Exchange rates, Shocks and Inter-Dependency in East Asia: Lessons from a Multinational Model

Sophie Saglio (CEPN-CNRS, University Paris Nord), Yonghyup Oh (KIEP) and Jacques Mazier (CEPN-CNRS, University Paris Nord)

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Abstract

This paper presents a simple macroeconomic model of international interdependency describing Korea, Japan, China, and the rest of East Asia in their relations with the United States and the rest of the world. The model includes both a foreign trade block and an internal demand block analysing demand formation and the price-wage-employment adjustment process. Exchange rates are fixed but can be manipulated exogenously. The main features of the East Asian trade structures are integrated into the model, and foreign trade price elasticities are higher for Korea and China and smaller for Japan.

The model also analyses East Asian interdependency using symmetric and asymmetric shocks. We found that China would be the most affected by a slowdown in the US economy and Japan the least, that a global slowdown would influence Korea the most and Japan the least, and that a devaluation of the dollar would have a stronger negative impact on Korea and China and less so on Japan. On the whole, Japan appears to be less influenced by external shocks.

Facing an asymmetric negative demand shock, China, and to a lesser extent, Korea, would be more reactive than Japan due to larger trade openness and higher foreign trade price elasticity. Japan would experience a longer period of lower growth and deflation, which could be connected to the stagnation of the Japanese economy that began in the 1990s.

These findings may be able to provide valuable lessons regarding the future of an exchange rate regime in East Asia. A revaluation of the yuan would induce a deflationist trend in China and would have clearly a negative impact on growth. This pleads in favour of a progressive revaluation policy. A revaluation of the won would also take its toll on Korean growth with little impact on the other Asian countries. The Japanese economy would be less affected by a revaluation of the yen, but the effects of the resulting recession would be more enduring. This impact of the yen revaluation can also be related to the aforementioned Japanese stagnation.

In terms of the creation of an area of stabilised exchange rates between won, yen and other currencies, a set of simulations comparing adjustment mechanisms between East Asian countries, with or without the possibility of monetary adjustment, plainly shows the cost of renunciation to exchange rate adjustment. This pleads for a sufficiently flexible regime that stabilises exchange rates but permits limited monetary adjustments in cases of necessity.

JEL classification: C53, F15, F17, F42
Keywords: multinational model, East Asian interdependency, exchange rates, asymmetric shocks

1 sophsag@yahoo.fr; yho@kiep.go.kr; mazier@seg.univ-paris13.fr
1. Introduction

Economic and financial integration has been rapidly increasing in East Asia since the settlement of a new division of labour between the East Asian countries and the role played by FDI in the 1980s. It is in this context that China came to occupy a key position. The Asian financial crisis of 1997 and 1998 revealed this strong regional interdependency, both real and financial. In spite of its centrality, China was able to escape the crisis, thanks to an absence of financial liberalisation, a strong control of capital movements, and its largely undervalued currency. Since the recovery of the late 1990s, the factors of interdependency in East Asia have been reinforced with a strengthening of China’s central position. The way in which China has surfaced to the world economy as an important player presents some similarities to the strategy followed by most of the newly industrialised countries in Asia in the 1970s and the 1980s. China is both a large exporter and a large importer in global trade, and a significant part of its foreign trade forms a triangle with the United States and other countries in East Asia, importing from other parts of Asia and re-exporting to the United States. Its currency is largely undervalued, which boosts its exports and gives large profits to the export sector. But the specificity of the Chinese strategy is the scale at which it operates and this has never been observed in the past.

The future of East Asian integration is usually studied in three directions. Firstly, implications for regional partners of a deeper integration through the implementation of Free Trade Agreements removing both tariff and non-tariff barriers are analysed with the help of multinational general equilibrium models. Regional impacts appear unequal and call for new forms of regional arrangements (Chirathivat 2004). Secondly, the consequences of FDI on regional integration and vertical intra-industry trade are studied extensively at the micro and sectoral levels (Ando and Kimura 2003; Fukao et al. 2003; Gaulier et al. 2005). Lastly, prospects for regional monetary integration in East Asia are outlined with different possible exchange rate regimes: a common basket of key currencies used as an external anchor, a yen bloc, or the creation of an Asian Currency Unit (Williamson 1998; Kim and Ryou 2001; Kwan 2001; Mundell 2003; Aminian 2004).

However, these studies do not give a precise evaluation of regional adjustments prevailing at the macro-level. How does a national economy react to a specific shock (asymmetric), how does this shock diffuse to other countries, how does an external shock (symmetric) affect the various economies, and what are the main differences which appear between the Asian countries? In which respect is China playing a specific role?

The actual configuration of the exchange rates in East Asia and the incertitude concerning the future of an exchange rate regime in this area are other reasons to analyse this interdependency in more detail. The yuan is clearly undervalued while the yen and, to a lesser extent, the won are in an asymmetric position: undervalued with respect to the dollar and overvalued regarding most of the Asian currencies (Jeong and Mazier 2003a and 2004b; Coudert and Couharde 2005). Lastly, the dollar is under pressure facing the huge US account deficit. The impact of a revaluation of the yuan or a devaluation of the dollar has to be estimated at the level of East Asia. In the same way, the viability of an exchange rate regime based on more stable exchange rates between some Asian countries (yen, won, and others) can be analysed looking how these countries can adjust in a fixed exchange rate regime facing symmetric or asymmetric shocks.
These questions will be examined in this paper using the same methodology as the one used to study adjustments inside the European Union (Mazier and Saglio 2004). This study underlines the importance of asymmetric adjustments and the inefficiency of relative price adjustments in a monetary union, which could partly explain the blocking factors observed since the 1990s in the EU. A simple macroeconomic model of international interdependency will be used, describing Korea, Japan, China and the rest of East Asia in their relations with the United States and the rest of the world.

The paper is organized as follows. Section 2 presents data on the interdependency of East Asian countries, their degree of trade openness and the evolution of their price competitiveness. Section 3 illustrates the structure and main characteristics of the model used. Econometric results are given in the annex. Section 4 presents results of simulations with asymmetric or symmetric shocks which will allow us to draw some lessons on East Asian interdependency and an optimal exchange rate regime. Section 5 concludes.

2. Trade openness and real effective exchange rates in East Asia

Without analysing East Asian regional integration completely, we focus on global indicators describing the relative importance of intra- and extra-Asian trade and the trade openness of each country. East Asia regroups into ASEAN + 3 (Korea, Japan, China) + Taiwan. The indicator of trade openness relates the share of intra (extra) trade of the GDP with special treatment for trade with the United States.

Figure 1: Trade openness
Exports: X-intra/GDP, X-extra/GDP, X-US/GDP, X-total/GDP
Korea
Imports: M-intra/GDP, M-extra/GDP, M-US/GDP, M-total/GDP

Korea

Japan

China
The second indicator relates the share of intra (extra) trade in the total trade. More detailed figures on imports and exports are given in the annex.

Figure 2: The share of intra- and extra-East Asian trade
\((X+M)_{\text{intra}}/(X+M)_{\text{total}}, (X+M)_{\text{extra}}/(X+M)_{\text{total}}\)

Korea
Further decompositions of the trade balance by area (intra, extra and US) is given in the annex.

The total degree of openness varies from one country to another. This figure has been around 25 to 30% since the 1970s in Korea, and is only 10% in Japan in spite of an increase in imports in the 1990s. China’s openness has rapidly increased since the end of the 1980s and is now around 20 to 25%. The rest of Asia is more open and the degree of openness has risen progressively to reach 35 to 40% of GDP.

On the whole, the share of intra-East Asian trade in the total trade has been increasing since the 1980s. In 2002 it represented 50% in Korea, and around 45% in Japan and in the rest of East Asia. On the contrary, in spite of a complete change regarding China’s trade openness, its share of intra-East Asian trade has remained stable around 40% since the 1970s, with even an increasing trend of the share of extra-East Asian trade during the 1990s. In the rest of East Asia, the share of intra-East Asian trade has risen slowly but was still around 40% at the beginning of the 2000s. The US market plays different roles in different economies. During the 1990s, exports to the United States represented around 8% of the GDP in Korea and China, but only 3% in Japan and in the rest of East Asia.

Though intra-East Asian trade has been increasing since the 1980s, extra-East Asian trade continues to be essential to the realisation of a large trade surplus in all the East Asian countries. China is the only country with a deficit in intra-East Asian trade (around 2% of GDP in the second half of the 1990s). More so than the other nations, China imports with the intent to re-export.

Lastly, real effective exchange rates (REER), measured with the GDP price indexes, give basic determinants of price competitiveness. This can be defined for all partners or reduced to intra- or extra-East Asian trade (Figure 3).

Figure 3: Real effective exchange rates (REER)
Ep*/p; p= GDP price index, p*= GDP price index of partners (whole partners, intra-East Asian or extra-East Asian partners)
Significant differences appear between intra- and extra-East Asian REER in the case of Korea. Extra-East Asian REER has been appreciating considerably since the 1970s, while intra-East Asian REER has been more stable. The crisis of 1997-98 was followed by a large real...
depreciation, partly offset after. The real revaluation of the yen is more general in a long run, with cyclical evolutions since the middle of the 1980s.

At the opposite end, the Chinese yuan had been progressively depreciating in real terms until 1994, and after 1994, the real appreciation has been more pronounced in intra-East Asian trade.

Lastly, the configuration of REER of the rest of East Asia is the opposite of Korea. Real depreciation is stronger in intra-East Asian trade and more limited in extra-East Asian trade, except after the Asian crisis where real adjustment has been marked.

3. A macroeconomic model for East Asian economic integration

East Asian economic integration can be studied with the help of a simplified multiregional model describing the interdependencies between areas in East Asia and, for each area, of an aggregate model of internal demand. We consider in this first version of the work three countries, South Korea, China and Japan. It would be interesting to consider four areas in the second version: the three previous countries - South Korea, China and Japan - and the rest of East Asia, including Indonesia, Thailand, the Philippines and Malaysia.

3.1. Foreign Trade

We divide the world into six areas. The East Asian zone is divided in four areas: South Korea, China, Japan, and the rest of East Asia, but only Korea, China, and Japan are interdependent at this stage of the work. The rest is the United States and the rest of the world less the United States (the latter henceforth denoted as the rest of the world).

Foreign trade is modelled only for Korea, China and Japan. Foreign demand is studied exhaustively with the help of export and import equations distinguishing between intra-East Asian and extra-East Asian trade and comprising competitiveness/price effects as well as demand ones. For extra-East Asian trade, we distinguish between the United States and the rest of the world. Foreign trade prices are modelled in a simple way with the help of mark-up behaviours.

In an ideal case, the study of Asian regional foreign trade would utilize bilateral exports and imports both in value and in volume. The problem is that bilateral trade exists only in value and not in volume in the CHELEM data bank. Due to this lack of information, we make the hypothesis that there is no price differentiation in exports and that prices are the same for intra- and extra-East Asian exports. This hypothesis induces a bias difficult to estimate.

For each Asian country, we estimate three export equations (exports to the East Asian zone, exports to the United States, and exports to the rest of the world) and three import equations (imports from the East Asian zone, imports from the United States, and imports from the rest of the world). Following the hypothesis made, we estimate one export price equation. The econometric estimates are made on manufactured goods.

For that, we need to calculate nine indicators: three import prices (import prices from the East Asian zone, import prices from the United States, and import prices from the rest of the world), three competitor export prices (export prices of competitors in the East Asian zone
market, in the United States market, and in the world market less the United States). And to finish, we need to calculate three demands in volume (demand from the East Asian zone, from the United States, and from the rest of the world).

Following the hypothesis made, export prices to the rest of East Asia, to the United States, and to the rest of the world, are global export prices.

The data used comes from:
- the CHELEM data bank (bilateral trade in value),
- the OECD Economic Outlook,
- the IMF data bank.

Insert n°1: Long-term relations between trade blocks

Exports of manufactured goods to the East Asian zone (XI)
\[
\log(XI) = x_{11}\log(DEI) + x_{12}\log(PXCI/PX) \text{ (estimated)}
\]
with DEI = demand from the East Asian zone addressed to the country, PX = export prices of manufactured goods, PXCI = competitor export prices in the East Asian market.

Exports of manufactured goods to the United States (XE1)
\[
\log(XE1) = x_{11}\log(DEE1) + x_{12}\log(PXCE1/PX) \text{ (estimated)}
\]
with DEE1 = demand from the United States addressed to the country, PX = export prices of manufactured goods, PXCE1 = competitor export prices in the US market.

Exports of manufactured goods to the rest of the world (XE2)
\[
\log(XE2) = x_{21}\log(DEE2) + x_{22}\log(PXCE2/PX) \text{ (estimated)}
\]
with DEE2 = demand from the rest of the world addressed to the country, PX = export prices of manufactured goods, PXCE2 = competitor export prices in the rest-of-the-world market.

Imports of manufactured goods from the East Asian zone (MI)
\[
\log(MI) = m_{11}\log(DI) + m_{12}\log(PMI/P) \text{ (estimated)}
\]
with PMI = price of intra-East Asian imports of manufactured goods; DI = domestic demand or final demand; P = domestic price (GDP price or product price).

Imports of manufactured goods from the United States (ME1)
\[
\log(ME1) = m_{11}\log(DI) + m_{12}\log(PME1/P) \text{ (estimated)}
\]
with PME1 = price of imports of manufactured goods from the United States; DI = domestic demand or final demand; P = domestic price (GSP price or product price).

Imports of manufactured goods from the rest of the world (ME2)
\[
\log(ME2) = m_{21}\log(DI) + m_{22}\log(PME2/P) \text{ (estimated)}
\]
with PME2 = price of imports of manufactured goods from the rest of the world; DI = domestic demand or final demand; P = domestic price (GDP price or product price).

Imports prices of manufactured goods (PMM)
\[
\log(PMM) = \phi \log(PMI) + \phi_1\log(PME1) + (1 - \phi - \phi_1) \log(PME2) \text{ (calculated)}
\]
with \(\phi\) = share of imports coming from the East Asian zone in total imports;
\(\phi_1\) = share of imports coming from the United States in total imports.
Export prices (PX)

\[
\log(PX) = pxi1.\log(P) + (1-pxi1).\log(PXCI) + pxi2.\text{trend (estimated)}
\]

\[
\log(PX) = pxe11.\log(P) + (-1-pxe11).\log(PXCE1) + pxe12.\text{trend (estimated)}
\]

\[
\log(PX) = pxe21.\log(P) + (1-pxe21).\log(PXCE2) + pxe22.\text{trend (estimated)}
\]

Intra-East Asian import prices of area \(i\)

\[
\log(\text{PMI}_i) = \sum_j [(\text{VMI}_{ij}/\text{VMI}_i)*\log((\text{ITX}_j/\text{ITX}_i).\text{PX}_{ji})] \] (calculated)

Area \(i\) is one of the four East Asian areas. The areas \(j\) are the other three East Asian areas. \(\text{ITX}_i\) is the exchange rate index of area \(i\) (on a yearly basis). \(\text{ITX}_j\) is the exchange rate index of areas \(j\) (on a yearly basis). \(\text{VMI}_i = \text{value of imports from the East Asian zone, } \text{PX}_{ji} = \text{price of exports from } j \text{ to } i = PX_j \text{ (due to lack of information)}\).

The export prices of competitors in the East Asian market

\[
\log(\text{PXCI}_i) = \sum [ (\text{VX}_{ij}/\text{VX}_i)*(\Sigma(\text{VX}_{kj}/\text{VM}_j)*\log((\text{ITX}_k/\text{ITX}_i).\text{PX}_{kj}) )] \] (calculated)

The area \(j\) represents the other three East Asian areas, \(k\) the other East Asian areas, \(\text{VX}_{ij}\) exports from \(i\) to \(j\), \(\text{VM}_i = \text{global imports of } j\).

Export prices of competitors in the United States market

\[
\log(\text{PXCE1}_i) = \Sigma (\text{VX}_{k-us}/\text{VM}_{us})*\log((\text{ITX}_k/\text{ITX}_i).\text{PX}_{k-us}) \] (calculated)

The area \(j\) represents the other three East Asian areas, \(k\) the other East Asian areas, \(\text{VX}_{k-us}\) exports from \(k\) to the United States in value, \(\text{VM}_{us}\) = American global imports in value.

The export prices of competitors in the rest-of-the-world market

\[
\log(\text{PXCE2}_i) = \Sigma [ (\text{VX}_{ih}/\text{VXE}_i)* (\Sigma(\text{VX}_{kh}/\text{VM}_h)*\log((\text{ITX}_k/\text{ITX}_i).\text{PX}_{kh}) )] \] (calculated)

The variable \(k\) represents the other three East Asian areas, \(h\) the United States, \(\text{VX}_{ih}\) exports from \(k\) to \(h\), \(\text{VM}_h = \text{global imports of } h\) in value.

Intra-East Asian demand of area \(i\)

\[
\text{DEI}_i = \Sigma [\text{VX}_{ij}/\text{VM}_j]*\text{M}_j \] (calculated)

\(M\) is global imports of area \(j\), in volume. The variable \(j\) represents the other three East Asian areas.

Domestic demand (DI)

\[
\text{DI} = \text{Cons} + \text{Exo} \quad (\text{Exo} \text{ is the rest of internal demand and is exogenous})
\]

Equilibrium of goods and services

\[
Y = DI + XI + XE - \text{MI} - ME + SO
\]

with \(Y = \text{GDP}\) and \(SO = \text{trade balance of non-manufactured goods (exports and imports of non-manufactured will be exogenous)}\).

The interdependencies between the four East Asian areas are taken into account in the calculations of the intra-East Asian import prices (PMI), the export prices of competitors in
the East Asian market (PXCI), in the US market (PXCE1), and in the rest of the world market (PXCE2), and intra-East Asian demand (DEI). The calculations of these five indicators must be integrated in the simulation’s program. (The insert n°2 gives the details of these calculations.)

3.2 The model of internal demand

For each country, an aggregate model focuses on the adjustment mechanisms of the labour market. Each national model simultaneously integrates wage and relative price flexibility, which allows real exchange rate adjustments, as well as external flexibility which emphasizes the institutional aspects of labour contracts (employment adjustment and activity rates flexing). It also includes closure by demand. Domestic demand has not been subject to detailed modelling so as not to make the model more complex. The traditional consumption function has been retained (consumption depends on real disposable income, the inflation rate and the unemployment rate in the short term, and a total indexation to real disposable income in the long term.)

Equations take the shape of an error-correction model which allows the simultaneous taking into account of short-term dynamics and a long-term target. Long-term relations are analysed in the following insert n°2. In the short run, supplementary variables will appear, such as the rate of utilisation of production capacities in the GDP price equation.

Insert n°2: Long term relations of internal demand

Per capita real wage rate (w/pc)
\[
\log (w/pc) = \log (Q/N) + a_1 U + a_2 \text{ (estimated)}
\]
with \(Q/N\) = labour productivity, \(U\) = unemployment rate \((a_1 < 0)\), \(w\) = per capita gross wage

GDP deflator \((p)\) (estimated)
\[
\log p = \log w - \log (Q/N)
\]

Consumer prices \((pc)\) (not estimated)
\[
\log pc = \mu \log pmbs + (1 - \mu) \log p
\]
with \(pmbs\) = import prices of good and services, \(\mu\) = import share of the GDP

\[
\log pmbs = \alpha \log pmm, \text{ (non estimated)}
\]
with \(pmm\) = import prices of manufactured goods

Labour productivity \((Q/N)\) (estimated)
\[
\log (Q/N) = a + b t \text{ (t = time trend)}
\]

Active population \((PA)\) (estimated)
\[
\log PA = (1-b_1) \log PAT + b_1 \log N
\]
with \(PAT\) = working age population \((15-64)\), \(N\) = employment
\[
U = (PA - N) / PA
\]

Demand side
Consumption \((Cons)\)
\[
\log(Cons) = \log (RD/ pc) \text{ (estimated)}
\]
with \(RD/ pc\) = real household disposable income
RD = MSc + AR
With MSc = corrected total wages = wn*N
With wn = wage rate = w/ts, where ts is the social contributions rate.

3.3 Adjustment representative parameters

It is possible to give a synthetic view of adjustment mechanisms prevailing in the model which cover mainly income and price effects. Trade openness and trade structures were given in the first part. We will focus on relative price adjustments related to the labour market and foreign trade with some representative parameters coming from the econometric estimations. In Annex 3, the results are given in more detail.

Representative parameters of the labour market

The price-wage loop is studied using three equations: a wage equation describing the sensitivity of wages to tensions in the labour market, an equation linking GDP price to unit wage costs and an equation linking consumption prices to GDP and import prices. This last equation is not estimated, as it is only a semi-accounting equation. Equations regarding the labour market were estimated for Korea and Japan. Figures for China come from Brillet (2000). In the future work, it would be interesting to re-estimate the internal block of china, particularly the labour market, to have more recent estimates (Table 1).

Concerning the wage curve, nominal rigidities in the short term are stronger in Japan than in Korea. Even if the force to revert to its long term level in the wage equation is more significant in Japan, real rigidities in the short term remain slightly higher. They are also higher in the medium to long term in Japan than in Korea (and China), and there is no unit indexation of labour productivity to real wages in the medium to long term in Japan. Korea should therefore be more reactive when facing shocks, particularly supply shocks.

While nominal rigidities in the short term in the GDP price equations are bigger in China than in Korea and Japan, the force to revert to its long term level is higher in China.

Consumption prices are more dependent on import prices in Korea and China than in Japan, as these countries are more open, if we take into account the share of total imports in GDP (26% in Korea and China, 10% in Japan).

Labour market external flexibility is studied through two equations which emphasize the institutional aspects of labour contracts. The employment equation is used to calculate the duration of employment adjustment and the labour force (active population) equation gives the flexibility of the activity rate. The duration of employment adjustment is short in China and long in Japan. It is rather well established that Japan’s pattern is not characterized by strong labour market external flexibility. However, the activity rate flexibility is important and is close to China’s rate (0.76 and 0.80, respectively).

The labour market is less flexible in Japan than in Korea and China, with stronger nominal and real rigidities and weaker external flexibility. Nevertheless, labour market flexibility in

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2 Wage equation specifications are a little different for China.
3 This parameter has been imposed. It was not estimated by Brillet (2000).
China may be overestimated, at least in some labour market segments. More recent estimates would be useful for this country.

Table 1: Main representative parameters of the labour market

Korea and Japan (1976-2003); China (1980-1998)

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<th>Korea</th>
<th>Japan</th>
<th>China</th>
<th>Korea</th>
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<th>China</th>
<th>Korea</th>
<th>Japan</th>
<th>China</th>
</tr>
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<tbody>
<tr>
<td>Sensitivity of real wages to unemployment in the medium term</td>
<td>-0.0552</td>
<td>-0.0396</td>
<td>-0.0227</td>
<td>1.16</td>
<td>0.59</td>
<td>1.00</td>
<td>0.63</td>
<td>0.70</td>
<td>0.26</td>
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<tr>
<td>Indexation of wages to prices in the short term</td>
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<tr>
<td>Price elasticity to unit wage costs in the short term</td>
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Employment adjustment duration (number of years)                |       |       |       |       |       |       |       |       |       |
| Flexibility of the activity rate                               |       |       |       |       |       |       |       |       |       |

Source: Korea, Japan, author’s estimates; China, Brillet (2000)

Representative parameters of foreign trade

Foreign trade equations have been estimated for Korea, China, Japan and the rest of East Asia, but only estimations for Korea, China and Japan are used at this stage. Unsurprisingly, China’s export price elasticities are higher, both in the short and medium term, than those of Korea and especially Japan. Nevertheless, price elasticities on the US market are stronger for Japan than for Korea (both in the short and medium term), but are very weak on the intra-Asian market due to the intra-firm type of trade that occurs. Import price elasticities are in most cases weak and even non-significant, thanks also to the strong division of labour in East Asia. But there are two exceptions to this: Korean imports of manufactured goods from the rest of the world and Chinese imports of manufactured goods from East Asian markets.

Concerning our export price equations, Japan is the price maker for all the markets while Korea and China, are price takers for all the markets. For China, we have imposed a coefficient equal to 0.2 for GDP prices in this equation, but in fact, this coefficient is equal to zero, which means that exports prices are completely aligned to foreign prices.

Table 2: Foreign trade price elasticities

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<tr>
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<th>Sum of price elasticities in the medium term</th>
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Source: Authors' estimates.
4. Symmetric and asymmetric shocks and interdependency in East Asia

There are several different kinds of shocks to consider:  

-symmetric shocks which affect all the countries in the same way; we shall examine external shocks like a slowdown in US demand, a slowdown in rest-of-the-world demand, a devaluation of the dollar against all the other currencies; supply shocks on world prices could also be analysed;

-asymmetric shocks which concern only one country; we shall consider demand shocks like a slowdown in China, Korea, or Japan to appreciate the reactive capacities of each country and diffusion to other economies; supply shocks on wages are also examined;

-some aspects of the future of an exchange rate regime in East Asia are analysed separately through specific asymmetric shocks like a revaluation of the yuan, the won, or the yen. It is also possible to compare adjustment mechanisms in fixed exchange rate regimes with those prevailing in a regime where exchange rate adjustments are feasible.

The results of these simulations will be presented with the help of graphics, which will represent relative deviations with regard to a central account in percentages; to be more precise, the relative deviations are calculated as \((X_s - X_r)/X_r \times 100\) for all dates, where \(X_s\) is the value of \(X\) after a shock and \(X_r\) the \(X\) value of the central account.

4.1 External symmetric shocks

Three shocks will be analysed: a slowdown in US demand, a slowdown in rest-of-the-world demand, and a devaluation of the dollar against the other currencies.

A slowdown in US demand

Predictably, a slowdown in US demand (a 10% decrease in total US imports) has a negative effect on growth in all the Asian countries. Unemployment rises and wages and prices decrease. China, the most dependent on the US market, is the most affected (a 1.4% decrease in GDP), with a 2% compression of prices. The Chinese trade balance also deteriorates (a 1% decrease in GDP). The Japanese economy, which is less dependent on the US market, is less affected (a 0.4% decrease in GDP) (Figure 4).

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4 Simulations are made over a long enough period (15 years) so as to let adjustments operate. Simulations for ever longer periods have been made to be sure that long-term stabilisation does well occur. They are not presented in this article. When it comes to interpretation, one should not forget that some equations merely extend simple short-term mechanisms over medium- and long-term periods, without taking into account longer term factors such as the effects of capital accumulation.
Figure 4: Impact of a slowdown of the US demand (a 10% decrease in US imports)
A slowdown of the rest-of-the-world demand

A slowdown of the rest-of-the-world demand (a 10% decrease in world imports, excluding the United States) has a similar impact. Because the initial shock would be stronger and because Korea is more dependent on the rest of the world, Korea is now more affected (a 2% decrease in GDP). With a slowdown, Korean prices would decrease sharply, which helps in the long term to improve the trade balance at the expense of the other Asian countries. As in the previous shock, Japan, more independent, is less affected (Figure 5).

Figure 5: Impact of a slowdown of the rest of the world demand (a 10% decrease in total imports)
Devaluation of the dollar

A devaluation of the dollar by 20% against all the currencies would have a strong negative impact on Asian growth due to the loss of price competitiveness. Korea, more open and with higher price elasticities, is the most affected (a 5% decrease in GDP), followed by China (a 3.5% decrease in GDP). As before, Korean prices decrease strongly with both the revaluation of the won and the deflationist effect of the slowdown. This helps to improve the Korean trade balance after the initial deterioration (nearly a 3% decrease in GDP for extra-Asian markets) at the expense of the other partners. In the US market, China loses more market shares and is more persistently affected (Figure 6). Japan is less affected in the short and medium term. In that sense, the resistance of the Japanese government to accept an appreciation of the yen with respect to the dollar may seem exaggerated.

Figure 6: Impact of a devaluation of the dollar by 20%
4.2 Asymmetric shocks

We will now consider asymmetric shocks, which affect only one country. The shock will have the same amplitude in each country, and we will examine the unequal reactive capacities of each country separately. The diffusion effects in the other countries, initially not affected by the shock, are not presented in the graphics, but are given in Annex 4. Two kinds of shocks will be analysed, demand shocks with a negative asymmetric shock on consumption or on external market shares and supply shocks with an increase of per capita nominal wage.

Asymmetric demand shocks

**Negative shock on internal demand**

We consider first a negative shock on internal demand equivalent to a -1% change in GDP, due to a fall in consumption or a reduction in public expenditure. The impact and the adjustment mechanisms are the same in all countries but the amplitude differs significantly. Production decreases in the short term, unemployment rises, wages and prices fall. This allows a progressive recovery, thanks to the improvement of price competitiveness. China, and to a lesser extent, Korea, are more reactive due to higher trade openness and rather high foreign trade price elasticity. However it is only in the medium to long term that the initial shock is offset, which confirms the limited efficiency of price-wage mechanisms to compensate for a negative demand shock.

At the opposite end, Japan appears more enduringly affected and less reactive than the other countries. Japanese production remains weaker (-0.6% in the long term) while price deflation is reinforced (-1.5%). This can be explained by greater employment rigidity, but mainly by the smaller degree of trade openness and the weaker foreign trade price elasticities which make the wage-price adjustment mechanisms rather inefficient and very costly in terms of growth. This scenario can partly explain the stagnation and the deflation in which the Japanese economy has existed since the 1990s, in clear contrast to China and Korea (Figure 7).

The diffusion effects in other East Asian countries are given in Annex 4. A negative shock in China has a significant short-term impact on Korea (a -0.15% change in GDP), but less in Japan. The negative shock in Japan affects both China and Korea in the short term (-0.16%
for GDP, but China experiences more lasting effects. The deflationist effect on prices is also noticeable (around -0.2%).

Figure 7: Impact of a negative shock on internal demand (consumption or public expenditures) equivalent to a 1% decrease in GDP
Negative shock on external market shares

We will now consider a negative shock of -10% on external market shares on each market due to a loss in competitiveness. It induces a decrease in GDP, a rise in unemployment and a fall in wages and prices. In the medium term this improvement of price competitiveness enables stabilisation or a partial recovery. But the adjustment mechanism through wages and prices is once again very slow and inefficient (Figure 8). The slowdown is more pronounced and long-lasting than in the case of a negative internal demand shock.

As before, there are important differences between countries. Japan is less influenced (a 1.5% decrease in GDP) in the medium term thanks to its smaller trade openness but the decline continues for longer as the pressure on prices is more limited and less efficient. Korea and China are more affected (a 4.5% and 3.5% decrease in GDP in the medium term, respectively) with a substantial fall in prices in Korea, which enables only a partial recovery through price competitiveness gains.

Figure 8: Impact of a negative shock on external market shares (-10% for each market)
Asymmetric supply shocks

A 10% shock on per capita nominal wages in a country induces temporary gains in terms of growth and employment, due to the wage demand push. But inflationary skidding, increased by the price-wage slope, induces in the medium to long term a strong slowdown due to a
degradation in price-competitiveness. Finally, the medium-term negative effects of a wage increase are more important than the short-term positive effects (Figure 9).

Beyond this general pattern, there exist important asymmetric trends among the East Asian countries. In Korea, we don’t observe temporary gains in terms of growth in the short term due to the high degree of trade openness. The impact on GDP is negative even in the short term (-0.5% after two years and -2.5% in the medium term). But in China, the positive short-term effects are substantial (+1.5% after one year). This is offset after six years by a 1% decrease. Japan doesn’t exhibit any negative effects on GDP because its degree of trade openness is weaker, but the positive effect on GDP, 0.5% after one year, is very small and slowly decreases.

The diffusion effects on other East Asian countries are given in Annex 4. They are positive but rather limited, around 0.3% of GDP in the short term for a wage increase of 10% in China or in Japan.

-Figure 9: Impact of a positive 10% shock on gross wage
4.3. A contribution to the analysis of East Asian exchange rate regimes

The future of exchange rate regimes for East Asia can be partly analysed with the help of this simple multinational model, although it is purely real. We first study impacts of asymmetric shocks to the exchange rate which affect only one country, such as a revaluation of the yuan, the won, or the yen. The shock has the same amplitude in each country and we examine the unequal impact of exchange rate adjustments in each country separately. The diffusion effects on other countries, initially not affected by the shock, are also presented. Instead of simple bilateral adjustment against the dollar, intra-East Asian monetary adjustment can be considered in a second step, especially to analyse the consequences of a revaluation of the yuan against the other East Asian currencies.

Lastly the efficiency of a devaluation to face a negative demand shock can be compared with a fixed exchange rate regime where only the mechanisms of relative prices adjustment are at work and which was examined in the previous section. In that sense it would be possible to have a rough estimation of the cost of a fixed exchange rate regime between East Asian currencies in contrast to a more flexible regime where bilateral monetary adjustments are still feasible.

Bilateral monetary adjustment against the dollar

*A revaluation of the yuan by 20%*

The revaluation of the yuan is a subject that has been highly debated for many years, as many studies have concluded that the yuan is significantly undervalued. The consequences of a 20% revaluation are straightforward. Predictably, its impact on China would be clearly negative. GDP would be strongly reduced (-5% in the medium term, compared to the initial trend) and a deflationary process would begin, due both to the revaluation and to the price-wage adjustment in the context of slowdown. The inefficiency of this process is once again confirmed. The trade balance strongly deteriorates in all the markets (more than a 1% decrease in GDP in each of them). Unsurprisingly, it is the US market which is the more sensible, contrary to the intra-Asian market where an improvement of trade performance can be observed (Figure 10). The consequences for the other Asian countries are positive, especially for Korea with an increase in GDP (+0.7% in the medium term, compared to the...
initial trend) and an improvement of the intra-Asian trade balance (+0.3% in the medium term in percent of GDP). Inflationist pressures are however developing moderately in Korea, which contributes to deteriorate the extra-Asian trade balance. The Japanese economy is less affected.

In view of these results, the reluctance of the Chinese government to engage in a revaluation can be understood, especially with the fear of deflation in a context of high indebtedness. At the same time, the fact of the yuan’s undervaluation has been well established since the middle of the 1990s. On the whole, this pleads for a progressive process to revaluate the yuan.

Figure 10: Impact of a yuan revaluation by 20%
A revaluation of the won by 20%

A revaluation of the won by 20% would have a negative impact on Korea with a strong reduction in GDP (-6% in the medium term compared to the initial trend) and with a deterioration of the trade balance on the extra-Asian market (-2% in the short term in percent of GDP) and on the US market (-1%). The efficiency of the deflationary process remains limited. But consequences on the other Asian countries (China and Japan) are weak (Figure 11).

Figure 11: Impact of a won revaluation by 20%
A revaluation of the yen by 20%

The impact of a revaluation of the yen by 20% would be negative on the Japanese economy (more than -2% on GDP), but less than the impact of a revaluation in the case of China or Korea (Figure 12). Japan is less affected thanks to its smaller trade openness and to its weaker foreign trade price elasticities. On the other hand, the deflationary process is moderate and the return to the initial conditions is very slow. The negative effect is more significant on the US market trade balance than on the extra- and intra-Asian markets. Lastly, the diffusion effects are almost insignificant in Korea, but not negligible in China (more than 1% on GDP in the medium term).

Figure 12: Impact of a yen revaluation by 20%
Intra-East Asian monetary adjustment and dollar devaluation

A more complicated scenario can be described combining intra-East Asian monetary adjustment and dollar devaluation. The yen, the won and the rest of the East Asian currencies are revalued by 20% with regard to the dollar while the yuan is revalued by 40% with regard to the dollar. On the whole, East Asian currencies are devalued by 20% with regard to the yuan, but revalued with regard to the dollar. To a certain extent, this scenario reflects the intra-East Asian monetary misalignments that currently prevail, although the magnitude of the adjustments is too significant (Figure 13). The impact of this scenario is clearly negative for China, with a GDP reduction of -8% in the medium term, and to a lesser extent, for Korea (-5%). As before, Japan is less affected (-1.5%) but it should be remembered that Japan’s growth rate has been very slow since the 1990s. Korea is more reactive thanks to wage-price flexibility and to trade openness. China, although also reactive, is more lastingly affected. Its
trade balance deteriorates in all foreign markets (especially in extra-Asian and US markets). These results confirm the necessity of progressive adjustments to resolve present misalignments.

Figure 13: Impact of East Asian currency devaluation by 20% with regard to the yuan and of a dollar devaluation

A fixed versus a more flexible exchange rate regime

From the perspective of the creation of an area where exchange rates would be stabilised, at least between the yen and the won, the mode of adjustment that would prevail in such a zone
can first be analysed using the previous model where the exchange rates are fixed or can be modified exogenously.

The case of negative demand shocks (internal or external) has already been presented in a fixed exchange rate regime. It has been shown that the adjustment through wages, prices and employment facing a negative asymmetric demand shock is painful and rather inefficient (Figures 7 and 8). Furthermore, important asymmetries appear between countries. Korea and China are more reactive while Japan is more durably penalised.

In order to first assess the role played by exchange rate adjustments, the previous shocks in a fixed exchange rate regime can be compared with a scenario where the negative demand shock (a fall in consumption or a loss in external market share) is combined with a devaluation of each relevant currency (yen, won, or yuan).

Asymmetric internal demand shock and devaluation

We simulate an asymmetric shock on consumption or on public expenditures equivalent to a negative 1% of GDP at time 1(T1) followed by a devaluation by 5% of the currency at time 2 (T2) of the considered country. After the recessive effect induced by the negative demand shock, Korea and China manage to compensate for this negative impact in almost one year, thanks to the 5% depreciation of their currencies. The simulation goes on to show a GDP increase of 1% in the medium term (Figures 15 and 16). Their trade balances improve in all the markets. For Korea, the improvement is stronger, particularly for its extra-Asian market. For China, the amelioration of the trade balance is less evident, but its intensity is the same in all markets. The counterpart is, of course, the development of inflationist pressures which, in the long term, will put an end to the recovery movement.

Concerning Japan, the scenario is slightly different. Indeed, after the negative shock, the depreciation of the yen allows a progressive return to initial conditions, but this recovery is much slower than for the two other countries, due to weaker trade openness and to weaker price elasticities. Nevertheless, its trade balance improves in all the markets, particularly in the US market (Figure 14). Above all, even in Japan, the improvement of economic activity is clearly more significant than in the case of fixed exchange rates.

The comparison of a fixed exchange rate regime with a more flexible regime where exchange rates adjustments are possible shows a rather clear-cut conclusion. Facing asymmetric demand shocks, a return to the initial state is slower and more painful when a fixed exchange rate regime prevails. On the contrary, the possible use of monetary adjustments strongly facilitates a return to an initial state.

Figure 14: A negative demand shock in Japan in T1 combined with a yen devaluation in T2
Figure 15: A negative demand shock in Korea in T1 combined with a won devaluation in T2
Loss of external market shares and devaluation

The examination of an external asymmetric shock confirms the previous results. We now consider a 10% loss in external market shares in each market in T1 due to a decline in competitiveness, followed by a 20% devaluation of the currency of the considered country in T2 (Figure 17). The loss of external market shares has a strong negative impact in the short term, especially in Korea and China. The devaluation enables a quick recovery which begins one or two years after the initial negative impact. Trade balances are improved, particularly in extra-Asian markets. The counterpart is, of course, the development of inflation pressures with the devaluation which limits medium-term recovery. Japan is more able to contain medium-term inflation and appears to benefit the most. Inflationist skidding is more marked in Korea and China. However, a comparison with the same external demand shock with fixed exchange rates (Figure 8) shows that a return to an initial state is highly facilitated by devaluation, instead of the painful and inefficient process of wage and price compression, which is the only way to adjust under the scenario of a fixed exchange rate regime.

On the whole, these simulations comparing adjustment mechanisms in a fixed exchange rate regime and a more flexible exchange rate regime, where limited monetary adjustments are authorised, illustrate the costs of the renunciation of any kind of monetary adjustments. Facing asymmetric demand shocks (external or internal), a return to an initial state is slower and more painful when a fixed exchange rate regime prevails among the East Asian countries. On the contrary, the possible use of monetary adjustments (here, devaluation) strongly facilitates a return to an initial state. This pleads for a more flexible regime with stabilised exchange rates, but without forbidding limited monetary adjustments in case of necessity.
Figure 17: Loss of external market shares (-10%) in T1 and devaluation by 20% in T2
5. Conclusion

This paper presents a simple macroeconomic model of international interdependency describing Korea, Japan, China and the rest of East Asia in their relations with the United States and the rest of the world. The model includes both a foreign trade and an internal demand analysing the demand formation and the price-wage-employment adjustment process. The exchange rates are fixed, but can be manipulated exogenously.

The model integrates the main features of East Asian trade structures, the high degree of trade openness in Korea and of the rest of East Asia, the relative closure of Japan and rising openness in China. Intra-Asian trade has increased its share of total trade and accounts for around 45 to 50% in Korea, Japan and rest of East Asia. China stands apart with an increasing share of extra-Asian trade (around 60%). The US market is important for China and Korea (8% of GDP), but less so for Japan and the rest of Asia. Foreign trade price elasticities are higher for Korea and China and smaller for Japan.

East Asian interdependency can be analysed with the help of the model using symmetric or asymmetric shocks. China is the most affected by a slowdown in the US economy while Japan is most preserved. A global slowdown, not including the United States, would have a greater effect on Korea than on Japan. Dollar devaluation has a stronger negative impact on
Korea and on China and less on Japan. On the whole, Japan appears less influenced by external shocks.

Facing an asymmetric negative internal demand shock China, and to a lesser extent, Korea, are the more reactive due to larger trade openness and higher foreign trade price elasticities. On the contrary, Japan appears more rigid and is more durably touched with lower growth and deflation, which can be related to the stagnation of the Japanese economy in the 1990s. However relative prices adjustments appear rather inefficient and painful. They allow only a limited and slow return to an initial state. In the case of a loss of external market shares, the slowdown is even more pronounced and durable than in the case of a negative internal demand shock. Japan, less open, is less touched. A supply shock with a nominal wage increase induces temporary gains in terms of growth but inflationary skidding deteriorates price-competitiveness and leads to a marked slowdown in the medium term. Korea is the most negatively affected by a wage push whereas positive effects are more significant in the short term in China. Japan is less touched.

Some lessons can be drawn from this regarding the future of exchange rate regimes in East Asia. A revaluation of the yuan has a clear negative impact on Chinese growth with a deflationist trend but the diffusion effects, especially for Korea, are favourable. The magnitude of the negative effect on China pleads however in favour of a progressive revaluation policy. A revaluation of the won has also a high cost on Korean growth with little impact on the other Asian countries. The Japanese economy is less affected by a revaluation of the yen, thanks to smaller trade openness and weaker price elasticities, but the recessionist effect is more durable and the positive impact on Chinese economy is not negligible. This impact of a yen revaluation can also be related to the Japanese stagnation of the 1990s. Lastly, a more complex scenario, combining intra-East Asian monetary adjustment with a yuan revaluation and a dollar devaluation, has a negative impact, particularly in China, and less in Japan. This confirms the necessity of progressive adjustments to resolve present misalignments.

From the perspective of the creation of an area of stabilised exchange rates between won, yen and other currencies, a set of simulations comparing adjustment mechanisms between East Asian countries, with or without the possibility of monetary adjustment, plainly shows the cost of renunciation to exchange rate adjustments. In case of asymmetric demand shocks, the return to an initial state is slower and more painful within a fixed exchange rate regime between East Asian countries. On the opposite, the possible use of monetary adjustments strongly facilitates the return to an initial state. This pleads for a sufficiently flexible regime where exchange rates would be stabilised, but without forbidding limited monetary adjustments in cases of necessity.
References

Annex 1: The share of intra and extra trade

Export: Xintra/Xtotal, Xextra/Xtotal, XUS/Xtotal
Import: Mintra/Mtotal, Mextra/Mtotal, MUS/Mtotal

Korea
Rest of east Asia
Decomposition of the trade balance
(X-M)intra/GDP, (X-M)extra/GDP, (X-M)US/GDP, (X-M)total/GDP

Korea

Japan

China
Rest of East Asia
## Annex 2: The calculations of indicators

### The intra-East Asian import prices of area \(i\) (endogenous variable)

The price of intra-East Asian imports of area \(i\) is a geometric mean of global export prices of competitor \(j\), weighted by the structure of imports of zone \(i\).

\[
\log(PMI_i) = \sum_j \left( \frac{VMI_{ij}}{VMI_i} \right) \ast \log\left( \frac{ITX_j}{ITX_i} \right) \ast PX_j
\]

With \(\sum_j \left( \frac{VMI_{ij}}{VMI_i} \right) = 1\). \(VMI = \) imports from the East Asian area in value (intra-East Asian imports in value).

(Normally we would have \(PX_{ji}\) instead of \(PX_j\)).

The area \(i\) is one of the four East Asian areas (South Korea, Japan, China, and the rest of the East Asian zone). The rest of East Asia consists of Indonesia, Malaysia, the Philippines and Thailand.

Area \(j\) is the three other East Asian areas.

\(ITXi\) is the exchange rate index of area \(i\) (on a yearly basis).

\(ITXj\) is the exchange rate index of area \(j\) (on a yearly basis).

### The price of imports from the United States to area \(i\) (exogenous variable)

The price of imports from the United States to area \(i\) is the price of United States exports \((PX_{us})\).

\[
PME1_i = PX_{us} \ast ITX_i
\]

(Normally we would have \(PME1_i = PX_{us-\cdot i} \ast ITX_i\), with \(PX_{us-\cdot i}\) the price of exports from United States to \(i\)).

### The price of imports from the rest of the world to the area \(i\) (exogenous variable)

The price of imports from the rest of the world to the area \(i\) is a geometric mean of the global export prices of competitor \(h\), weighted by the structure of imports of country \(i\).

\[
\log(PME2_i) = \sum_h \left( \frac{VME2_{ih}}{VME2_i} \right) \ast \log\left( \frac{ITX_h}{ITX_i} \right) \ast PX_h
\]

With \(\sum_h \left( \frac{VME2_{ih}}{VME2_i} \right) = 1\). \(VME2 = \) imports from the rest of the world in value.

The countries represented by \(h\) are Australia, Austria, Belgium and Luxembourg, Canada, the Czeck Republic, Denmark, Finland, France, Germany, (Greece), Hungary, Iceland Ireland, Italy, Mexico, the Netherlands, Norway, New Zealand, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, AMF (Africa and the Middle-East area), LAT (the Latin America area), SO (Other Asian countries including non-OECD Oceania, excluding Dynamic Asia and Asian countries who were part of the Soviet Union), and SEE (Central and Eastern Europe and countries who were part of the)
Export prices of competitors in the East Asian market (endogenous variable)

The export price of competitors of area $i$ in the East Asian market is a geometric mean of import prices of competitor $j$, weighted by the share of area $j$ in exports of area $i$.

With the import price of area $j$

$$\log(PXCI) = \sum_j \left( \frac{VX_{ij}}{VXI_i} \right) \left( \Sigma_k \left( \frac{VX_{kj}}{VM_j} \right) \log((ITX_k/ITX_i) \cdot PX_k) \right)$$

with $\Sigma_j(VX_{ij}/VM_j) = 1$, and $\Sigma_j(VX_{ij}/VXI_i) = 1$. $VM$ = global imports in value. $VXI$ = exports to the East Asian area (intra-East Asian exports) in value.

The area $j$ are the three other East Asian areas, and $k$ represents the three other East Asian areas, the United States and the rest of the world (i.e the countries or area $h$). $VM_j$ is the global import of $j$ in value. $VX_{ij}$ is exports from $i$ to $j$. (Normally, we would have $PX_{kj}$ the price of exports from $k$ to $j$, instead of $PX_k$)

The export prices of competitors in the United States market (endogenous variable)

The export prices of competitors of area $i$ in the United States market are the import prices of the United States.

With the import prices of the United States, $\Sigma_k(VX_{kus}/VM_{us})\log(PX_k)$ with $k$ different from $i$. 

$$\log(PXCE1) = \Sigma_k \left( \frac{VX_{kus}}{VM_{us}} \right) \log((ITX_k/ITX_i) \cdot PX_k)$$

with $\Sigma_k(VX_{kus}/VM_{us}) = 1$. $VX_{kus}$ = exports from $k$ to United States in value, and $VM_{us}$ = American global imports in value.

The areas $j$ are the three other East Asian areas, and area $k$ are the three other East Asian areas, the United States and the rest of the world (countries or area $h$). (Normally, we would have $PX_{kus}$ the price of exports from $k$ to the United States, instead of $PX_k$.)
**The export price of competitors in the rest-of-the-world market (endogenous variable)**

The export price of competitors of area $i$ in the rest of the world is a geometric mean of the import price of competitor $h$, weighted by the share of the country (or area) $h$ in the export of country $i$.

With the import price of country or area $h$, $\sum_k(VX_{kh}/VM_h)\log(PX_h)$ with $k$ different from $i$.

$$\log(PX_{CE2})_i = \sum_h \left[ \frac{(VX_{ih}/VXE2_i)}{\sum_k(VX_{kh}/VM_h)} \ast \log((ITX_k/ITX_i).PX_k) \right]$$

with $\sum_k(VX_{kh}/VM_h) = 1$ and, $\sum(VX_{ih}/VXE2_i) = 1$. $VXE2$ = exports to the rest of the world in value.

The variable $k$ represents the three other East Asian areas, the United States, and the rest of the world (countries or areas $h$, i.e $k = h+j$). (Normally, we should have $PX_{kh}$ the price of exports from $k$ to $h$, instead of $PX_k$.)

**The intra-East Asian demand of the area $i$ (endogenous variable)**

The intra-East Asian demand of the area $i$ is an arithmetic mean of the imports of each intra-East Asian competitor $j$ of area $i$, weighted by a share of market fixed conventionally or by a slipping share.

$$DEI_i = \sum_j[VX_{ij}/VM_j]\ast M_j$$

$M$ is the global imports of area $j$, in volume. The zone $j$ is the three other East Asian areas.

**The demand from the United State to area $i$ (exogenous variable)**

American demand of area $i$ is American global imports in volume $M_{US}$, weighted by a share of market fixed conventionally or by a slipping share.

$$DEE_{1i} = (VX_{i-US}/VM_{US})\ast M_{US}$$

**The demand from the rest of the world to area $i$ (exogenous variable)**

The demand from the rest of the world to area $i$, is an arithmetic mean of the imports of each extra-Asian competitor $h$ of countries $i$, weighted by a share of market fixed conventionally or by a slipping share.

$$DEE_{2i} = \sum_h(VX_{ih}/VM_h)\ast M_h$$
Annex 3 : Main econometric results

Retained parameters for internal block

Active population equation
\[ \text{dlog(PA)} = \text{pa}_0 + \text{pa}_1 \cdot \text{dlog(N)} + \text{pa}_2 \cdot \text{dlog(pat)} \]

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Source: Estimates of authors, except for China. For China, pa1 has been imposed.

Prob ≤ 1% « white » (significant at 1% level)
1%<probs≤5% « * » (significant at 5% level)
5%<probs≤10% « ** » significant at 10% level)
10%<probs≤15% « *** » significant at 15% level)
prob>15% « ns=non significant »

Total Employment equation
\[ \text{dlog(N)} = \text{n}_0 + \text{n}_1 \cdot \text{dlog(Y)} + \text{n}_2 \cdot (\text{log(N}) - \text{log(Y)} - \text{n}_3 \cdot \text{trend}) \]

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Source: Estimates of authors, except for China. China estimates are Brillet estimates.

Prob≤1% « white » (significant at 1% level)
1%<probs≤5% « * » (significant at 5% level)
5%<probs≤10% « ** » significant at 10% level)
10%<probs≤15% « *** » significant at 15% level)
prob>15% « ns=non significant »
### Wage and Price curve

\[
d\log(W) = w_0 + w_1 \cdot d\log(P_c) + w_2 \cdot d\log(Y/N) + w_3 \cdot (\log(W) - \log(P_c)) + w_4 \cdot \log(U)
\]

for China: \(d\log(W) = w_0 + w_1 \cdot d\log(P_c) + w_3 \cdot (\log(W) - \log(P_c)) - w_5 \cdot \log(Y/N) + w_4 \cdot \log(U)\)

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</tr>
<tr>
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<tr>
<td>w2</td>
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<td>0</td>
</tr>
<tr>
<td>w3</td>
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<td>-0.42***</td>
<td>-0.3*</td>
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<td>-0.0396</td>
<td>-0.0227</td>
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<tr>
<td>w5</td>
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<td>1 (ctr)</td>
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<tr>
<td>R²</td>
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<tr>
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<td>0.9</td>
</tr>
<tr>
<td>DW</td>
<td>1.81</td>
<td>2.11</td>
<td>2.36</td>
</tr>
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</table>

**Source:** Estimates of authors, except for China. China estimates are Brillet estimates.

**CtR=constrained**

Prob ≤ 1% « white » (significant at 1% level)
1% < Prob ≤ 5% « * » (significant at 5% level)
5% < Prob ≤ 10% « ** » (significant at 10% level)
10% < Prob ≤ 15% « *** » (significant at 15% level)
Prob > 15% « ns=non significant »

\[
d\log(PP) = p_0 + p_1 \cdot d\log(W/N/Y) + p_2 \cdot d\log(Y/Y^*) + p_3 \cdot (\log(PP) - \log(W/N/Y))
\]

<table>
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<tr>
<th></th>
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<td>0.7</td>
<td>0.26*</td>
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<tr>
<td>p2</td>
<td>ns</td>
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</tr>
<tr>
<td>p3</td>
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<td>-0.09</td>
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<td>Adjusted R²</td>
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<td>0.935</td>
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<tr>
<td>DW</td>
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<td>1.81</td>
<td>2.66</td>
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**Source:** Estimates of authors, except for China. China estimates are Brillet estimates.

Prob ≤ 1% « white » (significant at 1% level)
1% < Prob ≤ 5% « * » (significant at 5% level)
5% < Prob ≤ 10% « ** » (significant at 10% level)
10% < Prob ≤ 15% « *** » (significant at 15% level)
Prob > 15% « ns=non significant »
Consumption price equation (not estimated)

\[ \log(P_c) = pc1 \log(P_{Mbs}) + (1 - pc1) \log(PP) \]
\[ pc1 = (PMbs \cdot Mbs) / (P \cdot Y) \]

<table>
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<th>Japan</th>
<th>China</th>
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<td>0.1</td>
<td>0.26</td>
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</table>

Household consumption function

\[ \text{dlog(cons)} = c0 + c1 \cdot \text{dlog}(RD/Pc) + c2 \cdot \text{dlog}(Pc) + c3 \cdot \text{dlog}(U) + c(4) \cdot (\log(\text{cons},) - \log(RD/Pc,)) \]

<table>
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<th>China</th>
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<td>ns</td>
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<td>0.72</td>
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<td>c3</td>
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<td>c4</td>
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<td>-0.36*</td>
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<tr>
<td>R²</td>
<td>0.81</td>
<td>0.72</td>
<td>0.69</td>
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<tr>
<td>adjusted R²</td>
<td>0.79</td>
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<tr>
<td>DW</td>
<td>1.81</td>
<td>1.72</td>
<td>1.8</td>
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Source: Estimates of authors, except for China. China estimates are Brillet estimates.

\( Ctr = \text{constrained} \)

Prob ≤ 1% « white » (significant at 1% level)
1% < Prob ≤ 5% « * » (significant at 5% level)
5% < Prob ≤ 10% « ** » (significant at 10% level)
10% < Prob ≤ 15% « *** » (significant at 15% level)
Prob > 15% « ns = non significant »
Foreign trade block

Exports prices equations
\[
d\log(P_{XI}) = pxi0 +pxi1*d\log(PP) + (1 - pxi1)*d\log(PXCl)+ pxi2*trend
\]
\[
d\log(PXE) = pxe0 +pxe1*d\log(PP) + (1 - pxe1)*d\log(PXCE) + pxe2*trend
\]
\[
d\log(PXus) = pxus0 +pxus1*d\log(PP) + (1 - pxus1)*d\log(PXCus) +pxus2*trend
\]
for China pxi1 = pxe1 = pxus1 = 0.2, we imposed these coefficients.

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<tr>
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<td>(R^2)</td>
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<td>adjusted (R^2)</td>
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<td>0.99</td>
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<tr>
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<td>pxe2</td>
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<td>ns</td>
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<tr>
<td>AR(1)</td>
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<tr>
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<td>0.91</td>
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<tr>
<td>adjusted (R^2)</td>
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<td>0.63</td>
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<td>pxus2</td>
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<td>0.96</td>
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<tr>
<td>adjusted (R^2)</td>
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<tr>
<td>DW</td>
<td>2.31</td>
<td>1.88</td>
</tr>
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</table>

Source: Estimates of authors, except for China

Probs\(1\% « white » (significant at 1% level); 1\%<probs\(5\% « * » (significant at 5% level); 5\%<probs\(10\% « ** » significant at 10% level); 10\%<probs\(15\% « *** » significant at 15% level); prob>15\% « ns=non significant »
Exports Function
\[ d\log(X) = c1 + c2\cdot d\log(D) + c3\cdot d\log(\text{comp}) + \alpha\cdot\left[\log(X_{i})-c4\cdot d\log(D_{i})-c5\cdot d\log(\text{comp}_{i})-c6\cdot \text{trend}\right] \]

<table>
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<tr>
<th></th>
<th>(c1)</th>
<th>(c2)</th>
<th>(c3)</th>
<th>(\alpha)</th>
<th>(c4)</th>
<th>(c5)</th>
<th>(c6)</th>
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<th>(R^2/\text{adjusted})</th>
<th>AR(1)</th>
<th>AR(2)</th>
<th>Sample (adjusted)</th>
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</thead>
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<tr>
<td>(X_{\text{jap vers us}})</td>
<td>-0.01**</td>
<td>1.09</td>
<td>1.01</td>
<td>-0.46</td>
<td>cont=1</td>
<td>ns</td>
<td>1.65</td>
<td>0.93/0.92</td>
<td>ns</td>
<td>1981-2002</td>
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<td></td>
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<tr>
<td>(X_{\text{jap vers rw}})</td>
<td>ns</td>
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<td>cont=1</td>
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<td>0.94</td>
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<tr>
<td>(X_{\text{jap vers asie}})</td>
<td>0.01</td>
<td>0.97</td>
<td>0.76</td>
<td>-0.73*</td>
<td>cont=1</td>
<td>ns</td>
<td>2.77</td>
<td>0.999/0.998</td>
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<tr>
<td>(X_{\text{kor vers us}})</td>
<td>0.22*</td>
<td>0.92</td>
<td>0.79</td>
<td>-0.66*</td>
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<td>-0.0125*</td>
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<td>0.83/0.79</td>
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<td></td>
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<td>ns</td>
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<td>1991-2002</td>
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<tr>
<td>(X_{\text{china vers rw}})</td>
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<td>0.88</td>
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<td>-1.11*</td>
<td>cont=1</td>
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<td>ns</td>
<td>2.15</td>
<td>0.95/0.93</td>
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<td>1991-2002</td>
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<tr>
<td>(X_{\text{china vers asie}})</td>
<td>ns</td>
<td>1.07</td>
<td>1.18*</td>
<td>-0.44 ns</td>
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<td>ns</td>
<td>1.74</td>
<td>0.95/0.92</td>
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<td>1991-2002</td>
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Source: Estimates of authors.

Cont=constrained
Probs: 1% « white » (significant at 1% level)
1%<probs<5% « * » (significant at 5% level)
5%<probs<10% « ** » (significant at 10% level)
10%<probs<15% « *** » (significant at 15% level)
prob>15% « ns=non significant »
Imports function
\[ \text{dlog}(M) = c1 + c2\text{dlog}(DF) + c3\text{dlog}(\text{comp}) + \alpha \left( \text{log}(M) - 1 \right) - c4\text{log}(DF) - c5\text{log}(\text{comp}) - c6\text{trend} \]

<table>
<thead>
<tr>
<th></th>
<th>c1</th>
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<th>c3</th>
<th>alpha</th>
<th>c4</th>
<th>c5</th>
<th>c6</th>
<th>DW</th>
<th>R² / adjusted R²</th>
<th>AR(1)</th>
<th>Sample (adjusted)</th>
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<td>2.44</td>
<td>-0.3</td>
<td>-0.29</td>
<td>cont=1</td>
<td>-0.95</td>
<td>ns</td>
<td>1.69</td>
<td>0.86/0.83</td>
<td>1978-2002</td>
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<tr>
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<td>0.0368</td>
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<td>0.81/0.77</td>
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<td>0.997/0.995</td>
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<td>-0.94**</td>
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<td>0.78/0.72</td>
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<td>1.31</td>
<td>-0.98</td>
<td>-0.59</td>
<td>cont=1</td>
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<td>ns</td>
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<td>0.87/0.85</td>
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<tr>
<td><strong>Mkor vers asie</strong></td>
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<td>2.97</td>
<td>ns</td>
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<td>cont=1</td>
<td>ns</td>
<td>0.0468**</td>
<td>1.82</td>
<td>0.975/0.966</td>
<td>1991/2002</td>
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<tr>
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<td>1.21**</td>
<td>-0.27 ns</td>
<td>-0.67</td>
<td>cont=1</td>
<td>ns</td>
<td>1.84</td>
<td>0.79/0.71</td>
<td>1991-2002</td>
<td></td>
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</tr>
<tr>
<td><strong>Mchina vers rw</strong></td>
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<td>2.66*</td>
<td>-0.64**</td>
<td>0.96</td>
<td>0.55/0.45</td>
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<tr>
<td><strong>Mchina vers asie</strong></td>
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<td>2.85***</td>
<td>-0.36***</td>
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<td>-1.5**</td>
<td>ns</td>
<td>2.31</td>
<td>0.75/0.61</td>
<td>1991-2002</td>
<td></td>
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</table>

Source : Estimates of authors.

Cont=constrained

Probs<1% « white » (significant at 1% level)

1%<probs<5% « * » (significant at 5% level)

5%<probs<10% « ** » significant at 10% level)

10%<probs<15% « *** » significant at 15% level)

prob>15% « ns=non significant »
**Annex 4 : Diffusion effects**

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<th>After</th>
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<th>Price-Korea</th>
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<th>Employment-Korea</th>
<th>GDP-Japan</th>
<th>GDP-Korea</th>
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Sources: Estimations of authors.
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<tr>
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<td>0,2076</td>
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<td>1,2409</td>
<td>0,0712</td>
<td>0,1229</td>
<td>0,0680</td>
<td>0,0344</td>
</tr>
</tbody>
</table>

Sources : estimations'authors