An Empirical Study of Exchange Rate Pass Through in China

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Abstract

This paper estimates exchange rate pass through in China and investigates its relationship with monetary policy, especially the debate of exchange rate regime, by applying single equation model. Result shows that 1% appreciation of NEER declines 0.132% CPI inflation rate and 0.495% PPI inflation rate over the long run. When monetary policy regime is considered, such as exchange rate regime and inflation environment, I find that monetary policy regime matters for CPI pass through, but not for PPI. Especially, CPI pass through in fix exchange rate period is higher, combined with the fact that appreciation declines inflation rate, it implies Chinese government could pursue more flexible exchange rate policy. In addition, reason for low CPI exchange rate pass through is also discussed, from the aspect of price control, basket and weight of Chinese price indices, distribution cost, non-tradable share and imported input.

Keywords: Pass-through, Exchange rate, Consumer price, Producer price, Monetary policy

JEL classification: E31, E42, F31, F41

1 Introduction

The debate about revaluation of Chinese Yuan has been a hot topic for long time. Although Chinese Yuan appreciated almost 20% during 2005 and 2008, the degree of appreciation is not satisfied by international community, exchange rate war restarted since subprime crisis was eased. Krugman's impossible trinity pointed out, in the framework of open economy, exchange rate stability, domestic monetary policy independence and free capital movement could not obtain together. It is without doubt that China would open its capital market gradually, therefore the reform of the exchange rate is inevitable. But when and how would the reform be operated is still a large issue for China's central bank. After all, they would not like to sacrifice economic growth, suffer from high unemployment and inflation.

The transmission movement from exchange rate to price level, namely exchange rate pass through(ERPT), is one of the concern. In new open economy macroeconomics, the degree of exchange rate pass through is critical for appropriate monetary policy. A low exchange rate pass through implies government need not worry about price instability or inflation, while adjusting exchange rate policy. Hence it is thought to provide great freedom for pursuing an independent monetary policy. In this paper I attempt to exam the movement from exchange rate to domestic price, which may assist Chinese government to consider the revaluation issue of Chinese Yuan to a certain degree. Additionally, Chinese Yuan experienced three years' revaluation, does this appreciation influence exchange rate pass through?

One doubt is the meaning of measuring exchange rate pass through, since most of time Chinese Yuan is purely pegging to US dollar. Whereas, Appendix A illustrates major importing countries and regions for China, which implies exchange rate should not only concern US dollar, but also other main currencies. Nominal effective exchange rate is universally used, which considers all main trading partners' currencies, and fluctuates all the time.

Concerning empirical literature, three approaches are applied to estimate exchange rate pass through, single equation method, Vector Autoregressive Model and Cointegration Model. And few literatures calculated China's exchange rate pass through. Ca' Zorzi et al.(2007) analyzed plenty of emerging countries' ERPT, included China. Shu & Su (2009), Wang & Li (2009) and Chen & Liu (2007) calculated China's exchange rate pass through for batch of price index. One innovation of my paper is to introduce the distribution cost into computation of ERPT, which is thought to be an important factor leading to the violation of purchase power parity. Attributed to the difficulty of assessing appropriate data, it is always neglected by empirical

work. Other intriguing innovation is to shed light on the associate between monetary policy and ERPT comprehensively, in particular the effect from exchange rate regime's transform. Although Wang & Li(2009) mentioned the increase of ERPT during appreciation period by simple divide sample, this method is not so suitable owing to the limit number of data, my method involving dummy variable would improve it and be more reliable. Last but not least, this paper also discusses the cause of pass through discrepancy for various price indices (here is CPI and PPI), while previous work only stated the discrepancy, but not the reason.

To assess the degree of pass through for CPI and PPI, three methods are all attempted. Nevertheless, VAR model is not so convenient to survey relation between monetary policy and ERPT (VAR's result available in the appendix C), Cointegration model relies on cointegration rank test (not ideal test result for my data), so single equation approach is the best from my point of view. Result demonstrates that appreciation of Chinese Yuan could decrease the CPI inflation rate, but the degree is statistically insignificant. PPI's effect is much larger than CPI's over the long run. Different monetary policy regime such as inflation environment and exchange rate regime is tested as well. Result finds monetary policy regime impacts on CPI pass through, in particular, CPI pass through is higher in fix exchange rate regime. Followed Bustein et.al (2003), Campa and Ihrig (2006), and combined the definition of price indices, I supply some evidence about the share of imported inputs and non-tradables, distribution cost, to interpret the low CPI pass through and discrepancy between CPI and PPI pass through.

This paper is organized as following. Section 2 is a review of literature about the theoretical and empirical work has been done in the field of exchange rate pass through. Section 3 illustrates the stylized facts of exchange rate policy and inflation environment after 1990. Section 4 presents the analytical framework, reports the result of pass through measurement for CPI and PPI, and surveys the relation between monetary policy and exchange rate pass through. Section 5 discusses the reason for a fairly low CPI pass through. Section 6 is conclusion.

2 Literature Review

2.1 Theoretical Work

In traditional open economy macroeconomic model, purchasing power parity holds all the time, implies that pass through is complete and immediate. However, many empirical works have demonstrated purchasing power parity or law of one price does not hold in real world.

There are plenty of theoretical explanations, one reason is export producers' pricing to market behavior (Krugman 1987): in an incomplete competition market, a firm sets different price for its goods across segmented national markets to compete with local competitor, and it could adjust its mark-up according to exchange rate shock as well. A similar framework is also stemming from pricing behavior is local currency pricing, mentioned by Devereux and Engel (2003). Instead of setting price in producers' currency, firm could choose local currency pricing, when exporting to countries with relative low exchange rate variability or stable monetary policies. Then in the framework of new open economy macroeconomics, the incomplete pass through is explained by some firms follow local currency pricing, some firms practise producer currency pricing.

Another cause for incomplete ERPT is distribution cost of tradable goods purposed by Bustein, et.al (2003). They stated that the costs of distributing tradable goods like transportation, wholesale and retail also contribute to the incomplete exchange rate pass through. They defined distribution margin and calculated it for America and Argentina to reflect the huge scale of distribution sector. The growing globalization of production (Campa and Goldberg 2006) is also an explanation. If the proportion of imported components is higher, then the domestic prices will be more sensitive to exchange rate, as it supplies another channel for exchange rate transmission besides importing final goods. There is also argument relating to slow adjustment of goods prices (Devereux and Yetman 2009). Due to the endogenous sticky price and menu cost, pass through is not complete.

2.2 Empirical Study

In terms of empirical work, three methods are mainly applied to measure exchange rate pass through. Firstly is linear model. Originating from law of one price of tradable good, Ihrig et al.(2006) added interpretation terms like trade barriers, lags of independent variables and other control variables as well, to analyze the relation between import price or consumer price and exchange rate in G7 countries. Especially, they used a general to specific algorithm from Hendry and Krolzing (2001) to select the appropriate specification for independent variables. They found a quite low long run exchange rate pass through for CPI in the period 1990-2004, from 0.002 to 0.083.

Campa and Goldberg (2005) also started from law of one price, then treated foreign producers' export prices by a monopolistic mark-up over exporter marginal cost. They estimated pass through into import prices across a large sample of OECD countries, and cross-country pass

through is 46% in short run and 65% in long run.

Bailliu and Bouakez (2004) founded on monopolistic producers' profit maximization, and applied dynamic panel data GMM model to measure exchange rate pass through for 11 industrial countries, and found on average, the short run and long run PPI pass through are 0.202 and 0.301 respectively, and for CPI are 0.080 and 0.160.

Second approach is Vector Autoregressive Model (VAR) , started from McCathy (2000)'s study. This kind of work regards exchange rate pass through as the response of price to an exchange rate's structural shock. He examined the impact of exchange rate and import price shock on CPI and PPI for several industrial economies, utilizing impulse response function and variance decomposition, and found that aggregate consumer price's pass through is moderate in most of countries. Hahn (2003), Faruqee (2006) followed this method for euro area, while Ito & Sato (2008) checked the situation in east Asian.

A slightly different method is Cointegration and Error Correction Model (ECM). Its advantage is the long run exchange rate pass through is just estimated by the stable cointegration relationship among exchange rate, domestic and foreign prices, maybe also some other variables. Kim (1998) applied ECM for US data, Beirne et al. (2009) used for eastern Europe. However, the condition for a cointegration estimation is much stronger than VAR model.

Concerning empirical work about China, Ca' Zorzi et al.(2007) used VAR model to plenty of emerging countries, included China. They found that 1% of exchange rate shock leads to 0.08% response of consumer price over 4 quarter, 0.77% over 8 quarter. Their result for China is thought too high comparing with other literatures. Following the similar approach, Chen & Liu (2007) stated 1% of nominal effective exchange rate's shock only causes 0.0076% response of CPI in maximum. Shu & Su (2009) applied single equation regression combined with general to specific method, the result is 1% of appreciation causes 0.065% and 0.104% decline of consumer price and producer price respectively in short run, 0.201% and 0.367% decrease over long run. Wang & Li(2009)'s estimation of long run ERPT for CPI is 0.24, which also used linear method.

2.3 Monetary Policy and Exchange Rate Pass Through

Furthermore, the relation between ERPT and monetary policy regime is often discussed. The idea inflation environment could affect exchange rate pass through comes from Taylor (2000). He established a simple sticky price setting model with market power, claimed that the low inflation may be associated with less persistent changes in costs and the prices at

other firms in the economy, and then results in low pass through. Bailliu and Bouakez (2004) empirically supported Taylor (2000)'s argument, they suggested pass through declined during inflation stabilization period (in the early 1990s) for industrialized countries. Choudhri and Hakura (2006) provided strong evidence of a positive relation between pass through and average inflation rate across 71 countries. Ihrig et al. (2006) also compared pass through in subsample (before and after 1990s), and found a significant decrease for almost all G7 countries.

For emerging transition and countries, Coricelli et al. (2006a, b) stated that reform towards more flexible exchange rate, combined with an inflation targeting framework, disconnects the link between exchange rate and prices. Beirne et al. (2009) found higher ERPT for countries within fixed regime across nine central and eastern European EU member state. Barhoumi (2005) used Panel Cointegration model for 24 developing countries, and found out countries with fixed exchange rate, lower tariff barriers and higher inflation rate associate with a higher long run import price pass through. Wang & Li(2009) mentioned the increase of ERPT during appreciation period for China.

3 Stylized Facts on Post-1990 Inflation and Exchange Rate in China

Between 1992 and 1993, China experienced a serious inflation period. The CPI inflation rate reached the peak in Oct 1994, around 28%. Subsequent monetary tightening policy lowered inflation rate successfully, without obviously negative impact on output. However, the Asian financial crisis brought the CPI to another direction: deflation. The deflation was mild (the peak value was only 2.2% occurred in June 1999), but lasted for long time, until 2002 this round of deflation ended. After that, China's inflation was relative low and stable, except in 2007, which year the asset price bubble was serious. For PPI inflation, the general trend is analogous to CPI, merely with more significant fluctuation. Figure 1 illustrates the trend of CPI and PPI inflation based on 12 months changes.

Concerning exchange rate, the reform is propelled step by step. Before 1994, there were two different exchange rates: official rate and swap market rate. On Jan 1994, government merged two exchange rates, and implemented a so-called market-based, single, managed floating exchange rate system. But in fact it was still pure US Dollar pegging system, and adjusted the nominal USD/CNY rate suddenly from 5.8 to 8.7. Since then until 2005, the nominal value of

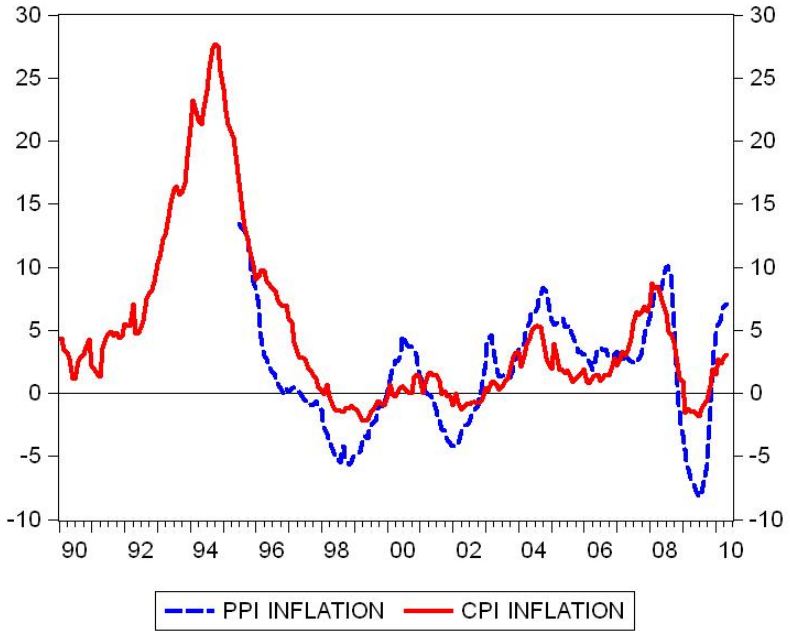

Figure 1: Inflation Rate for CPI and PPI (12 months change)

Chinese Yuan vis-*à*-vis the dollar fluctuated in a rather narrow range around 8.28, even in the asian financial crisis. Due to the imbalance of international payments, challenge of independent monetary policy, overheating concern and pressure from western countries, China executed a new manageable floating exchange rate policy on July 21, 2005. This new policy was based on market supply and demand and with reference to a basket of currencies. Reference currencies consisted of US Dollar, Euro, Japanese Yen and Korea Won, but the operation was not transparent yet. In the subsequent 3 years, the nominal USD/CNY rate decreased to 6.84, appreciated nearly 20%. With the breakout of subprime crisis, the step of appreciation was ceased, and the nominal USD/CNY rate maintained in this level until now.

Figure 2 plots the nominal USD/CNY rate, which might arises doubt about the meaning of measure exchange rate pass through, as most of time Chinese Yuan is pegging to US dollar. However, concerning ERPT, transmission of exchange rate to price level is not only considering US dollar, but many other major currencies as well. Appendix A depicts the main importing countries and regions for China, in 2000 and 2005. It indicates Japan is the largest importing country for China, then is Korea and Taiwan region, US only ranks fourth. Consequently, the exchange rate should consider all trade partners' currencies, normally is nominal effective exchange rate, which fluctuates all the time (see figure 3). Nominal effective exchange rate

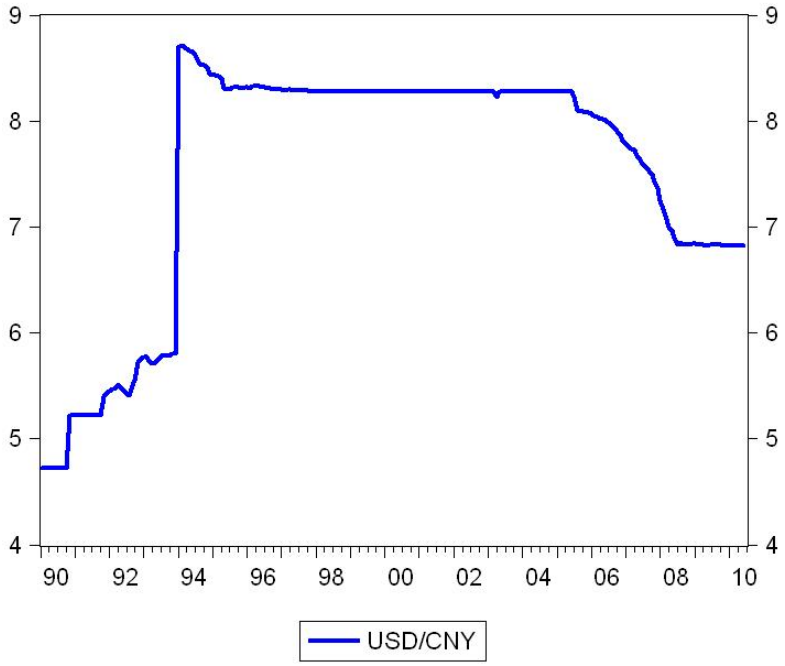

Figure 2: Nominal Exchange Rate vis-a-vis the U.S.Dollar

calculated by IMF appreciated around 7% from 2005 to 2008.

Figure 3 describes the co-movement between domestic price (CPI,PPI) and nominal effective exchange rate (NEER) as well. The trend of CPI and PPI is similar, and compared with NEER, they moved in the same direction during 1995-1997 and 2005-2010, but between 1998 and 2004, they varied in opposite direction.

4 Empirical Analysis

4.1 Framework

Many literatures use single equation to regress domestic price as a function of exchange rate, foreign price and control variables such as output gap, like Ihrig et al.(2006), Campa and Goldeberg (2005), Bailliu and Fuji (2004).

My framework comes from Devereux and Yetman (2009): Assuming a large number of importing firms, they purchase a differentiated consumer good from foreign countries and sell

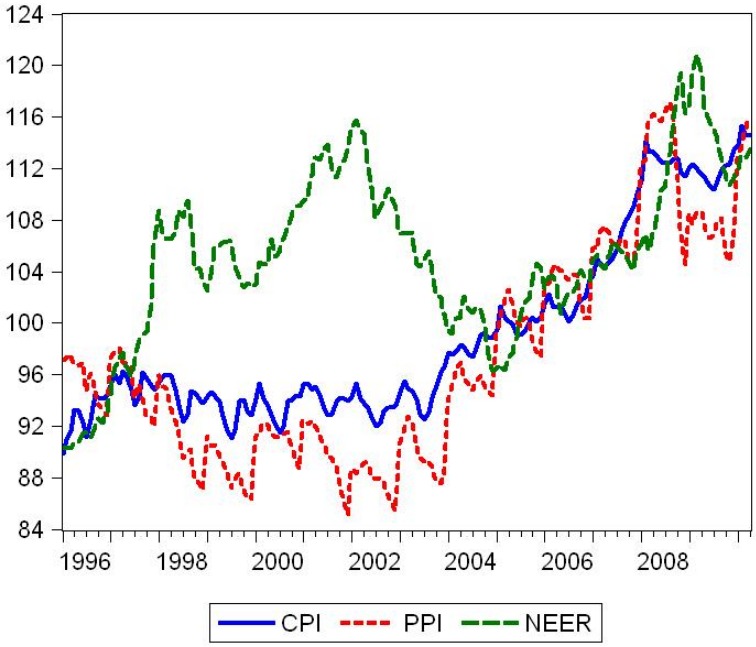

Figure 3: CPI, PPI and NEER(2005=100)

to domestic consumers. Demand function for firm i is:

$$C_t(i) = (\frac{P_t(i)}{P_t})^{-\lambda} C_t$$

where $C_t(i)$ is demand for firm i , C_t is total demand, $P_t(i)$ is firm i's price, P_t is composite price index for importing goods, λ is elasticity of substitution. Profit function for firm i is:

$$\Pi_t(i) = P_t(i)C_t(i) - \frac{P_t^*}{S_t}\Theta_t C_t(i)$$

where S_t is exchange rate foreign currency per unit of domestic currency, P_t^* is all differentiated imported goods' foreign currency price, Θ_t is per unit distribution cost. Importing firm's price setting is:

$$P_t(i) = \frac{\lambda}{\lambda - 1}\Theta_t \frac{P_t^*}{S_t}$$

Assuming all importing firms are identical, hence $P_t(i) = P_t$. Then the log version of this equation is:

$$p_t = \zeta_t + \theta_t + p_t^* - s_t$$

where $\zeta_t = \ln(\frac{\lambda}{\lambda-1})$, small letters represent logs.

As a result, import price could be expressed as a function of markup, distribution cost, exchange rate and foreign price. Since what I am interested in is CPI and PPI, monetary policy instrument is introduced into as well, in order to control monetary policy's influence for domestic price.

4.2 Data description and Econometric Specification

The domestic price indices are consumer price index(CPI) and producer price index(PPI). Import price index started from 2005, so could not be used. Main CPI and PPI data published are based on CPPY=100 (current period previous year=100). In order to adjust these indices to base on 2005=100, (which is consistent with other index data), I use CPI's chain index data and CPI data based on CPPY=100 for CPI adjustment, and use PPI data based on CPPY=100 and producer goods' chain price index data for PPI adjustment.

Exchange rate is the nominal effective exchange rate (NEER) from IMF. This index represents the ratio (expressed on the base 2005=100) of an index of a currency's period average exchange rate to a weighted geometric average of exchange rates for the currencies of selected countries and the euro area. So an increase in this index means appreciation of a currency.

Foreign price index (FPI) is calculated by FPI=NEER*CPI/REER, REER is the real effective exchange rate based on corresponding consumer price. This index comes from Campa and Goldberg (2005), and indicates a measure of trading partners' cost, weighted by its importance in the importing country's trade. One issue is FPI and NEER seems correlated with each other. However, as all regressions use log difference variables, the correlation coefficient is only -0.066.

Markup is decided by demand condition, denoted by output gap. It is constructed by using gross industrial output value data, and applying Hodrick-Prescott filter. GDP data is more suitable for output gap computation, however, GDP is not a monthly data.

Per unit distribution cost is hard to measure, what I use is monthly average Baltic Exchange Dry Index (BDI), to represent distribution cost, mainly transportation cost. BDI is a daily average of prices to ship raw materials. It represents the cost paid by an end customer to have a shipping company transport raw materials across seas on the Baltic Exchange, the global marketplace for brokering shipping contracts.

Monetary policy instrument is represented by broad money supply (M2). China's nominal

Table 1: Unit Root Test

Variable	Deterministic terms	ADF test stat	PP test stat	5% Critical Value	Decision
lncpi	c,t	-1.312	-0.949	-3.438	I(1)
Δlncpi	none	-2.962	-10.301	-1.943	
lnppi	c,t	-1.807	-1.632	-3.436	I(1)
Δlnppi	none	-5.746	-5.681	-1.943	
lnneer	c,t	-2.364	-2.169	-3.436	I(1)
Δlnneer	none	-8.347	-9.070	-1.943	
lnfpi	c,t	-3.214	-2.904	-3.436	I(1) or I(0)
Δlnfpi	none	-2.351	-5.758	-1.943	
outputgap	none	-4.786	-8.963	-1.943	I(0)
lnbdi	c,t	-3.458	-2.150	-3.438	I(1) or I(0)
Δlnbdi	none	-5.729	-7.910	-1.943	
lnm2	c,t	-0.503	- 2.773	-3.437	I(1)
Δlnm2	c	-7.088	-18.022	-2.879	

anchor is money growth, to maintain a relative pegging exchange rate, money supply is always used for price stability. (check Appendix F, money growth and inflation rate seem correlated.)

Considering the stickiness of price, lagged variables for p_t, p_t^* and s_t are involved. Then the exchange rate pass through could be estimated by the following Autoregressive Distributed Lag Model. Then the short run exchange rate pass through is β_0, long run exchange rate pass through is $(\sum_{i=0}^{5}\beta_i)/(1-\sum_{i=1}^{5}\alpha_i)$.[1][2]

$$\Delta\text{lncpi}=\sum_{i=1}^{5}\alpha_i\Delta\text{lncpi}_{t-i}+\sum_{i=0}^{5}\beta_i\Delta\text{lnneer}_{t-i}+\sum_{i=0}^{5}\gamma_i\Delta\text{lnfpi}_{t-i}+\zeta\text{outputgap}+\eta\Delta\text{lnbdi}+\delta\Delta\text{lnm2}$$

$$\Delta\text{lnppi}=\sum_{i=1}^{5}\alpha_i\Delta\text{lnppi}_{t-i}+\sum_{i=0}^{5}\beta_i\Delta\text{lnneer}_{t-i}+\sum_{i=0}^{5}\gamma_i\Delta\text{lnfpi}_{t-i}+\zeta\text{outputgap}+\eta\Delta\text{lnbdi}+\delta\Delta\text{lnm2}$$

All the index data is based on 2005=100, and all data series is seasonal adjusted by X12-ARIMA. To exam the stationarity of these variables, Augmented Dickey-Fuller Test and Phillips-Perron Test are applied as table 1. The test indicates that most of the variables except output gap are I(1), therefore in the OLS estimation, they are involved in log difference form, except output gap.

[1] Where Δln denotes the corresponding variable is in the first difference level of natural log. lncpi and lncpi are two indices represented for p_t, lnfpi for p_t^*, lnneer for s_t, outputgap for ζ_t, lnbdi for θ_t, lnm2 for broad money supply.

[2] Different version of independent variables are taken account of, such as only lagged lncpi or only consider lagged lnneer and lnfpi, and different numbers of lags as well. According to information criteria such as Akaike information criterion and adjusted R^2, this form is more suitable than other specifications.

Table 2: CPI exchange rate pass-through by OLS estimation

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
Δlncpi$_{t-1}$	0.104 (0.082)	Δlnneer$_t$	0.016 (0.027)	Δlnfpi$_t$	0.613***(0.199)
Δlncpi$_{t-2}$	0.116 (0.082)	Δlnneer$_{t-1}$	-0.058*(0.029)	Δlnfpi$_{t-1}$	0.035 (0.206)
Δlncpi$_{t-3}$	0.070 (0.079)	Δlnneer$_{t-2}$	0.041 (0.029)	Δlnfpi$_{t-2}$	-0.392*(0.203)
Δlncpi$_{t-4}$	0.108 (0.078)	Δlnneer$_{t-3}$	-0.036 (0.029)	Δlnfpi$_{t-3}$	0.260 (0.204)
Δlncpi$_{t-5}$	0.138*(0.080)	Δlnneer$_{t-4}$	0.026 (0.028)	Δlnfpi$_{t-4}$	-0.022 (0.214)
outputgap	0.000 (0.000)	Δlnneer$_{t-5}$	-0.050*(0.027)	Δlnfpi$_{t-5}$	-0.527***(0.194)
Δlnbdi	-0.003 (0.002)	Δlnm2	0.015 (0.034)		
R^2	0.284	Short run $ERPT$	0.016$\veebar$	Long run $ERPT$	-0.132$\veebar$

Note: The figures in parentheses are standard errors, the figures in square parenthesis are p value.
* significance at the 10% levels, **-significance at the 5% levels, ***- significance at the 1% levels.
$\barwedge(\veebar)$implies an ERPT elasticity is significantly different from 0(1) at the 5% level.

Table 3: PPI exchange rate pass-through by OLS estimation

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
Δlnppi$_{t-1}$	0.311***(0.081)	Δlnneer$_t$	0.012 (0.028)	Δlnfpi$_t$	0.999***(0.212)
Δlnppi$_{t-2}$	0.147*(0.085)	Δlnneer$_{t-1}$	-0.058*(0.031)	Δlnfpi$_{t-1}$	0.523 (0.233)
Δlnppi$_{t-3}$	0.015 (0.088)	Δlnneer$_{t-2}$	-0.069**(0.030)	Δlnfpi$_{t-2}$	-0.112(0.224)
Δlnppi$_{t-4}$	0.120 (0.086)	Δlnneer$_{t-3}$	-0.011 (0.031)	Δlnfpi$_{t-3}$	-0.150 (0.222)
Δlnppi$_{t-5}$	0.051 (0.076)	Δlnneer$_{t-4}$	-0.031 (0.030)	Δlnfpi$_{t-4}$	-0.125 (0.229)
outputgap	0.000 (0.000)	Δlnneer$_{t-5}$	-0.019 (0.030)	Δlnfpi$_{t-5}$	-0.578***(0.215)
Δlnbdi	0.002 (0.002)	Δlnm2	0.052 (0.036)		
R^2	0.647	Short run $ERPT$	0.012$\veebar$	Long run $ERPT$	-0.495$\barwedge\veebar$

Note: The figures in parentheses are standard errors, the figures in square parenthesis are p value.
* significance at the 10% levels, **-significance at the 5% levels, ***- significance at the 1% levels.
$\barwedge(\veebar)$implies an ERPT elasticity is significantly different from 0(1) at the 5% level.

4.3 Results

From table 2, we can see that the prior CPI inflation has a positive influence on the current inflation. The coefficients of previous one and two month's NEER are significant at the level of 10%, implies the movement from NEER to inflation is not immediately. For FPI, it seems both current and prior FPI influence CPI inflation rate. The short run CPI pass through is 0.016, and in long run is -0.132, suggest that 1 percent increase in NEER (1% appreciation) leads to 0.016% incline of CPI inflation rate in the first month, and 0.132% decline in the long run. And the hypothesis test suggests neither short run or long run pass through is significantly different from 0 at the significance level of 5%.[3]

To keep the outcome's comparability, the same regression is applied for PPI, although it is not the best choice from information criteria and adjusted R^2. Table 3 reports the result.

[3]For the hypothesis test of long run pass through, delta method is utilized to compute the mean and variance, and then test founds on normal distributed statistic.

R^2 improved a lot compared to the same regression for CPI. According to the significance of coefficients, the PPI inflation rate is affected by previous PPI inflation rate, previous NEER change, and both current and prior FPI variation. The short and long run PPI pass through is 0.012 and -0.495 respectively, so initially the PPI response to NEER is weaker than CPI, but over long run PPI pass through is almost fourfold as large as CPI's. The long run pass through is significant different from 0, although the short run pass through is still not.[4]

Compare with industrial countries' estimation by Bailliu and Bouakez (2004)(on average, the short run and long run PPI pass through are 0.202 and 0.301 respectively, and for CPI are 0.080 and 0.160), and Ihrig et al.(2006)(long run CPI pass through from 0.002 to 0.083), my estimation of low CPI pass through is not strange. And considering Shu & Su (2009)(CPI and PPI long run pass through are 0.201 and 0.367) and Wang & Li(2009)(0.24 for CPI long run pass through) the long run CPI pass through is a little lower in my analysis, however the gap between CPI and PPI is widespread.

4.4 Monetary Policy and Exchange Rate Pass Through

In literature review, an amount of papers supported monetary policy regime affects exchange rate pass through, it could be a change of inflation environment, such as adoption of inflation targeting and structural break in inflation rate, and also could be a shift in exchange rate regime, from fixed to floating exchange rate policy. Concerning China, I think two monetary event could be investigated, one is more flexible exchange rate regime from Jul 2005 to Jul 2008, another is deflation period from Feb 1998 to Dec 2002.[5]

Consequently I distinguish exchange rate regime between nominal fix and appreciating period, inflation environment between CPI inflation and deflation period. And adding dummy variables EX and INF to the original equation for this distinction. EX equals to 1 during nominal appreciating exchange rate period, 2005.07-2008.07, otherwise 0, while INF takes the value 1 during deflation period, 1998.02-2002.12, otherwise 0. The new econometric equation is as following,[6]

$$\Delta\text{lncpi(lnppi)}_t = \sum_{i=1}^{5}\alpha_i\Delta\text{lncpi(lnppi)}_{t-i} + \sum_{i=0}^{5}\beta_i\Delta\text{lnneer}_{t-i} + \sum_{i=0}^{5}\gamma_i\Delta\text{lnfpi}_{t-i} + \zeta\text{outputgap}$$
$$+\eta\Delta\text{lnbdi} + \delta\Delta\text{lnm2} + \sum_{i=1}^{5}\varphi_i\Delta\text{lncpi(lnppi)}_{t-i} * EX(INF) + \sum_{i=0}^{5}\chi_i\Delta\text{lnneer}_{t-i} * EX(INF)$$

Then the short run exchange rate pass through within fixed exchange rate(or without deflation) is β_0, within flexible exchange rate(or within deflation)is $\beta_0 + \chi_0$. The long run exchange

[4]The single equation regression neglects the fact that inflation rate could impact on exchange rate as well, considered the robustness, VAR model is applied as well, check result in Appendix B

[5]Some literatures such as Bailliu and Bouakez (2004) used structural break test for inflation, I also apply this sort of test. Whereas it suggests a break in Feb 2008, it is too close to the end of data period, so I suggest to consider inflation environment between deflation and inflation period instead.

[6]Chen & Li (2009) estimated ERPT before and after the exchange rate reform, however, they simply separated the sample size, then estimation based on only 44 observation data could not be so accurate. My approach could overcome this drawback, as the discrepancy during different monetary policy regime can not only be tested through pass through in different period, but also the significance of dummy variables.

Table 4: ERPT and Monetary Policy

	CPI		PPI	
	Short run	Long run	Short run	Long run
Whole period	0.160	-0.132	0.012	-0.495
Exchange rate regime				
Fixed exchange rate	0.009	-0.140	0.014	-0.502
Flexible exchange rate	0.134	-0.031	-0.036	-0.524
Inflation environment				
Without deflation	-0.009	-0.146	-0.024	-0.537
With deflation	0.071	0.002	0.073	-0.455

rate pass through within fixed exchange rate(or without deflation) is $(\sum_{i=0}^{5}\beta_i)/(1-\sum_{i=1}^{5}\alpha_i)$, within flexible exchange rate(or within deflation) is $(\sum_{i=0}^{5}\beta_i+\sum_{i=0}^{5}\chi_i)/(1-\sum_{i=1}^{5}\alpha_i-\sum_{i=1}^{5}\varphi_i)$.

Four regressions' results are in the Appendix B. Table 4 lists the exchange rate pass through estimation for different monetary policy period. Short run pass through's coefficient is always insignificant, so more attention is paid to long run pass through. For CPI, there is an obvious distinction between different monetary policy regime, as in fix exchange rate regime, long run CPI pass through is -0.140, while in flexible exchange rate regime, it is only -0.031, and without deflation period, long run CPI pass through is -0.146, while within deflation period is only 0.002. In addition, the CPI pass through in fix exchange rate regime and without deflation period are higher than the pass through in whole period. Furthermore, in Appendix B we can see some coefficients for interaction term with dummy variables are significant, implies monetary policy regime indeed impacts on CPI pass through. In terms of PPI, the difference among various monetary policy regime is not so obvious, and none of interaction term dummy variables' coefficients is significant. This conclusion is also consistent with Beirne et al. (2009) and Barhoumi (2005)'s work in developing countries, Chen & Li's work for China.

5 Discussion: why CPI pass through is so low

From OLS and VAR estimation, both results indicate CPI pass through is fairly low, and much lower than PPI's. Superficially, one explanation might be different definition of CPI and PPI. PPI reflects the price change when industrial product goes into circulation for the first time, while CPI traces the price of consumer goods and service for the final consumers. Another interpretation is the composition of price indices. The different basket and weight of price indices could be a reason. Chinese government does not publish the detail construction of price indices. However, the general construction for CPI is: food 33.2%, tobacco and alcohol 3.9%, clothes 9.1%, household equipment and maintenance services 6.0%, medical care and personal products 10.0%, transportation and communications 10.4%, entertainment, education and culture 14.2%, residence 13.2%. In the composition of PPI, means of production such as

raw materials and machinery, electronics, chemical, textile products are the majority, the weight of means of subsistence for residents' final consumption is less than 30%. Hence, the cross term is CPI contains 50% industrial consumer goods, PPI includes 30% means of subsistence.

Considering more deeply, Bustein et.al(2003), Campa and Ihrig (2006) explained this puzzle by imported inputs, the existence of non-tradable goods and distribution cost, through information from input-output table. I would like to follow these two papers, and supply some evidence for China.[7]

5.1 Imported inputs and non-tradable sector

In Campa and Ihrig(2006), the calibration of pass through into CPI demonstrated that imported input can improve pass through for CPI, as higher imported inputs contribute to the price of non-tradable goods and home produced tradable products. Imported inputs ratio refers to the ratio of total value of imported intermediate inputs to the value of total intermediate inputs. Table 5 reports the share of imported inputs in the third column for several countries, the ratio of imported inputs for China seems raising gradually, from 0.087 in 1995 to 0.109 in 2002, due to the heightening degree of openness. While comparing with other countries, China's share is only a little lower.

It is widely accepted that exchange rate only influences the price of tradables. Although Campa and Ihrig (2006) pointed out that the price of non-tradables can also be affected by exchange rate through imported inputs, the pass through is still much lower than tradable goods. Therefore, if the scale of non-tradable sector is larger, then exchange rate pass through for CPI, which combines the price of both tradables and non-tradables, would be lower. Reversely, PPI is regarded as a proxy domestic price index for tradables, the scale of non-tradable sector could not affect it.

Following the method from Campa and Ihrig (2006), I compute the share of tradable goods in consumption, as the ratio of the value of consumption by households in tradable products relative to the value of total consumption by households. The tradable goods comes from industry category 1 to 25 of OECD input-output table (category detail in Appendix D). The rest is non-tradables. The fourth column of table 5 suggests the China's share of non-tradable consumption increases from 0.26 in 1995 to 0.468 in 2002, in the year 2000 China's ratio is nearly half of US, France, Japan's. Only India and Indonesia have the similar composition of consumption, it seems one country's degree of development is directly proportional to the ratio of non-tradables.

5.2 Distribution cost

The concept of distribution cost comes from Bustein et.al(2003). In that paper, they considered distribution cost as the cost of distributing tradable goods, like transportation, wholesaling and retailing, and defined distribution margin as (retail price-producers price)/(retail price),

[7]The resource of input-output table is OECD.

Table 5: Share of Imported Input, Non-tradables

Country	Year	Imported Inputs	Non-tradables to Consumption
China	1995	0.087	0.260
	2000	0.095	0.304
	2002	0.109	0.468
US	2000		0.797
France	2000	0.144	0.676
Japan	2000	0.070	0.779
UK	2000	0.160	0.682
Germany	2000	0.201	0.689
Indonesia	2000	0.210	0.432
Korea	2000	0.235	0.698
India	1998	0.117	0.396

Note: Some data is identical to Campa and Ihrig (2006), due to the identical calculation method

obviously high distribution cost leads to low exchange rate pass through. In addition, distribution cost could also explain higher PPI pass through than CPI partly, as the definition of CPI involves more intermediate distribution link, which leads to more distribution cost.

However, there are no suitable data to calculate such kind of margin. [8] So I use input-output table to calculate distribution margin for three final demand sections: final consumption expenditure by households, gross fixed capital formation and exports. The distribution cost for service and non-tradable goods is assumed to be zero, then the whole cost is allocated to tradable goods (category 1-25 in Appendix D). The distribution sectors are Wholesale & retail trade, repairs, Land transport, transport via pipelines, Water transport,Air transport (category 31,33-35).

Distribution margin for tradable goods is just the inputs in distribution sectors divided by the total inputs of tradable goods for final demand. Table 6 computes distribution margin for three sectors. For all the countries, distribution margin for final consumption expenditure by households is larger than export and gross fixed capital formation sections. For final household consumption section, China's distribution service represents 10.2%, 10.3% and 16.5% of final consumer price, in the year 1995, 2000 and 2002. In comparison with other countries, the distribution sector is not so critical element for tradable consumption, as industrial countries' ratio is over 0.6 in 2000. This differences probably comes from the distinct structure of developed and developing countries, since the distribution margins for Indonesia, Korea and India are relatively smaller too.

Above all, the evidence from low imported inputs, considerable scale of non-tradable and distribution sector for China could interpret the low exchange rate pass through of CPI to a

[8] In the linear model part, I only consider one kind of distribution cost- transportation cost, as it is easier to measure, compared with other distribution cost.

Table 6: Distribution Margin

Country	Year	Final consumption expenditure by households	Gross fixed capital formation	Exports
China	1995	0.102	0.051	0.032
	2000	0.103	0.046	0.094
	2002	0.165	0.083	0.174
US	2000	0.904	0.189	0.263
France	2000	0.593	0.120	0.111
Japan	2000	1.052	0.332	0.181
UK	2000	0.616	0.221	0.278
Germany	2000	0.600	0.103	0.094
Indonesia	2000	0.253	0.240	0.134
Korea	2000	0.377	0.120	0.144
India	1998	0.279	0.140	0.280

certain extent. However, the impact from distribution and non-tradable sector is much smaller than industrial countries. Hence, there must be some other reasons for the low CPI pass through in China, like price regulation. Chinese government's price control mainly is in the field of energy industry, agricultural commodities, land and resource. Particularly in the energy industry, retail price of petrol, diesel oil and electricity is seriously administrated. Take product oil for instance, the price policy is that domestic product oil will make corresponding adjustment, while average price of crude petroleum in international market changes more than 4% for consecutive 22 working days. This policy implies the product oil's price in China is lack of elasticity and hysteretic to international oil price fluctuation. (Appendix E detail for product oil price adjustment). Concerning electricity supply, coal price is decided by market demand and supply, but not for the electricity price. Agricultural commodities' price is regulated as well, especially grain's price. Comparing with other agricultural commodities, such as pork, vegetables, the variation of grain's price is always the smallest.

6 Conclusion

In this paper, exchange rate pass through for China's CPI and PPI is estimated by single equation regression. OLS model found that 1% devaluation of exchange rate (NEER) leads to 0.016% of CPI deflation in the short run, 0.132% of CPI inflation over the long run. The exchange rate pass through for PPI is much higher in the long run, which amounts to 0.495, higher exchange rate pass through for PPI is also consistent with prediction. The negative relation between exchange rate variation and inflation in the long run implies appreciation could reduce inflation rate .

Considering the relation between monetary policy regime and exchange rate pass through, monetary policy regime like inflation environment and exchange rate regime indeed impacts on

pass through for CPI, but not for PPI. In the long run, the periods without deflation or within fix exchange rate regime have higher CPI pass through.

The different definition, basket and weight of price indices could be the reason for the obvious difference of CPI and PPI pass through. More deeply, the low exchange rate pass through could be partly explained by low imported inputs, considerable scale of non-tradable and distribution sector, but not all, further reasons need be discussed, like price control.

The estimation result suggests government could pursue more flexible exchange rate policy and strengthen the independence of monetary policy, need not worry too much about the unfavorable impact of exchange rate fluctuation on price stability. However, this conclusion is not absolute, as the exchange rate pass through maybe varies according to different macro environment, such as inflation performance (Taylor 2000) and monetary policy regime (Devereux and Yetman 2009), even more extremely, making exchange rate pass through endogenous in open economy macroeconomic framework (Devereux et al. 2004), the variation of pass through should be paid attention to.

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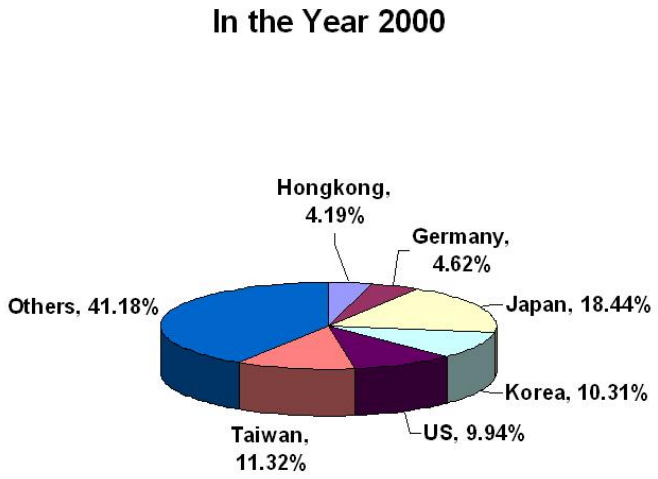
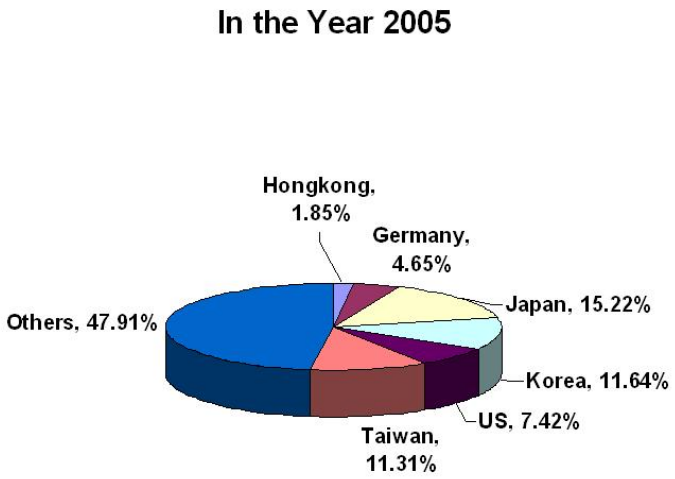
Appendices

A:Main Importers for China





B: Exchange Rate Pass-through by OLS Estimation with Dummy Variable

CPI

Regression with EX dummy		Regression with INF dummy	
Variable	Coefficient	Variable	Coefficient
Δlncpi$_{t-1}$	0.045 (0.097)	Δlncpi$_{t-1}$	0.148 (0.095)
Δlncpi$_{t-2}$	0.020 (0.095)	Δlncpi$_{t-2}$	0.228** (0.096)
Δlncpi$_{t-3}$	0.004 (0.092)	Δlncpi$_{t-3}$	0.072 (0.092)
Δlncpi$_{t-4}$	0.108 (0.091)	Δlncpi$_{t-4}$	0.004 (0.090)
Δlncpi$_{t-5}$	0.170* (0.093)	Δlncpi$_{t-5}$	0.202** (0.091)
Δlnfpi$_{t}$	0.614*** (0.206)	Δlnfpi$_{t}$	0.440** (0.219)
Δlnfpi$_{t-1}$	0.013 (0.214)	Δlnfpi$_{t-1}$	0.220 (0.213)
Δlnfpi$_{t-2}$	-0.247 (0.206)	Δlnfpi$_{t-2}$	-0.489** (0.206)
Δlnfpi$_{t-3}$	0.188 (0.205)	Δlnfpi$_{t-3}$	0.219 (0.205)
Δlnfpi$_{t-4}$	-0.058 (0.218)	Δlnfpi$_{t-4}$	0.161 (0.219)
Δlnfpi$_{t-5}$	-0.523*** (0.194)	Δlnfpi$_{t-5}$	-0.631*** (0.195)
Δlnneer$_{t}$	0.009 (0.028)	Δlnneer$_{t}$	-0.009 (0.033)
Δlnneer$_{t-1}$	-0.055* (0.031)	Δlnneer$_{t-1}$	-0.053 (0.037)
Δlnneer$_{t-2}$	0.013 (0.030)	Δlnneer$_{t-2}$	0.081** (0.036)
Δlnneer$_{t-3}$	-0.036 (0.031)	Δlnneer$_{t-3}$	-0.095** (0.037)
Δlnneer$_{t-4}$	0.039 (0.030)	Δlnneer$_{t-4}$	0.050 (0.039)
Δlnneer$_{t-5}$	-0.062** (0.028)	Δlnneer$_{t-5}$	-0.024 (0.035)
Δlncpi$_{t-1} * EX$	0.146 (0.194)	Δlncpi$_{t-1} * INF$	-0.106 (0.190)
Δlncpi$_{t-2} * EX$	0.477** (0.188)	Δlncpi$_{t-2} * INF$	-0.380** (0.185)
Δlncpi$_{t-3} * EX$	0.222 (0.183)	Δlncpi$_{t-3} * INF$	-0.174 (0.188)
Δlncpi$_{t-4} * EX$	-0.241 (0.186)	Δlncpi$_{t-4} * INF$	0.270 (0.194)
Δlncpi$_{t-5} * EX$	-0.306* (0.183)	Δlncpi$_{t-5} * INF$	-0.228 (0.206)
Δlnneer$_{t} * EX$	0.125 (0.083)	Δlnneer$_{t} * INF$	0.079 (0.062)
Δlnneer$_{t-1} * EX$	-0.061 (0.082)	Δlnneer$_{t-1} * INF$	-0.020 (0.066)
Δlnneer$_{t-2} * EX$	0.152** (0.076)	Δlnneer$_{t-2} * INF$	-0.077 (0.061)
Δlnneer$_{t-3} * EX$	-0.013 (0.083)	Δlnneer$_{t-3} * INF$	0.135** (0.061)
Δlnneer$_{t-4} * EX$	-0.199** (0.089)	Δlnneer$_{t-4} * INF$	-0.037 (0.064)
Δlnneer$_{t-5} * EX$	0.077 (0.090)	Δlnneer$_{t-5} * INF$	-0.029 (0.057)
Δlnm2	0.008 (0.034)	Δlnm2	0.021 (0.035)
outputgap	0.000 (0.000)	outputgap	0.000 (0.000)
Δlnbdi	-0.004* (0.002)	Δlnbdi	-0.002 (0.002)
R^2	0.367	R^2	0.364

Note: The figures in parentheses are standard errors, the figures in square parenthesis are p value.
* significance at the 10% levels, **-significance at the 5% levels, ***- significance at the 1% levels.

PPI

Regression with EX dummy		Regression with INF dummy	
Variable	Coefficient	Variable	Coefficient
Δlnppi$_{t-1}$	0.296*** (0.086)	Δlnppi$_{t-1}$	0.371*** (0.101)
Δlnppi$_{t-2}$	0.151* (0.091)	Δlnppi$_{t-2}$	0.136 (0.108)
Δlnppi$_{t-3}$	0.003 (0.095)	Δlnppi$_{t-3}$	-0.059 (0.111)
Δlnppi$_{t-4}$	0.084 (0.092)	Δlnppi$_{t-4}$	0.105 (0.113)
Δlnppi$_{t-5}$	0.094 (0.082)	Δlnppi$_{t-5}$	0.081 (0.095)
Δlnfpi$_{t}$	0.976*** (0.220)	Δlnfpi$_{t}$	1.077*** (0.230)
Δlnfpi$_{t-1}$	0.486* (0.248)	Δlnfpi$_{t-1}$	0.496* (0.252)
Δlnfpi$_{t-2}$	-0.113 (0.235)	Δlnfpi$_{t-2}$	-0.114 (0.240)
Δlnfpi$_{t-3}$	-0.106 (0.232)	Δlnfpi$_{t-3}$	-0.115 (0.235)
Δlnfpi$_{t-4}$	-0.241 (0.243)	Δlnfpi$_{t-4}$	-0.141 (0.244)
Δlnfpi$_{t-5}$	-0.673** (0.230)	Δlnfpi$_{t-5}$	-0.558** (0.229)
Δlnneer$_{t}$	0.014 (0.032)	Δlnneer$_{t}$	-0.024 (0.037)
Δlnneer$_{t-1}$	-0.054 (0.034)	Δlnneer$_{t-1}$	-0.038 (0.040)
Δlnneer$_{t-2}$	-0.068** (0.033)	Δlnneer$_{t-2}$	-0.098** (0.039)
Δlnneer$_{t-3}$	-0.034 (0.034)	Δlnneer$_{t-3}$	0.020 (0.040)
Δlnneer$_{t-4}$	-0.028 (0.034)	Δlnneer$_{t-4}$	-0.008 (0.042)
Δlnneer$_{t-5}$	-0.015 (0.033)	Δlnneer$_{t-5}$	-0.049 (0.040)
Δlnppi$_{t-1} * EX$	-0.005 (0.236)	Δlnppi$_{t-1} * INF$	-0.110 (0.190)
Δlnppi$_{t-2} * EX$	0.057 (0.266)	Δlnppi$_{t-2} * INF$	-0.028 (0.197)
Δlnppi$_{t-3} * EX$	0.119 (0.257)	Δlnppi$_{t-3} * INF$	0.237 (0.187)
Δlnppi$_{t-4} * EX$	0.282 (0.268)	Δlnppi$_{t-4} * INF$	0.014 (0.189)
Δlnppi$_{t-5} * EX$	-0.290 (0.237)	Δlnppi$_{t-5} * INF$	-0.057 (0.176)
Δlnneer$_{t} * EX$	-0.050 (0.093)	Δlnneer$_{t} * INF$	0.097 (0.073)
Δlnneer$_{t-1} * EX$	-0.037 (0.093)	Δlnneer$_{t-1} * INF$	-0.061 (0.076)
Δlnneer$_{t-2} * EX$	0.017 (0.084)	Δlnneer$_{t-2} * INF$	0.087 (0.071)
Δlnneer$_{t-3} * EX$	0.120 (0.084)	Δlnneer$_{t-3} * INF$	-0.098 (0.071)
Δlnneer$_{t-4} * EX$	0.038 (0.096)	Δlnneer$_{t-4} * INF$	-0.004 (0.075)
Δlnneer$_{t-5} * EX$	-0.011 (0.099)	Δlnneer$_{t-5} * INF$	0.033 (0.066)
Δlnm2	0.051 (0.037)	Δlnm2	0.052 (0.038)
outputgap	0.000 (0.000)	outputgap	0.000 (0.000)
Δlnbdi	-0.002 (0.002)	Δlnbdi	-0.001 (0.003)
R^2	0.666	R^2	0.665

Note: The figures in parentheses are standard errors, the figures in square parenthesis are p value.
* significance at the 10% levels, **-significance at the 5% levels, ***- significance at the 1% levels.

C: Vector Autoregressive Model

The single equation regression neglects the fact that inflation rate could impact on exchange rate as well. Thereby, VAR model with Cholesky decomposition is applied to measure exchange rate pass through as well, which regards all variables endogenous, and could strengthen the robustness of previous OLS measure. This work is completed by two parts of time series analysis: Firstly I check the impulse response of price level to 1% structure shock from exchange rate, and then re-define and calculate dynamic exchange rate pass through using impulse responses' data. Second is the variance decomposition, which provides evidence about the contribution of external shocks for price variation.

As mentioned in literature review, cointegration relation could be a good approach to measure ERPT, in case the cointegration test is ideal. Therefore, I exam several Johansen test for various groups of variables, however, the result is confused. For this reason, Error Correction Model is abandoned.

The variables for this VAR model include two price index, CPI and PPI, nominal effective exchange rate (NEER), output gap (control supply shock), foreign price index (FPI) and board money supply (M2). The unit root test for these variables are in Table 1, to make sure stationarity, all variables except output gap are introduced in the natural log difference form. The baseline VAR model involves CPI and PPI separately, and contains five variables each time. In this setting, the result could be compared with former OLS measure.

VAR Approach and Cholesky Decomposition

A reduced-form VAR(p) model is:

$$Y_t = c + A(L)Y_t + \mu_t$$

$$E(\mu_t \mu_t^{'}) = \Omega$$

where c is the deterministic terms, A(L) is a matrix polynomial of degree p in the lag operator L, and μ_t is the vector of reduced-form VAR residuals.

In order to generate structural shock, namely orthogonalized innovations ε_t, a unique lower triangular Cholesky matrix C is used as following:

$$C\varepsilon_t = \mu_t$$

where $E(\epsilon_t \epsilon_t^{'}) = I$, $CC^{'} = \Omega$, and C= $\begin{bmatrix} C_{11} & 0 & 0 & 0 & 0 \\ C_{21} & C_{22} & 0 & 0 & 0 \\ C_{31} & C_{32} & C_{33} & 0 & 0 \\ C_{41} & C_{42} & C_{43} & C_{44} & 0 \\ C_{51} & C_{52} & C_{53} & C_{54} & C_{55} \end{bmatrix}$

According to the structure of Cholesky matrix C, the ordering indicates which shocks are

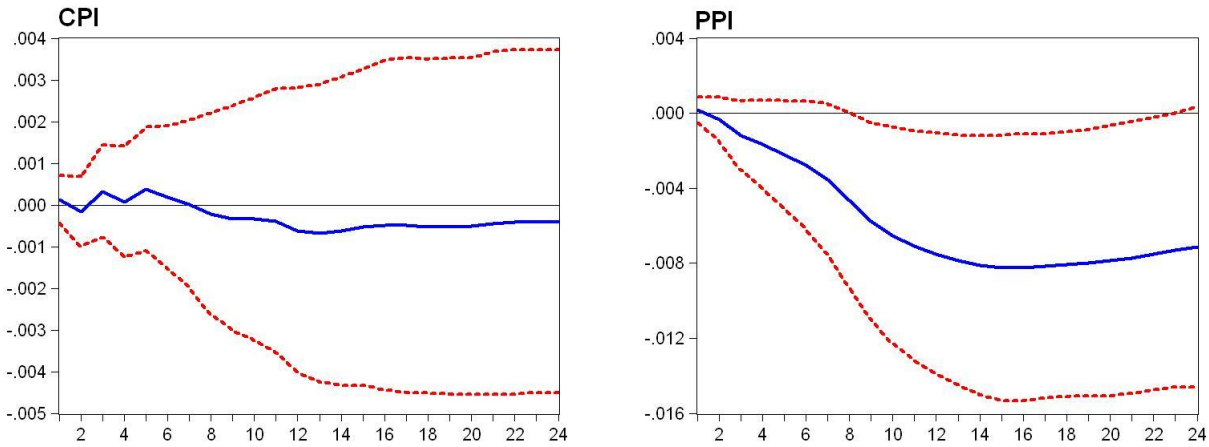


Figure 4: Impulse response to NEER shocks

not allowed to contemporaneously affect which variables. Hence, selecting the appropriate order of the endogenous variables through economic interpretation is critical. Foreign price index is ordered first as its residual is hardly influenced by any other shocks. Then is the output gap, means it is only affected by foreign price index, but affect all other shocks except foreign price index simultaneously. M2 can be settled prior to NEER, assuming that monetary policy does not react to current inflation and NEER change, but to expected inflation, as Ito and Sato (2008). Meanwhile, it can be ordered last, implies monetary policy reacts to any other shocks at the same time. At first, I set it in the middle. NEER is ordered before domestic price, because many empirical literature indicated that NEER granger causes price, but the opposite is not true. To begin with, $Y_t = (\Delta\text{lnfpi}, \text{outputgap}_t, \Delta\text{lnm}_t, \Delta\text{lnneer}_t, \Delta\text{lnp}_t)$, where $\ln p_t$ could be lncpi or lnppi. The number of lags is decided by Akaike Information Criterion, both CPI and PPI models are VAR(7).

Impulse Response Functions

In this section, we considered two baseline models with five variables, to check the effects of domestic price to different structural shocks over two-year (24 months) horizon. The result for NEER shock to CPI and PPI is in figure 4. The vertical axis in figures reports the accumulative percentage change in domestic prices in response to 1% shock. The dotted line denotes a 2 standard error confidence band around the estimate (computed by Monte Carlo method).

Response of CPI to NEER shock is positive initially, then becomes negative eight month later, which means an appreciation from NEER would reduce CPI inflation in the long run. In addition, the response is statistically insignificant, in the first month is 0.000132%, then after experiencing slight fluctuation, it remains around -0.0004%.

In comparison with CPI, PPI response is much larger and lasts for longer horizon, almost one year. The initial impact of NEER shock for PPI is similar to CPI, but later the difference appears. One year later, the response of PPI reaches -0.00786%, 18 times larger than CPI.

Table 7: Dynamic ERPT Elasticity

Country		T=1	T=6	T=12	T=18	T=24
China	CPI	0.01	0.01	-0.04	-0.04	-0.03
	PPI	0.02	-0.20	-0.56	-0.80	-0.74
Indonesia	CPI	0.01	0.27	0.37	0.40	0.40
	PPI	0.26	0.50	0.54	0.56	0.56
Korea	CPI	0.04	0.09	0.08	0.08	0.08
	PPI	0.12	0.26	0.24	0.24	0.24
Thailand	CPI	0.01	0.04	0.04	0.04	0.04
	PPI	0.09	0.23	0.22	0.22	0.22
Philippines	CPI	-0.03	0.01	0.03	0.04	0.04
	PPI	0.12	0.16	0.17	0.17	0.17
Malaysia	CPI	0.00	0.03	0.04	0.03	0.03
	PPI	0.19	0.25	0.21	0.19	0.17

Note: Indonesia, Korea, Thailand, Philippines and Malaysia's result from Ito & Sato (2008)

Followed Faruqee (2006) , the dynamic exchange rate pass through elasticities could be defined as the percent change in prices divided by percent change in exchange rate, when facing a structural NEER shock.

$$\text{Dynamic ERPT} = \frac{\hat{P}_{t,t+j}}{\hat{E}_{t,t+j}}$$

where $\hat{P}_{t,t+j}$ represents the cumulative response of price change to the NEER shock after j month, $\hat{E}_{t,t+j}$ represents corresponding responses of NEER changes itself.

From the second and third rows of Table 7, we can see that the elasticities for both price index are positive at first, and then negative in the long run, the sign is consistent with our OLS measure. The CPI pass through is 0.01 in the first month, and then decreases to -0.03 24 months later . For PPI, the size of pass through raises from 0.02 to 0.74. This implies 1% depreciation of NEER causes 0.03% CPI inflation and 0.74% PPI inflation over the long run. The other rows explicate the estimation of five eastern countries from Ito & Sato (2008). China's CPI dynamic ERPT is similar to all other countries in Table 7 except Indonesia, which has a relatively high ERPT, while China PPI dynamic ERPT is higher than all others. Whatever, the insignificant CPI pass through and relative higher PPI pass through is widespread.

Robustness

As mentioned before, the order of variables is critical for impulse response analysis. Hence, in this section, re-ordering is executed to analyze the sensitivity of our result. I attempt three new order for both CPI and PPI estimation.

First try is $Y_t = (\Delta\text{lnfpi}_t, \mathit{outputgap}_t, \Delta\text{lnneer}_t, \Delta\text{lnm}_t, \Delta\text{lnp}_t)$, in this case monetary policy responds to NEER contemporaneously.

Table 8: Variance Decomposition

Index	Period	FPI	Output Gap	M2	NEER	CPI
CPI	1	3.898	0.207	0.144	0.130	95.621
	6	9.246	1.348	1.870	3.343	84.192
	12	13.482	2.260	2.731	3.623	77.904
	18	15.036	2.534	3.512	3.599	75.319
	24	14.975	2.842	3.642	3.599	74.941
	Period	FPI	Output Gap	M2	NEER	CPI
PPI	1	16.226	0.002	0.962	0.192	82.618
	6	32.534	1.122	1.858	5.960	58.525
	12	34.904	1.187	1.690	14.543	47.676
	18	38.040	1.524	1.802	13.951	44.683
	24	37.694	1.731	1.938	14.129	44.508

Second try is $Y_t = (\Delta\text{lnfpi}_t, \Delta\text{lnm}_t, \Delta\text{lnneer}_t, outputgap_t, \Delta\text{lnp}_t)$,which considers the possibility that movement of monetary policy and NEER influences on demand situation simultaneously.

Third one is $Y_t = (\Delta\text{lnfpi}_t, gap_t, \Delta\text{lnneer}_t, \Delta\text{lnp}_t, \Delta\text{lnm}_t)$, this case gives monetary policy the chance to respond to NEER and domestic price simultaneously, namely central bank responds to all shocks, both McCathy(2000) and Hahn(2003) ordered monetary policy last. I run all these three re-ordered impulse response function, and calculate the exchange rate pass through as well. The results suggest the influence from different order of these variables is fairly tiny.

Variance Decomposition

Impulse response reflects the extent of exchange rate pass through for domestic price, while variance decomposition checks the importance of external factors to price fluctuation, since it measures how much the forecast variance of domestic price indices can be attributed to these shocks. Result is reported in table 8.

For CPI, most of variance is explained by itself. Its share ranges from 74% to 95%. The shock from foreign price is a relatively important factor for CPI variance, they explain approximately 15% forecast variance after 2 years. NEER shock's contribution is comparatively small, around 3.5 %, similar as the role of M2 shock.

For PPI, most of variance is explained by foreign price shock and PPI shock itself. Foreign price is of great importance for PPI's variance, contributes almost 38 % of PPI variance. Third important determinant in the PPI variance is NEER, it explains 14% of PPI variance. This result is consistent with the impulse response analysis for NEER shock.

In summary, external shocks contribute more to PPI fluctuation than CPI. NEER is so crucial for explaining CPI, but provides considerable scale explanation power for PPI.

D: OECD Industry Classification

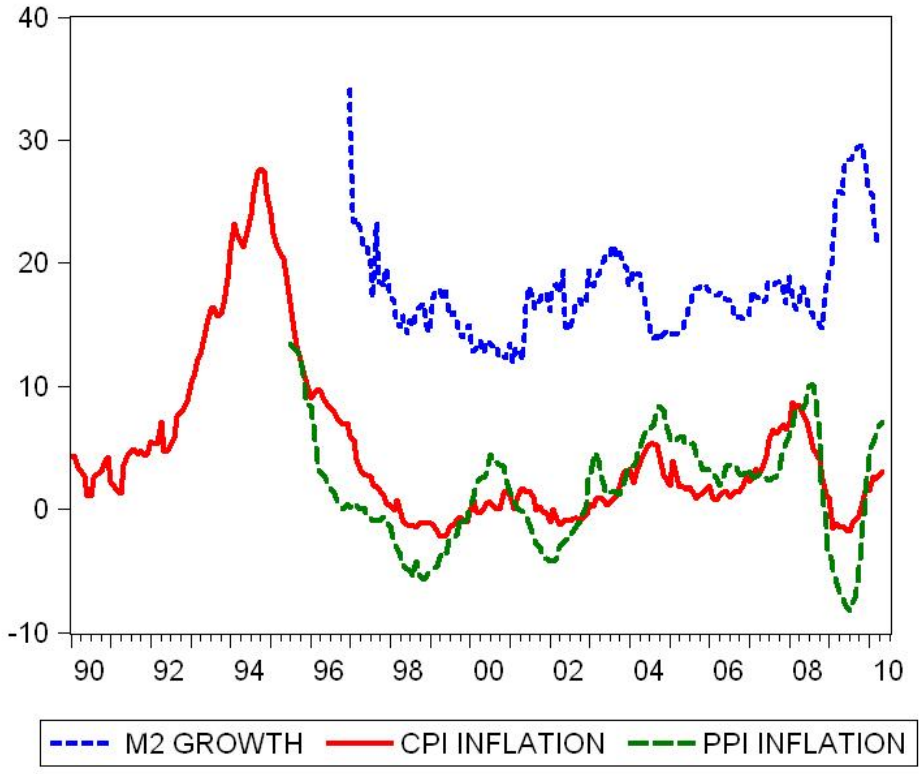
OECD Industry	Description
1	Agriculture, hunting, forestry and fishing
2	Mining and quarrying (energy)
3	Mining and quarrying (non-energy)
4	Food products, beverages and tobacco
5	Textiles, textile products, leather and footwear
6	Wood and products of wood and cork
7	Pulp, paper, paper products, printing and publishing
8	Coke, refined petroleum products and nuclear fuel
9	Chemicals excluding pharmaceutical
10	Pharmaceuticals
11	Rubber and plastics products
12	Other non-metallic mineral products
13	Iron and steel
14	Non-ferrous metals
15	Fabricated metal products, except machinery and equipment
16	Machinery and equipment, nec
17	Office, accounting and computing machinery
18	Electrical machinery and apparatus, nec
19	Radio, television and communication equipment
20	Medical, precision and optical instruments
21	Motor vehicles, trailers and semi-trailers
22	Building , repairing of ships and boats
23	Aircraft and spacecraft
24	Railroad equipment and transport equip nec.
25	Manufacturing nec; recycling (include Furniture)
26	Production, collection and distribution of electricity
27	Manufacture of gas; distribution of gaseous fuels through mains
28	Steam and hot water supply
29	Collection, purification and distribution of water
30	Construction
31	Wholesale and retail trade; repairs
32	Hotels and restaurants
33	Land transport; transport via pipelines
34	Water transport
35	Air transport

OECD Industry	Description
36	Supporting and auxiliary transport activities; activities of travel agencies
37	Post and telecommunications
38	Finance and insurance
39	Real estate activities
40	Renting of machinery and equipment
41	Computer and related activities
42	Research and development
43	Other Business Activities
44	Public admin. and defence; compulsory social security
45	Education
46	Health and social work
47	Other community, social and personal services
48	Private households with employed persons , extra-territorial organizations , bodies

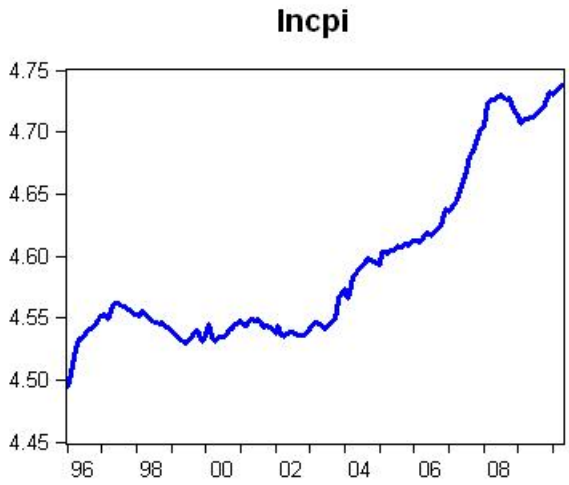
E: Adjustment of Product Oil Price In China

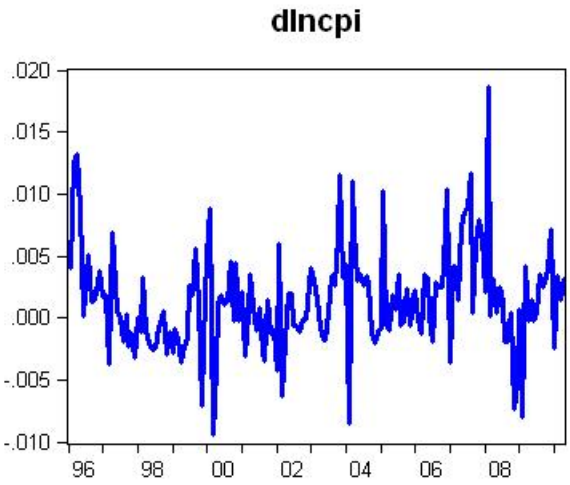
Time	Adjustment
Apr,13, 2010	Domestic petrol and diesel oil price increase 320 Yuan per ton
Nov, 11, 2009	Domestic petrol and diesel oil price increase 480 Yuan per ton
Sep, 30, 2009	Domestic petrol and diesel oil price decrease 190 Yuan per ton
Sep, 2, 2009	Domestic petrol and diesel oil price increase 300 Yuan per ton
July, 29, 2009	Domestic petrol and diesel oil price decrease 220 Yuan per ton
June, 29, 2009	Domestic petrol and diesel oil price increase 600 Yuan per ton
May, 31, 2009	Domestic petrol and diesel oil price increase 400 Yuan per ton
Mar, 25, 2009	Domestic petrol and diesel oil price increase 290 Yuan
	Diesel oil price increase 180 Yuan per ton
Jan, 15, 2009	Domestic petrol and diesel oil price decrease 140 Yuan
	Diesel oil price decrease 160 Yuan per ton
Dec, 12, 2008	Ex-factory price of petrol declines 900 Yuan per ton
	Ex-factory price of diesel oil declines 1100 per ton
June, 20, 2008	Domestic petrol and diesel oil price raises 1000 Yuan per ton
	Aviation kerosene price raises 1500 Yuan per ton
Nov, 1, 2007	Price of petrol, diesel oil and aviation kerosene increase 500 Yuan per ton
Jan, 14, 2007	Ex-factory price of petrol decreases 220 Yuan per ton
	Ex-factory price of aviation kerosene decreases 90 Yuan per ton
Mar, 26, 2006	Ex-factory price of petrol increases 300 Yuan per ton
	Diesel oil by 200 Yuan per ton
	Aviation kerosene by 300 Yuan per ton
July , 23, 2005	Increase ex-factory price of petrol by 300 Yuan per ton
	Diesel oil by 250 Yuan per ton
	Aviation kerosene by 300 Yuan per ton
June ,25, 2005	Increase ex-factory price of petrol by 200 Yuan per ton
	Diesel oil by 150 Yuan per ton
	Aviation kerosene by 300 Yuan per ton
May, 23, 2005	Decrease ex-factory price of petrol by 150 Yuan per ton
May, 10, 2005	Increase ex-factory price of diesel oil by 150 Yuan per ton
Mar, 23, 2005	Ex-factory price of petrol raises 300 Yuan per ton

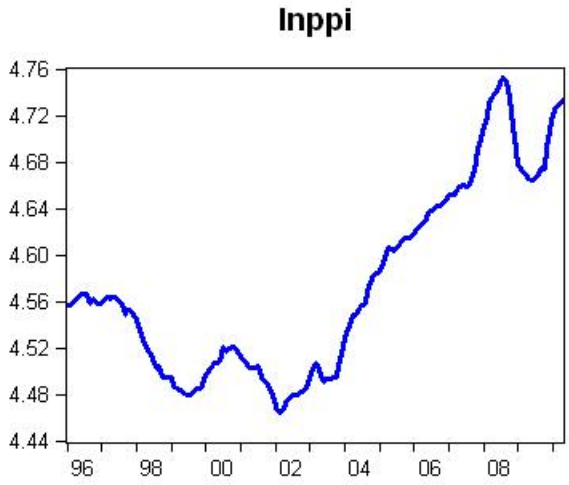
F: Money Growth and Inflation (12 months change)

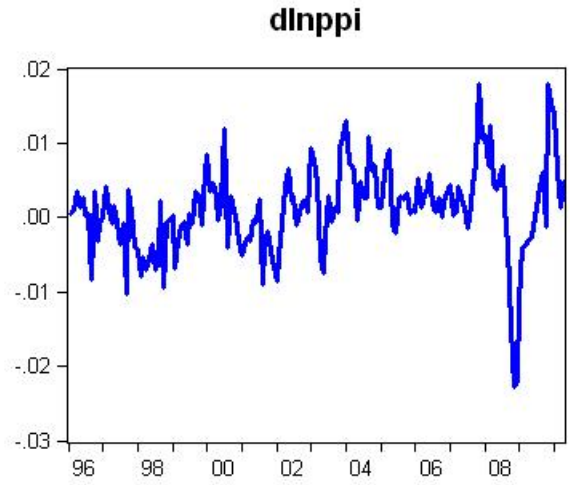


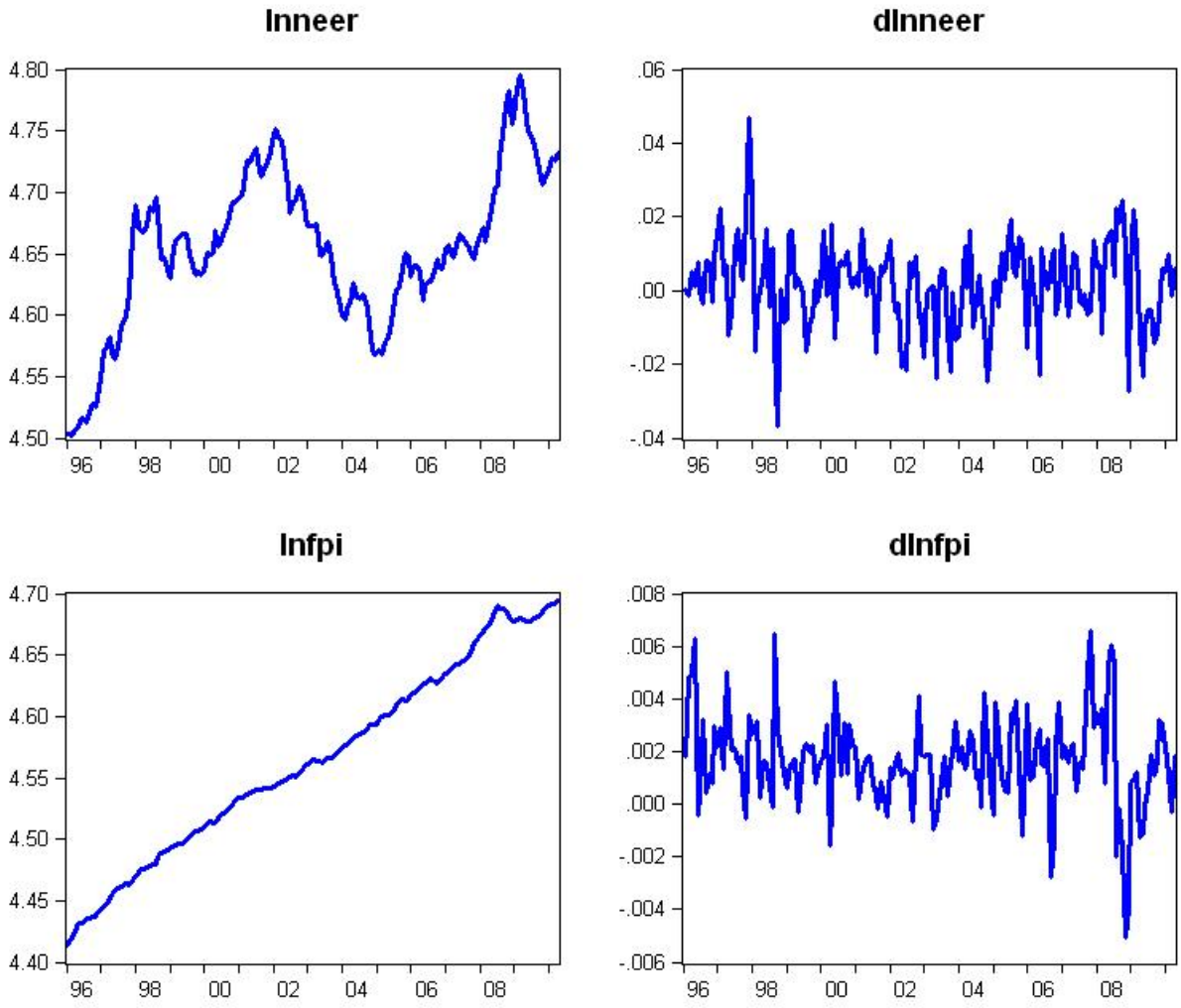
G: All Data Series' Graphs







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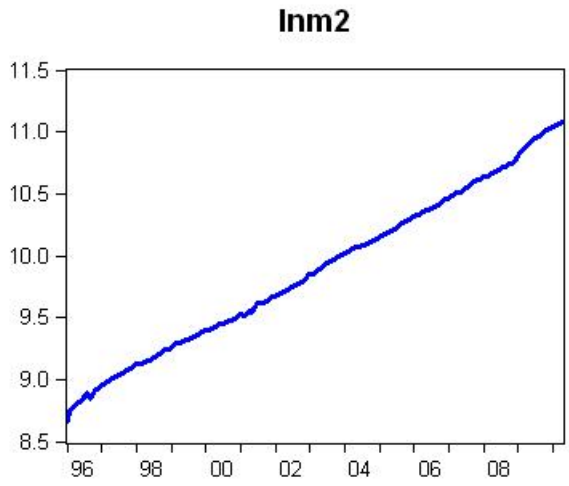
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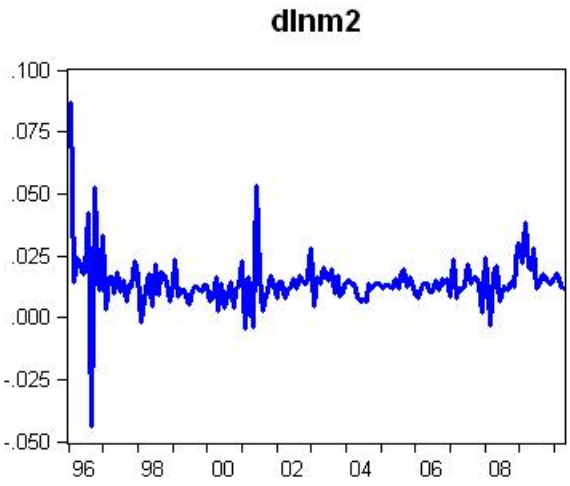
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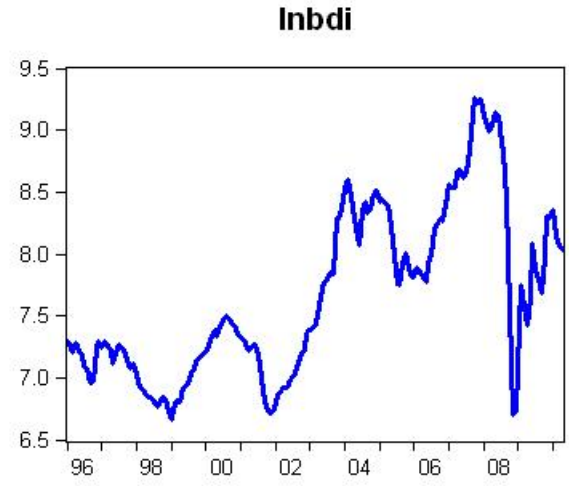
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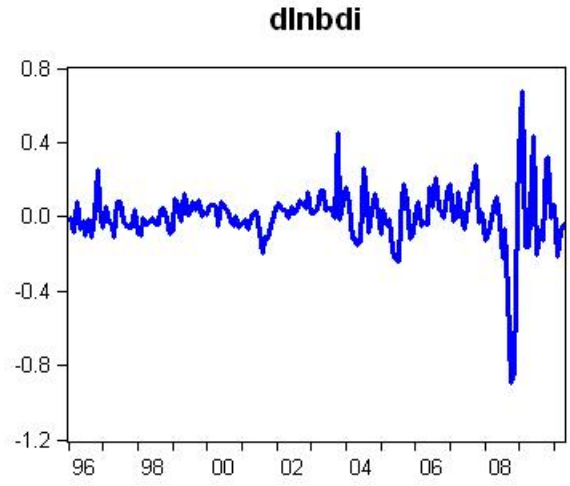
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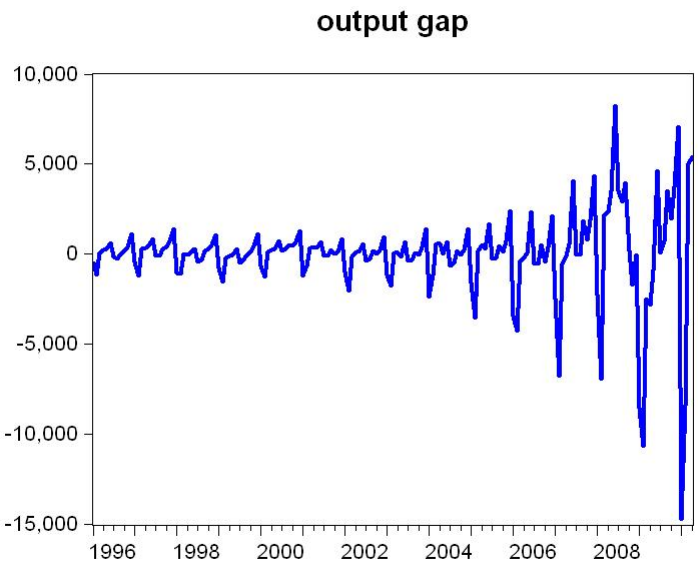
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2000
2002
2004
2006
2008