China in a Regional Monetary Framework

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Very Preliminary

Comments welcome

1. Introduction

During the 1997 crisis, the succession of devaluations in Asian countries put the yuan under strong pressure, which ended in a 12% real effective appreciation of the Chinese currency against its Asian competitors.[1] Although the yuan was not devalued at that time, Chinese officials have since then been suggesting that they were willing to move the exchange-rate regime out of the fixed peg on the US dollar towards more flexibility. The case for more flexibility has been sharpened by the perspective of WTO membership, because WTO could turn the trade account into a deficit and/or enhance capital inflows into China.

Whether more flexibility should end in a depreciation of the yuan (to recover lost price competitiveness against Asian competitors) or to an appreciation (in line with capital inflows) is questionable, and would likely depend on the schedule of the liberalization of capital flows compared to that of trade flows. More fundamentally, however, a more flexible exchange-rate regime could take different shapes. The lightest reform would consist in simply broadening the fluctuation band of the yuan against the USD. Another possibility would be to move to a basket peg in line with the relatively balanced distribution of Chinese trade across major economic blocks. Finally, China could abandon any form of exchange-rate management, although a true floating regime would be in sharp contrast with its strategy over the past.

These various options would likely have different implications for the Chinese economy, but also for Chinese neighboring countries. This paper examines the impact of potential changes in the exchange-rate strategy of China on the amount and distribution trade and foreign direct investment in China and in other East-Asian emerging countries. Exchange-rate regimes are defined through the joint behavior of the real exchange rate level and the nominal exchange rate volatility. The impact of different regimes is simulated through the use of two econometric relationships estimated on a large sample of countries.

The impact of the exchange-rate regime on trade is discussed in Section 2. Section 3 deals with its impact on inward FDI. Section4 concludes.

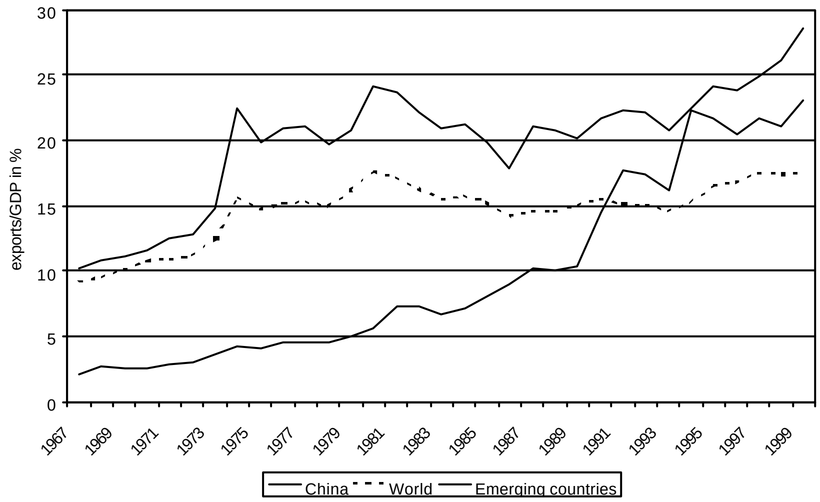
2. Exchange rates and exports

2.2. An overview of China's foreign trade

The quick opening of the Chinese economy is a well-known feature of the 1990s. Indeed, Chinese exports have been growing more rapidly than world trade since the early 1990s (Graph 1). This feature can be related to the reforms implemented in China in 1988 and 1994 (see, for instance, Cerra and Dayal-Gulati, 1999).

[1] Author's calculations using CHELEM and IMF data, taking the following Asian partners into account: Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore and Thailand.

Graph 1. The evolution of openness in China compared to other countries

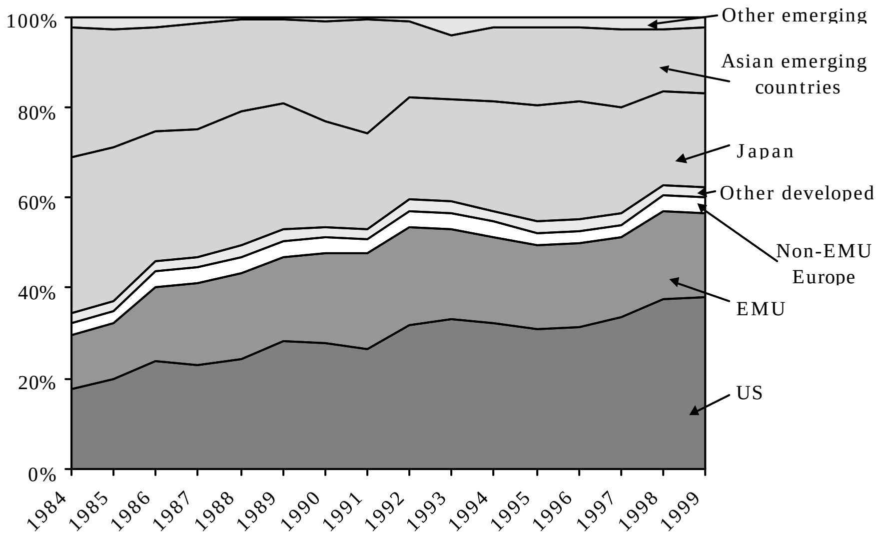


Source: CEPII-CHELEM database.

The United States have received an increasing part of Chinese rising exports, although the share of Europe has been increasing too (Graph 2). Strikingly, the role of other Asian markets has been slightly decreasing since the mid 1980s.

The rising role of the US market may be have been related to the dynamism of this economy over the period and to the exchange-rate regime of China, with a fixed peg on the dollar since the unification of the official and the swap market in 1994 (Song, 2000). This point will be addressed below.

Graph 2. The distribution of Chinese exports

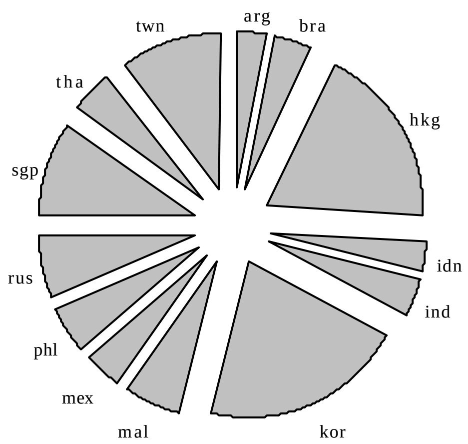


Source: CEPII-CHELEM database.

Emerging countries altogether received 16.7% of Chinese exports in 1998. Among them, the weight of Asian partners amounts to 83%. The roles of Hong Kong and South Korea are specially important (Graph 3).

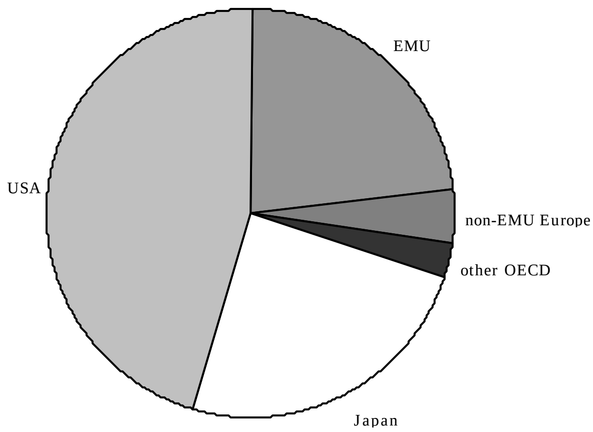
Among highly developed countries (83.3% of Chinese exports), the USA is the main partner, although it amounts to less than 50% of Chinese exports to the developed world (Graph 4). The share of EMU countries is comparable of that of Japan, and it is larger when extended to non-EMU European countries.

Graph 3. The distribution of China's exports across emerging partners, 1998



Source: CEPII-CHELEM database.

Graph 4. The distribution of China's exports to developed countries, 1998.



Source: CEPII-CHELEM database.

2.2. The impact of exchange-rate regimes on trade

Exchange-rate regimes can be defined various ways. A first definition relies on official regimes declared at the IMF, that range from free floating to fix pegs, and include various kinds of managed floats. However, it is now well documented that such exchange-rate regimes do not perfectly fit the effective management of exchange rates, and that most floating regimes are de facto pegged regimes (usually on the dollar; see Levy Yeyati and Sturzenegger 2000, Bénassy-Quéré and Coeuré 2001). As a consequence, the choice is made here to define exchange-rate regimes on such a *de facto* basis by the joint behavior of the exchange-rate *level* and exchange-rate *volatility*.

Modeling trade flows

Two main methods are widely used to analyze the determinants of foreign trade.

The traditional method consists in explaining the export volume of a country by world demand, price competitiveness (the real exchange rate) an miscellaneous factors such as capacity utilization or dummies for reforms. Such a methodology has recently been implemented by Song (2000) and Cerra & Dayal-Gulati (1999) on the case of China, with quarterly data. Song finds a significant export elasticity to the real exchange rate over the whole period of estimation (1980-1988). Conversely, Cerra and Dayal-Gulati evidence a structural break following the 1988 reforms: the real exchange rate becomes a significant determinant of exports only after 1988 (however they are unable to test for a break following the 1994 reforms). Chinese trade data also allow for a sector-level or type of trade analysis; for instance, Dées (2001) treats separately the ordinary trade and the export-processing trade, and shows that only the former is significantly sensitive to exchange-rate changes.

The alternative approach relies on a "structural" estimation of trade where bilateral flows across a wide range of countries are explained by gravitational variables such as GDP, population, distance, trade barriers and the sharing of a common border or of a common language. These are the long-run determinants of trade, to which more short term factors such as price competitiveness can be added. While the first gravitational analysis were essentially empirical, their theoretical foundations have been recently elaborated (see for instance Anderson & Wincoop, 2001).

The advantages of using gravitational models is threefold. First, they allow for a fundamental analysis of the determinants of trade, where the role of prices (and therefore the real exchange-rate level) can be introduced on theoretical grounds. Second, they can be used both in cross-country and panel data analysis, which circumvents the problems linked to the scarcity of time series in most emerging countries. Finally, they allow to estimate *structural* trade equations, which, if the country sample is large enough, allow to perform in and out-of sample simulations using elasticities that are not biased by the special behavior of a specific country or a specific period.[2]

Finally, gravity models are bilateral in nature, which allows to detail bilateral features such as the existence of trade agreements or the choice of a specific anchor for the exchange rate.

[2] In a panel estimation, country and time peculiarities can be caught by fixed effects on exporters and time respectively.

Exchange-rate volatility and trade

The impact of exchange-rate volatility on trade flows has been a major concern especially in the debate on European monetary integration. The huge literature surveyed by McKenzie (1999) leads to mixed results though. When a statistically significant relationship is obtained, it can be either positive or negative. Overall, the results appear dependent on the precise measure of volatility, on the estimation technique and on the sectors and countries concerned. In particular, it seems that long-run volatility (i.e. a measure of the amplitude of large swings in the exchange rate) has more impact than short-run volatility (Sapir, Sekkat and Weber, 1994) and that short-run volatility may only have a transitory effect on trade (Sekkat, 1998).

Some authors have included exchange-rate volatility in gravitational analyses of trade flows. For instance, Frankel and Wei (1995) evidence a significant negative impact of exchange-rate volatility on trade flows across Asian countries on a cross-section basis. Devlin et al (2001) find a significant impact of volatility on trade amongst a set of 136 countries over 1981-1996 (especially for developing countries) when working on three-year groupings. However there is no consensus on the magnitude of this impact.

2.3. The empirical specifications

The baseline specification

According to gravitational models, exports from country *i* to country *j* will depend on four groups of factors:

(i) the GDP and population (or GDP per capita) of both countries, accounting for size effects together with endowment differences;

(ii) geographic distance between *i* and *j*, as a proxy of transportation costs;

(iii) relative trade barriers, i.e. trade barriers encountered by country *i* in country *j* compared to the level of multilateral trade resistance that country *i* experiences; this factor is introduced through fixed effects on both the exporter and the importer, in addition to traditional proxies for trade impediments (usually defined by the existence of a common border or language, of non-tariff and tariff barriers, or of a trade agreement between *i* and *j*);

(iv) relative prices.

On this basis, the following equation is estimated, where the dependent variable ($\ln X_{ijt}$) is the logarithm of exports of country *i* to country *j* during year *t* :

$$\ln X_{ijt} = a_1 \ln GDP_{it} + a_2 \ln GDP_{jt} + a_3 \ln POP_{it} + a_4 \ln POP_{jt} + a_5 \ln DIST_{ij} + a_6 \ln RER_{ijt} + a_7 VOL_{ijt} + b_i + b_j + b_t + \text{TRADE}_{ijt} + CB_{ij} + e_{ijt} \quad \textbf{(Eq. 1)}$$

Gravitational variables: GDP_{it} is the GDP in current dollars of country *i* during year *t*, POP_{it} is the population (in millions) of country *i* during the same year, $DIST_{ij}$ is the geodesic distance between *i* and *j*, corrected in order to take peculiarities for some countries into account (see Appendix), $TRADE_{ijt}$ is a vector of dummies that describe the existence of regional trade agreements between countries, taking the date of enforcement into account. Finally, CB_{ij} is a dummy for the existence of a common border.[3]

Exports and GDPs are expressed in current dollars. This is because export prices are generally not available for emerging countries (and especially for China). A possibility could be to deflate exports with consumer prices. However there may be a large difference between consumer price and export price indices, especially in China where exporting industries are concentrated in a limited part of the country. Like Dées (1998), we decided to work on nominal aggregates. Given that exports and GDPs are in logarithm, the world relative evolution of export and GDP prices is accounted for by the fixed-time effects.[4]

Exchange-rate variables: RER_{ijt} is the bilateral real exchange rate between i and j, calculated with CPI indices. The impact of the real exchange rate level in 1995 (base year) is caught through country fixed effects. Exchange-rate volatility (VOL_{ijt}) it is computed on a quarterly basis, using two definitions. The first one is the coefficient of variation of the quarterly nominal exchange rate over the year under study, which describes the dispersion of nominal exchange rates around their mean. The second one is the standard deviation of quarterly variations in nominal exchange rates, which describes the dispersion of exchange-rate changes.

The estimation is carried out on a panel of 15 emerging countries and 33 importing countries, including the 15 emerging countries (see the list of countries in Appendix).[5] The time sample covers the 1984-1999 period. Hence, the maximum number of observations is 7,920 (note that the cross-country dimension of the sample is much larger than its time dimension). The estimated equation includes country i and j fixed effects (b_i and b_j), as well as a time fixed effect b_t.

Among exporting countries, China might be an outlier. In a second step, Eq. 1 is estimated on the same sample of countries excluding China.

The role of exchange-rate misalignments

When estimating the impact of the real exchange rate on trade on a panel basis, it is implicitly assumed that a given appreciation will have the same impact on the competitiveness of all the countries of the sample (the elasticity is the same in the within approach). Such an exercise typically ignores the equilibrium path of the real exchange rate. This is especially problematic as far as emerging countries are concerned since their real exchange rates are expected to appreciate to some extent without any loss in competitiveness in the long run (Balassa-Samuelson effect).

In order to deal with this issue, real exchange-rate misalignments were calculated in two steps. First, a simplified real equilibrium exchange rate equation was estimated, following the Balassa-Samuelson model:

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[3] A common language dummy was also introduced, but it proved to be highly correlated with the common border, and had to be removed from the set of explanatory variables.

[4] Later work will include estimations on exports volumes calculated with CPIs or regional export unit values.

[5] As far as China is concerned, the 33 importing countries of the sample account for more than 80% of the Chinese exports (86 % in 1998).

$$\ln RER_{ijt} = b_1 \ln GDPC_{it} + b_2 \ln GDPC_{jt} + g_t + g_i + g_j + e_{ijt} \quad \textbf{(Eq. 2)}$$

where $GDPC_{it}$ denotes GDP per capita in country *i* (in PPP) and is used as a proxy for relative productivity in the tradable and in the non-tradable sectors. Consistent with the trade equation, fixed effects were introduced for the exporters, the importers and time. The estimated equation yields the following result (p-values into brackets):

$$\ln RER_{ijt} = -\underset{[.000]}{.691} \ln GDPC_{it} + \underset{[.000]}{0.684} \ln GDPC_{jt} + g_t + g_i + g_j + e_{ijt},$$

$\overline{R}^2 = .653$, F(31,4963)=81.604 [.000], θ=.011,

Hausman test $\chi^2(9)$=564.28 [.000], number of observations : 5024.

This result is robust to the exclusion of China from the sample, as the results are, in this case:

$$\ln RER_{ijt} = -\underset{[.000]}{.697} \ln GDPC_{it} + \underset{[.000]}{0.700} \ln GDPC_{jt} + g_t + g_i + g_j + e_{ijt},$$

$\overline{R}^2 = .751$, F(30,4382)=141.39 [.000], θ=.006,

Hausman test $\chi^2(10)$=852.76 [.000], number of observations : 4441.

In both cases, a relative increase in GDP per capita in country *i* compared to country *j* is associated with a real exchange-rate appreciation of country *i* currency against country *j*. Hence, the Balassa-Samuelson effect is confirmed, a 1% increase in GDP per capita leading to an almost .7% real equilibrium appreciation.

In a second step, real exchange-rate misalignments were calculated as the residuals of Eq. 2.

The gravitational equation can then be re-estimated substituting real exchange-rate misalignments for real exchange-rate levels:

$$\begin{aligned}\ln X_{ijt} &= a_1 \ln GDP_{it} + a_2 \ln GDP_{jt} + a_3 \ln POP_{it} + a_4 \ln POP_{jt} + a_5 \ln DIST_{ij} \\ &+ a_6 RERMIS_{ijt} + a_7 vol_{ijt} + b_i + b_j + b_t + \text{TRADE}_{ijt} + CB_{ij} + e_{ijt}\end{aligned} \quad \textbf{(Eq. 3)}$$

where $RERMIS_{ijt}$ is the real exchange rate misalignment relative to the Balassa-Samuelson standard. A positive value of $RERMIS_{ijt}$ signals that the real exchange rate is weak compared to its Balassa-Samuelson level.

2.4. The econometric results

The results are reported in Table 1 and in Table 2. Columns (I) refer to estimations carried out on the whole sample of countries, while columns (II) estimates exclude China. In principle, the latter should be better fitted to provide simulations, as it should not be biased by China being a possible outlier. In columns (I-a) and (II-a), the volatility of the exchange rate is measured through the coefficient of variation, while in columns (I-b) and (II-b) the volatility is measured through the standard deviation of quarterly exchange-rate changes. Finally, columns (I-c) and (II-c) exclude the volatility of the exchange rate from the estimates, as this variables proves insignificant in most cases.

The coefficients on gravity variables are significant and they bear the expected signs: the larger the GDP of the importer or of the exporter, the larger the export flow.[6] A larger population in the importing country also raises exports to this country. However a larger population in the exporting country tends to reduce exports, probably because the GDP per capita is lower.

Turning to exchange rate variables, two conclusions can be drawn.

First, except in one case, *exchange-rate volatility* has an insignificant impact on exports. This result is hardly surprising though. Indeed, the effect of uncertainty on trade is theoretically unclear, and previous empirical works have also produced mixed results (McKenzie, 19999, Devlin et al., 2001). Calculating exchange-rate volatility on a longer time span (like in Rose, 2000) may lead to a significant impact of volatility. Conversely, Sekkat (1998) shows that volatility has only a short-run impact on trade. On the whole, then, it is not clear whether a change in volatility would impact on trade in the short run and in the long run. This variable will be dropped in the simulations below.

Second, a *real exchange-rate* depreciation (rise in RER_{ijt}) raises the dollar value of exports. Note that this results is the combination of a fall in Chinese prices in dollars and of a rise in the volume of exports. The elasticity is higher when China is excluded from the sample of exporting countries, which means that the elasticity is lower for China than for other countries. This result is robust to the inclusion of a dummy variable for the reforms implemented in China since 1994. It is consistent with Cerra and Dayal-Gulati (1999) who find that the real exchange rate has an insignificant impact on Chinese exports before 1988, and with Dées (2001) who shows that part of Chinese trade is insensitive to the real exchange rate.

It is interesting to note that both a real exchange rate appreciation and an excess real appreciation (misalignment compared to the Balassa-Samuelson standard) tend to depress exports. This result suggests that, in the sample, appreciating countries tend to be also over-appreciating, and that the first set of equations is not biased by the fact that the equilibrium behavior of exchange rate is not taken into account.

It can be argued that a real exchange-rate depreciation reduces exports through lowering the dollar value of GDP. This is especially the case for a large country like China where the bulk of GDP is carried out in yuan. Denoting Y_i the volume of GDP in i, P_i its deflator and E_{ij} the nominal exchange rate of i against j, we can extract from Eq. 1:

$$\ln X_{ijt} = a_1\left(\ln Y_{it} + \ln P_{it} - \ln E_{ijt} - \ln E_{j\$t}\right) + a_2\left(\ln Y_{jt} + \ln P_{jt} - \ln E_{j\$t}\right) + a_6\left(\ln P_{jt} + \ln E_{ijt} - \ln P_{it}\right)$$

This can be re-arranged as:

$$\ln X_{ijt} = a_1 \ln Y_{it} + a_2 \ln Y_{jt} - a_1\left(\ln E_{i\$t} - \ln P_{it}\right) - a_2\left(\ln E_{j\$t} - \ln P_{jt}\right) + a_6\left(\ln E_{ijt} + \ln P_{jt} - \ln P_{it}\right)$$

If neither prices nor the exchange rates against the USD move in country j, then the net impact of a 1% real depreciation in country i is $(-a_1+a_6)\%$ rather than $a_6\%$. This is because the dollar size of country i is lowered, which reduces the potential for exports in USD (however the domestic value of each dollar of exports rises by 1%). Along the same

[6] The coefficient on the exporter's GDP is non significant in the estimations with exchange-rate misalignments, probably due to some collinearity between GDP_{it} and $RERMIS_{ijt}$, the latter being calculated with the GDP per capita of country i.

line, a depreciation in country *j* reduces exports of country *i* both through lower competitiveness and through the devalorisation of country *j*'s market in dollars. Note that this valorization effect does not apply in a traditional framework where the volume of exports is explained by world demand but not by domestic GDP.

Whether such an effect should be accounted for when assessing the impact of a depreciation is questionable. In the one hand, GDPs are just proxies for size in the gravity model. Their impact on trade is a long-run impact, with no sensitiveness to the exchange-rate policy. In the other hand, exchange-rate variations may have impacted on exports through GDP dollar values over the estimation period, and this should be accounted for in the interpretation of the results.

The simulations below will detail the impact of exchange-rate variations through both competitiveness and GDP valorization effects.

Table 1. Baseline estimation

	I – China in the sample			II – China out of the sample		
	(a)	(b)	(c)	(a)	(b)	(c)
Nb. of obs.	4749	4749	4749	4197	4197	4197
GDP_{it}	.146 [.044]	.157 [.032]	.165 [.021]	.448 [.000]	.412 [.000]	.459 [.000]
GDP_{jt}	.426 [.000]	.382 [.000]	.441 [.000]	.187 [.053]	.173 [.076]	.192 [.043]
POP_{it}	-1.756 [.000]	-1.907 [.000]	-1.786 [.000]	-1.190 [.013]	-1.270 [.008]	-1.206 [.000]
POP_{jt}	1.395 [.000]	1.471 [.000]	1.387 [.000]	2.079 [.000]	2.120 [.000]	2.075 [.000]
$DIST_{ij}$	-.875 [.000]	-.891 [.000]	-.875 [.000]	-.946 [.000]	-.963 [.000]	-.946 [.000]
RER_{ijt}	.273 [.085]	.232 [.000]	.275 [.000]	.692 [.000]	.594 [.000]	.693 [.000]
VOL_{ijt} Coef. Variation	-.214 [.085]	-	-	-.107 [.415]	-	-
VOL_{ijt} instability	-	.118 [.447]	-	-	.075 [.644]	-
MERCOSUR	1.986 [.000]	1.938 [.000]	1.996 [.000]	1.955 [.000]	1.901 [.000]	1.956 [.000]
NAFTA	1.268 [.000]	1.255 [.000]	1.269 [.000]	1.316 [.000]	1.293 [.000]	1.317 [.000]
ASEAN	.119 [.077]	.118 [.081]	.120 [.075]	.073 [.315]	.074 [.303]	.073 [.312]
BPT	.416 [.001]	.423 [.001]	.416 [.001]	.316 [.013]	.322 [.011]	.316 [.013]
CB	.274 [.009]	.248 [.017]	.275 [.009]	.190 [.068]	.161 [.121]	.190 [.067]
Adj. R^2	.842	.843	.842	.844	.844	.843
F test	F(31;4679) = 89.70 [.000]	F(31,4651) = 89.79 [.000]	F(31;4679) = 90.35 [.000]	F(30,4129) = 85.71 [.000]	F(30,4103) = 85.16 [.000]	F(30,4103)= 85.18 [.000]
Theta	.009	.010	.010	.010	.010	.010
Hausman test	$\chi^2(26)$ = 67.51 [.000]	$\chi^2(25)$ = 61.73 [.000]	$\chi^2(24)$ = 64.24 [.000]	$\chi^2(25)$ = 81.47 [.000]	$\chi^2(24)$ = 87.57 [.000]	$\chi^2(24)$ = 87.40 [.000]

Table 2. Impact of real exchange rate misalignements

	I – China in the sample			II – China out of the sample		
	(a)	(b)	(c)	(a)	(b)	(c)
Nb. of obs.	4707	4721	4790	4197	4171	4237
GDP_{it}	-.018 [.776]	.003 [.914]	-.044 [.484]	-.014 [.821]	.020 [.768]	-.004 [.905]
GDP_{jt}	.238 [.000]	.539 [.000]	.608 [.000]	.667 [.000]	.586 [.000]	.648 [.000]
POP_{it}	-1.796 [.000]	-1.857 [.000]	-1.632 [.001]	-.845 [.081]	-.984 [.042]	-.893 [.063]
POP_{jt}	1.269 [.000]	1.292 [.000]	1.252 [.000]	1.538 [.000]	1.655 [.000]	1.599 [.000]
$DIST_{ij}$	-.879 [.000]	-.891 [.000]	-.896 [.000]	-.947 [.000]	-.963 [.000]	-.972 [.000]
$RERMIS_{ijt}$	.214 [.000]	.197 [.000]	.242 [.000]	.573 [.000]	.483 [.000]	.528 [.000]
VOL_{ijt} Coef. Variation	-.059 [.691]	..	..	-.104 [.431]	..	..
VOL_{ijt} instability	..	.129 [.405]	..	..	.116 [.472]	..
MERCOSUR	1.960 [.000]	1.936 [.000]	1.930 [.000]	1.950 [.000]	1.898 [.000]	1.893 [.000]
NAFTA	1.251 [.000]	1.249 [.000	1.256 [.000]	1.298 [.000]	1.277 [.000]	1.283 [.000]
ASEAN	.120 [.076]	.117 [.082]	.119 [.079]	.074 [.309]	.076 [.295]	.071 [.329]
BPT	.423 [.001]	.423 [.001]	.426 [.001]	.315 [.013]	.322 [.011)	.329 [.010]
CB	.266 [.011]	.248 [.017]	.241 [.020]	.191 [.067]	.163 [.117]	.151 [.147]
Adj. R^2	.843	.843	.842	.843	.843	.842
F test	F(31;4637) = 89.175 [.000]	F(31,4651) = 89.105 [.000]	F(31;4721) = 88.57 [.000]	F(30,4129) = 83.442 [.000]	F(30,4103) = 83.404 [.000]	F(30,4170)= 83.012 [.000]
Theta	.010	.010	.010	.010	.010	.010
Hausman test	$\chi^2(25)$ = 58.742 [.000]	$\chi^2(26)$ = 57.905 [.000]	$\chi^2(23)$ = 54.488 [.000]	$\chi^2(25)$ = 60.249 [.000]	$\chi^2(25)$ = 83.333 [.000]	$\chi^2(21)$ = 59.513 [.000]

2.5. The impact of the exchange-rate on Chinese trade

The empirical estimates allow to assess the impact of a devaluation or reevaluation of the Chinese yuan, in real terms. Since the model is linear, the impact of an appreciation is just the opposite of that of an appreciation. However the devaluation of the yuan in 1994 has often been viewed as one cause of the Asian currency crises of 1997. Conversely, the absence of devaluation of the yuan in 1997 was considered an important ingredient for stopping domino devaluations. Hence, a devaluation of the yuan would likely trigger devaluations of other Asian currencies, whereas an appreciation would likely be an isolated event in Asia.

Three possible reactions of other Asian emerging countries to a devaluation of the yuan are considered.

(i) the real devaluation is limited to China;

(ii) the devaluation of the yuan triggers a devaluation of the HK dollar, due to the fact that Hong Kong is the major re-exporting center for Chinese products;

(iii) all Asian countries devalue following China, in a domino-style scenario.

In all cases, the devaluation is of 10% and does not trigger immediate price rise. Other currencies in the world are assumed to stay stable against the US dollar.

The simulations are performed with estimates where the volatility of the exchange rate is not taken into account: I-c (sample including China) and II-c (sample excluding China) of Table 1. The two simulations provide a range of responses of exports to a devaluation. Tables 3 to 5 report the impact of the three scenarios on exports in dollars, which is the variable to be looked at for assessing the external constraint. The impact on exports in domestic currency is obtained by adding to the figures the percentage change of the domestic exchange rate against the US dollar.

Table 3. The impact of a 10% yuan depreciation on Chinese exports (% gain)

	China in the sample			China our of the sample		
	Competitiveness	GDP value	Total	Competitiveness	GDP value	Total
Only China devaluates	2.75	-1.65	1.10	6.93	-4.59	2.34
China + Hong Kong devaluate	2.66	-1.79	0.87	6.71	-4.65	2.06
All Asian countries devaluate	2.39	-2.23	0.16	6.02	-4.84	1.18

Source: author's calculations.

A 10% real devaluation of the yuan alone produces a 2.75 to 6.93% increase in Chinese exports in USD through higher competitiveness while the contraction of the Chinese dollar-GDP reduces Chinese exports by 1.65 to 4.59%. If size matters in the short and medium run, then the net effect is 1.10 to 2.34% (note that the impact on the yuan value of exports is 11.0-12.3%). This figure is rather small. Conversely, if size does not matter at the horizon of the exchange-rate policy, then only the competitiveness effect should be considered, which implies a 2.75 to 6.93% impact on the dollar value of exports. The higher bound would stand if the behavior of Chinese exports was to resemble more that of other emerging countries than it did in the past.

Table 3 also shows that a devaluation in China would have similar impact on Chinese exports whether or not other East Asian emerging countries would also devalue. Despite a neutral effect on bilateral competitiveness, a devaluation in several countries of the region may *lower* intra-regional trade due to the reduced dollar size of Asian markets compared to US, Japanese and European markets. However the impact of a domino-style scenario would not be substantial for China since Asian markets only represent 13.7% of Chinese exports (1998 figure).

Finally, Table 3 can also be used to measure the impact of a possible appreciation of the yuan in case of a move to a free floating regime. As shown in Section 2.4, the main concern for exports would not be exchange-rate volatility, but rather possible large movements in the real exchange rate. Taking the US dollar against the euro as a benchmark, such movements can easily fluctuate by 50-70% in a few years. A 60% appreciation of the yuan would mean a drop in Chinese exports (through lower competitiveness) by 16 to 41%, whereas the rising dollar size of China would entail a 10 to 28% increase in Chinese exports (but also a rise in imports).

The impact of a devaluation of the yuan on two Asian partners is described in Tables 4 and 5.

Table 4. The impact of a 10% yuan depreciation on HK exports (% gain)

	China in the sample			China our of the sample		
	Competitiveness	GDP value	Total	Competitiveness	GDP value	Total
Only China devaluates	-0.88	-1.42	-2.30	-2.23	-0.62	-2.85
China + Hong Kong devaluate	1.87	-3.07	-1.23	4.70	-5.21	-0.56
All Asian countries devaluate	1.52	-3.62	-1.96	3.84	-5.41	-1.46

Source: author's calculations.

Even when correcting bilateral trade for re-export, over 32% of Hong Kong exports are directed to continental China (compared to "only" 23.4% to the United States). Hence, a devaluation of the yuan but not of the HK dollar reduces HK exports through lower competitiveness by 0.9 to 2.2%. The devalorization of Chinese GDP reduces HK exports by an additional 0.6 to 1.4%. If the HK dollar is devalued too, then the competitiveness effect becomes positive while the size effect is further negative. If both effects are taken into account, then the dollar value of exports is reduced in all cases for Hong Kong. In brief, HK may actually loose from devaluations in the region which would reduce the dollar value of intra-regional trade while having a limited impact on exports towards the rest of the world. The loss would not take the form of a lower current account (since imports would also be reduced), but rather on a falling share in international trade.

Korea is in a different situation since “only” 16% of its exports are carried out with continental China (+4.5% with Hong Kong). Hence the impact of a yuan devaluation is smaller than for Hong Kong. The fact that HK devalues or not does not change the picture. Again, a devaluation of the domestic currency (the won) would raise exports through higher price competitiveness, but it would reduce the dollar size of the economy, leading to an ambiguous impact on exports in dollars.

Table 5. The impact of a 10% yuan depreciation on Korean exports (% gain)

	China in the sample			China our of the sample		
	Competitiveness	GDP value	Total	Competitiveness	GDP value	Total
Only China devaluates	-0.43	-0.69	-1.12	-1.08	-0.30	-1.38
China + Hong Kong devaluate	-0.46	-0.74	-1.20	-1.16	-0.32	-1.49
All Asian countries devaluate	1.68	-3.36	-1.60	4.24	-5.33	-1.01

Source: author’s calculations.

Three conclusions can be driven from this simulation analysis:

First, there is a large uncertainty on the potential impact of a devaluation in China. If Chinese exports behave like they did in the past, then a devaluation of the yuan would have very little effect through higher competitiveness. However economic reforms have been implemented in China, and additional reforms will be implemented in the future to cope with WTO requirements. This could make the reaction of Chinese exports to a devaluation converge upwards with that of other emerging countries. Conversely, the major risk of floating the yuan would be that of an appreciation which could yield very large losses in Chinese exports in the short run.

Second, the impact of a devaluation of the yuan on China’s exports is little dependent on the exchange-rate reaction of other currencies in the region, included the HK dollar. This is because exports to Eastern Asia (other than Japan) only account for 13.7% of Chinese exports. One implication is that China will unlikely push for regional monetary cooperation on this ground (although it could do so on other grounds).

Finally, a domino-style scenario of devaluations and depreciations in East Asia would reduce the share of this region in world trade through lower GDPs in dollars, although the domestic value of international trade would be raised. For countries which are indebted in dollars or for those wishing to invest abroad, there is a trade-off to be made between higher competitiveness and a higher size in dollars.

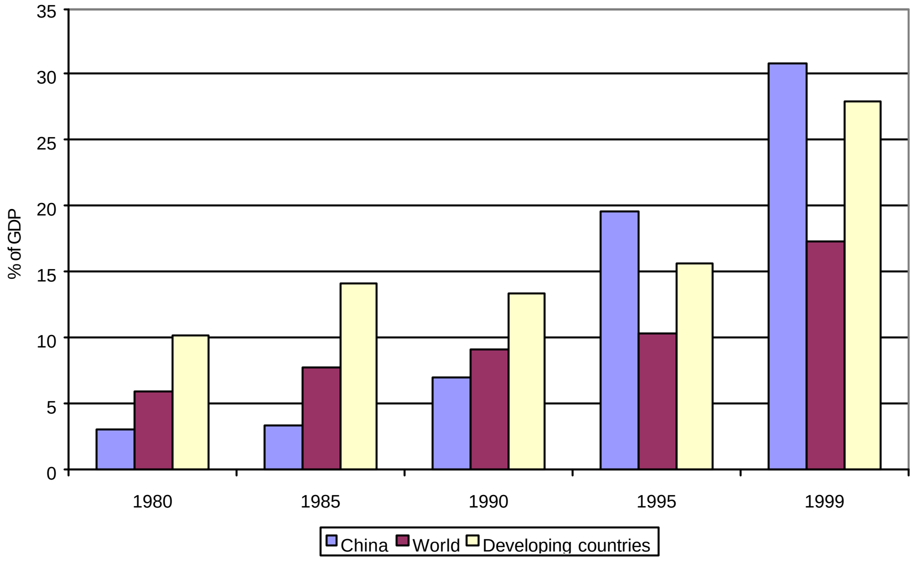
3. Exchange-rate strategy and FDI in China

Foreign direct investment is often presented as a substitute for exports in the presence of trade barriers (the so-called "tariff-jumping" argument). However Fontagné (1999) or Stone and Jeon (2000) show that FDI and exports are complements rather than substitutes. Indeed, local investment is often needed to facilitate exports (selling networks, after-sale workshops,…). Conversely, FDI often entails exports of intermediate goods to the target country where the final good is produced. By having China reduce its trade barriers, WTO membership thus yields an important opportunity in terms of FDI inflows.

Indeed, the inward FDI stock in China has been growing very fast in recent years (Graph 5). In 1999, the Chinese ratio of inward FDI to GDP was higher than the world average.

Inward FDI in China has two main motivations. The first one is to serve (or take a position to be able to serve in the future) the huge Chinese market. The second one is to hire cheap labor in order to re-export the local production. The concentration of FDI in coastal regions of China (Lemoine, 2000) indicates that the second motivation may have been prominent over the past years.

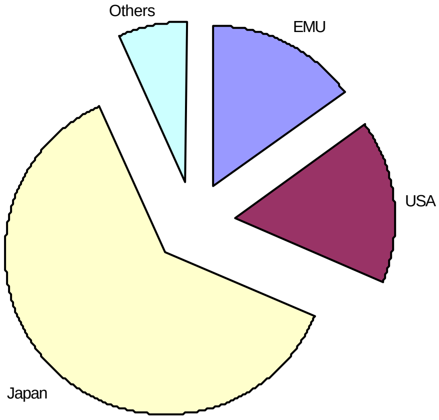
Graph 5. Inward FDI stock in % of GDP



Source: UNCTAD, *World Investment Report*, 2001, pp. 325-333.

The major part of foreign direct investment in China comes from Japan, whereas the share of the United states and of EMU countries are similar and other countries play a minor role (Graph 6).

Graph. 6: Distribution of investing countries in China, average 1995-1997.



Source: OECD.

3.2. Exchange rates and inward FDI

The link between exchange-rate regimes and trade has been carefully studied, among others, by Cushman (1985 and 1988). Bénassy-Quéré, Fontagné and Lahrèche-Révil (2001) propose a multi-country extension where host countries compete for attracting FDI through higher price competitiveness, lower exchange-rate uncertainty and some differentiation in the exchange-rate strategy. They carry out a panel estimation for a range of 42 host, emerging countries and 17 investing, industrialized countries over the 1984-1996 period (1749 observations). The following equation is obtained using OECD FDI data:

$$\log FDI_{ijt} = \underset{(2.614)}{0.222}\log RER_{ijt} - \underset{(-3.179)}{0.597} Vol_{ijt} - \underset{(-2.537)}{0.044}\, r_{ijt} \times \log RER_{i\bullet t} - \underset{(-6.389)}{0.310}\log DIST_{ij}$$
$$+ \underset{(16.009)}{0.891} OPEN_{jt} + OIL_{jt}\left(-\underset{(-3.717)}{0.454}\log RER_{ijt} - \underset{(-1.947)}{0.742} Vol_{ijt} + \underset{(4.800)}{0.352}\log DIST_{ij} \right) \quad \textbf{Eq.4}$$
$$\overline{R}^2 = 0.604$$

where FDI_{ijt} is the stock of FDI received from country i by country j at time t (in constant dollars), RER_{ijt} is the real exchange rate of i against j (a rise signals a depreciation of country i's currency), $RER_{i\bullet t}$ is the real exchange rate of i against the aggregate of all emerging countries (GDP-weighted average of all bilateral real exchange rates against i), Vol_{ijt} is the coefficient of variation of the quarterly nominal exchange rate of i against j over the past three years, r_{ijt} is the correlation between the nominal exchange rate of i against j and against the aggregate of all emerging currencies (over the same period), and $DIST_{ij}$ is the geographic distance between i and j (proxying transportation costs). In a standard fashion, the estimation is carried out with fixed effects on time and on investing countries. The latter control for the size and other characteristics of the investing countries, whereas the former catch trends in the world economy such as deregulation. The size of the host country is partially captured by the openness variable (see below), although other characteristics not accounted for by the theoretical model such as human capital are not included in the estimation.

An openness variable ($OPEN_{jt}$) is introduced to control for the nature of foreign direct investment: if FDI aims at re-export, then it should translate into a large openness ratio (the ratio of exports plus imports to GDP), since entering the small domestic markets can hardly be the investor's motivation. A dummy (OIL_j) is also introduced to control the particular behavior of FDI into oil exporting countries.

Student statistics are given in parentheses. All the coefficients are significant at the 1% level, except that on exchange rate volatility in the oil exporting countries, which is significant at the 5% level.

As expected in the case of re-export strategies, an appreciation of i against j (rise RER_{ijt}) raises FDI from i to j (*competitiveness effect*), whereas an increase in the nominal exchange rate volatility tends to reduce FDI (*volatility effect*). The coefficient associated to the multiplicative variable $r_{ijt} \times \ln RER_{i \cdot t}$ (*interdependence effect*) bears a negative sign: when the exchange rate of i against alternative locations is positively correlated to that against host j, an improved competitiveness in other emerging countries reduces FDI inflows to country j (through substitution); conversely, in the case of a negative correlation, an improved competition in other emerging countries raises FDI to country j (through complementarity).

Geographic distance (which proxies transportation costs) accounts for a significant share of the investing behavior of industrialized countries, consistent with the literature on economic geography. Moreover, openness has a significant impact on FDI, consistent with the assumed re-export nature of FDI.

The effect of a real appreciation is opposite in oil producing countries compared to other emerging countries: it raises FDI inflows. This is consistent with the Dutch disease effect referred to above. The impact of volatility is reinforced compared to other emerging countries, whereas the coefficient on economic distance is almost zero (0.357-0.347=0.010).

Eq. 4 is used below to measure the impact of various exchange-rate scenarios in China.

3.3. The impact of exchange-rate strategies on inward FDI in China

Change in exchange-rate level

Here the impact of a 10% devaluation of the yuan against the USD on inward FDI in China is studied. Two effects are expected:

First, the devaluation lowers production costs in China, which attracts FDI.

Second, the devaluation may trigger devaluations elsewhere in East Asia. Since most Asian currencies followed the USD just like China over the past (and since there is some evidence that they still do so de facto, see Bénassy-Quéré and Coeuré, 2001), the correlation between the exchange rate of any investing country against the yuan and against other Asian currencies is positive (it is set to 0.5 here), and China can be viewed as a substitute rather than a complement to other locations in Asia. Hence, a devaluation in other Asian countries reduces inward FDI in China. For simplicity, only two scenarios are studied here: (i) only China devalues and (ii) all other emerging countries devalue. Of course, a devaluation in China may not trigger a devaluation in Brazil. However foreign investors will unlikely view Brazil as a close substitute for China. Hence, forgetting host countries outside Asia is not detrimental to our analysis. The results are reported in Table 6.

Table 6. The impact of a 10% devaluation of the yuan on inward FDI (% gain)

	Competitiveness effect	Interdependence effect	Total
Only China devalues	2.22	0.00	2.22
All emerging countries devalue	2.22	-0.22	2.00

Source: authors' calculations.

The gain for China is little dependent on the behavior of other East Asian countries. This is because only FDI from industrialized countries is considered: whatever the reactions elsewhere in Asia, the devaluation of the yuan against the USD entails a devaluation against all the currencies of investing countries. Like for trade, China will likely not push for monetary regional cooperation on this ground.

The model also allows to assess the impact of a change of exchange-rate regime in China. If China and its Asian competitors move back to their previous exchange-rate policies after the devaluation, then the volatility of the nominal exchange rate is unchanged and Table 6 is the final result. However the devaluation of the yuan could be the first step of a change in the exchange-rate regime.

Change in the exchange-rate regime

A change in the exchange-rate regime of China would impact volatility together with competitiveness. Here we study the impact of move to a peg on a euro-dollar basket, a yen-dollar basket or a yen basket.

a. *The volatility effect*: a move from a peg to the dollar to a peg on a euro-dollar basket (50/50) would raise the volatility of the yuan against the dollar from almost zero to half the euro/dollar volatility, whereas the exchange-rate volatility against the euro would fall from the level of euro/dollar volatility to half of this level. The same line of reasoning applies for a move to a peg on a yen-dollar basket or on the yen (in the latter case, the volatility against the yen falls to zero). For simplicity, we assume here a 7% volatility for both the euro/dollar and the yen/dollar (this is in line with the levels observed in the 1990s. The various scenarios are described in Table 7.

Table 7. The volatility effect of a change in the currency anchor

	USD	euro	yen	other	Total
Volatility of the yuan (%)					
- status quo (peg on the USD)	0	7	7	7	-
- peg on a euro-dollar basket	3.5	3.5	7	7	-
- peg on a yen-dollar basket	3.5	7	3.5	7	-
- peg on the yen	7	7	0	7	-
% variation of inward FDI					
- peg on a euro-dollar basket	-2.09	2.09	0.00	0.00	-0.03
- peg on a yen-dollar basket	-2.09	0.00	2.09	0.00	0.95
- peg on the yen	-4.18	0.00	4.18	0.00	1.89

Source: authors' calculations.

From Table 7, it is clear that a change in the currency anchor used by China would hardly impact on aggregate inward FDI, except in the case the yen is selected as a significant anchor. This is because the bulk of inward FDI in China comes from Japan (see Graph 6). Conversely, a move to a euro-dollar peg would only raise FDI from EMU countries at the expense of FDI from the United States, with little net impact. However a peg on a basket would make FDI inflows more stable (less dependent on euro/dollar and/or yen/dollar fluctuations). We now examine this point. Finally, floating the yuan would reduce FDI inflows from both the United States and other regions. According to the estimated equation, the loss would be of 0.6% per point of volatility (ie 6% in the case of a 10% volatility).

b. *The competitiveness effect.* Assume the dollar appreciates by 10% against other OECD currencies. If pegged to the dollar, the yuan appreciates by 10% against the euro, the yen and other OECD currencies. If pegged on a euro-dollar (or yen-dollar) basket, the yuan appreciates by only 5% against the euro (or the yen), whereas it depreciates by 5% against the dollar. As shown in Table 8, a basket peg yields increased stability in inward FDI.

Table 8. The impact of an appreciation of the dollar against other OECD currencies

	USD	euro	yen	Other	Total
% change in the yuan*					
- status quo (peg on the USD)	0	-10	-10	-10	-
- peg on a euro-dollar basket	5	-5	-5	-5	-
- peg on a yen-dollar basket	5	-5	-5	-5	-
- peg on the yen	10	0	0	0	-
% variation of inward FDI					
- status quo (peg on the USD)	0.00	-2.22	-2.22	-2.22	-1.86
- peg on a euro-dollar basket	1.11	-1.11	-1.11	-1.11	-0.75
- peg on a yen-dollar basket	1.11	-1.11	-1.11	-1.11	-0.75
- peg on the yen	2.22	0.00	0.00	0.00	0.36

* a positive sign means a depreciation of the yuan.

The aggregate amount of inward FDI is more unstable if the yuan is pegged to the USD than if it is pegged to the yen, because the stability of the yuan/dollar exchange rate benefits a smaller share of inward FDI than the stability of the yuan/yen exchange rate. Along the same line, a peg on a basket makes inward FDI more stable because lower FDI from one region (here Europe and Japan) is partly compensated by higher FDI from other ones (here the United States).

c. *The interdependence effect.* Finally, moving to another currency anchor may yield different results depending on the anchors used by other countries in the region. For instance, if China moves to a peg on the yen whereas other East Asian countries would keep a de facto peg on the US dollar, then the potential investors may view China and alternative Asian locations as complements rather than substitutes, which would raise the amount of FDI. For instance, if the correlation coefficient falls from 0.5 to –0.5, this yields a rise of inward FDI in China by about 8.8%. If the coefficient only falls to zero, the gain is half, but it remains rather large compared to previous amounts.

Conclusion : according to our model, a move out of the peg on the dollar towards either a peg on a basket or a peg on the yen would have three main consequences on inward FDI in China. First, it would modify the distribution of investors in favor of Japan and EMU countries and moderately raise the aggregate amount of FDI. Second, it would stabilize the aggregate amount of FDI when the dollar moves against the euro or against the yen. Finally, provided other East-Asian countries do not follow the same strategy, it would reduce competition within East Asian countries to attract FDI. Conversely, a free floating regime would yield the risk of reducing inward FDI through higher volatility, although the impact through competitiveness would depend on the way the yuan moves.

4. Conclusion

Several conclusions can be drawn from the econometric results and simulations presented in this paper. First, the real exchange rate is likely to be an increasing concern for both trade and foreign direct investment in China. Second, exchange-rate volatility is also shown to play a role for attracting FDI in China, but we were unable to evidence an influence of exchange-rate uncertainty on trade. Third, the simulations show that China has little economic incentive to push for regional monetary cooperation, at least on the two grounds of trade and FDI, whereas the reverse is not true: other emerging countries in East-Asia may loose from a domino-style cascade of devaluations and depreciations.

According to our results, diversifying the peg of the yuan would likely stabilize inward FDI in China, especially if the yen was to acquire a significant role. Conversely, the risk from moving to a free floating regime would be more that of lasting fluctuations of the yuan than that of short-run volatility.

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Appendix.

Countries of the sample

The estimates are run on 15 exporting, emerging countries and 33 importing, emerging or developed countries. The country lists are the following.

Exporting countries: Argentina, Brazil, China, Hong Kong, Indonesia, India, Korea, Malaysia, Mexico, Thailand, Russian Federation, Singapore, Thailand, Taiwan and Vietnam.

Importing countries: all exporting countries plus Australia, Austria, Belgium-Luxembourg, Germany, Denmark, Spain, Finland, France, the United Kingdom, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Portugal, Sweden and the United States.

Data sources and definitions

1) Gravitational variables

- GDP_{it} is the GDP of country i at year t in million current US dollars (source: CEPII-CHELEM database).
- POP_{it} is the population if country i at year t in million (source: CEPII-CHELEM database).
- $DIST_{ij}$ is the geodesic distance between the economic centers of i and j (source: http://www.cepii.fr/francgraph/bdd/bdd.htm). This distance variable receives a special treatment in the case of the USA, which lies on the argument that when trade between the US and for instance Asian countries is considered, San Francisco should be considered as the main economic center for trade flows. As a consequence, two economic centers are introduced in the case of the US : New York and San Francisco (the same treatment is applied to Canada, where the main economic centers are Montreal and Vancouver). The distance data which is provided selects the minimum distance between the two possible economic centers and the economic center of the partner country.
- $TRADE_{ij}$ is a vector of dummies that take the value of one when country *i* has a trade agreement with country *j*. The trade agreements are the MERCOSUR, the NAFTA, the ASEAN and the BPT (British preferential trade agreement).
- CB_{ij} is a dummy which takes the value of one when *i* and *j* share a common border. The data are available on John Haveman's web site :

http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html#Gravity

2) Exchange rate variables

- RER_{ijt} is the real exchange rate between i and j at year t. It is computed using nominal exchange rates (IMF, International Financial Statistics, line 00rf) and consumer price indices (IMF, International Financial Statistics, line 64). It is normalised on year 1995.
- VOL_{ijt} is the nominal exchange-rate variability between currencies i and j. It is calculated with quarterly nominal exchange rates (IMF, International Financial Statistics, line 00rf). Two definitions are alternatively used.

  - The coefficient of variation of the quarterly exchange rate during year t, which compares the standard deviation of the quarterly nominal exchange rate to the mean of the quarterly nominal exchange rate on year t.

  - The standard deviation of the log-variation of the quarterly nominal exchange rate, on year t.