The Impact of Chinese Exchange Rate Policy on the Rest of the World: Evidence from Firm-Level Data

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Abstract

This paper aims to gauge the global effect of renminbi revaluation on stock markets. To deal with the potential endogeneity of exchange rate movements, we identify 29 instances of actual or market-perceived changes in China's currency policy from 2003 to 2010 that were driven by domestic or foreign political pressure and not by macroeconomic news. Using data on 12,300 firms operating in tradable sectors in 44 economies, we find that stock returns increased with renminbi revaluation expectations but that this reaction was related more to improved market sentiment than to specific trade channels. In terms of trade channels, we find that expectations of renminbi appreciation reduce the relative stock returns of firms providing components or raw materials to China as inputs for that country's exports. We also find some evidence that expectations of renminbi appreciation reduce the stock prices of financially-constrained firms.

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1. Introduction

China's exchange rate policy has become a flashpoint in policy debate and analytical discussion of the prospects for the global economy. In policy circles the questions include whether China should allow its currency to appreciate more rapidly to encourage global rebalancing – that is, in order to shift the composition of economic activity away from exports and facilitate the efforts of deficit countries like the United States to export more.[2] They include whether a change in Chinese exchange rate policy will have a significant impact on the recovery of U.S. output and employment from the low levels plumbed in 2009-10.[3]

In analytical discussion, the questions include how a change in Chinese exchange rate policy would affect different sectors and activities in the rest of the world. China exports a wide range of consumer goods: firms in other countries competing with Chinese exporters in third markets would therefore feel positive effects from a change in Chinese policy that signaled a willingness to allow the renminbi to appreciate and from some rebalancing of the Chinese economy away from exports. On the other hand, firms in relatively low income countries especially rely increasingly in their operations on machinery and equipment imported from China. Insofar as renminbi appreciation renders this imported machinery and equipment more expensive, such firms will be adversely affected.[4] Similarly, China is an increasingly important source of parts and components for manufacturing in other countries, high- and middle- as well as low-income. Firms that rely on these inputs imported from China will again be adversely affected by renminbi appreciation. Some investigators focusing on the United States conclude that this channel has grown to the point where the impact of renminbi appreciation on U.S. firms would, on balance, be negative.[5]

Conversely, firms in other countries exporting final goods to China would expect to benefit from renminbi appreciation that increased the purchasing power of Chinese firms and

[2] For competing perspectives, see Eichengreen (2007) and Garber et al. (2009).
[3] For competing perspectives see Scott (2010) and Evenett and Francois (2010).
[4] As emphasized by Ali and Dadush (2010), who note that 17 per cent of the total machinery and transport equipment imports of low income countries are now drawn from China.
[5] As documented in the U.S. case by Evenett and Francois (2010) and, in more detail, by Francois (2010).

households. Insofar as currency appreciation was accompanied by other measures intended to stimulate domestic spending, the benefit to other countries exporting final goods to China would be greater still. China is also an important source of demand for parts and components producers in Asia and elsewhere. Renminbi appreciation would increase China's command over these products, but it also might signify a shift away from the export-oriented assembly operations that have been a source of this demand, and thus adversely impact producers in other countries that sell parts and components to China. Some analysts have suggested that this effect could be large: Garcia-Herrero and Koivu (2008) estimate that a ten per cent rise in the renminbi would reduce China's imports of components by as much as 6 per cent.

China is also a voracious consumer of raw materials imported from countries in neighboring Asia (such Australia and Indonesia) as well as from Latin America and Africa. Here, once again, the impact of renminbi appreciation is not obvious. On the one hand, renminbi appreciation would increase the purchasing power of Chinese firms and households, and might thereby boost the country's demand for raw commodity imports. On the other, renminbi appreciation might signal slower growth and rebalancing of the Chinese economy away from raw-material-intensive manufacturing in favor of services, with the opposite effect. Ma and Lu (2010) conclude that the two effects largely wash out and that the net impact on commodity markets will be very small (slightly negative for oil and gas, non-ferrous metals and iron ore, slightly positive for lumber, coal and sugar).[6]

Finally, China has been important as a purchaser of foreign assets and therefore as an influence on foreign financial conditions. Its purchases of U.S. treasury securities have been a concomitant of its exchange rate regime; they have been required, in other words, to prevent the renminbi from appreciating further against the dollar. Greater willingness to allow renminbi to appreciate might imply fewer Chinese purchases of foreign treasuries and, in turn, higher treasury yields. This in turn could affect the cost of external funding for foreign corporations, insofar as those funding costs are linked to conditions in treasury markets. Foreign firms that

[6] Lumber, coal and sugar are largely imported for domestic consumption, while iron, non-ferrous metals and (to a lesser extent) oil and natural gas are heavily used in producing finished metals and other exported items, explaining the difference across commodities.

depend on external finance to fund their investments would be hardest hit, adversely impacting their economic prospects and market valuation. Firms that borrow on markets where Chinese treasury purchases have been greatest would similarly be expected to feel the strongest effects.

In this paper we attempt to shed further light on the nature of these channels through which a change in China's exchange rate policy can influence other countries. In contrast to previous studies, which have tended to concentrate on the country level – estimating, for example, import-demand and export-supply equations using bilateral country-level data – we utilize firm data. We first ask how two previous announcements of changes in China's exchange rate policy by the People's Bank of China, on July 21st, 2005 and June 19th, 2010, both of which gave rise to expectations of currency appreciation, affected the market valuation of non-Chinese firms.

As the number of actual People's Bank of China (PBOC) announcements is very limited, we then expand the sample by considering dates of a potential politically-motivated change in exchange rate policy as perceived by the market. To identify these dates, we analyze the movements in Renminbi Non-Deliverable Forward (RMB NDFs), and use media coverage to identify those movements that were driven by political pressure and not by other macroeconomic news, such as news on trade balance.[7] Using this approach, we identify 27 dates of expectations of politically-driven RMB NDF appreciation.

By focusing on the PBOC announcements and politically-driven NDF movements, we also aim to address a basic challenge in the empirical literature on exchange rates, i.e., the difficulty of separating the impact of exchange rate changes on other macroeconomic variables from causality running in the opposite direction. As Engel (2009) writes of the exchange-rate-trade-balance nexus, "…it should be noted that it is very difficult to assess the effect of exchange rates on trade balances. There are few if any cases of "exogenous" changes in the exchange

[7] For example, on Nov 23, 2007 (Friday), there was a large appreciation of RMB Forward due to the coming Sino-Euro meeting the following week. The market expected that China might speed up its appreciation after the meeting. Meanwhile, there was no major release of macroeconomic data, such as trade surplus or inflation, in either China or the United States.

rate…Instead, any comovements between exchange rates and trade quantities are confounded by the forces that cause the exchange rate to change in the first place…But then it is hard econometrically to separate out the effect of the depreciation on the trade balance and the effect of the trade balance on the depreciation."[8] Because the two PBOC announcements and 27 NDF movements we consider in this paper reflect political rather than economic factors, the possibility of reverse causality flagged by Engel (2009) should not be as serious a problem here.

Firm-level data enable us to distinguish different channels through which Chinese currency policy can affect other countries. We can distinguish firms that compete with Chinese exports of similar products in third markets from firms that sell their exports directly to China. We can distinguish exporters of parts and components to China from exporters of raw materials and final goods. We can distinguish foreign firms according to their degree of dependence on external finance.

We find that stock return increased with expectations of renminbi revaluation but that this response has been more related to improved market sentiment than to specific trade channels. Among trade channels, it turns out, a large effect is felt by exporters of manufacturing inputs to China. Suppliers of parts and components to China experienced strong negative effects on their market valuation at the time of the two announcements, other things equal. We find similar negative effects for exporters of ores to China, reflecting heavy usage of those ores in the production of steel and other metals, much of which is then exported to other markets. Placebo tests that look for similar effects on adjoining days but do not find them suggest that these effects are not being caused by other events affecting market valuations. That these effects are strongly negative suggests that Chinese currency appreciation, even if it is helpful from the point of view of global rebalancing, is not an unmixed blessing for foreign firms, some of which will be adversely affected.

[8] Earlier studies have examined how exchange rates affect equity prices (see for example Phylaktis and Ravazzolo 2005). Effects for individual firms vary in expected way by exposures to exchange rates (firm size, multinational status, foreign sales, international assets, competitiveness and so forth; see Griffin and Stulz 2001, and Dominguez and Tesar, 2006).

In addition, we find weak evidence of positive effects on foreign firms that sell final goods directly to China, and mixed support for the view that the Chinese currency announcements, by causing investors to revise upward their estimates of actual and expected treasury yields, reduced the market valuation of firms that depend on external finance for funding investments. In contrast, there is little consistent evidence of firm valuation being affected by the implications of Chinese currency policy for competition in the firm's home market or for third-market competition, or as a function of financial dependence.

We will first describe data and the empirical approach in Section 2. Section 3 discusses the empirical results for the two PBOC announcements. Section 4 extends the sample to 27 dates of market expectations of a change in exchange rate policy. Section 5 performs robustness checks and Section 6 concludes.

2. Data and Approach

Our basic specification is of the form:

$$\text{Stock Return}_{ijkt} = a*\text{Trade Channel}_{jkt} + b*\text{Financial Channel}_{jkt} + c*\text{Controls}_{ijkt} \quad (1)$$

Here "Stock Return" is the one-day return for firm i in sector j in country k at time t. For example, for the July 21st, 2005 announcement (Thursday, 4pm Shanghai time), it is the stock return computed on the basis of the closing price on July 20th and the closing price on July 22nd for firms in Asian countries. For firms in other countries it is the return computed on the basis of the change in the closing price between July 20th and July 21st. (This difference in procedures is designed to pick up time-zone effects). For the June 19th, 2010 announcement, which took place on a Saturday, it is the log difference between the closing prices on June 18th and 21st. Stock price data are from Datastream. Table 1 shows the number of listed firms in the sample by country for the June 19, 2010 announcement. We look at all countries other than China for which data on a minimum of five firms are available (44 countries in all).

Appendix Table I shows the market return and exchange rate movements around these two announcements. Three quarters of countries experienced a stock market boom, with an average of stock market return of 0.6% and a standard deviation of 1%. Interestingly, the stock market return of the U.S. is negative in both announcements (-0.69% in 2005, and -0.39% in 2010). These heterogeneous responses across countries could be due to idiosyncratic shocks or systematic factors. In what follows, we further examine the differential responses across firms within a country by exploring these firms' different degree of trade linkage with China. Appendix Table I also shows that some currencies, particularly in Asia, appreciated together with the renminbi around the time of the two announcements. This then suggests another channel through which renminbi announcements could affect global stock market—by affecting other exchange rates. We will consider this as well in the analysis.

"Trade Channel" in equation (1) encompasses three trade-related effects of China's exchange rate announcements: the impact on exports to China, the impact on competition with China in third markets, and the impact on imports from China. Trade data are collected from the UN Comtrade dataset, which provides detailed data on bilateral imports and exports for each country pair at the 4-digit US SIC level. Endogeneity – causality running from stock prices to exchange rate policy – should not be a problem here since, while exchange rate policy may be affected by aggregate trade flows, and even aggregate bilateral flows with countries like the United States, it is unlikely to be affected by firm- or sector-specific export prospects and financial performance. Nonetheless, to address even the remote possibility of causality running in the other direction, we lag the trade data, for example, using 2004 observations for the 2005 announcement and 2008 observations for the 2010 announcement, respectively.[9] We also focus on episodes where expectations of changes in the exchange rate arise from political as opposed to economic developments, as noted above.

In practice we distinguish the importance to these various classes of firms of (a) China's own market, as captured by exports to China by sector j of country k divided by global exports of sector j of country k, (b) Chinese competition in third markets, as captured by China's global

[9] 2009 data would be contaminated by the effects of the financial crisis.

exports of sector j divided by the World's total exports of sector j, calculated separately for each year, and (c) the impact on home-market competition, as captured by imports from China by sector j in country k divided by total imports of sector j in country k.[10] For sectors with no export data, these trade channels are assigned a value of zero. Note that we only focus on tradable sectors, i.e., sectors with a 4-digit U.S. SIC code below 4000 (including agriculture, mining and manufacturing sectors).

Figure 1 plots stock market returns and trade with China at the country level. The top two charts consider exports to China, as measured by exports to China over total exports, around the time of the PBOC announcements in 2005 and 2010. We do not see a significant association between the stock market reaction and export exposure to China. The bottom two charts consider imports from China, as measured by imports from China over total imports, for the two PBOC announcements. Again we do not find a significant association between the stock market reaction and import exposure to China (the association was actually negative in 2005).[11]

The "Financial Channel" term is designed to capture the impact on firms that depend on external finance of higher U.S. treasury yields and, consequently, higher corporate funding costs of a smaller Chinese trade surplus and smaller Chinese flows into the treasury market.

We construct a sector-level approximation of a firm's intrinsic dependence on external finance for capital investment following the methodology of Rajan and Zingales (1998):

$$\text{Dependence on external finance for investment} = \frac{\text{capital expenditures - cash flow}}{\text{capital expenditures}},$$

where "cash flow" denotes cash flow from operations plus decreases in inventories plus decreases in receivables plus increases in payables. This variable is derived using data for U.S.

[10] The second and third of these variables are constructed following Forbes (2004).
[11] In following sections we will further examine the association between trade exposure and stock return at the micro level.

firms, which are judged to be least likely to suffer from financing constraints in normal periods. While the original Rajan and Zingales (1998) paper covers only 40 (mainly SIC 2-digit) sectors, we expand the coverage to around 250 SIC 3-digit sectors.

To calculate the demand for external financing of U.S. firms, we take the following steps. Every firm in COMPUSTA USA is first sorted into one of the SIC 3-digit sectors. We then calculate the ratio of dependence on external finance for each firm from 1990-2006. Finally we calculate the sector-level median from firm ratios for each SIC 3-digit sector that contains at least 5 firms, and the median value is then chosen, to be the index of demand for external financing in that sector.

Conceptually, the Rajan-Zingales (RZ) index aims to identify sector-level features, i.e. which sectors are naturally more dependent on external financing for their business operation. It ignores the question of which firms within a sector are more liquidity constrained. What the RZ index measures could be regarded as a "technical feature" of a sector, almost like a part of the production function. To capture the economic concept of the percentage of capital expenditure that has to be financed by external funding, we winsorize the RZ index so that it ranges from 0 to 1.

The principal control variable is beta from the one-factor Capital Asset Pricing Model multiplied by contemporary local market return around the announcement date. Beta is measured as the correlation of the weekly firm-level stock return and the local market return over the year. Beta is lagged by one year when we include it in our estimating equation.

3. Results for PBOC Announcements

Table 2 presents our benchmark estimates of equation (1). We cluster the standard errors at the level of country-sector-date. In the first column we find that, on average, firms exporting to China benefit from renminbi appreciation.

Column 2 separates parts and components and from other trade. The components sector is defined as U.S. SIC Industry Groups 367 (Electronic Components and Accessories) and 3714 (Motor Vehicle Parts and Accessories). According to the Chinese Department of Commerce, a large part of the trade imbalance between China and the U.S. is associated with the exports of "processing industries," in which multinational firms import intermediate goods from other countries and assemble them as finished products in China before re-exporting them. In an accounting sense multinationals heavily involved in processing trade are responsible for more than 80 percent of the surplus between China and the U.S. The export of laptops alone contributes to about half of China's surplus in the processing trade, with 95 percent of laptops worldwide assembled in China.[12]

Due to the importance of processing trade in electronics, we hence examine the effect of exchange rate on stock price of component sectors. We use a dummy variable to indicate firms that are active in these sectors; this equals one for 8 per cent of the firms in the sample. We find that (Exports to China/Exports to the world)*Components enters with a negative coefficient, consistent with the idea that firms exporting components to China are negatively impacted by renminbi appreciation.

In Column 3, we add the beta factor. Now the coefficient capturing the importance of non-component trade becomes insignificant, while beta factor is positive and significant at the 1 per cent level. This raises the question of whether observed stock market booms in the countries in question were driven by a specific trade-related effect or by more general market sentiment. There are some examples of public commentary consistent with this view. For example, BBC Business (6/21/2010) noted in the wake of the 2010 announcement that Chinese yuan flexibility comments buoyed markets, as "the move, ahead of the G20 summit later this month, has tempered market fears of a possible trade war between China and the US." Deutsche Bank Global Market Research (6/21/2010) noted that "the decline in the probability of a trade war between China and the US – as a result of China's currency move -- should help lift market sentiment for risky asset classes". AFP London (Jun 21, 2010) noted that "Global equities surged

[12] See "Processing industry at root of trade imbalance," *China Daily* (1/6/2011).

on Monday after China said it would relax constraints on the yuan, in a surprise move seen by analysts as an attempt to defuse tensions before a crucial G20 summit this weekend … Investor sentiment has improved quite dramatically over the weekend, with the news that China has pledged to allow its yuan to appreciate, helping to drive all major markets higher."

The Capital Asset Pricing Model (CAPM) interprets the beta factor in terms of market risk, with higher beta associated with larger risk. An improvement in market sentiment will reduce perceived market risk and hence boost stock prices for firms with higher betas. Hence, the significance of beta factor, the insignificance of the non-component trade channel, and the market comments are consistent with the hypothesis that China's exchange rate announcements boosted market through the sentiment effect (such as reducing the perceived likelihood of a trade war) at least as much as through a specific trade effect (such as additional exports to China).[13]

In Column 4, we add fixed effects for the announcement day. In Column 5, we further add the country fixed effects. The negative effect on firms exporting components to China remains significant throughout. Note that we do not find significant effects, either positive or negative, for firms exporting other categories of products to China. We undertook a number of additional tests to establish the robustness of these findings. For example, in a placebo test we looked at the daily stock returns on 7/19/2005 and 6/17/2010, i.e., two trading days before the PBOC announcements. For these two days, we do not find a significant coefficient on (Exports to China/Exports to the world)*Components. The point estimate is smaller than in Table 2, and its t-statistic is -0.43.

In Table 3 we further control for other potential trade channels: competition in third markets (as captured by China's exports as a share of world exports to the markets in question) and competition in the firm's domestic market (as captured by imports from China as a share of total imports). Neither of the two additional trade-related effects has a significant impact on firm

[13] Note that in Column 3, with the addition of beta factor, the coefficient on components becomes significantly negative. We will further examine this in the following columns.

valuation, but the term capturing parts-and-components exports to China still has the same sign and significance as before.

In Table 4 we normalize parts-and-components and other categories of exports to China in a different manner, dividing by sectoral sales rather than exports, where sectoral sales is the sum of sales of listed companies in a given sector- country-year (in current U.S. dollars). Parts-and-components exports to China enter negatively and significantly as before. So normalized, non-parts-and-components exports to China now enter positively and border on statistical significance at the 90 per cent level. This is consistent with the intuition that exporters of raw materials and final goods should benefit from renminbi appreciation insofar as it stimulates the demand for final imports by Chinese households and enterprises.

Table 5 corresponds to Table 3 by testing for the significance of several additional trade channels but now normalizing, once again, for sectoral sales. The coefficient estimates here are less well determined, but they are consistent with previous findings: exporters of final goods to China benefit from expectations of renminbi appreciation; exporters of parts and components to China are hurt; and other trade-related channels (third market and home market competition) do not appear to exert significant effects.

In Table 6 we distinguish commodity from non-commodity exports by adding a commodity-export dummy interacted with exports to China. Commodity-exporting firms are defined as those active in sectors with a U.S. SIC code between 1000 and 1500. This includes metal mining, coal mining, oil extraction, and mining and quarrying of nonmetallic minerals, and comprises approximately 10 per cent of the sample. As shown in the first column, the coefficient on the new interaction term is positive but insignificantly different from zero.

However, if we focus on the ores sector, (that subset of metal mining that includes iron ores, copper ores and lead and zinc ores (approximately one per cent of the sample)), again interacted with exports to China, the coefficient becomes negative and significant (as shown in the second column). This is consistent with the intuition of Ma and Lu (2010), that ores are heavily utilized in the production of finished metal products, many of which are exported. We

obtain the same results when adding fixed effects (Column 3) and country fixed effects (Column 4).[14]

In Table 7, finally, we examine the financial channel: the possibility that expectations of renminbi appreciation put upward pressure on treasury yields, making it more expensive for financially-depend firms to fund their investment plans. U.S. treasury bond yields in fact increased on both announcement dates, albeit modestly. The question is whether this had a differential impact on more financially dependent firms. As column 1 shows, the valuation of firms that are financially dependent saw their share prices decline with the two announcements of changes in China's exchange rate regime, consistent with the hypothesis. The results still hold if we add date fixed effects and country fixed effects, as in columns 2 and 3. In practice, however, the effects are driven by the 2010 announcement. When we replicate the same analysis but separately for the two dates, as in columns 4 and 5, we do not find the same negative coefficient for 2005. Hence we are reluctant to make too much of these results.

4. Results for Market-Perceived Policy Changes

Moving from country-level to firm-level data extends the empirical basis for drawing inferences about the likely impact of renminbi appreciation along one dimension. It is possible to look at the impact on exports in different types of products to different markets, in other words. But it does nothing to address the problem of limited variation on another dimension: the fact that as of the time of writing there have only two announcements of changes in the exchange rate regime pointing to the prospect of future appreciation. While our sample is large along one dimension, it is small along another.

We address this problem by considering changes in market expectations concerning the exchange rate regime in addition to actual announcements. We focus on sharp changes in the

[14] In a placebo test, we again looked at the daily stock returns on 7/19/2005 and 6/17/2010. For these two pre-PBOC-announcement dates, (Exports to China/Exports to the world)*Ores has a positive coefficient of 1.08 with a t-stat of 1.20, in sharp contrast with its negative coefficient in Column 2 of Table 6.

price of nondeliverable forward (NDF) dollar-renminbi contracts that coincide with newspaper articles about possible changes in Chinese exchange rate policy owing to domestic or foreign political pressures. We identify 27 such dates between 2003 and 2010 when movements in renminbi NDF reacted to, inter alia, upcoming G-7 meetings, China-US/Euro Summit meetings, or speeches by senior U.S. officials. We use media coverage from Factiva to check that these NDF movements were not driven by other macroeconomic news, such as data release of inflation, policy rate or trade balance in China or the U.S.

Appendix Table 2 lists the 27 episodes in question. The daily appreciation of 12-month renminbi NDF varies from 0.13 per cent to 1.16 per cent on these dates, with a median of 0.5 per cent. By comparison, for the two PBOC announcements the daily change in 12-month NDF is 0.37 per cent and 0.98 per cent.

In Table 8, we examine the effect of renminbi NDF appreciation on firm stock-market valuation operating the trade channel. We include date fixed effects throughout and again cluster the standard errors at the level of country-sector-date. In Column 1, we look at the cases of NDF changes of less than 0.5 per cent (the median value) and find no significant effect for (Exports to China/Exports to the world)*Components.[15] But in Column 2, where we consider NDF changes of more than 0.5 per cent, we find that (Exports to China/Exports to the world)*Components now is significantly negative. This is consistent with our earlier results for the two PBOC announcements.[16]

[15] To some degree, Column 1 also serves as a placebo test, suggesting that (Exports to China/Exports to the world)*Components does not necessarily have negative coefficients.

[16] The coefficient on (Exports to China/Exports to the world) is significantly negative at the 1 per cent confidence level. This suggests that renminbi appreciation may actually reduce the stock prices of firms exporting to China, which is counterintuitive. But other recent work also finds negative long-term effect of renminbi appreciation on China's imports; see for example Marquez and Schindler (2006), and Garcia-Herrero and Koivu (2009), who examine quarterly data of China's imports. A potential explanation for this pattern is that a significant fraction of China's imports is used in China's processing exports, but these are not fully captured by our dummy of components. Indeed, based on Chinese trade statistics on normal and processing imports, in year 2006, 45.7 per cent of China's imports were used for processing exports (35.7 per cent being to intermediate imports and 10 per cent bing to capital imports).

In Column 3, we include the 27 dates in the same regression and add a triple interaction term of renminbi Appreciation*(Exports to China/Exports to the world)*Component. This interaction term turns out to be significantly negative. This suggests that renminbi NDF appreciation reduces stock returns of firms exporting components to China, particularly when the NDF appreciation is large. In Column 4, we add firm fixed effects and again find similar results.

In Table 9, we repeat the same exercise but replace the component sector with the ores sector. Again, we separate renminbi NDF changes as above and below the median of 0.5 per cent. Column 1 looks at small appreciations in the NDF market. There the variable Ores sector*(Exports to China/Exports to the world) has a negative but insignificant coefficient. Column 2 looks at large appreciation cases. Ores sector*(Exports to China/Exports to the world) now has a larger coefficient that is significantly negative at the 5 per cent level, again consistent with what we found in Section 3 for the two official policy announcements. In Columns 3 and 4, we further include the triple interaction of Yuan appreciation*Ores sector*(Exports to China/Exports to the world). This triple interaction has a negative coefficient as well, albeit insignificant.

5. Exchange Rate Movements

So far we have shown that the negative coefficient for the variable, Component*(Exports to China/Exports to the world), is consistent with the global production chain story. Now we further examine alternative explanations. One alternative story is that countries exporting more components to China may also experience higher appreciation of local currency at the same time. For example, suppose that Korean firms export components to China while the British firms do not. Meanwhile, Korean Won may appreciate more than British Pound, assuming that renminbi appreciation boosts Chinese demand for Korean service (such as travel to Korea) but having no impact on U.K. service industry. In this case, one may observe that component-producing Korean firms experience lower stock return than British firms, which, however, is due to the asymmetric response of the local currency.

To address this issue, we further add two interaction terms as explanatory variables: Local currency appreciation*(Exports to China/Exports to the world), and Yuan NDF appreciation*(Exports to China/Exports to the world). The results are reported in Table 10. Columns 1 and 2 consider the two PBOC announcements. In Column 1, (Yuan NDF appreciation*Exports to China) has a significant and positive coefficient, while (Local currency appreciation*Exports to China) does not have a significant coefficient. Reassuringly, Component*Exports to China still has a negative coefficient significant at the 5% level. In Column 2, we further add country fixed effects and date fixed effects, and find similar results. In Columns 3 and 4, we look at market-perceived policy changes with Yuan NDF movements of more than 0.5 per cent. In Column 3, we do not find a significant result for the interaction term between exports to China and exchange rate appreciation, for Yuan NDF or local currency. But Component*Exports to China has a significant and negative coefficient. In Column 4, we further add country dummies and date dummies, and the results carry through. Hence the asymmetric movement of the local currency, if any, does not overshadow the hypothesis of global production chain.

6. **Conclusions**

In this paper we have extended existing empirical work on the likely impact of appreciation of the renminbi exchange rate on the rest of the world by employing data for non-Chinese firms. We start by considering the impact on share prices of the two announcements of changes in China's currency policy in 2005 and 2010, both of which created expectations of renminbi appreciation. We examine the stock price movement of some 12,280 firms in agriculture, mining and manufacturing in 44 economies around the time of these two announcements. We then further expand the time dimension of the sample to include 27 dates of market-perceived likely changes in exchange rate policy, as reflected in large renminbi appreciation in the NDF market that were associated with political factors.

Our results suggest that firms exporting to China, rather than firms competing with China's own exports in either their home or third markets, tend to feel the strongest effects. One reason why the full impact on firms exporting to China may not have been adequately appreciated previously is that the nature of the effect is very different for firms exporting

different types of products. Expectations of renminbi appreciation have negative effects on firms selling to China parts and components as well as raw materials, such as iron ore, that go into the production of China's own exports. In contrast, they have no such negative effect – if anything, the effect is positive – in the case of firms selling China final goods. There is also some evidence of a negative impact on financially dependent firms, which may find it more costly to fund their investments as a result of the upward pressure on yields resulting from reduced Chinese purchases of foreign treasury bonds. Again, the message is that across-the-board inferences are misleading; the impact on more and less financially dependent firms may be very different.

Table 1. Number of Listed Firms

Country	Number	Country	Number
Argentina	23	Japan	1,482
Australia	364	Korea (South)	644
Austria	36	Malaysia	362
Belgium	47	Mexico	35
Brazil	95	Netherlands	57
Canada	422	New Zealand	19
Chile	25	Norway	73
Colombia	9	Pakistan	58
Czech Republic	3	Peru	14
Denmark	46	Philippines	32
Egypt	31	Poland	129
Finland	62	Portugal	16
France	201	Russian Federation	42
Germany	231	Singapore	169
Greece	106	South Africa	87
Hong Kong	287	Spain	44
Hungary	9	Sweden	129
India	552	Switzerland	85
Indonesia	108	Thailand	198
Ireland	16	Turkey	129
Israel	70	United Kingdom	337
Italy	112	United States	1,623

Note: These are listed firms in 44 countries for the sectors of agriculture, mining and manufacturing on June 21, 2010.

Table 2. Impact of two actual PBOC announcements on stock returns -- trade channel

	Average effect	Component sector	Adding beta	Adding date effects	Adding country effects
Exports to China/Exports to the world	0.78**				
	[0.36]				
(Exports to China/Exports to the world)		1.03***	0.17	0.17	-0.2
*Non-components sector		[0.37]	[0.32]	[0.32]	[0.36]
(Exports to China/Exports to the world)		-0.6	-1.37**	-1.39**	-1.81***
*Components sector		[1.11]	[0.63]	[0.64]	[0.65]
Beta*Market return			0.78***	0.76***	0.63***
			[0.035]	[0.044]	[0.047]
Constant	0.29***	0.29***	0.073		
	[0.055]	[0.055]	[0.051]		
Date fixed effects	N	N	N	Y	Y
Country fixed effects	N	N	N	N	Y
Observations	13,908	13,908	13,826	13,826	13,826
R-squared	0.001	0.001	0.061	0.061	0.073

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for two actual PBOC announcements on July 21, 2005 and June 21, 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

Table 3. Impact of two actual PBOC announcements on stock returns --controlling for additional trade channels

	Average effect	Component sector	Adding beta	Adding date effects	Adding country effects
Exports to China/Exports to the world	0.47				
	[0.38]				
(Exports to China/Exports to the world)		0.73**	0.039	0.04	-0.3
*Non-component sector		[0.37]	[0.34]	[0.34]	[0.36]
(Exports to China/Exports to the world)		-1.04	-1.57**	-1.58**	-1.97***
*Component sector		[1.12]	[0.65]	[0.66]	[0.65]
Imports from China/Imports from the World	0.44	0.44	0.18	0.18	0.31
	[0.28]	[0.28]	[0.23]	[0.23]	[0.25]
China's Exports/World Exports	0.096	0.18	0.16	0.12	-0.083
	[0.60]	[0.59]	[0.52]	[0.53]	[0.53]
Beta*Market return			0.77***	0.76***	0.63***
			[0.034]	[0.044]	[0.047]
Constant	0.25***	0.24***	0.05		
	[0.065]	[0.065]	[0.058]		
Date fixed effects	N	N	N	Y	Y
Country fixed effects	N	N	N	N	Y
Observations	13,908	13,908	13,826	13,826	13,826
R-squared	0.001	0.002	0.061	0.061	0.074

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for two actual PBOC announcements on July 21, 2005 and June 21, 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

Table 4. **Impact of two actual PBOC announcements on stock returns**
-- alternative trade channel

	Average effect	Component sector	Adding beta	Adding date effects	Adding country effects
Exports to China/Exporter's Sectoral Sales	0.88				
	[1.49]				
(Exports to China/Exporter's Sectoral Sales)		1.31	0.51	0.51	0.058
*Non-component sector		[1.54]	[1.53]	[1.53]	[1.51]
(Exports to China/Exporter's Sectoral Sales)		-6.6	-8.24*	-8.19*	-10.5**
*Component sector		[4.54]	[4.36]	[4.34]	[4.10]
Beta*market return			0.78***	0.77***	0.62***
			[0.035]	[0.044]	[0.047]
Constant	0.34***	0.34***	0.071		
	[0.050]	[0.049]	[0.045]		
Date fixed effects	N	N	N	Y	Y
Country fixed effects	N	N	N	N	Y
Observations	13,908	13,908	13,826	13,826	13,826
R-squared	0	0	0.061	0.061	0.073

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for two actual PBOC announcements on July 21, 2005 and June 21, 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

Table 5. Further analysis of Impact of two actual PBOC announcements on stock returns -- alternative trade channels

	Average effect	Component sector	Adding beta	Adding date effects	Adding country effects
Exports to China/Exporter's Sectoral Sales	2.27				
	[1.61]				
(Exports to China/Exporter's Sectoral Sales)		2.73*	1.71	1.73	1.11
*Non-component sector		[1.65]	[1.67]	[1.67]	[1.63]
(Exports to China/Exporter's Sectoral Sales)		-5.19	-7.00	-6.93	-9.46**
*Component sector		[4.67]	[4.47]	[4.45]	[4.22]
Imports from China/Importer's Sectoral Sales	-0.82	-0.8	-0.76	-0.77	-0.52
	[0.55]	[0.55]	[0.50]	[0.50]	[0.53]
(China's Global $Exports_{jt}$/World Exports in that $sector_{jt}$)	-0.19	-0.21	-0.13	-0.14	-0.21
*(Exports to world except $China_{jkt}$ /Exporter's Sectoral $Sales_{jkt}$)	[0.54]	[0.54]	[0.53]	[0.53]	[0.54]
Beta*market return			0.78***	0.76***	0.62***
			[0.035]	[0.045]	[0.047]
Constant	0.35***	0.35***	0.081*		
	[0.051]	[0.051]	[0.046]		
Date fixed effects	N	N	N	Y	Y
Country fixed effects	N	N	N	N	Y
Observations	13,908	13,908	13,826	13,826	13,826
R-squared	0	0.001	0.061	0.061	0.073

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for two actual PBOC announcements on July 21, 2005 and June 21, 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

Table 6. Impact of two actual PBOC announcements on stock returns -- role of commodity sector

Exports to China/Exports to the world	-0.21	-0.047	-0.05	-0.42
	[0.30]	[0.31]	[0.31]	[0.36]
Commodity sector	-0.27			
	[0.19]			
Ores sector		1.42***	1.43***	1.45***
		[0.52]	[0.52]	[0.54]
Commodity sector*(Exports to China/Exports to the world)	0.79			
	[1.23]			
Ores sector*(Exports to China/Exports to the world)		-4.12**	-4.15**	-3.39*
		[2.03]	[2.04]	[2.03]
Beta*Market return	0.77***	0.78***	0.77***	0.68***
	[0.035]	[0.035]	[0.044]	[0.041]
Constant	0.11**	0.068	0.04	-0.33***
	[0.050]	[0.051]	[0.048]	[0.13]
Date fixed effects	N	N	Y	Y
Country fixed effects	N	N	N	Y
Observations	13,826	13,826	13,826	13,826
R-squared	0.061	0.061	0.061	0.073

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for two actual PBOC announcements on July 21, 2005 and June 21, 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

Table 7. Impact of two actual PBOC announcements on stock returns -- financial channel

	Average effect	Adding date effects	Adding country effects	For year 2005	For Year 2010
Financial dependence	-0.12**	-0.12**	-0.094*	0.026	-0.20***
	[0.058]	[0.059]	[0.057]	[0.044]	[0.048]
Beta*market return	0.77***	0.75***	0.61***	0.31***	0.56***
	[0.035]	[0.043]	[0.049]	[0.12]	[0.067]
Constant	0.11***				
	[0.039]				
Country fixed effects	N	N	Y	Y	Y
Date fixed effects	N	Y	Y	N	N
Observations	12,660	12,660	12,660	6,160	6,500
R-squared	0.064	0.064	0.075	0.032	0.12

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for the two actual PBOC announcements on July 21, 2005 and June 21, 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

Table 8. Analysis of impact on stock return for listed firms
--Market-perceived change of exchange rate policy and component sector

	Small Change	Large Change	Whole Sample	Adding Firm Effects
Exports to China/Exports to the world	-0.16	-0.51***	-0.33	-0.53
	[0.13]	[0.14]	[0.27]	[0.37]
Component*Exports to China/Exports to the world	0.45	-1.08**	1.45	2.59**
	[0.43]	[0.46]	[0.97]	[1.28]
Yuan appreciation*Component			-3.50**	-3.67**
*(Exports to China/Exports to the world)			[1.67]	[1.74]
Yuan appreciation*Exports to China/Exports to the world			0.033	0.12
			[0.48]	[0.48]
Yuan appreciation*Component			0.36	0.41
			[0.32]	[0.34]
Beta*market return	0.65***	0.75***	0.71***	0.73***
	[0.019]	[0.017]	[0.013]	[0.014]
Component	-0.063	-0.0089	-0.22	
	[0.075]	[0.066]	[0.18]	
Date fixed effects	Y	Y	Y	Y
Firm fixed effects	N	N	N	Y
Observations	84,474	90,734	182,799	182,799
R-squared	0.034	0.091	0.067	0.159

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for 27 dates of Yuan appreciation in the Yuan Non-deliverable Forward market from 2003 to 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

Table 9. Further analysis of impact on stock return for listed firms
--Market-perceived change of exchange rate policy and Ores sector

	Small Change	Large Change	Whole Sample	Adding Firm Effects
Exports to China/Exports to the world	-0.12	-0.66***	-0.19	-0.083
	[0.13]	[0.14]	[0.26]	[0.37]
Ores sector*(Exports to China/Exports to the world)	-1.54	-1.94**	-1.06	-2.25
	[0.96]	[0.79]	[1.64]	[1.68]
Ores Sector*Yuan appreciation			-1.24	-0.77
*(Exports to China/Exports to the world)			[2.47]	[2.62]
Yuan appreciation*(Exports to China/Exports to the world)			-0.35	-0.32
			[0.47]	[0.48]
Ores sector*Yuan appreciation			0.86	0.97
			[0.78]	[0.78]
Beta*market return	0.65***	0.75***	0.71***	0.73***
	[0.019]	[0.017]	[0.013]	[0.014]
Ores sector	0.51*	0.71***	0.14	
	[0.29]	[0.24]	[0.56]	
Date fixed effects	Y	Y	Y	Y
Firm fixed effects	N	N	N	Y
Observations	84,474	90,734	182,799	182,799
R-squared	0.034	0.091	0.067	0.159

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The sample is for 27 dates of Yuan appreciation in the Yuan Non-deliverable Forward market from 2003 to 2010. The sample is for listed firms in 44 countries for the sectors of agriculture, mining and manufacturing. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. The key variables are measured with one-year lag, except the contemporary market return. Standard errors are clustered at the level of country-sector-date.

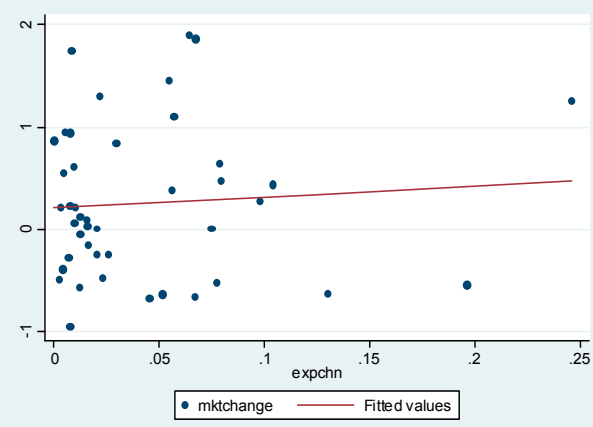
Table 10. Impact of expectations of renminbi appreciation on stock return --Robustness checks

	Two PBOC announcements	**Two PBOC announcements**	**Large NDF Change**	**Large NDF Change**
Component	-2.16**	-2.49***	-0.95*	-0.78*
*(Exports to China/Exports to the world)	[0.97]	[0.96]	[0.49]	[0.45]
Component	0.13	0.18	-0.042	-0.022
	[0.19]	[0.19]	[0.071]	[0.065]
Exports to China/Exports to the world	-1.25	-2.30***	0.46	-0.12
	[0.80]	[0.88]	[0.57]	[0.55]
Yuan NDF appreciation	2.29**	3.15***	-1.3	0.031
*(Exports to China/Exports to the world)	[1.01]	[1.04]	[0.82]	[0.79]
Local currency appreciation	-0.29	-0.17	0.26	0.17
*(Exports to China/Exports to the world)	[0.27]	[0.31]	[0.36]	[0.39]
Yuan NDF appreciation	-0.0011		0.15	
	[0.18]		[0.11]	
Local currency appreciation	0.041	-0.14**	0.15***	0.028
	[0.044]	[0.070]	[0.043]	[0.045]
Beta*market return	0.75***	0.56***	0.89***	0.73***
	[0.044]	[0.053]	[0.016]	[0.018]
Constant	0.061		0.017	
	[0.11]		[0.076]	
Date fixed effect	N	Y	N	Y
county fixed effects	N	Y	N	Y
Observations	13,826	13,826	90,734	90,734
R-squared	0.062	0.075	0.08	0.094

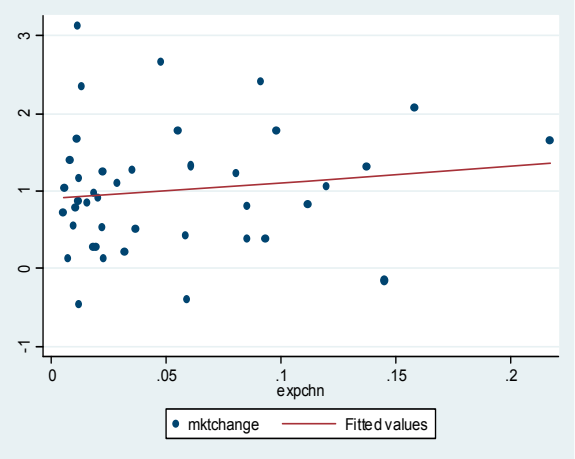
Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. The trade channel is measured at the 4-digit sector level for the country where the listed firm belongs. Standard errors are clustered at the level of country-sector-date.

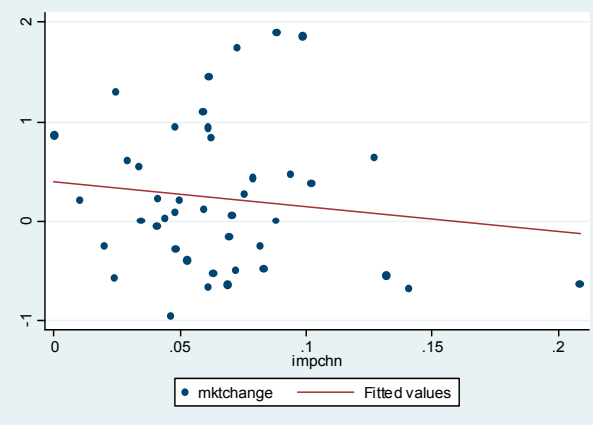
Figure 1. Correlation of stock market return (vertical axis) and trade linkage with China (horizontal axis) during two PBOC announcements

Horizontal axis: exports to China; for PBOC announcement in 2005.

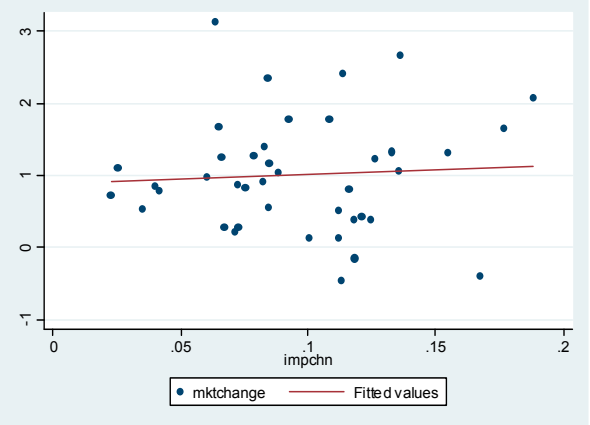


Horizontal axis: exports to China; for PBOC announcement in 2010.





Horizontal axis: imports from China; for PBOC announcement in 2005.



Horizontal axis: imports from China; for PBOC announcement in 2010.

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Appendix Table 1. Stock Market Return and Exchange Rate Movement around Two PBOC Announcements

COUNTRY	Market return 2005	Exchange rate 2005	Market return 2010	Exchange rate 2010
UNITED STATES	-0.69	0.00	-0.39	0.00
UNITED KINGDOM	0.12	0.70	0.90	-0.53
AUSTRIA	-0.57	0.10	0.85	-0.64
BELGIUM	0.61	0.10	0.79	-0.64
DENMARK	-0.05	0.09	0.97	-0.68
FRANCE	0.09	0.10	1.25	-0.64
GERMANY	0.83	0.10	1.27	-0.64
ITALY	0.02	0.10	0.27	-0.64
NETHERLANDS	0.06	0.10	1.16	-0.64
NORWAY	0.21	0.32	1.67	-1.03
SWEDEN	1.29	0.26	0.53	-0.39
SWITZERLAND	-0.26	-0.04	1.10	-0.36
CANADA	-0.15	0.33	0.13	-0.29
JAPAN	-0.64	2.22	2.07	-0.34
FINLAND	-5.78	0.10	0.22	-0.64
GREECE	0.54	0.10	3.39	-0.64
IRELAND	0.94	0.10	0.27	-0.64
PORTUGAL	0.20	0.10	0.73	-0.64
SPAIN	0.22	0.10	0.87	-0.64
TURKEY	0.95	0.47	0.56	-0.18
AUSTRALIA	0.64	1.16	1.31	0.40
NEW ZEALAND	0.38	1.08	1.32	0.03
SOUTH AFRICA	-0.25	0.36	0.44	-0.07
ARGENTINA	-0.53	0.03	0.40	0.06
BRAZIL	1.10	0.50	0.81	0.55
CHILE	0.43	-0.31	-0.15	-0.45
MEXICO	-0.50	0.11	0.14	0.09
PERU	0.27	0.00	1.07	-0.67
ISRAEL	0.00	0.76	0.93	0.00
EGYPT	-0.38	-0.02	2.35	0.11
HONG KONG	1.26	0.14	2.59	0.16
INDIA	1.46	0.97	1.77	0.79
INDONESIA	1.89	0.50	0.39	0.84
KOREA (SOUTH)	-0.55	0.82	1.64	2.48
MALAYSIA	1.86	0.00	1.23	2.03
PAKISTAN	-0.48	0.05	0.52	0.04
PHILIPPINES	-0.66	0.09	0.82	0.67
SINGAPORE	0.48	2.12	1.77	0.58
THAILAND	0.00	2.09	2.41	0.37
RUSSIAN FEDERATION	-0.64	0.35	2.66	0.40
CHINA	0.86	1.98	3.62	0.44
POLAND	-0.96	0.56	1.39	-1.03

Appendix Table 2: Dates of actual or market-perceived change of China's currency policy

Date	12m NDF Change	Date	12m NDF Change
6-Jan-03	0.75	11-May-05	0.35
17-Jun-03	0.4	21-Jul-05	0.37
22-Sep-03	0.74	26-Aug-05	0.38
23-Sep-03	1.16	18-Oct-07	0.45
3-Oct-03	0.96	23-Nov-07	0.6
23-Oct-03	0.54	5-Apr-10	0.47
16-Feb-04	0.7	8-Apr-10	0.32
8-Oct-04	0.4	10-Jun-10	0.62
5-Nov-04	0.88	18-Jun-10	0.51
12-Nov-04	0.57	21-Jun-10	0.98
19-Jan-05	0.47	10-Sep-10	0.51
19-Apr-05	0.51	16-Sep-10	0.39
22-Apr-05	0.64	21-Sep-10	0.44
29-Apr-05	0.67	24-Sep-10	0.38
3-May-05	0.13		

Note: The data of 12-month renminbi Non-deliverable Forward is from Bloomberg, measured at the New York time at 6pm. 21-Jul-05 and 21-June-2010 are two announcements on exchange rate policy by the People's Bank of China. The other 27 dates are used to measure market-perceived change of China's exchange rate policy.