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The internationalisation of the RMB: New starts, jumps and tipping points

Jonathan A. Batten [a,*], Peter G. Szilagyi [b,c]

[a] Department of Banking and Finance, Monash Business School, Monash University, PO Box 197, Caulfield East, Victoria 3145, Australia
[b] CEU Business School, Central European University, Frankel Leó út 30-34., Budapest 1023, Hungary
[c] Judge Business School, University of Cambridge, Trumpington Street, Cambridge, CB2 1AG, United Kingdom

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ABSTRACT

We investigate the process of currency internationalisation of the Chinese Renminbi (RMB). Aggregated cross-border data provided by the Society for Worldwide Interbank Financial Telecommunications (SWIFT) allows better measurement of the role played by a currency in trade and settlement. RMB transactions are significant and increasing but remain concentrated in key financial centres. Analysis using an asset pricing framework shows that the footprint of Chinese corporations in international markets has at times been significant, with the size of these transactions prompting many to reassess the likely pace of RMB internationalisation and its usage as an alternate vehicle currency.

1. Introduction

Currency internationalisation provides significant economic benefits to a country's residents (Kenen, 2009; Cohen, 2012, McCauley, 2015; Liao and McDowell, 2016; Zhang, and Tao, 2016). However, what makes a currency international and how should one measure internationalisation? The simple answer to the first question is to consider its role in cross-border transactions, both trade and capital account, and as a

* Corresponding author.
E-mail addresses: jonathan.batten@monash.edu (J.A. Batten), szilagyip@business.ceu.edu, p.szilagyi@jbs.cam.ac.uk (P.G. Szilagyi).

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reserve currency (Krugman, 1980; Chinn and Frankel, 2005; Goldberg, 2005; Gray, 2011). The economic size of a home country, the flexibility of its exchange rate and the stability of its economic and political institutions are also important determinates in the scale and scope of currency usage. We will also show that wide usage is also characteristic of an internationalised currency. In other words, in order for a currency to be international it must be used by everyone and accepted everywhere to transact cross-border business.

The answer to the second question is more complex in that researchers have been limited to traditional sources of macroeconomic statistics, typically the quarterly international banking, trade and currency statistics, collected by international organisations such as the International Monetary Fund (IMF) and the Bank for International Settlements (BIS). In this paper, we approach the measurement of currency internationalisation by considering the single most important component of internationalisation: its role in international trade and capital account settlement. More specifically, we use monthly aggregated data provided by the Society for Worldwide Interbank Financial Telecommunication (SWIFT) to investigate the degree of internationalisation of the currency of the People's Republic of China (henceforth simply China) termed the renminbi (RMB).

We are able to utilise a host of RMB financial variables: usage in foreign exchange, international fixed income and money markets, as well as for trade settlement, previously unavailable to earlier researchers. Importantly, the currency usage in international trade and finance suggested by the SWIFT variables is consistent with benchmark surveys by institutions such as the BIS (e.g. BIS, 2010, 2013a, 2013b, 2016), while the SWIFT data have the advantage of being available at a higher frequency and with greater cross-border detail.

Much attention has been directed towards the economic rise of China, whose economy has shown stellar growth in the recent past and momentum that analysts agree will likely propel China to become the world's largest economy sometime after 2020. However, what role will its currency play in this new world order and how widespread is RMB usage now? In the first instance, this paper updates earlier work by SWIFT (2012, 2013), which uses key SWIFT messages to track the pace and extent of RMB internationalisation. We also provide a more detailed statistical assessment that better enables the tracking of the degree of internationalisation of the RMB.

One key question addressed in this study is the appropriate way to measure the degree of currency internationalisation of a currency? For example, should the RMB's degree of internationalisation simply be measured relative to the holdings of RMB by central banks (e.g. Gray, 2011) or its use in trade and portfolio transactions (e.g. Chen and Cheung, 2011; Chinn and Frankel, 2005) tackled this question with respect to the internationalisation of the euro and employed a panel of macroeconomic variables in their statistical analysis. Clearly all these factors are important.

While our analysis considers RMB denominated transactions across these single areas, a key contribution of this work is that we tackle the measurement problem differently to other researchers. Our approach borrows from the literature on financial market integration and international asset pricing to consider the degree of internationalisation in terms of the sensitivity of the covariance structure of a set of RMB financial variables to transactions in all currency markets.

Our analysis shows that the correlations between all SWIFT messages are generally low and are not statistically significant, although there are some exceptions, such as the relationship between bank transfers and trade, which is highly correlated (about 52%). Similar relationships hold for transactions in RMB, although the previously mentioned exception has a higher correlation of 0.73%), the likely consequence of recent regulatory reforms that expanded market access by all participants (see Jing, 2007; Zhang, 2009; Wang and Hussein, 2010; and Zhang, 2010 amongst other studies). We rely on the relatively low correlation levels between monthly changes in the SWIFT messages investigated and the fact that monthly changes in log values are essentially random, with a mean close to zero, to undertake statistical analysis of a set of SWIFT messages in the context of portfolio theory. This approach also enables us to track the sensitivity of single RMB components to international and domestic developments despite the restrictions that exist with the limited times-series history of our data.

This approach differs from an internationalisation index based on the adding of underlying trade, banking or currency ratios, and provides an alternate perspective to various measures already developed by various practitioner organisations that tend to focus on single measures such as trade settlement or currency use as a vehicle for trading.[1] Subject to data availability this measure could be applied historically to enable an

[1] For example, the RMB Tracker, already developed by SWIFT (2013).

assessment of the impact of policy decisions and reform aimed at enhancing currency use in global markets. Our approach benefits from the higher frequency SWIFT data and so provides an insight into whether there is a "tipping point" for RMB internationalisation in the sense of Chinn and Frankel (2005). For example, does the usage of a currency for pricing commodities and trade increase monotonically over time, or does a certain level of usage (the tipping point) cause the currency to become more widely used? We show that when comparing the rate of change in the value of various SWIFT messages worldwide to those denominated in RMB, the relationship is positive, which is consistent with the wider usage of the RMB worldwide, although the recent pace of usage is now more consistent with worldwide macroeconomic developments.

Overall, our results show that the RMB has definitely internationalised in recent years, with both single and aggregate measures changing in response to recent deregulatory measures. Anecdotal evidence suggests that a tipping point has not yet been reached. If anything our results highlight the effects of declining momentum. It is important to note that other emerging currencies, such as the Indian rupee and the Brazilian real are also gaining importance internationally and are increasingly used for trade settlement especially within their local regions (BIS, 2010, 2013a).

This study also provides further insights into the existing role of international financial centres (e.g. Garcia-Herrero, Tsai and Le, 2012; BIS, 2013a; and He, Korhonen, Guo and Liu, 2016). Not surprising is our finding that RMB transactions are mostly undertaken where one counterparty is located in the financial centres of first Hong Kong, then Macau and Singapore and to some extent Taipei, where cultural and social links place them at an advantage to those counterparties undertaken in Europe. However, transactions in RMB where both counterparties are non-residents (as currently occurs in the USD Eurobond markets) are increasingly undertaken in the financial centres of London and New York, especially for foreign exchange trading and international money market transactions. Recall that London and New York are the world's primary and secondary centres for foreign exchange trading. Our findings confirm that the value of London based RMB foreign exchange trading now exceeds transactions undertaken in Hong Kong and Singapore, which is consistent with London's pre-eminent role as the world's centre for derivatives and foreign exchange trading (BIS, 2010, 2013a, 2016).

For now the results from this analysis show that the momentum of RMB internationalisation has stabilised, suggesting that China's path to RMB internationalisation will remain slow. This conclusion is consistent with many other studies, including Hua (2010), Tung et al. (2012), Eichengreen and Kawai (2014), and Shu, He and Cheng (2015). Ultimately reform initiatives must be maintained to ensure that China is able to fully capitalise upon the opportunities that are now unfolding as the international economic and political landscape shifts more towards its favour. (e.g. Taylor, 2013; He, Luk and Zhang, 2016; Tsuchiya, 2016; Yelery, 2016; and Zhang and Tao, 2016).

The paper is set out as follows: next we provide further background on the recent literature on currency internationalisation and China's footprint and role in international financial markets; then we explain the SWIFT data and method used in the study. Our results are presented in two stages: first we provide analysis of single measures of internationalisation based on the SWIFT variables; then we present the results using a covariance based measure. The final section offers conclusions and recommendations.

2. Background

In the post Bretton–Woods international environment the U.S. dollar (USD) has been the preferred currency for reserve denomination and the settling of international trade and capital transactions (Lee, 2010; Maziad et al., 2011; He and Yu, 2016). In all aspects, the USD remains pre-eminent despite an expected reversal in its fortunes due to the introduction of the euro and a perceived decline in US political and economic hegemony (see Chinn and Frankel, 2005). More recently there was hope that the new economic giant of China, might attempt to better position its currency, the RMB, in international markets.

Recent discussions investigating the role that the RMB now plays in international markets[2] invariably compare China's recent experience with the earlier experience of Japan (e.g. Kawai and Takagi, 2011). Two decades ago, Japan failed to fully internationalise its currency, the Japanese yen (JPY), despite having a

[2] See the milestones of offshore RMB internationalisation (Source: HKEx, Market Statistics 2011) http://www.hkex.com.hk/eng/newsconsul/hkexnews/2012/documents/120119news.pdf.

commanding position in international trade and investment (Oi, Otani and Shirota, 2004; and Zhang, Makin and Bai, 2016). This remains the case today, based on evidence from the SWIFT message database.

Earlier theoretical work by Krugman (1980) argued that economically dominant countries should take on the role of a vehicle currency for international trade, settlement and financing both internationally or regionally. The later work by Bacchetta and van Wincoop (2005) also highlighted the importance of economic size and dominance stating that the higher the market share of an exporting country in an industry, and the more differentiated its goods, the more likely would its exporters price in the home currency. One possible explanation for the failure for other currencies to develop lies in the lack of a critical level of liquidity, in both relative and absolute terms, in foreign exchange, (e.g. Tchang, 2011) and money markets, which would minimise transactions costs, especially for non-residents.

Greenspan (2001) made this point when commenting on the likely role of the euro, following its introduction, suggesting that any dollar displacement would be a drawn out and protracted process until sufficient levels of liquidity were achieved by the alternate currency. Even now it is obvious that the absence of liquidity in secondary markets will undermine the development of the RMB as an international currency. This is especially so, as will be shown later, due to the one-off and large size of many international transactions in some market segments (such as trade) that occurs on the RMB.

The international outcomes of the past 100 years provide many obvious similarities, as well as differences, to events unfolding in China today. Like Japan, China is now slowly embarking on a protracted internationalisation programme beginning with the gradual lifting of capital control restrictions, while simultaneously introducing reforms aimed at developing financial markets. Recent initiatives include expanding the role of international investors, while past initiatives focused more on providing international access to China's financial and non-financial corporations (and their subsidiaries), as well as access to China's domestic markets by foreign banks (see SWIFT, 2012; Gao, 2013). These actions form part of eight key areas of reform discussed at the Fourth National Financial Work Conference, Beijing, in January 2012.[3]

China now faces an interesting quandary: its economy could soon become the world's largest, while its financial markets remain underdeveloped, and trade invoicing and settlement in RMB are only gradually taking place. There are many anomalies that result as a consequence, of particular importance is the pricing of RMB in onshore (termed CNY markets) and offshore markets (termed CNH) and the feedback channels between them (see Song and Gochet, 2011; McCauley, 2013; Tobin, 2013; Minikin and Lau, 2015; and Shu, He and Cheng, 2015).

While the debate on currency internationalisation continues it is worthwhile highlighting China's expanding presence in international markets. He and McCauley (2012) have previously noted that the offshore RMB market in the future could largely serve to intermediate between non-residents. For example, in recent years, China has also been the largest international bond issuer to South Korea in the Asia-Pacific region (South Korea's outstandings are US$171.4 billion compared with China's US$194.7 billion in March 2013).

3. Data

The construction of any measure of internationalisation measure should incorporate the “Three Pillars” that are regarded as being critical for a currency to be international (e.g. Chinn and Frankel, 2005; Gao and Yu, 2009; Kawai and Takagi, 2011). This requirement is for a currency to be used as a unit of account for trade invoicing and financial product denomination; a medium of exchange for market transactions, such as trade payments and settlements, and payments in financial transactions; and as a store of value for saving, such as cross-border deposits and securities investments.

We are able to address these requirements by incorporating specific data from SWIFT that broadly align with these three classifications. SWIFT classify their data in a number of ways based on the type of financial product and relationship of counterparties (e.g. bank to bank versus bank to customer). Of relevance in this study are aggregated sent and received cross-border transactions denominated in RMB (the SWIFT code is CNY). This aggregated data are bundled into monthly maturities for the period from October 2010 to January 2012 and is available for cross-border transactions for up to 252 countries for each SWIFT currency. The

[3] People's Bank of China, ‘Assessment of Greater Liberalisation of China's Capital Account’ (Chinese language), 24 February, 2012, http://www.cs.com.cn/xwzx/07/201202/t20120223_3253890.html).

sample period in this study begins between two major expansion dates of RMB trade settlement: June 2010, when 365 corporates in 18 provinces were permitted direct settlements of RMB transactions for cross-border trade, and December 2010, when this number was increased to 67,359 corporates (Song and Gochet, 2011).

Our analysis measures the following message types[4]: MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit). The messages may also be considered in terms of the "three pillars" of internationalisation, although there is evident overlap between different SWIFT message types and the "three pillars":

(1) Unit of account for trade invoicing (MT700) and financial product denomination (MT300 and MT400)
(2) A medium of exchange for market transactions, such as trade payments and settlements, and other payments in financial transactions. This requirement reflects trade and capital account transactions and would include MT300, MT320 and MT202 to the extent that they reflect interbank cross-border settlements and the MT540, MT541 and MT543 series since they represent payments for securities purchases and sales.
(3) Store of value for saving, such as cross-border deposits and securities investments. The key source for data on official reserve holdings is from the International Monetary Fund (IMF) Currency Composition of Official Foreign Exchange Reserves (COFER) database.[5] However, these data are limited. First, it is only available quarterly from 1999. In addition, only 34 developed and 108 emerging countries report balances to COFER. Of these transactions the IMF only report amounts for the USD, Euro, Pound sterling, Japanese yen, Swiss francs and other remaining currencies as an aggregate. Here we rely on MT540, MT541 and MT543 to best represent this category, although MT320 also captures gross flows and MT103 reports flows associated with non-financial institutions. Collectively these messages are able to capture cross-border flows between many emerging economies that currently do not report to the IMF.

Table 1A summarises the properties of the various message types over the sample period for all currencies in the SWIFT database, while Table 1B provides information on offshore RMB transactions. The top panel presents the total number of cross-border monthly messages (for example, between two countries such as the US and the UK by message type), while the bottom panel shows the value of these transactions in USD.

The most messages were in the MT300 category (foreign exchange transactions) with 280 billion over the sample period, while the lowest was MT400 with just 4.4 million. The next three rows report the monthly cross-border average (between 2 countries), the standard deviation (SD) as a measure of dispersion, and the mean adjusted SD, being the coefficient of variation (CV). The CV enables comparisons to be made given the variation that occur with the message averages.

The message type with the highest monthly average is MT540, while MT700 has the lowest. The largest standard deviation was with MT541, while MT700 also had the lowest. The CV was highest for MT300, highlighting the variation (and concentration) in the size of interbank foreign exchange transactions,[6] while the lowest was for MT540. In the next row, the number reported is the size of the sample employed in this study. These numbers represent aggregated cross-border transactions between country counterparts. The largest sample was MT103 with 797,054 observations, while the smallest was MT540 with just 30,985. The number of countries and counterparties and the number of different currencies employed are reported in the next two rows. MT103 and MT202 had the highest number of cross-border countries as counterparties with 217, while MT300 had the most number of currencies (167). The economic value of these transactions is recorded in the bottom panel. These values are reported in USD and are vast by any measure. For example, the 797,054 monthly observations of MT103 aggregated 552.4 million messages, with total USD value of USD 224.5 trillion.

[4] These measures were developed in consultation with SWIFT with the messages types selected that best represent the 'Three Pillars'.
[5] http://www.imf.org/external/np/sta/cofer/eng/index.htm
[6] The BIS (2010) reports concentration in FX trading with the top 16 (bank) participants accounting for up to 75% of market turnover (Fig. 1, BIS Quarterly Review, page 28).

Table 1A
SWIFT cross-border traffic October 2010 to January 2012 (all currencies).

Message type	Number of messages sent or received								
	MT103	MT202	MT300	MT320	MT400	MT540	MT541	MT543	MT700
Total sample messages (million)	552.4	289.8	280,104.1	18,414	4.4	58.6	205.6	196,623.5	5606
Cross-border monthly average	693	812	467	98	30	1886	1141	1127	28
Cross-border monthly SD	9683	12,292	10,156	651	307	13,328	21,154	18,602	216
Cross-border monthly CV	14.0	15.1	21.8	9.3	10.2	7.1	18.5	16.5	7.7
Total number of cross-border monthly observations (all currencies)	797,054	356,998	600,323	264,728	147,626	30,985	180,137	174,463	201,662
Total number of cross-border monthly observations (RMB)	3932	2957	7615	2224	129	24	1860	1591	692
Total number of cross-border countries (N)	217	217	211	211	207	119	142	139	207
Total number of currencies used in cross-border transactions	156	153	167	123	66	49	93	89	84
Message type	Value of transactions (US$)								
	MT103	MT202	MT300	MT320	MT400	MT540	MT541	MT543	MT700
Total sample (all currencies), billion USD	224,477	3,347,665	3,093,572	2,917,875	409	940	1,063,333	1,435,719	2798
Cross-border monthly average, million USD	644.5	20,122. 6	9620. 9	30,472.4	8.3	51.8	8351.9	11,602.6	48.9
Cross-border monthly SD, Million USD	11,652.8	321,114.3	384,045.0	785,487.8	57.1	1193.7	325,038.4	728,231.1	260.4
Cross-border monthly CV	18.08	15.96	39.92	25.78	6.87	23.04	38.92	62.77	5.33
World average USD per message (K USD)	406	11,550	11,044	158,455	93	16.1	5172	7302	499

Notes: The table reports the number (top panel) and value, in US dollars (bottom panel), of SWIFT messages worldwide over the sample period. SD is the sample standard deviation, CV is the coefficient of variation, K = 1000. MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment), MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

Table 1B reports the same detail as Table 1A but for offshore RMB transactions, with the aim of comparing the statistical properties of these transactions in comparison to world averages. The first row of this table reports the total number of transactions. In the case of the RMB, the largest numbers of messages (27.4 billion) arise from trade (MT700). Even though the RMB share of the world (all currency) total is 0.49%,[7] each of the RMB transactions is on average 7.34 times larger in terms of USD value than the world currency average. The cross-border monthly average is also higher (40 compared with the world average of 28), while the dispersion measures (SD and CV) are both smaller. That is, the transactions are concentrated to a smaller group of counterparties and have a significantly greater economic value. The same occurs for foreign exchange transactions (MT300), bank transfers (MT202) and customer fund transfer (MT103), which are respectively 2.28, 1.39 and 2.28 times world averages. MT400 (cash letters advice of payment) is especially noteworthy since RMB transactions are on average 127 times larger than other currency averages. Thus, while RMB transactions may be fewer and account for only a modest share of transactions denominated in other currencies, they tend to have significantly higher economic value. However, the reverse is also true. Outside the main transactions associated with trade and currency trading, RMB usage is significantly below world averages. For example, the remaining message classes of MT320, MT540, MT541 and MT543, which collectively deal with settlements associated with money market and fixed income transactions, the RMB share is only a fraction of word averages (0.31, 0.03, 0.28 and 0.18, respectively).

[7] Note that SWIFT (2013) with more recent data than available in this study now report a slightly higher value of 0.87% for June 2013, although the source message type is not provided. Anecdotal evidence suggests that higher volumes in foreign exchange markets (MT300) may be driving this increase.

Table 1B
SWIFT cross-border traffic October 2010 to January 2012 (RMB).

	Number of messages sent or received								
Message type	MT103	MT202	MT300	MT320	MT400	MT540	MT541	MT543	MT700
Total sample messages(million)	136.3	450.6	1368.2	293.8	0.2	2.1	323.2	308.9	27.4
Cross-border monthly average	35	152	180	132	2	88	174	194	40
Cross-border monthly SD	183	1397	1417	1342	3	74	869	921	194
Cross-border monthly CV	5.3	9.2	7.9	10.16	1.9	0.9	5.0	4.7	4.9
Total number of cross-border monthly observations (RMB)	3932	2957	7615	2224	129	24	1860	1591	692
RMB share of world total (%)	0.03	0.16	0.49	1.60	0.01	0.01	0.16	0.16	0.49
Total number of cross-border countries (*N*)									
	Value of transactions (US$)								
Message type	MT103	MT202	MT300	MT320	MT400	MT540	MT541	MT543	MT700
Total sample (RMB), billion	126.5	7209	34,515	14,239	0.2	1.1	470.6	418.5	100.6
Cross-border monthly average, million USD	91.4	5482	8859	12,243	18	55	351.2	357.7	609.7
Cross-border monthly SD	219	40,253	165,798	147,451	20	239	7047	921	1309
Cross-border monthly CV	2.4	7.34	18.71	12.04	1.1	4.3	20.1	5.1	2.1
RMB average USD per message (K USD)	928	15,998	25,226	48,469	1187	0.52	1456	1355	3668
Ratio of RMB average/world average USD per message	2.28	1.39	2.28	0.31	127.0	0.03	0.28	0.18	7.34

Notes: The table reports the number (top panel) and value, in US dollars (bottom panel), of SWIFT messages worldwide in RMB over the sample period. SD is the sample standard deviation, CV is the coefficient of variation, K = 1000. MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

Table 2 places the international role of the RMB in the context of the top 5 currencies for denomination of nine SWIFT messages investigated. Recall that these messages represent cross-border payments between two counterparties. The USD is the number one and the EUR is number two currency, for all message classes where a currency code is provided. The number three currency is the GBP in all message classes with the exception of

Table 2
RMB versus Top 5 currencies in each SWIFT message class: number of messages sent/received.

Message class	Rank 1 (%)	Rank 2 (%)	Rank 3 (%)	Rank 4 (%)	Rank 5 (%)	RMB rank (%)	Others (%)	Number of monthly messages
MT103	USD	EUR	GBP	CHF	JPY	25		797,054
%	20.9	17.2	8.0	4.9	3.9	0.5	44.6	
MT202	EUR	USD	GBP	CHF	JPY	25		356,998
%	16.1	15.6	5.6	4.5	3.9	0.8	53.5	
MT300	USD	EUR	GBP	JPY	CHF	22		600,323
%	10.9	8.9	6.3	5.2	5.2	1.3	62.2	
MT320	USD	EUR	GBP	AUD	CAD	21		264,728
%	22.3	16.4	8.8	5.5	4.6	0.8	41.6	
MT400	USD	EUR	GBP	CAD	JPY	25		147,626
%	45.2	29.1	5.0	2.6	2.4	0.1	15.6	
MT540	N/A	USD	EUR	GBP	HKD	31		30,985
%		3.1	1.8	0.9	0.6	0.1	93.5	
MT541	EUR	USD	GBP	AUD	JPY	31		180,137
%	8.8	8.7	4.8	3.9	3.8	1.0	69.0	
MT543	EUR	USD	GBP	JPY	AUD	33		174,463
%	8.6	8.5	4.6	3.8	3.7	0.9	69.9	
MT700	USD	EUR	JPY	GBP	CHF	15		201,662
%	48.9	30.9	4.2	3.0	1.4	0.3	11.3	

Notes: The table reports the rank by currency of each of the SWIFT messages investigated: MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

JPY, which is third ranked in trade (MT700). Fourth and fifth places are either the AUD (3 instances), CAD (2 instances), CHF (4 instances), HKD (one instance), GBP (1 instance) and finally the JPY (6 instances). These positions broadly reflect the role these currencies play in international financial markets as recorded in the Triennial Foreign Exchange Survey of the BIS (2013a).

The rank of the RMB and remaining currencies is reported in the next 2 columns, with the monthly sample size that these percentages relate to, reported in the last column. The RMB lingers behind a host of other minor currencies in all message classes. Its best performance in these league tables occur in the MT700 category where it is ranked 15. Note the percentage recorded in Table 2 for RMB of 0.30% (MT700) is the percentage of total monthly observations (of 201,662), whereas the percentage recorded in Table 1B (0.49%) is the RMB component of all MT700 messages (5606 million).

Although tables are not provided for the location of counterparties, given London's role as an international financial centre, the United Kingdom (UK) is typically the number one counterparty location for most message classes. The various message types and the percentage of transactions from counterparties domiciled in the UK are as follows: MT103 (4.4%), MT202 (6.4%), MT300 (7.6%), MT300 (6.6%), MT400 (3.7%), MT541 (9.3%), MT543 (9.4%) and MT700 (3.7%). The only two exceptions were MT540, where the United States (8.37%) was first, with the UK second with 7.21%. Given the need to undertake transactions with prime name counterparties to minimise potential credit risk, the other leading locations were financial institutions domiciled in Belgium, France, Germany, Netherlands and Switzerland, as well as the United States.

Recall that Table 1B reports the number of cross-border countries initiating RMB transactions. MT103 and MT300 have the most countries with 114 and 103, respectively. Of these countries, the major countries initiating transactions in RMB are those in the Asia-Pacific region: China (number one for MT103, MT400, MT500, MT541, MT543 and MT700); Hong Kong (number one for MT202 and MT320); and other Asian centres including Singapore (number 3 for MT202 and MT320) and Macau (number 3 for MT700). The UK is number one for MT300, with France ranked fourth behind Hong Kong and China. The major counterparties are typically domiciled first in Hong Kong (number one counterparty for MT202 and MT320) and China (number one counterparty for MT103, MT400, MT541, MT543 and MT700). Hong Kong, the United States and the United Kingdom typically place second, third and fourth, respectively. The notable exception is MT300 where interbank foreign exchange transactions in London exceed those in Hong Kong and Singapore. These findings generally confirm earlier reports on how the RMB market has developed across the Asia-Pacific region and between existing financial centres of London and New York (see SWIFT, 2011 and 2012).

4. Measuring internationalisation

In order to measure the dynamics of the currency internationalisation process, it is necessary to first develop an appropriate measure of currency internationalisation. For guidance, one can refer to a number of well-known development indices including the Financial Development Index, constructed by the World Economic Forum, the World Bank's governance index and the OECD's model of country risk.[8] What is important in each of these indices is the selection of the underlying components and their weighting in the final measure. This is clearer in the allocations provided by Dreher (2006) when developing his globalisation index. Thus, it is important that whatever method is applied it must be transparent and consistent in its treatment to enable comparisons to be made over time.

Consider a cross-border trade or capital account transaction $i \in I$ between two counterparties at time t, where I represents the set of all cross-border transactions. This transaction may involve counterparties that are either a resident of a particular country and a non-resident, or two non-residents (as typically occurs in offshore markets such as Euromarkets). Residents may engage in international transactions with one another; however, by definition they are excluded. These cross-border transactions represent a range of capital and trade account functions, such as non-resident purchases and sales of good, services and financial instruments, as well as foreign exchange trading of various financial products, which require cash settlement over different time periods (such as spot, forwards, swaps and other complex derivatives). Each of these transactions may be settled in a number of different currencies $n \in N$ at t. Of interest in this paper is the relationship between a

[8] E.g. WEF (2011), 'The Financial Development Report 2011', http://www3.weforum.org/docs/WEF_FinancialDevelopmentReport_2011.pdf, Governance Index: http://wbi.worldbank.org/wbi/topic/governance and OECD Model of Country risk: http://www.oecd.org/document/49/0,2340,en_2649_34171_1901105_1_1_1_1,00.html.

single currency n_i and all world currencies (n_i/N_i) and the matrix of [I X N] that represents the full set of these possibilities.

In this setting, we can assume that economic agents should prefer to settle these transactions in their home currency to minimise foreign exchange transaction and translation exposures, although there is no requirement for them to do so. However, scale and scope economies apply to cross-border transactions such that one currency may be preferred over another for settlement purposes. In our case, the subset of interest is transactions in RMB, with respect to a wider group incorporating all currencies. For convenience in this study, the currency denomination of these transactions is represented by SWIFT currency codes.

We first measure the value of these transactions and then estimate their monthly change in value or growth:

$$R_{it} = Ln\,(M_{it}) - Ln\left(M_{i.t-1}\right) \tag{1}$$

where R_{it} is the monthly change in value of the SWIFT message class for a specific currency (equivalent to a return) and M_{it} is the USD value of a SWIFT message, with i representing each message type (MT103, MT202, etc.) investigated and t represents time, which is measured at an interval of 1 month. Ln represents the natural logarithm of the USD value, a necessary requirement given the different scale of the monthly messages.

The USD value of the wider group of all SWIFT messages by currency code may be formed in two ways: first, where each class of message is treated equally, or second, where the growth on each message class are weighted to reflect their relative value in the group. We present the results of the second approach, although they are also consistent with those when estimated using an equal weighted approach. A summary of the arguments in favour of an equal weighted approach is provided by De Miguel, Garlappi and Uppal (2009) in their discussion of financial portfolio construction. Thus, the growth on the SWIFT message portfolio is

$$R_{mt} = G_{mt} - Gn_{mt-1} \tag{2}$$

where R_{mt} is the change in the monthly value of the group (G) of all world messages, such that $G = \Sigma\ LnM_{mt}w_{mt}$ where each message is weighted by a factor w. As was discussed earlier the world portfolio is largely denominated in USD since the primary denomination of each message type is USD, although the amount in USD varies with each of the message types.

Next we calculate the covariance between R_{it} and R_{mt} and ascertain its temporal properties. To do so, we estimate a coefficient, β_i calculated as

$$cov(R_{it}, R_{mt})/var(R_{mt}) \tag{3}$$

where the covariance/variance of R_i and R_m. is estimated over a period τ, a subset of the sample period N, such that $\tau < N$. This measure provides a single measure of the relationship between one message class and the entire group. We trade-off statistical concerns over degrees of freedom with the limited monthly data availability and consider one 6-month estimation length (i.e. set $\tau = 6$ months), which enables the subsequent tracking of β_i over the remaining next 10 months of the sample. This measure provides an insight into how a specific message type, in our case denominated in RMB (i.e. R_{it}, such that $i =$ a specific message type denominated in RMB), responds to changes in the value of the entire group of messages (R_{mt}). We will show that β_i is time-varying.

When $\beta_i = 1$, the value of RMB messages is responding in an identical manner to changes that have occurred in the group of all messages, that is, the RMB message flow is equally sensitive. If β_i is either greater than or less than 1, it is more or less sensitive, respectively. We interpret this sensitivity as reflecting RMB message growth relative to the message growth in all currencies. One interpretation of the change in beta provides insights into the question of whether a tipping point has been reached. For example, if $\Delta\beta_i > 1$ then message growth is greater than world message growth; if $\Delta\beta_i = 1$, then message growth relative to world message growth has stabilised; and if $\Delta\beta_i < 1$, then message growth relative to world message growth has declined. This would occur when one currency "tips" another currency to become more widely used relative to the other currency.

Using statistical techniques used in international finance to measure financial market integration in an asset pricing setting (e.g. Jeon, Oh and Yang, 2006; Chi, Li and Young, 2006), we can consider the relationship between the group of single currency messages and the group of messages in all currencies. This is equivalent to the benefit of diversification in a financial portfolio: if financial markets are integrated then there is no benefit from holding foreign assets since all assets – both domestic and international – respond to the same news or events. Note that this approach builds on the portfolio modelling and diversifictaion literature undertaken on Chinese stock markets as a result of recent deregulation (e.g. Li, 2013; Liu et al., 2013; Yunus, N. 2013; Zheng, Li, and Zhu, 2015; Guidi, Savva, Ugur, 2016 amongst many others).

Consider the following relationship for the estimated change in the value of RMB messages:

$$E(R_{it}) = \alpha_{it} + \varphi_i[\beta_i E(R_{mt})] + \Sigma_i \, \Upsilon_i \, D_i + \varepsilon_{it} \tag{4}$$

where R_{it}, and R_{mt} are the previously measured monthly returns (measured in log form) on the RMB denominated message portfolio *i*, and the world message portfolio, respectively; *i* represents each message type (MT103, MT202, etc.) investigated and *t* represents time, which is measured at an interval of 1 month; D_i is the dummy variables for each message *i* and ε_{it} is the error-term; and φ_i and Υ_i are the regression coefficients of $[\beta_i E(R_{mt})]$ and each message dummy.

We follow Jeon et al. (2006) when estimating Eq. (2) and set α_{it} to zero such that the regression is estimated without a coefficient. The coefficient term φ_i is a measure of statistical efficiency, while Υ_i indicates the specific effects that remain after the risk associated with changes in the world message group is controlled. As Chi et al. (2006) note with respect to the financial market integration literature, if the pricing of the variable investigated is efficient and highly integrated, then φ_i should be close to one and Υ_i should not be significantly different from zero. Efficiency in this context means whether the estimated beta is able to predict the estimated value of the change in RMB messages, $E(R_{it})$. In order for this to occur, the estimated beta coefficient must be stable. Instability on the other hand will reflect unanticipated shocks (perhaps due to regulatory developments) in the growth rate of RMB messages.

One additional advantage of this approach is that as monthly data are accumulated the statistical implications and analysis can be expanded in scope to more accurately measure temporal components, such as the impact of specific regulation.[9] Given the limitations of the monthly data, we do not include a time dummy variable in the model, but instead divide the sample into two subsamples to provide temporal comparisons.

5. Results

The descriptive statistics of the monthly returns (Eq. (1)) are presented in Table 3. Like the changes in the natural logarithm of the financial assets that underpin the value of a SWIFT message, the changes in the overall value of SWIFT messages are expected to be normally distributed and possess a zero mean.

The SWIFT message returns conform to this prediction. The top panel of Table 3 records the four moments of monthly returns on all world messages (all currencies), while the bottom panel records those for RMB only. The mean for all world messages tend to be close to zero, although this is not the case for RMB messages. MT103, MT202, MT320, MT540 and MT700 all recorded a positive mean. This suggests the value of messages in each of these groups increased over the sample period. The mean of all world messages MT013, MT202 and MT700 were also slightly positive over the sample period but not to the same extent. This result may be interpreted as an improvement in the world economy leading to accelerated message growth in RMB. However, RMB and world MT320, MT400 and MT540 messages groups had the opposite sign, while MT300 and MT543 were both negative. This suggests that a system-wide economic shock (both positive and negative) will not necessarily trigger a unilateral increase, or decrease, in all message types. The standard deviation of RMB messages, across message classes, is also larger than world averages, with the exception of MT541 and MT543. Both world and RMB messages growth display some skewness, while the RMB messages tend to possess positive kurtosis (i.e. fat tails). This would be consistent with large intermonth changes in the value of RMB transactions, whereas world averages tend to be more consistent over time.

[9] The Table 1 of Cockerell and Shoory (2012) provides a detailed list of regulatory developments.

Table 3
Descriptive statistics of the SWIFT monthly message returns (Eq. (1)).

Statistic	MT103	MT202	MT300	MT320	MT400	MT540	MT541	MT543	MT700
All messages all currencies									
Mean	0.0092	0.0052	−0.0056	−0.0025	0.0118	−0.0009	0.0242	−0.0264	0.0033
Standard deviation	0.0931	0.1425	0.2694	0.5222	0.0927	0.4286	0.6186	0.5884	0.1361
Skewness	0.7501	0.2973	−0.3323	0.5451	0.4233	0.1498	0.0421	−1.7254	0.6227
Kurtosis	0.0939	2.1836	−1.1171	−1.0938	0.5103	1.6698	−0.8880	3.9044	1.0507
RMB messages only									
Mean	0.0844	0.1676	−0.1400	0.0063	−0.0816	0.0073	−0.0066	−0.0029	0.0215
Standard deviation	0.3327	0.2603	0.6853	0.8189	1.1691	0.6533	0.5727	0.3531	0.2873
Skewness	−0.1730	−0.4387	−1.8096	0.3126	−3.0049	−1.0227	1.3284	0.5962	0.3866
Kurtosis	−0.5228	0.0064	4.7285	5.8453	11.5630	4.3240	2.3191	0.8904	0.9159

Notes: The table reports the four moments of the monthly changes in the US dollar values of all cross-border SWIFT messages worldwide. MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

Table 4A records the full sample period correlation between monthly returns of each message class for transactions in all world currencies world, while Table 4B records those denominated in RMB. Beginning with Table 4A, the largest positive correlations occur where the trade finance variable MT700 is positively correlated with several variables: MT700 and MT103 (0.863), MT700 and MT400 (0.844) and MT700 and MT300 (0.513). Trade finance should increase and decrease along with economic growth, which suggests these other messages class are also sensitive to the same macroeconomic factors. MT103, MT202 and MT400 are also all correlated and positive. There is also a significant negative correlation between MT300 and MT541 (−0.496).

The RMB correlations in Table 4B were found to be of a similar magnitude to those for all world messages reported in Table 4A with the key exception that MT103 is not correlated with MT202. MT103 tend to be transfers by individuals so it would be expected, given the capital restrictions in China that this would be the case. MT700 was also found to be significantly correlated with MT103, MT202 and MT400, which is different to the correlations recorded for world messages mentioned above. The reason would again be the regulatory changes undertaken in 2010, which allowed a large group (but not all) Chinese corporation to settle using

Table 4A
Correlations of monthly changes in US$ value (returns)—world messages.

	MT103	MT202	MT300	MT320	MT400	MT540	MT541	MT542	MT543
MT202	0.543								
p-value	*0.036*								
MT300	0.269	0.098							
p-value	*0.333*	*0.729*							
MT320	−0.051	−0.177	−0.140						
p-value	*0.856*	*0.528*	*0.618*						
MT400	0.756	0.660	0.347	−0.240					
p-value	*0.001*	*0.007*	*0.204*	*0.389*					
MT540	0.002	−0.395	0.095	0.039	−0.215				
p-value	*0.995*	*0.145*	*0.737*	*0.889*	*0.442*				
MT541	−0.325	−0.258	−0.496	−0.061	−0.219	−0.230			
p-value	*0.237*	*0.354*	*0.060*	*0.828*	*0.433*	*0.409*			
MT542	−0.011	−0.344	0.169	0.214	−0.230	0.918	−0.398		
p-value	*0.970*	*0.209*	*0.547*	*0.444*	*0.410*	*0.000*	*0.142*		
MT543	0.114	0.060	0.067	0.296	0.208	0.198	0.065	0.318	
p-value	*0.687*	*0.832*	*0.812*	*0.284*	*0.456*	*0.479*	*0.819*	*0.248*	
MT700	0.863	0.487	0.513	−0.059	0.844	−0.063	−0.238	−0.115	0.099
p-value	*0.000*	*0.066*	*0.050*	*0.835*	*0.000*	*0.824*	*0.393*	*0.682*	*0.727*

Notes: The table reports the Pearson correlation coefficient between two SWIFT message types for all transactions worldwide. The *p*-value of each correlation is reported below the respective value. MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

Table 4B
Correlations between monthly changes in US$ value (returns): RMB messages.

	MT103	MT202	MT300	MT320	MT400	MT541	MT543
MT202	0.367						
p-value	*0.179*						
MT300	0.040	−0.021					
p-value	*0.886*	*0.940*					
MT320	0.282	0.149	−0.006				
p-value	*0.309*	*0.596*	*0.984*				
MT400	0.584	0.267	0.496	0.107			
p-value	*0.022*	*0.335*	*0.060*	*0.704*			
MT541	0.259	0.376	0.366	−0.006	0.173		
p-value	*0.351*	*0.167*	*0.180*	*0.984*	*0.537*		
MT543	0.494	0.590	0.423	0.076	0.421	0.816	
p-value	*0.061*	*0.021*	*0.116*	*0.789*	*0.118*	*0.000*	
MT700	0.596	0.732	−0.067	0.258	0.490	0.280	0.544
p-value	*0.019*	*0.002*	*0.812*	*0.354*	*0.064*	*0.312*	*0.036*

Notes: The table reports the Pearson correlation coefficient between two SWIFT message types denominated in RMB. The *p*-value of each correlation is reported below the respective value. MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

RMB. Overall, the Chinese correlations appear driven more by domestic regulatory developments than the effects of obvious changes in the external macroeconomic setting.

The average of the monthly covariance structure between the RMB messages and the group of all world currencies (R_{it} and R_{mt}, respectively), estimated using Eq. (3), is recorded in Table 5. R_{mt} is estimated using the market values of weights previously recorded in Table 1A. The top panel of Table % records the four moments of the betas for the RMB messages against an equal weighted world messages portfolio, while the bottom panel records the four moments for the RMB messages against a value weighted world message portfolio.

The means of these messages (top row in both panels) are exactly the same in terms of sign and approximately the same in terms of scale. Recall that a beta of one means the change in the value of the world message is correlated with the change in the value of the RMB messages (i.e. equivalent to an asset beta in a CAPM model). The mean of MT320 of 2.86 (equal weighted) and 2.29 (value weighted) is consistent with high growth (and high variation) relative to the world average. MT202 while positively correlated with world message growth averages at a slower pace. The negative betas all show these remaining message classes are uncorrelated to world growth.

To provide a more intuitive interpretation of the Table 5 means, Fig. 1 provides a monthly plot of the estimated 6-month betas. The plots show that generally growth in the various RMB messages has gone from

Table 5
Average 6-month rolling estimates of the beta between RMB and world messages (Eq. (3)).

Statistic	MT103	MT202	MT300	MT320	MT400	MT541	MT543	MT700
RMB messages: equal weighted world messages								
Mean	−1.5380	0.4097	−1.8094	2.8565	−1.3661	−2.0922	−0.4652	−0.2828
Standard deviation	1.6002	0.6743	2.6379	3.0961	1.5526	2.1144	1.3042	0.8632
Skewness	−0.9611	0.6076	−0.6859	0.9226	−0.8799	−0.9895	−0.3567	−0.3276
Kurtosis	−1.8209	−1.2216	0.4556	−1.7111	−1.2894	−1.6118	−1.1356	−1.5167
RMB messages: value weighted world messages								
Mean	−0.2655	0.3153	−1.5841	2.2931	−0.2174	−0.8891	−0.1834	−0.3401
Standard deviation	0.6735	0.4492	2.2787	2.3672	0.7117	1.7092	0.8931	0.7975
Skewness	−0.3943	0.7019	−0.6952	0.9687	−0.3054	−0.5202	−0.2054	−0.4265
Kurtosis	0.5427	−1.0429	1.1356	−1.4015	3.1996	−1.0558	−1.2301	0.5899

Notes: The table reports the 6-month rolling estimation of the beta from Eq. (3) for the various SWIFT messages: MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); MT700 (confirmations of the issuance of a trade documentary credit).

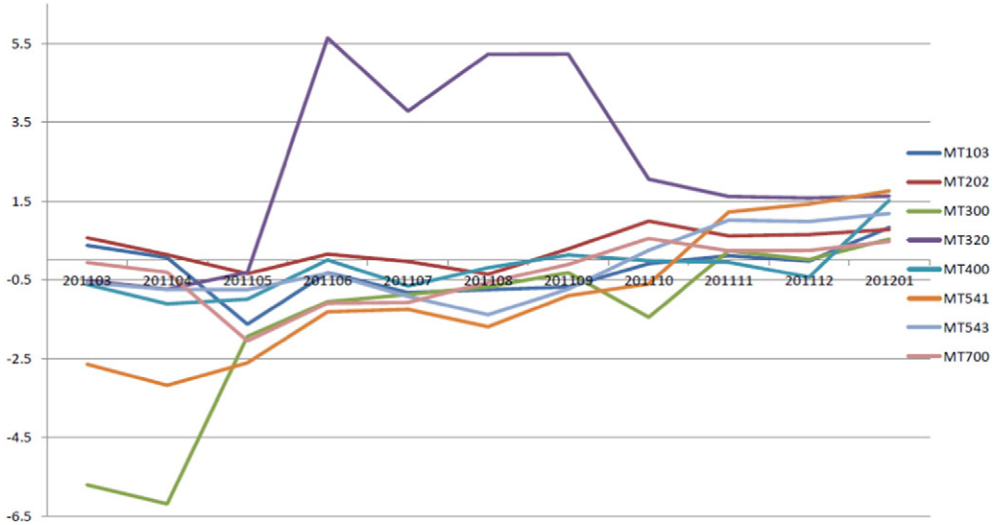

Fig. 1. Plots of the RMB Betas Estimated from Eq. (3) for Different SWIFT Message Classes. Notes: Our analysis measures the following message types: MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

being negatively correlated to growth in world messages to it being positively correlated. A positive correlation would signal RMB growth is more likely linked to global macroeconomic factors (such as GDP growth) than to domestic deregulatory effects. Clearly the significant negative correlations at the start of the sample were due to the deregulatory measures, such as the expansion of Chinese exporters able to settle cross-border transactions in RMB at the end of 2010. The key insight from this analysis is both the sensitivity of these relationships to these event driven factors as well as their nonlinear properties. Any non-linearity in beta (i.e. $\Delta\beta_i \neq 1$) suggests RMB message growth relative to world message growth has changed. This is broadly consistent with theories of internationalisation supporting tipping points in currencies. The empirical evidence presented here suggests that this point has not been reached in the case of the RMB. The plots show evidence of gradual but positive momentum (i.e. the RMB is displacing usage of other currencies). The change in RMB message growth is now positively correlated but the beta has a maximum of 1.76 for MT541 and 0.48 for MT700. The full set of monthly betas is reported in Table 6.

Table 6
Rolling estimates of the beta between RMB and world messages (Eq. (3)).

Date	MT103	MT202	MT300	MT320	MT400	MT541	MT543	MT700
201103	0.3724	0.5700	−5.7077	−0.5167	−0.6182	−2.6434	−0.5699	−0.0551
201104	0.0672	0.1375	−6.1883	−0.7340	−1.1072	−3.1847	−0.7472	−0.3087
201105	−1.6273	−0.3423	−1.9401	−0.3145	−0.9880	−2.6094	−0.7513	−2.0509
201106	−0.3177	0.1528	−1.0560	5.6447	0.0072	−1.3140	−0.3358	−1.0954
201107	−0.8225	−0.0340	−0.8733	3.7822	−0.6553	−1.2506	−0.9234	−1.0731
201108	−0.7502	−0.3565	−0.6763	5.2309	−0.1907	−1.6903	−1.3895	−0.5644
201109	−0.6803	0.2878	−0.3189	5.2344	0.1332	−0.9011	−0.7342	−0.1057
201110	−0.0861	0.9941	−1.4541	2.0609	−0.0147	−0.6022	0.2513	0.5534
201111	0.1150	0.6210	0.2373	1.6239	−0.0543	1.2217	1.0164	0.2380
201112	−0.0254	0.6543	0.0169	1.5817	−0.4292	1.4277	0.9812	0.2489
201201	0.8339	0.7838	0.5349	1.6303	1.5263	1.7660	1.1850	0.4714

Notes: The table reports the actual monthly beta (this value is averaged in Table 5) of each of the SWIFT messages: MT103 (customer fund transfers); MT202 (bank transfers); MT300 (settlements associated with foreign exchange transactions); MT320 (settlements associated with money market and fixed income transactions); MT400 (cash letters advice of payment); MT540, MT541 and MT543 (securities payments); and MT700 (confirmations of the issuance of a trade documentary credit).

While these results suggest that RMB message growth will continue to expand the effect of the initial deregulatory shock appears to have declined. Thus, recent changes in regulatory policy appear to be failing to impact the internationalisation process of the RMB to the same extent as earlier policy decisions. This is especially clear in Fig. 1 with the plot of the MT320 betas. Now, all message betas appear to have converged so that they collectively average close to one, with $\Delta\beta_i$ also equally 1. In other words RMB message growth is now equally sensitive as the total of all world messages to developments in the world economy. The only caveat to a conclusion that RMB internationalisation has stalled is that due to data limitations, our analysis does not include more recent developments.

The final results report the estimation of Eq. (4). Recall that φ_i and Υ_i are the regression coefficients of $[\beta_i E(R_{mt})]$ and each message dummy variable (set as either one or zero). If Eq. (4) is efficient and highly integrated, then φ_i should be close to one and Υ_i should not be significantly different from zero. Efficiency in this context implies that the estimated change in the left hand side variable (RMB message growth) can be predicted by the previous estimated beta multiplied by the growth of world message overall.

Table 7A reports the results when world messages are value weighted, to reflect the impact of differences in their scale, whereas Table 7B shows the results when world message growth is equally weighted across the various message classes. The results for both approaches to portfolio construction are not consistent for the degree of efficiency (φ_i); however, they are for the degree of integration of individual messages with overall world messages (Υ_i).

Table 7A
Eq. (4) Estimated using a value weighted world message portfolio.

Predictor	Coefficient	Standard error Coefficient	*t*-statistic	*p*-value	VIF statistic
Full sample					
R_m	1.193	0.436	2.740	0.008	1.034
MT103	0.048	0.300	0.160	0.874	2.000
MT202	0.062	0.213	0.290	0.770	1.004
MT300	−0.002	0.213	−0.010	0.994	1.004
MT320	−0.038	0.213	−0.180	0.860	1.004
MT400	−0.157	0.213	−0.740	0.464	1.004
MT541	−0.042	0.213	−0.200	0.843	1.004
MT543	−0.037	0.213	−0.180	0.861	2.009
MT700	−0.046	0.213	−0.210	0.831	1.004
Subsample 1					
R_m	−0.048	0.666	−0.070	0.942	1.325
MT103	0.035	0.324	0.110	0.913	2.000
MT202	0.286	0.233	1.230	0.227	1.041
MT300	0.140	0.233	0.600	0.554	1.041
MT320	0.102	0.233	0.440	0.664	1.041
MT400	0.223	0.233	0.960	0.345	1.041
MT541	0.092	0.233	0.390	0.696	1.041
MT543	0.087	0.233	0.370	0.711	2.081
MT700	0.143	0.233	0.610	0.543	1.041
Subsample 2					
R_m	1.482	0.665	2.230	0.033	1.004
MT103	0.063	0.557	0.110	0.911	2.000
MT202	−0.099	0.394	−0.250	0.803	1.001
MT300	−0.064	0.394	−0.160	0.872	1.001
MT320	−0.098	0.394	−0.250	0.805	1.001
MT400	−0.505	0.394	−1.280	0.209	1.001
MT541	−0.096	0.394	−0.240	0.809	1.001
MT543	−0.080	0.394	−0.200	0.841	2.001
MT700	−0.165	0.394	−0.420	0.678	1.001

The Durbin–Watson statistic was 2.780 (subsample 1), 2.677 (subsample 2) and 2.899. The value of the Durbin–Watson statistic ranges from 0 to 4. The regression residuals are uncorrelated if the Durbin–Watson statistic is approximately 2. A value close to 0 indicates strong positive correlation, while a value of 4 indicates strong negative correlation.

Table 7B
Eq. (4) Estimated using an equal weighted world message portfolio.

Predictor	Coefficient	Standard error Coefficient	*t*-statistic	*p*-value	VIF statistic
Full sample					
R_m	0.843	0.505	1.670	0.099	1.000
MT103	0.048	0.309	0.150	0.877	2.000
MT202	0.102	0.218	0.470	0.643	1.000
MT300	0.038	0.218	0.170	0.864	1.000
MT320	0.002	0.218	0.010	0.994	1.000
MT400	−0.117	0.218	−0.540	0.593	1.000
MT541	−0.003	0.218	−0.010	0.990	1.000
MT543	0.002	0.218	0.010	0.993	2.000
MT700	−0.006	0.218	−0.030	0.977	1.000
Subsample 1					
R_m	−1.268	1.206	−1.050	0.300	1.434
MT103	0.035	0.319	0.110	0.912	2.000
MT202	0.338	0.232	1.460	0.152	1.054
MT300	0.191	0.232	0.830	0.414	1.054
MT320	0.154	0.232	0.660	0.510	1.054
MT400	0.275	0.232	1.190	0.242	1.054
MT541	0.144	0.232	0.620	0.538	1.054
MT543	0.139	0.232	0.600	0.552	2.109
MT700	0.195	0.232	0.840	0.405	1.054
Subsample 2					
R_m	0.818	0.728	1.120	0.270	1.078
MT103	0.063	0.588	0.110	0.916	2.000
MT202	−0.073	0.418	−0.170	0.863	1.010
MT300	−0.038	0.418	−0.090	0.928	1.010
MT320	−0.072	0.418	−0.170	0.864	1.010
MT400	−0.479	0.418	−1.150	0.261	1.010
MT541	−0.070	0.418	−0.170	0.869	1.010
MT543	−0.053	0.418	−0.130	0.899	2.019
MT700	−0.139	0.418	−0.330	0.741	1.010

$N = 88$ for full sample, $N =$ the Durbin–Watson statistic was 2.780 (subsample 1), 2.677 (subsample 2) and 2.899. The value of the Durbin–Watson statistic ranges from 0 to 4. The regression residuals are uncorrelated if the Durbin–Watson statistic is approximately 2. A value close to 0 indicates strong positive correlation, while a value of 4 indicates strong negative correlation.

The top panel in Tables 7A and B report estimations of Eq. (4) for the full sample (October 2010 to January 2012), and for the first (October 2010 to May 2011) and the second half (June 2011 to January 2012) of the sample. None of the message dummy variables are statistically significant, which means they are integrated with world messages. That is, they change in the same way and to the same extent if on average the same set of economic factors driving changes in the market values of RMB messages relative to all others, then the RMB message class will appear to be integrated with all world messages. However, the reverse is also true. For example, if domestic regulatory changes in China are prompting growth in RMB denominated assets beyond developments that are impacting other currencies, then the RMB will be shown to not be integrated—as would occur in a growth phase of the RMB market segment. Our results confirm the former and not the latter: RMB message growth across the range of types presented appear integrated with world markets. The VIF tests for multicollinearity are also not significant, although as a robustness check, message MT543 (VIF statistic >2.0) was removed from the regression and the results were unchanged.

What does vary is the degree of efficiency of Eq. (4). Full sample using value or equal weighted approaches, the efficiency coefficient is statistically greater than zero and slightly more than one in the case of the value weight and less than one in the case of the equal weight. In the first half of the sample the efficiency variable was negative for both approaches and was not statistically significant. In the second half only, the value weighted approach was significant and had a positive value of 1.482. That is using a value weighted approach, actual RMB message growth was 48.2% more than estimated using historical values.

Overall, statistical inference from the value weighted approach better matches the economic events that affected the RMB markets: in the first half of the sample (October 2010 to May 2011), the effects of significant

domestic deregulation in China were very apparent and triggered significant change in RMB usage in world markets. These events included the effects of foreign banks entering the domestic markets and wider access to international markets by Chinese corporations (see Gao, 2013). This surge in RMB usage could not be predicted using past estimates of message growth since it was sporadic and affected message types to different degrees. In the second half of the sample (June 2011 to January 2012), the effects of domestic deregulation were overshadowed by growth in world messages, which had responded to a more benign and optimistic macroeconomic environment (for example, stock markets rose during 2011 and 2012). Nonetheless, the better economic environment triggered significant growth in both world messages and RMB messages, although the latter grew at a faster rate. Full sample the effects offset to some extent.

6. Conclusions

This paper addresses key questions in the currency internationalisation debate: first, what constitutes currency internationalisation; and second, how should internationalisation be measured. To provide insights into both questions we investigate the recent internationalisation of the RMB, whereas for the second question we develop an internationalisation measure that demonstrates the pace of RMB internationalisation relative to all other currencies worldwide. Our approach benefits from a higher frequency dataset from SWIFT where the focus is on capital and trade account settlements.

The initial analysis presented here, of SWIFT message flow data, confirms the prominence of the USD across trade, foreign exchange and international securities settlements. The role currently played by the RMB, despite the support of its economy is modest. Thus, economic size and political influence do not necessarily mandate the internationalisation of a currency, although they are important factors. Krugman (1980) argued that once established as an international medium of exchange, a currency will remain as such, despite an economic decline. The persistence of the United Kingdom's pound as a medium of exchange after the 1920s is testament to this fact, as is the current role of the USD. There is no doubt that displacing the USD as the world's vehicle currency will not be an easy task: inertia will be great (Chinn and Frankel, 2005).

With respect to results from this study, it remains unclear as to whether there is sufficient momentum from the existing capital account liberalisation for the RMB to achieve wider use for trade settlement and international capital transactions prior to full convertibility. Full convertibility is acknowledged by many as the necessary precondition for full currency internationalisation although the regulatory roadmap and sequence may be a complex and difficult process (e.g. Li, 2004; Chen, Zhang and Wang, 2009; Wang, 2009; Chen and Cheung, 2011; Tung, Wang and Yeh, 2012; Gao, 2013, Eichengreen and Kawai, 2014). One must also be mindful of the role played by segments in the domestic market, especially those that are undeveloped, such as derivatives and bond markets Gang and Shiyuan (2012).

There are many remaining questions unanswered in this paper that are associated with a greater role for the RMB in international and regional markets. How quickly will the RMB become an important regional currency to eventually challenge the Japanese yen in the diverse Asia-Pacific region (Di Meglio, 2011), and if so what would this mean for regional economies and financial markets, such as their degree of integration (de Menil, 2011), or the extent of financial and monetary cooperation (Park, 2010; Park and Song, 2011)?

The uncertainty in answering these questions highlights the difficulty for those attempting to measure the scale and scope of RMB internationalisation, as well as the identification of those factors that may drive the process. Nonetheless, one thing is clear, it will not be simply the preference for one currency over another for trade settlement, the degree of holdings by central banks, or the extent of RMB denomination of international securities, but all of these factors – and others – together, driven by complex regulatory and price interactions between domestic and international markets. Together this will make the RMB an international currency, or not.

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