

The Rise of the “Redback” and China’s Capital Account Liberalization: An Empirical Analysis on the Determinants of Invoicing Currencies

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Abstract

We investigate the determinants of currency choice for trade invoicing in a cross-country context while focusing on the link between capital account liberalization and its impact on the use of the RMB. We find that while countries with more developed financial markets tend to invoice *less* in the U.S. dollar, countries with more open capital account tend to invoice in either the Euro or their home currency. These results indicate that financial development or financial openness are among the keys to challenging the U.S. dollar dominance in general, and to internationalizing the RMB for China. Our model also suggests that the share of the RMB in export invoicing should have been higher than the actually observed share of less than 10%. The underperformance of the RMB export invoicing can be attributed to the inertia in the choice of currency for trade invoicing; once a currency is used for trade invoicing or settlements, it becomes difficult for traders to switch from one currency to another. This same phenomenon was also observed in the cases of the Japanese Yen and the Euro at their inceptions as international currencies. Our model predicts the share of RMB invoicing for China’s exports will rise to above 25% in 2015 and above 30% in 2018 whether or not China implements drastic financial liberalization. Because the near future path of RMB use is also expected inertial, these forecasts are probably at the upper end of the actual path of RMB export invoicing.

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1. Motivation

One of the key puzzles in international finance involves the question of which currencies are selected to be international currencies. In particular, the status of international currency confers both substantial privileges, as well as burdens, although conventional wisdom places greater weight on the former. Before proceeding further, it is important to clearly identify what we mean by an “international currency”. Table 1 (adapted from Kenen, 1983) summarizes the various roles of an international currency.

Table 1:

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

Source: Kenen (1983)

The table highlights the fact that there are several dimensions to consider in terms of to what degree a currency fulfills the characterization of being international. One can distinguish between the roles of money, and for what actors those roles pertain to. Clearly, it is possible to fulfill some roles of an international currency, while not fulfilling others.

With China’s rapid economic ascent, in terms of sheer economic size and outsized role in trade flows, it is entirely natural that questions should arise with respect to the evolution of the Renminbi (RMB) or Yuan. That debate on the “internationalization” of China’s RMB was largely a speculative one as long as the currency remained unconvertible, and capital controls were in place. With recent policy declarations and policy measures aimed at increasing the use of the RMB in trade invoicing and other transactions, the use of RMB in international markets has risen significantly, making the goal of an international RMB less and less aspirational and more concrete.

That being said, it is clear that whatever progress is being made, it is an uneven sort, with current initiatives focused on the medium of exchange dimension. As of the last quarter of 2012, 14% of China's trade was settled in Chinese Yuan, a significant increase from nil in 2009. \$1.9 billion of Yuan-denominated bonds (i.e., "dim-sum" bonds) are in circulation as of the beginning of 2013. In 2012, China accounted for 27% of the world's money supply, larger than the share of its GDP (in PPP) of 8%. Chinese borders are no longer sealed.

In contrast, in the dimension of use as a store of value, the rise of the RMB or "redback" is a potential challenge to the current international monetary system that is heavily dependent on the U.S. dollar only in the longer term. While the United States accounts for 20% of global output, 11% of trade, and 30% of financial asset trade, about 60% of foreign exchange reserves are held in U.S. dollars in the world.

Many argue that such a dollar-centric international monetary system creates an unstable environment for the world economy by providing the U.S. with privileged access to funds ("exorbitant privilege"), while constraining developing economies with the opposite effect (i.e., "original sin," the inability to issue sovereign debt in own currency). As Eichengreen (2011) argues, a new international monetary with multiple reserve currencies – the U.S. dollar, the Euro, and the Chinese Yuan – might be more stable than the current unipolar system. That is because the loss of exorbitant privilege by the US 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. With the RMB the only viable competitor amongst emerging market economies (Chinn, 2012), the issue of internationalization of the Chinese RMB is now a global issue. Nonetheless, because most observers believe that major *reserve currency* status for the Yuan is a long way off, we will particularly focus on the private actor role of an international reserve currency – the use in trade invoicing.¹

Whether and how fast the RMB becomes an international currency depends on some key points. First, how soon and in what ways China implements two policies: allowing greater market determination of the value of the RMB, and liberalizing transactions of capital across its borders. The value of the currency needs to be able to fluctuate freely, so that international investors can read signals from the market and consider portfolio strategy accordingly. Investors

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

also need to be able to find it easy to acquire or redeem Yuan-denominated bonds at their convenience in terms of both time and location. Both these conditions appear far off.

China has been extremely cautious in implementing both external and internal financial liberalization.² The global financial crisis of 2008 and the Euro debt crisis that followed have naturally enhanced reservations regarding the wisdom of financial liberalization by making clearer the potential, short-term costs of financial liberalization than the long-term gains (Kaminsky and Schmukler, 2002). However, observers have also long pointed out the high degree of financial repression and the potential risk of financial losses associated with gross inefficiencies of the current system, all of which may be mitigated by financial liberalization. Considering how the country's financial system, long dominated by state-owned financial institutions and the government, impedes smooth transformation of saving to productive investment, further capital account liberalization is an inevitable policy choice for China in the medium run. The question, however, is how orderly can liberalization proceed in order to avoid the tumultuous fate of other emerging market economies.

Thus, one important key to the RMB becoming an international currency hinges upon China's commitment to liberalizing capital account transactions though its pace may not satisfy people both inside and outside the country.³ In this paper, we are interested in the link between the inevitable path of financial globalization and the potential path for the RMB to become an international currency.

Against this backdrop, we investigate how China's efforts to liberalize its capital account transactions would affect the use of the RMB for invoicing in international trade. An increased use of a currency as an invoicing currency is not a sufficient condition for it to become an international currency. In fact, while the RMB's use in trade has been rapidly growing in the last few years, the share of the RMB in average daily foreign exchange turnover is just around 2% as of this writing.⁴ (The RMB's share among the reserve currencies is essentially zero.) However, we focus on the impact of China's financial liberalization on the use of the RMB in invoicing for international trade for two reasons. First, it is practical for us to focus on currency invoicing

² See Huang, et al. (2013) and Hung (2009) among others.

³ Thus far, China has attempted to foster use of the RMB via development of offshore markets in the Chinese yuan (sometimes referred to as the CNH).

⁴ The BIS Triennial Central Bank Survey for 2013 reports as preliminary results as of April 2013 that the share of the RMB in average daily foreign exchange turnover is 2.2%, rising from 0.9% as of 2010. The volume of RMB turnover soared from \$34 billion in 2010 to \$120 billion as of April 2013, becoming the ninth most actively traded currency in 2013.

simply because the data for currency invoicing for trade are relatively available, albeit quite limited. The data for currency denomination for securities transactions are even more limited, making a reasonable empirical analysis infeasible. 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 study, 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.

The questions we address are:

1. What factors, including capital account liberalization, affect the use of currencies in terms of invoicing in international trade?
2. How does the Chinese 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 China may implement affect the level of use of the RMB in international trade?
4. What can we expect for the internationalization of the RMB once China furthers financial liberalization efforts? Would the RMB proceed smoothly toward the status of international currency, along other dimensions?

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

2.1 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, GDP alone will not

be the main determinant. Rather, financial market development and openness to the rest of the world will be the critical factors (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 (e.g., rule of law, a low degree of corruption) as well as open capital markets are 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 – is unlikely to increase rapidly. Financial repression would also limit the desirability of each currency in international transactions.

To make these points concrete, consider that many of the reserves are held in the form of government bonds. When it is difficult to purchase and sell government bonds across borders (and especially if there is no secondary market for those bonds), and agents worry about the default risk associated with those 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, policy authorities 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

2.2 Theory and Evidence on Trade Invoicing

The literature on trade invoicing goes back to the 1970s when the Euro dollar 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 British

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, et al., 2013; Obstfeld, et al., 2005). However, if its currency becomes international, its use outside the border increases, which means the amount of currency out of the reach of monetary authorities increases as in the case of the U.S. dollar (Goldberg, 2010), and therefore that the country loses its grips on monetary policy.

Pound, the French Franc, and the Deutsche Mark started becoming the major currencies used in invoicing or settling international trade transactions.

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

As the Bretton Woods system breaks down in 1973, the uncertainty and the risk arising from exchange rate movements became one of the issues that need to be incorporated in determining the currency to invoice international trade transactions. The question of the choice of currency for trade invoicing is essentially the question of whether the producer prices her products in her own currency – producer currency pricing – or the price of a product is “priced to the market” (Krugman, 1987; Dornbusch, 1987) – local currency price. Furthermore, whether to price in producer's or local currency is a question of whether to avoid demand uncertainty or price uncertainty. A producer who prices her product in her home country's currency would not face any price uncertainty, but the demand for her product can be uncertain since it is subject to exchange rate fluctuations. If she prices her product in the local currency of the export destination, demand uncertainty can be minimized while the price or the revenue of her product can be uncertain.

Thus, not only the bargaining power but also exchange rate volatility matter for trade invoicing while the latter raises the issue of transactions cost for the currency. McKinnon (1979) focused on the impact of product differentiation on the choice of invoicing currency. He argued that exporters from European industrialized 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, tend not to price in their own home currency. In such a market, currencies with low transaction costs tend to be preferred. Given the tradition and the depth of the market, the U.S. dollar is usually a dominant vehicle currency in the commodity markets.

Goldberg and Tille (2008) in their seminal paper argued that when the demand elasticity is high, or there are competitive substitutes in the export destination market, exporters would opt for pricing in the currency used by the 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 and showed that exporters who have higher market shares in the export market or who produce more differentiated products tend to invoice in their own currency.

While microeconomic factors play an important role, 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.⁶ This is more of a case if the currency is widely used and liquid. Rey (2001) examined this issue theoretically, and argued that if more than one currencies are used in invoicing, that would yield higher transaction costs which will be passed through to export prices. Hence, if a particular currency is dominantly used, that would lower the transaction cost as the market size gets bigger. Such a “thick market externality” leads the currencies of countries with higher levels of trade volumes and openness tend 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 U.S., the issuer of the dollar, provides vast, liquid, and deep financial markets, which tremendously help reduce the transaction costs of the currency and increases the liquidity and usability of the dollar. In other words, the depth and openness of financial markets affects the transaction of the currency and matters for the choice of invoicing currency. As Caballero, et al. (2008), Chinn and Ito (2007), and Chinn, et al. (2013) show, the level of financial development and the extent of financial openness matter for current account balances, and countries with deeper and more open financial markets tend to run worsened current account or deficit. Hence, a country's financial development and openness can affect the availability and

⁶ Chinn and Frankel (2007, 2008) points out the inertia for 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.

usability of its own currency abroad, and therefore the transaction cost of the currency. Goldberg and Tille (2008), however, find only a moderate role for transaction costs in the foreign exchange markets using data on bid–ask spread for each sample country’s currency relative to the U.S. dollar. Kamps (2006) finds that countries with forward markets tend to invoice more in their home currencies.

In contrast to the relatively rich theoretical literature on the choice of currency for trade invoicing, the empirical literature is thin. The paucity of the empirical literature is due to data availability. Few countries tend to disclose currency invoicing data.⁷ Hence, most empirical studies on currency invoicing have focused on individual countries, asin Donnenfeld and Haug (2003) for Canada, Wilander (2004) for Sweden, Ligthart and Werner (2012) for Norway, Ito, et al. (2010) for Japan, and Da Silva (2004) for the Netherlands. Goldberg and Tille (2008) and Kamps (2006) are the exceptions, conducting cross-country analysis on the determinants of trade invoicing, though the scope of country coverage tends to be small and highly unbalanced.

For more literature review, refer to Goldberg and Tille (2008), Kamps (2006), Aubion (2012), Maziad, et al. (2011), and ECB (2005).

3. Empirical Analysis on the Share of Major Currencies in Trade Invoicing

3.1 Currency Shares in Trade Invoicing: Stylized Facts

The Augmented Currency Invoicing Dataset

In this study, we update and expand the dataset constructed by Goldberg and Tille (2008) and Kamps (2006). For that, we rely upon 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. Appendix 1 reports the data availability and data sources of our dataset. Hence, although a large portion of our dataset relies on the data compiled by Kamps (2006), the coverage of currency shares in export and import invoicing are considerably expanded, especially with respect to the use of the Euro. Hence, our analysis relies upon longer, more complete time series than were utilized in Goldberg and Tille (2008) or Kamps (2006).

⁷ Exceptions are the European Union and several Asian countries. The ECB has been reporting the share of the 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 consistently reporting currency share data for the country’s trade. Korea used to report consistently, but seem to have stopped publicizing the data in 2006.

Regarding our data collection efforts, we must make one important note. While we focus on analyzing the determinants of currency use for trade invoicing, our dataset on the shares of invoicing currencies for exports and imports, namely, the U.S. dollar, the Euro, and the domestic currencies, mix data on currencies used for invoicing or 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 the differences in the invoicing or settlement currencies is sometimes negligible, as Page (1977, 1981) finds, for a newly internationalized currency such as the RMB, the difference can be large. In fact, China only publishes the data on RMB settlements, not invoicing. Yu (2012) argues that, although the amount of RMB use in settlements for China's imports has been rising, a large bulk of the imports settled in RMB is initially invoiced in the U.S. dollar. 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. Hence, we must keep in mind that the Chinese data on settlements may overstate the actual use of the currency as an invoicing currency. Thus, due to data limitations we are forced to rely on a dataset that includes both invoicing and settlement currencies, and use the phrase "currency for invoicing" interchangeably with "currency for trade settlements."

Our dataset covers 50 countries, including China, but with a varying extent of coverage depending on the type of invoiced currency and on whether for exports or imports. While Japan provides the most extensive data, going back to 1969 for both exports and imports, the data availability varies among countries, including those countries for which the data are available for only a single year or a single currency (often the U.S. dollar or the Euro).⁸

Stylized Facts

⁸ Goldberg and Tille (2008) cover 25 countries whereas Kamps (2006) expands the former dataset and covers 42 countries. Our dataset updates the share of the Euro invoicing in both exports and imports to 2012, using a series of the European Central Bank's reports on the role of the Euro (ECB, 2005, 2007-2012) and the Eurostat. We also augment the dataset with longer time series for Australia (2000-03, 2006-11), Indonesia (1991-2012), Korea (1976-2005), Thailand (1993-2012), and Japan (1969-2012) as well as data from earlier years (e.g., 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, refer to Appendix 1.

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

First, Figure 1 -- the share of the use of the U.S. dollar in export invoicing against the share of exports to the U.S. in the total exports -- makes it clear that the U.S. dollar retains a dominant role. Conceptually, the dollar invoicing share in export transactions of countries should be proportional to the share of the United States as a destination of countries' exports if the U.S. dollar did not play any dominant role or the role of the vehicle currency. However, the figure clearly shows that countries invoice their exports in the U.S. dollars much more than proportionally to the share of their exports to the U.S.

Figure 2 shows the share of exports invoiced in the home currency against the share of exports in the world exports. We can see that China, that provides about 10% of the world's exports, is an outlier given its low level of export invoicing with its home currency. Excluding China, 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, China's deviation dwarfs the other's deviations, indicating that the level of home currency invoicing is much lower than what its export share in the world's exports suggests.

Figures 3-1 and 3-2 further illustrate the dominant role of the U.S. dollar in trade invoicing. These two figures show the sample-average shares of the U.S. dollar, the Euro, and the home country's currency for the invoicing of exports (Figure 3-1) and imports (Figure 3-2).⁹ We must 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 Euro countries; it is included in the share of the home currency.¹⁰

In both export and import transactions, we can observe that the U.S. dollar has the highest share, although it was on the 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 benefitted dollar-denominated assets, leading to

⁹ Because the dataset 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.

¹⁰ These rules are applied throughout the paper including the estimation exercises.

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 till the mid-2000s, followed by a decline in the share in the last years of the sample period.¹¹ The use of the home currency has been increasing for both exports and imports, but it mainly reflects the use of the Euro by the Euro member countries. In general, we see evidence of the so-called “Grassman’s Law” (1973); the share of home currency invoicing is higher for exports than for imports.

The extent of reliance on the U.S. dollar as a major invoicing currency seems to differ across different regions. Figure 4-1 illustrates the shares of currencies in export invoicing for the EU countries.¹² For this group of countries, the Euro is the most commonly 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 countries has been stable around 30-35% in the sample period.

Figure 4-2 shows the shares of invoicing currencies for the group of Asian 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 the products from the Asian supply chain is the United States. As Goldberg and Tille (2008) and Ito, et al. (2010) argue, firms tend to price to market, i.e., invoice their exports in the importer’s currency (i.e., the U.S. dollar) so as to protect their competitiveness in the destination market.¹³ The Asian dollar bloc therefore stands as a big challenge to Chinese ambitions for the RMB to become the regional international currency.¹⁴

For China, we have only four years of observations, but they reflect the country’s financial liberalization policy. In the immediate aftermath of the Global Financial Crisis of 2008,

¹¹ 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).

¹² The figure shows the averages of currency shares for the current 27 EU countries regardless of the year of accession to the union. Hence, strictly speaking, the average is calculated for the EU member countries and candidates.

¹³ Takagi (2009) argues that established practices of pricing and invoicing trade in U.S. dollar in the Asian region hampered the internationalization efforts of Korean Won despite the country’s increased presence as a major exporter.

¹⁴ We could also argue that given the imperative role of China in the Asian supply chain network, once the RMB could replace the dollar as the major invoicing currency in the Asian region, the use of the RMB could rise dramatically.

the Chinese government became active in promoting RMB trade settlements, with the hope that firms should be able to lessen exchange rate risk if they could invoice their trade transactions in the RMB. The People Bank of China (PBC) prepared the environment for RMB settlements by signing currency swap agreements with countries. By the spring of 2013, PBC has signed swap agreements with the monetary authorities of 20 countries and areas for the total amount of 1,936.2 billion Yuan (\$317.9 billion).¹⁵ In July 2009, the government started a policy of allowing several pilot firms to settle trade with the RMB through designated domestic banks and banks in the offshore markets in Hong Kong. By the fall of 2013, the scope of the policy has been expanded to become national and banks in other countries and areas (such as Singapore, Taipei, China, Japan, Australia, and New Zealand) became allowed to deal with offshore RMB (i.e., RMH) for trade settlements. As of the end of 2012, about 80% of RMB trade settlement is conducted through the offshore market in Hong Kong while other countries such as the U.K. are eager to become offshore RMB markets.¹⁶

The data of the RMB use for trade settlement reflects 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% of total trade was settled in RMB. According to the Annual Report of the People's Bank of China, the ratio only grew up to 2.2% in 2010. In 2011, it started taking off; the share of RMB use in trade settlement rose to about 6.6% and 8.4% in 2012.¹⁷

Let us look at the development of RMB trade settlement in a global context. In Figure 5, 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% of Japan's exports were invoiced in the Japanese Yen while essentially none of Japan's imports were invoiced in the currency. The share

¹⁵ The countries and areas China signed currency swap agreements with are: Korea (180 Bil. Yuan in 2008, renewed to BY360 in 2011), Hong Kong (BY200, 2008, renewed to BY400 in 2011), Malaysia (BY80, 2009), Belarus (BY20, 2009), Indonesia (BY100, 2009), Argentina (BY70, 2009), Iceland (BY3.5, 2010), Singapore (BY150, 2010), New Zealand (BY25, 2011), Uzbekistan (BY0.7, 2011), Mongolia (BY5 later expanded to BY10, 2011), Kazakhstan (BY7, 2011), Thailand (BY70, 2011), Ukraine (BY15, 2012), Brazil (BY190, 2011), Pakistan (BY10, 2011), UAE (BY35, 2012), Malaysia (BY100 later expanded to BY180, 2012), Turkey (BY10, 2012), and Australia (BY200, 2012). For more details on China's swap agreements, refer to Garcia-Herreno and Xia (2013), Huan, et al. (2013), and Yu (2013).

¹⁶ Many authors have produced in-depth review and analysis of China's financial liberalization efforts and internationalization of Yuan, including Chen and Cheung (2011), Prasad and Ye (2012), Ito (2011), Subramanian (2012), Huang, et al. (2013), Vallée (2012), and Yu (2012, 2013) among others.

¹⁷ According to the SWIFT (Society for Worldwide Interbank Financial Telecommunication), the ratio of RMB settlement in China's trade was 10% in 2011 and 14% in the first quarter of 2012.

of Yen invoicing for exports peaked in 1983, hitting 42%, although that for imports only reached 3%. Figures 6 and 7 show that since the mid-1980s the share of Yen in export invoicing has hovered around 35-40%, with that of the U.S. dollar around 50%. In contrast, the share of Yen in import invoicing has stabilized around 20-25%; the dollar has maintained higher levels around 70%. After all, despite all the discussions and initiatives about the internationalization of the Yen, the currency has failed to become the dominant currency even for the country's own trade.¹⁸

Figure 5 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 break down for exports and imports. However, it also reports the ratios between RMB receipts and payments in international trade transactions. 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.¹⁹

Figure 5 shows a rapid rise in the share of RMB use for both export and import invoicing in recent years though the government allowed RMB invoicing only in 2009. While the share of the Japanese Yen for exports has been always higher than that for imports, consistent with the Grassman's Law, the RMB has had an opposite experience. According to the PBC Annual Report, the ratio of the RMB receipts and 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 RMB overseas.

Another, more recent challenger as an international currency is the Euro. Figure 8 shows that the use of the Euro for trade invoicing has been moderately rising trend since its introduction in 1999. As was the case with the Japanese Yen, the share of Euro invoicing is higher for exports than for imports, and the gap between export and import invoicing seems to be widening in recent years, possibly reflecting the Euro debt crisis. The larger-scale use of the Euro for trade

¹⁸ This is in sharp contrast with the German Deutsche Mark (DM). The share of DM invoicing for exports remained consistently around 80% for the entire 1980s. That for imports increased from 43% in 1980 to 53% 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 would help currency appreciation, and thereby possibly hurt the international competitiveness of the exporting sectors. In the 1990s, Japan changed its policy stance and started promoting the internationalization of the Yen. However, the economy soon fell into the recession that turned out to be long-lasting, thereby leading the general demand for the currency to fall.

¹⁹ The PBC's 2012 Annual Report does not report the ratio between RMB receipts and 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, as we do to calculate the shares of RMB in export or import invoicing for 2012.

invoicing makes it clear that there is still a long way for the RMB to become international to the same extent.

3.2 Panel Analysis on the Determinants of Export Invoicing

The Model and the Candidate Determinants of Exporting Invoicing Currencies

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. More specifically, we investigate the determinants of the use of three currencies, the U.S. dollar, the Euro, and the home country's currency by using the dataset that encompasses the 50 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 about 33 to 43 countries, depending on the currency of focus, for the period from 1970 through 2011. As we have already described, the data availability of the currency share data makes the dataset highly unbalanced.

We use an empirical specification similar to those used in 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:

$$\lambda_{EXit}^C = \beta_1 + \beta_2 X_{it}^C + \beta_3 D_{it}^C + \gamma_1 FL_{it}^C + \varepsilon_{it}^C. \quad (1)$$

λ_{EXit}^C indicates the share of exports from country i in year t invoiced in currency C where C can be the U.S. dollar, the Euro, and the home country's currency.²⁰ That is, we repeat this estimation for export invoicing in these three types of currencies. The vector X_{it}^C includes the economic factors of country i that affect the share λ_{EXit}^C . In X_{it}^C We will include $ShareEX_{it}^C$, the share of country i 's exports to the U.S. or the Euro area when C is either the U.S. 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_{it}^C also includes the share of commodity

²⁰ Again, we do not include the use of the U.S. dollar by the United States in the share of the U.S. 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 Euro countries in the Euro share, but include it in the share of the home currency

exports in total exports (*Comm_{it}*), relative income level to the U.S. (*Rel_inc*), exchange rate volatility (*ExVol_{it}^C*) and inflation differentials (*InfDif_{it}^C*), relative to the U.S., the Euro, and the world, depending on the currency of interest, and a measure for financial development (*FD_{it}*).²¹

Because we think 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_{it}^C includes the dummies pertaining to currency arrangement (CA_{it}^C), 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 Euro Union (EU_i).²² 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 on the variable FL_{it}^C , the variable for capital account openness. 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 on information regarding regulatory restrictions on cross-border capital transactions reported in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)*. 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 and 2008).²³

²¹ "Commodity" includes fuel, food, and metal products based on the *World Development Indicator* categorization. The exchange rate for the United States, that is included in the "home currency" estimation, is the one against the Special Drawing Rights (SDR).

²² The dummy for the EU membership is time-invariant, i.e., 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 the members, partly because of the existence of precursor organization such as the European Community and also 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.

²³ The index is normalized to range between zero and one. High values indicate more open capital account. The original index is available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm.

The inclusion of these variables is based on the past literature on trade invoicing. Below, let us 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 externality 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 on 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 the competitors’. This prediction suggests the estimate would be positive.²⁴ We use the data from the IMF’s *Direction of Trade*.

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 homogenous 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 (i.e., the “coalescing effects” in 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 U.S. as a proxy. The expected sign is negative for both the U.S. dollar and the Euro estimations, but positive for the home currency estimation.²⁵

Exchange rate volatility and inflation differentials – A more unstable macroeconomic environment would make investors shy away from holding the currency subject to such uncertainty. Higher inflation is also associated with an unstable macroeconomic environment. Volatile exchange rates or unstable macroeconomic environment for a certain currency would make investors flee to hard currency or real assets. Hence, a country with a volatile exchange

²⁴ This can be true for the Euro share estimation.

²⁵ We use the data from Penn World Table 7.1 for real per capita income.

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 dollar, and to lesser extent the Euro too. For the home currency, both variables should have negative estimates.²⁶

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*).²⁷ 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 the effect of financial openness has to be evaluated separately from that of domestic financial development. A currency of a more open financial markets 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 for the country to invoice its trade in that currency. Therefore, the impact of financial openness on the shares of the U.S. 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 of economies of scale, and therefore tends to be used more extensively in trade than the sum of the currencies it replaces. If

²⁶ Inflation differentials are included as the differentials with the U.S. rate of inflation in the estimations for the dollar share and the home currency share. For the Euro share estimation, inflation differentials with the Euro area 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 while the estimation for the Euro share uses the exchange rate against the Euro.

²⁷ *PCGDP* is extracted from the World Bank’s Financial Structure Database (first introduced by Beck, et al., 2001).

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.²⁸

Estimation Results

Table 2 reports the results for both with random and fixed effects. While 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 the export market share matters. The larger share its export goes to the U.S. or the Euro area, the more likely it is for the country to invoice in the U.S. dollar or the Euro, 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 degrees of competition, the exporters tend to invoice in the U.S. dollar to minimize the fluctuations of the prices of their products in the local market's currency (i.e., 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.²⁹

If a country exports more commodities, it tends to invoice in the U.S. dollars. The same result is obtained for the Euro share estimation, but it is somewhat counterintuitive. The more differentiated products it exports (which we proxy for by using the relative income level to the US in PPP), the more likely it is to invoice in the home currency (and weakly in the Euro). These results provide evidence that the U.S. dollar function as the vehicle currency in international trade. A country with higher inflation tends to invoice its exports in the U.S. dollar. The estimate on the inflation differential variable is negative in the home currency share estimations, but not

²⁸ For the pre-Euro period, the dummy is assigned for countries pegging their currencies to the Deutsche Mark.

²⁹ 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 Euro area, 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 U.S. 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 U.S. dollar or the Euro share, our findings suggest that if a country has greater presence in either the U.S. or the Euro area, exports from that country would face stronger need to invoice in the U.S. dollar or the Euro to maintain their market presence. As for the estimations for the home currency, if a country has 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.

statistically significant. The fixed effect estimation for the dollar share suggests that a country with volatility exchange rates also tends to invoice its exports in the U.S. dollar.

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 the U.S. dollar.³⁰ 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 it has, the more a country 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 the 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 and therefore it may lead to more invoicing in the home currency.

On average, the EU countries have lower shares of dollar invoicing by 30 percentage points while they tend to have higher shares of their home currencies (including the Euro for the Euro countries) by 16 percentage points.

After the collapse of the Bretton Woods system in 1973, the share of home currency invoicing rose by nine percentage points, though we do not detect any significant change in the U.S. dollar share. After the Euro entered the circulation in 2002, the share of dollar invoicing declined by (an insignificant) 1.6 percentage points while the share of the Euro for non-Euro countries increased by 4 to 7 percentage points.

Those countries that peg their currencies to the dollar tend to invoice their exports in the dollar. A similar conclusion can be made for those countries that peg their currencies to the Euro; those countries that peg their currencies to the Euro tend to invoice in the Euro while they tend to reduce their home currency invoicing.

We repeat this exercise by removing all the observations for Korea and Japan because these two countries have the longest time series among the sample countries and may possibly

³⁰ 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.

bias the results. Even after removing the observations of these countries, the central results remain intact. This suggests that our results are not driven by these countries.³¹

3.3 Further Analyses

De Facto vs. De Jure Measure of Financial Openness

We used the Chinn-Ito index to measure the extent of financial openness. This index reflects the regulatory environment for cross-border capital transactions. However, the actuality of cross-border capital transactions are much more complex, and, therefore, it can differ from the picture we depict through the lens of regulatory framework.³²

According to the Chinn-Ito index, as Figure 9 (a) shows, China and India have not made progress in opening markets for capital account transactions and have been lagging behind Russia and Brazil or other developing countries. If we measure the extent of capital account openness by the actual size of cross-border capital transactions, however, we get a different picture. In Figure 9 (b), we show the extent of financial openness by using another oft-used, quantity-based *de facto* measure of financial openness, namely, the sum of total stocks of external assets and liabilities as a ratio to GDP using the dataset compiled by Lane and Milesi-Ferretti (2007). According to this measure, the BRIC countries are generally progressing toward greater financial openness. China appears to be steadily increasing the extent of financial openness and to be more financially open than Brazil.³³

We repeat the above empirical exercise while including the *de facto* measure of financial openness instead of the *de jure* measure (not reported). We get the regression results that the estimate of the *de facto* measure of financial openness in the U.S. dollar share estimation is significantly positive; that in the Euro share estimation is significantly negative; and that in the

³¹ The fact that the fixed effects estimations yield similar results to those of the random effects estimations also suggest that our findings from the random effects estimations are not just driven by the observations of Japan and Korea.

³² Researchers have constructed different *de facto* and *de jure* measures of financial openness. For more details on comparison across different measures of financial openness, refer to Kose et al. (2006) and Quinn, et al. (2011).

³³ This kind of *de facto* measure has its own drawbacks, however. For one, the extent of ‘openness’ can differ depending on how to normalize the size of the volumes of cross-border capital transactions. 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 U.S. and make the one for an international financial center—such as Ireland, Luxemburg, Singapore, or Hong Kong, China—appear extremely high. Secondly, *de facto* measures can be susceptible to business cycles as well as ebb and flow of cross-border capital flows. In Figure 9 (b), Russia appears to be getting more ‘financially open’ in the late 1990s, but part of it is due to a shrinkage of the denominator, i.e., the country’s GDP.

home currency share estimation is insignificant with its magnitude close to zero. That is, all these results are either inconsistent with or contradictory to theoretical predictions. These results are primarily due to the inclusion of financial center countries such as the U.K, 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 is greater than the value of 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 give 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 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 a variable *LEGAL* as a measure of general legal/institutional development, that is the first principal component of law and order (*LAO*), bureaucratic quality (*BQ*), and anti-corruption measures (*CORRUPT*).³⁴ The estimated coefficient on *LEGAL* is found to be insignificantly negative 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 put the credibility of the currency of the crisis country into question, thereby discouraging the use of that currency for trade settlements or invoicing. Furthermore, if a financial crisis involves expectations for future depreciation or devaluation, that would further help make traders shy away from the currency.

³⁴ *LAO*, *BQ*, and *CORRUPT* are extracted from the ICRG database. Higher values of these variables indicate better conditions.

Hence, we include the dummy for currency, banking, or debt crisis individually in the each of the three estimations. We use the crisis dummies from Aizenman and Ito (2013) to identify the three types of the crises.³⁵ 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 3.4 percentage points while they also tend to *decrease* the share of the Euro by 2.3 percentage points.³⁶ The effect of banking crisis on the home currency share or that of other types of crises turn out to be insignificant.

We also investigate if 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 dollar invoicing by 5.0 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 dollar.

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

Furthermore, we test if 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 invoice in that currency. When we include the variable for net investment positions (as a share of GDP) based on the Lane and Milesi-Ferretti dataset, we find that the estimate is significantly positive only 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 finances from the international financial markets and turn into debtor countries as it happened to the U.S. and the U.K.

Lastly, we test if exchange rate changes contribute to the choice of invoicing currencies. One contributing factor to the internationalization of the Yuan is the one-side expectation of the appreciation trend of the currency. As long as China experiences rapid productivity growth

³⁵ To identify currency crisis, Aizenman and Ito use the exchange market pressure index using the exchange rate against the currency of the base country (i.e., the country a country follows most closely in determining its monetary policy. See Aizenman, et al. (2013) for details). The banking crisis dummy is based on the papers by Laeven and Valencia (2008, 2010, 2012). For the debt crisis dummy, they augment the dataset by Reinhart and Rogoff (2009) with other papers including the World Bank's *Global Development Finance* (2012). See Aizenman and Ito's Appendix for more details.

³⁶ The estimation results are available from the authors upon request.

compared to advanced economies, which is expected to continue in the foreseeable future, the Chinese Yuan can continue to be on the appreciation trend.

If the currency of exporters is in an appreciation trend, nonresidents outside the home country would have more incentives to hold the home country's currency and therefore to agree with invoicing in that 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 dollar and the home currency the centered three year moving average of the rate of depreciation. The rate of depreciation variable should have a positive coefficient in the U.S. dollar share regression – trend currency appreciation (i.e., negative rates of depreciation) would lead to a decrease in the dollar share, whereas it should have a negative estimate in the home currency share regression – currency appreciation trend would lead to an increase in the home currency share.³⁷

It turns out that the estimate on the rate of depreciation in the dollar share estimation is significantly positive, but that the estimate in the home currency share estimation is insignificantly positive.³⁸ In other words, appreciation of the home currency does lead to a fall in the share of 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 zero and one. 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.

Second, as another way of dealing with the possible nonlinearity of the currency share data, we transform the dependent variable into the logistic form as Chinn and Frankel (2007, 2008) do. 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

³⁷ We also control for large rates of depreciation (when the three-year moving average rate of depreciation is greater than 30%).

³⁸ Results are available from the authors upon request.

point” or threshold due to externality. To better capture the nonlinearity, Chinn and Frankel transform the share of a currency in central banks’ reserves as “ $\log(\text{share}/(1 - \text{share}))$.” 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 do.

Third, we suspect that the the shares of the U.S., the Euro, and the home currency are correlated because the shares must sum to one. 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 correlated with each other. Because our dataset 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 OLS, often with greater statistical significance. One exception is exchange rate volatility, which turns out to have estimated coefficients contrary to priors.³⁹ 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, supporting 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.

4. Implications and Prospects for China

³⁹ Considering that this variable contains outliers, these contradictory results can be due to the outliers.

4.1 Goodness of Fit

Panel (a) of Figure 10 shows both the predicted and actual shares of RMB in China's export invoicing. The prediction is based on the estimates (with random effects) reported in Table 2. Overall, the actual use of RMB to settle for Chinese exports is much smaller than what our estimation model suggests, though the recent rapid rise in RMB settlements in exports makes it look like the actual settlement ratios is getting closer to the predictions. When China started liberalization of RMB invoicing in 2009, our model suggests that 20% of China's exports *should* be invoiced in RMB although the actual use of the RMB was essentially non-existent. As of 2011, while our model predicts the share of RMB use in China's exports would be 23%, the actual share is still a meager 6.2%. Cui, et al. (2009) argue that, based on the correlation between the pricing-to-market (PTM) coefficients they found in a panel analysis and the actual share of home currency invoicing in exports, China has the potential of invoicing 20-30% of its exports in its home currency, an estimate which is similar to our predictions.

While there is a possibility that the estimates in our model suffer from omitted variable bias, comparison with other countries experience tells us that there is more to it than just omitted variable bias. Panel (b) illustrates the predicted and actual shares of the Japanese Yen among the currencies used for export invoicing, and Panel (c) shows the predicted and actual shares of the U.S. dollar use in Japan's exports. It appears that the actual level of Japanese Yen export invoicing finally reached the level of the model prediction in 1983, more than 10 years after Yen invoicing started taking place, but followed by the actual share again hovering at lower levels than the model prediction. In the U.S. dollar invoicing, we can observe the opposite (Panel (c)); the actual use of the dollar is persistently higher than the model prediction. The fact that Yen invoicing did not become as prevalent as predicted while the U.S. dollar invoicing prevailed much more than predicted indicate that "inertia" does affect the choice of currency for trade invoicing.

Panels (b) and (c) of Figure 10 suggest that the underperformance of RMB invoicing can be attributed to the RMB's recent entry as an invoicing currency and the persistency or the "inertia" of other currencies' use, particularly that of the U.S. dollar, as the vehicle currency for

trade invoicing.⁴⁰ Once a currency becomes a dominant invoicing or settlement currency, it tends to continue to be dominant.⁴¹

Panel (d) shows the share of the Euro, a newly introduced and internationalized currency, used for the Euro area's exports.⁴² The model again predicts much higher levels of Euro invoicing, but the actual use of the Euro has been gradually rising, narrowing the gap.

4.2 Prospects of RMB Export Invoicing

So, where is the RMB heading in the near future? To answer this question, we implement out-of-sample prediction for 2015 and 2018, using the estimates we obtained in the baseline regression (Table 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 Appendix 2. 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 (i.e., 2007-11).

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, China will increase the level of financial openness to 0.35, a level higher than the current level of 0.16, but not as high as the level of financial openness of Brazil, Columbia, and Indonesia (which all score 0.41 as of 2011). For 2018, we assume the level of China'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 China does not change in 2015; it is the same as the 2011 level (i.e., 0.16). In 2018, we assume it rises to 0.25, a level still lower than in

⁴⁰ Cui et al. (2009) also mention the persistency of invoicing practice in other non-RMB currencies.

⁴¹ When we repeat the same exercise for the Korean Won, Indonesia rupee, and Thai baht, the currencies for which we have longer time series of invoicing currency shares, we observed similar patterns. That is, the actual use of the U.S. dollar tends to be persistently higher than the model prediction and declining only slowly while the actual use of the home currency tends to be lower than what the model suggests even when the share of the home currency starts rising with the gap between the two slowing narrowing.

⁴² For this prediction, we also include the data for the Euro area in the regression exercise as one entity (in addition to individual Euro countries) while the estimation exercise reported in Table 2 does not include the Euro.

the baseline scenario for 2015. Under the optimistic scenario, *KAOPEN* rises rapidly to 0.60 in 2015 and to 0.95 in 2018, a comparable level to high-income countries.

Figure 11 illustrates our predictions from 2008 through 2011, and 2015 and 2018. Based on the baseline prediction, the share of RMB invoicing for China's exports would rise up to 26.5% in 2015 and 31.5% 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 up to 33.5% in 2018, not much different from the baseline scenario.⁴³

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 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, China may allow greater exchange rate flexibility, leading to greater volatility. In addition, it's likely China's financial markets will continue to grow faster than what occurred in 2007-11. Or, the country could experience higher than expected inflation. All these factors would tend to decrease the RMB use (although the insignificant coefficients suggest little effect). If China experiences an even greater increase in its relative income level, export market share, or both, then China's share of RMB invoicing might also increase. Nonetheless, the convergence to the predicted values should happen as the use of RMB in export invoicing rises and creates scale benefits.

5. Conclusion

One of the important keys to the RMB becoming an international currency hinges upon how widely and soon the RMB becomes a major currency for trade invoicing or settlement. Despite the fact that 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 China's commitment to liberalizing capital account transactions. In this paper, we investigated the determinants of currency choice for trade invoicing in a cross-country context while focusing on the impact of capital account liberalization.

⁴³ 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.

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, the 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. and the United States as the ultimate export destination. The Asian dollar bloc therefore stands as a large challenge to Chinese ambitions for the RMB to become the regional international currency

Despite the recent liberalization of the use of the RMB for trade transactions, the share of the RMB use has been rapidly rising. Interestingly, as opposed to other currencies, for which the share of the use for exports is usually higher than that for imports, the Chinese RMB has been more used for import invoicing rather than for export invoicing. That reflects the government's goal to increase the use of RMB overseas and support the government-run efforts of internationalizing the currency. Despite the rapid increase in the use for trade invoicing, however, compared to the Japanese Yen and the Euro -- the two previous challengers against the dollar dominance -- the RMB is still far behind in its use as an invoicing currency.

Our panel data analysis provided results consistent with the previous studies. Among the variables of our focus, which are also the variables that have not 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 account tend to invoice in either the Euro or their home currency. Hence, financial development or financial openness are among the keys to challenging the U.S. dollar dominance in general, and to internationalizing the RMB for China.

Our estimates suggest that in the last few years, the use of the RMB in export invoicing should have been higher, around low to mid-20s as a percentage of total exports, rather than the actual share of less than 10% as of 2011. The underperformance of RMB export invoicing can be attributed to inertia. That is, 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 Japanese

Yen and the Euro had not been used as much as the model predicts especially at their inceptions as international currencies. That inertial tendency is likely to persist.

To provide some outlook of 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 China's exports will rise up 26.5% in 2015 and 31.5% 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 the RMB use for export invoicing, including exchange rate volatility, the relative size and depth of China's financial markets, its relative income level, and 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 RMB in export invoicing creates scale benefits.

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Appendix 1: Availability of Currency Invoicing Data (50 countries)

Country	Country code	Currency	Availability Exports:	Imports:	Sources
1 Austria	122	USD	1973, 1975, 2006, 2010, 2012	2006, 2010, 2012	Scharrer (1981), Eurostat
		EURO	2006, 2008-2012	2006-2012	ECB
		Home	1973, 1975, 2006, 2008-2012	1975, 2006-2012	
2 Belgium	124	USD	1971, 1975, 1976, 2002-2004, 2010	1972, 1976, 2002-2004, 2010	Kamps (2006), ECB, Eurostat, Scharrer (1981)
		EURO	2000-2011	2000-2011	
		Home	1971, 1975, 1976, 2000-2011	1972, 1976, 2000-2011	
3 Bulgaria	918	USD	1998-2006	1998-2006	Kamps (2006), Hristov and Zaimov (2001), ECB, Bulgarian National Bank Annual Report (2006)
		EURO	1998-2011	1998-2011	
		Home			
4 Croatia	960	USD	1998-2004	1998-2004	Kamps (2006)
		EURO	1998-2009	1998-2009	
		Home			
5 Cyprus	423	USD	2003, 2004, 2010, 2012	2003, 2004, 2010, 2012	Kamps (2006), ECB, Eurostat
		EURO	2003-2012	2003-2012	
		Home	2007-2012	2007-2012	
6 Czech Republic	935	USD	1999-2004	1999-2004	Kamps (2006), ECB
		EURO	1999-2011	1999-2011	
		Home	2001-2003	2001-2003	
7 Denmark	128	USD	1971, 1975-1976, 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, 1975-1977, 1999-2004, 2010, 2012	1972, 1976, 1977, 1999-2004, 2010, 2012	
8 Estonia	939	USD	2003, 2004, 2010, 2012	2003, 2004, 2010, 2012	Kamps (2006), ECB, Eurostat
		EURO	2001-2012	2001-2012	
		Home	2010-2012	2010-2012	
9 Finland	172	USD	1971, 1975, 1976, 2010, 2012	2010, 2012	Scharrer (1981), Eurostat
		EURO	2006, 2010, 2012	2006, 2010, 2012	
		Home	1971, 1975, 1976, 2006, 2010, 2012	2006, 2010, 2012	

Country	Country code	Currency	Availability	Exports:	Imports:	Sources
10 France	132	USD	1972, 1975-1976, 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, 1975-1977, 1980, 1988, 1992, 1999-2012		1977, 1980, 1988, 1992, 1999-2012	
11 Germany	134	USD	1972, 1975, 1976, 1980-88, 1992, 2002-2004, 2009, 2010, 2012		1972, 1976, 1980-88, 1992, 2002-2004, 2006, 2010	Scharrer (1981), Park and Shin (2009), Kamps (2006), ECB, Eurostat, Tavlas (1993), Tavlas and Ozeki (1992)
		EURO	2002-2007, 2009-2012		2002-2007	
		Home	1972, 1975, 1976, 1977, 1980, 1987, 1992, 2002-2007, 2009-2012		1972, 1976, 1977, 1980, 1988, 1992, 2002-2007	
12 Greece	174	USD	2001-2004, 2012		2001-2004, 2010, 2012	Kamps (2006), Eurostat, ECB
		EURO	2001-2012		2001-2011	
		Home	2001-2012		2001-2011	
13 Hungary	944	USD	1992-2004, 2010, 2012		1992-2004, 2010, 2012	Kamps (2006), Eurostat, ECB
		EURO	1992-2004, 2008-2009, 2010, 2012		1992-2004, 2008-2009, 2010, 2012	
		Home	1999-2004, 2010, 2012		1999-2004, 2010, 2012	
14 Iceland	176	USD	2010		2010	Eurostat
		EURO	2010		2010	
		Home	2010		2010	
15 Ireland	178	USD	2006, 2010		2006, 2010	Eurostat
		EURO	2006-2011		2006-2011	
		Home	2006-2011		2006-2011	
16 Italy	136	USD	1971, 1975-1976, 2010, 2012		1972, 1976, 2010, 2012	Scharrer (1981), Kamps (2006), ECB, Eurostat, Tavlas and Ozeki (1992)
		EURO	2001-2010, 2012		2001-2010, 2012	
		Home	1971, 1975-1977, 1980, 1987, 2001-2010, 2012		1972, 1976-1977, 1980, 1987, 2001-2010, 2012	
17 Latvia	941	USD	2000-2004, 2010, 2012		2000-2004, 2010, 2012	Kamps (2006), ECB, Eurostat
		EURO	2000-2012		2000-2012	
		Home	2010, 2012		2010, 2012	
18 Lithuania	946	USD	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	

	Country	Country code	Currency	Availability Exports:	Imports:	Sources
19	Luxembourg	137	USD	2002-2004, 2010, 2012	2002-2004, 2010, 2012	Kamps (2006), ECB, Eurostat
			EURO	2000-2012	2000-2012	
			Home	2000-2012	2000-2012	
20	Macedonia, FYR	962	USD	1998-2004	1998-2004	Kamps (2006)
			EURO	1998-2009	1998-2009	ECB
			Home			
21	Malta	181	USD	2012	2010, 2012	ECB
			EURO	2000-2003, 2012	2000-2003, 2010, 2012	
			Home	2000-2003, 2012	2000-2003, 2010, 2012	
22	Netherlands	138	USD	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, 1975-1977, 1998-2002, 2006, 2010, 2012	1977, 1998-2002, 2006, 2010, 2012	
23	Norway	142	USD	2010	2010	Eurostat
			EURO	2010	2010	
			Home	2010	2010	
24	Poland	964	USD	1994-2004	1994-2004	Kamps (2006), ECB
			EURO	1994-2009	1994-2009	
			Home	1998-2004	1998-2004	
25	Portugal	182	USD	2002-2004, 2010	2002-2004, 2010	Kamps (2006), Eurostat, ECB (2012)
			EURO	2000-2011	2000-2011	
			Home	2000-2011	2000-2011	
26	Romania	968	USD	1999-2005	1999-2005	Kamps (2006), ECB (2012)
			EURO	1999-2011	1999-2011	
			Home			
27	Slovak Republic	936	USD	1999-2003, 2010	2010	Kamps (2006), ECB, Eurostat
			EURO	1999-2011	2002-2011	
			Home	2008-2011	2008-2011	

	Country	Country code	Currency	Availability Exports:	Imports:	Sources
28	Slovenia	961	USD	2000, 2001, 2003, 2004, 2010, 2012	2000, 2001, 2003, 2004, 2010, 2012	Kamps (2006), ECB, Eurostat
			EURO	2000-2012	2000-2012	
			Home	2006-2012	2006-2012	
29	Spain	184	USD	1998-2004, 2010, 2012	1998-2004, 2010, 2012	Kamps (2006), ECB
			EURO	1998-2012	1998-2012	
			Home	1998-2012	1998-2012	
30	Sweden	144	USD	1973, 1993, 2010, 2012	1968, 1973, 1993, 2010, 2012	Scharrer (1981), Friberg (1966) ECB
			EURO	2010-2012	2010-2012	
			Home	1973, 1977, 1993, 2010, 2012	1968, 1973, 1977, 1993, 2010, 2012	
31	Switzerland	146	USD	1977		Scharrer (1981)
			EURO			
			Home	1977	1973	
32	Turkey	186	USD	2002-2004	2002-2004	Kamps (2006), ECB
			EURO	2001-2009	2001-2009	
			Home	2002-2004	2002-2004	
33	U.K.	112	USD	1977, 1980, 1992, 1999-2002, 2010-2012	1980, 1992, 1999-2002, 2010-2012	Scharrer (1981), Park and Shin (2009), Kamps (2006), UK, HM Customs and Revenue (trade with non-EU); Eurostat, non Euro area trade
			EURO	1999-2002, 2010-2012	1999-2002, 2010-2012	
			Home	1968, 1977, 1980, 1988, 1992, 1999-2002, 2010-2012	1980, 1988, 1992, 1999-2002, 2010-2012	
34	Ukraine	926	USD	2001-2004	2002-2004	Kamps (2006)
			EURO	2001-2007	2002-2007	
			Home	2003-2004	2003-2004	
Asia Pacific						
35	Australia	193	USD	1997-2011	1997-2011	abs.gov.au
			EURO	1997-2011	1997-2011	
			Home	1997-2011	1997-2011	
36	China	924	USD			People's Bank of China
			EURO			
			Home	2009-2012	2009-2012	

Country	Country code	Currency	Availability Exports:	Imports:	Sources
37 India	534	USD	2005, 2008	2005, 2008	Kamps (2006), Rajiv and Prakash (2010)
		EURO	1998, 2005, 2008	1998, 2005, 2008	
		Home			
38 Indonesia	536	USD	1991, 1994-2012	1991-2012	Kamps (2006), Bank of Indonesia, Balance of Payments Statistics; data transformed to represent overall trade (not only non-oil trade). http://www.bi.go.id/web/en/Data+Statistik/
		EURO	1991, 1994-2012	1991-2012	
		Home	1991, 1994-1995, 1997-2012	1991-2012	
39 Japan	158	USD	1969-2012	1969-1980, 1986-2012	Yarita (1999), Park and Shin (2009), Masuda (1995), Kamps (2006), Japan's Ministry of Finance
		EURO	2000-2012	2000-2012	
		Home	1969-2012	1969-1980, 1983, 1985-2012	
40 Korea	542	USD	1976-2005	1980-2005	Bank of Korea
		EURO	1990, 1995, 1996, 2000-2005	1990, 1995, 1996, 2000-2005	
		Home			
41 Malaysia	548	USD	1995, 1996, 2000	1995, 1996	Kamps (2006)
		EURO	1995, 1996	1995, 1996	
		Home	1995, 1996		
42 Pakistan	564	USD	2001-2003	2001-2003	Kamps (2006)
		EURO	2001-2003	2001-2003	
		Home			
43 Thailand	578	USD	1993-2012	1993-2012	Bank of Thailand, bilateral data. http://www.bot.or.th/BOThomepage/databank/EconData/EconData_e.htm
		EURO	1993-2012	1993-2012	
		Home	1993-2012	1993-2012	
North America					
44 Canada	156	USD	2001		Kamps (2006)
		EURO			
		Home	2001		
45 United States	111	USD	1980, 1988, 1992	1980, 1988, 1992, 2003	Park and Shin (2009), Tavlas and Ozeki (1992), Kamps (2006)
		EURO		2003	
		Home	1980, 1988, 1992	1980, 1988, 1992, 2003	

Country	Country code	Currency	Availability	Exports:	Imports:	Sources
Middle East and Africa						
46	Algeria	612	USD	2003, 2004		Kamps (2006)
			EURO	2003, 2004	2003, 2004	
			Home			
47	Israel	436	USD	2000, 2004		Kamps (2006)
			EURO	2000, 2004		
			Home			
48	Morocco	686	USD			Kamps (2006)
			EURO		2003	
			Home			
49	South Africa	199	USD	2003		Kamps (2006)
			EURO	2003		
			Home	2003		
50	Tunisia	744	USD			
			EURO	1995-2001	1995-2001	Kamps (2006)
			Home			

Appendix 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 liner extrapolations. We use the product of the two variables.
Inflation difference	Same as the average in the 2007-11 period
Financial openness	KAOPEN For 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 USD	Same as the average in the 2007-11 period
Pegged to Euro	Same as the average in the 2007-11 period

Table 2: Determinants of Currency Shares in Export Invoicing

	US Dollar Random 1970-2011 (1)	US Dollar Fixed 1970-2011 (2)	EURO Random 1990-2011 (3)	EURO Fixed 1990-2011 (4)	Home Random 1970-2011 (5)	Home Fixed 1970-2011 (6)
Share of exports	0.447 (0.119)***	0.382 (0.179)**	0.617 (0.108)***	0.701 (0.135)***	2.454 (0.699)***	2.202 (0.791)***
Commodity exports (%)	0.337 (0.080)***	0.145 (0.137)	-0.094 (0.084)	-0.073 (0.103)	0.198 (0.116)*	0.326 (0.140)**
Relative income	-0.118 (0.052)**	-0.208 (0.131)	0.137 (0.101)	0.911 (0.169)***	0.421 (0.088)***	0.564 (0.139)***
Exchange rate volatility	0.010 (0.032)	0.059 (0.032)*	-0.027 (0.029)	-0.022 (0.027)	-0.018 (0.025)	-0.031 (0.025)
Financial Development/Size	-0.406 (0.089)***	-0.399 (0.103)***	-0.075 (0.169)	-0.102 (0.162)	-0.056 (0.090)	-0.097 (0.097)
Inflation diff.	0.322 (0.119)***	0.426 (0.125)***	-0.083 (0.083)	-0.122 (0.078)	-0.219 (0.171)	-0.225 (0.174)
Financial openness	0.008 (0.033)	0.007 (0.035)	0.101 (0.028)***	0.073 (0.027)***	0.060 (0.032)*	0.069 (0.034)**
EU states	-0.300 (0.042)***		0.070 (0.069)		0.156 (0.079)**	
Years after 2002	-0.016 (0.013)	-0.015 (0.013)	0.070 (0.011)***	0.040 (0.012)***	0.007 (0.012)	0.001 (0.012)
Bretton Woods	-0.016 (0.030)	-0.000 (0.029)			-0.089 (0.025)***	-0.093 (0.025)***
Pegged to USD	0.056 (0.033)*	0.055 (0.032)*	0.019 (0.036)	-0.008 (0.034)	-0.049 (0.041)	-0.061 (0.041)
Pegged to Euro	-0.021 (0.025)	-0.030 (0.026)	0.067 (0.020)***	0.051 (0.020)**	-0.102 (0.021)***	-0.101 (0.022)***
Constant	0.569 (0.050)***	0.526 (0.081)***	-0.065 (0.067)	-0.256 (0.092)***	-0.125 (0.082)	-0.149 (0.091)
<i>N</i>	336	336	281	281	326	326
# of countries	43	43	33	33	37	37
Overall R ²	0.73	0.25	0.65	0.18	0.57	0.38
W/in R ²	0.21	0.22	0.37	0.44	0.27	0.27

Figure 1: U.S. Dollar as the Vehicle Currency

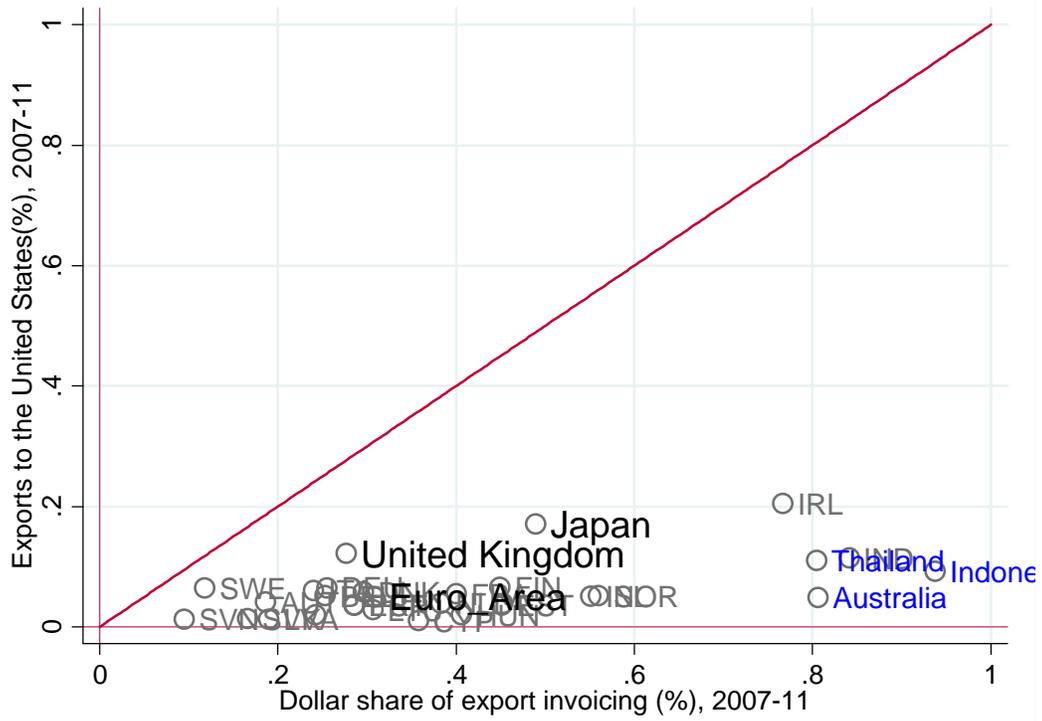


Figure 2: U.S. Dollar as the Vehicle Currency

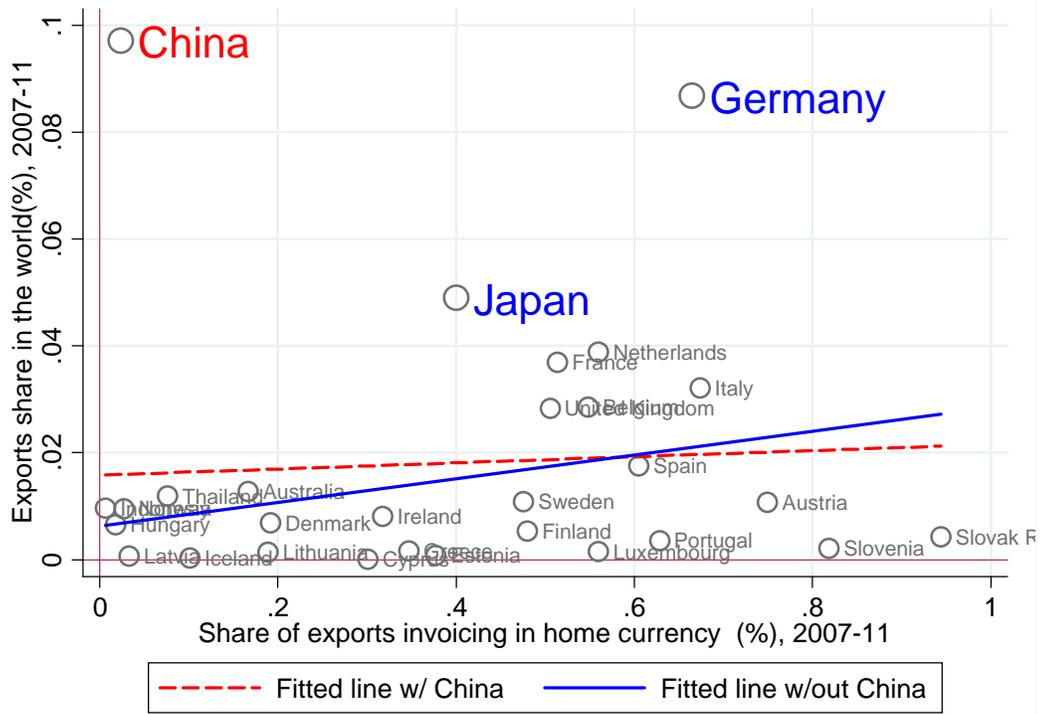


Figure 3-1: Shares of Currencies Invoiced in Exports

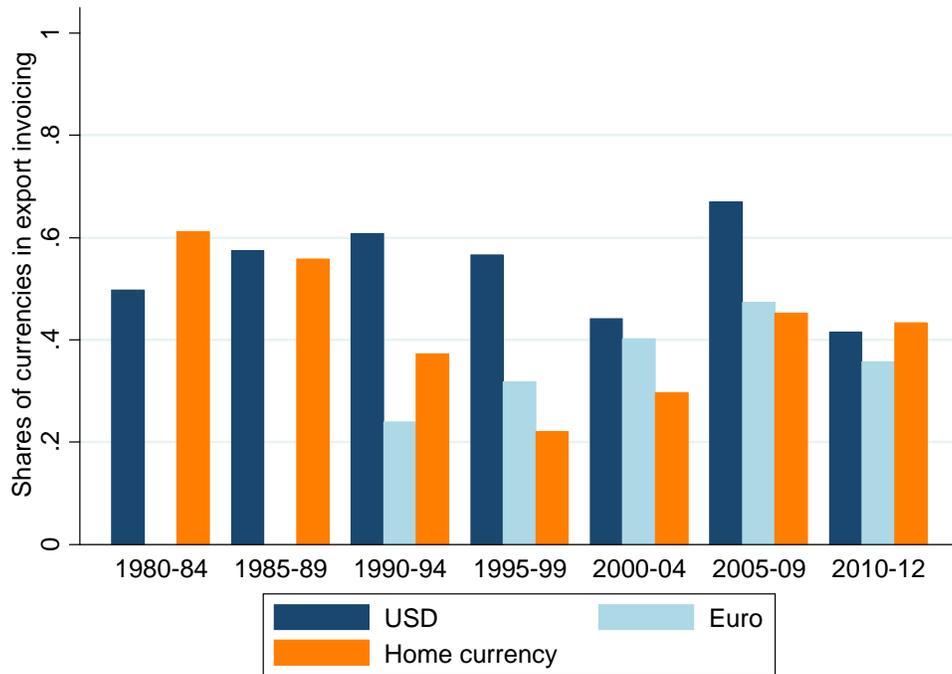
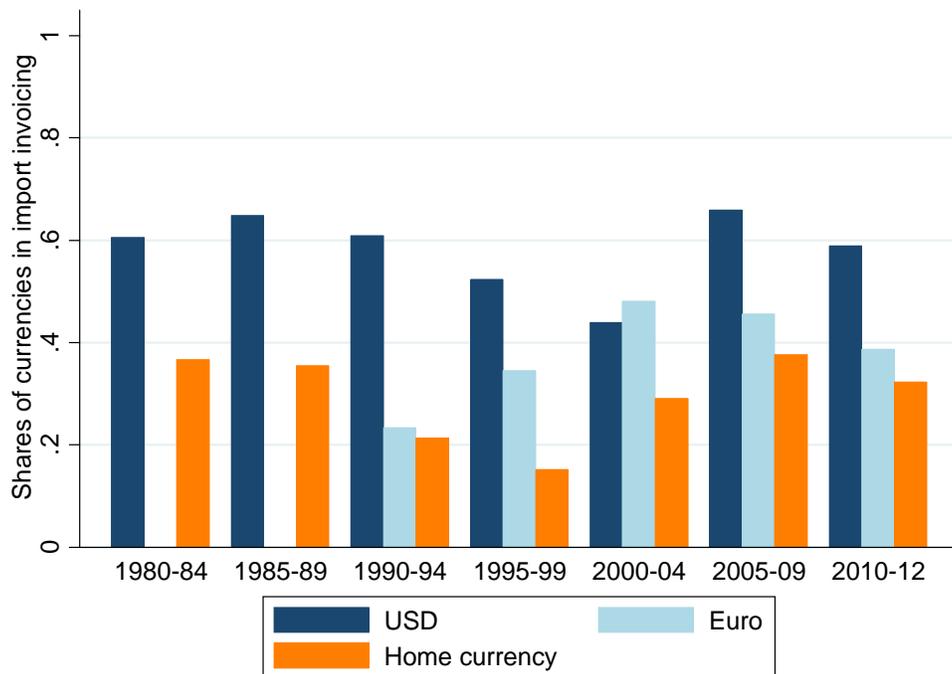
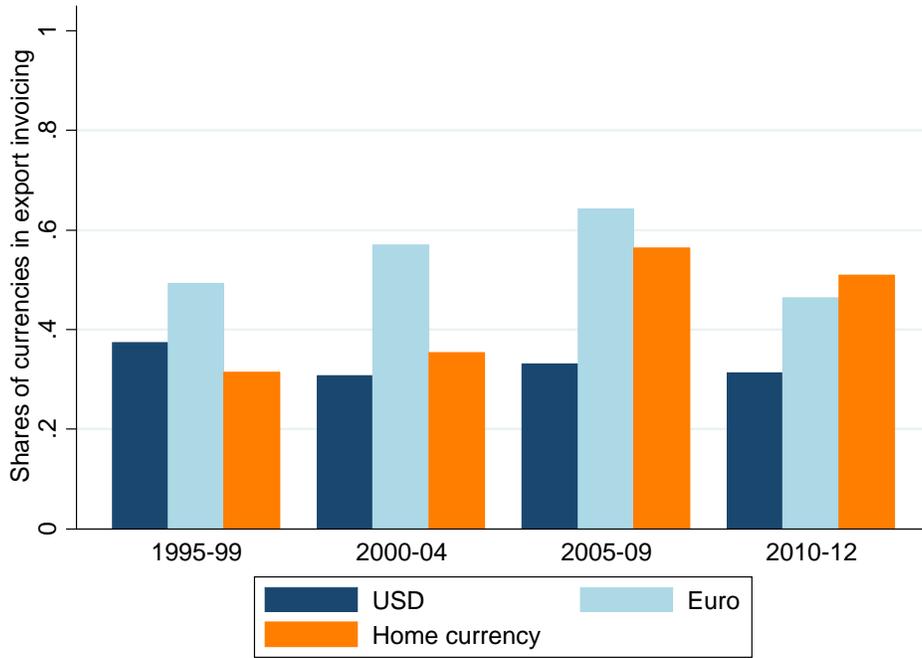


Figure 3-2: Shares of Currencies Invoiced in Imports



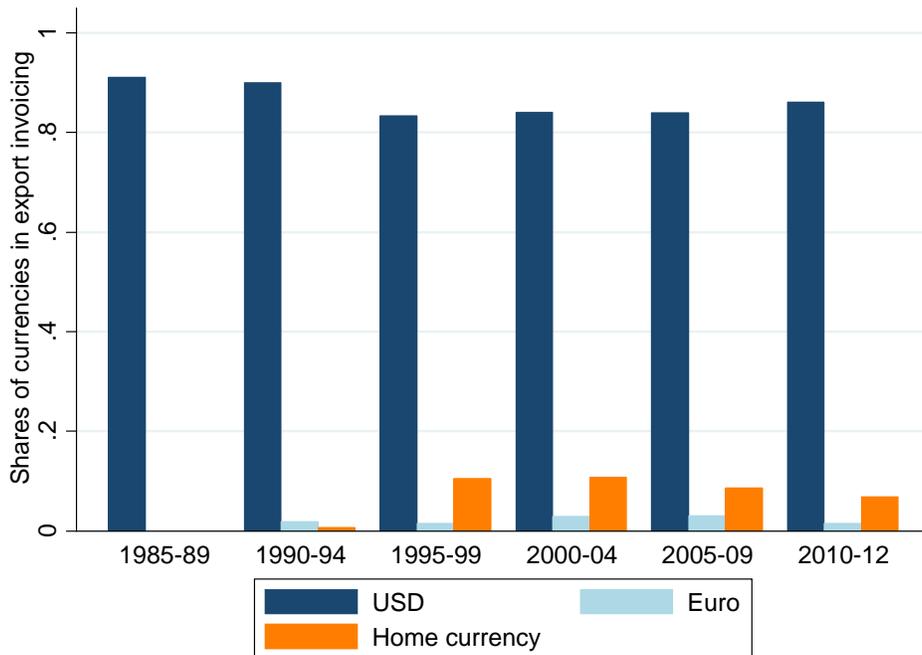
Notes: The use of the U.S. dollar in trade invoicing by the United States is not included in the average share of the U.S. dollar, but it is included in the share of the home currency. Similarly, the use of the Euro by the Euro countries is not included in the Euro share, but included in the share of the home currency.

Figure 4-1: Shares of Currencies in Export Invoicing – EU Countries



Note: The countries in the EU 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.

Figure 4-2: Shares of Currencies Invoiced in Exports – ex-Japan Asian and Pacific Countries



Note: The countries in this subsample are: Australia, China, India, Indonesia, Korea, Malaysia, Pakistan, and Thailand.

Figure 5: Share of Currencies in Japan's and China's Trade

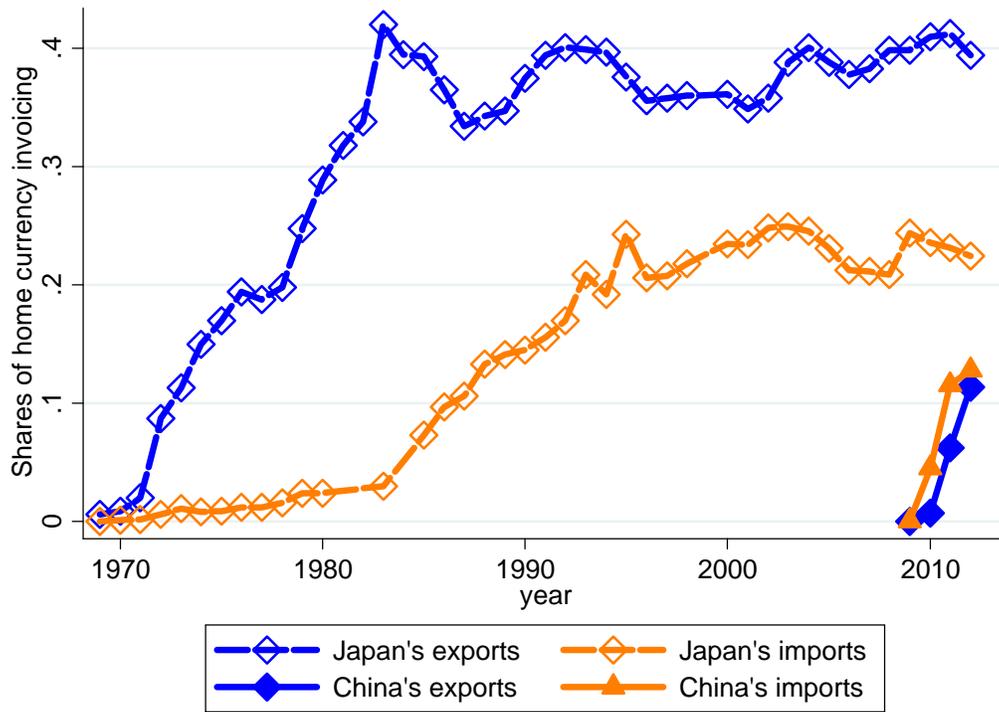


Figure 6: Share of Currencies in Japan's Exports

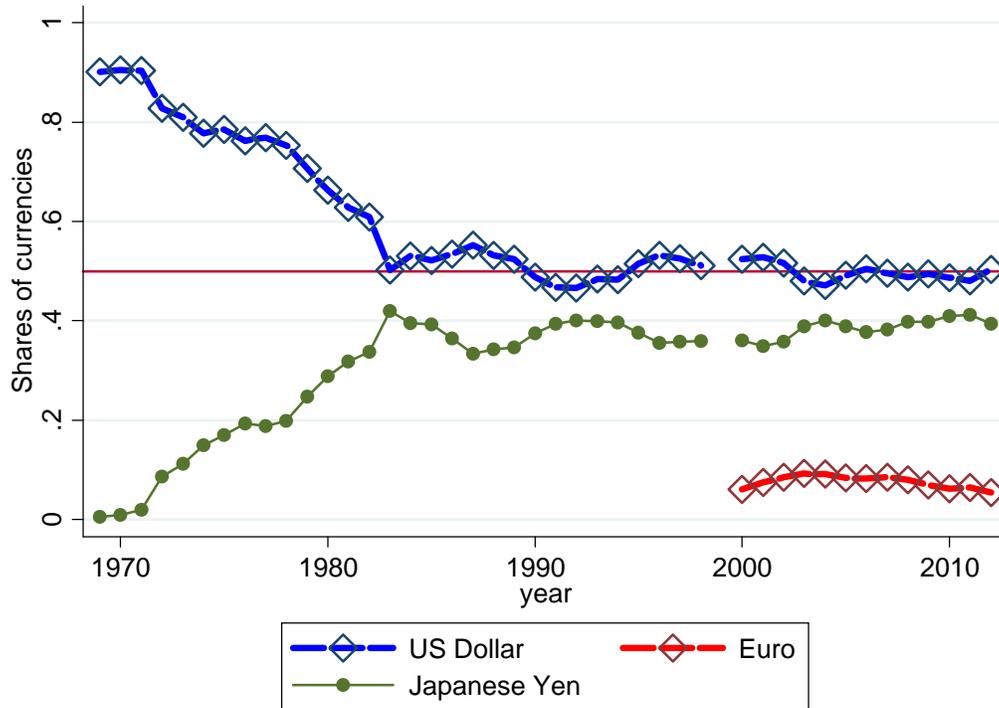


Figure 7: Share of Currencies in Japan's Imports

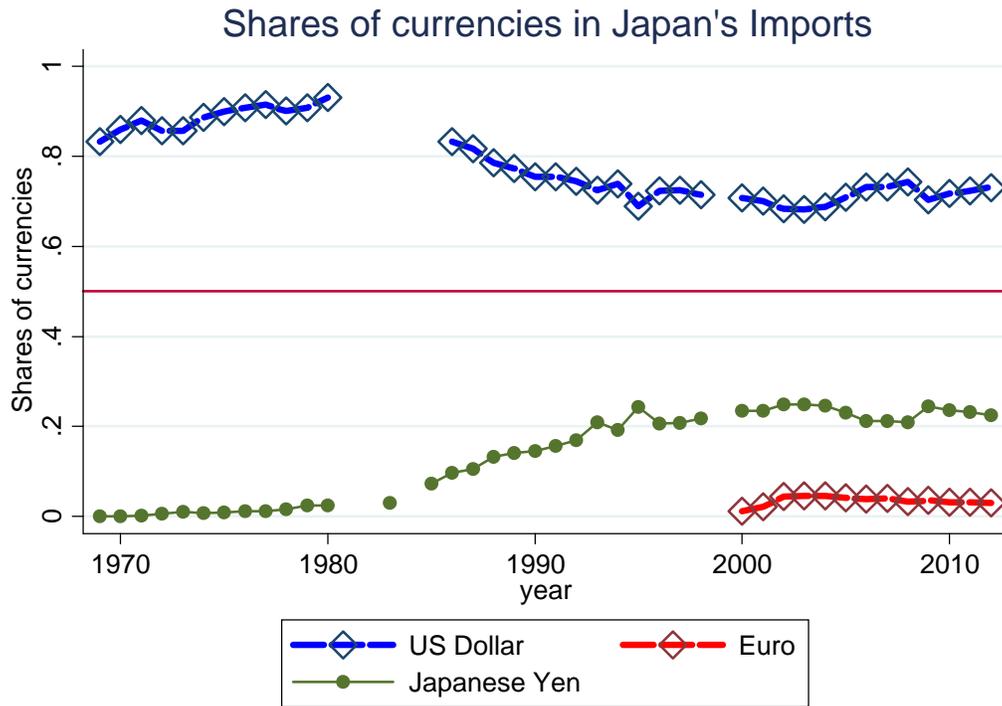


Figure 8: Share of Currencies in China's and Euro Area's Trade

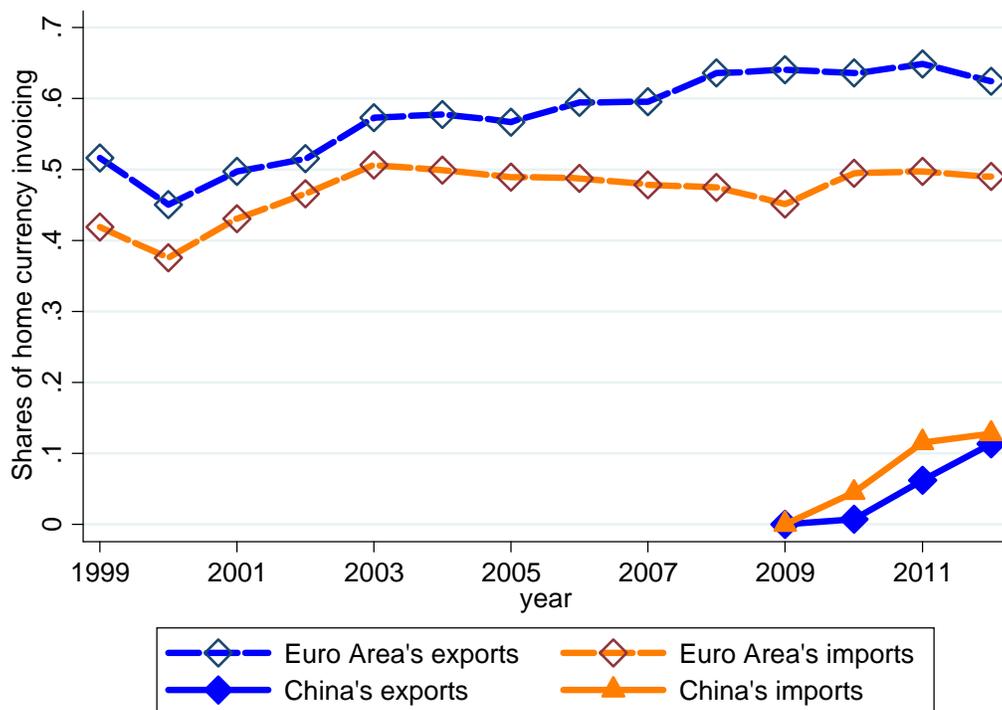
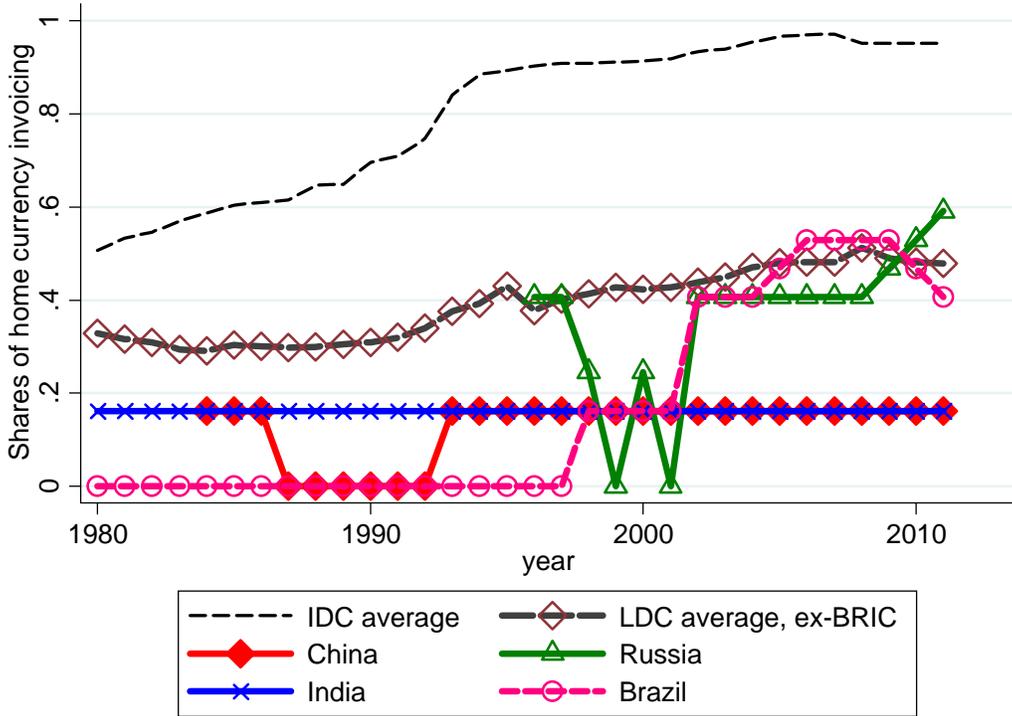


Figure 9: Financial Openness in Different Measures

(a) Chinn-Ito index



(b) De facto Measure of Financial Openness

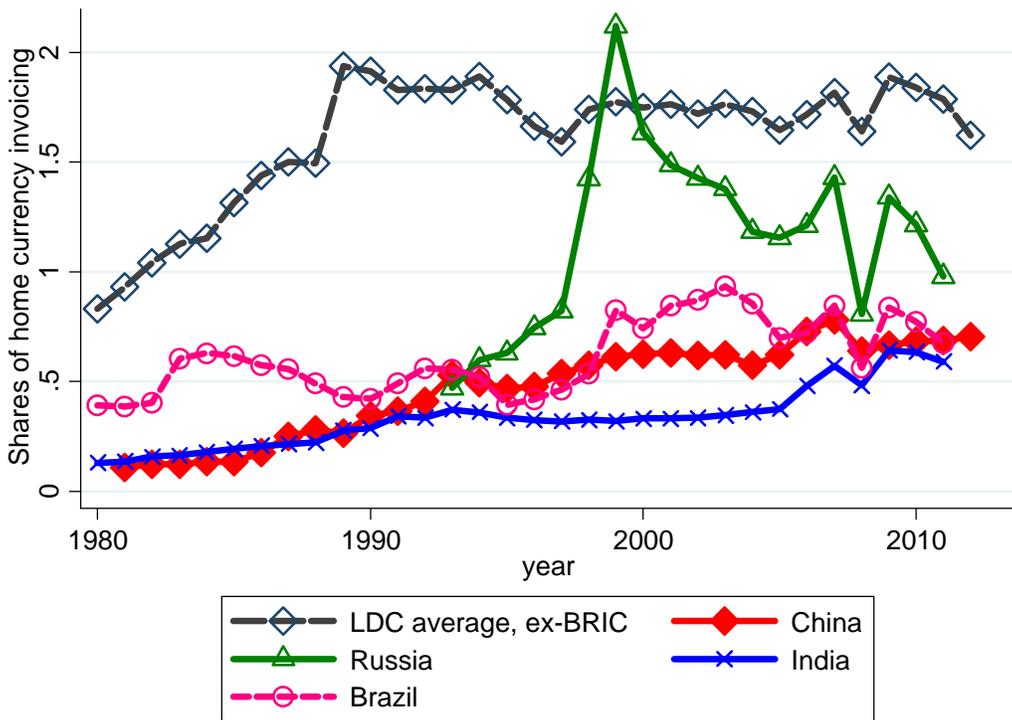
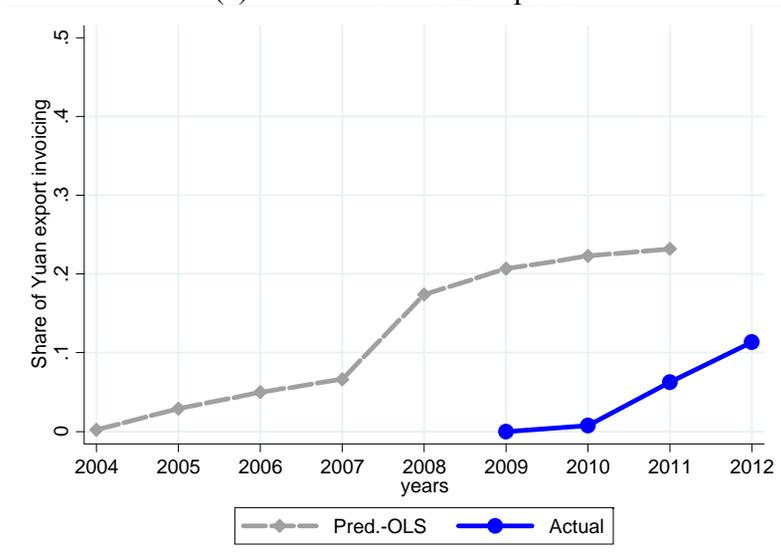
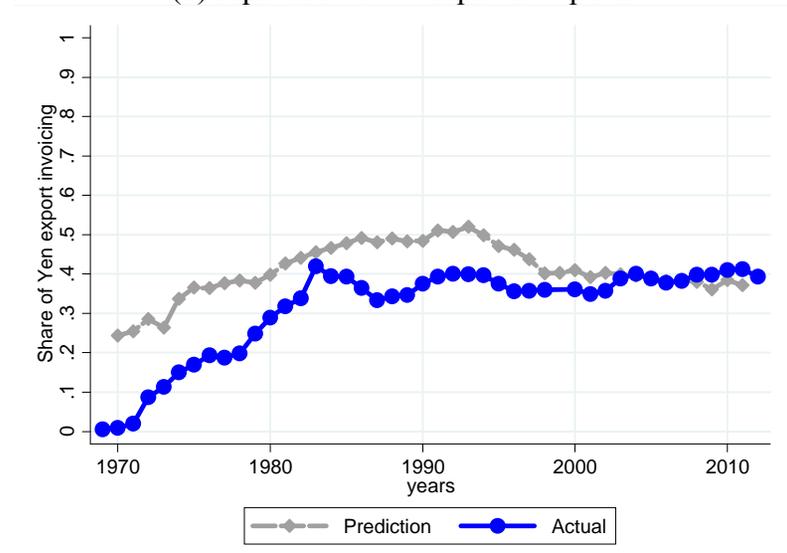


Figure 10: Predicted vs. Actual Currency Shares

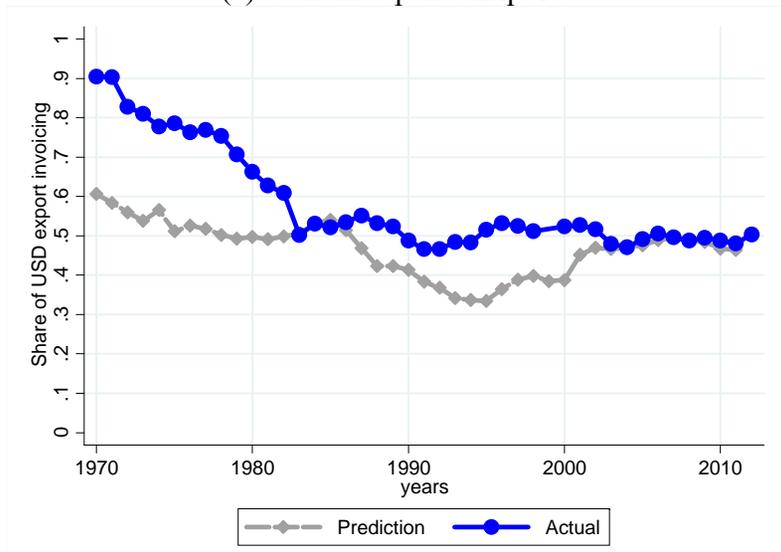
(a) RMB in Chinese Exports



(b) Japanese Yen in Japan's Exports



(c) USD in Japan's Exports



(d) Euro Share in Euro Area's Exports

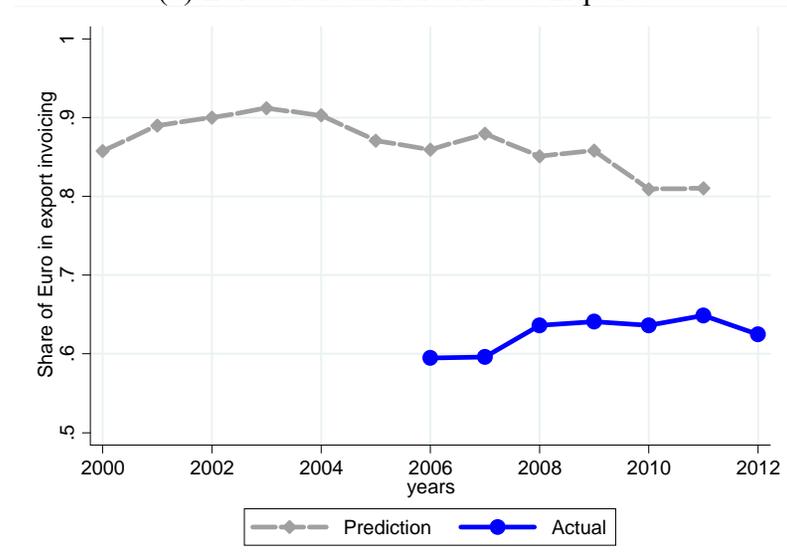


Figure 11: Forecasting of the RMB Share in China's Exports

