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The Rise of the Redback: Evaluating the Prospects for Renminbi Use in Invoicing

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One of the key puzzles in international finance is why certain currencies become international currencies. "International currency" status confers both substantial privileges and burdens, although conventional wisdom places greater weight on the former. But what, exactly, is an international currency? Table 5-1 summarizes the various functions of an international currency.

The table shows that there are several dimensions to consider in terms of the degree to which a currency fulfills the characterization of being international. Money has many roles, of relevance to different actors. Clearly, an international currency can fill some roles of money while not fulfilling others.

With the rapid economic ascent of the People's Republic of China (PRC)—its sheer economic size and outsized role in trade flows—it is entirely natural that questions should arise regarding the evolution of the PRC's currency, the renminbi (RMB). The RMB's potential for internationalization has been actively debated, but the issue has remained largely speculative, because the RMB remained unconvertible, and capital controls were in place. Recently, however, policy declarations and measures aimed at increasing the use of the RMB in trade invoicing and other transactions have led to a significant increase in its use in international markets, making the prospects for an internationalized RMB look increasingly less aspirational and more concrete.

Still, progress is uneven, with current initiatives focused on the medium-of-exchange dimension. As of the last quarter of 2012, 14 percent of the PRC's trade

Table 5-1. *Roles of an International Currency*

Function of money	Governments	Private actors
Store of value	International reserve holdings	Currency substitution (private dollarization)
Medium of exchange	Vehicle currency for foreign exchange intervention	Invoicing trade and financial transactions
Unit of account	Anchor for pegging local currency	Denominating trade and financial transactions

Source: Adapted from Kenen (1983).

was settled in yuan—a significant increase from zero in 2009. As of the beginning of 2013, $1.9 billion of yuan-denominated bonds, so-called dim sum bonds, were in circulation. In 2012, the PRC accounted for 27 percent of the world's money supply, larger than its GDP (in purchasing price parity) share of 8 percent. The PRC's borders are no longer sealed.

In contrast, in the dimension of use as a store of value, the rise of the RMB, sometimes called the "redback," is a potential challenge to the current international monetary system, which is heavily dependent on the greenback—the U.S. dollar. About 60 percent of global foreign exchange reserves are held in U.S. dollars, although the United States accounts for 20 percent of global output, 11 percent of trade, and 30 percent of financial assets trade.

Many argue that such a dollar-centric international monetary system creates an unstable environment for the world economy by providing the United States with privileged access to funds ("exorbitant privilege"), while constraining developing economies with the opposite effect ("original sin," the inability to issue sovereign debt in their own currency). As Eichengreen (2011) argues, a new international monetary system with multiple reserve currencies—the dollar, the euro, and the RMB—might be more stable than the current unipolar system. That is because the loss of exorbitant privilege by the United States would discipline the nation's public finance.

The conventional wisdom holds that the arrival of such a multipolar international currency system is a long way off, although there are dissenters. Since the RMB is the only viable competitor among emerging market economies (Chinn 2012), the issue of internationalization of the RMB is now a global issue. Nonetheless, because most observers believe that major reserve currency status for the RMB is a long way off, we focus here particularly on the private actor role of an international reserve currency: its use in trade invoicing.[1]

Whether and how fast the RMB will become an international currency depends on some key points. First, it depends on how soon and in what ways the PRC

1. Use of the RMB seems to have progressed more rapidly as an anchor, either formally or informally, than it has along other dimensions. See Subramanian and Kessler (2012) and, for a critique, Spencer (2013).

invoicing for trade, although quite limited, are not as limited as the data for currency denomination for securities transactions, and therefore allow us to conduct a reasonable empirical analysis. Second, currency invoicing in trade is an important first step for a currency to become an international currency. Therefore, it is appropriate for us to forecast for the foreseeable future with more reasonable scenario analysis.

In this chapter we first survey the literature regarding capital account liberalization and openness, and its impact on reserve holding, asset denomination, and currency invoicing in international trade. We then empirically investigate the determinants of currency invoicing with special focus on capital account liberalization. Armed with estimates of the important relationships, we investigate the various scenarios for RMB use in currency invoicing based upon differing rates of progress in capital account liberalization.

We attempt to answer the following questions:

1. What factors, including capital account liberalization, affect the use of currencies in terms of invoicing in international trade?

2. How does the RMB's recent experience differ from that of other currencies in terms of their use for invoicing exports?

3. How would foreseeable capital account liberalization implemented by the PRC affect the level of use of the RMB in international trade?

4. What can we expect for the internationalization of the RMB once the PRC furthers financial liberalization efforts? Would the RMB proceed smoothly toward the status of international currency, along other dimensions?

Theory and Evidence on the Link between Capital Account Openness and the Use of a Currency in International Financial Markets

Capital Account Openness and Its Impact on Reserve Holding, Asset Denomination

The literature on developed country reserve currencies suggests that the increasing relative economic mass of key emerging market economies will lead to a greater role for their respective currencies. However, if previous empirical findings are relevant, the key factor will not be GDP alone but rather, financial market development and openness to the rest of the world (Chinn and Frankel 2007, 2008).

Financial development involves the creation of institutions that are able to funnel large amounts of capital from savers to borrowers in an efficient manner. Empirical work suggests that institutional development (rule of law, a low degree of corruption) as well as having open capital markets is important (Chinn and Ito 2006). To the extent that the largest emerging-market countries with currencies that are candidates for reserve status have relatively closed and underdeveloped financial markets, the path forward is unclear.

As long as countries restrict capital flows in a heavy-handed fashion and limit convertibility, use of their respective currencies in international transactions, including financial transactions, is unlikely to increase rapidly. Financial repression—a state where financial markets do not function at their full capacities because of government's active interventions and regulatory controls—in a currency's issuer country would also limit the desirability of the currency in international transactions.

To make these points concrete, suppose that many of the reserves are held in the form of government bonds. If it is difficult to purchase and sell government bonds across borders (and especially if there is no secondary market for the bonds), and agents are worried about the default risk associated with the bonds, then the currency those government bonds are denominated in will not be a good candidate for a reserve currency.

The nature of policy preferences is key to determining the pace of developments. In particular, policymaking officials will determine when and how much they are willing to surrender the policy autonomy associated with capital controls and repressed financial systems in favor a more internationalized currency.[5]

Theory and Evidence of Trade Invoicing

The literature on trade invoicing goes back to the 1970s when the eurodollar markets started appearing and cross-border capital transactions became more active in the advanced economies despite tight capital controls under the Bretton Woods system. Especially in Europe, the absolute dominance of the dollar in international trade and finance ended, and the pound sterling, the French franc, and the deutsche mark started becoming the major currencies used in invoicing or for settling international trade transactions.

Grassman (1973) found that a much larger portion of Swedish exports is invoiced in Swedish kronor than are imports, and argued that exporters tended to invoice in their own currency because exporters usually have more bargaining power (so-called Grassman's law). Krugman (1984) supported this idea but argued that the relative sizes of trading partners matter: when an importer is larger than an exporter, Grassman's law does not apply.

As the Bretton Woods system broke down in 1973, the uncertainty and the risk arising from exchange rate movements became issues to consider in determining which currency to use for invoicing international trade transactions. Which to use

5. In the context of the "impossible trinity" or the "trilemma," even if a country removes capital controls, it could still retain monetary autonomy as long as it allows flexible movements in its currency's exchange rates (Aizenman, Chinn, and Ito 2013; Obstfeld, Shambaugh, and Taylor 2005). However, if its currency becomes international, its use outside its borders increases, which means the amount of currency out of the reach of the monetary authority increases and the country loses its grip on monetary policy—as occurred with the U.S. dollar (Goldberg 2010).

for trade invoicing essentially comes down to producer currency pricing, pricing a product in the producer's currency, versus "pricing to the market," pricing a product in the local currency (Krugman 1987; Dornbusch 1987). This is basically a question of whether to avoid demand uncertainty or price uncertainty. Producers who price their products in their home country's currency do not face any price uncertainty, but the demand for the product could be uncertain since the price is subject to exchange rate fluctuations. Conversely, if they price their products in the local currency of the export destination, demand uncertainty can be minimized but the price or the revenue of the product can be uncertain.

Thus, not only bargaining power but also exchange rate volatility matters for trade invoicing. The latter also raises the issue of transaction costs of a currency as another factor that affects the choice of invoicing currency. McKinnon (1979) focused on the impact of product differentiation on the choice of invoicing currency. He argued that exporters from industrialized European countries tended to price their products in their home countries because they tended to export differentiated manufactured goods. Facing the downward demand curve, the producers of differentiated goods can exercise more market power, which allows them to avoid bearing the exchange rate risk. Conversely, exporters of relatively homogeneous primary goods, who are price takers in the market (market participants who have no control over the price) tend not to price in their home currency. In such a market, currencies with low transaction costs tend to be preferred. Given the tradition and the depth of the dollar's market, the dollar is usually a dominant vehicle currency in the commodity markets.

Goldberg and Tille (2008) argued in a seminal paper that when demand elasticity is high or there are competitive substitutes in the export destination market, exporters will opt for pricing in the currency used by competitors so that they can limit the fluctuations of their prices relative to those of the competitors' goods—the so-called "coalescing effect." Bacchetta and Van Wincoop (2005) used a general equilibrium model and showed that exporters who have higher market shares of the export market or who produce more differentiated products tend to invoice in their own currency.

Although microeconomic factors such as those just discussed affect the choice of invoicing currency, researchers have also argued that the choice of invoicing currency can be affected by "inertia." Krugman (1980) argued that once a currency is established as the invoicing currency, it becomes difficult for users to switch to another currency—more so if the currency is widely used and liquid.[6] Rey (2001) examined this issue theoretically, and argued that if more than one currency were used in invoicing, it would yield higher transaction costs, which would be passed

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6. Chinn and Frankel (2007, 2008) point to the inertia that affects the choice of reserve currencies. However, they also argue that there is a "tipping point," or threshold, above which the share of a currency in central banks' reserves would rise rapidly due to externality.

on to export prices. Hence, if a particular currency is dominantly used, as the market size gets bigger the transaction costs are lowered. Such a "thick market externality" leads the currencies of countries with higher levels of trade volumes and openness to be chosen as invoicing currencies. Similarly, Bacchetta and Van Wincoop (2005) predicted that the currency formed in a monetary union should be used more extensively than the sum of the currencies it replaces because of its enlarged market share.

The "thick market externality" or the inertia in the choice of currency invoicing may not be a sufficient condition for major currencies such as the U.S. dollar to be dominantly used in international trade. The United States, the issuer of the dollar, provides vast, liquid, and deep financial markets, which significantly help reduce the transaction costs of the currency and increase the liquidity and usability of the dollar. In other words, the depth and openness of financial markets affect the transaction costs associated with use of the currency and thus affect the choice of the invoicing currency. As Caballero, Farhi, and Gourinchas (2008), Chinn and Ito (2007), and Chinn, Eichengreen, and Ito (2011) show, the level of financial development and the extent of financial openness affect current account balances, and countries with deeper and more open financial markets tend to run a worsened current account balance or a deficit. Hence, a country's financial development and openness can affect the availability and usability of its own currency abroad, and therefore the transaction costs of the currency. Goldberg and Tille (2008), however, using data on the bid–ask spread for each sample country's currency relative to the U.S. dollar, find only a moderate role for transaction costs in the foreign exchange markets. Kamps (2006) finds that countries with forward exchange markets tend to invoice more in their home currencies.

The empirical literature on the choice of currency for trade invoicing is much thinner than the theoretical literature, owing to limited data availability. Few countries disclose currency invoicing data.[7] Hence, most empirical studies on currency invoicing have focused on individual countries, for example, Donnenfeld and Haug (2003) for Canada, Wilander (2004) for Sweden, Ligthart and Werner (2012) for Norway, Ito and others (2010) for Japan, and Da Silva (2004) for the Netherlands. Goldberg and Tille (2008) and Kamps (2006) are the exceptions, having conducted cross-country analysis on the determinants of trade invoicing, although the scope of country coverage tends to be small and highly unbalanced.[8]

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7. Exceptions are the European Union and several Asian countries. The ECB has been reporting the share of euro use in trade invoicing for euro and non-euro countries since the early 2000s, and the currency share data are available in Eurostat. Japan, Thailand, and Indonesia have been relatively consistent in reporting currency share data for the country's trade. See table 5A-1 for sources of our trade invoicing data.

8. For further literature reviews, see Goldberg and Tille (2008), Kamps (2006), Auboin (2012), Maziad and others (2011), and European Central Bank (2005).

Empirical Analysis of Major Currencies' Shares of Trade Invoicing

We conduct panel data analysis to examine the determinants of export invoicing while focusing on the impact of financial liberalization. Using our data set, we first discuss the general trend of currencies used for trade invoicing. Then we present the results of our panel data analysis and robustness checks.

Currency Shares in Trade Invoicing: Stylized Facts

Although it is clear that the U.S. dollar has been dominant in trade invoicing, a closer look at individual countries' experiences suggests that the countries' behavior of choosing currencies for trade invoicing is rather heterogeneous. In this section we introduce our data set on the shares of major currencies used for trade invoicing, then discuss the general trends of the use of major currencies in trade invoicing.

THE AUGMENTED CURRENCY INVOICING DATA SET. In this study we update and expand the data set constructed by Goldberg and Tille (2008) and Kamps (2006), relying on data provided on the websites of central banks and other government agencies, as well as other past and more recent studies that looked into the issue of trade invoicing (see table 5A-1 in the appendix to this chapter). Although a large portion of our data set relies on the data compiled by Kamps (2006), the coverage of currency shares in export and import invoicing is considerably expanded, especially with respect to the use of the euro. Hence, our analysis is based on a longer, more complete time series than the two earlier data sets.

Regarding our data sets, please note: Although our focus is on analyzing the determinants of currency use for trade invoicing, data limitations force us to rely on a data set that includes both invoicing and settlement currencies. Our data set on the shares of invoicing currencies for exports and imports—the U.S. dollar, the euro, and the domestic currencies—mixes data on currencies used for both invoicing and settlements for trade transactions. Strictly speaking, the currency for trade invoicing and that for actual settlements may differ. However, reporting government agencies often do not make it clear whether they are reporting the currency of invoicing or settlement. Although, as Page (1977, 1981) finds, the differences in the invoicing or settlement currencies is sometimes negligible, for a newly internationalized currency such as the RMB the difference can be large. In fact, the PRC only publishes the data on RMB settlements, not invoicing. Yu (2012) argues that notwithstanding the growth in the amount of RMB use in settlements for the PRC's imports, a large bulk of the imports settled in RMB is initially invoiced in dollars. This scheme reflects the persistent appreciation expectations for the RMB. Conceptually, in order to become an international currency, a candidate currency should be used for trade invoicing rather than settlements. Here we must bear in

mind that the PRC's data on settlements may overstate the actual use of the currency as an invoicing currency. We use the phrases "currency for invoicing" and "currency for trade settlements" interchangeably.

Our data set covers fifty countries, including the PRC, but with a varying extent of coverage depending on the type of invoiced currency and whether the data are for exports or imports. For example, Japan's data go back to 1969 for both exports and imports, but for some countries data are available for only a single year or a single currency (often the U.S. dollar or the euro).[9]

STYLIZED FACTS. Using our augmented and updated data set on trade invoicing, we now discuss how the choice of currency for trade invoicing has changed over time and differs among countries or regions.

Figure 5-1, showing the shares of the use of the U.S. dollar in export invoicing for individual countries compared to the shares of the countries' exports to the United States in the countries' total exports, makes it clear that the dollar retains a dominant role. If the U.S. dollar did not play a dominant role or the role of the vehicle currency, we would expect the dollar invoicing share in export transactions of countries to be proportional to the share of the United States as a destination of countries' exports. In fact, the figure clearly shows that countries invoice their exports in dollars much more than proportionally to the share of their exports to the United States.

Figure 5-2 shows the shares of exports invoiced in individual countries' home currencies against the shares of their exports in the world's total exports. We can see that the PRC, which provides about 10 percent of the world's exports, is an outlier given its low level of export invoicing with its home currency. Excluding the PRC, there is a moderate positive correlation between the shares of exports invoiced in the home currency and the shares of exports in the world exports. Although the other two large exporters, Germany and Japan, also appear to be off the fitted line, the PRC's deviation dwarfs the other deviations, indicating that the level of home currency invoicing is much lower than would be expected from its share in the world's exports.

Figures 5-3 and 5-4 further illustrate the dominant role of the dollar in trade invoicing. These two figures show the sample-average shares of the dollar, the euro, and the home country's currency for the invoicing of exports (figure 5-3) and

9. Goldberg and Tille (2008) cover twenty-five countries, whereas Kamps (2006) expands the former data set and covers forty-two countries. Our data set updates the share of euro invoicing in both exports and imports to 2012, using a series of the European Central Bank's reports (2005, 2007–12) on the role of the euro and Eurostat. We also augment the data set with longer time series for Australia (2000–03, 2006–11), Indonesia (1991–2012), the Republic of Korea (1976–2005), Thailand (1993–2012), and Japan (1969–2012), as well as data from earlier years (1970s) for several advanced economies using earlier papers such as Scharrer (1981), Tavlas (1993), Tavlas and Ozeki (1992), Magee and Rao (1980), and Page (1977). For more details see table 5A-1.

Figure 5-1. *U.S. Dollar as the Vehicle Currency, 2007–11*

Exports to the United States
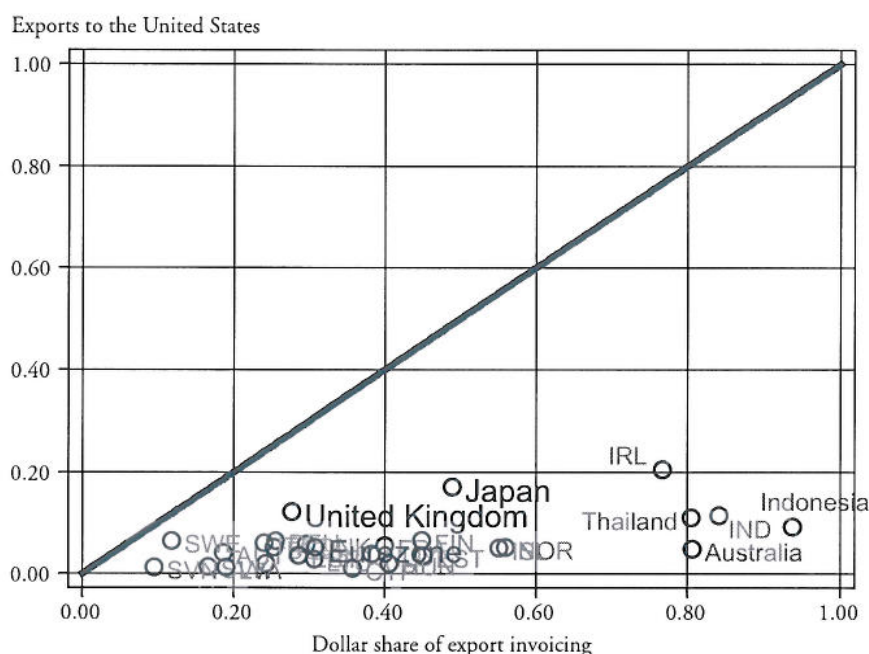
Source: Authors' calculations; see table 5A-1 in the appendix for data sources.

imports (figure 5-4).[10] Note that when calculating the share of the U.S. dollar in trade invoicing, we do not include the use of the U.S. dollar by the United States but include it in the share of the home currency. Similarly, the euro share does not include the use of the euro by the eurozone countries; it is included in the share of the home currency.[11]

In both export and import transactions, the U.S. dollar has the highest share, although it was on a declining trend until the mid-2000s. The recent rise in the dollar share may reflect the effects of the global financial crisis and the euro debt crisis. In both instances, there was "flight to quality," which benefited dollar-denominated assets and led to more dollar invoicing in international trade. Conversely, the share of the euro by non-eurozone countries in both export and import transactions was on a steadily rising trend until the mid-2000s, followed by a decline in the share in the last years of the sample period.[12] The use of the home currency has been increasing for both exports and imports, but it mainly reflects

10. Because the data set is highly unbalanced, annual averages of the currency shares are highly subject to data availability. To mitigate this, we report five-year averages of the currency shares.

11. These rules are applied throughout the chapter, including the estimation exercises.

12. The euro share before the introduction of the euro in 1999 reflects the sum of the uses of the "legacy currencies" before they were replaced by the euro (Kamps 2006).

Figure 5-2. *Home Currencies' Shares of Export Invoicing versus Home Countries'*
Shares of Exports in the World's Total, 2007–11

Exports to the world

Share of exports invoicing in home currency
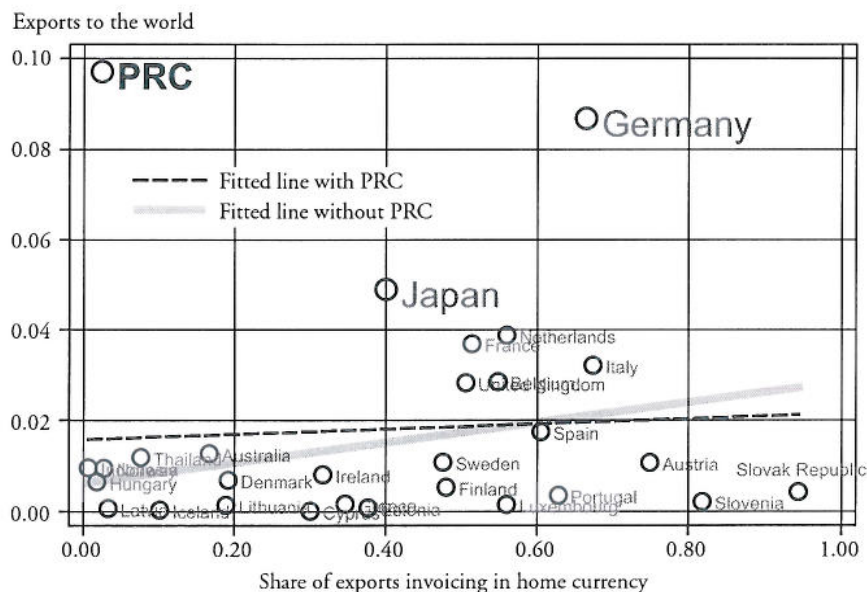
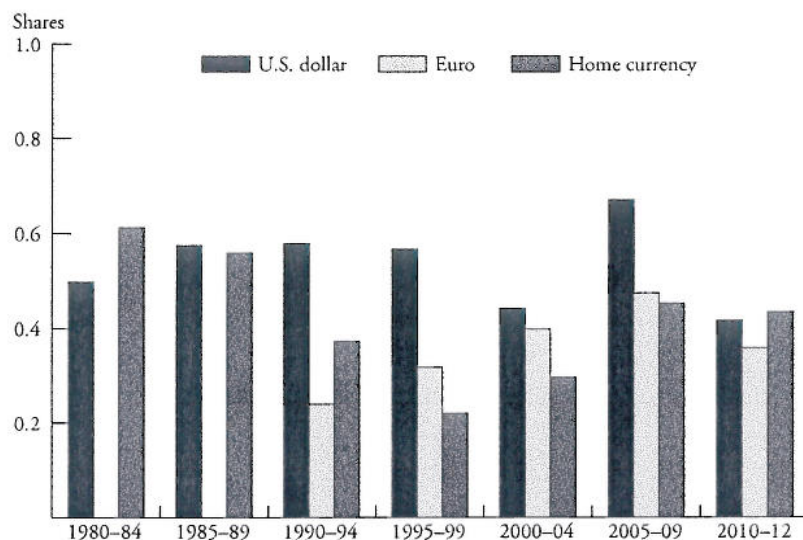Source: Authors' calculations; see table 5A-1 for data sources.

the use of the euro by the eurozone countries. In general, we see evidence of the
operation of Grassman's law (Grassman 1973), mentioned earlier: the share of
home currency invoicing is higher for exports than for imports.

The extent of reliance on the dollar as a major invoicing currency seems to dif-
fer across regions. Figure 5-5 illustrates the shares of currencies in export invoic-
ing for the EU countries.[13] For this group of countries, the euro is the most com-
monly invoiced currency. Considering that the home currency in the figure also
includes the use of the euro by the euro member countries, the share of the euro
invoicing overall is even higher. The share of the U.S. dollar for this group of coun-
tries was stable at around 30 to 35 percent in the sample period.

Figure 5-6 shows the shares of invoicing currencies for a selection of Asian and
Pacific countries, excluding Japan. It is clear that the countries in this region have
relied heavily on the U.S. dollar as the vehicle currency. The main cause for the
high reliance on the dollar is the regional supply chain network that primarily uses
the U.S. dollar as the currency for transactions. Also, the main export market for
products from the Asian supply chain is the United States. As Goldberg and Tille

13. The figure shows the averages of currency shares for the current twenty-seven EU countries
as of 2014, regardless of the year of accession to the union. Hence, strictly speaking, the average is
calculated for the EU member countries and former candidate countries.

Figure 5-3. *Average Shares of the Dollar, the Euro, and Home Currencies in Export Invoicing*

Source: Authors' calculations; see table 5A-1 for data sources.

Figure 5-4. *Average Shares of the Dollar, the Euro, and Home Currencies in Import Invoicing*[a]
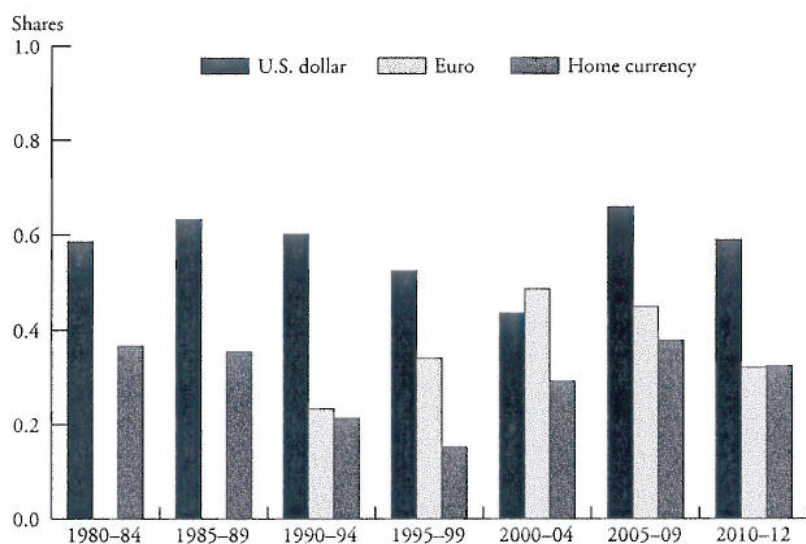
Source: Authors' calculations; see table 5A-1 for data sources.

a. The use of the U.S. dollar in trade invoicing by the United States is not included in the U.S. dollar average share, but it is included in the home currency's share. Similarly, the use of the euro by the eurozone countries is not included in the euro's share, but is included in the home currency's share.

Figure 5-5. *Average Shares of the Dollar, the Euro, and Home Currencies in Export Invoicing, European Union Countries*[a]
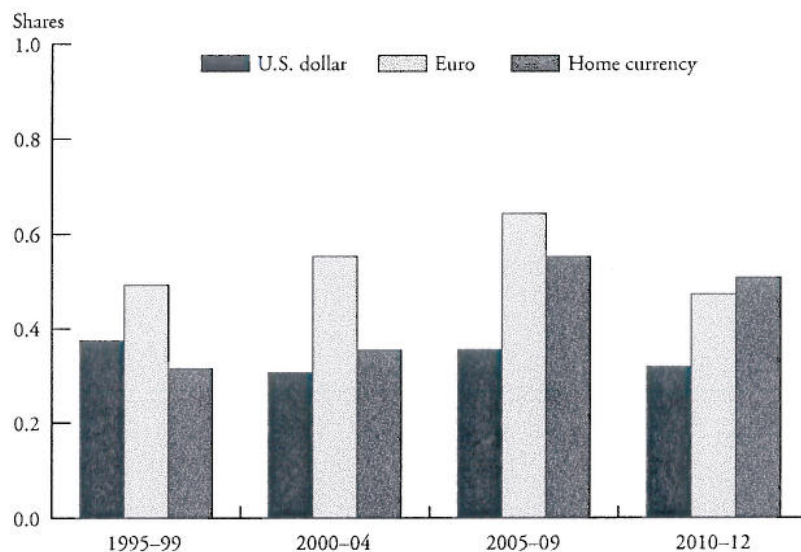
Source: Authors' calculations; see table 5A-1 for data sources.

a. The countries in the European Union subsample are Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom.
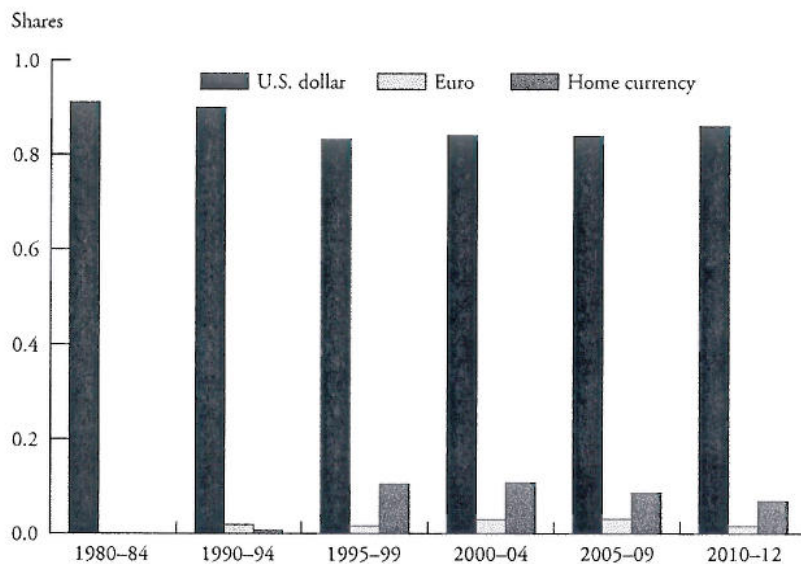
(2008) and Ito and others (2010) argue, firms tend to price to market, that is, invoice their exports in the importer's currency, the U.S. dollar, so as to protect their competitiveness in the destination market.[14] The Asian dollar bloc therefore stands as a big challenge to the PRC's ambitions for the RMB to become the regional international currency.[15]

We have only four years of observations for the PRC, but what we have reflects the country's financial liberalization policy. In the immediate aftermath of the global financial crisis of 2008, the PRC government became active in promoting RMB trade settlements, with the hope that firms would be able to reduce exchange rate risk if they could invoice trade transactions in yuan. The People's Bank of China (PBOC) prepared the environment for RMB settlements by signing currency swap agreements with countries. By the spring of 2013, the PBOC

14. Takagi (2009) argues that established practices of pricing and invoicing trade in the U.S. dollar in Asia hampered the internationalization efforts of the Republic of Korea's won, despite the country's increased presence as a major exporter.

15. We could also argue that given the indispensable role of the PRC in the Asian supply chain network, if the RMB could replace the dollar as the major invoicing currency in the Asian region, the use of the RMB could rise dramatically.

Figure 5-6. *Average Shares of the Dollar, the Euro, and Home Currencies in Export Invoicing, Asia and Pacific Countries (Excluding Japan)*[a]

Shares

[Bar chart showing shares of U.S. dollar, Euro, and Home currency across time periods 1980–84, 1990–94, 1995–99, 2000–04, 2005–09, 2010–12, with y-axis from 0.0 to 1.0]
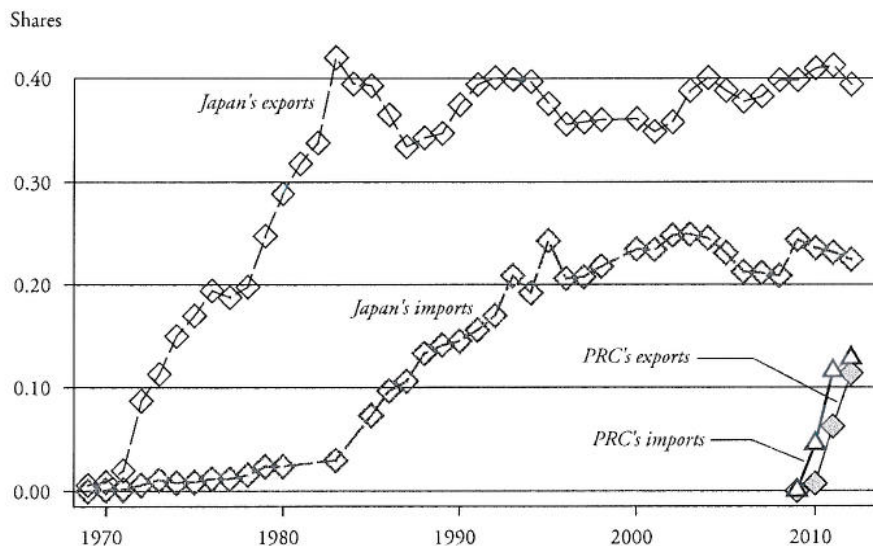
Source: Authors' calculations.
a. Australia, the PRC, India, Indonesia, the Republic of Korea, Malaysia, Pakistan, and Thailand.

had signed swap agreements with the monetary authorities of twenty countries and areas, for the total value of CNY1,936.2 billion ($317.9 billion).[16] In July 2009 the government started a policy of allowing several pilot firms to settle trades using the RMB through designated domestic banks and banks in offshore markets in Hong Kong, China. By fall 2013 the scope of the policy had been expanded to the national level, and banks in other economies (such as Singapore, the PRC, Japan, Australia, New Zealand, and Taipei,China) were allowed to deal with offshore RMB (that is, CNH) for trade settlements. As of the end of 2012, about 80 percent of RMB trade settlement was conducted through the offshore

16. The economies and areas the PRC signed currency-swap agreements with are as follows: the Republic of Korea (CNY180 billion in 2008, renewed to CNY360 billion in 2011); Hong Kong, China (CNY200 billion in 2008, renewed to CNY400 billion in 2011); Malaysia (CNY80 billion in 2009); Belarus (CNY20 billion in 2009); Indonesia (CNY100 billion in 2009); Argentina (CNY70 billion in 2009); Iceland (CNY3.5 billion in 2010); Singapore (CNY150 billion in 2010); New Zealand (CNY25 billion in 2011); Uzbekistan (CNY0.7 billion in 2011); Mongolia (CNY5 billion, later increased to CNY10 billion, in 2011), Kazakhstan (CNY7 billion in 2011); Thailand (CNY70 billion in 2011); Ukraine (CNY15 billion in 2012); Brazil (CNY190 billion in 2011); Pakistan (CNY10 billion in 2011); United Arab Emirates (CNY35 billion in 2012); Malaysia (CNY100 billion, later increased to CNY180 billion, in 2012); Turkey (CNY10 billion in 2012); and Australia (CNY200 billion in 2012). For more details on the PRC's swap agreements, see Garcia-Herreno and Xia (2013), Huang, Wang, and Fan (2013), and Yu (2013).

Figure 5-7. *Shares of Home Currency Invoicing for the Trade of Japan and the People's Republic of China*

Shares

Source: Authors' calculations; see table 5A-1 for data sources.

market in Hong Kong, China, and other economies are eager to become offshore RMB markets.[17]

The data on RMB use for trade settlement reflect this short history of the liberalization of RMB trade settlement. As of the end of 2009, the first year of policy implementation, a mere 0.02 percent of total trade was settled in RMB. According to the People's Bank of China (2011 to 2013) the ratio only grew to 2.2 percent in 2010. In 2011 it started taking off; the share of RMB use in trade settlements rose to about 6.6 percent in 2011 and 8.4 percent in 2012.[18]

Let us look at the development of RMB trade settlement in a global context. In figure 5-7 we first compare the experience of RMB invoicing with that of a previous challenger for the international currency, the Japanese yen. As of the end of the 1960s, a few years after the currency became convertible in 1964, only 0.6 percent of Japan's exports were invoiced in yen, and essentially none of Japan's imports

17. Many authors have produced in-depth reviews and analyses of the PRC's efforts at financial liberalization and internationalization of the RMB, including Chen and Cheung (2011), Prasad and Ye (2012), Ito (2011), Subramanian and Kessler (2012), Huang, Wang, and Lin (2013), Vallée (2012), and Yu (2012, 2013).

18. According to the Society for Worldwide Interbank Financial Telecommunication (SWIFT), the percentage of RMB settlement in the PRC's trade was 10 percent in 2011 and 14 percent in the first quarter of 2012.

Figure 5-8. *Share of the U.S. Dollar, the Euro, and the Japanese Yen in Japan's Export Invoicing*
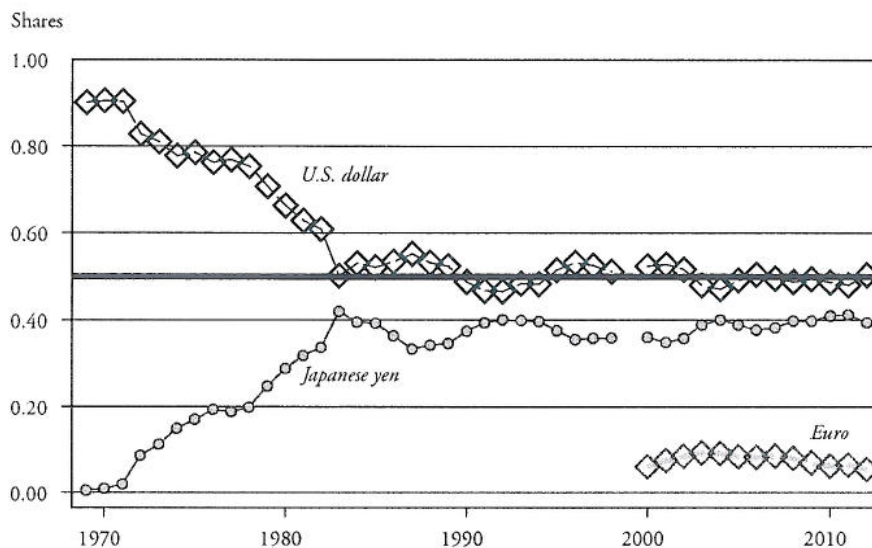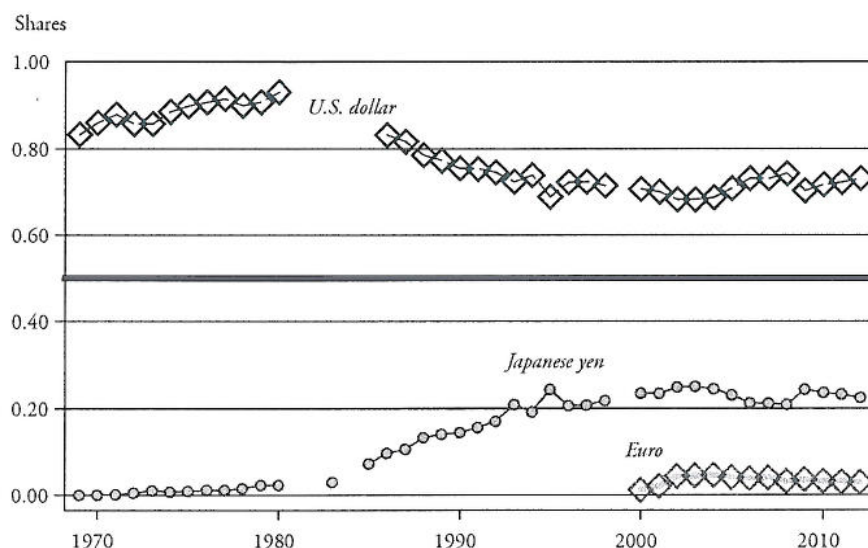
Shares

Source: Authors' calculations; see table 5A-1 for data sources.

were invoiced in yen. The share of yen invoicing for exports peaked in 1983, hitting 42 percent, although that of imports only reached 3 percent. Figures 5-8 and 5-9 show that since the mid-1980s the share of yen in export invoicing has hovered around 35 to 40 percent, and that of the U.S. dollar, around 50 percent. In contrast, the share of yen in import invoicing has stabilized at 20 to 25 percent; the U.S. dollar has maintained higher levels of around 70 percent. After all the discussions and initiatives regarding the internationalization of the yen, the currency has failed to become a dominant currency, even for the country's own trade.[19]

Figure 5-7 also illustrates the development of the ratio of RMB invoicing with respect to total exports and imports. The PBC only publishes the RMB settlement figures for total trade, so there is no breakdown for exports and imports. However, it also reports the ratios of RMB receipts to payments in international trade trans-

19. This is in sharp contrast with the German deutsche mark (DM). The share of DM invoicing for exports remained consistently around 80 percent for the entire 1980s and for imports increased from 43 percent in 1980 to 53 percent in 1988 (Tavlas 1993). Frankel (2011) explains that both Japan and West Germany were reluctant to internationalize their currencies when these currencies began to gain shares in the 1980s, because internationalization of the currencies might create appreciation pressure on the currencies and thus could hurt the international competitiveness of the countries' exporting sectors. In the 1990s Japan changed its policy stance and started promoting the internationalization of the yen. Soon after, however, the economy went into a long recession, which led the demand for the currency to fall.

Figure 5-9. *Share of the U.S. Dollar, the Euro, and the Japanese Yen in Japan's Import Invoicing*

Shares

Source: Authors' calculations; see table 5A-1 for data sources.

actions. Using the ratios as well as the published total volumes of RMB trade settlements, we estimate the shares of RMB use for export and import settlements.[20]

Figure 5-7 shows a rapid rise in the share of RMB use for both export and import invoicing in recent years, even though the government only started to allow RMB invoicing in 2009. Whereas the share of the yen for exports has always been higher than that for imports, consistent with Grassman's law, the RMB has had an opposite experience. According to the PBOC (People's Bank of China 2011), the ratio of the RMB receipts to payments was 1:5.5 in 2010, though it improved to 1:1.7 in 2011. This lopsidedness reflects the government's intention to increase the use of the RMB overseas.

Another, more recent challenger as an international currency is the euro. Figure 5-10 shows that the use of the euro for trade invoicing has had a moderately rising trend since its introduction in 1999. As was the case with the yen, the share of euro invoicing is higher for exports than for imports, and the gap between export and import invoicing seems to have been widening in recent years, possibly reflecting the euro debt crisis. The larger-scale use of the euro for trade invoicing makes

20. The PBOC's 2012 *Annual Report* does not report the ratio of RMB receipts to payments in international trade. However, given that the ratio improved from 1:9 in 2009 to 1:1.7 in 2011, it is reasonable to assume the ratio has become close to 1:1. We assume this when we calculate the shares of RMB in export or import invoicing for 2012.

Figure 5-10. *Shares of Home Currency Invoicing for the Trade of the People's Republic of China's and the Eurozone*

Shares
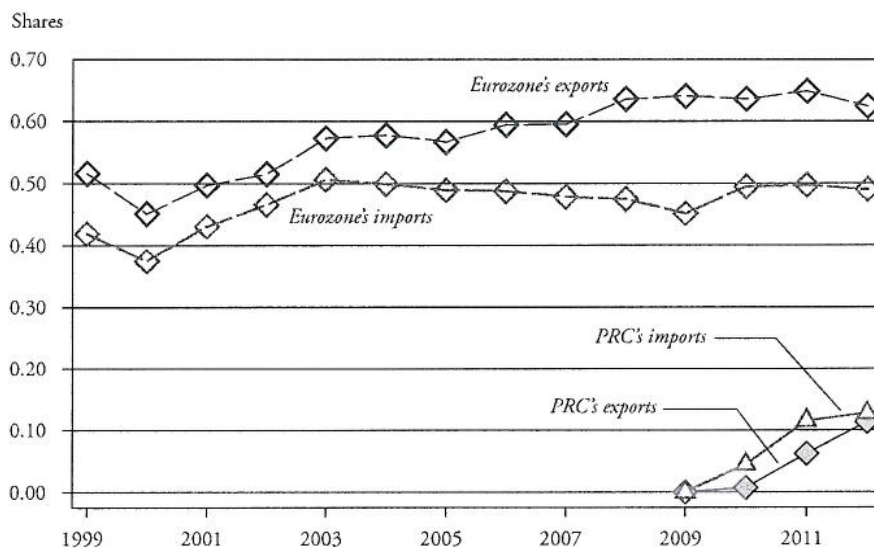
Source: Authors' calculations; see table 5A-1 for data sources.

it clear that the RMB still has a long way to go before it becomes international to the same extent.

Panel Analysis on the Determinants of Export Invoicing

Now that we have observed different paths of development for the use of currencies in trade invoicing, we conduct a panel data analysis to investigate the determinants of trade invoicing and the role of financial liberalization.

THE MODEL AND CANDIDATE DETERMINANTS OF EXPORTING INVOIC-ING CURRENCIES. Here, we investigate the determinants of the use of three currencies, the dollar, the euro, and the home country's currency, by using the data set for fifty countries, including both advanced and emerging-market economies, for which the currency share data are available. However, the data limitations for other variables reduce the number of countries included in our panel data analysis to thirty-three to forty-three countries, depending on the currency of focus, for the period 1970 to 2011. As we have already described, the data availability of the currency share data makes the data set highly unbalanced.

We use an empirical specification similar to that used by Goldberg and Tille (2008) and Kamps (2006), but test other variables that have been suggested as contributors to the share of currency in trade invoicing including financial openness.

The specification relates the share of export invoicing in a specific currency to

$$(5\text{-}2) \qquad \lambda^{C}_{EXit} = \beta_1 + \beta_2 X^{C}_{it} \; \beta_3 D^{C}_{it} + \gamma_1 FL^{C}_{it} + \epsilon^{C}_{it}.$$

λ^{C}_{EXit} indicates the share of exports from country i in year t invoiced in currency C, where C can be the dollar, the euro, or the home country's currency.[21] That is, we repeat this estimation for export invoicing in these three types of currencies. The vector X^{C}_{it} includes the economic factors of country i that affect the share. In X^{C}_{it}, we include EX^{C}_{it}, the share of country i's exports to the United States or the eurozone when C is either the dollar or the euro, respectively, or country i's export share in world exports when we run the estimation for the home currency's share in export invoicing. Vector X^{C}_{it} also includes the share of commodity exports in total exports (*Commd*); relative income level to the United States (*Rel_inc*); exchange rate volatility ($ExVol^{C}_{it}$) and inflation differentials ($Inf Dif^{C}_{it}$) relative to the United States, the eurozone, and the world, depending on the currency of interest; and a measure for financial development (FD_{it}).[22]

Because it is natural to assume each country is exposed to its own idiosyncratic shocks that are not systematically intrinsic to itself, we estimate a random effects model. We also run the estimations with fixed effects as a robustness check for the possibility of each country's intrinsic characteristics (such as institutional or regulatory environment) affecting the choice of invoicing currencies.

Vector D^{C}_{it} includes the dummies pertaining to currency arrangement (CA^{C}_{it}), such as pegs to the dollar or the euro (or the deutsche mark prior to the introduction of the euro), and also pertaining to whether or not country i participates in the European Union (EU_i).[23] We also include a vector of time effects. One is the dummy for the Bretton Woods period (*BW*); it takes the value of one for all observations before 1973. The other is the dummy for the introduction of the euro (*Euro*); it takes the value of one for all observations after 2002, when the euro was introduced and the national "legacy currencies" ceased circulating in the market.

We focus on the estimate of the variable for capital account openness, FL^{C}_{it}. For the measure of capital account openness, we use the Chinn-Ito index of capital account openness (Chinn and Ito 2006, 2008, and updates). *KAOPEN* is based

21. Again, we do not include the use of the dollar by the United States in the share of the dollar use, but include it in the share of the home currency. Similarly, we do not include the use of the euro in trade invoicing by the eurozone countries in the euro share, but include it in the share of the home currency.

22. "Commodity" includes fuel, food, and metal products, as categorized by the *World Development Indicators*. The exchange rate for the United States, which is included in the "home currency" estimation, is the one against the special drawing right (SDR).

23. The dummy for the EU membership is time-invariant, that is, the dummy is assigned for the entire sample period regardless of the year of entry to the union. This is due to stylized facts that the invoicing behavior would differ for EU member countries even before they actually become members, partly because of the existence of precursor organizations such as the European Community and also because of geographical reasons for other countries that did not participate in the precursor organizations (such as former communist states). We follow Kamps (2006) on this.

on information regarding regulatory restrictions on cross-border capital transactions reported in the International Monetary Fund *Annual Report on Exchange Arrangements and Exchange Restrictions*.[24] Specifically, *KAOPEN* is the first standardized principal component of the variables that indicate the presence of multiple exchange rates, restrictions on current account transactions, on capital account transactions, and the requirement of the surrender of export proceeds (see Chinn and Ito 2006, 2008).[25]

The inclusion of these variables is based on the past literature on trade invoicing. Now we briefly discuss the theoretical rationales for testing the variables and what we should expect for the estimates of the variables.

Share of exports. Larger exporters are expected to have more bargaining power in the market. They can exploit externalities arising from the economies of scale for the use of the currency as well. Hence, we should expect a positive estimate for this variable, especially for the home currency. However, at the same time, for the estimation of the U.S. dollar share, given that the U.S. markets are quite competitive, we can expect the "coalescing effect"; exporters tend to invoice in the currency of the export market to minimize the fluctuations of their prices relative to those of their competitors. This prediction suggests the estimate would be positive.[26] We use data from the IMF's *Direction of Trade*.[27]

Commodity exports as a percentage of total exports. Commodities are almost exclusively denominated in the U.S. dollar, which is consistent with McKinnon's (1979) argument that homogeneous goods tend to be invoiced in a single, low-transaction-cost currency. We should expect a positive effect on the dollar share, but a negative one on the euro and the home currency's shares.

Relative income. We use this variable as a proxy for the extent of differentiation in exported goods. When the extent of competitiveness is high in the destination market or there are other competitive substitutes available in the market, exporters tend to invoice in the local market's currency ("coalescing effects"; see Goldberg and Tille 2008). That is, the more differentiated goods a country exports, the more likely it is to invoice its exports in its home currency. However, we do not have good measures in the cross-country context. Hence, we use the relative per capita income level to the United States as a proxy. The expected sign is negative for both the dollar and euro estimations, but positive for the home currency estimation.[28]

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24. These annual reports are available as pdfs at the IMF website, for example, www.imf.org/external/pubs/nft/2013/areaers/ar2013.pdf.

25. The index is normalized to range between 0 and 1. High values indicate a more open capital account. For more details on the index, see "The Chinn-Ito Index" (http://web.pdx.edu/~ito/Chinn-Ito_website.htm).

26. This can be true for the euro share estimation.

27. This database is available by subscription at the IMF website (see www.imf.org/external/pubs/cat/longres.cfm?sk=19305.0).

28. We use the data from Penn World Table 7.1 for real per capita income (see "PWT 7.1," https://pwt.sas.upenn.edu/php_site/pwt71/pwt71_form.php).

Exchange rate volatility and inflation differentials. A more unstable macro-economic environment would make investors shy away from holding a currency that is subject to such uncertainty. Higher inflation is also associated with an unstable macroeconomic environment. Volatile exchange rates or an unstable macroeconomic environment for a certain currency would make investors flee to hard currency or real assets. Hence, a country with a volatile exchange rate or high inflation tends to rely more on the U.S. dollar and less on its home currency as a medium of trade. For both variables, the estimates should take positive signs for the U.S. dollar, and to a lesser extent the euro, too. For the home currency, both variables should have negative estimates.[29]

Financial development/size. A currency for which large, liquid, and deep markets exist should face lower transaction costs, and therefore should be used more as an invoicing currency. Hence, we examine the impact of financial development on the invoicing currencies while incorporating the level of liquidity, the size, and the depth of the markets with respect to the world market. For that, we use a variable for "financial development/size" (FD_SIZE) which we define as the product of private credit creation (as a share of GDP: PCGDP) and the relative size of private credit creation of country i to the world total private credit creation (PRIV_SIZE).[30] Because a currency associated with a larger and deeper market tends to be used more intensively for trade invoicing in that currency, we expect a negative estimate for the U.S. dollar share coefficient, but a positive one for the home currency share coefficient while that for the euro can be ambiguous.

Financial openness. We consider the effect of financial openness as being similar to that of domestic financial development. Considering that full convertibility of a currency is a necessary, if not sufficient, condition for that currency to become an international currency, the effect of financial openness has to be evaluated separately from that of domestic financial development. A currency of a more open financial market could provide more usability and investment opportunities for international investors. Hence, the more open the capital account is for the issuer country of a currency, the more likely it is that the country will invoice its trade in that currency. Therefore, the impact of financial openness on the shares of the dollar and the euro should be negative and the impact on the home currency share should be positive.

Monetary union and exchange rate arrangements. Bacchetta and van Wincoop (2005) show that the currency for a currency union can make the best use

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29. Inflation differentials are included as the differentials with the U.S. rate of inflation in the estimations for the U.S. dollar share and the home currency share. For the euro share estimation, inflation differentials with the eurozone rate of inflation are included. For exchange rate volatility, the estimations for the dollar share and the home currency share use the exchange rate against the U.S. dollar, and the estimation for the euro share uses the exchange rate against the euro.

30. PCGDP is extracted from the World Bank's Financial Structure Database, first introduced by Beck, Demirgüc-Kunt, and Levine (2001).

of economies of scale and therefore tends to be used more extensively in trade than the sum of the currencies it replaces. If a country pegs its currency to another anchor currency such as the U.S. dollar or the euro, it should surely tend to invoice its trade in the anchor currency.[31]

ESTIMATION RESULTS. Table 5-2 reports the results for both random and fixed effects. Both random and fixed effects models yield similar results; we focus our discussions on the results from the random effect models.

First of all, for all the currencies we find evidence that export market share matters. The larger the share of its exports that goes to the United States or the euro-zone, the more likely it is for a country to invoice in dollars or euros, respectively. In the case of the dollar share, the coalescing effect is in effect; given the vast size of the U.S. market and its supposedly high degree of competition, exporters tend to invoice in the U.S. dollar to minimize fluctuations in the prices of their products in the local market's currency (that is, the U.S. dollar) and to retain their market shares. The same observation is applicable to the euro share estimation. Also, if they have a larger export share in the world, exporters tend to invoice their exports in the home currency as well.[32]

If a country exports more commodities, it tends to invoice more in dollars and less in the euro, suggesting that the dollar is a vehicle currency especially for commodity exports. The positive estimate result is obtained for the home currency share estimations—although significantly only in the fixed effects model, which is somewhat counterintuitive. The more differentiated products it exports (which we proxy for by using the relative income level to the U.S. in PPP), the more likely it is to invoice in the home currency (and weakly in the euro) and the less likely to invoice in dollars. These results also provide evidence that the dollar functions as the vehicle currency in international trade. A country with higher inflation tends to invoice its exports in U.S. dollars. The estimate on the inflation differential variable is negative in the euro and home currency share estimations, but only statistically significant in the euro share estimation with fixed effects. The fixed effects estimation for the dollar share suggests that a country with volatile exchange rates also tends to invoice its exports in dollars.

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31. For the pre-euro period, the dummy is assigned for countries pegging their currencies to the deutsche mark.

32. The findings that the variables for the shares of exports have positive signs for all of the three estimations may appear puzzling. However, while the share variables for the estimations for the U.S. dollar share or the euro share refer to the share of country i's exports to the U.S. or the eurozone, respectively, the export share variable for the home currency estimation represents country i's export share in *world* exports. In other words, as far as the exports share variable is concerned, the estimations for the dollar share or the euro share are not directly comparable with those for the home currency share, which makes all the export share variables having positive signs acceptable. As for the estimations for the dollar or the euro share, our findings suggest that if a country has a greater presence in either the United States or the eurozone area, exports from that country would face a stronger need to invoice in the dollar or the euro to maintain their market presence. As for the estimations for

While financial openness does not affect the share of dollar invoicing, the size of domestic financial markets does matter for it: a country with deeper and larger financial markets is *less* likely to invoice its exports in dollars.[33] Although financial openness does not matter for the U.S. dollar share, it does matter for the share of the euro or the home currency in export invoicing. The more open financial markets a country has, the more it tends to invoice in either the euro or the home currency. Since our measure of financial openness can refer to capital account openness in both directions of capital flow, our findings suggest that financial liberalization may allow countries to diversify investment instruments in international financial markets, which may make euro-denominated assets look more accessible to domestic investors and therefore make euro invoicing more acceptable. At the same time, greater financial openness may lead to more usability and investment opportunities of the home currency for international investors; therefore it may lead to more invoicing in the home currency.

On average, the EU countries have lower shares of dollar invoicing by twenty-six percentage points, while they tend to have higher shares of their home currencies (including the euro for the eurozone countries) by twenty-one percentage points.

After the collapse of the Bretton Woods system in 1973, the share of home currency invoicing rose by nine percentage points, although we do not detect any significant change in the U.S. dollar share. After the euro entered circulation in 2002, the share of dollar invoicing declined by (an insignificant) one percentage point while the share of the euro for non-eurozone countries increased four to seven percentage points.

Countries that peg their currencies to the dollar tend to invoice their exports in dollars. A similar conclusion can be reached for those countries that peg their currencies to the euro; countries that peg their currencies to the euro tend to invoice in euros while tending to reduce their home currency invoicing.

Further Analyses

DE FACTO VERSUS DE JURE MEASURES OF FINANCIAL OPENNESS. Although we used the Chinn-Ito index to reflect the de jure, or regulatory, environment for cross-border capital transactions, one could argue that the reality of cross-border capital transactions is much more complex and so can differ from the picture we depict through the lens of a regulatory framework.[34] In other words,

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the home currency, if a country has a greater presence in the world, exporters from that country seem able to exercise greater bargaining power so that they can invoice in their home currency.

33. When we include *PCGDP* or *PRIV_SIZE* individually, *PCGDP* does not turn out to be a significant contributor to any of the currency share estimations, but *PRIV_SIZE* is found to be a negative contributor to the U.S. dollar share estimation. These findings suggest that the relative size of financial markets, rather than their depth, matters for the choice of whether or not to invoice exports in the U.S. dollar.

34. Researchers have constructed different de facto and de jure measures of financial openness. For more details on comparisons across different measures of financial openness, see Kose and others (2006) and Quinn, Schindler, and Toyoda (2011).

Table 5-2. Determinants of a Currency's Share of Export Invoicing[a]

	U.S. dollar random 1970 to 2011 (1)	U.S. dollar fixed 1970 to 2011 (2)	Euro random 1990 to 2011 (3)	Euro fixed 1990 to 2011 (4)	Home random 1970 to 2011 (5)	Home fixed 1970 to 2011 (6)
Share of exports	0.491 (0.116)***	0.354 (0.164)**	0.617 (0.099)***	0.678 (0.131)***	2.557 (0.697)***	2.224 (0.791)***
Commodity exports Percent	0.270 (0.086)***	0.198 (0.126)	-0.133 (0.082)*	-0.127 (0.100)	0.232 (0.118)	0.331 (0.140)**
Relative income	-0.153 (0.058)***	-0.295 (0.120)**	0.117 (0.094)	0.882 (0.165)***	0.395 (0.088)***	0.552 (0.140)***
Exchange rate volatility	0.008 (0.029)	0.034 (0.029)	-0.025 (0.029)	-0.021 (0.027)	-0.016 (0.025)	-0.029 (0.025)
Financial development/size	-0.406 (0.082)***	-0.356 (0.094)***	-0.080 (0.165)	-0.105 (0.159)	-0.047 (0.090)	-0.092 (0.098)
Inflation differential	0.314 (0.110)***	0.356 (0.114)***	-0.107 (0.081)	-0.138 (0.077)*	-0.213 (0.172)	-0.218 (0.175)
Financial openness	0.005 (0.031)	0.004 (0.032)	0.082 (0.027)***	0.059 (0.026)**	0.058 (0.032)*	0.069 (0.034)**

European Union states	-0.259 (0.049)***		0.068 (0.062)		0.207 (0.080)**	
Years after 2002	-0.011 (0.011)	-0.012 (0.012)	0.066 (0.011)***	0.037 (0.011)***	0.010 (0.012)	0.004 (0.012)
Bretton Woods	-0.013 (0.027)	-0.003 (0.027)			-0.089 (0.025)***	-0.091 (0.026)***
Pegged to U.S. dollar	0.055 (0.029)*	0.048 (0.030)	0.017 (0.035)	-0.006 (0.033)	-0.045 (0.041)	-0.060 (0.042)
Pegged to euro	-0.029 (0.023)	-0.030 (0.024)	0.105 (0.022)***	0.082 (0.022)***	-0.094 (0.021)***	-0.092 (0.021)***
Constant	0.571 (0.055)***	0.568 (0.074)***	-0.041 (0.064)	-0.221 (0.091)**	-0.156 (0.082)	-0.145 (0.091)
N	336	336	285	285	326	326
Number of countries	43	43	34	34	37	37
Overall R^2	0.73	0.27	0.67	0.20	0.58	0.38
W/in R^2	0.25	0.26	0.39	0.45	0.26	0.27

Source: Authors' calculations; see table 5A-1 for data sources.

a. Standard errors are in parentheses.

* = $p < 10\%$; ** = $p < 5\%$; *** = $p < 1\%$.

the extent of financial openness depicted by a de jure index such as the Chinn-Ito index can differ from what can be measured by a de facto index that is based upon actual volumes or prices of cross-border capital transactions.
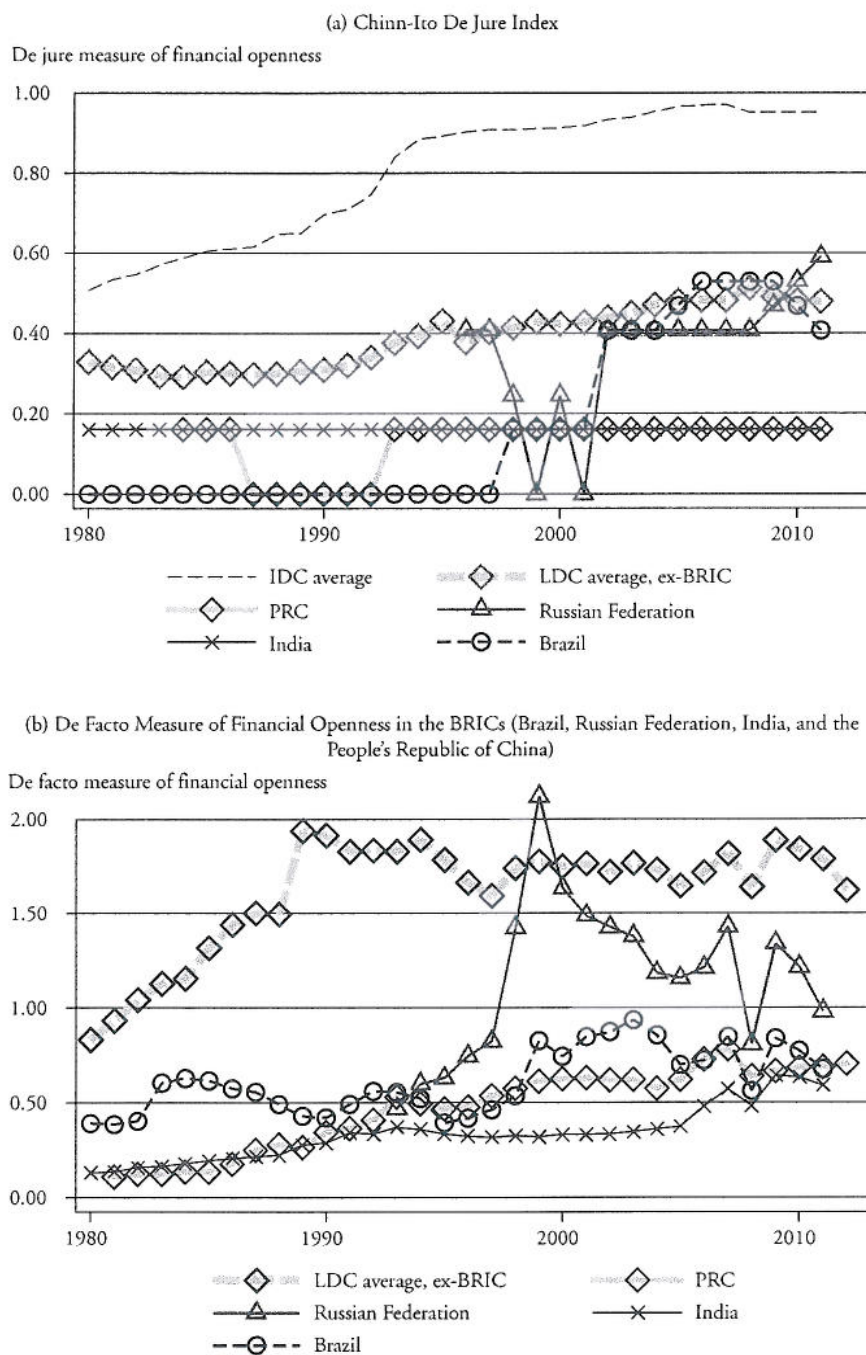
According to the Chinn-Ito index, the PRC and India have not made progress in opening markets for capital account transactions and have been lagging behind the Russian Federation and Brazil and other developing countries (see figure 5-11[a]). But if we measure the extent of capital account openness by the actual size of cross-border capital transactions, we get a different picture. In figure 5-11(b) we show the extent of financial openness by using another often-used quantity-based de facto measure: the ratio of the sum of total stocks of external assets and liabilities to GDP, using the data set compiled by Lane and Milesi-Ferretti (2007). According to this measure, the BRIC countries (Brazil, the Russian Federation, India, and the PRC) are generally progressing toward greater financial openness. The PRC appears to be steadily increasing the extent of financial openness and to be more financially open than Brazil.[35]

We repeat this empirical exercise while including the de facto measure of financial openness instead of the de jure measure (not reported). The results of our regression are that the estimate of the de facto measure of financial openness in the U.S. dollar share estimation is significantly positive; in the euro share estimation is significantly negative; and in the home currency share estimation is insignificant with its magnitude close to zero. Notably, all these results are either inconsistent with or contradictory to theoretical predictions. These results primarily reflect the inclusion of financial-center countries such as the UK, Ireland, and Luxembourg in the sample. When we interact the de facto measure of financial openness with the dummy for high values of the measure (such as de facto measure > 3) to control for the financial-center countries, we can obtain results more consistent with theoretical predictions. However, the results are quite sensitive to what we use as the threshold for the financial-center countries. In sum, we do not think the de facto measure gives us consistent results.

OTHER FACTORS. We should suspect other potential determinants of currency choice for export invoicing so that we can minimize missing variable bias.

We first test the effect of legal development. A currency might be used more intensively in trade if it is associated with an economy where legal systems and institutions are sufficiently well developed to guarantee smooth and predictable

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35. This kind of de facto measure has its own drawbacks, however. For one thing, the extent of "openness" can differ depending on how the sizes of the volumes of cross-border capital transactions are normalized. For example, normalizing the sum of total assets and liabilities as a ratio of GDP would make the index appear unnecessarily low for large economies such as the United States, and would make the one for an international financial center such as Ireland, Luxembourg, Singapore, or Hong Kong, China appear extremely high. Second, de facto measures can be susceptible to business cycles as well as the ebb and flow of cross-border capital flows. In figure 5-11(b), the Russian Federation appeared to be becoming more "financially open" in the late 1990s, but part of this is due to a shrinkage of the denominator, the country's GDP.

Figure 5-11. *Different Measures of Financial Openness*

(a) Chinn-Ito De Jure Index

De jure measure of financial openness

IDC average   LDC average, ex-BRIC
PRC   Russian Federation
India   Brazil

(b) De Facto Measure of Financial Openness in the BRICs (Brazil, Russian Federation, India, and the People's Republic of China)

De facto measure of financial openness

LDC average, ex-BRIC   PRC
Russian Federation   India
Brazil

Source: Authors' calculations; see table 5A-1 for data sources.

transactions. Hence, we also expect higher levels of legal or institutional development to lead to more home currency invoicing and less invoicing in the vehicle currency, the U.S. dollar. We use the variable *LEGAL* as a measure of general legal and institutional development, which is the first principal component of law and order (*LAO*), bureaucratic quality (*BQ*), and anticorruption measures (*CORRUPT*).[36] The estimated coefficient on *LEGAL* is found to be insignificantly positive for the U.S. dollar share estimation, significantly negative for the euro share estimation, and insignificantly positive for the home currency share estimation (results not reported). We do not have sufficient evidence to support the hypothesis that legal development matters for the choice of invoicing currency.

Next, we investigate the effect of financial crises. Any financial crisis can throw the credibility of the currency of the crisis country into question, thereby discouraging the use of that currency for trade settlements or invoicing. And a financial crisis that involves expectations for future depreciation or devaluation leads traders to avoid the currency more decisively.

Hence, we include the dummy for currency, banking, or debt crisis individually in each of the three estimations. We use the crisis dummies from Aizenman and Ito (2013) to identify the three types of crisis.[37] The results indicate that countries that experience a banking crisis tend to increase the share of the U.S. dollar for their export invoicing by 4 percentage points and they also tend to *decrease* the share of the euro by 2.4 percentage points.[38] The effect of the banking or other type of crisis on the home currency share turns out to be insignificant.

We also investigate whether the recent global financial crisis had any impact on the choice of invoicing currencies. When we replace the crisis dummy with a dummy variable for the years after 2008, we find that countries on average increase the share of U.S. dollar invoicing by 5.8 percentage points. However, the crisis does not affect other currency shares, suggesting that the global financial crisis may have led investors and traders to flee to the U.S. dollar.

Overall, a crisis, particularly a banking crisis, contributes to more U.S. dollar invoicing, reflecting the role of the dollar as a safe-haven refuge.

Furthermore, we test whether net investment positions matter for the choice of a currency for export invoicing. The currency of a net creditor country may become more available outside the home country, which may make it easier to

36. *LAO, BQ,* and *CORRUPT* are extracted from the International Country Risk Guide database. Higher values of these variables indicate better conditions.

37. To identify currency crisis, Aizenman and Ito use the exchange market pressure index, which uses the exchange rate against the currency of the base country, which is the country a country follows most closely in determining its monetary policy. See Aizenman, Chinn, and Ito (2013) for details. The banking crisis dummy is based on Laeven and Valencia (2008, 2010, 2012). For the debt crisis dummy, they augment the data set by Reinhart and Rogoff (2009) with other sources, including the World Bank's *Global Development Finance* (World Bank 2012). For more details, see Aizenman and Ito (2013, appendix).

38. The estimation results are available from the authors upon request.

invoice in that currency. When we include the variable for net investment positions (as a share of GDP), on the basis of the Lane and Milesi-Ferretti data set, we find that the estimate is significantly positive for the home currency share estimation, suggesting that countries with better net investment positions tend to be able to invoice their exports in their own currency. However, we must take this result with a grain of salt because of potential endogeneity issues. That is, history has told us that countries with international currencies often find it easier to get finance from international financial markets and then to turn into debtor countries, as happened to the United States and the United Kingdom.

Last, we test whether exchange rate changes contribute to the choice of invoicing currencies. One contributing factor to the internationalization of the RMB is the one-sided—that is, only appreciation—expectations of the currency's exchange rate. As long as the PRC continues to experience more rapid productivity growth than advanced economies, which is expected to continue in the foreseeable future, the RMB can continue on the appreciation trend.

If the currency of exporters is on an appreciation trend, nonresidents outside the home country would have more incentive to hold the home country's currency and therefore would agree with invoicing in the home currency. Similarly, the appreciation trend of the home currency may help lower the share of the U.S. dollar use.

Hence, we include in the regressions for the shares of the U.S. dollar and the home currency the centered three-year moving average of the rate of depreciation as a proxy for currency depreciation trend. The rate-of-depreciation variable should have a positive coefficient in the U.S. dollar share regression; a currency appreciation trend (that is, negative rates of depreciation) would lead to a decrease in the U.S. dollar share, whereas it should have a negative estimate in the home currency share regression. A currency appreciation trend would lead to an increase in the home currency share.[39]

It turns out that the estimate on the rate of depreciation in the U.S. dollar share estimation is significantly positive, but that the estimate in the home currency share estimation is insignificantly positive.[40] In other words, appreciation of the home currency does lead to a fall in the share of U.S. dollar invoicing in exports, but it may not necessarily mean that exporters would invoice in their home currencies.

OTHER SPECIFICATIONS. We also test using different specifications to incorporate the unique traits of the currency share data. First, we incorporate the fact that the dependent variable for the share of a currency use ranges between 0 and 1. The truncation of the dependent variable suggests that we conduct a robustness check using the tobit estimation method. The nonlinearity of the estimation method may better fit with the nature of changes in the shares of currencies used for trade invoicing, which entails persistency or inertia, as we have shown.

39. We also control for large rates of depreciation (when the three-year moving average rate of depreciation is greater than 30 percent).
40. Results are available from the authors upon request.

Second, as another way of dealing with the possible nonlinearity of the currency share data, we transform the dependent variable into the logistic form, following Chinn and Frankel (2007, 2008). They argue that the share of a currency in central banks' reserves can develop in a nonlinear fashion so that the share of a currency can rise rapidly once it surpasses a "tipping point," or threshold, due to externality. To better capture the nonlinearity, Chinn and Frankel transform the share of a currency in central bank reserves as

$$\log\left(\frac{share}{1 - share}\right).$$

Although the nature of the development of invoicing currency shares differs from that of the shares of reserve currencies, we conduct a robustness check by transforming our dependent variables in the same way as Chinn and Frankel.

Third, we suspect that the shares of the dollar, the euro, and the home currency are correlated because the shares must sum to 1. In other words, positive disturbances in one currency should be associated with negative disturbances on average across the other currencies, making the error terms of the three estimation models correlate with each other. Because our data set is far from complete or balanced, such correlation does not have to be the case in a strict sense—in fact, there are some cases where the sign of the estimate remains the same across the three estimations for several variables, which would be inconsistent if we had complete data on the three types of currency shares. Nonetheless, we test the possibility that the error terms across the three estimations are correlated by employing the seemingly unrelated regression (SUR) estimation.

Summarizing the results from these alternative econometric specifications, we find most of the estimates in accord with those obtained using ordinary least squares (OLS), often with greater statistical significance. One exception is exchange rate volatility, which turns out to have estimated coefficients contrary to priors.[41] While the financial development/size variable often had a significantly negative coefficient for the home currency share regression, contradictory to theoretical predictions, the estimate in the U.S. dollar share estimation is significantly negative in all the nonlinear models. This supports the OLS result that a country with deeper and larger financial markets is *less* likely to invoice its exports in the U.S. dollar. The variables whose results are persistently consistent with the OLS estimation results include the variables for the share of exports, commodity exports, and relative income all for the three estimations. Financial openness is also often found to be a significantly positive contributor to the share of home currency invoicing, suggesting that the positive effect of greater financial openness on the share of home currency in export invoicing is robust.

41. Considering that this variable contains outliers, these contradictory results can be due to the outliers.

Implications and Prospects for the People's Republic of China

With the estimation results in hand, we are now interested in examining the implications of our results for the path of RMB internationalization. We first compare predicted and actual shares of some currencies, including the RMB, within the sample period. Then we examine the prospects for the use of RMB for export invoicing for the foreseeable future by making predictions of the RMB share outside our sample period.

Goodness of Fit

Figure 5-12(a) shows both the predicted and actual shares of the RMB in the PRC's export invoicing. The prediction is based on the estimates (with random effects) reported in table 5-2. Overall, the actual use of RMB for settling PRC exports is much smaller than our estimation model suggests, although the recent rapid rise in RMB settlements of exports makes it look as though the actual settlement ratios are getting closer to the predictions. Looking at when the PRC started liberalization of RMB invoicing in 2009, our model suggests that about 20 percent of the PRC's exports *should* be invoiced in RMB, although the actual use of the RMB was essentially nonexistent. As for 2011, where our model predicts the share of RMB use in PRC's exports to be 21 percent, the actual share is still a meager 6.2 percent. Cui, Shu, and Chang (2009) argue that, on the basis of the correlation between the pricing-to-market (PTM) coefficients found in their panel analysis and the actual share of home currency invoicing in exports, the PRC has the potential of invoicing 20 to 30 percent of its exports in its home currency, which is similar to our predictions.

Although there is a possibility that the estimates in our model suffer from omitted variable bias, comparison with other countries' experiences tells us that there is more to it than just omitted variable bias. Figure 5-12(b) illustrates the predicted and actual shares of the yen among the currencies used for export invoicing, and figure 5-12(c) shows the predicted and actual shares of U.S. dollar use in Japan's exports. It appears that the actual level of yen export invoicing finally reached the level predicted by the model in 1983–more than ten years after yen invoicing started taking place. But this was followed by the actual share's again hovering at lower levels than the model predicts. In the dollar invoicing, we can observe the opposite (figure 5-12[c]): the actual use of the dollar is persistently higher than the model predicts. The fact that yen invoicing did not become as prevalent as predicted while dollar invoicing was more prevalent than predicted indicates that "inertia" does affect the choice of currency for trade invoicing.

Figures 5-12(b) and 5-12(c) suggest that the underperformance of RMB invoicing can be attributed to the RMB's recent advent as an invoicing currency and the persistence or the "inertia" of the use of other currencies, particularly that

of the U.S. dollar, as the vehicle currency for trade invoicing.[42] Once a currency becomes a dominant invoicing or settlement currency, it tends to continue to be dominant.[43]

Figure 5-12(d) shows the share of the euro—a newly introduced and internationalized currency—used for the eurozone's exports.[44] The model again predicts much higher levels of euro invoicing; in fact the actual use of the euro has been rising, gradually narrowing the gap between the prediction and reality.

Prospects of Renminbi Export Invoicing

So where is the RMB heading in the near future? To answer this question, we implement out-of-sample predictions for 2015 and 2018, using the estimates we obtained in the baseline regression (see table 5-2).

For the out-of-sample predictions, we need to make assumptions about the explanatory variables. We summarize the assumptions we make for the forecasting exercise in table 5A-2 (see appendix). Some of the assumptions are based on the IMF's forecasts reported in the *World Economic Outlook* (as of April 2013). Some other variables are assumed to be the same as the average of the relevant variables in the last five years of the sample period, 2007 to 2011.
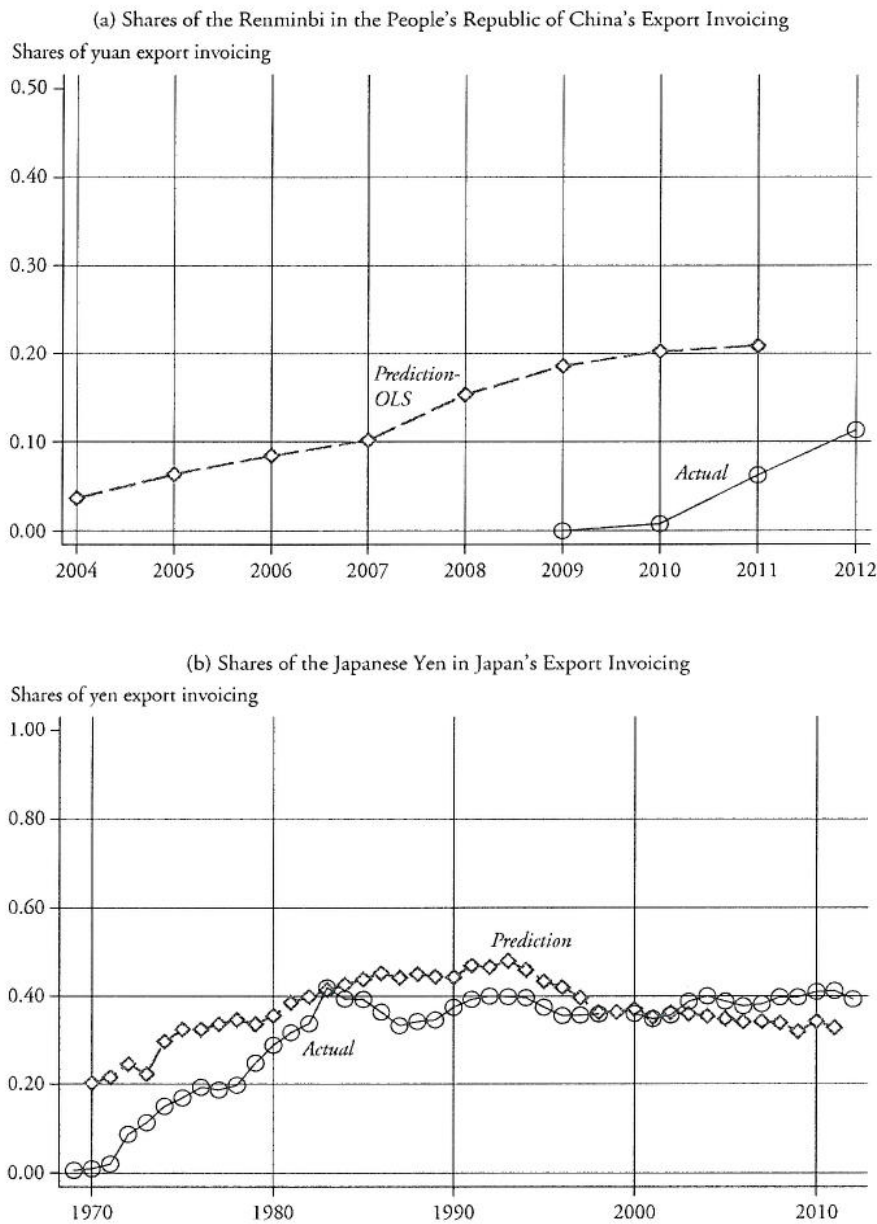
We also conduct some scenario analysis to see how the RMB share in export invoicing can be affected by hypothetical paths of financial liberalization. The baseline assumption for the Chinn-Ito index of financial openness (*KAOPEN*) is that for 2015 the PRC will increase the level of financial openness to 0.35, higher than the current level of 0.16 but not as high as that of Brazil, Colombia, and Indonesia, all of which scored 0.41 in 2011. For 2018, we assume the level of the PRC's financial openness continues to rise up to 0.50, more financially open than Turkey (0.45 as of 2011). We also think about both optimistic and pessimistic scenarios and make predictions for these scenarios as points of reference. Under the pessimistic scenario, the level of financial openness for the PRC is the same in 2015 as the 2011 level, 0.16. In 2018, we assume it rises to 0.25, a level still lower than in the baseline scenario for 2015. Under the optimistic scenario, *KAOPEN* rises rapidly to 0.60 in 2015 and to 0.95 in 2018, a level comparable to those of high-income countries.

Figure 5-13 illustrates our predictions for the 2008–2011 period, 2015, and 2018. Based on the baseline prediction, the share of RMB invoicing for the PRC's

42. Cui, Shu, and Chang (2009) also mention the persistency of invoicing practice in other non-RMB currencies.

43. We observe similar patterns when we repeat the same exercise for the Korea won, Indonesia rupee, and Thai baht, the currencies for which we have longer time series of invoicing currency shares. That is, the actual use of the dollar tends to be persistently higher than the model predicts and declines only slowly, or the actual use of the home currency tends to be lower than the model suggests, even when the share of the home currency starts rising, with the gap between the two slowly narrowing.

44. For this prediction, we also include the data for the eurozone in the regression exercise as one entity (in addition to individual eurozone countries); the estimation exercise reported in table 5-2 does not include the euro.

Figure 5-12. *Predicted versus Actual Shares of Currencies in Export Invoicing*

(a) Shares of the Renminbi in the People's Republic of China's Export Invoicing

Shares of yuan export invoicing

(b) Shares of the Japanese Yen in Japan's Export Invoicing

Shares of yen export invoicing

Source: Authors' calculations; see table 5A-1 for data sources.

(continued)

Figure 5-12. *Predicted versus Actual Shares of Currencies in Export Invoicing (continued)*

(c) Shares of the U.S. Dollar in Japan's Export Invoicing

Shares of U.S. export invoicing

(d) Shares of the Euro in Eurozone's Export Invoicing

Shares of euro in export invoicing
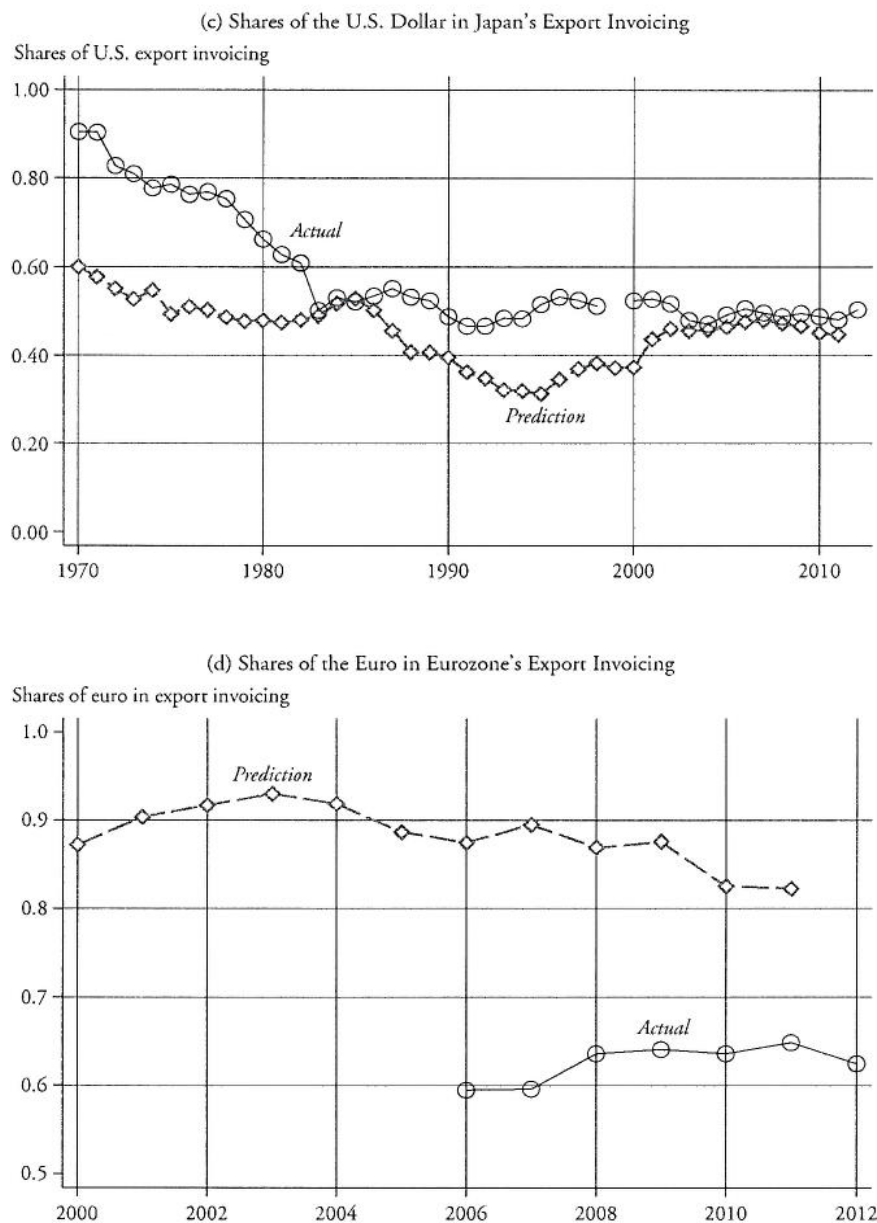
Source: Authors' calculations; see table 5A-1 for data sources.

Figure 5-13. *Forecasting the Renminbi's Share in the People's Republic of China's Export Invoicing*

Share of RMB in export invoicing
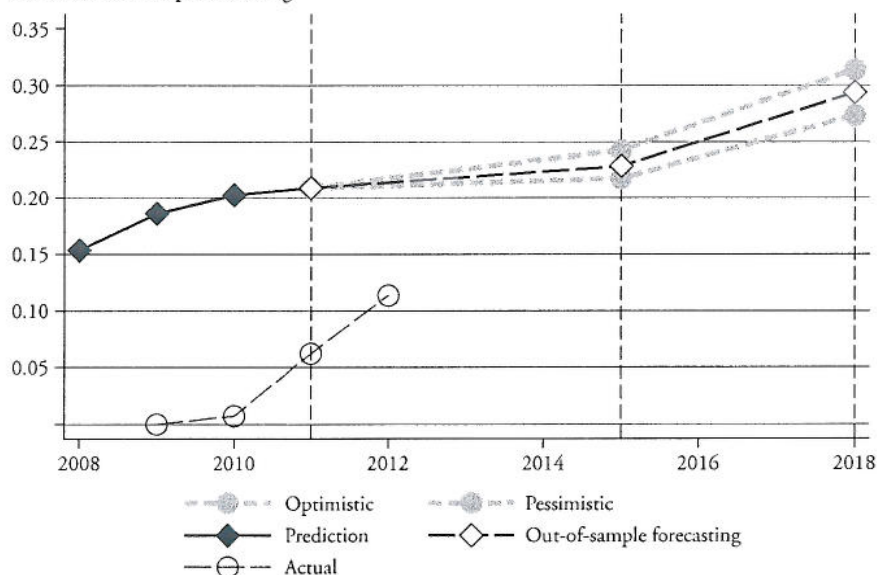
Source: Authors' calculations; see table 5A-1 for data sources.

exports would rise to 22.8 percent in 2015 and 29.4 percent in 2018. Despite the significant coefficient on *KAOPEN,* the different scenarios on financial liberalization do not appear to make much difference. Even in the optimistic scenario, the share of RMB invoicing rises only to 31.4 percent in 2018, which is not much different from the baseline scenario.[45]

Considering that the gap between the predicted and actual paths for the share of RMB export invoicing can be due to the inertia of invoicing currencies, we can expect the gap to narrow over the years to come. Hence, our predictions probably show the upper end of the actual path of RMB internationalization in terms of export invoicing.

As for the foreseeable future, the PRC may allow greater exchange rate flexibility, leading to greater volatility. In addition, it is likely the PRC's financial markets will continue to grow faster than they did from 2007 to 2011; or the country could experience higher than expected inflation. All these factors would tend to decrease RMB use (although the insignificant coefficients suggest little effect). If the PRC

45. However, we have shown that the financial openness variable is one of the robust variables to other (nonlinear) estimation models. Hence, financial openness is still one important contributor to the share of home currency use for export invoicing.

experiences an even greater increase in its relative income level or export market share, or both, then the PRC's share of RMB invoicing might also increase. Nonetheless, the convergence to the predicted values should take place as the use of RMB in export invoicing rises and creates scale benefits.

Conclusions

One of the important keys to the RMB's becoming an international currency is how widely and how soon the RMB becomes a major currency for trade invoicing or settlement. Although RMB use for trade settlement began only in 2009, its use has risen rapidly since then. Many have argued that the future of the RMB as an invoicing currency is closely tied with the issue of the PRC's commitment to liberalizing capital account transactions. In this chapter we investigated the determinants of currency choice for trade invoicing in a cross-country context while focusing on the impact of capital account liberalization.

Our data of trade invoicing reconfirmed that the U.S. dollar still plays an important role as the vehicle currency. Although the use of the euro as an invoicing currency had been steadily increasing before the euro debt crisis, a rise in the risk involving the currency seems to have contributed to the plateauing or even the decline of the currency's use in recent years. In contrast, both the global financial crisis and the euro sovereign debt crisis seem to have helped the U.S. dollar to increase its use for trade invoicing. Furthermore, in the Asian region, countries have relied heavily on the U.S. dollar as the vehicle currency, reflecting the reliance of the regional supply chain network on the U.S. as the ultimate export destination. Such an Asian dollar bloc stands as a large challenge to the PRC's ambitions for the RMB to become the regional international currency

Although the liberalization of the use of the RMB for trade transactions took place only in 2009, the share of RMB use has been rapidly rising in recent years. The RMB has been used more for import invoicing than for export invoicing, whereas in other currencies the share of the use for exports is usually higher than that for imports. This reflects the government's goal to increase the use of RMB overseas and to support the government-run efforts to internationalize the currency. Despite the rapid increase in use for trade invoicing, however, the RMB is still far behind the Japanese yen and the euro—the two previous challengers to the U.S. dollar's dominance—in its use as an invoicing currency.

Our panel data analysis provides results consistent with previous studies. Focusing on variables that have not been tested in the past studies, we find that countries with more developed and larger financial markets tend to invoice *less* in the U.S. dollar. At the same time, countries with more open capital accounts tend to invoice in either the euro or their home currency. Hence, financial development and financial openness are among the keys to challenging the dominance of the dollar in general and to internationalizing the RMB for the PRC.

Our estimates suggest that in the last few years of our sample period—2009 to 2011—the use of the RMB in export invoicing should have been higher, around the low- to mid-twenties as a percentage of total exports, rather than the actual share of less than 10 percent in 2011. The underperformance of RMB export invoicing can be attributed to inertia—once a currency is used for trade invoicing or settlements, it becomes difficult for traders to switch from one currency to another. In fact, both the yen and the euro were not used as much as the model predicts, especially at their inception as international currencies. That inertial tendency is likely to persist.

To provide some outlook on the use of the RMB as a trade invoicing currency, we implemented out-of-sample prediction for 2015 and 2018, using the baseline estimation results. Based on the projections, the share of RMB invoicing for the PRC's exports will rise to 22.8 percent in 2015 and to 29.4 percent in 2018. Despite the statistically significant coefficient on *KAOPEN*, drastically different assumptions regarding financial liberalization do not appear to make much difference.

Other factors could affect the future path of RMB use for export invoicing, including exchange rate volatility, the relative size and depth of the PRC's financial markets, its relative income level, and its export market share. Nonetheless, our predictions probably show the upper end of the actual path of RMB export invoicing. The convergence to the predicted levels could accelerate as the increased use of the RMB in export invoicing creates scale benefits.

Appendix

Appendix tables 5A-1 and 5A-2 are on the following pages.

Table 5A-1. Availability of Currency Invoicing Data for Fifty Countries for the U.S. Dollar, the Euro, and Home Currencies

Country	Currency	Years export data available	Years import data available	Sources
Austria	U.S. dollar	1973, 1975, 2006, 2010, 2012	2006, 2010, 2012	Scharrer (1981); Eurostat
	Euro	2006, 2008–12	2006–12	ECBank
	Home	1973, 1975, 2006, 2008–12	1975, 2006–12	
Belgium	U.S. dollar	1971, 1975, 1976, 2002–04, 2010	1972, 1976, 2002–04, 2010	Kamps (2006); ECB; Eurostat, Scharrer (1981)
	Euro	2000–11	2000–11	
	Home	1971, 1975, 1976, 2000–11	1972, 1976, 2000–11	
Bulgaria	U.S. dollar	1998–2006	1998–2006	Kamps (2006); Hristov and Zaimov (2001); ECB
	Euro	1998–2011	1998–2011	Bulgarian National Bank (2006)
	Home			
Croatia	U.S. dollar	1998–2004	1998–2004	Kamps (2006)
	Euro	1998–2009	1998–2009	ECB
	Home			
Cyprus	U.S. dollar	2003, 2004, 2010, 2012	2003, 2004, 2010, 2012	Kamps (2006); ECB; Eurostat
	Euro	2003–12	2003–12	
	Home	2007–12	2007–12	
Czech Republic	U.S. dollar	1999–2004	1999–2004	Kamps (2006); ECB
	Euro	1999–11	1999–2011	
	Home	2001–03	2001–03	
Denmark	U.S. dollar	1971, 1975–76, 1999–2004, 2010, 2012	1972, 1976, 1999–2004, 2010, 2012	Scharrer (1981), Kamps (2006); ECB; Eurostat
	Euro	1999–2004, 2010, 2012	1999–2004, 2010, 2012	
	Home	1971, 1975–77, 1999–2004, 2010, 2012	1972, 1976, 1977, 1999–2004, 2010, 2012	

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Country	Currency			Source
Estonia	U.S. dollar	2003, 2004, 2010, 2012	2003, 2004, 2010, 2012	Kamps (2006); ECB; Eurostat
	Euro	2001–12	2001–12	
	Home	2010–12	2010–12	
Finland	U.S. dollar	1971, 1975, 1976, 2010, 2012	2010, 2012	Scharrer (1981); Eurostat
	Euro	2006, 2010, 2012	2006, 2010, 2012	ECB
	Home	1971, 1975, 1976, 2006, 2010, 2012	2006, 2010, 2012	
France	U.S. dollar	1972, 1975–76, 1980, 1992, 1999–2003, 2010, 2012	1980, 1992, 1999–2003, 2010, 2012	Scharrer (1981); Park and Shin (2009); Kamps (2006); ECB; Eurostat; Tavlas and Ozeki (1992)
	Euro	1999–2012	1999–2012	
	Home	1972, 1975–77, 1980, 1988, 1992, 1999–2012	1977, 1980, 1988, 1992, 1999–2012	
Germany	U.S. dollar	1972, 1975, 1976, 1980–88, 1992, 2002–04, 2009, 2010, 2012	1972, 1976, 1980–88, 1992, 2002–04, 2006, 2010	Scharrer (1981); Park and Shin (2009); Kamps (2006); ECB; Eurostat; Tavlas (1993); Tavlas and Ozeki (1992)
	Euro	2002–07, 2009–12	2002–07	
	Home	1972, 1975, 1976, 1977, 1980, 1987, 1992, 2002–07, 2009–12	1972, 1976, 1977, 1980, 1988, 1992, 2002–07	
Greece	U.S. dollar	2001–04, 2012	2001–04, 2010, 2012	Kamps (2006); Eurostat; ECB
	Euro	2001–12	2001–11	
	Home	2001–12	2001–11	
Hungary	U.S. dollar	1992–2004, 2010, 2012	1992–2004, 2010, 2012	Kamps (2006); Eurostat; ECB
	Euro	1992–2004, 2008–09, 2010, 2012	1992–2004, 2008–09, 2010, 2012	
	Home	1999–2004, 2010, 2012	1999–2004, 2010, 2012	

(continued)

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Table 5A-1. *Availability of Currency Invoicing Data for Fifty Countries for the U.S. Dollar, the Euro, and Home Currencies (Continued)*

Country	Currency	Years export data available	Years import data available	Sources
Iceland	U.S. dollar	2010	2010	Eurostat
	Euro	2010	2010	
	Home	2010	2010	
Ireland	U.S. dollar	2006, 2010	2006, 2010	Eurostat
	Euro	2006–11	2006–11	ECB
	Home	2006–11	2006–11	
Italy	U.S. dollar	1971, 1975–76, 2010, 2012	1972, 1976, 2010, 2012	Scharrer (1981); Kamps (2006); ECB; Eurostat, Tavlas and Ozeki (1992)
	Euro	2001–10, 2012	2001–10, 2012	
	Home	1971, 1975–77, 1980, 1987, 2001–10, 2012	1972, 1976–1977, 1980, 1987, 2001–10, 2012	
Latvia	U.S. dollar	2000–04, 2010, 2012	2000–04, 2010, 2012	Kamps (2006); ECB; Eurostat
	Euro	2000–12	2000–12	
	Home	2010, 2012	2010, 2012	
Lithuania	U.S. dollar	1999–2005, 2010, 2012	1996–2005, 2010, 2012	Kamps (2006); ECB; Eurostat
	Euro	1999–2012	1996–2012	
	Home	1999–2005, 2010, 2012	1996–2005, 2010, 2012	
Luxembourg	U.S. dollar	2002–04, 2010, 2012	2002–04, 2010, 2012	Kamps (2006); ECB; Eurostat
	Euro	2000–12	2000–12	
	Home	2000–12	2000–12	
Macedonia, FYR	U.S. dollar	1998–2004	1998–2004	Kamps (2006)
	Euro	1998–2009	1998–2009	ECB
	Home			

Country				Source
Malta	U.S. dollar	2012	2010, 2012	ECB
	Euro	2000–03, 2012	2000–03, 2010, 2012	
	Home	2000–03, 2012	2000–03, 2010, 2012	
Netherlands	U.S. dollar	1971, 1975, 1976, 1998–2002, 2010, 2012	1998–2002, 2010, 2012	Scharrer (1981); Kamps (2006); Eurostat
	Euro	1998–2002, 2006, 2010, 2012	1998–2002, 2006, 2010, 2012	
	Home	1971, 1975–77, 1998–2002, 2006, 2010, 2012	1977, 1998–2002, 2006, 2010, 2012	
Norway	U.S. dollar	2010	2010	Eurostat
	Euro	2010	2010	
	Home	2010	2010	
Poland	U.S. dollar	1994–2004	1994–2004	Kamps (2006); ECB
	Euro	1994–2009	1994–2009	
	Home	1998–2004	1998–2004	
Portugal	U.S. dollar	2002–04, 2010	2002–04, 2010	Kamps (2006); Eurostat, ECB (2012)
	Euro	2000–11	2000–11	
	Home	2000–11	2000–11	
Romania	U.S. dollar	1999–2005	1999–2005	Kamps (2006); ECB (2012)
	Euro	1999–2011	1999–2011	
	Home			
Slovak Republic	U.S. dollar	1999–2003, 2010	2010	Kamps (2006); ECB; Eurostat
	Euro	1999–2011	2002–11	
	Home	2008–11	2008–11	
Slovenia	U.S. dollar	2000, 2001, 2003, 2004, 2010, 2012	2000, 2001, 2003, 2004, 2010, 2012	Kamps (2006); ECB; Eurostat
	Euro	2000–12	2000–12	
	Home	2006–12	2006–12	

(continued)

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Table 5A-1. *Availability of Currency Invoicing Data for Fifty Countries for the U.S. Dollar, the Euro, and Home Currencies (Continued)*

Country	Currency	Years export data available	Years import data available	Sources
Spain	U.S. dollar	1998–2004, 2010, 2012	1998–2004, 2010, 2012	Kamps (2006); ECB
	Euro	1998–2012	1998–2012	
	Home	1998–2012	1998–2012	
Sweden	U.S. dollar	1973, 1993, 2010, 2012	1968, 1973, 1993, 2010, 2012	Scharrer (1981); Grassman (1973)
	Euro	2010–12	2010–12	ECB
	Home	1973, 1977, 1993, 2010, 2012	1968, 1973, 1977, 1993, 2010, 2012	
Switzerland	U.S. dollar	1977		Scharrer (1981)
	Euro			
	Home	1977	1973	
Turkey	U.S. dollar	2002–04	2002–04	Kamps (2006); ECB
	Euro	2001–09	2001–09	
	Home	2002–04	2002–04	
United Kingdom	U.S. dollar	1977, 1980, 1992, 1999–2002, 2010–12	1980, 1992, 1999–2002, 2010–12	Scharrer (1981); Park and Shin (2009); Kamps (2006);
	Euro	1999–2002, 2010–12	1999–2002, 2010–12	Eurostat
	Home	1968, 1977, 1980, 1988, 1992, 1999–2002, 2010–12	1980, 1988, 1992, 1999–2002, 2010–12	
Ukraine	U.S. dollar	2001–04	2002–04	Kamps (2006)
	Euro	2001–07	2002–07	
	Home	2003–04	2003–04	
Asia-Pacific				
Australia	U.S. dollar	1997–2011	1997–2011	Australian Bureau of Statistics
	Euro	1997–2011	1997–2011	
	Home	1997–2011	1997–2011	

Economy	Currency			Source
People's Republic of China	U.S. dollar	2009–12	2009–12	People's Bank of China (2010 to 2013)
	Euro			
	Home			
India	U.S. dollar	2005, 2008	2005, 2008	Kamps (2006)
	Euro	1998, 2005, 2008	1998, 2005, 2008	
	Home			
Indonesia	U.S. dollar	1991, 1994–2012	1991, 1994–2012	Kamps (2006); Bank of Indonesia (www.bi.go.id/web/en/Data+Statistik)
	Euro	1991, 1994–2012	1991, 1994–2012	
	Home	1991, 1994–95, 1997–2012		
Japan	U.S. dollar	1969–2012	1969–80, 1986–2012	Yarita (1999); Park and Shin (2009); Kamps (2006)
	Euro	2000–12	2000–12	Japan Ministry of Finance
	Home	1969–2012	1969–80, 1983, 1985–2012	
Republic of Korea	U.S. dollar	1976–2005	1980–2005	Bank of Korea
	Euro	1990, 1995, 1996, 2000–05	1990, 1995, 1996, 2000–05	
	Home			
Malaysia	U.S. dollar	1995, 1996, 2000	1995, 1996	Kamps (2006)
	Euro	1995, 1996	1995, 1996	
	Home	1995, 1996		
Pakistan	U.S. dollar	2001–03	2001–03	Kamps (2006)
	Euro	2001–03	2001–03	
	Home			
Thailand	U.S. dollar	1993–2012	1993–2012	Bank of Thailand (www.bot.or.th/English/Statistics/Pages/index1.aspx)
	Euro	1993–2012	1993–2012	
	Home	1993–2012	1993–2012	

(continued)

Table 5A-1. *Availability of Currency Invoicing Data for Fifty Countries for the U.S. Dollar, the Euro, and Home Currencies (Continued)*

Country	Currency	Years export data available	Years import data available	Sources
North America				
Canada	U.S. dollar	2001		Kamps (2006)
	Euro			
	Home	2001		
United States	U.S. dollar	1980, 1988, 1992	1980, 1988, 1992, 2003	Park and Shin (2009); Tavlas and Ozeki (1992)
	Euro		2003	Kamps (2006)
	Home	1980, 1988, 1992	1980, 1988, 1992, 2003	
Middle East and Africa				
Algeria	U.S. dollar	2003, 2004		Kamps (2006)
	Euro	2003, 2004	2003, 2004	
	Home			
Israel	U.S. dollar	2000, 2004		Kamps (2006)
	Euro	2000, 2004		
	Home			
Morocco	U.S. dollar			Kamps (2006)
	Euro		2003	
	Home			
South Africa	U.S. dollar	2003		Kamps (2006)
	Euro	2003		
	Home	2003		
Tunisia	U.S. dollar	1995–2001	1995–2001	Kamps (2006)
	Euro			
	Home			

Source: Authors' compilation.
ECB = European Central Bank.

Table 5A-2. *Assumptions for Out-of-Sample Predictions*

Variable	Assumptions
Share of exports	Based on predictions in WEO
Commodity exports	Same as the average in the 2007–11 period
Relative income	Based on predictions in WEO
Exchange rate	Same as the average in the 2007–11 period
Financial development	PCGDP is assumed to be the same as in the 2007–11 average. The relative size of the market is based on linear extrapolations. We use the product of the two variables.
Inflation difference	Same as the average in the 2007–11 period
Financial openness	KAOPEN
	For People's Republic of China:
	<Middle course> 2015: 0.35; 2018: 0.50
	<Pessimistic course> 2015: 0.16; 2018: 0.25
	<Optimistic course> 2015: 0.70; 2018: 0.80
Pegged to U.S. dollar	Same as the average in the 2007–11 period
Pegged to euro	Same as the average in the 2007–11 period

Source: Authors.

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