

Where is China's Place in the World Economy: Lessons from a Gravity Model¹

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Abstract

In the past decade, the share of China in world trade has increased at an unprecedented speed. The aim of this paper is to better understand the factors behind the rapid integration of China in world markets using a gravity model. This model was estimated for a large dataset of bilateral trade flows across 60 countries over more than 20 years. A parsimonious specification relating bilateral trade with the economic size of the economies involved, the geographical distance between them and other policy-related factors influencing bilateral trade (such as free trade agreements or common cultural factors) successfully explains most of the variation in bilateral trade flows. The outcome of the model provides a natural benchmark against which observed bilateral trade flows can be assessed. Preliminary results based on a two-stage approach suggest that China is already well integrated in world markets, particularly with North American and most euro area countries, whereas it may still have scope to integrate more with other regions, especially other rapidly developing Asian countries.

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1. Introduction

The brisk pace of China's integration into the world economy has been one of the most striking developments affecting global trade in recent years. The emergence of the Chinese economy is perceived to have triggered tensions, ranging from holding China partly responsible for global imbalances to complaints about the "excessive" competitiveness of Chinese products, and adversely affecting the employment situation in partner countries. Such tensions seem to have affected many regions, including the euro area, the United States and Japan, as well as other Asian countries. However, the increasing importance of China in world trade could be rationalised at least partly by the quickly growing size of its economy and by its transition towards a market economy. The natural question that arises from these considerations is then what is the "natural" place of China in the world economy. Although a quantification of China's role in international trade (given its economic size and location) would constitute a useful benchmark, empirical evidence on the subject is surprisingly scarce.

This paper aims to fill this gap and to provide an important input to the policy debate. We use an enriched gravity model to analyse the factors behind China's rapid integration and derive a benchmark for China's trade intensity with major partner countries such as the euro area and the United States as well as within the Asian region. For that purpose, we build on earlier work², which focussed on the trade integration of Central and Eastern European countries (CEEC) in the euro area. As the emergence of the Chinese economy shares many characteristics with the transition process of the Eastern European countries, insights gained from our initial study can be applied to the particular case of China. This methodology also allows us to investigate the question of regionalisation versus globalisation patterns, noticeably the role of free trade agreements.

Our gravity model is estimated in a two-step panel data framework following the approach suggested by Cheng and Wall (2005).³ We use a large dataset of bilateral trade flows including more than sixty trading partners over more than twenty years (regressions include typically more than 50000 observations). In line with the findings commonly reported in the literature, this model relates bilateral trade with the economic size of the economies involved, the geographical distance between them and other policy-related factors supporting (or impeding) bilateral trade, such as free trade agreements or common cultural factors, while the inclusion of FDI data is also discussed. With this relatively parsimonious specification, we are able to capture most of the variations of the trade flows, both across countries and over time. We can then use this model – checked for robustness using different empirical approaches (such as dynamic OLS and appropriate random effects estimator) and country samples – as a benchmark for assessing trade patterns.

² See Bussière et al. (2005).

³ See Cheng, I-H. and H. J. Wall (2005). Controlling for Heterogeneity in Gravity Models of Trade and Integration. *Federal Reserve Bank of St. Louis Review*, 87, 1, 49-63.

This method allows comparing the trade intensity across countries using an indicator which can be interpreted as a “multilateral resistance term” along the lines of Anderson and van Wincoop (2003). It shows that – given the characteristics of the economy – China is already very well integrated into the world economy. The indicators of trade intensity suggest that China displays a higher degree of global trade integration than many other industrialised countries as well as Asian trading partners. It also shows that China is very well integrated with Canada, Australia, the United States and several Latin American countries (Peru, Uruguay and Argentina) if compared to the overall trade integration of these countries, while there is significant potential for many CEECs to intensify their trade with China. Among euro area countries, Germany, France and Spain seem to be well integrated with China already, whereas for Italy there seems to be some room for stronger trade links. Finally, several Asian countries also have significant potential to raise bilateral trade with China (particularly India). Using, instead of the overall world market integration, the degree of trade integration of individual countries with other Asian countries as a benchmark confirms the high trade intensity of China with Latin American trading partners and Canada and the low intensity with India. For the United States and Australia, trade intensity with China does not seem to be exceptional if compared with the trade intensity of these countries with other Asian economies.

In view of their simplicity and high explanatory power, gravity models have been applied to the particular case of China. However, our approach differs in several ways from the existing literature on the topic: while we selected a rather large set of countries and have kept the specification relatively parsimonious, most papers that use a gravity model to analyse trade in China or Asia use a smaller set of countries and try to refine the model by adding new regressors. This difference stems from the different objectives: in our case, we use a relatively general specification to yield a benchmark, whereas other papers aim at understanding in greater detail the nature and the evolution of trade flows over time. For instance, Filippini et al. (2005) decompose trade into three categories (low, medium and high tech) and test whether a measure of “technological distance” help explaining bilateral trade flows. Using a dataset of 26 countries only, and focusing on China, they conclude that the more “technologically distant” countries are from each other, the less they trade. Using a panel of 11 Asian exporters and 23 importers, Bénassy-Quéré and Lahrière-Révil (2003) aim at evaluating the impact of a 10% change in the real value of the yuan. They conclude that such policy change would have a strong impact on China and on the rest of Asia. Focusing on India’s global trade potential, Batra (2004) estimates a gravity model using a simple cross-section OLS equation (based on year 2000) and concludes that India has a very strong scope for increasing trade flows with China and the rest of Asia. At the other end of the spectrum (from a sample size perspective), Lee and Park (2005) use the much larger sample set up by Glick and Rose (2002) to study the impact of free trade arrangements, with a special emphasis on the possible trade diverting and trade creating effects. Their sample covers 186 countries from 1948 to 1997. Although there are also pitfalls associated with such large dataset (related, for instance, to the issue of homogeneity of the countries included), the

approach developed by Lee and Park (2005) brings many insights and could be replicated using the present dataset as a possible extension for future research.

The rest of the paper is organised as follows: section 2 reviews the stylised facts, section 3 presents the gravity equation and the regression results, section 4 shows the results for selected country-pair examples, section 5 focuses on the information extracted from the second stage regression, while section 6 concludes.

2. Bilateral trade flows: stylised facts

The purpose of the present section is to document long-run trends in bilateral trade flows across the world, using the charts presented in the Appendix. For convenience and to make the charts comparable across countries of different sizes, these charts plot, for each country, the *share* of selected trading partners as a percentage of total trade. We consider here total trade (i.e. the sum of exports and imports) rather than exports or imports separately, which may be a natural extension of the present exercise, using a very similar approach. Three key findings emerge from the stylised facts presented in this section: first, the share of China has risen in almost all countries in the world since the early 1990s (not only within developed countries in Europe and North America, but also in Japan and in the rest of developing Asia); second, the share of Japan has noticeably fallen in most markets; and third, the impact of free trade arrangements on trade flows can sometimes be spectacular, while the magnitude of this effect varies significantly across country pairs.

From a euro area perspective (Chart 1a), i.e. expressing the value of the bilateral trade flows between the euro area and its trading partners as a percentage of total extra-euro area⁴ trade flows, the share of China has doubled in the past ten years. This increase has actually accelerated noticeably in 1999 whereas, over this period, the share of the UK, the US and Japan have fallen markedly. In the case of Japan's share in the euro area, a declining trend seems to be ongoing since the early 1990s, and Japan has now been overtaken by all the other countries represented in the chart. The share of the other Asian countries has remained broadly stable in extra-euro area trade in the past five years, after falling sharply around the time of the Asian crisis, which put a halt to the steady rise observed since the early 1980s. Finally, one of the most striking patterns of extra-euro area trade is the very strong growth of the new European Union Member States (NMS), which joined the EU in 2004. Altogether, Asian countries (adding up Japan, China and the countries included in the aggregate "Rest of Asia", ROA) now represent (with a share above 16%) a larger trading partner than the UK and the US, while the NMS represent (with a share slightly above 10%) the fourth trading partner. While the increase in the trade share of China is broad based across individual euro area countries, the magnitude of this increase varies considerably across countries. It is for instance higher for Germany (Chart 1b) than for France

⁴ Extra-euro area trade flows exclude trade among the countries that are part of the euro area.

(Chart 1c) and Italy (Chart 1d); in the case of Germany, the strong rise in the share of China and especially of the new EU Member States was accompanied by a fall in the share of intra-euro area trade in the past ten years.

The trade share of China also increased strongly in the US (Chart 1e) and in the UK (Chart 1f), although China's share is now much larger in the former (10%) than in the latter (less than 4%). In the case of the United States, China is not the only developing country that saw its export market share increase rapidly in the past ten years. After a short-run drop related to the 1994/1995 Tequila crisis, the share of Mexico in US trade increased at a faster rate than ever before, until 2001 when it started to decline slightly. This increase could be related to the completion of NAFTA in 1993, although other factors could have played a role as well, such as the devaluation of the peso at the end of 1994. However, it is striking that the rise in the share of Mexico affected trade flows in both directions: between 1993 and 2001, the share of Mexico in US exports rose from 8.9% to 13.9% (a 5 p.p. increase), and its share in US imports from 6.8% to 11.2% (a 4.5 p.p. increase). Another example of the sometimes powerful effect of free trade arrangements is provided by the example of Spain (Chart 1g), whose trade connections with other EU countries increased dramatically around the time of accession in 1986. The example of Spain also offers a nice illustration of some of the other factors that influence bilateral trade flows, as captured by our right-hand side variables. For instance, the high share of trade with Latin America can be related to the common language spoken in these countries. The fact that France is Spain's largest trading partner may be associated with France's size and (relative) geographical proximity with Spain, but maybe also with the common border between the two countries.

Taking now an Asian perspective, the rising importance of China seems to have affected all other countries in the region. For Japan, the share of China has been multiplied by almost three in the past ten years (Chart 1i). This increase seems to have come mostly at the expense of the share of the US, which decreased from above 25% to less than 20% over this period, while the share of the euro area remained broadly stable since 1994. In the other Asian countries of the region, the share of China has also risen very quickly (Chart 1j), while, again, the share of Japan has continuously declined. In China itself (Chart 1h), the group of other Asian countries constitutes the first trading partners. There does not seem to have been any significant reallocation of shares, except perhaps a marked decrease in the share of Japan.

3. Estimating the model

3.1. Gravity fundamentals

Following a specification reminiscent of Newton's gravitation theory, gravity models relate bilateral trade to the mass of these two countries – commonly measured as the economic size of the countries involved – and the distance that separates them. This standard formulation of the

model, which is consistent with standard models of international trade (see among others Anderson, 1979, Anderson and van Wincoop, 2003), can be extended to include other factors generally perceived to affect bilateral trade relationships between two countries. Indeed, the notion of distance does not only relate to the geographical distance (i.e. transportation costs), but also to other factors affecting transaction costs. Four natural candidates are relevant in this context. Firstly, countries sharing the same language tend to trade more with each other than otherwise. This may be partly related to historically established trade ties if these countries constituted colonies in the past. The intuition here is that countries sharing the same language may have a lot more in common than the countries that do not, which should, *ceteris paribus*, reduce transaction costs. Secondly, countries sharing a common border have lower transaction costs and higher bilateral trade. Thirdly, if two countries were part of the same territory (such as the countries of former Yugoslavia or the former Soviet Union), they have closer trade ties than otherwise (history matters). Finally, participation in a free trade arrangement may stimulate trade among the constituent countries.

We considered adding FDI flows as an additional regressor but eventually decided to drop it due to a number of caveats. First, FDI data are very volatile, which considerably complicates estimation. Second, it is not clear *per se* whether FDI impacts trade or the reverse so that endogeneity issues are particularly acute for FDI flows. Theoretically, it is also ambivalent whether FDI is a substitute for or a complement to trade, so that the direction of the impact is undetermined (see Markusen and Venables, 1998, and Egger and Pfaffermayr, 2004). Moreover, FDI inflows may simply imply a change in the ownership of an existing firm without having any impact on international trade. Tentative results indicate that FDI enters the regression with a positive sign, but a low (though significant) coefficient. Thirdly, bilateral FDI data appear to be subject to significant quality constraints. Frequently, data on bilateral FDI inflows reported in the recipient country seem to be unrelated to FDI outflows in the source country. Clearly, more research on this issue, based on higher quality data, is needed before a better picture can be reached.

3.2. Methodological aspects

In the literature on gravity models, the emphasis was often placed on the relevance and importance of certain policy variables – such as common borders, free trade areas or the participation in a currency union – on international trade instead of the intensity of trade *per se*.⁵ In terms of methodology, in many applications heterogeneity is not properly taken into account using (repeated) cross-section analyses, pooled OLS specifications or data averaged over longer horizons. However, ignoring country heterogeneity can lead to highly distorted estimates, (Serlenga and Shin (2004) as well as Cheng and Wall (2005)). Taking this into account,

⁵ See Egger (2004) on FTA and Rose (2000) on currency union. Exceptions from this mainstream of applied trade analysis are Cheng and Wall (2005) and Fidrmuc (2004).

Anderson and van Wincoop (2003) included a so-called multilateral trade resistance term in their cross-section analysis, which may be modelled as country dummies (see also Feenstra, 2002). In a time series context, Mátyás (1997, 1998) included two sets of country dummies (for exporting and importing countries).⁶ Egger and Pfaffermayr (2003) showed, however, that instead of having one dummy variable per country, individual country-pair dummies (fixed effects) and time dummies to control for common shocks should be used to get efficient estimators. Moreover, Micco et al. (2003) suggest that the inclusion of fixed effects may mitigate endogeneity problems. For instance, unusually high trade flows may lead to the establishment of a free trade arrangement rather than *vice versa*. Fixed effects take into account whether two countries have traditionally traded a lot.

If the variables entering the gravity model may contain a unit root, cointegration analysis instead of standard panel estimation techniques would be more appropriate (Faruquee, 2004). In order to account for possible non-stationarity in the data, the results of the fixed-effects estimator are compared with the results of the dynamic OLS specification (Kao and Chiang, 2000). Moreover, Serlenga and Shin (2004) argue that the fixed-effect estimator ignores the potential correlation between the time-invariant variables and unobserved country-pair specific effects which may again lead to biased coefficient estimates. In order to address this issue, they propose to cross-check the fixed effects results by employing the instrumental variables estimation technique proposed by Hausman and Taylor (1981), which allows estimating consistently the coefficients of the time-invariant variable as well.⁷

3.3. Specification

Formally, the estimated gravity equation is expressed as follows (all variables are defined in logarithms):

$$T_{ijt} = \alpha_{ij} + \theta_t + \beta_1 y_{ijt} + \beta_2 d_{ij} + \beta_3 q_{it} + \beta_4 q_{jt} + \sum_{k=1}^K \gamma_k Z_{ijkt} + \varepsilon_{ijt} \quad (1)$$

where T_{ijt} corresponds to the size of bilateral trade between country i and country j at time t , y_{ijt} is the sum of y_{it} and y_{jt} , which stand for the (real) GDP in the country i and j , respectively, at time t , d_{ij} is the distance variable, Z_k reflects cultural, historical and political factors affecting bilateral

⁶ This approach is being referred also to as triple indexed error composition model (that is, using two country dimensions and the time dimension). However, these estimates are still based on pooled versions instead of panel versions of gravity models.

⁷ The Hausman-Taylor (HT-) estimator is a random-effects estimator which yields consistent and efficient estimates even if some explanatory variables are correlated with the error term. Thereby, it also better accounts for possible endogeneity between the explanatory variables and trade and allows the estimation of the coefficient of the time-invariant variables. In gravity models, the HT-estimator has been used, among others, by Egger (2003, 2004), Koukhartchouk and Maurel (2003) and Serlenga and Shin (2004). From the time-varying variables discussed before, the size is considered as endogenous variables, while the real exchange rate variables and the regional trade arrangements and the time effects are included as exogenous variables.

trade between two countries.⁸ Consistent with the above arguments, β_1 should be positive and β_2 negative. As standard in the literature, trade is defined as the average of exports and imports and distance is measured in terms of great circle distances between the capitals of country i and country j . Following Micco et al. (2003) and Graham et al. (2004), we also include the real exchange rate q of each country against the USD, mainly to control for valuation effects as all trade data are expressed in US dollar terms. In addition dummies were included (Z) for country-pairs sharing a common language, a common border or being members of the same free trade areas. Accordingly, all γ_k are expected to have a positive sign.

The terms α_{ij} are the country-pair individual effects covering all unobservable factors related to trade resistance and not already captured by the other explanatory variables. For instance, they account for tariff and non-tariff trade barriers, historical developments, product specialisation, and openness to trade in general, as it is unlikely that Z_k encompasses all cultural, historical and political factors, which are intrinsically difficult to measure in practice. θ_t are the time-specific effects – controlling for common shocks or the general trend towards “globalisation”. In more general terms, these time-dummies account for any variables affecting bilateral trade that vary over time, are constant across trading-pairs and have not been included in the list of explanatory variables such as global changes in transport and communication costs. Finally, ε_{ij} is the error term.

We first estimate the regression using the standard fixed-effects estimator. As the time-invariant variables are collinear with the country-pair individual effect, which precludes the estimation of coefficients for d_{ij} and Z_k (except the dummies for the free trade areas) we follow Cheng and Wall (2005) and estimate an additional regression of the estimated country-pair effects on the time-invariant variables in order to filter out the importance of these variables in the fixed effects.

$$\hat{\alpha}_{ij} = \beta_1 + \beta_2 d_{ij} + \sum_{k=1}^K \gamma_k Z_k + \mu_{ij} \quad (2)$$

The error term of this last equation can be interpreted as a measure of trade integration, “net of” the impact of the other explanatory variables. It therefore represents an alternative and more refined measure of trade openness than the usual ratio’s of exports and imports to GDP as it takes into account the geographical location of the country and its participation in free trade agreements.

3.4. Data

The dataset includes bilateral trade flows, in value terms (they are measured in current US dollars) across 61 countries. The data span the period from 1980 to 2003 and the frequency is annual. This amounts to more than 3,500 bilateral trade relationships and almost 53,000

⁸ As in Micco et al. (2003), real GDP per capita is not included in the fixed effect estimation owing to the high collinearity between those dummies and the population.

observations in the standard fixed-effects regression.⁹ Trade data are from the International Monetary Fund's Direction of Trade Statistics (IMF DOTS); they are expressed in US dollars and deflated by US industrial producer prices. GDP data come from the IMF International Financial Statistics (IMF IFS) and are deflated by US CPI. The distance term reflects the aerial distance between the capitals of the two countries under consideration and comes from Fidrmuc and Fidrmuc (2003) and the MS Encarta World Atlas software (for details, see data appendix). Obviously, this measure has the caveat that it implicitly assumes that (1) overland transport costs are comparable to overseas transport costs, and (2) that the capital city is the only economic centre of a country which is probably more appropriate for small than for large countries. The latter assumption appears to be particularly unsuited for China and the United States. To account for this the variable was adjusted for those two countries by using a weighted average of the distance of each country in the sample to five big cities in China and the four big cities in the United States.¹⁰ The real exchange rate variables are defined as the CPI-based US dollar exchange rates of each country.

The dummy variable for common language was set equal to one if in both countries a significant part of the population speaks the same language (English, French, Spanish, Portuguese, German, Swedish, Dutch, Chinese, Malay, Russian, Greek, Arabic, Serbo-Croatian or Albanian). Some countries even enter more than one language grouping, such as Canada, where both English and French are native idioms or Singapore, where English, Chinese and Malay are commonly understood languages. This of course implies to define a cut-off point; overall, there are 274 country pairs in which the same language is spoken (see data Appendix for further details). The dummy variable for having a common border refers to 179 land borders shared by the countries included in the sample. Finally, dummy variables have been included for the most important free trade arrangements, namely the European Union, Asean, Nafta, Cefta and Mercosur. The free trade areas have been introduced or have expanded during the analysed period; hence, they were included already in this step.

3.5. Results

The variables included in the specification – except the EU dummy – have the expected sign and are statistically significant (Table 1). Four different specifications were estimated. The first column shows the results following the fixed effects (FE-) formulation, which is suggested by Cheng and Wall (2005). In the first step, a regression excluding all time-invariant variables was run including as many country pairs as possible.

⁹ Most Central and Eastern European countries enter the dataset in the 1990s only, when the transition period to market economies started.

¹⁰ As regards the United States, New York (0.48), Los Angeles (0.23), Chicago (0.17) and Houston (0.12) were considered. For China, Shanghai (0.35), Beijing (0.20), Guangzhou (0.19), Chongqing (0.13) and Tianjin (0.13) were included. The numbers in parantheses are the respective weights.

The FE-model confirms that economic size has a highly significant impact on bilateral trade.¹¹ The magnitude of the coefficients suggests that a one percent increase in economic activity at home or abroad should raise bilateral trade by about 0.56%, i.e. a less-than-proportional impact. The real exchange rate variables also enter the regression significantly – consistent with our concerns about valuation effects. The dummies for free trade arrangements enter significantly and with the right sign, with the exception of the EU dummy, which is not significant in this specification.¹² This result is surprising, especially given the strong increases noted in Section 2 for Spain (referring e.g. to Chart 1g in the Chart Appendix), and will be analysed more in depth below.

Table 1: Estimation Results

	FE	DOLS	FE excluding CEE countries	HT excluding CEE countries	FE OECD
	(1)	(2)	(3)	(4)	(5)
GDP/Size	0.56**	0.55**	0.52**	0.57**	0.59**
Distance	-0.67**	-0.70**	-0.85**	-0.84**	-0.58**
Border	1.22**	1.25**	0.62**	0.62**	0.91**
Language	1.26**	1.19**	0.60**	0.59**	0.26**
Territory	-0.05	-0.13	--	--	--
EU	-0.00	-0.04	0.01	0.02	0.22**
Asean	0.46**	0.42**	0.48**	0.47**	--
Mercosur	0.25**	0.21**	0.26**	0.25**	--
Nafta	0.46**	0.45**	0.46**	0.49**	0.21**
Cefta	0.22**	0.19**	--	--	--
First stage:					
R ²	0.64	0.65	0.67		0.67
N	52724	43651	36714	36714	10509
Second stage:					
R ²	0.33	0.32	0.37		0.63
N	3413	3413	1660		459

** = Significant at the 1% level, * = Significant at the 5% level.

FE = fixed effects, HT = Hausman-Taylor random effects estimator, DOLS = dynamic OLS.

The shaded rows correspond to the second stage regressions.

The overall fit (in terms of R-squared) of the FE-regression is above 60%. The distance term is strongly negative, implying that trade between two countries is almost 70% higher if the country is half as distant as another otherwise identical market. Similarly, having a common border and speaking the same language roughly triples trade between the two countries, while the common territory dummy is not significant. The adjusted R-squared in the second-stage regression is 0.33, implying that these factors explain roughly one-third of the distribution of the country-specific

¹¹ The coefficients for the time-invariant variables could be estimated by using a random effect (RE-) model, which assumes that explanatory variables are uncorrelated with random effects. However the Hausman test strongly suggests that this assumption is violated in the present case.

¹² The marginal effect of the dummy variables can be calculated by taking the exponential of the estimated coefficient minus one: a coefficient of 0.5 means that when the dummy is equal to 1, trade increases – ceteris paribus — by 65% ($e^{0.5} - 1 = 0.6487$) and a coefficient of 0.25 implies a 28% increase.

factors. The rest, i.e. the share of the fixed-effect which is not accounted for by the right-hand side variables of the second stage regression, reflects the degree of integration of the two countries. For one given country, the average of these terms across all other partner countries reflects the degree of integration in world markets.

The sensitivity analysis confirms the overall robustness of the estimates: Accounting for possible non-stationarity in and cointegration among the variables, we also employ panel dynamic OLS. This approach also takes better into account the potential endogeneity autocorrelation issues by adding leads and lags of the differenced explanatory variables. The DOLS results are very close to the results of the FE-estimator suggesting that the potential bias from the FE-specification should be small. As a second robustness check, two alternative samples have been estimated. The first exclude the transition countries as the inclusion of countries may have undesirable effects on the estimates (see Bussiere et al. 2005). With the exception of the border and the language dummies – both of which are dropping notably – the results are very stable. The distance term is only slightly higher and the dummies included for free trade arrangements are relatively close to the estimates shown before. For this sample, the Hausman-Taylor estimator shows once more that the specification is very robust to using different econometric methods. Secondly, we restrained our sample to the OECD countries.¹³ Although the number of observations drops to about 10,000, i.e. by roughly 80%, the coefficients retain their signs and significance. The variable for economic size is still highly significant and the coefficients are close to those estimated in the full model. The dummy variable for Nafta remains positive and significant but is smaller than in the previous specification, the EU dummy becomes significant and positive. The coefficients of the time-invariant variables are again somewhat smaller. The fact that the goodness-of-fit of the regression presented in column (5) is even better than for the regression of column (1), which includes more countries, suggests that the larger database possibly encompasses more noise.

The fact that the EU dummy variable is not significant in the first regression is puzzling, especially given the evidence presented in Section 2 (particularly for Spain). One possible interpretation is that most member countries of the European Union have joined a common free trade agreement long before the first observation in the sample, implying that the effect of the EU is already accounted for in the fixed effects. A first (and admittedly rough) validation of this hypothesis is that the EU dummy is significant in the simple OLS regression and in the random effect regressions, i.e. when not all the between information has been eliminated (like in the fixed-effect regression). This is only indirect evidence given that, as explained above, the coefficients of the simple OLS and of the random effect regressions are biased. A second insight can be seen from regressing the fixed effects on the EU dummy variable: the coefficient of the EU dummy variables comes out positive and significant, which suggests that the EU dummy variable is indeed strongly positively correlated with the fixed effect. A second interpretation (not

¹³ In this specification, several variables used in the full model drop out in this specification as there are no relevant observations (e.g. Mercosur, Cefta or common territory).

incompatible with the first one) of the low effect of the EU dummy in the first stage deals with the potential endogeneity of the creation of FTA's, implying again that the fixed effects already capture the strong trade connections between member countries.

4. In-sample fit for selected countries

The results of the gravity model can be interpreted in two different and complementary ways. In the present section, we focus on the predicted values yielded by the first stage of the fixed effect regression, looking at selected country-pair examples, while section 5 delves into the interpretation of the second stage results.

To facilitate the interpretation of the results, we show the ratio of the actual (i.e. observed) divided by predicted trade flows, in percent (see Chart appendix).¹⁴ For instance, the first chart (France/Germany) shows that trade flows between the two countries rose in the early 1980s by 20% above the value predicted by the model, before quickly returning to the region implied by our right-hand side variables. A quick glance at most of the other charts for developed countries suggests that the model successfully captures the evolution of trade flows over time: the actual values are often in the same ballpark as the observed values, and the ratios tend to rapidly converge back to 100% when they depart from it.

Partly, this result depends to a large extent on the fixed effects, which ensure that the residuals are equal to zero on average (equivalently, they ensure that the ratios are equal to 100 on average for each country pair). However, even controlling for the between information (i.e. the fixed effects), the model satisfactorily explains the within dimension of the panel. The fact that the ratio remains around 100% and does not show a clear trend over time also means that the time-varying right-hand side variables of the regression successfully capture the dynamics of bilateral trade flows across countries. This is clearly the case for countries pairs like France/Germany, Germany/Italy, USA/France, Germany/USA, Germany/UK or France/UK. Among the developed economies, the country-pair France/Italy is an important exception: in the late 1980s/early 1990s, as well as in the early 2000s, the observed trade flows between these two countries have increased by a lesser amount than predicted. A closer look at the data shows that the trade flows between France and Italy slowed down both ways in these two periods. These two periods also correspond to two waves of integration of EU countries with newly opened countries in Europe (Spain and Portugal after 1986, and Eastern European countries in the early 2000s).

The Canada-US country pair provides an interesting example of the sometimes powerful effect of FTA's on trade flows: the completion of the 1988 agreement increased the predicted value of trade (the denominator), resulting in a fall of the ratio from 120 to 80. This result highlights a potential pitfall of capturing the effect of FTA's using shift dummies: often, the effect of FTA's

¹⁴ The predicted values correspond to the projected values of the first stage fixed effect estimation of column 1, Table 1. To compute the ratios, both actual and predicted trade values have been "unlogged".

starts before the official completion of the treaties and takes time, sometimes several years, to reach its full impact.

Turning to trade flows between developed countries and China, the charts presented in the Chart Appendix also show that, in most cases, the ratio's of actual to predicted trade flows remain close to 100%. This is a surprising result, because it suggests that the dynamics of observed trade flows with China are successfully captured by our right-hand side variables. In other words, the growth of China's trade flows with most developed countries seems roughly in-line with GDP growth rates and the other policy variables. This situation contrasts with, for example, trade flows between euro area countries and the new EU Member States, for which the actual to predicted ratios are strongly upward trending (see for instance trade between Germany and the Slovak Republic in the Chart Appendix). Bussière et al.(2005) suggested that this increase can be interpreted as a convergence towards equilibrium: in the beginning of the transition period, the Eastern European countries were trading far below potential (i.e. below the value corresponding to the fundamentals), and they later on progressively caught up with fundamentals, implying that the actual trade flows rose faster than the predicted trade values in the 1990s.

For China, the ratios presented in the Chart Appendix tend to be stationary with the developed Asian countries (Japan, Hong Kong and Singapore). This highlights the perhaps surprising fact that the right-hand side variables are very successful in capturing the dynamics of trade flows between China and these countries over time. By contrast, the ratios are strongly upward trending with the other developed countries in Asia (like Indonesia, Malaysia, South Korea, etc). A possible interpretation of these results can be related to the ongoing relocation of production of firms based in other emerging markets in Asia into China.

Finally, the selected charts presented in the Appendix for Japan reveal that, after rising strongly in the 1980s, the ratios fell significantly in the 1990s. A possible interpretation of this evolution is that in the 1980s, Japan was still pursuing its integration in world markets (a trend that actually started after the second World War), while in the 1990s it started to relocate its production in other Asian countries, implying a decrease in trade flows with respect to what is predicted with the model.

5. Extracting information from country-heterogeneity

5.1. Overall trade intensity of countries

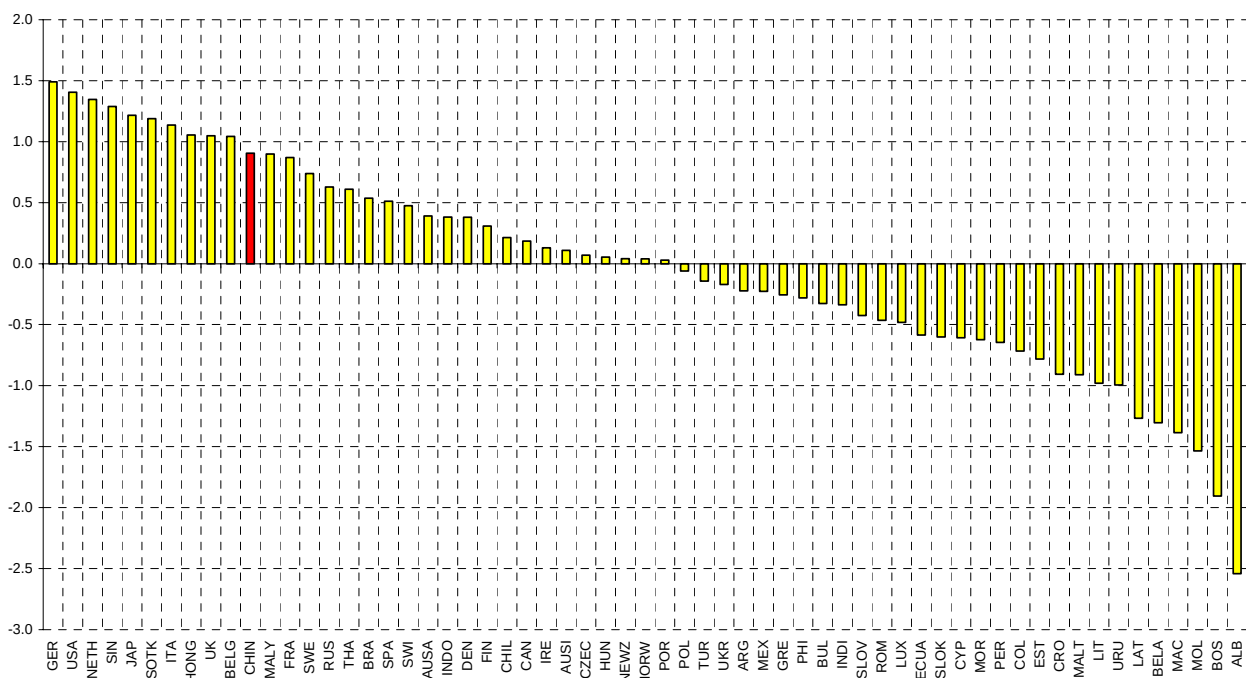
While Cheng and Wall (2005) call the fixed effects a “result of ignorance” for the estimation, they include valuable information for analysing the degree of integration of these countries into the world economy. Accordingly, the residuals of the second stage regression constitute a measure of trade integration after controlling for the fundamentals of the gravity equation. For a given country, strongly positive average residuals correspond to high trade intensity, while

strongly negative average residuals indicate a relatively closed economy. More formally, from equation (2), the residuals denoted by $\hat{\mu}_{ij}$ are aggregated for a country h into a simple “trade indicator”, TI_h :

$$ti_h = \frac{1}{2(N-1)} \left(\sum_{i=1}^{N-1} \hat{\mu}_{ih} + \sum_{j=1}^{N-1} \hat{\mu}_{hj} \right) \quad (3)$$

For a given country, a high TI_h signifies that this country has on average strong trade links with the rest of the world. Chart 1 ranks the indicator of trade intensity for all countries in ascending order implying that multilateral resistance declines from the left to the right.

Chart 1: Trade Indices by Countries, World Markets Integration



Source: Authors' calculations

This provides several insights. Firstly, the variance of the indicators reveals a considerable degree of heterogeneity across countries. Secondly, the industrialised countries tend to display above-average trade integration. For example, Germany, the Netherlands and the USA trade about three times more than an average country in our sample after controlling for the relevant fundamentals.¹⁵ Thirdly, at the other end of the spectrum are many transition economies in Central and Eastern Europe which are by far less integrated into the world.

The South-East Asian countries show a high trade indicator and, thus, little overall trade resistance.¹⁶ The fact that countries like Singapore, Japan, South Korea, or Hong Kong are found

¹⁵ Exceptions are Luxembourg and Greece which appear to face a somewhat higher level of overall trade resistance which in the case of Luxembourg may be due to the specific structure of the economy.

¹⁶ This may partly reflect strong intra-regional integration and a relatively low domestic value-added in their exports. For instance, Singapore and South Korea trade about 2.5 times above the average.

on the left-hand side of the spectrum is relatively intuitive as it is well-known that these countries have very strong trade connections with the rest of the world. In this context, it is noteworthy how well China is already integrated into the world economy. The trade condition index amounts to 0.8, implying that after controlling for the fundamentals of the gravity model China trades about 1.5 times more than the average country included in the sample. While this number should be put into perspective given that the sample includes a number of high disintegrated countries at the Balkan, for instance, the finding that China is even among the Asian countries more integrated into the global economy than Malaysia, Thailand and Indonesia, albeit less so than Japan and the tiger economies of Hong Kong, South Korea and Singapore, testifies the low multilateral trade resistance the country faces.

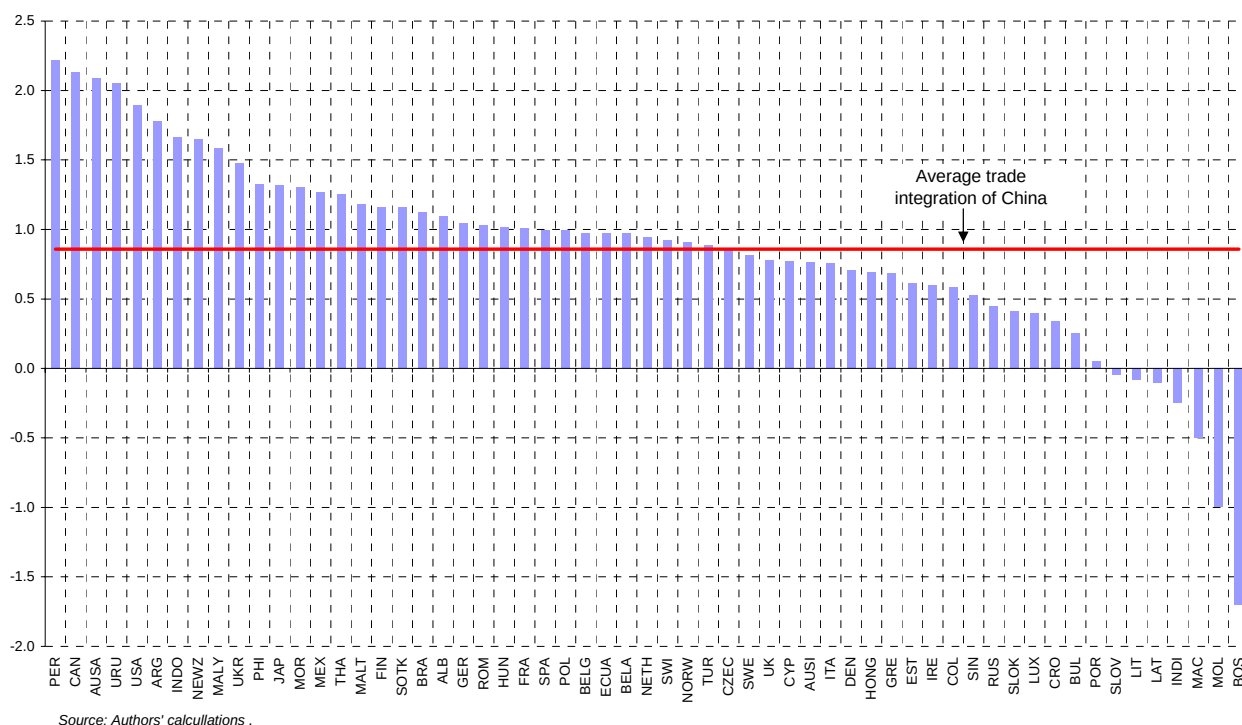
5.2. Conditional trade integration with China

While the results of the previous section show that China is overall already well integrated into world markets, the degree of bilateral integration between China and its partners varies substantially and contains additional information. Accordingly, it is important to analyse the distribution of the average trade integration of China and to condition it on the overall trade integration of each trading partner (this is done in Chart 2). For example, the United States is in Chart 1 next to Germany the country most integrated into world markets (trade condition index amounting to about 1.4). At the same time, the United States is even more integrated with China, having a trade conditions index of about 3.3 (this represents the residual of the second stage regression corresponding to the country-pair China/USA). This implies that after controlling for the fundamentals of the gravity model the United States trades much more with China than with the average trading partner. The integration of the United States with China conditional on the overall integration of the United States amounts to about 1.9 (subtracting 1.4 from 3.3). In order to illustrate the concept it is also worthwhile to consider the case of Albania which is least globally-integrated country in the sample ($TI = -2.5$). China's trade integration with Albania is also very limited ($TI = -1.4$) but given the Albanian global trade integration standards, the countries are in fact fairly well integrated. This conditional trade integration index with China has been computed for each country and ascendingly ordered in Chart 2. The horizontal line reflects China's overall integration into world markets.

Chart 2 suggests that China is very well integrated with Canada, Australia, the United States and several Latin American countries (Peru, Uruguay and Argentina). These countries are more integrated with China than most of the emerging economies in Asia and Japan. Somewhat surprisingly, Singapore and Hong Kong can only be found towards the right hand side of the spectrum and below the average trade integration of China. This finding, however, requires a cautions interpretation. It may reflect the fact that for China, Hong Kong and Singapore a common language dummy has been included (and for Hong Kong also a common border dummy) in the estimation of the gravity model. As the coefficients estimated for these dummies

are very high, this adds significantly to the trade potential for these country pairs; since the coefficients of these dummies decline for alternative specifications, it may be argued that the effect of having a common border and a common language is overstated in these calculations, shifting Singapore and Hong Kong to the right-hand side of the spectrum.

Chart 2: Conditional Trade Indices by Countries, Integration with China as compared with overall integration



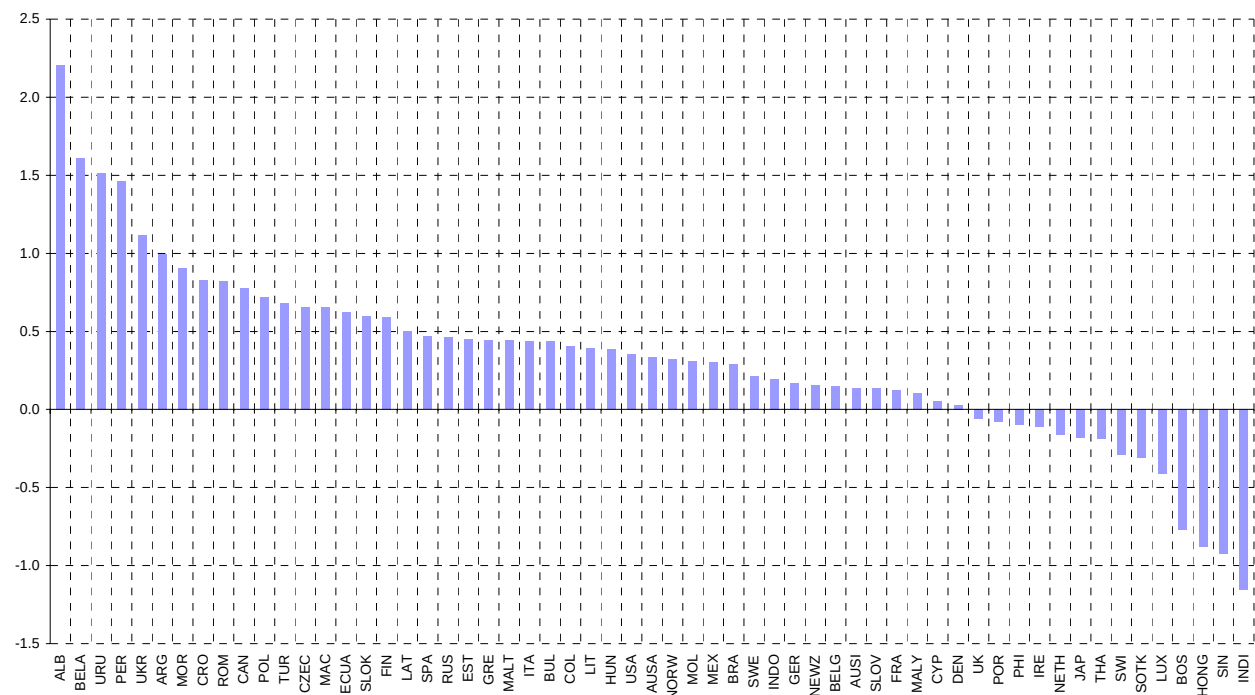
Turning to the euro area countries, Finland seems to be the country most closely linked to China in terms of international trade, which may partly reflect their specialisation on high-tech products, where China may provide significant inputs. Germany, France and Spain are also rather well integrated with China while Luxembourg and Portugal show little trade integration with China. In the case of Luxembourg, this is likely to be due to the specific economic structure of the economy. Moreover, consistent with Bussiere et al. (2005), there still seems to be significant potential for many of the Central and South Eastern European countries to increase their trade with China. Finally, the location of India in the Chart towards the right-hand end of the spectrum is noticeable, suggesting significant potential to improve trade conditions, which confirms the results of Batra (2004).

5.3. Conditional trade integration with China if Asia is the benchmark

An alternative perspective offers a stronger focus on Asia. It could be argued that for assessing the depth of trade of individual countries with China it is more important to compare it with

actual trade with other Asian economies. Recall that in the above example, the overall trade index of the United States was 1.4 while it was 3.3 for bilateral trade with China. However, the US is also more tightly integrated with the other Asian economies. On average against eight Asian countries (Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore, South Korea and Thailand), the bilateral trade indicator ranges from about 1.8 for the Philippines to 3.6 for Malaysia with an average of 2.95. This implies that the gap between Sino-US trade integration and Asian-US trade integration is much smaller than the gap between Sino-US trade integration and overall US trade integration. Accordingly, Chart 3 ranks the countries with regard to their trade integration with China conditional on their trade integration with the other Asian economies.

Chart 3: Conditional Trade Indices by Countries, Integration with China as compared with integration with Asia



Source: Authors' calculations

It suggests that most Asian economies are less integrated with China than among themselves suggesting that there is still leeway for trade deepening in the region. It also confirms that trade between India and China has significant potential to rise. While the results for Hong Kong and Singapore may again be affected by the language and border dummies, South Korea, Thailand and Japan are also less integrated with China than with their Asian counterparts. By contrast, the Latin American countries referred to above (Argentina, Peru and Uruguay) and also a number of central and eastern European countries are well integrated with China if compared to their integration with other Asian countries. While the United States, Australia and New Zealand

looked very well integrated with China if compared with their overall trade integration, this seemed to reflect that these countries share a particularly strong trade relationship with the Asian region. From this perspective, their trade intensity with China does not seem to be exceptional. Only Canada still shows much stronger trade relationships than with the rest of Asia. Many other OECD countries are also found towards the centre of the Chart, where Finland and Spain show a high degree of integration while United Kingdom Portugal, Ireland, the Netherlands, Switzerland and Luxembourg still seem to have potential to intensify their trade with China.

6. Conclusions

This paper analysed the rapid trade integration that took place in the past decade between China and the rest of the world, focusing in particular on the euro area, the United States and the rest of Asia. Estimations from a gravity model augmented with a set of additional variables showed that our relatively simple model already captures well the evolution of trade flows over time and across countries. The comparison of actual and predicted trade flows shows that for most country-pairs, the model successfully captures the dynamics of bilateral trade over time, especially in the case of trade between developed countries. The fact that the ratios are generally in the ballpark of 100% (contrasting with results from other gravity models, which return ratios far above this level) is comforting. The evolution of these ratios over time tends to be very intuitive and consistent with the stylised presented in Section 2. Finally, the results tend to be robust to the use of alternative estimation techniques, although more robustness tests can be conducted later on.

Overall, the rapid integration of China in world markets is well reflected by the fundamentals in the case of many developed countries in Western Europe and North America. The results suggest that China is already well integrated in world markets, while it still has scope to integrate further with some regions of the world, especially Eastern Europe and some other emerging markets in Asia. These preliminary results, which need to be further confirmed by forthcoming analysis, tend to put in perspective the strong growth in bilateral trade flows between China and its partner countries. Clearly, more research needs to be carried out before definite conclusions can be reached. Such research will aim at better understanding the specific nature of trade flows in Asia, in particular how regional trade integration relates to further integration in other markets. Another extension of the ongoing research presented in this paper would be to delve further into the effect of free trade arrangements, particularly regarding their potential trade creating or trade diverting effects.

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Data Sources

Countries included: Albania, Algeria, Argentina, Australia, Austria, Belarus, Belgium, Bosnia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Macedonia, Malaysia, Malta, Mexico, Moldova, Morocco, Netherlands, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Romania, Russia, Singapore, Slovak Republic, Slovenia, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, Ukraine, Uruguay, USA.

Trade data: IMF DOTS.

GDP: IFS line 99b. For Ecuador data from WDI. Data for Greece up to 1994 from WDI. Data for Turkey up to 1985 from WDI. If there was a large discrepancy between World Bank and IMF data, observations have been dropped. This includes Argentina (1980-84), Bulgaria (1985-92), China (1980-1993), Estonia, Latvia, Lithuania (each 1993-95), Moldova (1995), Russia (1993-94), Ukraine (1993-95), For Albania, Bosnia and Herzegovina, Moldova and Macedonia data from EBRD.

Distance: Great circle distances based on MS Encarta World Atlas software.

Exchange rate: IFS line rf. Exchange rates for individual euro area countries were chain-lined with the euro exchange rate upon EMU entry.

Consumer prices: IFS line 64. For Belarus, China, Russia and the Ukraine, inflation rates (IFS line 64.xx) were transformed into price indices.

Industrial producer price: IFS line 63a for the United States.

Real exchange rate: Product of the US dollar exchange rate and the ratio of domestic and foreign consumer prices.

Exchange rate volatility: Standard deviation of the month-on-month log changes in the bilateral nominal exchange rate within a year.

Common border: A matrix is available upon request.

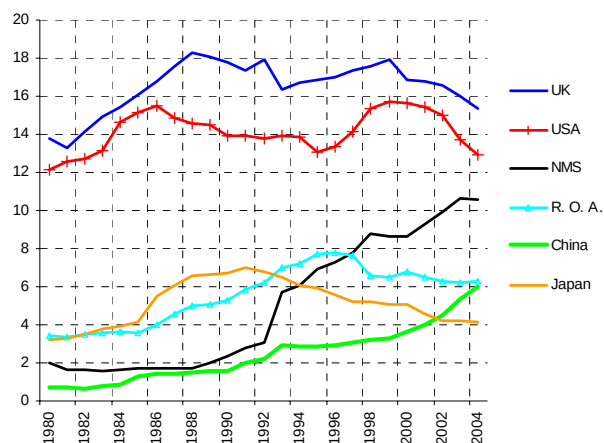
Common language: Based on a matrix including the following languages: English (Australia, Canada, India, Ireland, Hong Kong, Malta, New Zealand, Philippines, Singapore, United Kingdom and the USA), Spanish (Argentina, Chile, Colombia, Ecuador, Mexico, Peru, Spain, Uruguay, Venezuela), French (Algeria, Belgium, Canada, France, Luxembourg, Morocco, Switzerland), German (Austria, Germany, Luxembourg, Switzerland), Chinese (China, Hong Kong, Singapore), Russian (Belarus, Estonia, Latvia, Lithuania, Moldova, Russia, Ukraine), Dutch (Belgium, Netherlands), Greek (Greece, Cyprus), Arabic (Algeria, Morocco), Serbo-Croatian (Bosnia, Croatia, Slovenia), Portuguese (Brazil, Portugal), Swedish (Sweden, Finland), Albanian (Albania, Macedonia), Malay (Malaysia, Singapore).

Free-trade agreement: *ASEAN Association of South East Asian Nations (1992)*: Brunei, Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam, *CEFTA Central European Free Trade Agreement (1994)*: Bulgaria (1999), Czech Republic, Hungary, Poland, Romania, Slovak Republic, Slovenia (1997), *European Union (EU15)*: Austria (1995), Belgium, Denmark, Finland (1995), France, Germany, Greece (1981), Ireland, Italy, Luxembourg, Netherlands, Portugal (1986), Spain (1986), Sweden (1995), United Kingdom, *European Union (EU15)* and *Customs Unions*: EU15, Cyprus, Malta, Turkey (1996); *MERCOSUR Southern Common Market (1993)*: Argentina Brazil Paraguay Uruguay, *NAFTA North American Free Trade Agreement*: Canada (1988), Mexico (1993), United States (1988).

Common territory includes countries which constituted in the past 20 years at some point a common country. They include a) former Czechoslovakia (the Czech Republic and the Slovak Republic), b) countries of the former Soviet Union (Belarus, Estonia, Latvia, Lithuania, Moldova, Russia and the Ukraine, and c) countries of former Yugoslavia (Bosnia, Croatia, Macedonia, Slovenia).

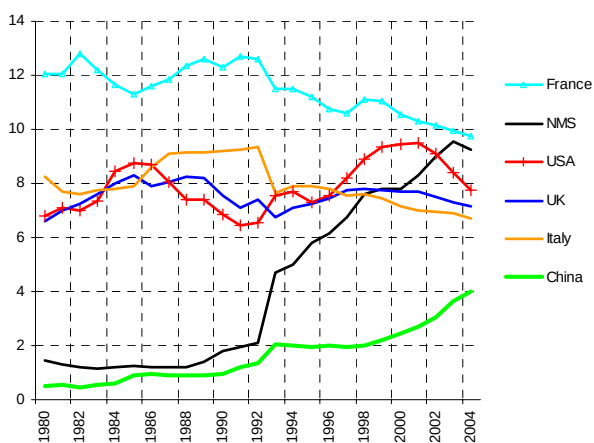
CHART APPENDIX

Chart 1a: Extra-euro area trade shares.
(percent of total extra-euro area trade)



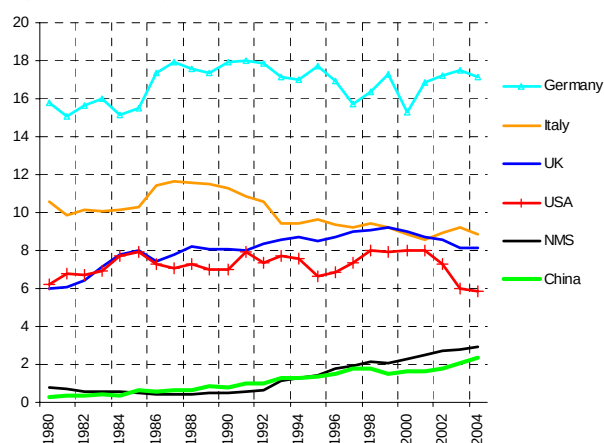
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1b: Trade shares, Germany.
(percent of total trade)



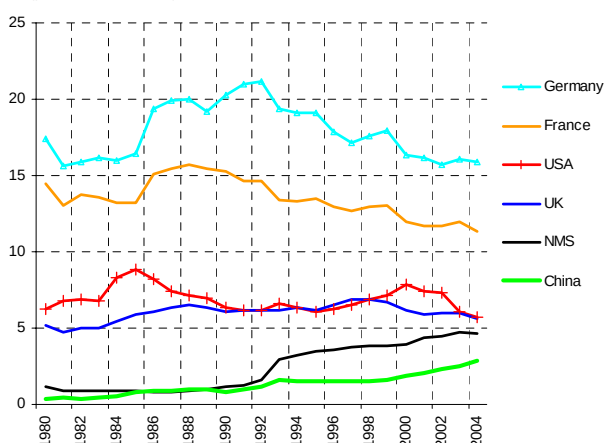
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1c: Trade shares, France.
(percent of total trade)



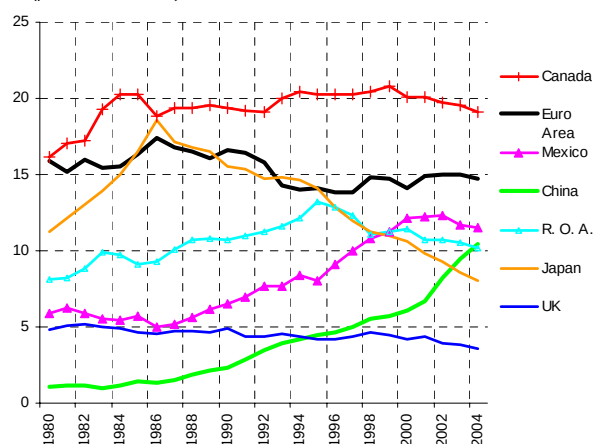
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1d: Trade shares, Italy.
(percent of total trade)



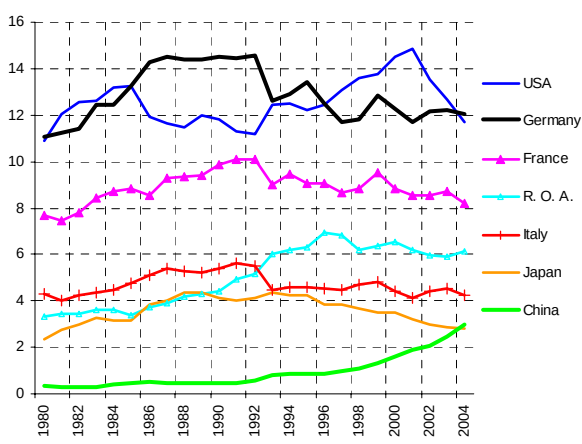
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1e: Trade shares, USA.
(percent of total trade)



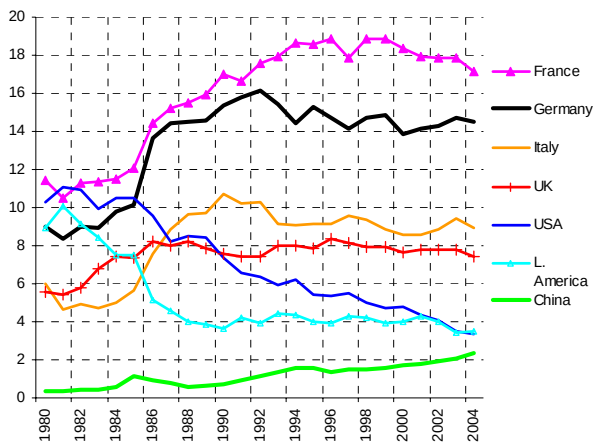
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1f: Trade shares, UK.
(percent of total trade)



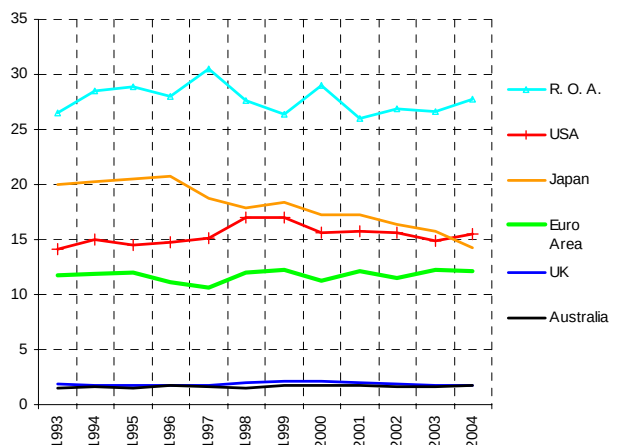
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1g: Trade shares, Spain.
(percent of total trade)



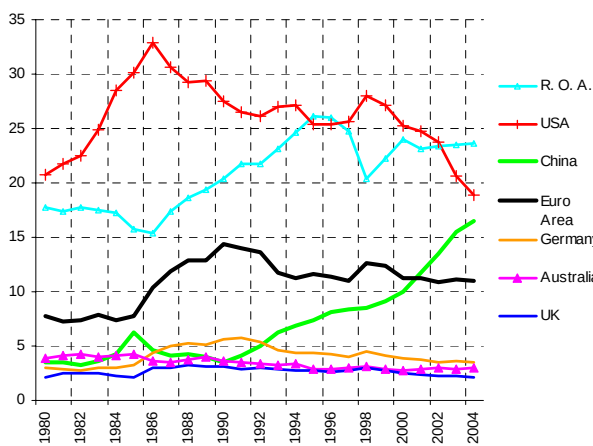
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1h: Trade shares, China.
(percent of total trade)



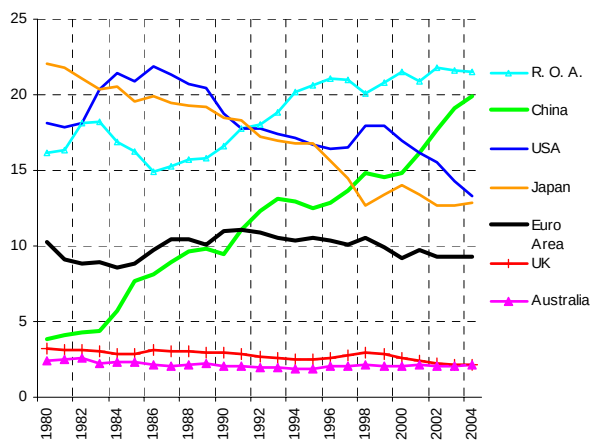
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1i: Trade shares, Japan.
(percent of total trade)



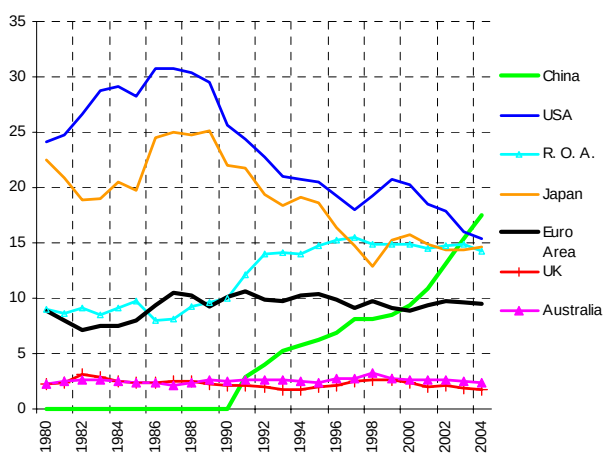
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1j: Trade shares, ROA.
(percent of total trade)



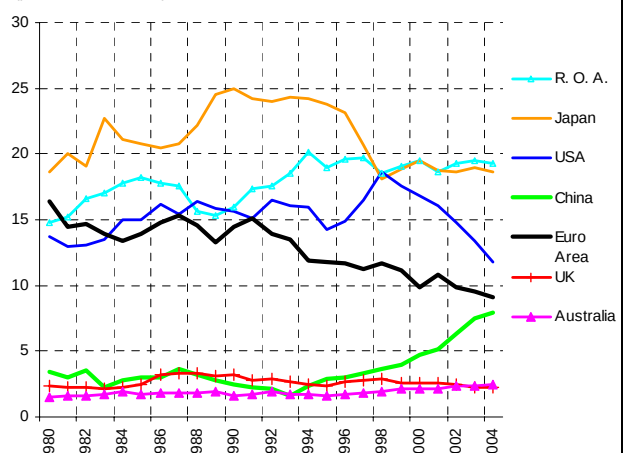
Source: IMF DOTS.
Note: Last observation refers to 2004.

Chart 1k: Trade shares, Korea.
(percent of total trade)



Source: IMF DOTS.
Note: Last observation refers to 2004.

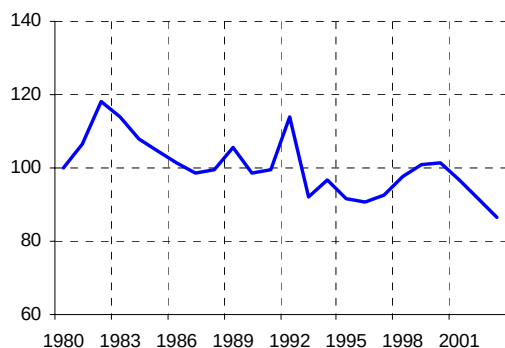
Chart 1l: Trade shares, Thailand.
(percent of total trade)



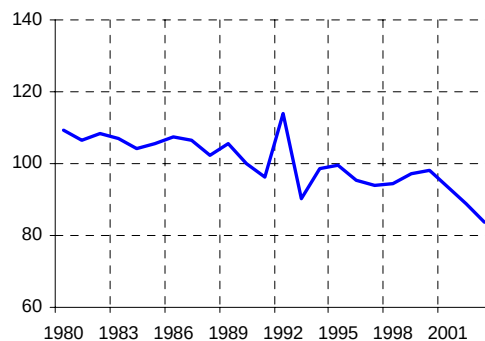
Source: IMF DOTS.
Note: Last observation refers to 2004.

Ratio actual to predicted trade flows, in percent

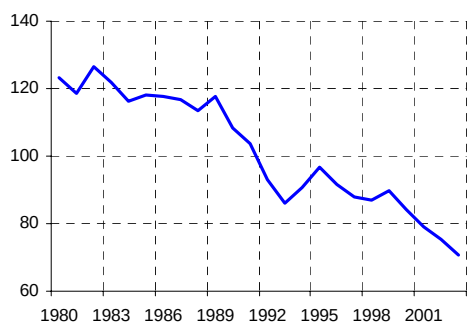
France/Germany



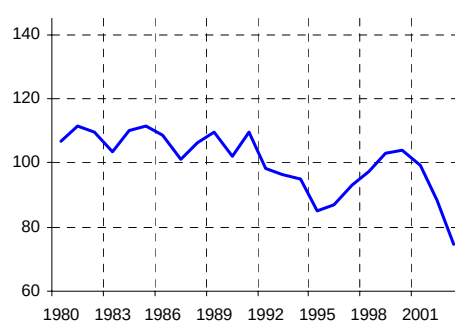
Germany/Italy



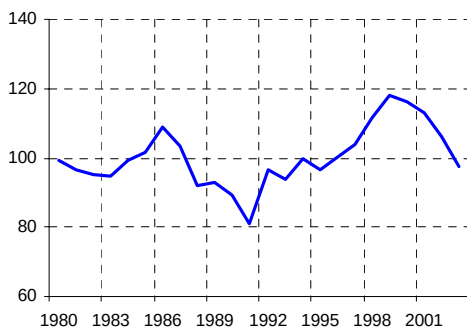
France/Italy



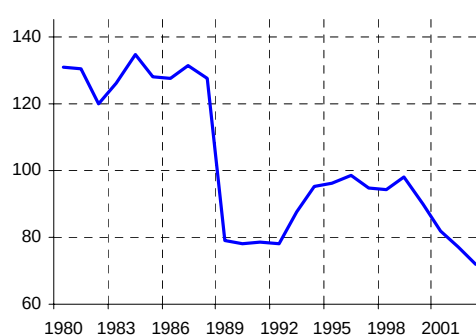
USA/France



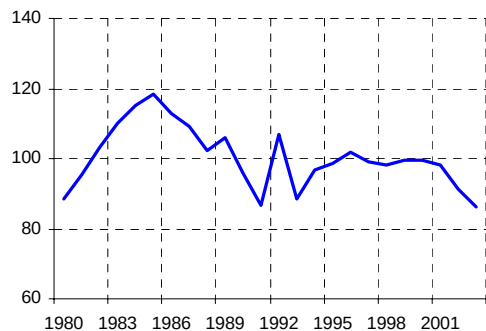
Germany/US



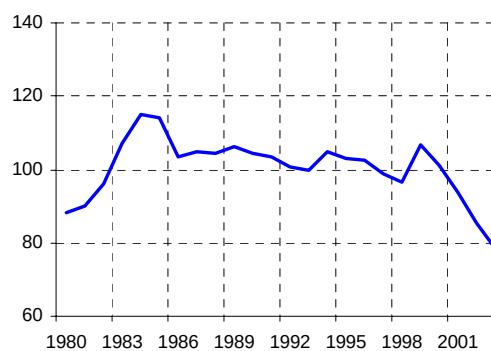
USA/Canada

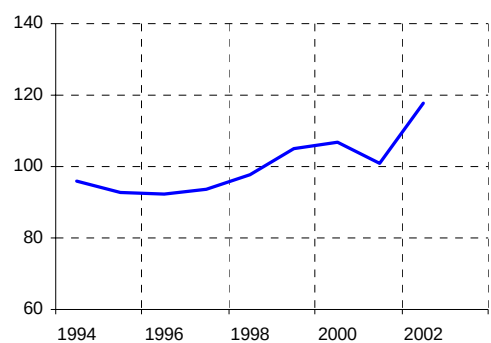
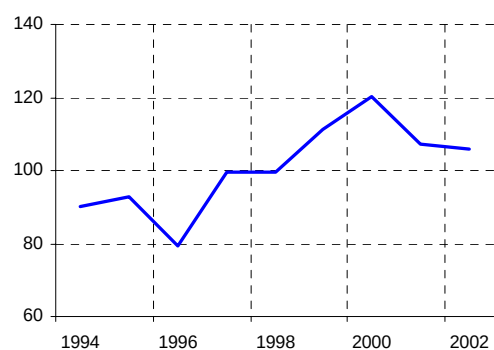
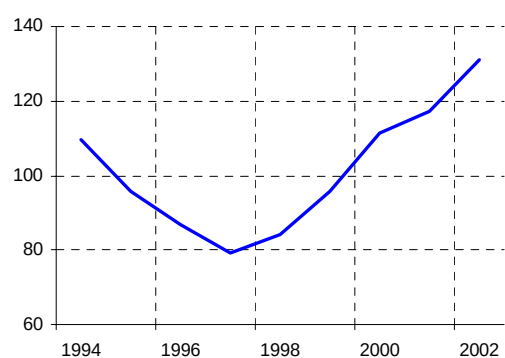
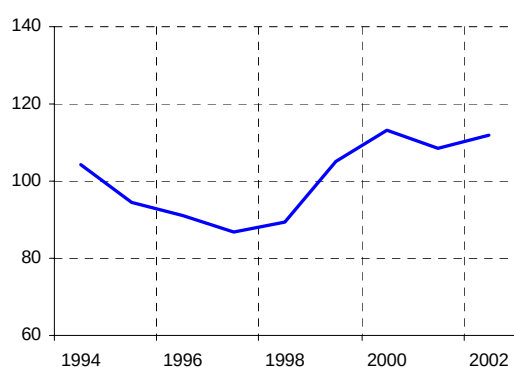
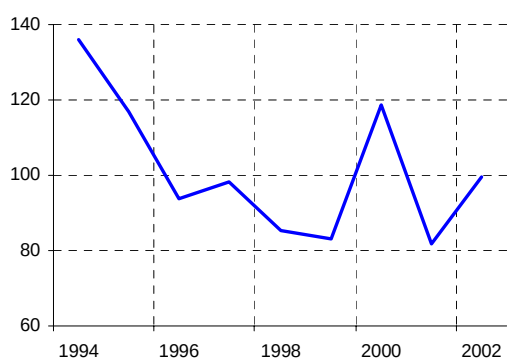
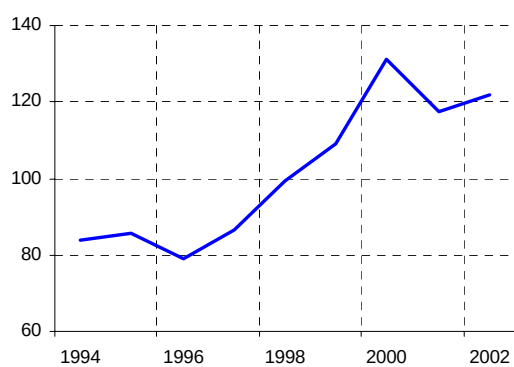
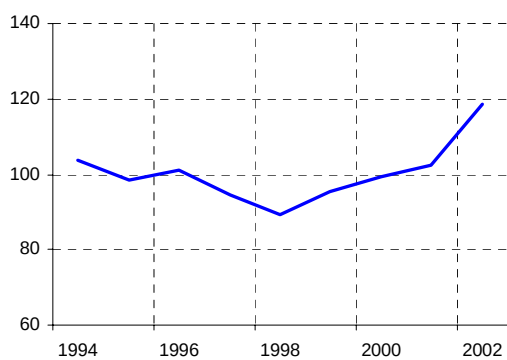
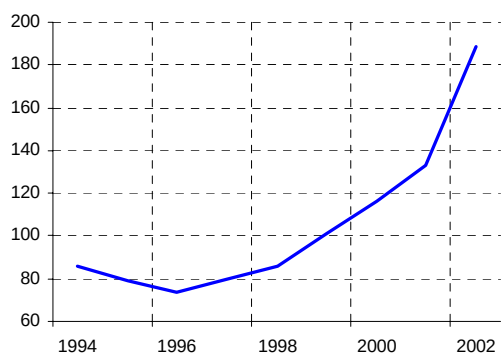


Germany/UK

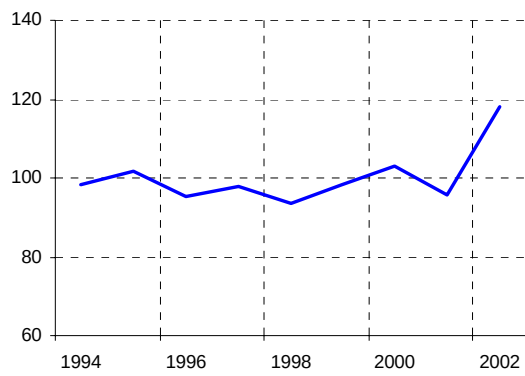


France/UK

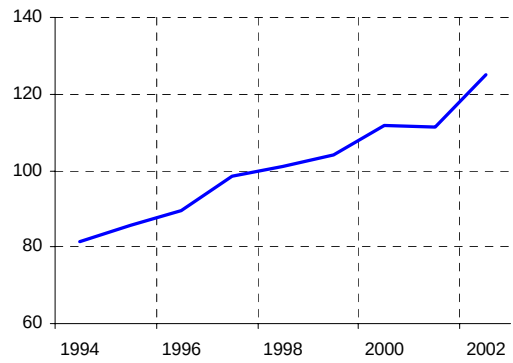


US/China**China/France****China/Germany****China/UK****China/Hong Kong****China/Indonesia****China/Japan****China/Malaysia**

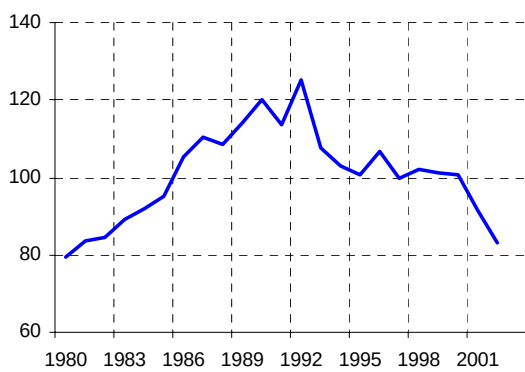
China/Singapore



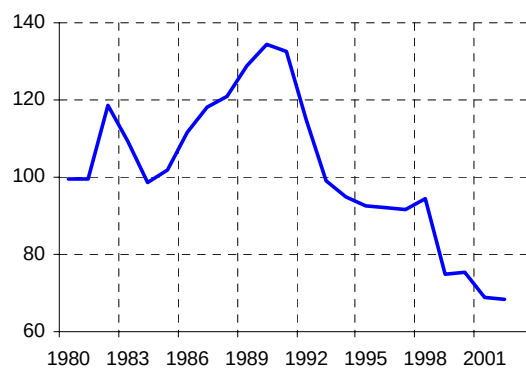
China/South Korea



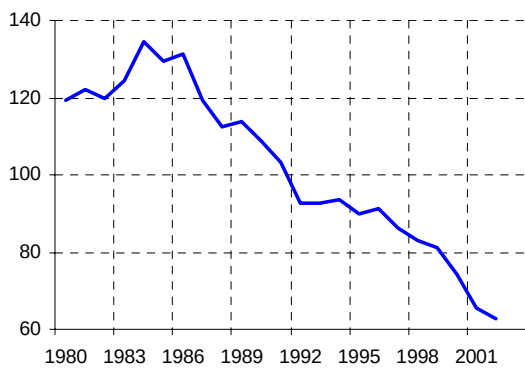
Germany/Japan



France/Japan



Japan/USA



Germany/Slovak Rep.

