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## Empirical research on effect of exchange rate pass-through into China's export price

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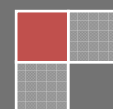
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### ABSTRACT

Exchange rate pass-through into prices (ERPT) is a very important mediate link between exchange rate and its economic effects. And the size of export effect induced by exchange rate change depends on the elasticity and speed of export price ERPT to some degree. On the basis of SITC, this paper uses Distributed Lag Model and Co-integration to research the elasticity of Chinese export price ERPT from 1995 to 2007. The result indicates China's export price shows obvious incomplete pass-through in the long run. The elasticity is slightly larger than 0.5. And there is a big difference among different products' elasticity. The products which have strong competitiveness in the world market own more power to pass the cost of RMB appreciation and their elasticity is relatively bigger.

### KEYWORDS

China; Export Price; Exchange Rate Pass-Through into Prices; RMB.



## INTRODUCTIONS

As exchange rate is one of the most important economic variables in the open market, its changes will change the contrast between the domestic and international commodity prices, and then affect the international competitiveness, exporter profits and so on. When the exchange rate changes, exporters can choose to completely pass-through to the export price (Complete Pass-through), or they can keep the export market prices unchanged and bear the impact of exchange rate changes (Zero Pass-through). Also the exporters can choose the mediate method (Incomplete Pass-through). Obviously, when other conditions remain unchanged, the exchange rate fluctuations impact on export mainly depends on the transmission elasticity of export price to the changes of exchange rate. Furthermore, it is of great significance on these problems which include export price elasticity and speed adjustment of external imbalances, the choice of exchange rate regime, monetary policy and so on.

Incomplete exchange rate pass-through leads the analysis framework of the traditional international economics to suffer from a serious challenge in reality. Many scholars have been studied on this issue, Froot and Klemperer<sup>[2]</sup>, Feenstra, Gagnon and Knetter<sup>[3]</sup> had established model to study the impact of the market share on exchange rate Pass-through. Goldberg and Knetter<sup>[4]</sup> had conducted a more comprehensive review and assessment on the PTM. Hooper and Mann (1989), Campa and Golberg<sup>[5]</sup>, Campa et al.<sup>[6]</sup> and McCarthy (2000), who did empirical research using single-equation Distributed Lag Model (DLM), Cointegration and Verified Error Correction (VEC), Vector Auto Regression (VAR) and other methods. Although samples and regression methods they selected are different, their conclusions are mostly incompletely pass-through especially in the short term and there are big differences about convey flexibility in different industries and countries. Due to the different elasticity of demands and degree of competitions in the market, there is a big difference in different types of products' transfer elasticity. On the basis of the product types' segment, the article will use the monthly data from 1995 to 2007 to study the Chinese export prices of currency transfer in order to provide some reference to further reform the RMB exchange rate system, trade policy adjustment and so on.

## MODEL HYPOTHESIS AND DATA PROCESSING

### Model hypothesis

In order to estimate export price's exchange rate pass-through, Hooper and Mann came up with the Markup Pricing Model in 1989. This model has widely applied to analyze the theory of export price's exchange rate pass-through. Suppose that the export price which is stood by the domestic currency expresses the production cost-plus. That is,

$$EXP = (1 + \phi)C \quad (1)$$

Where EXP is the export price, C is the production cost, both of which is stood by the domestic currency;  $\phi$  is the markup percentage and  $1 + \phi$  is the markup, short for MK.

The present studies and data show that  $\phi$  is influenced by many factors. Such as the demand, the competitive pressures from the foreign market, market structure, the necessity to maintain the foreign shares and so on. But considering the availability of data and existing researches, MK can be seen as a function of the price level of foreign competitors (FP), world demand (WD) and the exchange rate of the RMB in direct quotation. That is:

$$MK = MK (REER, WD, FP) \quad (2)$$

We can use corresponding lowercase letters to represent the logarithmic variable sequence, so export prices can be expressed as the following function:

$$exp = f(reer, c, wd, fp) \quad (3)$$

Then we make a stationary test on this sequence, it turns out that the above variable sequence is non-stationary I (1). Therefore, it is necessary to do some difference processing to avoid spurious regression. But due to export contracts, menu cost and other aspects, it is too difficult for the export price to change immediately after the adjustment of exchange rate and other control variables. There exists time lag with time-character. Based on Campa and Goldberg's researches and other studies, A Distributed-Lag Model finally is established as follows:

$$dexp_t = \alpha_0 + \sum_{i=0}^4 \alpha_{1,i} dreer_{t-i} + \sum_{i=0}^4 \alpha_{2,i} dc_{t-i} + \sum_{i=0}^4 \alpha_{3,i} dwd_{t-i} + \sum_{i=0}^4 \alpha_{4,i} dfp_{t-i} + u_t \quad (4)$$

While the most important factor is  $\alpha_{1,i}$ , it measures the changeable proportion of the exchange rate reflected in export price third-order lag (in domestic currency), namely the coefficient PMT. According to the theory of exchange rate pass-through, elasticity transmission is generally defined as the percentage of import price's change measured by the import country's currency which is caused by the one percentage of exchange rate change<sup>[4]</sup>, that is to say,  $\gamma = 1 + \alpha_{1,i}$ . Assuming that the exporter's marginal cost is constant, whether the PTM phenomenon exists or not depends mainly on the price elasticity of demand in export markets. If the elasticity of demand in export markets is not sensitive to price change, the export prices may remain in the same in domestic currency. While once export prices in foreign currency rise, and the degree of it is equal to that of exchange rate change, the phenomenon of complete transmission appears, rather than

PMT( $\alpha_{1,i} = 0, \gamma = 1$ ); While demand is elastic, in order to protect market shares, exporters will not pass exchange rate changes completely on to the foreign export prices, instead by adjusting the addition proportion to assume part of the exchange rate shocks, incomplete transmission phenomena of PTM, comes ( $-1 \leq \alpha_{1,i} < 0, 0 \leq \gamma < 1$ ). Besides, with the rise of price, if the import country's demand becomes more inflexible, finally the mark-up may rise, the phenomenon of inverse PTM will appear ( $\alpha_{1,i} > 0, \gamma > 1$ ).

PTM coefficient is associated with the competitiveness of exporters in the world market. If the exporters are price takers (it means lack of competitiveness), PTM coefficient will be -1. In this case, export prices (in domestic currency) and the RMB exchange rate movements in the opposite direction in the same proportion, while foreign currency prices remain constant, the transmission coefficient is 0. In another extreme case, the exporter is without any competition in the world market (this means strong market power), they do not adjust the price of the currency (PTM coefficient is 0), exchange rate changes are fully reflected in the foreign currency ( $\gamma = 1$ ). So what between the two phenomenon is an incomplete transmission.

### Data processing

Export Price Index (EXP). On the basis of Cerra and Saxena (2002) classification, we use amount and sum of monthly major export commodities, which are counted by customs, increase some kinds of commodities, and construct SITC—export price index at single-digit level by using Laspeyres chain index.

Effective Exchange Rate of RMB (REER). Although RMB is basically pegged to the dollar in quite a long time after implementing the system reformation of unification of exchange rates, some countries and regions except the United States that China mainly exports to, whose exchange rates of the currencies against the dollar fluctuates frequently, will lead to the changes of RMB against the value of currencies of other countries or regions indirectly. So using the real effective exchange rate can be better to reflect the comprehensive influences.

Production cost of exporters (C). Empirical research generally uses CPI or PPT (producer price index) on behalf of exporters’ production costs. But we use CPI of China as a substitute variable here because data availability is limited.

World Demand (WD). Considering that China’s exports are concentrated in the OECD countries, we use the OECD monthly industrial production index as a proxy variable.

Foreign competitors’ Price level (FP). We adopt the method of HUNG *et al.*<sup>[12]</sup>, and use the weighted average of wholesale commodity price index or producer price index of China’s 16 major export markets with the bilateral exchange rate as a proxy variable. The weight is the ratio of the value of export accounts for.

Firstly we convert the above sequences to domestic currency, then express them uniformly as the invariant index series of index 100 of January 1995, use the X11 method to reject seasonal trends, and take natural logarithm. <sup>4</sup>EXP, C and WD come from the database of China Economic Net, and other data comes from IMF.

### THE RESULT OF THE EMPIRICAL ANALYSIS

#### The return of the transfer elastic results

The TABLE 1 was concluded from the regression results of the formula (4), in which it described the exchange rate of the transfer elastic in Chinese export price.

TABLE 1 : Classification of China's export prices of PTM ratio and elastic.

PTM ratio	Total	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8
Short-term	0.0286	0.2230	-2.0789	-0.5266	-0.1468	0.5334	-0.3600	0.0194	-0.0013	-0.2607
Long-term	-0.4260	-0.8936	0.1916	-0.9944	-0.0810	-0.4132	-1.0957	-0.4539	-0.0571	-0.2085
Long-term transfer elastic	0.5740	0.1064	1.1916	0.0056	0.9190	0.5868	-0.0957	0.5461	0.9429	0.7915

According to the formation of the Standard International Trade Classification, the one-digit classification of SITC includes ten category products, they are: SITC0: food and live animals largely for food; SITC1: beverages and tobacco; SITC2: The non-edible raw materials; SITC3: Fossil fuels, lubricants and related materials; SITC4: plants and animals’ oils and waxes; SITC5: chemicals and related products; SITC6: according to the raw materials division of manufactured goods; SITC7: Machinery And Transport Equipment; SITC8: miscellaneous Products; SITC9: unclassified and unconventional commodities. The trading value in SITC9 is too little to consider.

States: short-term PTM ratio reflects the exchange rate movements which affect the current export prices; Long-term PTM ratio is four order lag ratio is the sum of the current period. The Long-term transfer elastic is  $1 + \sum_{i=0}^4 a_{1,i}$ .

We can see from the regression results, in the short term, China's total export prices is not obvious (PTM) in accordance with the market pricing, But in the long term the phenomenon of PTM exists. Lagging phase 3 of PTM ratios are statistically significant and the number is bigger. There is a lag in the incomplete transmission of export price. If the domestic currency appreciates 1% in real terms, the long-term export price (denoted by the domestic currency) will depreciate by 0.426%. The export price denoted by the foreign currency will appreciate by 0.574%, namely that the transfer elastic is 0.574. That is to say, in order to minimize the impact of exchange rate on fluctuation of export market demand, the exporters undertake more than 40% of the exchange rate’s strike. Indeed, exchange rate changes can be seen as a cost impact on the exporters. The regression results suggest that the competitiveness of China's overall exports in the international market is not strong enough and its ability to transfer the influence of RMB appreciation is relatively limited.

Prices of different types of export products are different to exchange rate fluctuations. This is because China's different types of competitive advantage, foreign demand elasticity and the marginal cost of output elasticity. However, they are consistent with the theory and other empirical research

conclusions. In the short term, there are several industries such as SITC2, SITC5, SITC8, in which the PTM phenomenon is significantly. When RMB appreciates by 1%, their export prices will fall 0.5266%, 0.36%, 0.2607%, respectively, especially SITC2 and ratio of SITC5 at about negative 1, long-term price decline was almost the same as the exchange rate appreciation and exchange rate appreciation caused by cost impact largely borne by exporters themselves. SITC2 are non-edible raw materials (apart from fuel), SITC5 are chemical products and related products. In these two kinds of products, China is at a comparative disadvantage so that is basically at a trade deficit over the years. In 2007, for example, these two kinds of products have a gap as much as \$108.8 billion and \$47.1 billion respectively. By the transfer theory, passing on the exchange rate shocks was positively correlated with the competitiveness of exporters in foreign markets, these two kinds of products with weaker competition led to their PTM ratio are bigger, so the ability to pass on exchange rate shocks are limited. SITC1 PTM ratio up to 2.0789 in a short time, but in the long term is positive, the number is not big. This industry is not in conformity with the theory of PTM, may be related to the industry's own characteristics, such as low degree of liberalization of trade of tobacco products. SITC8 include furniture, travel goods, footwear and other labor-intensive products. Chinese exports of many products have strong competitiveness in the international market and this kind of product with low price elasticity of demand. Exporters can pass on the appreciation of the RMB on the impact of it at nearly 80%.

Especially, we should pay more attention to SITC7 which mainly include capital-intensive and technology-intensive products, Based on the relationship between the industry products' price and the exchange rate fluctuations, we can know that the products are competitive in the worldwide and the majority of the cost of exchange rate movement can transfer to foreign consumers. Certainly, the high carry-over factor may have relationship to mode of trade and the nature of enterprise. Most of the export of the industry is produced by overseas-funded enterprises through processing trade. It means that to get further realize in the exchange rate pass-through of export price, we should make a distinction between mode of trade and the body in trade and know the change in the cost of import products.

### Wald test of regression coefficients

It is an important way for Wald test to research on exchange rate pass-through, TABLE 2 is the assay consequence of PTM coefficient. For the whole exports, it is very high to accept short-time PTM coefficient from 0 to P, that's to say, short-time PTM coefficient is not very obvious. However, PMT phenomenon is still exist in long time because coefficient P which accepts long-time PMT equals to 0 has a sharply decrease. For goods classification, except SITC1, other products all can't reject the hypothesis that the short-time PMT coefficients' value equal to 0, the P coefficients of them are very high and they have non-significant PMT phenomenon. Compared to other products, four types of products SITC1, SITC4, SITC7, SITC8 can accept the higher P coefficients on which PMT coefficients value equal to 0, SITC3 and SITC6 even refuse to equal to 0 under the 5% significance level.

TABLE 2 : Shot-time and long-time PTM coefficients and Wald test

hypothesis testing	Total	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8
Short-time=0	0.0212 (0.8844)	0.2865 (0.5934)	3.9784 (0.0482)	1.8865 (0.1720)	0.1438 (0.7052)	0.6563 (0.4194)	0.8757 (0.3512)	0.0159 (0.8999)	0.0000 (0.9975)	0.8584 (0.3560)
Long-time=0	1.0344 (0.3111)	0.5417 (0.4631)	0.0098 (0.9211)	1.8454 (0.1767)	4.1755 (0.0431)	0.1315 (0.7174)	2.2739 (0.1341)	12.0058 (0.0007)	0.0046 (0.9459)	0.1259 (0.7233)

Note: The statistics in the table is F statistics, and the value in the brackets is P coefficients.

### Long-term Pass-ThroughElasticity: based on the co-integration test

Co-integration is another important method for the study of long-run relation. In this section we will use this approach to analyze the pass-through elasticity of total export prices. There are two main methods of Co-integration test. The first one is raised by Engel and Granger<sup>[5]</sup>, which is regression equation residual error of two step test based on co-integration. The second one is raised by Johansen

and Juselius, which is Co-integration system test based on the VAR. When testing the relationship between two variables, TABLE 3 is the result of co-integration test, showing the co-integration relationship among EXP, REER, C, WD, FP, etc.

**TABLE 3 : Johansen co-integration test**

Suppose co-integration equation number	Characteristic root	Trace Test			Max-Eigenvalue Test		
		Trace Statistic	5%critical value	P-values**	Max-Eigenvalue Test	5%critical value	P-values**
No co-integration relationship	0.2383	122.1816	88.8038	0.0000	40.5570	38.3310	0.0273
At least one collaborators	0.1975	81.6246	63.8761	0.0008	32.7777	32.1183	0.0415
At least two collaborators	0.1585	48.8469	42.9153	0.0115	25.7178	25.8232	0.0516
At least three collaborators	0.1031	23.1291	25.8721	0.1057	16.2160	19.3870	0.1362

**Note : \*\*MacKinnon-Haug-Michelis (1999) p-values.**

TABLE 4 shows the co-integration vector coefficient estimation based on export price after the regularization. Besides competitor prices (FP), the other estimates, which show variable symbol is the same as distributed lag model, are statistically significant. PTM coefficient counted by co-integration is bigger than the one counted by DLM. The appreciation rate of the RMB is 1%, export prices fall 0.4977% and pass-through elasticity is 0.5023. Test also finds that there is a one-to-one relationship between the production costs of exporters and domestic currency export price. With other conditions unchanged, the rising of domestic production costs and appreciation of the RMB will make Chinese foreign export prices rising, weaken the price competitiveness of Chinese exports, which have a negative impact on exports.

**TABLE 4 : Co-integration vector coefficient**

<i>Exp</i>	<i>reer</i>	<i>c</i>	<i>wd</i>	<i>fp</i>	Constant term
1.0000	0.4977	-1.0100	-0.9249	-0.4955	-14.8647
	(0.1244)	(0.3411)	(0.3484)	(0.5394)	

**Note : Standard errors are shown in brackets**

### CONCLUSIONS AND IMPLICATIONS

On the basis of SITC 1, this paper uses Distributed Lag Model and co-integration to test the effect of pass-through of RMB's exchange rate on China's export price. We can get conclusions as follows through analysis.

Firstly, there is no PTM exciting in China's total export prices in the short run. But it excites in the long term. Exchange rate pass-through is incomplete. And the elasticity is about 0.5. Exchange rate pass-through into export price shows obvious time-lag effect.

Secondly, there is a big difference among different products' exchange rate pass-through into China's export price both in the short run and the long run. In the long run, PTM excites in many other products except SITC1. Exchange rate pass-through is incomplete. Products SITC3, SITC7 and SITC8 have bigger elasticity.

Thirdly, the exporter's cost of production has a significant impact on China's export price. The rising cost of domestic product and the significant appreciation of RMB result in the rise of China's

foreign currency export price. The price competitiveness of China's export products has been impaired, which has a negative effect on export.

Our research shows that, as for the research of exchange rate pass-through into export price, the subdivision of industries' data is necessary, which does help to distinguish between the specific pass-through of exchange rate into the export price, can also does benefit to the formulation of reasonable industrial policy and export policy. As mentioned above, there may be a big difference among the exchange rate pass-through into export price with different trade patterns and different subjects of trade. Processing trade exports occupy a large part of China's total exports. It's characteristics of the two heads out decides that the exchange rate pass-through is different from general trade. Half of China's exports are finished by foreign-capital enterprise. Its pass-through is different from domestic enterprises because of the transfer pricing and the internal exchange rate. To distinguish between the trade patterns and different subjects of trade is a major direction in the future research, which also has a great significance in policy.

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