GLOBAL PRICE TRANSMISSION FROM CHINA[*]

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Abstract

This paper attempts to assess the extent of price transmission between China and the G3, inclusive of exchange rate shocks. First, we investigate the factors explaining China's price formation and find two long-run relations identified as aggregate price and export price equations with wages, import prices and output gaps as the driving factors. Second, we assess the degree of price dependence between China and the G3 by using a VAR model and find that transmission from Chinese to US prices moves in the same direction, but not so strong in the context of EU and Japan. Regarding exchange rate shocks, currency depreciation in Japan or China depresses US prices reflecting dollar appreciation in the short run. Also, reduced import prices are another channel through which aggregate domestic prices in the G3 remain depressed. This paper suggests that the solution for both the US and China rests mainly on domestic policies and that the exchange rate for the US at least matters little.

JEL Classification: E31, F32, and C32

Keywords: Price transmission, Cointegration, China, and G3

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1. Introduction

Growing interdependence between China and the G3 (US, EU and Japan) has been an emerging trend in the recent years. The US relies heavily on China and other Asian countries to finance its budget deficit. For its part, China relies on the US to buy its exports, the US being China's largest export market absorbing 21.5% of total exports in 2002. International trade forms a direct channel through which prices are transmitted. China's price differential as a result of significant differential in the cost of production with the G3 could encourage corporations to move their manufacturing production base to low-cost economies such as China. Such move has the potential to reduce production and employment in the G3. But the capital flows—another mechanism for the transmission of shocks—can influence the exchange rates. In the recent months, international pressure for a revaluation of the Chinese renminbi has intensified, but the Chinese authorities resist such a move, mainly to avoid any reduction in export competitiveness. Moreover, the USD-pegged currency regime may be aiding price stability in China, given that the US is China's leading trading partner. A case for whether to discard the current exchange rate policy for a more flexible one should require us to explore the different linkages between China's leading trade currencies and relevant prices.

Thus it is pertinent to investigate the economic interdependence of China and the G3. Specifically, we focus on the price channel of international dependence, inclusive of exchange rate shocks. We measure the extent of price transmission between the G3 and China, in addition to investigating the factors driving China's price dynamics. We assess the degree of interdependence by using a VAR model. This paper is organized as follows: Section 2 gives a stylized description of the economic interdependence between China and the G3. We then formulate analytically the price dynamics in section 3, with empirical results in section 4. Section 5 concludes that the solution for

both the US and China rests mainly on domestic policies and that the exchange rate for the US at least matters little. Currency depreciation in Japan or China depresses US prices reflecting dollar appreciation in the short run, although the impact disappears in the long run. Also, reduced import prices appear to be the channel through which aggregate domestic prices in the G3 remain depressed.

2. Stylised facts on economic interdependence between China and the G3

The large and growing current account deficit of the US (at about 5 percent of GDP by end-2002) requires about US$500 billion of net capital inflows a year to finance the external deficit. "A large share of the imbalances between exports and imports are coming from Asia. In 2002, the current account surplus for emerging countries in Asia was US$133 billion, larger than that of Japan (US$113 billion) or the Euro area (US$72 billion)"[1] (Table 1).

Table 1 - Current account balances as a percentage of GDP

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Projections	
																			2003	2004
Japan	3.7	4.2	3.4	2.7	2.1	1.5	2.0	3.0	3.0	2.7	2.1	1.4	2.2	3.0	2.6	2.5	2.1	2.8	3.1	3.9
US	-2.8	-3.3	-3.4	-2.4	-1.8	-1.4	0.1	-0.8	-1.2	-1.7	-1.4	-1.5	-1.5	-2.3	-3.2	-4.2	-3.9	-4.8	-5.4	-5.5
Euro area	0.8	1.8	1.1	1.0	0.8	0.1	-1.1	-0.8	0.5	0.3	0.8	1.1	1.6	1.1	0.5	-0.4	0.2	1.1	1.4	1.4
EU	0.5	1.2	0.6	0.1	-0.2	-0.6	-1.2	-1.0	0.1	0.1	0.6	0.9	1.3	0.9	0.2	-0.5	0.1	0.9	1.0	1.0
Total OECD	-0.6	-0.3	-0.4	-0.3	-0.5	-0.6	-0.3	-0.3	0.1	-0.1	0.2	0.0	0.3	0.0	-0.6	-1.2	-1.0	-1.1	-1.2	-1.2

Source: *OECD.*

The national income identity is $Y = C + I + G + X - M$, with Y representing GNP, C consumption, I investment and G government purchases, and CA, the current account, equals $X - M$ with X denoting exports and M, imports. Since the right hand side of the identity is total expenditure on domestic output, changes in the current account can be associated with changes in output and thus employment. As national saving, S, equals $Y - C - G$ and that CA equals $X - M$, the GNP identity can be rewritten as $S = I + CA$. China's saving is partly helping to finance US spending. China's

[1] IMF (2003): p.27.

gross saving rate is about 40 percent of GDP, while the US savings averaged about 18 percent of GDP.

Dividing national savings into its private and government components, private savings expressed as S^p is the part of disposable income that is saved: $S^p = Y - T - C$ with T, net taxes collected by the government from households and firms. Similarly, government saving is expressed as $S^g = T - G$ with T, net tax revenue and G, government spending. The national income identity can thus be rewritten using the definitions of private and government savings. Because $S = S^p + S^g = I + CA$, $S^p = I + CA - S^g = I + CA + (G - T)$.

The identity above relates private saving to domestic investment, the current account, and government saving. $G - T$ defines the government budget deficit. The above equation therefore states that the US's private saving can take three forms: investment in domestic capital (I), purchases of wealth from foreigners (CA) and purchases of domestic government newly issued debt ($G - T$). The current account has to adjust depending on the size of the accumulated debt, the rate at which the new debt is accumulating (the current account), the speed of economic growth and the interest rate paid on the borrowed funds.

The question is what causes the US current account deficit. The identity $CA = S^p - I - (G - T)$ provides a framework. Because private saving, investment, the current account, and the government deficit are jointly determined, the cause of the current account change cannot be identified by the identity alone. Nonetheless it gives some directions.

Table 2 presents data for the US on the four variables linked by the CA identity as percent of GDP so that they can be compared. Gross savings and investment are taken rather than net because the depreciation data used to calculate the net flows are unreliable.

Table 2 US national income identity (percent of GDP)

	Current Account *CA*	Private Savings S^p	Investment *I*	Government Savings *T - G*	Discrepancy
1985	-2.8	19.63	18.48	-1.8	2.16
1986	-3.3	18.08	17.48	-2.0	1.90
1987	-3.4	17.59	17.07	-1.0	2.91
1988	-2.4	18.43	17.48	-0.3	3.06
1989	-1.8	17.37	17.90	0.2	1.48
1990	-1.4	17.46	17.32	-0.8	0.74
1991	0.1	18.28	17.23	-1.3	-0.34
1992	-0.8	18.38	16.59	-2.2	0.39
1993	-1.2	17.40	16.56	-1.4	0.64
1994	-1.7	16.91	17.12	-0.2	1.29
1995	-1.4	17.01	17.26	0.6	1.76
1996	-1.5	16.45	17.62	1.3	1.63
1997	-1.5	16.10	18.36	2.4	1.64
1998	-2.3	15.69	18.45	3.5	3.05
1999	-3.2	14.56	17.88	3.6	3.48
2000	-4.2	13.96	17.09	4.1	5.17
2001	-3.9	13.89	15.34	1.9	4.35
2002	-4.8	15.23	13.96	-1.4	4.68
Projections	-5.4			-2.7	
	-5.5			-2.4	

Note: The primary balance is the difference between the financial balance and net interest payments. For more details see footnotes of Annex Tables 28 and 32, OECD Economic Outlook, Sources and Methods.
Source: OECD; Bureau of Economic Analysis, U.S. Department of Commerce.

Other things being equal, a rise in private saving must increase the current account surplus. A rise in investment or the government budget deficit must lower it. For example, in 2002 the current account moved to –4.8% of GDP from –3.9 % in 2001, as the government budget turned into a deficit of –1.4% from a surplus of 1.9% in 2001. The discrepancy is exactly the extent to which the US economy is dependent on foreign savings to attain its balance of payments equilibrium. In 2002, the extent of dependence was about 4.7% of its GDP.

The data confirm a tendency for increases in the government budget deficit to lower the current account surplus while decreases in the government budget deficit raise it, but the data also show that the relationship is not a simple one. If bigger US budget deficits mean even bigger current account deficits, this also means a greater US reliance on foreign funding. A large share of the budget deficit is being financed by China and other Asian countries (see Table 3).

Table 3*:* Major foreign holders of US Treasury securities (end of period)

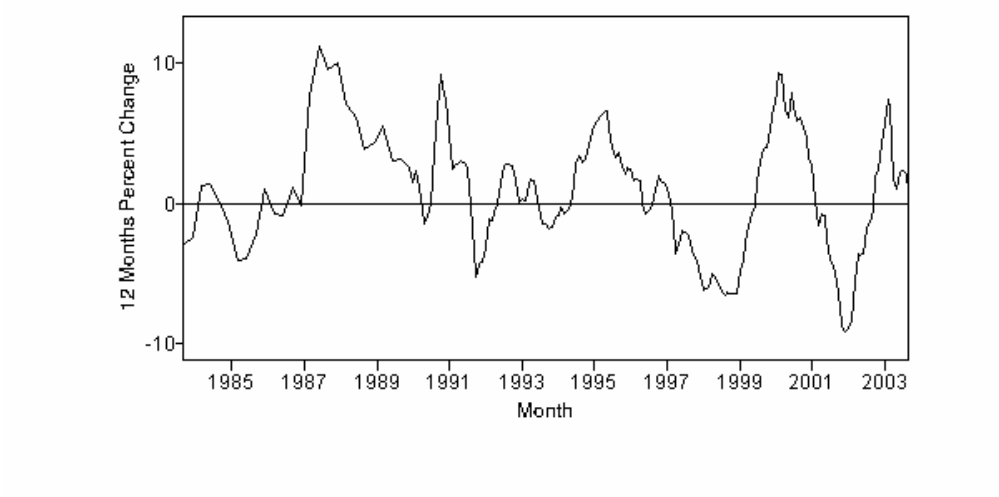
	2003		2002		2001		2000	
	US$ billions	**%**	**US$ billions**	**%**	**US$ billions**	**%**	**US$ billions**	**%**
Japan	443.8	31.9	364.7	30.3	317.9	30.6	317.7	31.3
UK	142.3	10.2	108.5	9.0	45	4.3	50.2	4.9
China	126.1	9.1	102.9	8.5	78.6	7.6	60.3	5.9
Germany	51.3	3.7	44.1	3.7	47.8	4.6	49	4.8
France	9.0	0.6	17	1.4	20.6	2.0	25.1	2.5
Asia 5	166.7	12.0	159.8	13.3	151.5	14.6	143.3	14.1
All Other	450.6	32.4	406.7	33.8	378.7	36.4	369.6	36.4
Total	1,389.8	100.0	1,203.7	100.0	1,040.1	100.0	1,015.2	100.0

Note: Estimated foreign holdings of U.S. Treasury marketable and nonmarketable bills, bonds and notes are based on Treasury Foreign Portfolio Investment Survey benchmarks and on monthly data reported under the Treasury International Capital (TIC) reporting system. Asia5 includes Hong Kong, Korea, Taiwan, Singapore, and Thailand; Data for 2003 are is end-July.
Source: Department of the Treasury/Federal Reserve Board.

China's fixed peg against the dollar implies that a current account surplus or capital inflows automatically translate into higher reserves. Since end-2001, China's foreign exchange reserves have increased by 63% to US$351.4 billion by Q2-2003. By buying US government bonds, China and other Asian central banks are keeping their currencies weak supporting their respective exports to the US. Table 3 shows that Japan, China, and the Asia5 are important buyers of American government debt. Without these purchases of government bonds, the US might face a rise in domestic interest rates that could threaten its economic recovery. If China decided to sell these dollar-denominated securities, the global bond market could mark down US government securities, thereby raising US long term interest rates and canceling out much or all of any stimulus provided by the dollar depreciation resulting from the sales of US bonds.

In theory, a falling dollar should curb US import demand. In practice, this will happen only if the dollar decline leads to a rise in import prices relative to domestic goods or if the rise in import prices reduces demand growth in response to the implied cut in US households' purchasing power. The currency's decline would be expected to boost prices of imported goods directly as well as indirectly. Imported materials are used in the production of domestic products and services, so a decline in the dollar's value would be expected to accelerate domestic prices by more than can be accounted for by the relative importance of imported final products. Figure 1 shows changes in US import prices that exactly reflect dollar appreciation/depreciation over time.

Figure 1: US import price index



Note: BEA End-use Import Indexes for All Commodities
Source: Bureau of Labor Statistics, US Dept of Labor (*http://data.bls.gov)*

Hooper et al. (2000) estimate and test the stability of income and price elasticities derived from conventional equations relating the foreign trade of the Group of Seven (G-7) countries to their incomes and relative prices. They conclude that either the U.S. external imbalance will widen indefinitely or relative prices will have to adjust over time to keep it from doing so. Their study examines the robustness of the asymmetry of estimated income elasticities for U.S. trade and calculates the rate of depreciation consistent with external balance. They find that a 1% drop in the dollar reduces US demand for imports by only 0.3% in the long term, and a 1% drop in income reduces imports by 1.8%. If we take these results as our starting hypothesis, this means that the level of the US dollar is not significant in depressing import demand. And if the exchange rate is not significant in determining import demand, then import costs may be, an issue to which we now turn.

Figure 2 indicates that a sustained decline in CPI in China since the early 1990s has given rise to concerns that deflationary impulses could be transmitted across countries through trade and financial linkages. This concern needs to be assessed against overall bilateral trade shares (see Table 4).

Figure 2: Inflation in G3 and China

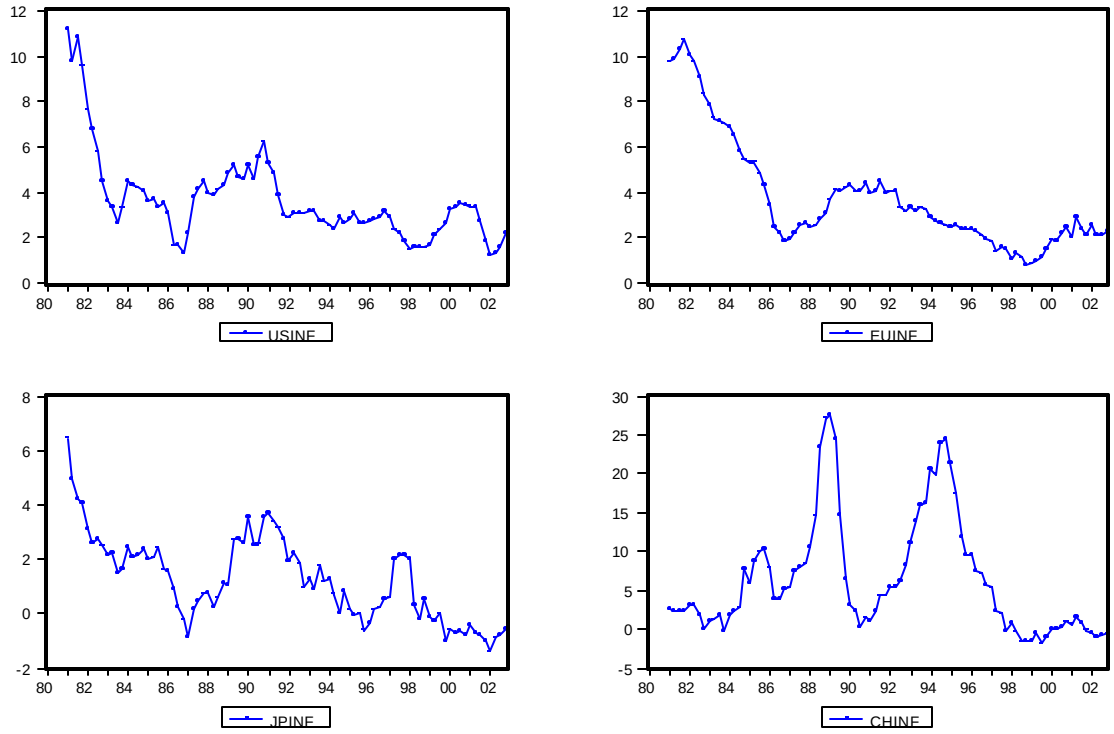


Table 4 China's Trade Weights (2002)

	% of Total		% of Total
Major exports		**Major imports**	
Apparel & Clothing	12.7	Electrical equipment & parts	18.8
Computers	11.1	Chemicals & products	13.2
Telecommunications products	9.8	Crude oil & fuels	6.5
Electrical equipment & parts	9.8	Textiles, yarn & fabrics	4.4
Leading Export Markets		**Leading Import Suppliers**	
US	21.5	Japan	18.1
Hong Kong	18.0	EU	13.1
Japan	14.9	Taiwan	12.9
EU	14.8	US	9.2

Source: EIU, Country forecast, October 2003.

Goldstein and Lardy (2003) note that China's current account surplus is overstated. While China is running a large bilateral trade surplus with the US (US$100 billion in 2002) its trade balance with the rest of the world is in deficit, at US$75 billion. Its underlying current account

surplus is about 2 or 3 percent of GDP. The overall capital account surplus during the 1999-2002 period was about 1 percent of GDP. Moreover, the capital account is controlled. This means that if the capital account is deregulated, this would increase the demand for foreign assets and could lead to capital outflows, putting downward (not upward) pressure on the yuan.

The yuan has been fixed at 8.3 to the dollar since 1994, even though the rapid development of China's economy is being accompanied by strong productivity gains that should push its currency higher relative to the dollar. But the case for a stronger yuan is rather complex.[2] Using a comparative static macroeconomic model, Roberts and Tyres (2003) support the standard view that a more flexible exchange rate regime would be beneficial to China and this benefit can be expected to increase as capital mobility increases.

The Chinese authorities fear that a more flexible currency might raise unemployment, aggravate deflationary pressures, and cause a meltdown in the banking system. Structural problems in the real economy seem to have worsened, leading to growing under-utilization of labor and a slowdown in real growth (OECD, 2002, p.9). Despite more than two decades of reform, China's investment mechanism retains major features of the old plan system constraining China's future growth, with huge excess capacity at the macro level and distorted factor prices at the micro level (Rawski 2002). Companies have found it cheaper to spend money on mechanisation than to employ and train workers. This has resulted in a fall in the number of jobs created per percentage point growth in GDP. The number of urban unemployed is rising despite the rate of headline growth. Regarding the banking system fragility, Gang (2003) notes that the financial risk of the Chinese economy is less serious than predicted by the level of the banks' NPLs, given government debt (amounting to 16 percent of GDP) and short-term foreign commercial debt (amounting to 1 percent of GDP) and current growth rates. This view seems to be shared by Gordon (2003) as well for whom the outstanding loans do not threaten financial stability.

3. An analytical setting

Given the relatively closed nature of China's financial markets, we examine the real linkage via prices. Assuming two closely related sectors, namely an export sector and a non-export sector, aggregate prices (P) are decomposed as export prices (P_x) that take external market conditions into account and non-export prices (P_{nx}) reflecting domestic market conditions.

$$P = P_x^a \, P_{nx}^b \qquad [1]$$

$$P_{nx} = P_h^d \, P_i^{1-d} \quad 0 < d < 1 \qquad [2]$$

Export price indices are readily available, whereas for non-export prices we need to identify the factors that explain the movement of such prices as in equation 2 namely P_h denoting the price of the home good and P_i the imported prices. These two factors explaining non-export prices can also influence export prices. To capture the effect of the exchange rate on domestic prices in China, both export and import prices are included in the aggregate price equation. We can define $P_x = P_{fx}.e$ and $P_i = P_{fi}.e$, where P_{fx} and P_{fi} are export and import prices denominated in foreign currencies.

As the local currency appreciates (depreciates), export prices rise (fall) and import prices fall (rise). If export prices rise, it might encourage domestic producers to switch to export-oriented industries thereby creating shortage of domestic goods, consequently prices of those non-traded goods may rise or vice-versa. If there is lack of domestic demand or an increase in productivity, then domestic prices may not increase.

With regard to home goods, we introduce a mark-up pricing equation with wage cost (W) and the rate of capacity utilisation (y/y^*) as variables influencing domestic prices such that

$$P_h = W^{1+q} \left(\frac{y}{y^*} \right)^m \qquad [3]$$

[2] For an historical overview of the reform of China's foreign exchange system, see Boke (1996).

where q is the size of the mark-up, and $W = wl$ with w as the nominal wage rate and l the labour per unit of output, and m is the parameter reflecting the rate of capacity utilisation.

This mark-up pricing rule suggests that cheaper labour cost lowers home prices, which in turn lowers export prices, and thereby could help lower global prices. This scenario gives a causal structure to examine the price mechanism in the context of China.

Substituting [3] in [2] and the resulting expression in [1], we get the following:

$$P = P_x^a \left[\left\{ W^{1+q} \left(\frac{y}{y^*} \right)^m \right\}^d P_i^{1-d} \right]^b$$

Taking logs, the above expression can be written as:

$$\ln P = a \ln P_x + b \left[d \left\{ (1+q) \ln W + m \ln \left(\frac{y}{y^*} \right) \right\} + (1-d) \ln P_i \right] \qquad [4]$$

High inflation in China during the 1980s and early 1990s was followed by a period of falling prices. Nearly 90% of retail prices are market-determined.[3] The average yearly CPI inflation declined from its peak of 24.1% in 1994 to about 0% in 2003. Growth in money stock has declined significantly since the early 1990s but still remains high in double digits, while China has entered deflation territory during the same period. This suggests that structural factors may be playing a greater role currently than the monetary variables, as formulated in this analytical framework. This theoretical construct makes it distinct from studies such as Hasan (1999) which found a long-run feedback relationship between the general price level and money stock in China from a historical standpoint since the nineteen fifties. Moreover, the rate of interest is administratively determined, it has been cut eight times in less than six years with the latest cut in February 2001, which brought the 1-year deposit rate to 1.98% and the 1-year lending rate to 5.31%.[4] Bennett and Dixon (2001) find that interest rate variation in China has the opposite of the desired effect: a higher nominal

[3] OECD (2002), p.13: "the main exceptions being energy and other utility prices."
[4] Sachs and Woo (2003).

interest rate is associated with a higher aggregate price index, and a lower rate reduces prices. 'In a system where state-owned commercial banks under a state-owned central bank with a board of governors lacking sufficient independence must loan funds to state enterprises and/or create cash to support government obligations, the rate of interest can only play a secondary role' (Dutta, 1995).

Further, improvement in productivity during the 1990s may have led prices to maintain their downward trend. Wu (2001) shows that China's comparative labour productivity increased from about 3.0 in 1952 to 7.6 in 1997 (USA=100), but with a long period of stagnation at around 4.5 between 1958 and 1990. High productivity, excess capacity in SOEs, and excess labour at the bottom end of the labour market[5] combined with a de facto pegged exchange rate may have contributed to such sharp declines in prices, thus warranting the inclusion of capacity utilisation or the output gap in our model.

Besides estimating the key factors determining Chinese prices, we also examine the price linkages between China and the G3. The idea is to show whether there is any causality running from China to Japan or EU or the US. There are studies examining the interdependence of the US and the Asia-Pacific region, exploring the real linkage through trade and investment, and the financial linkage through stock markets. For example, it has been evidenced that a slump in the US stock price indices causes stock market recession in Japan, but not China (Hsiao et al. 2003), providing credence to the notion that Chinese financial markets remain de-linked partly due to the absence of full currency convertibility.

In the next section we look at the pairwise and vector autoregression (VAR) model to test the Granger causality of real linkage in terms of general price level between China, Japan, the EU and the US. Impulse response functions (IRFs) from VAR will also be illustrated to show the interaction of the variables considered in this set up.

[5] Despite the progress on reforms in the last twenty years, a sizable surplus labour still exists in the rural sector and SOEs (Brooks and Tao, 2003).

4. Empirical analysis

We will test in this section to what extent is falling prices in China a result of structural factors such as nominal wage as opposed to cyclical factors, namely import prices and output gap. Having done that we would examine the linkages between China and G3 prices in a multivariate setting.

A. Data definitions and sources

Data are compiled from several published sources including Chinese monthly statistics, *China Statistical Yearbook, China Statistical Abstract,* published by the National Bureau of Statistics, China; and CEIC database. The label of each variable begins with CH denoting China and L referring to a logged series. The model estimation uses quarterly data starting from Q1-1980 to Q4-2002. The following data transformation methods were adopted to ensure consistency.

First, with regard to wage data, i.e., average annual earnings (1987 = 100), CHWAGE, we applied an interpolation method to transform the annual series into quarterly one to be consistent with other quarterly series in the model. To do so, we first searched for a similar quarterly series and assumed that the quarterly movements of both series were the same. In this case, we interpolated by assuming that the quarterly movements of the wage series were the same as those of industrial output in nominal terms.

Second, for calculating the output gap, we used industrial output data as opposed to China's GDP data, which is available only from Q1 1994, when our sample goes back to Q1 1980. It was also difficult to estimate China's potential industrial output using a production function approach. Neither quarterly data on real total investment (from which we would have derived quarterly capital stock) nor quarterly labour force data are available for the whole period. Therefore we used the Hodrick-Prescott filter[6] in order to derive an estimate of the output gap, to be used in the estimation.

[6] The Hodrick-Prescott filter is a smoothing method to obtain a smooth estimate of the long-term trend component of a series. This method is standard for estimating potential output to gauge the extent of overheating in the absence of a production function-led estimate. For example, using this method, IMF estimated potential output for a sample of 19 emerging market economies, suggesting that for most Asian

For the European Union (EU-12), we used historical quarterly time-series on harmonised CPI starting from Q1 1980. The Monetary Union Index of Consumer Prices (EUCPI) was compiled from Datastream for the 12 countries of the Euro area (and 11 countries of the Euro area in its initial composition for data up to December 2000). The CPI data for US and Japan come from the IMF's *International Financial Statistics* (IFS). The yen-dollar and yuan-dollar exchange rate data (quarterly average) from 1980-Q1 to 2002-Q4 were also collected from the IFS.

B. Testing China's long run price relation

We carry out cointegration tests in a multivariate set up to examine the statistical linkages between the variables under consideration in equation [4]. The variables included here are all non-stationary (integrated of order one)[7], justifying the estimation of a cointegration (long-run) relation (see Table 5 in the appendix). The long-run relations are as follows (t-values in parentheses):

LCHCPI=1.55 LCHWAGE+1.46 LGAP +0.68 LCIMPR-0.05 TREND -6.65
(4.644) (2.534) (5.081) (3.823)

LCEXPR= 0.65 LCHWAGE +0.295 LGAP +1.01 LCIMPR – 0.023 TREND – 3.22
(3.896) (1.033) (15.129) (3.570)

It appears from this estimation that both structural and cyclical factors are equally important in explaining the current deflationary environment in China, as both the factors are statistically significant. The trace statistics support the existence of two vectors at the 1% level of significance and hence the hypothesis of two cointegrating vectors cannot be rejected. The two long-run relationships can be identified as long-run CPI and export price equations. Theoretically, the second vector must be interpreted as an export price function in order to have a complete model in which factors influencing domestic prices can be transmitted to the prices of a country's trading partner. This export price

countries, output gaps in the first half of 1990s were about plus or minus 3% of potential output (see De Masi, 1997).

equation can be interpreted as a measure of competitiveness. The wage coefficient being positive and statistically significant partly reflects China's rising labour productivity in the 1990s as reported by Wu (2001).

The trend coefficients in these two price equations suggest a long term 0.05% quarterly decline in aggregate prices and a 0.023% decline in export prices, and the coefficients are statistically significant. Such decline in export prices is more likely to have been transmitted to the international prices. But the extent of the impact would depend on the bilateral trade weights. These two long-run equations determining general price level and export prices can therefore constitute the price block.

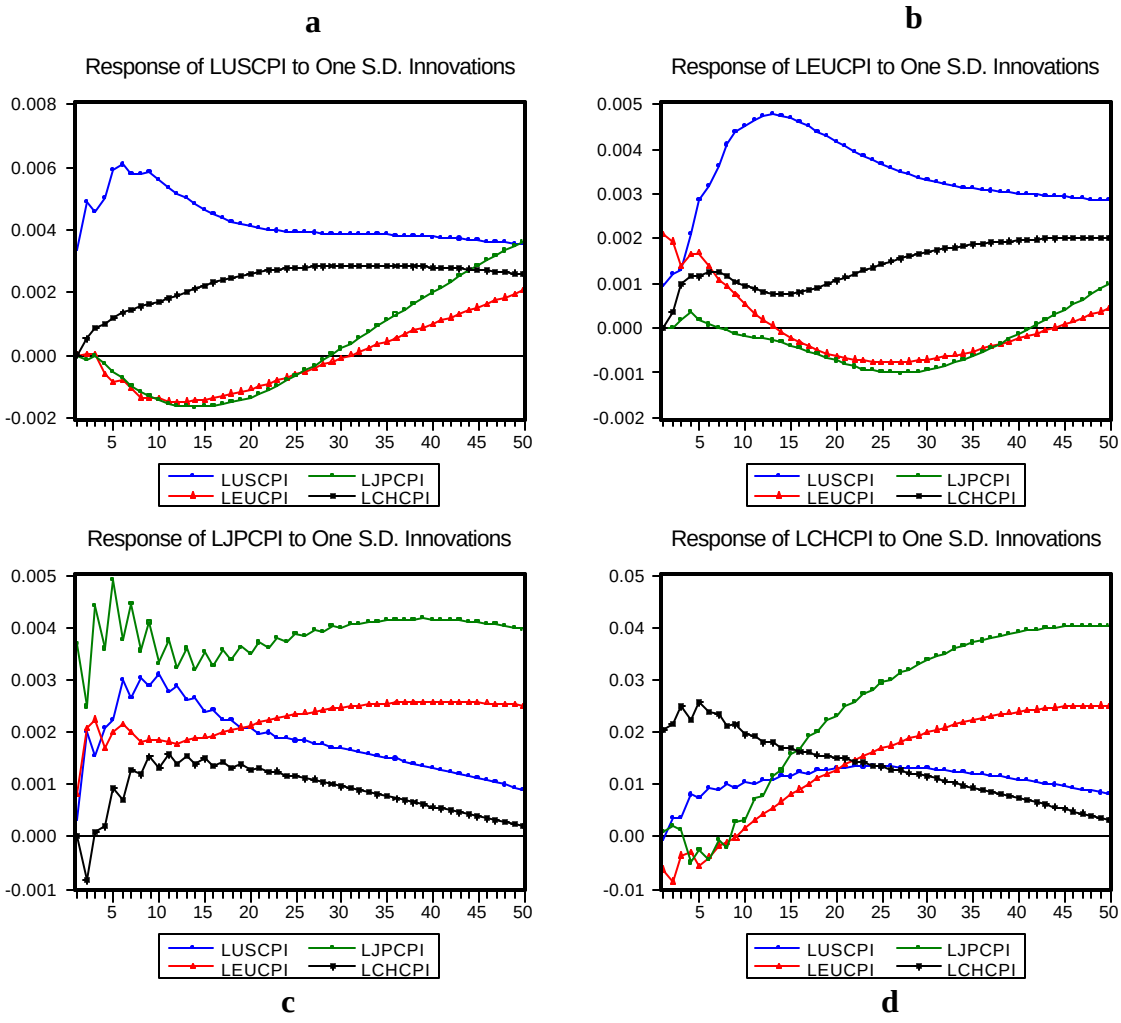
C. Estimating linkages between China and the G3

As the average price differential between China and the other three areas considered here remains large because of cost differences, price convergence is less likely to take place in the near future. For example, such cost differences might encourage Japanese companies to shift their production base to China. The existing price differential can be reduced slowly if the output gap or capacity utilisation in China reaches its saturation level or if the import prices are stable or increasing. So, as the global economy recovers, as the US dollar weakens, and as import prices cease to fall, the prospect of the price differential narrowing could be feasible. Dées (2001) defined competitiveness as the ratio of world to domestic prices. If the ratio of China's CPI to that of Japan or the US or the EU can be considered a measure of the average price gap, then it makes sense to relate all the four prices within a VAR setting to examine the dynamic interactions.

Using these four prices, we carry out purely statistical causality tests (see Table 6 in the appendix). The pair-wise Granger causality tests reveal that USCPI does 'granger cause' JPCPI and CHCPI, not the other way round, while EUCPI and CHCPI do granger cause JPCPI, not vice versa. From this we can infer a causal structure as follows: USCPI→JPCPI or USCPI→CHCPI→JPCPI.

[7] The unit-root test results are available upon request from the authors.

Figure 3: Impulse responses of price interdependence



Given the bi-variate causality tests, we then undertake a shock analysis in a multivariate framework using IRFs for the above-mentioned four variables. Figure 3 represents the IRFs for the four variables in the system. We describe below some of the important effects transmitted between those prices. The graphs represent the responses of each variable in the VAR due to the shock of a particular variable. The impulse responses of all variables to the shocks in all variables are plotted.[8] If one country has a tendency to be strongly influenced by the shocks given to other country, then

[8] The graphs represent the impulse response from a VAR of the US, EU, Japan, China ordering.

that country can be said to be dependent upon the country transmitting the shock. The standardised responses of USCPI (panel a) to a one-standard-deviation shock in CHCPI react strongly and positively and the impact dies out after 20 quarters, while the reaction to JPCPI and EUCPI is negative initially and turns positive after 10 quarters partly reflecting a weak linkage. European goods prices seem to have negligible impact on US prices, despite the currency fluctuations.

In contrast, the response of EUCPI (panel b) to a one-standard-deviation shock to USCPI is strongly positive, with a positive delayed impact to CHCPI and somewhat weak to JPCPI. In case of JPCPI (panel c), all the prices have a positive impact in the long run. CHCPI (panel d) reacts initially moderately negative to price shocks in EUCPI and JPCPI and then turns positive after 5 quarters, while USCPI has a moderately positive impact on CHCPI. With regard to the stability properties of the model, the responses appear satisfactory as they are not too explosive and there is a decaying response.

D. Transmission of exchange rate shocks

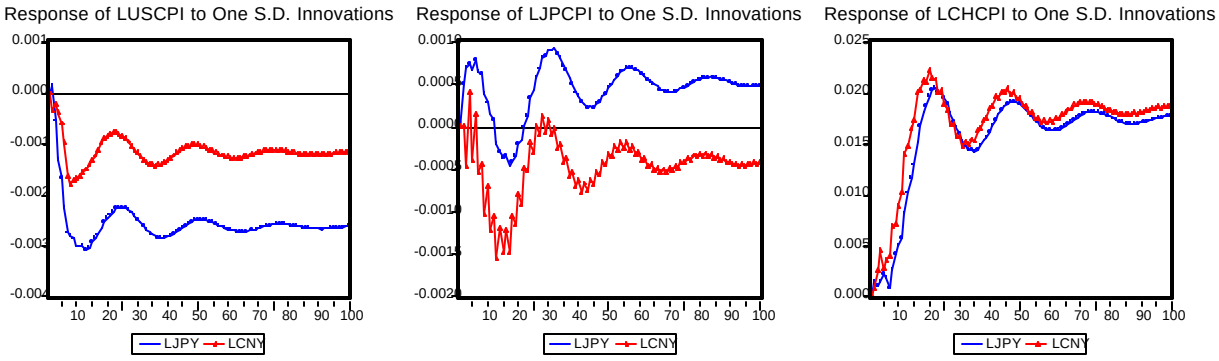
It appears from the above bi-variate and multivariate testing that EUCPI is less linked with CHCPI and JPCPI in a statistical sense. Hence, we consider a variant of the general VAR by eliminating EUCPI. We intend to examine the feedback linkages between USCPI, JPCPI and CHCPI via shocks to the exchange rates that can be captured within a VAR framework. The two exchange rates included in the VAR are those of the Japanese yen and Chinese yuan against the US dollar. Applying the method of cointegration, we found two cointegrating relations, which we identify as the US and Japan price equations being explained by CHCPI, JPY, and CNY (see Table 7 in Appendix).

The estimated long-run relations suggest a positive relationship between CHCPI and JPCPI and USCPI, while the impact of exchange rates is negative; the t-statistics, however, are not highly significant. We obtain the following cointegrating relations (numbers in parentheses are t-ratios):

LUSCPI= 0.136 LCHCPI - 0.196 LJPY- 0.562 LCNY + 0.0145 TREND +5.094
(1.466) (1.647) (1.747)
LJPCPI= 0.139 LCHCPI - 0.117 LJPY- 0.249 LCNY + 0.004 TREND +4.776
(2.617) (1.712) (1.349)

From these two long-run structural relations, a short-run vector error-correction model was estimated[9] which we used to carry out the IRFs exhibiting the short-run dynamics with respect to one SD innovations in the two exchange rates. These functions are presented in Figure 4. Given our main interests, we only provide IRFs of three prices to innovations in exchange rates. The responses appear stable, as they are smoothed out with a decaying response, but they are non-monotonic.

Figure 4: Short-run responses of Prices to innovations in exchange rates



Regarding the role of exchange rates, we note that US prices react negatively to the yen and yuan over 1- to 10-quarter horizons. A negative response suggests a dollar appreciation, implying yen and yuan depreciation. The response turns positive subsequently, however, and remains volatile until it goes to steady state. The non-monotonic nature of the response may have been due to exchange rate volatility partly as a result of changes in the external liquidity situation or by domestic demand conditions. While Japanese prices respond positively up to 5 quarters to shocks in exchange rates, Chinese prices react positively up to 20 quarters, suggesting that currency depreciation can have a big impact on prices in China as opposed to the case for Japan.

5. Conclusion

This paper made an attempt to assess the interdependence of the G3 with China and to measure the extent of price transmission among them, in addition to investigating the factors explaining China's price dynamics. The findings are summarised as follows:

First, the paper demonstrated the growing interdependence between the G3 and China on the external account via the national income accounting identity in an effort to learn about the interdependence relationship. In particular, China's growing foreign currency assets reflecting its strength on the external account are being diverted to finance growing US current account deficit, via the purchase of US Treasury securities. But there are weaknesses in the domestic financial system, which need to be minimised.

Second, since there are concerns about low value-added, cheap Chinese goods flooding G3 markets and putting a cap on G3 import prices, we investigated the factors driving China's price dynamics. We tested for cointegration and found two cointegrating vectors, one obviously identified as the aggregate price relation, and the other identified as the export price equation with wages, output gap and import prices as the key driving factors. In terms of relative impact, we found that cost factors (wages and import prices) dominate cyclical factors (output gap).

Third, with regard to the influence of Chinese prices on G3 prices, we carried out the simplest pair-wise causality testing and found that the USCPI does 'granger cause' JPCPI and CHCPI, not other way round, while EUCPI and CHCPI do 'granger cause' JPCPI, not vice versa. The paper then undertook a multivariate exercise for all the prices using a VAR model to assess the degree of interdependence and found that the price transmission from China's CPI to US CPI moves in the same direction, but not so strong in the context of EU and Japan. Chinese price shocks appear to have more substantial effects upon US prices, presumably through exports to the US.

[9] These results are available upon request from authors.

Finally, in terms of transmission of exchange rate shocks, dollar appreciation does induce downward pressure on US prices, reflecting a yen or yuan depreciation. Alternatively, any currency appreciation in China or Japan is likely to put upward pressure on US prices. If the yen or the yuan appreciates, such a trend may not be encouraging for the US, as that would make US assets less attractive making it difficult to finance its current account deficit.

The present exercise is important because of its international economic policy implications. International trade is an important vehicle for international dependence and forms a direct channel through which price shocks can be transmitted. Capital flows, of course, provide another mechanism for the transmission of income and monetary shocks. In this paper we concentrated on the price channel of international interdependence which mainly reflects an increase in trade dependence. The different effects of fiscal and monetary policy variables on interdependence using a similar VAR framework remain to be investigated, however.

Lastly, Abeysinghe and Lu (2003) emphasize the economic benefits that a rising Chinese economy can bring to the region, and they find that China has recently started shifting its growth strategy from an export-oriented economy to a more domestic-demand-driven one. Such a shift, against the backdrop of China's entry into the World Trade Organization, is opening up the country's huge domestic market to imports, thus providing great opportunities for economies of the region. The growing US trade deficit remains an area of major concern as it has the potential to induce protectionist pressures in the United States, particularly against China, as is well-documented in the press.[10]

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[10] See The *Economist* (2003): 75-76.

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Appendix

Table 5: China's long-run price relation

Sample: 1980:1 2002:4
Included observations: 83
Test assumption: Linear deterministic trend in the data
Series: LCHCPI LCEXPR LCHWAGE LGAP LCIMPR
Lags interval: 4 to 8

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.509565	141.0707	87.31	96.58	None **
0.420434	81.93633	62.99	70.05	At most 1 **
0.230839	36.66185	42.44	48.45	At most 2
0.147822	14.87813	25.32	30.45	At most 3
0.019110	1.601486	12.25	16.26	At most 4

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Unnormalized Cointegrating Coefficients:

LCHCPI	LCEXPR	LCHWAGE	LGAP	LCIMPR	@TREND(80:2)
1.532836	-1.343363	-1.507945	-1.833998	0.312254	0.044946
0.848979	-3.729811	1.098579	-0.134009	3.189482	-0.043759
0.764246	2.355666	-1.599948	3.137026	-2.465216	0.046896
-1.972975	1.694576	3.060358	-0.873585	-1.200075	-0.080041
0.088396	-3.910328	-0.699482	0.594548	3.010663	0.035295

Normalized Cointegrating Coefficients: 2 Cointegrating Equation(s)

LCHCPI	LCEXPR	LCHWAGE	LGAP	LCIMPR	@TREND(80:2)	C
1.000000	0.000000	-1.551366	-1.455293	-0.681710	0.049473	6.650452
		(0.33403)	(0.57437)	(0.13417)	(0.01294)	
0.000000	1.000000	-0.647662	-0.295324	-1.010303	0.022993	3.222296
		(0.16624)	(0.28586)	(0.06678)	(0.00644)	
Log likelihood	1064.581					

Table 6: Pairwise Granger Causality Tests

Sample: 1980:1 2002:4
Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
LEUCPI does not Granger Cause LUSCPI	84	1.46222	0.18781
LUSCPI does not Granger Cause LEUCPI		1.21619	0.30327
LJPCPI does not Granger Cause LUSCPI	84	0.47662	0.86850
LUSCPI does not Granger Cause LJPCPI		2.50921	0.01897
LCHCPI does not Granger Cause LUSCPI	84	1.24388	0.28794
LUSCPI does not Granger Cause LCHCPI		2.45542	0.02144
LJPCPI does not Granger Cause LEUCPI	84	0.08362	0.99954
LEUCPI does not Granger Cause LJPCPI		2.71014	0.01198
LCHCPI does not Granger Cause LEUCPI	84	1.70925	0.11235
LEUCPI does not Granger Cause LCHCPI		1.47417	0.18332
LCHCPI does not Granger Cause LJPCPI	84	3.10058	0.00489
LJPCPI does not Granger Cause LCHCPI		1.81742	0.08905

Table 7: Testing for cointegration between prices and exchange rates

Sample: 1980:1 2002:4
Included observations: 79
Test assumption: Quadratic deterministic trend in the data
Series: LUSCPI LJPCPI LCHCPI LJPY LCNY
Lags interval: 4 to 12

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.520740	126.7005	77.74	85.78	None **
0.353893	68.59499	54.64	61.24	At most 1 **
0.237978	34.08856	34.55	40.49	At most 2
0.101546	12.61795	18.17	23.46	At most 3
0.051280	4.158658	3.74	6.40	At most 4 *

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Unnormalized Cointegrating Coefficients:

LUSCPI	LJPCPI	LCHCPI	LJPY	LCNY
7.498996	-8.090564	0.108228	0.522795	2.196314
-13.41117	27.45008	-2.003103	0.581881	-0.695779
-12.82110	2.957848	-1.201065	-0.686792	0.742130
-17.09961	12.26559	0.682664	1.359061	-0.495311
-10.31998	12.42819	0.897068	-0.895141	-0.144110

Normalized Cointegrating Coefficients: 2 Cointegrating Equation(s)

LUSCPI	LJPCPI	LCHCPI	LJPY	LCNY	@TREND(80:2)	C
1.000000	0.000000	-0.135965	0.195785	0.561511	-0.014449	-5.093674
		(0.09274)	(0.11885)	(0.32133)		
0.000000	1.000000	-0.139400	0.116852	0.248988	-0.003813	-4.775675
		(0.05327)	(0.06827)	(0.18456)		

Log likelihood 1329.406