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Exchange rate pass-through in Mainland China

Chang Shu, Xiaojing Su and Nathan Chow

With persistent inflationary pressures since the second half of 2007 in Mainland China, renminbi appreciation has been increasingly advocated as a means to curb inflation. The effectiveness of appreciation in controlling inflation depends on the impact of exchange rate movements on import and domestic prices. Our analysis finds fairly large and speedy exchange rate pass-through (ERPT) to import prices, with 50% of an exchange rate change passed onto import prices immediately, and 60% over a year. The degree of ERPT decreases along the price chain from upstream to downstream prices. ERPT for consumer prices – the most downstream prices – is much milder and has substantial lags. A 10% rise in the nominal effective exchange rate will dampen consumer prices by 1.1% within a year with limited pass-through in the first half year, and 2.0% over two years.

These findings suggest that although there are lags in ERPT, renminbi appreciation can help to reduce inflationary pressures over the longer term. Also important is the finding that the renminbi needs to strengthen in effective terms in order to exert the desired dampening impact on prices.

Introduction

With persistent inflationary pressures since the second half of 2007 in Mainland China (henceforth China), renminbi appreciation is increasingly advocated as a means of helping to curb inflation. How effective appreciation will be in controlling inflation will depend on how much impact renminbi exchange rate movements have on domestic prices in China – an issue that has hardly been examined rigorously. This important question falls into the literature of exchange rate pass-through (ERPT), which contains substantial theoretical and empirical studies. The earliest theory linking the exchange rate and prices is the Law of One Price, which implies full ERPT. The failure of the Law of One Price has spurred considerable theoretical work attempting to identify factors influencing ERPT such as firms' pricing strategies, distribution and retail costs, and more recently stability of macroeconomic environment. A large number of empirical studies have also been undertaken, including many on developing economies in recent years, to assess the degree of ERPT in different countries and industries, and its determining factors. However, there have been few in-depth investigations examining China's case. A study by Ca' Zorzi, Hahn and Sanchez (2007) on ERPT in emerging markets includes China, while Fan and Xiang (2006) study the impacts of the exchange rate and foreign prices on some domestic prices.

This paper sets out to study ERPT in China in a comprehensive way by addressing a wide range of issues. What is the degree of ERPT to a range of domestic prices, particularly for import and consumer prices? Does ERPT diminish along the price chain? Has it declined in recent years as found in some developed economies?

The rest of the paper will be organised as follows. Section 1 reviews the literature on ERPT. Section 2 explains the empirical framework, while estimation results are presented in Section 3. The final section concludes by discussing policy implications of the empirical findings and pointing out directions for future research.

Section 1 Literature review

ERPT can be narrowly defined as the percentage change in local currency of import prices resulting from a one-percent change in the exchange rate between exporting and importing countries, or extended to refer to the impact of exchange rate changes on domestic prices in general. There is a vast literature on exchange rate pass-through (ERPT) to domestic prices. The starting point examining the link between the exchange rate and domestic prices is the Law of One Price which suggests that identical products would sell for the same currency price in different countries. Should the Law of One Price hold, ERPT will be complete and immediate. However, little evidence is found to support the Law of One Price, and deviations from it tend to be large and persistent, which points to incomplete ERPT.

In explaining incomplete ERPT, earlier literature, *e.g.* Dornbusch (1987), took an industrial organisation perspective where exchange rates are taken as exogenous variables. According to models in this vein, incomplete ERPT results from producers'

adjustment of their mark-ups in response to an exchange rate shock in an environment of imperfect competition. Mark-up responsiveness mainly depends on factors such as the market and industry structure, the degree of competition and the pricing behaviour of producers.

A closely related strand of literature is currency pricing where two pricing strategies are associated with two extremes of ERPT. Specifically, ERPT will be zero if producers set prices in the currency of the destination market, referred to as the local currency pricing (LCP), but it will be one if prices are set in producers' own currency, *i.e.*, producer currency pricing (PCP). The two pricing strategies and their implications on ERPT have often been studied in the new framework of international macroeconomics with a general equilibrium approach and micro-foundations as exemplified by Obstfeld and Rogoff (1995). Typically assuming sticky prices and the exchange rate being an endogenous variable, these models demonstrate that ERPT is a function of the underlying shocks in the economy and the given competitive structures of the industries involved. Most notably, Devereux and Engel (2001), Devereux, Engel and Storgaard (2004) and Bacchetta and van Wincoop (2002) endogenise a firm's choice of the invoicing currency, and argue that countries with low relative exchange rate variability or stable monetary policies are more likely to have their currencies chosen for trade invoicing, and hence more likely to have low ERPT.

Apart from producers' strategic behaviour, other factors giving rise to incomplete ERPT include trade distortions, transportation and distribution costs (Burstein, Neves and Rebelo, 2003), cross border production by multinational companies (Aksoy and Riyanto, 2000, and Hegji, 2000), and the use of currency hedging (Mann, 1986).

The empirical work on ERPT is as voluminous as the theoretical literature, particularly for developed economies with studies undertaken at the country, industry and product levels. In a fairly comprehensive review of early ERPT empirical studies, Goldberg and Knetter (1997) report that ERPT to import prices is found to be around 0.6 for the US, and slightly higher in other economies. Some recent studies often find ERPT to import prices is around 0.5-0.6 in the short run, and around 0.6-0.8 in the long run for developed economies such as the G7, euro area, or OECD countries, *e.g.* Campa and Goldberg (2002), and Campa and Gonzelez-Minguez (2005).

Many recent studies find that ERPT has declined in industrial economies in the past decade, *e.g.* Marazzi, Sheets and Vigfusson *et al.* (2005) for the US, Gagnon and Ihrig (2004) and Ihrig, Marazzi and Rothenberg (2006) for other developed economies. Taylor (2000) was among the first to suggest that the decline in ERPT is due to the low inflation environment in the industrialised countries, which has been brought about by more credible monetary policies. ERPT is primarily a function of the persistence of exchange rate and price shocks, which tend to be reduced in an environment where inflation is low and monetary policy is more credible. Nevertheless, a number of other studies

(Campa and Goldberg, 2006, and Campa, Goldberg and Gonzalez-Minguez, 2005) dispute the prevalence, magnitude and significance of the decline in ERPT.

Another important observation is that the degree of ERPT into aggregate price indexes is substantially smaller than into import prices, *e.g.* Ihrig, Marazzi and Rothenberg (2006). Many factors discussed above such as producers' pricing strategies, transportation and distribution costs can explain the dampened ERPT to consumer prices. For example, Campa and Goldberg (2006) establish that imported goods account for a much smaller share in the price of nontradable goods production than that of tradable goods, resulting in low CPI sensitivity to exchange rate movements. Burstein, Eichembaum and Rebelo (2002), and Burstein, Neves and Rebelo (2003) emphasise the role of distribution costs and substitution of domestic products in explaining the smaller ERPT to consumer prices than to import prices. In addition, some argue that the inflation impetus from a home currency depreciation may be countered by monetary tightening, and thus some of the inflationary pressures from depreciation are offset by policy (Gagnon and Ihrig, 2004, and Gust and Sheets, 2006).

Empirical studies on ERPT in developing economies have also been increasing in recent years.[1] For developing economies, ERPT is also found to be incomplete, and smaller for consumer prices than for import prices, *e.g.* Frankel, Parsley, and Wei (2005). Calvo and Reinhart (2000), and Goldfajn and Werlang (2000) show that ERPT is higher for emerging than for developed economies. However, in a study covering emerging economies in Asia, Latin America, and Central and Eastern Europe, Ca' Zorzi, Hahn and Sanchez (2007) find that ERPT to both import and consumer prices is low in emerging markets, and not that different from the levels of developed economies.

There have been only a small number of studies covering China so far. In their study on ERPT in a group of emerging economies, Ca' Zorzi, Hahn and Sanchez (2007) show that a 1% change in the exchange rate will lead to a change of 0.08% in China's consumer prices after 4 quarters, and 0.77% in 8 quarters. The estimates can be interpreted as the ERPT to consumer prices in China being around 10% and 80% over the short and long run respectively. Fan and Xiang (2006) suggest that if the exchange rate appreciates by 1%, producer and consumer prices will decline by 0.2% and 0.1% respectively.

Section 2 Empirical framework and data

This section will set up the empirical framework for estimating ERPT to import and domestic prices in China. Two empirical methodologies are often used for estimating ERPT. One is a Vector Autoregression model which typically includes the same number of lags for the exchange rate, domestic prices and some control variables. To allow more flexible dynamic structures such as varying lags for different variables, this study employs the other methodology widely applied in the

[1] A partial list includes Choudhir and Hakura (2001), Borensztein and De Gregorio (1999), Goldfajn and Werlang (2000), Devereux and Yetman (2002), Barhoumi (2005), and Frankel, Parsley and Wei (2005).

pass-through literature, *e.g.* Campa and Goldberg (2002), and Ihrig, Marazzi and Rothenberg (2006) to estimate an empirical model in the following form:

$$(1)\ \Delta p_t = \alpha + \sum_{j=1}^{k} \phi_j \Delta p_{t-j}^{k} + \sum_{j=0}^{k} \beta_j \Delta er_{t-j} + \sum_{j=0}^{k} \gamma_j \Delta fp_{t-j} + \sum_{j=0}^{k} \sigma_j comp_{t-j} + \sum_{j=0}^{k} \theta_j dd_{t-j} ,$$

where:

p = import or domestic prices measured in the renminbi
er = nominal effective exchange rates
fp = foreign prices
comp = commodity prices
dd = domestic demand.

In Equation (1), the variables are in year-on-year percentage changes as indicated by Δ. The estimation can only be undertaken using variables in year-on-year changes as most of the Mainland price series are published as such without level series. Unlike the majority of the studies which tend to focus on import and consumer prices, we investigate ERPT to a range of domestic prices along the price chain, including import, purchasing, producer, retail and consumer prices. Among the domestic prices, China's purchasing prices are the most upstream, measuring the costs paid by firms for production inputs such as raw materials, fuels and power. The next down the price chain are producer prices which measure those of industrial products when they are sold for the first time after production. Retail and consumer prices represent the most downstream prices, the difference between the two being that the former excludes consumption of most services.

Among the explanatory variables, *er* is the nominal effective exchange rate calculated as the trade-weighted average of the exchange rates of China's major trading partners. Control variables include foreign prices (*fp*), commodity prices (*comp*) and domestic demand (*dd*). Foreign prices are calculated as the weighted average of consumer prices of China's major trading partners. Three commodity price indices are used – an overall index and the two sub-indices for international food and energy prices. Domestic activity is measured as GDP minus net exports deflated by the GDP deflator, but a number of other proxies are also used including real GDP, industrial production and M2.

Compared to Fan and Xiang (2006), the current study examines a wider range of prices as well as controls for more important variables such as commodity prices and domestic conditions.

Most data are obtained from the CEIC, and those for commodity prices are from the *International Financial Statistics* compiled by the International Monetary Fund. Apart from import prices, equations for other prices are estimated using quarterly data mostly from 1998. Estimation for import

prices, whose time series starts at 2005, is based on monthly data.

The equations are estimated using the OLS. The general-to-specific modelling approach is adopted, with *k* in Equation (1) set to be 6 initially. The SIC is used as a yardstick for selecting the best specifications. Based on the estimated equations for the individual price series, short-run ERPT is taken as the sum of coefficients on the exchange rate variables, *i.e.* $\sum_{j=0}^{k} \beta_j$, while long-run ERPT is measured as:

$$\beta = \frac{\sum_{j=0}^{k} \beta_j}{1 - \sum_{j=1}^{k} \phi_j}.$$

In the empirical evaluation, we pay attention to two special cases: 1) a null hypothesis of zero ERPT, and 2) a unity pass-through.

Section 3 Results and analysis

China's nominal effective exchange rate (NEER) underwent several major swings during the sample period, mainly reflecting movements of the US dollar exchange rate against other currencies (Chart 1a). It was at its strongest at the end of 2001, but then went through a period of weakness until 2005. After the strengthening from the beginning of 2005, it was close to 15% stronger than at the beginning of the sample period. Charts 1b-d suggest that there is a negative relationship between the year-on-year changes of the NEER and those of import and domestic prices.

Chart 1a. NEER

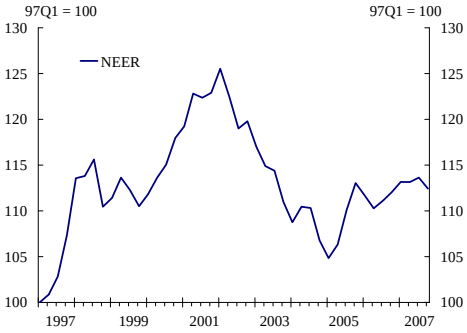


Chart 1b. Import price

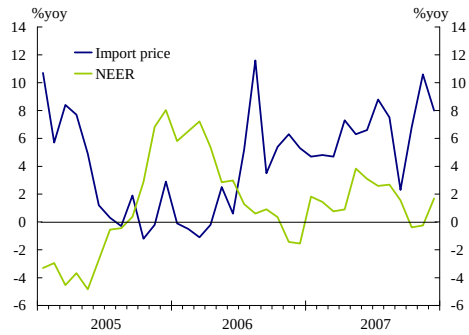


Chart 1c. Purchasing and production prices

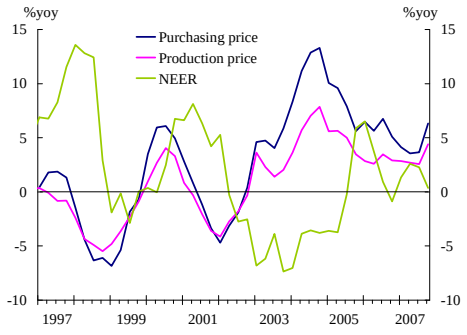
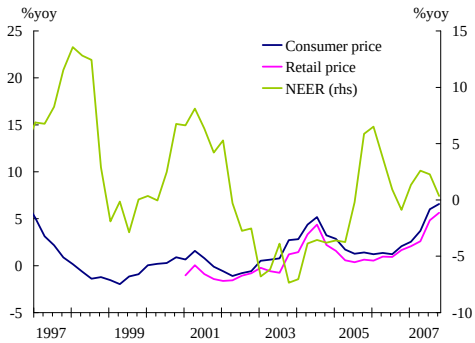


Chart 1d. Consumer and retail prices



Sources: CEIC, and staff estimates.

Estimation results

Estimation of Equation (1) confirms the negative relationship between the exchange rate and prices. Table 1 presents the estimated ERPT from the best specification for each of the five price series, with the smallest SIC.[2] Diagnostic tests generally show that the equations are well specified with well-behaved residuals. There are a large number of interesting findings. As found in nearly all empirical studies, exchange rate movements impact on domestic prices, but ERPT is incomplete in all cases. The Wald test rejects both hypotheses of zero and complete pass-through for all the prices.

Table 1. Short-run and long-run pass-through

	Short run			Long run		
	Pass-through (PT)	H_0: PT=0	H_0: PT=1	Pass-through (PT)	H_0: PT=0	H_0: PT=1
Import price	-0.505	0.010	0.000	-0.640	0.002	0.000
Purchasing price	-0.122	0.000	0.000	-0.542	0.002	0.000
Producer price	-0.104	0.002	0.000	-0.367	0.001	0.000
Retail price	-0.093	0.025	0.000	-0.239	0.005	0.000
Consumer price	-0.065	0.053	0.000	-0.201	0.022	0.000

Sources: staff estimates.

For import prices which are the first in the price chain for transmitting exchange rate shocks, the degree of ERPT is the largest with a short-term ERPT of around 0.5, and long-run ERPT of 0.64. These estimates are similar to those found for the OECD countries.

The degree of ERPT to consumer prices, which are at the bottom of the price chain, is much lower. The short-run ERPT is particularly low at around 0.07, which is close to that by Ca' Zorzi and Hahn and Sanchez (2007). Over the longer run, around 20% of exchange rate changes will be reflected in consumer prices. That is, if the renminbi appreciates by 10% in effective terms, consumer prices will decline by close to 2% in the long run. Judging by international experiences, our estimated long-run ERPT of 20% seems to be reasonable, while that of 80% by Ca' Zorzi, Hahn and Sanchez (2007) is surprisingly high. Compared with other economies, ERPT to consumer prices in China is higher than the very low ERPT reported for developed economies (Ihrig, Marazzi and Rothenberg, 2006, and Faruqee, 2004), but in the middle of the range reported for some developing economies (Ca' Zorzi, Hahn and Sanchez, 2007).

[2] The estimated equations and diagnostics are presented in the Appendix.

The estimates clearly show declines in the degree of ERPT along the price chain. ERPT to purchasing prices – among the most upstream prices in the pricing chain – drops markedly to 0.12 from 0.51 for that of import prices in the short run, but more modestly from 0.64 to 0.54 in the long run. Producer prices, which are next in the chain, see further drops in the degree of ERPT. Among the downstream prices, ERPT is still greater to retail prices than to consumer prices, possibly reflecting the greater service contents in the latter.

As reviewed earlier, the diminishing ERPT along the price may be explained by increasing contents to domestic inputs, such as transportation, distribution costs, and services. Also in China's case, utility prices such as water, electricity and fuel are controlled by the government at the retail end, which probably has also contributed to the small degree of ERPT to retail and consumer prices.

The speed of ERPT also seems to diminish down the price chain (Table 2). Import prices experience immediate impact from exchange rate changes. Within a quarter, over 95% of the long-run exchange rate impact will be translated into changes in import prices, and almost all the long-run ERPT is almost completed within two quarters. For purchasing and producer prices, ERPT in the first year is less than that of import prices, but still over 75% of the long-run levels. The estimated speed of ERPT for producer prices is close to that by Fan and Xiang (2006) who suggest that a 1% appreciation will lower producer prices by 0.2% after two quarters, *i.e.* a 20% ERPT. For the downstream prices, ERPT is notably slow. In the case of consumer prices, there is hardly any ERPT in the first half of the year, and after a year, there is only around 11% pass-through from exchange rate movements, *i.e.* only about half of the long-run ERPT.

Table 2. Speed of ERPT

	After 1 quarter	After 2 quarters	After 1 year	After 2 years	Long run
Import price	-61%	-63%	-63%	-63%	-63%
Purchasing price	-22%	-29%	-39%	-48%	-53%
Producer price	-18%	-23%	-29%	-34%	-36%
Retail price	0%	0%	-15%	-23%	-24%
Consumer price	0%	0%	-11%	-18%	-20%

Sources: staff estimates.

Robustness and stability

For each price series, we have obtained alternative estimates for a number of reasons. Several variables have been used to proxy domestic demand, and sometimes slightly different routes may be taken in eliminating variables in the general-to-specific estimation process. The alternative equations, from which the presented ERPT

estimates come, are also well specified with highly significant explanatory variables and well behaved residuals. Table 3 provides the range of the estimates for ERPT to different domestic prices. The results suggest the ERPT estimates for different prices are within quite a tight range. Our earlier observations continue to be born out by these estimates. Principally, ERPT is the highest to import prices, and diminishes along the price chain with the lowest pass-through to the most downstream prices of retail and consumer prices.

Table 3. Ranges of ERPT estimates

	Short run	Long run
Import price	-0.479 ~ -0.759	-0.640 ~ -1.197
Purchasing price	-0.122 ~ -0.172	-0.463 ~ -0.593
Producer price	-0.104 ~ -0.165	-0.259 ~ -0.367
Retail price	-0.040 ~ -0.110	-0.131 ~ -0.239
Consumer price	-0.054 ~ -0.112	-0.081 ~ -0.201

Sources: staff estimates.

As discussed earlier, declining ERPT is found for many economies in recent years. We test whether this has occurred in China by testing the stability of the estimated equations. The Andrew-Quandt test is used to test break points sequentially within the sample. Compared to conventional stability tests such as the Chow test, the Andrew-Quandt does not require an arbitrary choice of a break point, but searches for a break point systematically through the sample period. The test statistics presented in Table 4 show that for all the price equations, there is no evidence of a break throughout the sample, pointing to the stability of the estimations. This suggests that the degree of pass-through has been fairly stable for China's domestic prices.

Table 4. Test of stability

	A-Q statistics	Probability
Import price	1.127	1.000
Purchasing price	0.728	1.000
Producer price	1.186	1.000
Retail price	2.231	0.973
Consumer price	2.176	0.920

Sources: staff estimates.

Control variables

These estimated equations show that apart from the exchange rate, other variables also affect China's import and domestic prices. As expected, domestic conditions have impacts on prices, with higher domestic demand associated with higher inflation. Foreign prices are shown consistently to impact on import and domestic prices. Similarly to ERPT, their impacts also decline along the price chain with the effect being the biggest on import prices, and the smallest on retail and consumer prices.

The estimation yields some interesting findings with regard to commodity prices. The overall commodity price index is generally not found to be statistically significant in any of the price equations. However, energy prices in the global market can affect purchasing and producer prices. Most interestingly, international food prices are quite a significant factor influencing all the prices. For example, a 10% increase in international food prices would lead to a 0.5% rise in consumer prices in the short run, and 2% in the long run. Given that China only imports a small proportion of its food supply, the impacts seem to be quite high.

We also examined whether the degree of ERPT might be affected by international prices and domestic conditions by adding to the equations the terms interacting variables representing these conditions with the exchange rate variable. However, the interactive terms are generally not statistically significant. This suggests that the impact of international and domestic conditions on China's import and domestic prices is not through the ERPT channel.

Section 4 Summary, policy discussions and next steps

The major empirical findings of this study are:

- ERPT to import prices is close to 0.5 in the short run, and 0.6 in the long run.
- For consumer prices, ERPT is around 0.07 in the short run, and 0.20 in the long run.
- The degree of ERPT diminishes along the price chain, with exchange rate changes having impacts on purchasing and producer prices smaller than on import prices, and smaller still on downstream prices such as retail and consumer prices.
- The speed of ERPT also diminishes along the price chain. ERPT to import prices is almost instantaneous in the short run, and the long-run ERPT is largely completed within two quarters. For consumer prices, in contrast, there is hardly any ERPT in the first half year, and only half of the long-run ERPT is completed within a year.
- ERPT has been largely stable in China during the sample period.

These empirical findings on ERPT in China, especially that relating to consumer prices, have a number of important implications for macroeconomic policy. They suggest that although there are lags in ERPT, renminbi appreciation can help to reduce inflationary pressures over the longer term. Also important is that the renminbi needs to strengthen in effective terms in order to exert the desired dampening impact on price pressures. Despite the continuous appreciation against the US dollar since 2005, the renminbi has only begun in recent months to strengthen more consistently in effective terms. The strengthening of the renminbi in effective terms should help more in containing inflationary pressures in the coming periods.

By pinning down the size of ERPT to domestic prices in China, this study is useful as an initial step in assessing the potential role of the exchange rate in macroeconomic control. In the meantime, it has raised an important issue of what has caused the relatively low and slow ERPT to consumer prices in China. To shed light on this issue, we believe future research examining the following areas will be fruitful:

- China's import structure, such as the share of primary products and food;
- practice in trade invoicing, *e.g.* the proportion of invoicing in the US dollar and other currencies;
- possible impacts on the degree of ERPT of persistent appreciation expectations;
- influence of price controls on ERPT.

Appendix. Estimated price equations

The Appendix lists the representative estimates for the individual price equations.

Import price

$$\Delta imp_t = -29.07 + 0.21 * \Delta imp_{t-3} - 0.51 * \Delta neer_t + 1.92 * \Delta fp_t - 0.25 * \Delta food_t + 0.29 * \Delta food_{t-3} + 2.48 * \Delta rgdp_{t-3}$$
(-2.96) (1.35) (-3.04) (1.77) (-3.51) (4.26) (2.86)

Adjusted R^2: 0.62
Equation standard error: 1.99
LM for series correlation: F-statistics = 0.28 [0.60]
Normality test: $\chi^2(2)$ = 4.36 [0.11]
Heteroscedasticity: F-statistics = 0.86 [0.53]
Ramsey RESET: F-statistics = 5.04 [0.03]
Sample period: 2005M04 – 2007M12

Purchasing price

$$\Delta rmp_t = -6.62 + 0.77 * \Delta rmp_{t-1} - 0.12 * \Delta neer_t + 0.42 * \Delta fp_t + 0.04 * \Delta food_t + 0.04 * \Delta energy_t + 0.17 * \Delta rdd_t + 0.28 * \Delta m2_{t-2}$$
(-5.27) (18.66) (-3.13) (1.16) (2.21) (7.89) (2.14) (5.29)

Adjusted R^2: 0.97
Equation standard error: 0.84
LM for series correlation: F-statistics = 2.72 [0.11]
Normality test: $\chi^2(2)$ = 4.31 [0.12]
Ramsey RESET: F-statistics = 0.80 [0.38]
Heteroscedasticity: F-statistics = 0.44 [0.87]
Sample period: 1997Q2 – 2007Q4

Producer price

$$\Delta ppi_t = -3.41 + 0.72 * \Delta ppi_{t-1} - 0.10 * \Delta neer_t + 0.55 * \Delta fp_t + 0.04 * \Delta food_t + 0.03 * \Delta energy_t + 0.11 * \Delta rdd_t + 0.09 * \Delta m2_{t-2}$$
(-3.50) (14.24) (-3.32) (1.88) (2.73) (6.43) (1.72) (2.38)

Adjusted R^2: 0.96
Equation standard error: 0.68
LM for series correlation: F-statistics = 0.00 [0.98]
Normality test: $\chi^2(2)$ = 1.30 [0.52]
Ramsey RESET: F-statistics = 0.96 [0.33]
Heteroscedasticity: F-statistics = 1.18 [0.34]
Sample period: 1998Q1 – 2007Q4

Retail price

$$\Delta rpi_t = -3.34 + 0.61 * \Delta rpi_{t-1} - 0.09 * \Delta neer_{t-3} + 1.17 * \Delta fp_{t-5} + 0.07 * \Delta food_t + 0.16 * \Delta rdd_{t-3}$$
(-2.44) (5.47) (-2.41) (2.57) (3.96) (1.80)

Adjusted R^2: 0.88
Equation standard error: 0.67
LM for series correlation: F-statistics = 0.20 [0.66]
Normality test: $\chi^2(2)$ = 4.77 [0.09]
Ramsey RESET: F-statistics = 6.57 [0.01]
Heteroscedasticity: F-statistics = 0.46 [0.80]

Sample period: 2001Q2 – 2007Q4

Consumer price

$$\Delta cpi_t = \underset{(-2.30)}{-1.54} + \underset{(7.26)}{0.68} * \Delta cpi_{t-1} \underset{(-2.49)}{-0.07} * \Delta neer_{t-3} + \underset{(2.77)}{0.62} * \Delta fp_{t-5} + \underset{(2.92)}{0.04} * \Delta food_t + \underset{(1.88)}{0.03} * \Delta food_{t-2} + \underset{(1.70)}{0.10} * \Delta rdd_t ,$$

Adjusted R^2: 0.91
Equation standard error: 0.64
LM for series correlation: F-statistics = 0.58 [0.45]
Normality test: $\chi^2(2)$ = 1.06 [0.59]
Heteroscedasticity: F-statistics = 2.03 [0.09]
Ramsey RESET: F-statistics = 0.88 [0.35]
Sample period: 1998Q2 – 2007Q4

Variables:
imp = import price
rmp = purchasing price for raw materials
ppi = producer price
rpi = retail price
cpi = import price
neer = nominal effective exchange rates
fp = foreign prices
food = international food price
energy = international energy price
rdd = real domestic demand
rgdp = real GDP
m2 = broad money supply.

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About the Author

Chang Shu is Senior Manager, Xiaojing Su and Nathan Chow are Manager and Analyst respectively in the External Department. The authors are responsible for the views expressed in this article and any errors.

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