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SUMMARY

Capital market controls in China have been a strong determinant of the long-lasting peg of the yuan to the dollar. However, China entry into the WTO could lead at some time to the liberalization of capital flows, while the accumulation of foreign reserves fuels growing political pressure on the Chinese authorities to reevaluate the yuan, or at least allow it to react to market forces, through increased flexibility.

Reform proposals range from introducing some flexibility in the exchange rate to moving to a different peg, namely a basket including the euro and the yen together with the dollar. In any case, the potential change in the exchange rate regime will be an Asian-wide issue. First, because there has been *de facto* intra-Asian monetary stability (through a common Asian peg to the dollar). Second, because of the rising trade interdependence amongst Asian countries through both competition on third markets and complementarity related to the regional division of labor.

This paper focuses on assessing the consequences of an exchange-rate regime change in China, taking into account intra-Asian trade linkages. The combination of nominal exchange-rate volatility and real exchange rate behavior defines *de facto* exchange-rate regimes. Their impact on the volume and geographic distribution of exports is gauged within the framework of a multi-country gravitational equation, where intra-Asian and international trade can be disentangled, and where the competition of Asian exporters on OECD markets is taken into account. The estimates are run on a panel of 11 Asian exporters and 23 importers, from 1984 to 2001. Together with traditional gravity variables, exchange-rate regimes are found to be significant determinants of Asian exports, while their magnitude is higher for Asian-to-OECD trade than for intra-Asian trade, probably because of regional complementarity of trade in Asia.

The estimates are then used to simulate the impact on Asia of a 10% change in the real value of the yuan, and of a reaction of the Asian partners of China, which might be led to follow the move in the yuan. Real changes in the value of the yuan mainly affect China through its exports to industrialized countries; as to Asian countries, they are hit by a change in the real exchange rate of the yuan mostly because they compete with China on OECD markets. Because of the negative impact of exchange-rate volatility on exports, floating the yuan would be detrimental to Chinese exports, while diversifying the pegging basket would change their geographic distribution.

The paper concludes that exchange rate developments in China could well play a part in the future of monetary co-operation in Asia. Confronted to a depreciating yuan, Asian countries would feel an incentive to follow the Chinese currency, the outcome being a continued *de facto* monetary integration within the Asian area. If facing an appreciating yuan, they would have little incentive to follow the move of the Chinese currency. Hence, without explicit monetary coordination in the region, the yuan would probably be floating alone, at least as a first step. The paper shows that the building of regional monetary integration will need

strong support from Chinese partners in the region, because the latter should feel more economic incentives to cooperate than China.

ABSTRACT

China entry into the WTO, coupled with trade surplus and growing forex reserve, could end in a relaxation of the Chinese exchange-rate peg, which has remained stable against the dollar since 1994. This paper explores the consequence of such a move in the light of intra-Asian trade integration.

The impact of a change in the Chinese exchange-rate strategy is assessed through a gravity export equation for a sample of 11 Asian exporters and 23 importers, from 1984 to 2001. The panel estimates allow to disentangle the impact of exchange rate variables on intra-Asian and international trade. Together with traditional gravity variables, exchange rate regimes (characterized by real exchange rates and nominal exchange rate volatility behavior) are found to be significant determinants of Asian exports. Simulations show that changes in the value and volatility of the yuan impact on other Asian countries exports, and could therefore give grounds to a monetary co-operation within Asia.

J.E.L. classification: F15, F31, F33, O53
Keywords: exchange rate regime, trade, regional integration, Asia, yuan.

COMMERCE ET TAUX DE CHANGE EN ASIE : LE RÔLE DE LA CHINE

RÉSUMÉ

Les contrôles de capitaux ont permis à la Chine de maintenir durablement l'ancrage de sa monnaie sur le dollar. Cependant, l'entrée de ce pays dans l'OMC pourrait conduire à terme à une libéralisation des flux financiers, tandis que l'accumulation de réserves de change nourrit les pressions politiques sur les autorités chinoises destinées à réévaluer le yuan, ou du moins à le laisser réagir aux forces du marché par une flexibilité accrue.

Les réformes envisagées vont de la flexibilité à la diversification de l'ancrage autour d'un panier de monnaies composé d'euro, de dollar et de yen. Dans tous les cas, le changement de régime de change affecterait l'ensemble de l'Asie. D'abord parce que la région est caractérisée par une stabilité monétaire *de facto* (du fait d'un ancrage commun de fait sur le dollar). Ensuite parce que les pays asiatiques sont commercialement interdépendants du fait à la fois de la concurrence à laquelle ils se livrent sur les marché de l'OCDE et de la complémentarité de leurs échanges liés à la division régionale du travail.

On évalue ici les conséquences d'un changement de régime de change en Chine en tenant compte des interdépendances intra-asiatiques. Les régimes de change *de facto* sont définis par la combinaison de la volatilité et du niveau du taux de change. Leur impact sur les exportations est estimé dans le cadre d'une équation gravitationnelle multinationale, dans laquelle on distingue les commerces intra et extra-asiatiques, et où la concurrence des exportateurs asiatiques sur les marchés de l'OCDE est prise en compte. Les estimations sont réalisées en panel sur un échantillon de 11 exportateurs asiatiques et 34 importateurs (comprenant les exportateurs asiatiques), sur la périodes 1984-2001. Les variables de change, comme les variables gravitationnelles, apparaissent comme des déterminants significatifs des exportations asiatiques, mais leur impact est plus important sur les échanges entre l'Asie et les pays développés de l'OCDE que sur les échanges intra-asiatiques, probablement en raison de la complémentarité du commerce intra-asiatique.

Les estimations permettent de simuler l'impact sur les partenaires asiatiques d'une variation de 10 % de la valeur réelle du yuan, selon la réaction de ces derniers, qui pourraient être amenés à suivre les évolutions du yuan. On montre qu'un changement de parité réelle du yuan touche la Chine essentiellement par ses exportations vers les pays industrialisés ; quant aux pays asiatiques, ils sont affectés par un changement de parité du yuan essentiellement car ils sont concurrents de la Chine sur les marchés OCDE. En raison de l'impact négatif de la volatilité du taux de change sur les exportations, un flottement du yuan pèserait sur les exportations chinoises, tandis qu'une diversification du panier d'ancrage en modifierait la répartition géographique. Nous concluons que les évolutions du taux de change du yuan pourraient jouer un rôle dans la coopération monétaire en Asie. Face à une dépréciation du yuan, les pays asiatiques seraient incités à suivre la monnaie chinoise, ce qui entretiendrait une intégration monétaire de fait. Confrontés à une appréciation du yuan, ils seraient peu incités à suivre les mouvements de la monnaie chinoise. Ainsi, sans coordination monétaire explicite dans la région, le yuan pourrait se voir flotter isolément, du moins dans un premier temps. Nous montrons aussi que la construction d'une véritable coopération monétaire régionale nécessitera un soutien fort de

la part des partenaires régionaux de la Chine, qui ont davantage intérêt que la Chine à une telle coopération.

RÉSUMÉ COURT

L'entrée de la Chine dans l'OMC, couplée à de forts excédents commerciaux et à une accumulation rapide de réserves de change, pourraient avoir raison de l'ancrage fixe du yuan sur le dollar, en place depuis 1994. Nous explorons ici les conséquences d'un changement de régime de change en Chine au regard de l'intégration commerciale intra-asiatique.

L'impact d'un changement de régime est étudié à l'aide d'une équation gravitationnelle d'exportation estimée en panel pour 11 exportateurs asiatiques et 23 importateurs entre 1984 et 2001. L'impact des variables de change (niveau du taux de change réel, volatilité du taux de change nominal) apparaît significatif mais différent pour le commerce intra et extra-asiatique. Les simulations montrent que la valeur et la volatilité du yuan ont un impact important sur les exportations des partenaires asiatiques, ce qui pourrait justifier une coopération monétaire régionale.

J.E.L.: F15, F31, F33, O53
Mots-clés: régime de change, commerce, intégration régionale, Asie, yuan.

TRADE LINKAGES AND EXCHANGE RATES IN ASIA: THE ROLE OF CHINA

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1. INTRODUCTION

With the long-lasting peg of the yuan to the dollar, China looks like an exception amongst emerging countries, which have often been hit by currency crises during the last decade. But while the lack of capital markets liberalization in China has so far made the pegged exchange rate regime sustainable, things could change in the future. Indeed, the entry of China into the WTO could entail liberalizing capital flows at some time, while the accumulation of foreign reserves creates growing political pressure on the Chinese authorities to reevaluate the yuan, or at least allow it to react to market forces, through increased flexibility.

Reform proposals range from introducing some flexibility in the exchange rate, regardless of the anchor currency (Roberts and Tyers, 2003) to moving to a different peg, namely a basket including the euro and the yen together with the dollar. In any case, changing the Chinese exchange rate regime cannot be considered a purely Chinese issue given the shape and strength of economic linkages within Asia.

Existing papers on Chinese trade usually rely on single-country analysis. For instance, Chou (2000) explores the impact of (real) exchange rate variability on China's exports based on a cointegration analysis; Cerra and Dayal-Gulati (1999) also investigate the sensitiveness of China's exports to price signals, looking for structural breaks, while Yue and Hua (2002) explore the responsiveness of Chine exports to the real effective exchange rate at the Province level. Roberts and Tyers (2003) build an open-economy macro model to study the case for greater flexibility in the Chinese exchange rate. Such country-oriented studies do not allow by definition to explore the regional consequences of an exchange rate change in China. However, given the strategic nature of exchange rate arrangements (in particular because Asian competitors tend to peg to the same currency, even if this does not match the optimal currency area criteria – see Bayoumi and Eichengreen, 1998 for instance), the impact of a change in China should be better assessed in a multi-country framework, including the main export markets but also the main competitors of the country.

This paper focuses on the trade linkages in Asia to assess the consequences of an exchange rate regime change in China. Exchange rate regimes are defined in a de facto manner, by the combination of nominal exchange rate volatility and real exchange rate behaviour. The use of a multi-country gravitational equation allows to control for the main structural determinants of exports and to run simulation exercises where intra-Asian linkages are taken into account to assess the impact of a change in the Chinese exchange rate policy.

The remainder of this paper is organized as follows: in Section 2 the empirical specification is presented; estimates and robustness tests are displayed in Section 3. In Section 4, the impact of various possible exchange rate regime changes is simulated, and Section 5 concludes.

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2. CHOOSING AN EMPIRICAL SPECIFICATION

2.1. China and regional trade

The quick opening of the Chinese economy is a well-known feature of the 1990s and early 2000s. As illustrated in Table 1, in 2001 China already accounted for 5% of world exports, and this rise went on in 2002 and 2003, despite the SARS. Even if Chinese exports are mostly oriented to the United States (32%), which have been the most dynamic export market, they are relatively well distributed between other destinations: 19% to Japan, 13 % to other East-Asian countries and 19 % to the EU. On the import side, other Asian countries are the main Chinese suppliers (51% including Japan), which can be related to the raising international production sharing in place in Asia (Ng and Yeats, 2003). Indeed, Continental China is used for processing activies by advanced Asian countries such as Japan, Korea, Taiwan and Hong Kong, which implies both Chinese imports of intermediate goods from Asia and exports of final goods to both Asia and the rest of the world. This feature is mirrored by China being a major market for Japan, Korea, Taiwan and Hong Kong, but not for other East Asian countries. The latter are nevertheless close competitors of China on third markets, especially in Japan, the United States and the European Union. Most of them also rely on intra-regional trade, which contrasts with China whose exports are essentially directed to OECD countries (Table 1).

Table 1. Chinese and other East-Asian trade patterns in 2001

Country	Exports to (%)					Imports from (%)				
	China	Japan	Other East Asia	US	EU15	China	Japan	Other East Asia	US	EU15
China	-	19	12	32	19	-	21	30	12	13
Japan	11	-	27	30	16	18	-	24	17	13
South Korea	15	11	16	21	12	10	20	14	15	11
Thailand	6	16	21	21	17	6	22	23	11	12
Taiwan	11	11	21	25	16	6	25	22	16	12
Hong Kong	33	2	11	22	23	10	13	37	6	20
Philippines	4	17	28	29	14	3	23	26	21	11
Malaysia	6	13	29	23	13	6	18	37	14	13
Singapore	4	6	43	16	14	5	15	34	15	12
Indonesia	5	23	27	15	15	6	20	31	8	12
US	4	8	12	-	23	9	11	12	-	18
EU 15	3	4	8	22	-	6	7	10	17	-
World	3	5	9	18	15	5	7	10	11	37

Source: CEPII-CHELEM database.
This database corrects for world imbalance and for Chinese exports transiting through Hong Kong.

2.2. Assessing the impact of exchange rate regimes on trade

Modeling trade flows

Econometric estimations of *agregate* export equations for China are provided by Song (2000) and by Cerra & Dayal-Gulati (1999) for exports and imports. Song finds a significant export elasticity to the real exchange rate over the whole period of estimation (1980-1988) with quarterly data. Cerra and Dayal-Gulati evidence a structural break following the 1988 reforms: the real exchange rate is found to significantly determine exports only after 1988 (while no break can be associated with the 1994 reforms). Yue and Hua (2002) confirm this finding on Province data, showing that the sensitiveness of Chine exports to the real effective exchange rate has increased in the 1990s. 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.

However we need an empirical model of all *bilateral* trade flows from and to China in order to study the impact of possible monetary scenarios. This kind of multinational trade model usually relies on a gravity equation: exports from country *i* to country *j* are basically explained by the economic size of both countries and by the distance between them.

The gravity model can be related to the monopolistic competition theory of trade. When countries are symmetric in size, bilateral trade only depends on the product of the countries GDPs. However, when countries differ in size, impediments to trade enter in the bilateral trade equations and produce the so-called "border effect". Bilateral distances are a common and useful proxy for such impediments to trade (with iceberg trade costs, bilateral trade should be lower when countries are far one from the other). However, Anderson and van Wincoop (2003) argue that controlling for impediments to trade requires more sophisticated tools, because the impact of trade costs depends on a weighted average of trade costs against all the countries' partners. A well-specified gravity equation should therefore include the GDPs of both partners, their bilateral distance, a common-border variable and a price index taking distance into account. However, Feenstra (2003) shows that this last variable is empirically well proxied by a set of country fixed effects.

Because of their bilateral nature, gravity models allow to identify intra-regional flows, which is of particular interest as far as Asian trade is concerned. They also open the way to an analysis of features such as the existence of trade agreements or the choice of a specific anchor for the exchange rate. As far as exchange rate regimes are concerned, two issues have to be investigated: the volatility of the exchange rate and its real level.

Including exchange rates into a trade equation

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: the elasticity of trade flows to exchange rate volatility can be either positive or negative, and the results depend on the precise measure of volatility, on the estimation technique and on the sectors and countries concerned.[1]

[1] See Sapir, Sekkat and Weber (1994), Sekkat (1998). For a sectoral analysis, see Péridy (2003).

Moreover, the impact of exchange rate volatility might differ according to the countries under study: Sauer and Bohara (2001) show that exchange rate volatility has a negative impact on African and Latin American exports, a non-significant impact on Asian exports and on developed countries exports. The gravitational analysis of trade flows has renewed the literature however. Frankel and Wei (1995, 1996) evidence a significant negative impact of exchange rate volatility on trade flows across Asian countries on a cross-section basis. In his seminal paper, Rose (2000) finds exchange rate volatility to be a significant and systematic impediment to trade for an extensive sample of countries. The direct impact of the real exchange rate on exports is well-documented, a real appreciation usually having a deleterious impact on exports through a demand effect (higher competitiveness) or a supply effect (higher profitability of the traded goods sector compared to the non-traded goods sector). However, bilateral flows may not only depend on bilateral exchange rates when neighbour countries compete on third markets. For instance, Chinese exports to the United States may depend on the bilateral real exchange rate of the yuan against the USD, but also on the real exchange rate of potential competitors against the USD. This problem is specific to emerging countries, because a large share of their exports go to the same developed markets, and because they often display relatively close specialization structures. This paper provides a treatment for this issue of common export orientation, together with the more traditional issues of exchange rate volatility and competitiveness.

3. EMPIRICAL SPECIFICATION

The typical gravitational equation links trade (defined either as total trade, imports or exports) to the product of country sizes, impediments to trade, and a set of bilateral variables. In its theoretical expression, it has the following traditional form

$$X_{ij} = Y_i^{\alpha} Y_j^{\beta} D_{ij}^{\gamma} \delta_{ij}^{\eta} Z_{ij} \text{, with } \alpha, \beta > 0, \gamma < 0 \text{ and } \eta > 0 \qquad (1)$$

where X_{ij} stands for exports from country i to country j, Y_i refers to the economic size of country i (usually GDP when the sectoral dimension of production is not taken into account), D_{ij} is the distance between countries, δ_{ij} is a dummy for common borders and Z_{ij} is a vector of bilateral variables which frequently includes a dummy for the use of a common language, and can also include exchange rate variables, as in Rose (2000). While gravity models are often estimated on a cross-country basis, panel data analysis is being more and more common (See Frankel, 1997, or Egger and Pfaffermayr, 2003).

Baseline estimation

The baseline equation is the following:

$$\begin{aligned} \ln X_{ijt} = {} & \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln DIST_{ij} + \alpha_4 \ln RER_{ijt} \\ & + \alpha_5 \left(1 - ASIA_j\right) \times \ln RERC_{ijt} + \alpha_6 VOL_{ijt} + \text{TRADE}_{ijt} + CL_{ij} + CB_{ij} \\ & + \beta_i + \gamma_j + \gamma_t + \varepsilon_{ijt} \end{aligned} \qquad (2)$$

The sample includes 10 East-Asian countries exporting amongst themselves as well as to 23 developed and emerging countries during the period 1984-2001 (the list of countries is

displayed in Appendix).[2] Hence, the total possible number of observations is 5,760 (note that the cross-country dimension of the sample is larger than its time dimension). The estimated equation includes country *i* and *j* fixed effects (β_i and γ_j), as well as a time fixed effect δ_t.[3]

The dependent variable is the volume of exports in constant dollars.

Gravitational variables: GDP_{it} is the GDP (volume) of country *i* during year *t* in purchasing power parity standard. $DIST_{ij}$ is the geodesic distance between *i* and *j*, corrected in order to take peculiarities for some countries into account (see Appendix). It is used as a proxy for transportation costs and cultural distance. $TRADE_{ijt}$ is a dummy for the presence of a trade agreement between *i* and *j* at time *t*; given the geographical coverage of exporting countries, it is limited to the ASEAN. Finally, CL_{ij} is a dummy for the existence of a common language, while CB_{ij} is a dummy for the presence of a common border.

Exchange-rate variables: RER_{ijt} is the bilateral real exchange rate between *i* and *j* at time *t*. Two measures of the real exchange rate are successively used. The first one comes from the CEPII-CHELEM database, which provides internationally comparable real exchange rates (RER) using purchasing parity standards: the RER against the US dollar is lower than 100 when the domestic currency is over-valued compared to its PPP rate. This measure of the real exchange rate is interpretable both in the cross section and in the time series dimension. The second measure is built using IMF data. It is the CPI-deflated exchange rate, which is set to 100 in 1995 for all countries, and therefore only allows for time variance. Several measures of exchange rate volatility (VOL_{ijt}) are also used. All are defined as the yearly coefficient of variation of the nominal exchange rate. VOL_Q is the volatility of the quarterly nominal exchange-rate, while VOL_M is the volatility of the monthly exchange rate. Both are used on a contemporaneous basis (VOL_Q_{ijt}, VOL_M_{ijt}) or are lagged, to take reaction delays into account (VOL_Q_{ijt-p}, VOL_M_{ijt}).

Competition on third markets. Asian trade linkages with the rest of the world are an important issue when measuring the incentives for monetary stability is the area, because Asian economies compete against each other in world markets.[4] Therefore, the estimation includes the competitiveness of each Asian country relative to all Asian competitors, noted $RERC_{ijt}$, which is computed as the ratio of RER_{ijt} to the effective real exchange rate of East-Asian competitors (other than Japan) RER_{Ajt}, weighted by the share of Asian competitors in the destination market *j*. Hence, an increase in $RERC_{ijt} = RER_{it}/RER_{At}$ denotes a higher competitiveness of the exporting country *i* relative to the rest of Asia. This variable is expected to impact positively on *i* imports to *j* provided *j* is not itself an East-Asian country (otherwise the reasoning would be recursive). Hence, it is introduced with a multiplicative

[2] As far as China is concerned, the 28 importing countries of the sample account for more than 80% of the Chinese exports (87 % in 2001).

[3] Among exporting countries, China might be an outlier, and could therefore bias the estimates. However, we checked that excluding this country from the sample does not change the empirical results.

[4] A similar argument was developed by Wei et al. (2000), using a CGE model to explore the impact of a change in the real value of the yuan (a devaluation, in this paper) on Hong Kong.

dummy (1-$ASIA_j$) which takes the value of 1 when the target country is not an East-Asian country (except Japan), 0 otherwise.

Intra-Asian regional integration

This paper explores the implications of trade integration for the possible shape of exchange rate arrangements in Asia. The baseline estimation relies on the implicit assumption that trade reacts to real exchange rate and volatility changes in the same way whatever the destination market (Asian or OECD). However, differences in the structure and the nature of trade (nature of traded goods, export or reexport …) might make it an excessive assumption. We investigate this issue by distinguishing the impact of real exchange rate level and nominal exchange rate volatility changes according to the country of destination (Asian/not Asian). The geographical sample is then restricted to Asian countries for the exporters, and Asian + OECD developed countries for the importers.

Therefore, the baseline equation is changed as follows:

$$\begin{aligned}\ln X_{ijt} = {} & \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln DIST_{ij} \\ & + \alpha_4 ASIA_j \times \ln RER_{ijt} + \alpha_5 (1 - ASIA_j) \times \ln RER_{ijt} \\ & + \alpha_6 ASIA_j \times VOL_{ijt} + \alpha_7 (1 - ASIA_j) \times VOL_{ijt} + \alpha_8 (1 - ASIA_j) \times \ln RERC_{ijt} \\ & + \mathrm{TRADE}_{ijt} + CL_{ij} + CB_{ij} + \beta_i + \gamma_j + \delta_t + \varepsilon_{ijt}\end{aligned} \tag{3}$$

where $ASIA_j$ is a dummy which takes the value of 1 when the importer j is an East-Asian country (other than Japan), zero otherwise. Therefore, we are able to identify the sensitiveness of exports to exchange rate related determinants for two kinds of trade (intra-regional and international).

4. EMPIRICAL RESULTS

Baseline estimation

The results are reported in Table 1. Columns (1) and (2) provide the baseline estimation using CHELEM real exchange rates (which are comparable on a cross-country basis) and quarterly (resp. monthly) nominal exchange rate volatility. Columns (3) and (4) replicate the estimation using IFS real exchange rates (CPI-deflated nominal exchange rates). The difference between columns (1-2) and (3-4) lies in the definition of real exchange rates, which allow both for cross-sectional and time variance for the CHELEM real exchange rate, and only for time variance for the CPI-deflated real exchange rate.

Two variants are displayed in Table 1, that check for the robustness of the results to alternative volatility measures. In the first one (Column (5)), volatility is lagged to check for possible persistence in the impact of exchange rate uncertainty on exports. In the second variant (Column (6)), we use a three-year average. Similar results were obtained when lagging monthly volatility (not reported).

Gravity variables bear the expected signs and are significant at the 1% level: the larger the GDP of the importer or of the exporter, the larger the export flow; the elasticity is around unity, a standard result with gravity models. Distance impedes trade, with a rather low elasticity (between -.3 and -.5) however, which might be the result of the estimations

procedure (within panel).[5] As expected, the existence of a common border is associated to an increase in exports, while belonging to the ASEAN tends to significantly increase exports.[6]

Once the gravity-related determinants of exports are controlled for, exchange rate related variables have a strong, robust and significant impact. First, a *real exchange rate* depreciation (rise in $\ln RER_{ijt}$) is associated with an increase in the volume of exports from *i* to *j*. The magnitude of the coefficient differs according to the measurement of the real exchange rate. The elasticity is around .8 when CHELEM real exchange rates are used, but falls to .2 with standard real exchange rates, which probably results from the absence of cross-sectional variance in CPI-deflated real exchange rates. These coefficients are robust to the exclusion of China from the sample (not reported here).

Second, when exports are directed to non-Asian countries, an increase in *competitiveness relative to other Asian countries* also increases exports, with an elasticity around .5 when CHELEM real exchange rates are used, but the estimates are not significant when IMF real exchange rates are used.

Finally, a higher nominal *exchange rate volatility* reduces the volume of exports. Contrary to the previous one, this effect is symmetric in the sense that higher volatility reduces both exports from *i* to *j* and from *j* to *i*. The coefficient is around -1.3, meaning that a 1 point rise in the quarterly (resp. monthly) coefficient of variation of the nominal exchange rate reduces exports by 1.3%. When the sample is limited to Asia/developed OECD, volatility is no longer significant, which might be the consequence of assuming a similar behaviour for Asian countries intra-regional and international exports (see the estimation of Eq. 3 below).

The impact of exchange-rate regime variables seems robust to alternative definitions of real exchange rate level and nominal volatility. However, given the length of the time sample, which is marked by increasing liberalization of trade flows, and varying exchange-rate regime choices in the countries of the sample, it is possible that estimated coefficients have changed over time. This possibility is studied through cross-sample estimations of Equation (2) run on 5-years averages. The results are displayed in Table 2. Because estimates are similar when using quarterly or monthly exchange rate volatility, only the results for quarterly volatility are provided. In order to cancel out the potential impact of high exchange rate volatility during the 1997 Asian crisis, the last sub-period considered is of only four years (1998-2001). The estimations show that the impact of both real exchange-rate level and nominal exchange rate volatility are significant over each sub-period. While the impact of the real exchange rate seems to have declined in the 1990s compared to the 1980s, the impact of exchange rate volatility has been is rising in the late 1990s, even when the 1997 crisis-year is taken out of the time sample.

[5] Country fixed effects might catch some features which are usually embodied in distance in cross-section estimates.

[6] In a first step, the estimation included a common language dummy. However, this failed to be significant due to collinearity with common border, and was therefore dropped from the estimation.

Table 2. Estimation results, baseline

	1	2	3	4	5	6
# obs	5311	5302	4885	4876	5034	4463
intcpt	-30.513* [1.956]	-30.037* [1.952]	-18.059* [2.375]	-17.093* [2.375]	-29.984* [2.032]	-29.575* [2.276]
lnGDP_{it}	1.281* [.098]	1.270* [.098]	.843* [.110]	.834* [.110]	1.178* [.103]	1.039* [.112]
lnGDP_{jt}	1.128* [.084]	1.106* [.084]	1.040* [.111]	.987* .111]	1.148* [.087]	1.162* [.102]
ln$DIST_{ij}$	-.382* [.036]	-.379* [.036]	-.557* [.038]	-.556* [.038]	-.381* [.036]	-.390* [.036]
CB_{ij}	.453* [.097]	.447* [.097]	.472* [.10]	.460* [.10]	.473* [.094]	.449* [.096]
VOL_{ijt} quarterly	-1.245* [.098]	-	-1.344* [.103]	..	-.883* [.105]	-
VOL_{ijt-1} quarterly, one-year lag	-	-	-	-	-.661* [.101]	-
$\overline{VOL}_{ijt}$ quarterly, three-year average	-	-	-	-	-	-1.197* [.127]
VOL_{ijt} monthly	-	-1.383* [.104]	-	-1.475* [.109]	-	-
lnRER_{ijt} CHELEM	.842* [.048]	.842* [.048]	-	-	.931* [.052]	1.169* [.059]
lnRER_{ijt} IFS	-	-	.214* [.027]	.214* [.027]	-	-
(1-$ASIA_i$)×ln$RERC_{ijt}$ CHELEM	.552* [.038]	.556* [.038]	-	-	.531* [.038]	.485* [.038]
(1-$ASIA_j$)×ln$RERC_{ijt}$ IFS	-	-	-.003 [.035]	.013 [.036]	-	-
Adj. R^2	.855	.856	.85	.851	.859	.859
F-test	F(9,5244) 510.26 [.000]	F(9,5235) 514.11 [.000]	F(9,4818) 523.88 [.000]	F(9,4809) 525.80 [.000]	F(9,4967) 517.63 [.000]	F(9,4399) 512.66 [.000]
Breusch-Pagan LM test $\chi^2(1)$	75455.57 [.000]	75675.55 [.000]	70148.93 [.000]	70413.88 [.000]	70602.62 [.000]	71491.66 [.000]
Hausman test $\chi^2(8)$	113.40 [.000]	129.85 [.000]	46.07 [.000]	213.33 [.000]	718.12 [.000]	114.59 [.000]

Table 3. Cross-section estimations (5-year averages) using CHELEM real exchange rates

	1984-1989	1990-1994	1995-1999	1998-2001
Nb. of obs.	277	319	320	320
intercept	-5.141* [1.633]	-4.662* [1.529]	-5.340* [1.625]	-6.146* [1.634]
$Ln\ GDP_i$	-.009 [.076]	.198~ [.079]	.264* [.084]	.259* [.078]
$Ln\ GDP_j$	.816* [.056]	.755* [.054]	.784* [.059]	.803* [.059]
$Ln\ DIST_{ij}$	-1.013* [.128]	-1.007 [.110]	-1.015* [.110]	-.983* [.114]
$Ln\ RER_{ij}$	.936* [.154]	.549* [.117]	.556* [.118]	.652* [.120]
$(1\text{-}ASIA_j)\times \ln RERC_{ij}$	-1.847* [.268]	-1.209* [.182]	-.658* [.187]	-.488* [.188]
VOL_Q_{ij}	-4.092* [.609]	-3.179* [.551]	-7.691* [2.227]	-8.743* [2.399]
CB_{ij}	.996 [.637]	1.136~ [.557]	.610 [.589]	.403 [.601]
Adj. R^2	.64	.551	.497	.507

* relates to the 1% significance level, ~ to the 5% significance level. Standard errors are between brackets.

Intra-Asian regional integration

The results for Equation (3) are displayed in Table 4. Here, we do not use CPI-deflated real exchange rates, as these happen to be very similar to each other (against OECD countries) due to similar evolutions over time. Using CHELEM real exchange rate data, the elasticity of exports to the real exchange rate significantly differs when exports are directed to Asia and to the rest of the world: the direct elasticity is almost .8 for intra-Asian exports, and falls to .5 for extra-Asian exports. Because the elasticity of exports to *relative* competitiveness is .8, the total elasticity of exports to non-Asian partners is nevertheless higher (around 1.3).

The sensitiveness of exports to nominal exchange rate volatility does also differs according to the area of destination of exports. Exchange rate volatility fails to significantly explain exports within Asia, while it is significant at the 5% level when explaining exports outside Asia: a 1 point increase in nominal volatility reduces exports by .7%. The lower sensitiveness of intra-Asian exports to the real exchange rate can be related to the higher complementarity of exports within Asian than with the rest of the world (see Ng and Yeats, 2003). Non significant impact of volatility might confirm this interpretation. Moreover,

intra-Asian trade is for a significant part the outcome of intra-firm trade which is not much sensitive to exchange rate behaviour, because of pricing in dollar or using transfer prices.

Table 4. Estimation results: intra/extra regional trade

	1	2	3
Nb. of obs	4,718	4,718	4,718
$ASIA_j \times \ln RER_{ij,t}$	.795* [.052]	.797* [.052]	.797* [.052]
$(1\text{-}ASIA_j) \times \ln RER_{ij,t}$	.551* [.086]	.552* [.086]	.555* [.086]
$(1\text{-}ASIA_j) \times \ln RERC_{ijt}$	.805* [.0998]	.808* [.099]	.795* [.099]
VOL_{ijt} quarterly	-	-	-.476 [.265]
$ASIA_j \times VOL_{ijt}$ quarterlu	-.071 [.384]	-	-
$(1\text{-}ASIA_j) \times VOL_{ijt}$ quarterly	-.729~ [.317]	-	-
$ASIA_j \times VOL_{ijt}$ monthly	-	.068 [.391]	-
$(1\text{-}ASIA_j) \times VOL_{ijt}$ monthly	-	-.758~ [.329]	-
$\ln GDP_{it}$	1.358* [.091]	1.356* [.091]	1.357* [.091]
$\ln GDP_{jt}$	1.215* [.079]	1.210* [.079]	1.213* [.079]
CB_{ij}	.365* [.092]	.367* [.092]	.359* [.092]
Adj. R^2	.872	.872	.872
F test	F(9,4652) 432.92 [.000]	F(9,4652) 433.1 [.000]	F(9,4653) 432.67 [.000]
Breusch-Pagan LM test $\chi^2(1)$	48616.78 [.000]	48752,56 [.000]	48831.54 [.000]
Hausman test $\chi^2(11)$	2534.95 [.000]	2481.24 [.000]	2466.47 [.000]

* relates to the 1% significance level, ~ to the 5% significance level. Standard errors are between brackets.

5. THE IMPACT OF A REGIME CHANGE

The estimations carried out show that both the level and the volatility of the exchange rate affect the volume of exports for the Asian countries of the sample. Since a change in the exchange rate regime would impact on both variables, we combine simulations on the real exchange rate level and on the nominal exchange rate volatility to shape the possible impact of a regime change. Because the yuan is pegged to the dollar, the analysis draws on the hypothesis of a dollar/yuan parity change.

5.1. A real exchange rate change

At the end of the 1990s, the collapse of exchange rate regimes in Asia had raised the threat of a devaluation of the yuan, because China had lost in terms of competitiveness against its Asian competitors. Such a devaluation would have borne the potential of triggering new domino-style devaluations in Asia. Finally, China decided to keep the peg against the dollar, and therefore looked as the key for Asian monetary stability. In the early 2000s, the focus had changed significantly, because rapid reserve accumulation by the Bank of China raised suspicion that the yuan was undervalued. The question was then of whether a revaluation of the yuan would help to reduce global imbalances, including the huge US deficit. Since the direct impact of the yuan on foreign imbalances was expected to be relatively small, the main issue was on whether neighbouring countries would follow a revaluation of the Chinese currency.

Here we use Equation (3) to illustrate the impact of alternative monetary scenarios in East-Asia. Since the equation is linear, the impact of an appreciation on exports is just opposite to the one of a depreciation.

Should the Chinese exchange rate regime move towards more flexibility, the direction of change of the yuan would be highly dependent on the liberalization pace of the financial account. The only firm prediction is that floating currencies are submitted to large fluctuations over time, and that fluctuations do not always meet macroeconomic fundamentals. We study here the vulnerability of regional trade to possible ups and downs of the Chinese currency.

The impact of intra-Asian linkages: the mechanisms

A change in the real value of the yuan against the US dollar impacts on Chinese exports to the United States as well as to other countries in the world, including East-Asian countries. The amount of the effect depends on possible reactions of other Asian countries which can move their exchange rates against the US dollar in the same direction. This reaction of neighboring countries has two effects:

- By reducing the variation of intra-Asian exchange rates, it reduces the impact of the yuan/dollar variation on Chinese exports to East-Asia;

- By modifying the real exchange rate of Asian competitors as a whole against the US dollar, it narrows the competitiveness gain or loss of China against Asian competitors in third markets.

Both indirect effects can be studied in our framework. Let us denote by $eq_{A\$}$ the (opposite of the) effective real exchange rate the US against Asian countries, *i.e.* the real exchange rate of East-Asian competitors as a whole ($eq_{A\$}$ is in logarithm and it rises if the Asian region becomes more competitive). We have:

$eq_{A\$} = \sum_{k \in Asia} \alpha_k q_{k\$}$, where α_k denotes the weight of country k in total US imports from East Asia, q_k is the real exchange rate of country k against the United States and $\sum_{k \in Asia} \alpha_k = 1$.

Using our Table 3 estimates, which differentiate intra-Asian trade from extra-Asian trade, it is possible to calculate the total impact of yuan/dollar and of k/dollar variations on Chinese exports:

$$\Delta X_{CHN} = \underbrace{1.3\Delta q_{Y\$} X_{CHN}^{US} - 0.8\sum_k \alpha_k \Delta q_{k\$} X_{CHN}^{US}}_{\text{Chinese exports to the US}} + \underbrace{0.5\sum_k \Delta q_{Yk} X_{CHN}^{k}}_{\text{Chinese exports to Asia}}$$

Where Δ is the first difference operator and X_{CHN}^{i} stands for Chinese exports to country i.

The impact of any monetary scenario is obtained the same way for any country in Asia: when one Asian country k changes its real exchange rate q_k, this implies a change in the real exchange rate of Asia against the dollar, which affects Chinese exports to the US. The bilateral real exchange rate of the yuan against country k, q_{yuan}-q_k, also changes, which impacts on Chinese exports to Asia.

However, this is only a formal symmetry, because the size of Asian countries can differ widely in the weighting system of the real effective exchange rate, and because trade relations are very heterogeneous between Asian countries.

As Table 1 shows, leaving Japan aside, China is a major trade partner for Hong Kong (33% of exports, 10% of imports, excluding transit trade) and, to a lesser extent, for Korea (15% of exports, 10% of imports) and Taiwan (11% of exports, 6% of imports). Table 5 displays the extent of competition amongst East-Asian countries on OECD markets. China appears to be by far the heaviest competitor (40% of total OECD imports from East-Asia excluding Japan in 2001). Korea and Taiwan are second (12-13%). On the whole, Hong Kong, Korea and Taiwan seem to be the Asian countries most exposed to a variation of the Chinese exchange rate. Given the large market share of China on OECD markets, Asian countries should be very sensitive to real exchange rate changes in China, and record passive gains when the yuan appreciates, and a passive losses when it depreciates. For China, things are different, since competitors are more evenly distributed on OECD markets.

Table 5. Market share of Asian countries in OECD imports in 2001

OECD imports from	Share in total OECD imports (in%)	Share in OECD imports from Asia (in %)
Indonesia	0.9	6.3
India	0.6	4.1
South Korea	1.8	12.5
Hong Kong	0.3	1.7
Singapore	0.7	4.8
Taiwan	1.7	11.8
Malaysia	1.3	8.7
Philippines	0.6	4.1
Thailand	0.9	6.5
China	5.8	39.5
Asia	14.6	100
World	100.0	-

Source: CHELEM database.

Simulating a 10% real change in the value of the yuan

Here, we provide an assessment of the gains/losses in terms of exports that can be expected from a 10% real devaluation of the yuan.[7] Four possible reactions of other Asian emerging countries to a devaluation of the yuan are successively considered.

(i) the real devaluation is limited to continental China;

(ii) the devaluation is followed by a depreciation of the Korean won and of the HK and Taiwan dollars, which are the main competitors of China on the US market;

(iii) all East-Asian countries (except Japan) follow the Chinese move, in a domino-style scenario.

[7] As already mentioned, the impact of a revaluation is just the opposite to that of a devaluation. Should China move towards more flexibility, the yuan would experience ups and downs like any floating currency.

In all cases, the real exchange-rate variation can either come from a 10% nominal variation with no price reaction or, more realistically, from an over 10% nominal variation with endogenous price change that limits the real variation to 10%. Other currencies in the world are assumed to stay stable against the US dollar, so that the devaluation is *de facto* an effective devaluation against OECD countries.

The simulations are performed using a 1.3 elasticity of exports to the bilateral real exchange rate for exports to OECD countries, a .5 elasticity of exports to the bilateral real exchange rate for exports to Asian countries, and a -.8 elasticity of exports to the effective exchange rate of Asian competitors. These elasticities are taken from the estimates of Equation (3), and displayed in Table 4, Column (1). The results for a devaluation are presented in Table 6a and 6b.

Table 6a. A 10% devaluation of the yuan, under various reactions elsewhere in East Asia: total impact on exports (in %)

	Impact on export volumes of								
Scenarios	China	HK	Korea	Taiwan	Indon.	Malaysia	Philipp.	Sing.	Thailand
Only China devalues	12.2	-3.1	-1.6	-1.0	-1.0	-1.1	-0.8	-1.2	-0.9
China + HK + Korea + Taiwan	11.9	10.2	13.0	14.2	-6.6	-6.5	-6.9	-6.1	-7.0
All Asian countries devalue	11.3	6.9	8.2	9.3	8.3	8.1	9.0	7.1	9.2

Source: Authors' calculations.

Table 6b. A 10% devaluation of the yuan, under various reactions elsewhere in East Asia: decomposition of the total impact on exports (in %)

	(1) Only China			(2) China + Korea + Taiwan			(3) All Asian countries		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
China	11.3	0.2	0.6	11.3	0.1	0.5	11.3	0	0
Hong Kong	0	-2.2	-0.9	6.9	2.5	0.9	6.9	0	0
Korea	0	-0.9	-0.7	8.2	3.9	0.9	8.2	0	0
Taiwan	0	-0.5	-0.6	9.3	4.3	0.7	9.3	0	0
Indonesia	0	-0.3	-0.7	0	-5.5	-1.2	8.3	0	0
Malaysia	0	-0.3	-0.8	0	-5.3	-1.2	8.1	0	0
Philippines	0	-0.2	-0.6	0	-5.9	-1.0	9.0	0	0
Singapore	0	-0.3	-0.9	0	-4.6	-1.5	7.1	0	0
Thailand	0	-0.3	-0.6	0	-6.0	-1.0	9.2	0	0

Source: authors' calculations

(a) Direct competitiveness impact on OECD markets
(b) Direct competitiveness impact on Asian markets
(c) Relative competitiveness impact on OECD markets

According to the above simulations, a real depreciation of the yuan increases Chinese exports to the OECD, and reduces Asian exports to China in the case of no exchange-rate move in other Asian countries of the sample. Our simulations partially account for the high complementarity of intra-Asian trade compared to extra-Asian one, since the sensitivity to bilateral exchange rate variations is smaller in the former case. However, since only bilateral exchange rates determine intra-Asian trade, we do not account for the fact that higher competitiveness of the Chinese economy could raise some Asian exports to China, as the Chinese place becomes cheaper for processing. Hence, the impact of the Chinese exchange-rate variation on intra-Asian trade may be over-estimated.

Because its exports are very little oriented to Asia, the gain recorded by China falls mainly on OECD markets. The fact that other Asian currencies may follow the move has almost no impact on Chinese exports, because there is almost no loss in terms of bilateral competitiveness, and only small losses from the decline in relative competitiveness on OECD markets.

The externality of the Chinese devaluation on Asian exports can be strong. The loss does not exceed 1% of total exports for Indonesia, the Philippines, Thailand and Taiwan, mostly

because of weak bilateral trade integration. It is more important for the other half of the sample, because of higher exposure to trade with China. In all cases, losses stemming from relative competitiveness changes in OECD markets account for between 25% (Hong Kong) and 45% (Indonesia and Philippines) of total losses.

When other countries are assumed to follow the yuan real devaluation, the gains contract in China, to a limited extent however. Following countries record a gain from depreciating their currencies, while losses simultaneously worsen for non-movers. When the four "big" countries (China, Hong Kong, Taiwan and Korea) depreciate, the loss arises to around 7% of total exports for the other Asian countries, most of the additional loss stemming from direct competitiveness worsening in the devaluating countries' markets. Conversely, the relative competitiveness loss is roughly unchanged when the sole yuan depreciates, as China accounts for more than 40% of the Asian competitors market share in OECD markets.

Finally, the simulations illustrate the non-cooperative structure of any exchange-rate gain: Asian partners of China feel an incentive to follow a depreciating yuan, as when they do so, all of them record gains in OECD markets. However, they would feel little incentive on the export side to follow an appreciating yuan. On the whole, fluctuations in the Chinese currency would induce more uncertainty on their exports, justifying some form of regional monetary co-operation. Conversely, China is not very sensitive to whether neighboring countries follow or not its exchange-rate change. One implication is that, on economic grounds, China could feel less incentive than its neighbors to build a regional monetary arrangement.

5.2. Exchange rate volatility

The estimates presented in Table 2 also allow to evaluate the impact of a rise in exchange-rate volatility on intra- and extra-regional trade. More specifically, exchange rate volatility fails to impact on intra-regional trade whereas it is an impediment to trade with OECD countries. Here we consider the impact of three stylized scenarios[8]:

(i) A cooperative or de facto peg on a common basket of international currencies (1/3 US dollar, 1/3 euro, 1/3 yen);

(ii) a regional arrangement consisting on a common regional currency that would be floating;

(iii) a free float of the yuan.

Over the 1990s, the quarterly volatility of euro/dollar and yen/dollar nominal exchange rates was around 7%. We use this figure as a benchmark. We compare to the status quo where all Asian currencies are de facto pegged to the US dollar. The results are reported in Table 7.

[8] Although maybe not realistic, these scenarios are useful as benchmarks and because they have been discussed in international forums.

Table 7. The impact of a change in the yuan volatility on Chinese exports

	USD	euro	yen	Other Asia	Total
Volatility of the yuan (%)					
- status quo (peg on the USD)	0	7	7	0	-
- common basket	2.5	2.5	2.5	0	-
- common floating currency	7	7	7	0	-
- floating currency	7	7	7	7	-
% variation of Chinese exports					
- common basket	-1.8	+3,2	+3,2	0.0	+0,6
- common floating currency	-4,9	0.0	0.0	0.0	-1,6
- independently floating currency	-4,9	0.0	0.0	0.0	-1,6

Source: authors' calculations.

Because a large part of Chinese exports is directed to the United States and, to a lesser extent, to the EU and Japan, China would lose from increased volatility against key currencies, whether it is done alone or through a common Asian floating currency. China would more easily accept a regional arrangement in the form of a common peg to a basket of key currencies. The table also shows that a (common) basket would be preferred to the current dollar peg, although such an arrangement would be demanding in terms of regional cooperation.

Of course, our simulations are only illustrative and should be handled with care. However they suggest that China could indeed find some interest in diversifying its peg, possibly within a regional arrangement consisting in defining a common external monetary reference. Such an arrangement could be acceptable for Asian partners provided it is sufficiently flexible to enforce credible intra-regional commitments.

6. CONCLUSION

Because of the shape of Asian trade integration, the future of monetary co-operation in Asia will probably depend – at least partially – on exchange rate developments in China.

The limited scope for foreign-exchange reserve sterilization will probably combine with WTO entry and pear pressure, and end in a more flexible management of the yuan. As long as capital flows are not liberalized, the outcome should be an appreciation of the yuan; with capital account liberalization, the outcome is less predictable. But the simulations in this paper allow to draw some policy prospects about the possible shape of monetary integration in Asia, linked to the possible evolution of the Chinese currency exchange rate.

Confronted to a depreciating yuan, Asian countries would feel an incentive to follow the Chinese currency, because their exports would otherwise be hit on OECD markets. The outcome would therefore be a continued *de facto* monetary integration within the Asian area.

On the opposite, if facing an appreciating yuan, Asian countries would have little incentive to follow the move of the Chinese currency, as they would endure a loss in OECD export markets, which are still their major export markets. Without explicit monetary coordination in the region, the yuan would probably be floating alone, at least as a first step, other Asian countries keeping their implicit peg to the dollar.

What would happen in case of a diversification of the Chinese peg? If China were to peg on a basket, it would balance losses from appreciating against a given OECD currency by gains from depreciating vis-à-vis another currency. On average, exports would be more stable, and market shares in exports markets would be also more stable for Asian competitors. As most Asian countries are highly exposed on European and Japanese export markets, this could be a signal from them to switch from the dollar to a basket peg, a switch which might be useful for countries that are fearing exchange rate crisis in the kind of the 1997 crisis. Indeed, a peg on a basket leaves less room for the market to play against the peg, as the weights of the basket may be variable through time, and are sometimes not officially disclosed. Furthermore, a diversified peg helps isolate peggers from the detrimental effect of euro/dollar/yen fluctuations.

Although numerical simulations should only be considered as illustrative, several conclusions can be drawn. First, continental China could feel more incentive to diversify its currency peg than to float the yuan. This is because all three key currency blocks – USD, yen, euro – still play a major role as markets and as investors, and because exchange-rate volatility is an impediment to trade. Second, there is a priori little incentive for continental China to cooperate with other East-Asian countries, because its exports are little dependent on the exchange rates of other countries in the region. Conversely, Asian partners could feel an incentive to cooperate with China due to competition on third markets.

APPENDIX

Countries of the sample

The estimates are run on 11 Asian developing countries exporting to themselves, to 4 non-Asian emerging countries and to 19 developed economies.

Asian countries: China, Hong Kong, Indonesia, India, Korea, Malaysia, Thailand, Singapore, Thailand, Taiwan.

Emerging importers: Argentina, Brazil, Mexico, Russian Federation.

Developed importers: Australia, Austria, Belgium-Luxembourg, Canada, 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) Endogenous variable: bilateral exports of goods in current dollars from CEPII-CHELEM database, export price index (when available) from the IMF, International Financial Statistics, line 74, or manufacturing price index from World Bank (World Development Indicators); missing data are filled using the rate of increase of producer prices (1FS, line 63); nominal exchange rates from IMF, International Financial Statistics, line 00 rf.

2) Gravitational variables

- GDP_{it} is the GDP of country i on year t in million PPP US dollars (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. Here, it covers the ASEAN.

- CL_{ij} is a dummy which takes the value of one when i and j share a common language. The data are available on John Haveman's web site:

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

3) Exchange rate variables

- RER_{ijt} is the real exchange rate level between *i* and *j* on year *t*. When taken from the CHELEM database, it compares observed exchange rate to PPP ones, and it exceeds 100 in case the currency is undervalued. PPP-based real exchange rates are interpretable both in the cross-section and in the times-series dimension, which is of great importance when panel data are used. When built using IMF data, it is defined as the ratio of consumer price indexes (IMF International financial statistics, line 64) converted into the same currency using nominal exchange rates.
- VOL_{ijt} is the nominal exchange-rate variability between currencies *i* and *j*. It is calculated with quarterly or monthly nominal exchange rates (IMF, International Financial Statistics, line 00rf), and is defined as the coefficient of variation of the exchange rate during year *t*, which compares the standard deviation of the nominal exchange rate to its mean on year *t*.

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