the value of one in 2000 for the Euro and zero otherwise until the end of our sample. We introduce a similar set of dummies for the dollar and a final set of dummies for the remaining currencies taken altogether.

We are interested in whether the Euro year dummies are positive over and above the other variables included in the regression. This result would suggest that there was indeed a liquidity effect associated with the introduction of the Euro replacing the 12 national currencies. Moreover incorporating the Euro-year dummies allows us to see if the effect is increasing over time or suggests, for example, a shift to a new equilibrium. In the latter case, we expect a constant positive value for the Euro dummies, an initial increase of the Euro year dummies and a subsequently stabilization to a higher value. Finally introducing year dummies for the dollar and other currencies in the post-Euro

[14] We use the Levy Yeyati and Sturzenegger (2005) definition of *de facto* pegging to reflect actual policies and not stated ones. We use their variable, which also selects the reference currency (dollar, Euro, yen, etc.).

world allows us to see, if the Euro is gaining market share (over and above the other determinants) at the cost of the dollar or other currencies.

A further interesting issue is whether the Euro liquidity effect can be explained by the role of London as Europe's financial center. As London lies outside the Euro zone, Euro issues in the UK are included as international securities. Although we believe that this classification is correct, it might be countered that London was established as Europe's largest financial center before the creation of the Euro, and that any "London effect" should be netted out of the total Euro international issuance. While we do not agree with this interpretation, and our data do indeed include DM and other pre-Euro currency issues in London, we also estimate a version with a specific London Euro dummy to see if this accounts for any Euro liquidity effect. Our interpretation of this is then how much, if any, Euro liquidity effect can be accounted for by the fact that London provides economies of scale and scope for international security issuance. In our view, then, the UK Euro dummy should be included as part of any Euro liquidity effect, but it is certainly of interest to see how important it is as a share of any total Euro liquidity effect encountered.

- ***Persistence, Network Effects and Liquidity***

The literature on currency choice has stressed the role of inertia and network externalities – both of which suggest that liquidity is a crucial variable. Chinn and Frankel (2005) interpret the prolonged dominance of the pound after the First World War as an inertia effect despite the fact that England had lost its dominant economic role and its dominant role as the global center for trade and finance. Inertia suggests that there may be some stability in currency choice over time. In what follows we estimate both static and dynamic models using appropriate econometric techniques. Krugman (1984), and Aarstol (1999) suggest that network externalities are critical. An economic agent (government or private actor) is more likely to use a given currency to invoice trade or financial transactions if others are using that same currency. Under this view the intrinsic characteristics of a currency are of less importance than the actual use of the currency itself.[15] To the extent that currency choice is determined by these considerations, the

[15] Mundell (1968) considers the analogy between money and (the English) language. Frankel (1995) states, "Nobody would claim that English is particularly well-suited to be the world's *lingua franca* by virtue of its

equilibrium may be unstable and may flip from one currency to another depending on how agents coordinate. One way to capture these externalities is simply to add the currency dummies as described above.

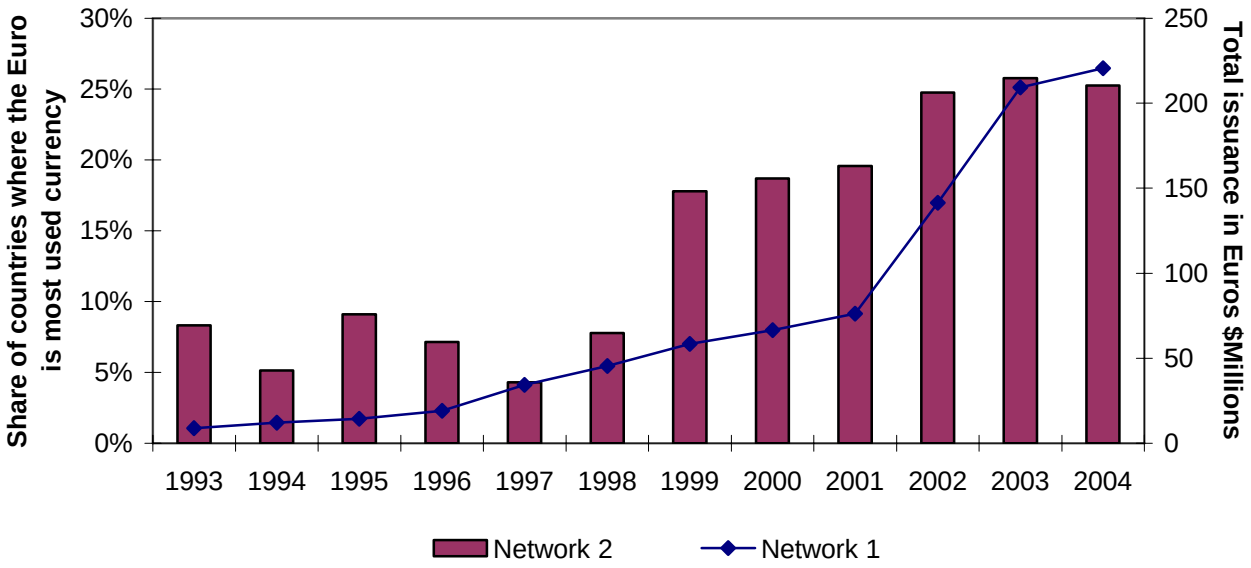
However, given our disaggregated data we are able to go further. In particular, we construct two network variables. The first (Network 1) is defined as the total issuance of all other countries in the currency in question for that year.[16] This variable then captures how much the currency is used by others. The second (Network 2) is defined as the percentage of countries in which the currency in question is the currency most used for international issuance in each year. Both variables capture network externalities that may lie behind liquidity effects in currency markets. We suggest that if we find the first to be significant then network externalities work through total issuance in a particular currency. If we find the second to characterize liquidity effects, then we suggest that network externalities have a winner-takes-all component. In what follows we will run a horse-race between them and the currency year dummies.

Figure 4 below plots the two Network variables over the period 1993-2004 for the Euro. Network 2 jumps in 1999 illustrating that a number of countries tipped to use the Euro more than any other currency for international issuance from that year. On the other hand, Network 1 for the Euro has been steadily increasing over the period.

intrinsic beauty, simplicity, or utility. Yet it is certainly the language in which citizens of different countries most often converse and do business, and increasingly so. One chooses to use a *lingua franca*, as one chooses a currency, in the belief that it is the one that others are most likely to use."

[16] We have normalized this variable by each country's GDP. The results do not change when alternative normalizations are used.

Figure 4. Network Externalities for the Euro



- ***The Econometric Model***

Our basic empirical model can then be represented by the following equation:

$$D_{ijt} = \alpha + \beta * GDP_{jt} + \delta * TRADE_{ijt} + \gamma * ANCHOR_{ijt} + \phi * NETWORK_{ijt} + \varphi * FINANCE_{jt} + EURO_{jt} + \eta_i + \sigma_j + \varepsilon_{ijt} \quad (1)$$

The dependent variable is the share of securities issued by country *i* in currency *j* at time *t* over the total amount of securities issued in all these five major currencies by each country. *TRADE* is the bilateral trade share between country *i* and the country that pertains to currency *j* (the United States, Euroland, Japan, the United Kingdom, Switzerland), *ANCHOR* is a dummy that takes a value of one for a country-currency pair if the country *j* pegs to the currency *i*. The variable $NETWORK_{ijt}$ represents a vector of network externality variables (Network 1: the issuance in currency *j* by all other countries except *i* and Network 2: the percentage of countries in which currency *j* was the most used for international issuance in each year). FINANCE is a vector containing inflation, the price of gold and the interest rate differential between the Dollar and currency *j*. And *EURO* represents the set of currency dummies grouped into Euro, Dollar and other currencies in each year starting from 1999 and taking the value of zero before that year.

The remaining two objects (η, σ) are country and currency fixed effects respectively. σ, the currency fixed effect, may be thought of as an underlying liquidity effect pertaining to each currency.

As discussed above we estimate different specifications of the above and also for different samples. In particular we estimate a model for all countries, for developed and for developing countries. We estimate a static model and also a dynamic version including the lagged dependent variable using GMM techniques. One further methodological concern is that currency shares are bounded between 0 and 1, and not all the right hand side variables are similarly constrained. One common way of taking this into account is to use a logistic transformation of the shares variables.[17] Hence we estimate a version employing a logistic transformation of the dependent variable. Finally, we estimate with different specifications of the Euro dummies (year dummies and time trend) and a version where we separate out a UK-Euro effect.

4. Estimation Results

As discussed above we estimate a static and dynamic versions of Equation 1. We choose to discuss the results of the static models first and then the dynamic models.

4.1 Static Models

Table 1 displays the results of the estimation of equation (1) by OLS across three different samples: all countries, developing and developed countries. All regressions include fixed currency and country effects. The dependent variable is the currency share. When we consider all countries (column 1), the results are somewhat mixed. Bilateral trade, economic size and network effects appear positive and strongly significant; financial variables, however, are not significant.

However, when we split the sample into developing and developed countries a clearer pattern emerges. For developing countries (column 2), we find that bilateral trade is a significant determinant for currency choice, as is the currency anchor variable and network externalities. In the case of developed countries (column 3) trade appears to

[17] Logistic=log(share/(1-share)). Among the explanatory variables, bilateral trade and GDP are expressed as shares.

matter less and anchor and Network 1 are dropped, but the financial variables are now statistically significant. In particular, the estimated coefficient of the interest rate differential shows countries issue more in currencies with a lower cost of carry. Economic size appears to be equally important for both subsamples. Hence, the determinants of currency choice contain similarities but also differ between developed and developing countries and in a fairly intuitive way.

Table 1. General Models for Currency Shares: OLS Estimates

Sample	(1) All Countries	(2) Developing Countries	(3) Developed Countries	(4) Developing Countries	(5) Developed Countries
Trade (% Total trade) (t-1)	0.517	0.528	0.496	0.529	0.497
	(7.16)***	(6.45)***	(3.74)***	(6.45)***	(3.74)***
Nominal Anchor (currency peg)	0.158	0.171	0.056	0.171	0.057
	(2.78)***	(2.47)**	(0.47)	(2.46)**	(0.47)
Gdp of the currency country(% Total Gdp)	1.308	1.568	0.674	0.538	0.253
	(4.15)***	(3.59)***	(1.67)	(1.37)	(0.49)
Network Externalities Variables					
Issuance by other countries (% country Gdp)	0.055	0.045	0.552	0.045	0.549
	(2.57)**	(2.07)**	(1.63)	(2.06)**	(1.62)
Share of countries that tipped				0.971	0.396
				(2.47)**	(2.09)**
Financial Variables					
Interest rate differential	-0.321	-0.615	0.387	-0.408	0.481
	(0.91)	(1.20)	(1.82)*	(0.89)	(2.13)**
Inflation	0.004	0.004	0.005	0.002	0.004
	(1.36)	(0.96)	(1.97)*	(0.41)	(1.66)
Price of Gold	0.001	0.002	-0.000	-0.000	-0.001
	(1.51)	(1.78)*	(0.43)	(0.14)	(1.30)
London financial hub	0.133		0.081		0.081
	(3.14)***		(1.07)		(1.07)
Euro Effect dummies					
Euro 1999	0.095	0.117	0.047	-0.032	-0.014
	(3.96)***	(3.79)***	(1.30)	(0.54)	(0.35)
Euro 2000	0.158	0.190	0.083	0.004	0.007
	(4.98)***	(4.70)***	(1.60)	(0.06)	(0.11)
Euro 2001	0.176	0.184	0.149	-0.004	0.072
	(5.12)***	(4.14)***	(2.66)**	(0.05)	(1.16)
Euro 2002	0.171	0.159	0.186	-0.068	0.094
	(4.91)***	(3.59)***	(3.02)***	(0.63)	(1.38)
Euro 2003	0.151	0.135	0.181	-0.073	0.096
	(4.19)***	(2.99)***	(2.95)***	(0.69)	(1.51)
Euro 2004	0.154	0.136	0.195	-0.021	0.131
	(4.19)***	(2.89)***	(3.46)***	(0.23)	(2.30)**
Dollar 1999	-0.048	-0.055	-0.045	0.034	-0.009
	(2.35)**	(2.06)**	(1.49)	(0.71)	(0.29)
Dollar 2000	-0.088	-0.106	-0.059	0.017	-0.010
	(3.71)***	(3.47)***	(1.69)	(0.29)	(0.23)
Dollar 2001	-0.120	-0.136	-0.098	0.016	-0.036
	(4.10)***	(3.57)***	(2.23)**	(0.24)	(0.74)
Dollar 2002	-0.141	-0.151	-0.134	0.050	-0.053
	(4.63)***	(3.86)***	(2.82)**	(0.56)	(0.99)
Dollar 2003	-0.112	-0.113	-0.132	0.071	-0.057
	(3.43)***	(2.77)***	(2.51)**	(0.79)	(1.02)
Dollar 2004	-0.118	-0.111	-0.176	0.027	-0.120
	(3.42)***	(2.54)**	(3.35)***	(0.34)	(2.31)**
Other currencies 1999	-0.003	-0.001	-0.008	0.004	-0.005
	(0.91)	(0.30)	(1.19)	(0.92)	(0.86)
Other currencies 2000	-0.018	-0.016	-0.024	-0.003	-0.019
	(3.71)***	(2.56)**	(3.13)***	(0.41)	(2.32)**
Other currencies 2001	-0.017	-0.016	-0.021	-0.007	-0.017
	(4.65)***	(3.60)***	(2.87)***	(2.01)**	(2.28)**
Other currencies 2002	-0.015	-0.015	-0.014	-0.006	-0.010
	(2.04)**	(1.53)	(1.58)	(0.75)	(1.06)
Other currencies 2003	-0.023	-0.025	-0.019	-0.013	-0.014
	(2.95)***	(2.31)**	(2.08)*	(1.73)*	(1.46)
Other currencies 2004	-0.030	-0.035	-0.022	-0.020	-0.016
	(3.42)***	(2.81)***	(2.14)**	(2.43)**	(1.44)
Constant	0.011	-0.076	0.212	-0.480	0.048
	(0.08)	(0.40)	(1.17)	(1.56)	(0.27)
Observations	3401	2415	986	2415	986
Number of countries	80	59	21	59	21
R-squared	0.72	0.73	0.75	0.73	0.75

Robust t statistics in parentheses
Currency dummies included but not reported
* significant at 10%; ** significant at 5%; *** significant at 1%

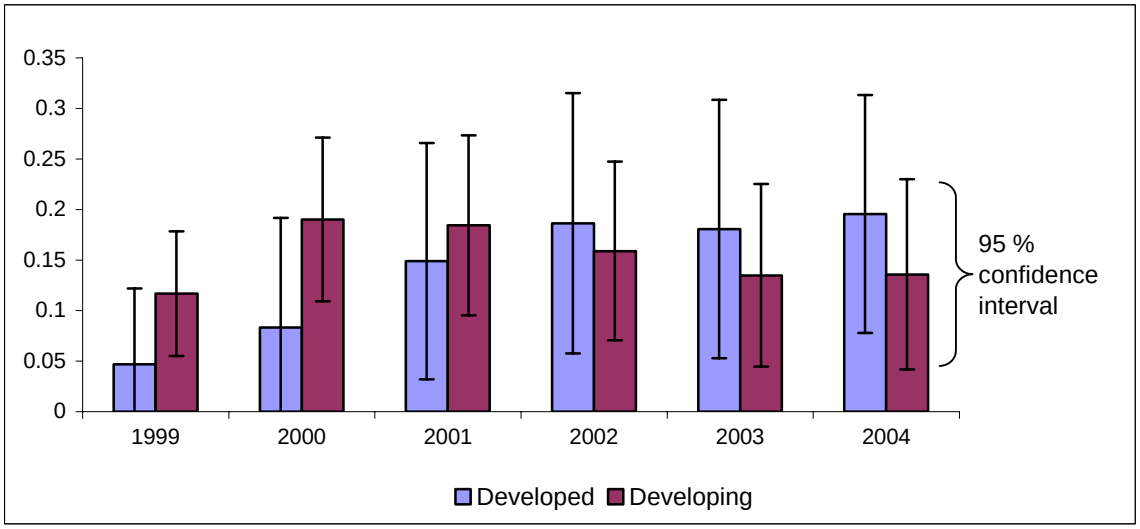
Moreover, in the first three columns the Euro-time dummies are positive and strongly significant whereas the corresponding Dollar-time dummies are negative and significant for both developed and developing countries. This result gives strong support to the hypothesis that liquidity matters for currency choice.. Taken jointly, the time dummies for the other currencies do not appear statistically significant. Figure 5 displays estimated coefficients with 95 percent confidence intervals of Euro and Dollar dummies for the period 1999-2004 for both sub samples. The emerging pattern differs considerably between developed and developing countries: controlling for other determinants, the Euro time dummies exhibit a hump-shape for developing countries with a peak in 2000 and a steady decline thereafter. However, in the case of developed countries the effect appears much more persistent with little evidence of a hump in this sample. The dollar time dummies follow precisely the opposite pattern. We interpret these findings as evidence that the creation of the Euro has induced a sudden and possibly stable change in currency denomination for developed countries whereas for developing countries the observed increase in liquidity seems to be a more temporary phenomenon.

In columns 1 and 3 we include a separate U.K. Euro effect dummy in order to test whether London has helped to concentrate Euro liquidity. The results suggest that for all countries the dummy picks up some of the liquidity effect in Euro issuance in London, but if we consider only developed countries the London location hub effect is not significant. Our interpretation is that London plays a role in Euro issuance that is larger than U.K. fundamentals would predict relative to all countries, but this effect is not significant relative to only developed countries. In any event, it is clear that any special role of London's financial markets does not account for the overall liquidity effects that we find for the Euro.

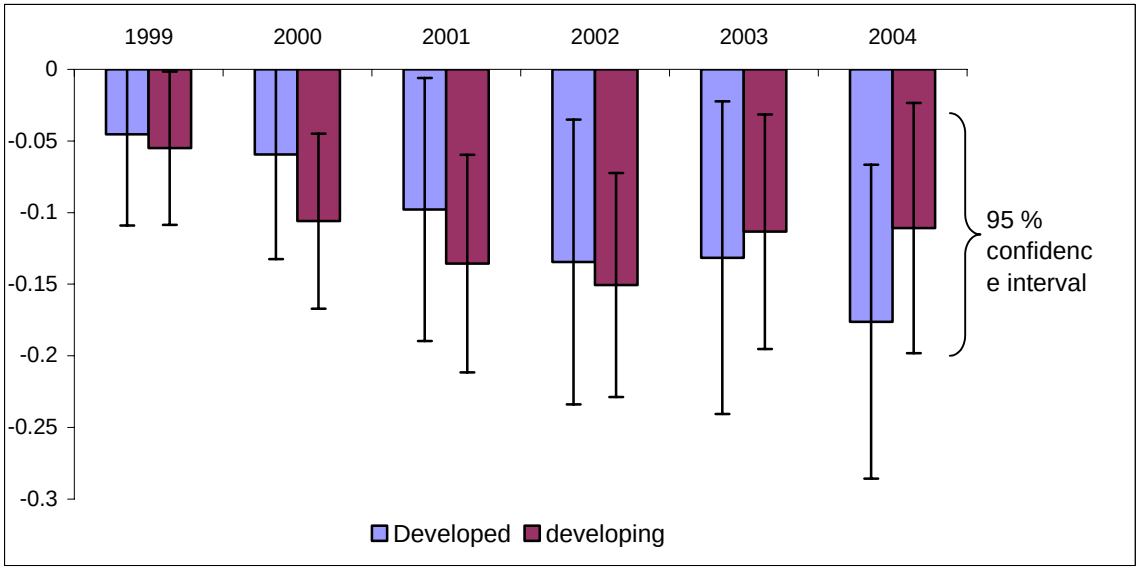
In columns 4-5 we introduce in the specification the second network variable, Network 2 (namely the share of countries that tipped toward using one currency in each year). This variable appears positive and strongly significant in both sub-samples and indeed when included, the Euro-time and Dollar-time dummies lose significance. Hence we suggest that this variable captures well the liquidity effects associated with the creation of the Euro. This suggests that network externalities are a non-linear or winner takes all phenomena.

Figure 5. Estimated Coefficients for Euro Liquidity Effects

A. Euro dummies



B. Dollar dummies



Appendix 1 displays results of the same models of Table 1 after applying the logistic transformation of the shares variables; the main results are unchanged. It is interesting to compare our results here to those of Chinn and Frankel, who argue in favor of the logistic transformation. We would claim two differences, first that we employ disaggregated data and then, linked to that, we include in our regressions specific terms in the static model to capture externalities and dummies that capture the Euro liquidity effect for different currencies in specific years. We suspect that our specification captures

the non-linearities that sway Chinn and Frankel towards the use of the logistic transformation. In other words, with aggregate data and hence without the possibility of specifying those effects, the logistic transformation may have been needed. As the results are very similar, we favor the simpler linear representation

Table 2 depicts a parsimonious representation for both developing (Columns 1-2) and developed countries (Columns 3) of the general model displayed in Table 1 obtained by dropping the non-significant variables. As we drop the liquidity time dummies, we introduce standard time dummies in the specification in order to control for common trends. Column 1 shows OLS estimates, and the results are consistent with the previous ones in terms of both magnitude and significance of the explanatory variables. All variables enter significantly and with the expected sign and, taken jointly, they explain 73 percent of the overall variation in currency shares for developing countries.

One concern with our specification is the reverse-causality critique that may apply for the nominal anchor variable: currency denomination of external debt may in fact be determined as a consequence rather than a cause of the exchange rate regime or, alternatively, the two decisions might be simultaneously determined. In either case, our OLS results would be biased and inconsistent. We have then adopted a two-stage approach for the baseline specification of Column 1. In the first step, we run a probit selection-equation for the choice of the country to anchor its currency to one of our five currencies on all the regressors included in equation (1) plus additional controls that may be assumed exogenous with respect to currency choice. The first is the degree of domestic liability dollarization measured as the ratio of dollar deposits over total bank deposits. We believe this variable represents a good instrument as the degree of dollarization, while explaining exchange rate regime, is unlikely to affect directly currency denomination of international securities. We also include three financial variables that proxy the confidence in the value of the currency and the cost of carry. As shown in Table 1, these factors do not seem to matter for developing country currency choice, but they are good candidates for explaining exchange rate regimes. We then take the predicted value from this first stage and use it as an instrument for the nominal

anchor. The corresponding results of this two-stage procedure, displayed in Column 2,[18] are consistent with the previous OLS model. The nominal anchor variable is positive and significant, confirming the importance of monetary and financial ties for currency choice, even controlling for potential endogeneity of this variable.

Column 3 shows a parsimonious representation of the general model of Table 1 for developed countries. We have dropped the nominal anchor variable, as it did not appear to matter for this subsample of countries, therefore endogeneity is not an issue here. The results change little, although some variables are now more precisely estimated (lower standard errors) and the standard error of the equation improves. We note in particular that monetary and financial variables that measure confidence in the value of the currency and cost of carry are now significant and with the expected signs. Our parsimonious model explains 61 percent of the overall variation in currency shares for developed countries.

[18] Table 2 displays also the coefficient and relative T-stat of the first stage in which nominal anchor has been regressed on its relative fitted value and all the other controls. As can be seen, the estimated coefficient is around 0.5 and appears strongly significant. Full first stage results are available upon request.

Table 2. Parsimonious Models for Currency Shares

Model	OLS	2SLS	OLS
	(1)	(2)	(3)
Sample	Developing Countries	Developing Countries	Developed Countries
Trade (% Total trade)	0.528	0.214	0.289
	(6.45)***	(0.97)	(1.87)*
Nominal Anchor (currency peg)	0.172	1.668	
	(2.49)**	(1.81)*	
Gdp of the currency country(% Total Gdp)	0.659	0.263	
	(1.77)*	(0.66)	
Network Externalities Variables			
Issuance by other countries (% country Gdp)	0.047	-0.060	
	(2.24)**	(0.88)	
Share of countries that tipped	0.758	0.887	0.677
	(4.03)***	(4.30)***	(3.11)***
Financial Variables			
Interest rate differential			1.000
			(1.87)*
Inflation			0.016
			(3.09)***
Price of Gold			-0.004
			(2.34)**
Constant	-0.340	-0.537	-0.044
	(1.57)	(1.65)*	(0.20)
First stage result: fitted nominal anchor on actual anchor		0.506	
		(3.51)***	
Observations	2415	2030	1276
Number of countries	59	53	28
R-squared	0.73		0.61

Robust t statistics in parentheses
Currency dummies included but not reported
* significant at 10%; ** significant at 5%; *** significant at 1%

The results support two main conclusions. First, there are a set of factors that determine currency choice, although that set differs between developed and developing countries. Rich countries tend to denominate their liabilities in one currency largely depending on the cost of carry, whereas for developing countries, trade and whether the exchange rate is fixed to a currency are also relevant. Furthermore, network effects are significant in both sub-samples, and they appear to explain the observed liquidity effects associated with the creation of the European currency.

4.2 Dynamic Models

As discussed, the literature has also suggested that there is considerable inertia in currency choice. Chinn and Frankel (2005) estimate their currency choice model for reserves with a lagged endogenous variable and OLS and find very high persistence. The main methodological caveat of estimating a dynamic model with OLS is that the fixed effect estimator produces inconsistent estimates. An alternative is to employ a dynamic panel GMM estimator.[19] This addresses both the potential problem of the endogeneity of our anchor explanatory variable (through the use of instruments and corresponding moment restrictions) and implicitly incorporates bilateral (country-currency) fixed effects.

Table 3 displays the GMM estimation results for the dynamic version of equation (1) for both developed and developing countries. As expected, the lagged endogenous variable enters significantly, and its magnitude reveals a high degree of persistence. Many of the results referred to above remain unchanged. In particular trade appears to be an important determinant of currency choice, and so is the network externalities variable, reflecting the share of countries that tipped to a currency in each year. This confirms that, even taking into account persistence, the network externalities variable is a significant determinant of currency choice and that the Euro is gaining market share at the cost of the dollar mainly through this channel.

[19] Within the range of GMM estimators for dynamic panel models, we prefer the Blundell-Bond system estimator, which stacks the levels and the difference equations together in a system, precisely because it allows us to incorporate fixed effects even though we also have time-invariant regressors, but also when compared to say the Arellano-Bond estimator, which considers only the difference equation, the Blundell-Bond estimator appears to do better in terms of efficiency and less bias when the series are persistent. See Bond et al. (2001).

Table 3. Dynamic Models for Currency Shares: GMM Estimator

Sample	(1) Developing Countries	(2) Developed Countries
Lagged dep var	0.720	0.854
	(21.33)***	(23.26)***
Trade (% Total trade) (t-1)	0.372	0.179
	(5.05)***	(2.01)**
Nominal Anchor (currency peg)	-0.035	
	(1.06)	
Gdp of the currency country(% Total Gdp)	0.019	
	(0.19)	
Network Externalities Variables		
Issuance by other countries (% country Gdp)	0.011	
	(0.62)	
Tipping variable	0.266	0.159
	(3.95)***	(3.14)***
Financial Variables		
Interest rate differential		-0.008
		(0.04)
Inflation		0.005
		(2.01)**
Price of Gold		0.000
		(0.27)
London financial hub		0.025
		(1.24)
Constant	-0.120	-0.110
	(1.90)*	(2.66)***
Observations	2410	1281
Number of countries	295	136
Test of overidentify restrictions	0.99	0.99
Arellano-Bond test for AR(1) in first differences	0.00	0.00
Arellano-Bond test for AR(2) in first differences	0.35	0.26

z statistics in parentheses
Currency dummies included but not reported
* significant at 10%; ** significant at 5%; *** significant at 1%

5. Conclusions

In this paper, we have estimated a model for currency choice in an international setting, using disaggregated data on security issuance. We have found that some determinants suggest stability in currency choice. For developing countries these include trade and if the currency regime is an anchor to a particular international currency this also favors the use of that currency for security issuance. In the case of developed countries, there appear to be fewer determinants that add stability as the anchor is dropped and trade is insignificant. The cost of carry is an important variable and so, to the extent that interest rate differentials are persistent, this suggests stability over time. A second reason to expect stability is persistence, and in the dynamic models we do find strong evidence for persistence for both developed and developing countries.

We noted remarkable differences in both actual currency composition and the determinants between developed and developing countries. While in the former, the Euro has already established itself as a leading international currency and a real competitor for the dollar, it remains an open question whether the European currency will continue to gain ground vis-à-vis the dollar in the developing world

However, we also find a very significant Euro liquidity effect on top of other determinants in both the static and the dynamic empirical representation. These are most clearly visible in the Euro time dummies that show that the liquidity effect of the creation of the Euro is significant, but we find a different pattern for developed and developing countries. For developed countries the creation of the Euro in 1999 seems to have induced a permanent shift in the currency denomination of developed countries in favor of the European currency. On the other hand, the observed hump-shape in the euro liquidity dummies for developing countries highlights that the initial boost in liquidity seems to fade over time and stresses the temporary nature of this phenomenon. In each year of our sample since the introduction of the Euro, the new currency has gained market share at the expense of the dollar, controlling for other determinants. We find that we can characterize this boost in liquidity by the presence of network externalities in currency use. Moreover our characterization of the relevant network effect suggests a non-linear or winner-take-all type of phenomenon. In turn, this suggests instability in currency choices and hence the possibility of sudden changes and multiple equilibria.

This result is interesting for at least two reasons. First, it confirms that liquidity effects are important for currency use. The creation of the Euro implied the coordination of 12 nations on one currency, immediately giving a boost to liquidity; this translated into a greater use of that currency in the rest of the world, as well in both developed and developing countries. That in turn produced a positive externality that enhanced the international use of the new currency. Second, the results suggest that the Euro is posing a threat to the domination of the dollar as the currency most used for international security issuance. While the liquidity effect appears to be declining for developing countries, this is not the case for developed countries, at least until the end of our sample. Moreover, if historical correlations are maintained, then the Euro may also threaten the total dominance of the dollar for reserve holdings as well. This would carry multiple implications for both Euroland and U.S. authorities.

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Appendix 1. List of Countries Included in the Analysis

Developed countries

Aruba
Australia
Austria
Bahamas, The
Bahrain, Kingdom of
Belgium
Bermuda
Canada
Cayman Islands
China,P.R.:Hong Kong
Cyprus
Denmark
Finland
France
French Polynesia
Germany
Greece
Iceland
Ireland
Israel
Italy
Japan
Korea
Kuwait
Luxembourg
Malta
Netherlands
Netherlands Antilles
New Zealand
Norway
Portugal
Qatar
Saudi Arabia
Singapore
Slovenia
Spain
Sweden
Switzerland
United Arab Emirates
United Kingdom
United States

Developing countries

Algeria
Argentina
Barbados
Belize
Bolivia
Brazil
Bulgaria
Chile
China,P.R.: Mainland
Colombia
Congo, Dem. Rep. of
Costa Rica
Croatia
Cuba
Czech Republic
Dominican Republic
Ecuador
Egypt
El Salvador
Estonia
Grenada
Guatemala
Haiti
Hungary
India
Indonesia
Iran, I.R. of
Jamaica
Jordan
Kazakhstan
Kenya
Latvia
Lebanon
Liberia
Lithuania
Malaysia
Mauritius
Mexico
Moldova
Mongolia
Morocco
Nicaragua
Oman
Pakistan
Panama
Papua New
Peru
Philippines
Poland
Romania
Russia
Slovak Rep
South Afric
Sri Lanka
Suriname
Thailand
Trinidad an
Tunisia
Turkey
Ukraine
Uruguay
Venezuela,
Vietnam
Zimbabwe

Appendix 2. General Models across Samples, OLS Estimates with Country and Currency Fixed Effects (Dependent variable is Logit)

Sample	(1) All Countries	(2) Developing Countries	(3) Developed Countries	(4) Developing Countries	(5) Developed Countries
Trade (% Total trade) (t-1)	1.054	1.155	0.692	1.157	0.695
	(3.86)***	(3.80)***	(1.70)	(3.80)***	(1.71)
Nominal Anchor (currency peg)	3.606	4.196	1.817	1.439	3.773
	(4.20)***	(3.53)***	(1.68)	(1.34)	(2.20)**
Gdp of the currency country(% Total Gdp)	2.925	2.986	-0.017	2.982	-0.031
	(2.12)**	(1.75)*	(0.01)	(1.74)*	(0.01)
Network Externalities Variables					
Issuance by other countries (% country Gdp)	2.178	1.381	30.504	1.369	30.659
	(3.29)***	(2.69)***	(4.72)***	(2.69)***	(4.77)***
Share of countries that tipped				22.035	-15.708
				(2.38)**	(1.99)*
Financial Variables					
Interest rate differential	-12.300	-19.003	5.992	-13.373	1.701
	(1.02)	(1.11)	(0.66)	(0.83)	(0.20)
Inflation	0.041	0.059	0.084	0.038	0.088
	(0.40)	(0.46)	(0.51)	(0.29)	(0.54)
Price of Gold	0.048	0.065	0.016	-0.007	0.068
	(1.57)	(1.56)	(0.44)	(0.18)	(1.80)*
London financial hub	0.427		0.139		0.140
	(0.62)		(0.12)		(0.12)
Euro Effect dummies					
Euro 1999	2.184	2.814	0.661	-0.335	2.911
	(3.79)***	(3.88)***	(0.76)	(0.27)	(1.79)*
Euro 2000	2.721	3.381	0.898	-0.345	3.572
	(4.15)***	(4.04)***	(0.96)	(0.22)	(1.86)*
Euro 2001	3.175	3.445	2.008	-0.359	4.727
	(5.33)***	(4.75)***	(1.71)	(0.22)	(2.21)**
Euro 2002	3.181	3.380	1.924	-1.430	5.357
	(4.41)***	(3.75)***	(1.43)	(0.65)	(2.04)*
Euro 2003	2.511	2.811	1.117	-1.889	4.472
	(3.24)***	(2.94)***	(0.79)	(0.84)	(1.71)
Euro 2004	2.634	3.028	1.057	-0.639	3.677
	(3.32)***	(3.02)***	(0.75)	(0.34)	(1.64)
Dollar 1999	-0.236	-0.325	-0.739	1.289	-1.852
	(0.62)	(0.63)	(1.89)*	(1.29)	(2.07)*
Dollar 2000	-0.752	-0.999	-1.070	1.089	-2.508
	(1.66)	(1.61)	(2.68)**	(0.91)	(2.42)**
Dollar 2001	-1.049	-1.136	-1.852	1.413	-3.625
	(2.26)**	(1.95)*	(2.85)***	(1.09)	(2.90)***
Dollar 2002	-1.553	-1.662	-2.045	2.061	-4.669
	(2.60)**	(2.20)**	(2.61)**	(1.13)	(2.70)**
Dollar 2003	-0.815	-0.978	-1.390	2.711	-3.980
	(1.22)	(1.18)	(1.32)	(1.43)	(2.16)**
Dollar 2004	-1.292	-1.356	-2.870	1.419	-4.808
	(1.89)*	(1.55)	(3.07)***	(0.90)	(3.57)***
Other currencies 1999	0.008	-0.046	0.270	0.039	0.204
	(0.04)	(0.24)	(0.56)	(0.19)	(0.43)
Other currencies 2000	-0.527	-0.505	-0.517	-0.368	-0.615
	(1.85)*	(2.04)**	(0.64)	(1.46)	(0.74)
Other currencies 2001	-0.454	-0.577	0.056	-0.396	-0.085
	(1.99)*	(2.22)**	(0.12)	(1.57)	(0.20)
Other currencies 2002	-0.527	-0.470	-0.522	-0.154	-0.766
	(1.31)	(1.06)	(0.58)	(0.37)	(0.90)
Other currencies 2003	-1.034	-1.215	-0.573	-0.790	-0.890
	(2.55)**	(2.64)**	(0.66)	(1.96)*	(1.02)
Other currencies 2004	-1.103	-1.347	-0.525	-0.807	-0.922
	(2.14)**	(2.16)**	(0.56)	(1.49)	(1.00)
Constant	4.847	5.797	1.812	-13.678	15.683
	(5.10)***	(5.21)***	(1.34)	(1.74)*	(2.08)*
Observations	3401	2415	986	2415	986
Number of id_2	80	59	21	59	21
R-squared	0.50	0.56	0.40	0.56	0.40

Robust t statistics in parentheses
Currency dummies included but not reported
* significant at 10%; ** significant at 5%; *** significant at 1%