Ownership Structure, Real Exchange Rate Movements and Labor Market Adjustment in China*

Abstract

This paper investigates the impacts of Renminbi (RMB) real exchange rate movements on employment and wage rates. Based on the panel dataset covering 456 narrowly defined four digit Chinese manufacturing industries and industry specific real exchange rates, we stress the links between impacts of exchange rate fluctuations on labor market with ownership structure of manufacturing industries. The empirical results show that movements of RMB real exchange rate would likely have pronounced effects on both net employment and wage rates. A 10% RMB real appreciation (depreciation) would likely cause a net employment decline (rise) of around 3.7% and a wage rate drop of 1.9% after controlling for other factors. The impacts of real exchange rate movements on net employment and wage rates vary significantly with the ownership structure of manufacturing sectors. Employment and wage rates for private enterprises are less responsive to RMB real exchange rate fluctuations than is true for state owned enterprises (SOEs) and foreign invested enterprises (FIEs). This finding is opposite to the widely held belief that the labor market behavior of Chinese SOEs shows stronger labor market rigidities than for private firms. Impacts of exchange rate movements emerge as systematically related to export openness, import penetration and profit margins of individual manufacturing industries.

JEL Codes: F16; F31; J21; J31

Risheng Mao
Institute of World Economics & Politics
Chinese Academy of Social Sciences
No.5 JianGuoMenNeiDajie,
Beijing, China 100732
maorsh@cass.org.cn

John Whalley
Department of Economics
Social Science Centre
The University of Western Ontario
London, Ontario N6A 5C2 CANADA
and NBER
jwhalley@uwo.ca

* We are grateful to the financial support from Ontario Research Fund (ORF) and comments from seminar participants in the department of economics, University of Western Ontario, Canada.

1. Introduction

Recent empirical studies on the labor market implications of exchange rate change typically find a significant relationship between exchange rate fluctuations and labor market adjustments in a number of countries, but these relationships vary by industry. Several studies find significant and large impacts of real exchange rate changes on net employment.(Branson and Love,1988; Revenga,1992; Dekle,1998; Leung and Yuen,2007; Hua,2007; Nucci and Pozzolo,2010). Others show that wage rates are typically more responsive to real exchange rate movements than employment (Goldberg and Tracy, 2001; Campa and Goldberg, 2001). Since the reform of exchange rate regime for RMB from the pegged U.S dollar strategy to a more dynamic, flexible exchange rate regime in July, 2005, both the nominal and real exchange rate of RMB have experienced substantial appreciation. Although there has been studies investigated the overall impacts of RMB exchange rate movements on net employment using data of aggregated at provincial or specific industry level (Hua, 2007; Chen and Dao, 2011), to our best knowledge, few studies have ever investigated the different impacts of real exchange rate movements on Chinese labor market based on the narrowly defined industries and industry specific real exchange rate of RMB. Moreover, few studies for China have investigated the effects of RMB exchange rate movements on wage rates of Chinese industries, and the existing related studies only focus on investigating the significance of Balassa Samuelson effects and implied the association of RMB real exchange rate change with real wage rates adjustments (McKinnon, 2005; McKinnon and Schnabl, 2006).

In this paper, we highlight the links between real exchange change impacts on labor market with ownership structure of manufacturing industries; this is because state owned enterprises(SOEs), private enterprise and foreign invested enterprises (FIEs) for Chinese manufacturing industries are systematically different in trade dependence, market competitive structure, ratio of capital to labor inputs and rigidity of labor market, which all potentially play important roles in influencing the pass-through effects of exchange rate movements on labor market. We use a panel data set covering 456 four digit industries over the period 2001 to 2009 to investigate the effects of exchange rate movements on labor market behavior taking into account trends of RMB real exchange rate changes by industry before and after the reform of RMB exchange rate regime in July, 2005. Instead of using an aggregate RMB real effective exchange rate, we construct industry specific real effective exchange rates for 163 three digit

industries over the period 2001 to 2009 which we apply to our four digit industry data. Although the panel data covers only a short time period from 2001 to 2009, the RMB real exchange rates for almost all sectors have experienced a consistent depreciation from 2001 to 2005 and then a sharp appreciation after 2005, which provides us a very good experiment to investigate the impacts of real exchange rate movements on net employment and wage rates.

We find that real exchange rate movements for RMB have both significant effects on wage rates and net employment. A 10% change in real exchange rate will cause effects on net employment about 3.7%, and wage rates will also decline about 1.7% with a 10% real appreciation. The estimation results show that impacts of RMB real exchange rate movements on wage and employment are systematically associated with export openness, overall import penetration, profit margin and ownership structure of Chinese manufacturing industries. In contrast to the previous empirical studies (Campa and Goldberg,2001, Nucci and Pozzolo, 2010) that highlight the different impacts of exchange rate changes on labor market through foreign sales and import input channels, we stress that a real appreciation has negative effects on net employment and wage rates both through export openness and import penetration channels.

The estimation results indicate that labor market for private enterprises is less responsive to exchange rate fluctuations than is true for SOEs. We also show that exchange rate movements generate larger effects on the labor market activity of SOEs and FIEs than private firms even after we control for the profit margins of industries and the effects of exchange rate change on labor market through trade channels. Alexandre, *et al.*,(2010) have earlier noted that institutional factors can substantially influence the pass-through effects of exchange rate on domestic prices and output due to rigidities and different adjustment costs in labor market . Other studies of Chinese SOEs (Buckley, *et al.,* 2007, Hale and Long, 2008) generally imply that the labor market activity of SOEs is less likely to be affected by real exchange rate shocks because wage determination and hiring by SOEs is less market based and more regulated by government policy. They also argue that SOEs are more likely to obtain financial support from the government and also more likely to be immune to price and exchange rate movements. Also, and in contrast to private enterprises, most SOEs have higher hiring or firing costs due to a higher percentage of formal employment and stronger labor market regulation. However, SOEs have lower average profit margins and productivity than private enterprises and FIEs, and the ratio of capital to labor

inputs for SOEs is more capital intensive than for private enterprises, which all imply that exchange rate movements can potentially have larger effects on labor market of SOEs than private firms. With lower performance and productivity, SOEs are also more likely to be driven out of the market and experience bankruptcy with increased market competition due to a real appreciation[①]. With higher capital intensive inputs, the labor input for SOEs is also more likely to be substituted by import input with a real appreciation than for private enterprises based on our theoretical framework. All the above facts suggest that it is an empirical question to investigate the links between the effects of exchange rate movements on labor market with ownership structure of Chinese manufacturing industries.

The paper is organized as follows. In section 2 we provide a simple theoretical framework to analyze the mechanism and channel that exchange rate movements have impacts on labor market. Section 3 describes data, summary statistics and identification strategy for wage and employment equations. Section 4 presents empirical findings and discusses their possible implications. Section 5 provides conclusions.

2. Theoretical Background and Empirical Specification

2.1 Theoretical Background and Framework

Exchange rate fluctuations typically affect labor demand of tradable sectors through two direct channels. Through the output channel, real exchange shocks affect relative prices between domestic and foreign sales and employment will change accordingly. They also have impacts on labor market through imported input or import competition channels. A real appreciation (depreciation) reduces (increases) cost of imported inputs and price of imported final products. Depending on the degree of substitutability between domestic output and imported goods, output and employment of domestic industries can be impacted in different ways. Exchange rate fluctuations also have ambiguous effects on labor market of non-tradable sectors through several channels indirectly; employment for non-tradable sectors tends to expand due to labor inflows from trade sectors with an appreciation of real exchange rates, while the employment for non-tradable sectors will also potentially shrink with a real appreciation due to the significant output linkage between tradable and non-tradable

① The Summary statistics for the empirical sample we use later show that the average profit to sales margins of SOEs, private enterprises and FIEs in 456 four digit industries are -1.67%, 5.32% and 6.05% respectively over the period 2001 to 2009; The market share of SOEs declines consistently from 18.4% in 2001 to 5.5% in 2009, while the market share of private enterprise increases from 14.5% to 39.8%. The market share of FIEs is relatively stable at around 30% over the same period.

sectors (Chen and Dao, 2011).

The degree of responsiveness of output and employment to exchange rate shocks depends on pass-through effects of exchange rate change on prices of domestic and foreign sales. Market structure matters because, in a competitive market, firms have limited ability to set prices and firms' output is affected by changes in prices of foreign sales. Thus in a monopolistically competitive environment and with extensive production differentiation and market power, exchange rate shocks on output and employment can be partially offset by changed price setting. Trade orientation matters because exchange rates shocks and with them pass-through on to foreign demand are proportional to export openness. The pass-through effects on output and employment of exchange rate shocks through import channel depends on the degree of import penetration, import input ratio and substitutability between domestic output and imported goods.

The regulatory environment also plays an important role. If domestic industries are protected or supported by the government policies, relative prices, costs and the market share of domestic industries may not change with an exchange rate shock. Labor market regulations also affect the speed of adjustment of employment to relative cost changes caused by exchange rate shocks. If costs of labor hiring or firing and output adjustment are large, firms are reluctant to make large changes in employment in an uncertain duration. All these factors together influence the responsiveness of employment and wage rates to real exchange shocks.

We formulate a theoretical framework that demonstrates the links between exchange rate movements and labor market adjustment. To simplify analysis, we assume a representative firm within an industry chooses inputs and output to maximize its profit (π(e)) in every period under the condition of monopolistic competitive market, that is,

$$\pi(e) = \max_{\substack{q^d, q^x \\ L,Z,M}} \left\{ p^d(e, q^d) * q^d + \frac{p^x(e, q^x)}{e} * q^x - w * L - r * Z - \frac{s(e)}{e} * M \right\} \quad (1)$$

Where the domestic price and sales in the domestic market are p^d, q^d respectively, and p^x, q^x represent price and sales in the foreign market., w and L are wage rates and labor employed, respectively; r and Z are cost of non-labor inputs and non-labor inputs employed from domestic market; $s(e)$ and M represent cost of import input and import inputs used , respectively, and the real exchange rate (e) is defined as the amount of foreign currency per unit of RMB. The maximization

for equation (1) is subject to,

$$Q = q^d + q^x = L^\alpha Z^\beta M^{1-\alpha-\beta} \quad (2)$$

The first order conditions of outputs for the solution of the above constrained maximization problems are

$$\frac{\partial \pi(e)}{\partial q^d} = \frac{\partial p^d(e,p^d)}{\partial q^d} * q^d + p^d - \lambda = 0 \quad (3)$$

$$\frac{\partial \pi(e)}{\partial q^x} = \frac{1}{e}\left(\frac{\partial p^x(e,p^x)}{\partial q^x} * q^x + p^x\right) - \lambda = 0 \quad (4)$$

$$\frac{\partial \pi(e)}{\partial L} = -w + \lambda\frac{\partial Q}{\partial L} = 0 \quad (5)$$

$$\frac{\partial \pi(e)}{\partial Z} = -r + \lambda\frac{\partial Q}{\partial Z} = 0 \quad (6)$$

$$\frac{\partial \pi(e)}{\partial M} = -\frac{s(e)}{e} + \lambda\frac{\partial Q}{\partial M} = 0 \quad (7)$$

$$\lambda = p^d\left(1+\frac{1}{\eta^d}\right) = \frac{p^x}{e}\left(1+\frac{1}{\eta^x}\right) = \frac{s(e)}{e}\left(\frac{\partial Q}{\partial M}\right)^{-1} \quad (8)$$

Where λ is the Lagrange multiplier for the technology constraint. Combining the above first order conditions and Euler's theorem, we can derive the optimal labor demand(L_D), that is,

$$L_D = \frac{1}{w}\left\{p^d\left(1+\frac{1}{\eta^d}\right)q^d + \frac{p^x}{e}\left(1+\frac{1}{\eta^x}\right)q^x - rZ - \frac{s}{e}M\right\} \quad (9)$$

Where η^d and η^x represent the price elasticities of products demand in the domestic market and foreign market, respectively,

Differencing the optimal labor demand to real exchange rates, we derive the elasticity of labor demand to exchange rate movements, that is,

$$\frac{\partial L}{\partial e}\frac{e}{L} = \frac{1}{\alpha}\left\{\begin{array}{c} p^d\left(1+\frac{1}{\eta^d}\right)\eta^{d,e} + \theta\left[\frac{p^x}{e}\left(1+\frac{1}{\eta^x}\right)(\eta^{x,e}-1) - p^d\left(1+\frac{1}{\eta^d}\right)\eta^{d,e}\right] \\ +\frac{s}{e}(1-\alpha-\beta)\left(\frac{\partial Q}{\partial M}\right)^{-1}(1-\eta^{s,e}) \end{array}\right\} \quad (10)$$

Where the $\eta^{d,e}, \eta^{x,e}, \eta^{s,e}$ represent the pass-through effects of real exchange rate on domestic price , export price and the cost of import input, respectively , Using equation (8), equation (4) can be written as,

$$\frac{\partial L}{\partial e}\frac{e}{L} = \frac{\lambda}{\alpha}\{\eta^{d,e} + \theta[(\eta^{x,e}-1) - \eta^{d,e}] + (1-\alpha-\beta)(1-\eta^{s,e})\}$$

$$= \frac{\bar{p}}{\alpha\bar{\mu}}\{\eta^{d,e} + \theta[(\eta^{x,e}-1) - \eta^{d,e}] + (1-\alpha-\beta)(1-\eta^{s,e})\} \quad (11)$$

Where $\bar{\mu}$ represents the average price over cost markup in the domestic and foreign markets, $\bar{\mu} = \frac{\bar{\eta}}{1+\bar{\eta}}$, and $\bar{\eta}$ is the average price elasticity of demand and the average price is $\bar{p}$. The above equation suggests that the response of labor demand to

exchange rate will rise with an increase in labor intensity of inputs and will decline with an increase in price over cost markup, and equation (11) also shows that the response of labor demand to exchange rate change not only depends on the export openness and import input ratio in the production, but also depends on the pass-through effects of exchange rate movements on prices in the product and factor markets. As indicated by related research (Campa and Goldberg, 1995, 1999, 2001), the pass through effects of exchange rates are proportional to import penetration of product markets, and products of any two trade shares can be taken as very small values and assumed to be zeros, that is , $\theta * (\eta^{x,e} - \eta^{d,e}) = 0$; $(1 - \alpha - \beta)\eta^{s,e} = 0$. Hence, equation (11) is reduced to the following form,

$$\frac{\partial L}{\partial e}\frac{e}{L} = \frac{\bar{p}}{\alpha\bar{\mu}}\{\eta^{d,e} - \theta + (1 - \alpha - \beta)\} \qquad (12)$$

And the above equation show that market competitive structure and ratio of capital to labor play important roles in influencing the response of optimal labor demand to exchange rate fluctuations, and also highlights other three important channels that exchange rate movements have effects on the optimal labor demand. As indicated by our previous analysis and the existing literature, the pass-through effects of exchange rate movements on domestic price ($\eta^{d,e}$) are not only proportional to import penetration rate, but also potentially depends on institutional factors of labor market, and in order to investigate the systematic association of exchange rate movements effects on labor market with ownership structure of Chinese manufacturing industries, we also assume that the elasticity of domestic price in product market to exchange rate movements is both proportional to import penetration (IP) and ownership structure of the firms (OWN), that is, $\eta^{d,e} \propto \delta_0 * ip + \delta_1 own$, with δ_0, δ_1 as proportionality factors, equation (12) is written as,

$$\frac{\partial L}{\partial e}\frac{e}{L} = \frac{\bar{p}}{\alpha\bar{\mu}}\{\delta_0 * IP + \delta_1 OWN - \theta + (1 - \alpha - \beta)\} \qquad (13)$$

Combing the equations (9) and (13), the total differenced logarithm form of optimal labor demand can be expressed as,

$$\widehat{L_D} = \kappa_0 + \kappa_1\hat{Y} + \{\kappa_2 IP + \kappa_3 OWN + \kappa_4\theta + \kappa_5(1 - \alpha - \beta)\}\hat{e} + \kappa_6\hat{w} + \kappa_7\hat{r} + \kappa_8\hat{s} \qquad (14)$$

Where for any variables $(\widehat{Z})$ in the above equation $\hat{Z} = \Delta LnZ$, and Y is the total income generated both in domestic and foreign product market; $\kappa_0 - \kappa_8$ are coefficients for those variables. We need introduce labor supply equation to solve the

equilibrium level of employment and wage in the labor market, by referring to Klein, *et al*.,(2003), the labor supply for the specific firm (L_s) depends on the wage rate of the specific firm and average wage rate of other firm, that is,

$$L_s = \left(\frac{w}{W^{*\delta}}\right)^{\gamma} \tag{15}$$

In equation (15), W^* is the average wage rate of firms alternative to the specific firm F; δ is the cross-elasticity of labor supply between the specific firm F and firms alternative to firm F, and γ is the elasticity of labor supply with respect to relative wage rates change. The total differential of logarithm of the labor supply equation is,

$$\widehat{L_s} = \gamma\widehat{w} - \gamma\delta\widehat{W^*} \tag{16}$$

Combining equation (14) and (16), the equilibrium level of employment and wage rate for the specific firm can be expressed as,

$$\hat{L} = \vartheta_0 + \vartheta_1\hat{Y} + \{\vartheta_2 IP + \vartheta_3 OWN + \vartheta_4\theta + \vartheta_5(1-\alpha-\beta)\}\hat{e} + \vartheta_6\widehat{W^*} + \vartheta_7\hat{r} + \vartheta_8\hat{s} \tag{17}$$

$$\widehat{w} = \varphi_0 + \varphi_1\hat{Y} + \{\varphi_2 IP + \varphi_3 OWN + \varphi_4\theta + \varphi_5(1-\alpha-\beta)\}\hat{e} + \varphi_6\widehat{W^*} + \varphi_7\hat{r} + \varphi_8\hat{s} \tag{18}$$

$\vartheta_0 - \vartheta_8; \varphi_0 - \varphi_8$ are coefficients for employment and wage equations, respectively.

2.2. Empirical Specification

Based on the theoretical background and framework in section 2.1, we specify the dynamic estimation equations of employment and wage rates for manufacturing industries as the following form,

$$\hat{L}_{i,t} = \chi_0 + \chi_1\hat{Y}_{i,t} + \chi_2 EXS_{i,t-1} + \chi_3 IMS_{i,t-1} + \chi_4 OWN_{i,t-1} + \chi_5 PRO_{i,t-1} + \left(\chi_6 EXS_{i,t-1} + \chi_7 IMS_{i,t-1} + \chi_8 OWN_{i,t-1}\right)\widehat{REER}_{i,t} + \chi_9\widehat{W^*}_{i,t} + \chi_{10}\hat{L}_{i,t-1} + \upsilon_t + \epsilon_{i,t} \tag{19}$$

$$\widehat{w}_{it} = \phi_0 + \phi_1\hat{Y}_{it} + \phi_2 EXS_{i,t-1} + \phi_3 IMS_{i,t-1} + \phi_4 OWN_{i,t-1} + \phi_5 PRO_{i,t-1} + \left(\phi_6 EXS_{i,t-2} + \phi_7 IMS_{i,t-2} + \phi_8 OWN_{i,t-2}\right)\widehat{REER}_{it-1} + \phi_9\widehat{W^*}_{i,t} + \phi_{10}\hat{L}_{i,t-1} + \pi_t + \varpi_{it} \tag{20}$$

In the above equations of employment and wage rate, Y_{it} represents the total sales for the four digit sector i in the year t; EXS denotes export openness at industry level measured as ratio of foreign sales to total sales.

IMS is the overall import penetration rate for different industrial sectors, which is measured as ratio of import value to total sales plus import value and minus foreign sales, due to restriction of data access, we cannot differentiate the value of import final

products and the value of import input[①]; hence, the variable IMS in our study is proportional to import penetration rate plus import input rate, $IMS \propto \alpha_0 IP + \alpha_1(1 - \alpha - \beta)$, with α_0 and α_1 as proportionality factors, therefore, the interactive term of IMS and real exchange rate in equations (19) and (20) investigates overall impacts of exchange rate change on labor market though both import competition and import input channels.

OWN is the variable representing ownership structure measured as the shares of total assets for different ownership enterprises in the manufacturing industries, and $SOEs$, PVT and $FIEs$ each represents the share of total assets for stated owned enterprises, for private enterprises and for foreign invested enterprises, respectively, in manufacturing industries, that is, $OWN = [SOEs, PVT, FIEs]$.

PRO denotes net profit margins of individual manufacturing industries measured as the ratio of net profit to total sales, which controls for the effects of domestic market competitive structure on labor market as presented in our theoretical framework in section 2.1.

$REER$ represents trade weighted real effective exchange rates ($REER$) for specific industries disaggregated at 3 digit level, as the related studies indicated ,the response of employment and wage rates at present to an exchange rate shock not only depends on the current and the past exchange rate shocks but also depends on the expected future exchange rate changes, therefore, we here use the permanent component of real exchange rates in the estimation equation, in order to get the permanent components of real exchange rate, we construct the trade weighted $REER$ for 3 digit manufacturing industries at monthly frequency, and then applying the Butterworth time series filter[②] to remove the temporary component of real exchange rates, and the variable $REER$ in our estimation equations at annual frequency is generated by the mean values of permanent component of real exchange rate at monthly frequency.

In order to investigate the impacts of exchange rate movements on labor market through different channels clearly, trade share and ownership structure variables are

[①] According to the related research conducted by Campa and Goldberg (2001) Dekle,1998; Leung and Yuen,2007; Nucci and Pozzolo,2010 ; the import penetration rate and import input rate for industries are highly correlated variables in most cases and these two variables are not usually controlled simultaneously in the estimation equations.

[②] The decomposition of REER into permanent and cyclical components is conducted using STATA(Version 12.1) command 'tsfilter bw", there are several other standard methods of decomposition time series into trend and cyclical components, such as the Beveridge–Nelson decomposition and HP filter ,and the Beveridge–Nelson method require the data to be nonstationary and the HP filter requires the data to be stationary.

also controlled for individually both in wage and employment equations. To avoid the simultaneity problems for interactive terms in estimation equations, trade shares, profit margins and variables representing ownership structure are all lagged one period in employment equation, and taking into account the possible endogenous problem between real wage rate change and real exchange rate change as indicated by Balassa-Samuelson effects, real exchange rate variable in wage equation is also lagged one period and the corresponding variables for trade share, ownership structure in interactive terms are lagged two periods.

W^* represents the average real wage rate of industries alternative to industry i, and the υ_t, π_t are time dummies in employment and wage equations respectively to control for other macroeconomics factors, such as the costs of non-labor inputs from domestic and foreign market. $\epsilon_{i,t}$, ϖ_{it} are error terms in the estimation equations.

3. Data , Summary Statistics and Model Identification

3.1 Data and summary statistics

We use industry level panel data covering 456 four digit narrowly defined manufacturing industries over the time period of 2001 to 2009. These panel data are drawn from the Chinese industrial database provided by National Bureau of Statistics, China. The database provides over 65 financial variables for every four digit industry, including total sales, foreign sales, total wage paid and employment, and net profits in sales. The panel dataset does not provide the import value for each industry. In order to access to the export and import values between China and its 51 bilateral trading partners corresponding to narrowly defined industries, we construct a concordance between HS (version) 4 digit codes for 1250 trade products and industry codes for 175 three digit manufacturing industries in China[①]. Bilateral trade data disaggregated at a HS 4 digit product level between China and 51 trading partners over the period of 1999 to 2009 are drawn from COMTRADE database of United Nations. The CPI index and nominal exchange rate for China and 51 trading partners are all drawn from International Financial Statistics, IMF.

Table1 presents summary statistics for variables, the descriptive statistics show that comparing to private firms and FIEs, average employment size and total sales for SOEs aggregated at the narrowly defined industries are relatively smaller, while the

[①] The concordance is constructed referring to the concordance between HS 96 codes and ISIC (Revision 4) codes and the classification codes (version 2002) for Chinese manufacturing industries.

average real wage rate for SOEs is higher than private enterprises but lower than FIEs across different percentiles. The average ratio of capital to labor inputs is substantially lower for private firms than for SOEs and FIEs; while the average net profit rate for SOEs is negative, which is also substantially lower than the profit rate of private enterprises and FIEs, but vary greatly across sectors as indicated by the larger standard deviation. Comparing to SOEs and private enterprises, FIEs are highly export oriented, and the average rate of export openness for FIEs is 0.35, while the average rates of export openness for SOEs and private firms range from 0.1 to 0.13 and is far below the corresponding statistics for FIEs in all different percentiles. The average import penetration rate across all 3 digit manufacturing industries is 0.18.

Table 1 is here

Figure 1 presents the movements of RMB real effective exchange rates （REERs） for the selected 16 three digit manufacturing industries of China at monthly frequency over the period of 1999 to 2011, and the real exchange rates for all specific industries are decomposed into permanent and cyclical components. Figure 1 clearly indicate that RMB real exchange rate have experienced significant fluctuations over the period of 2001 to 2009, RMB real exchange rates for most sectors present consistent depreciation before the reform of exchange rate regime in July,2005 ,and then demonstrate rapid real appreciation after 2005, while the magnitude of depreciation and appreciation varies significantly across sector over the period of 1999 to 2011, for example, the REER for crude oil mining shows consistent depreciation since 2001, and comparing to other industries, the REER for communication equipment manufacturing does not show significant appreciation after the reform of exchange rate regime, which all highlight the importance of using industry specific real exchange rates instead of aggregated real exchange rate applying to all sectors. The Figure 1 also shows that real exchange rate movements are mainly accounted by permanent changes and the varince of real exchange rate for 163 three digit industries accounted by cyclical movements (temporary shocks) is only 11% on average.

Figure 1 is here

3.2 Identification Methods for Wage and Employment Equations.

To identify employment and wage equations specified in section 3.1, it is not suitable to use OLS and fixed effect (FE) estimators because the endogenous variables in wage and employment equations are all potentially correlated with the error terms. The generalized moment method (GMM) and Panel IV (2SLS) FE estimators are

frequently adopted measures to identify the dynamic panel data model and to control for the endogeneity problem.

To identify our dynamic employment equation appropriately, we use two-step system GMM estimators (Blundell and Bond, 1998), which provides more efficient instruments than the difference GMM estimators. Robust standard errors are reported to correct the downward bias as emphasized by Windmeijer (2005)[①]. Wage equations are identified using both Panel IV (2SLS) FE estimators to control for endogeneity. As endogeneity tests of variables when applying the Panel IV-FE estimators, two variables (ΔLnY_{it} and ΔLnW_{it}^{*}) are set as endogenous variables both in the employment and wage equations. The lagged level and lagged difference endogenous variables and other exogenous variables are set as the instruments for those endogenous variables.

4. Empirical Results

The empirical specifications illustrated in section 2.2 provide us a suitable framework for investigating the systematic links between the impacts of exchange rate change on labor market with trade openness and ownership structure. In this section, we will present estimation results of those specifications and analyze factors influencing the pass-through effects of permanent exchange rate movements on labor market, and investigate the links between the effects of exchange rate changes on labor market with ownership structure of manufacturing industries.

4.1 Trade openness, ownership structure and the impacts of exchange rate movements on employment

The econometric results reported in Table 2 support the view that real exchange rate movements can have significant effect on net employment both through foreign sales channel and import penetration channel, and impacts of real exchange rate fluctuations on employment are also systematically associated with ownership structure change. In column 1 (Table 2), we investigate the effects of exchange rate variation on employment through export openness and import penetration channels respectively, the estimated coefficient for interactive variable ($\Delta LnREER_{it} * EXS_{it-1}$) measuring the effects of exchange rate change on employment through export openness is significant and negative at the 95% level, and the coefficient measuring the

[①] The robust and two-step GMM system estimators for identifying employment equation are conducted using STATA (version 12.1) command "xtabond2", and the theoretical background and estimation details of system and difference GMM estimators in STATA are referring to Roodman(2009).

effects of exchange rate variation through overall import penetration($\Delta LnREER_{it} * IMS_{it-1}$) is also significant and negative at the 90% level. Hence, an exchange rate appreciation (depreciation) will induce an employment contraction (expansion) both through foreign sales and import penetration channels, and the impact of exchange rate fluctuations on employment will increase with an increase in export openness and import penetration rate in the manufacturing industries. The above estimation results are somewhat at odds with the findings of some previous related studies (Campa and Goldberg, 2001; Nucci and Pozzolo, 2010) that the effects of exchange rate change on employment through import input is always positive, this is because the import penetration ratio in our study measuring overall effects of exchange rate fluctuations both through import competition channel and through affecting the cost of import input. The reported estimation results also imply that the impacts on employment of exchange rate movements through import competition channel dominant those impacts on employment through affecting the cost of import input.

Table 2 is here

The estimation results for investigating the links between the effects of exchange rate change with ownership structure of manufacturing industries are reported in columns 2 to 7 in Table 2, the coefficient measuring the effects of exchange rate change with variation of SOEs share specified in column 2 ($\Delta LnREER_{it} * SOE_{it-1}$) is negative and insignificant after controlling for the impacts of exchange rate change through trade channels , while the coefficients for the same interactive term in columns 4 and 5 are both negative and significant if we only control for the effects of exchange rate change through export openness channel, the different significance for above estimation results is possibly due to effects of exchange rate changes through import penetration channel are mixed with effects of exchange rate changes with variation of SOEs shares. The coefficients measuring the effects of exchange rate change on employment with variation of FIEs share in columns 6 and 7 ($\Delta LnREER_{it} * FIE_{it-1}$) are also negative and significant at the 95% level. Due to the high correlation between FIE share and export share in Chinese manufacturing industries, the effects of exchange rate change through export openness channel are not controlled for in column 6 and 7. The coefficients measuring the effects of exchange rate changes on employment with the variation of private enterprise share ($\Delta LnREER_{it} * PVT_{it-1}$) are all insignificant in different specifications in Table 2.

The above econometric results show that net employment for SOEs and FIEs are

more responsive to exchange rate fluctuations than for private firms, our empirical results do not support the commonly held belief that labor market of SOEs have higher rigidity and is less likely to adjust with the exchange rate shocks, while the input ratio of capital to labor for SOEs and FIEs is more capital intensive than for private enterprises as exhibited in Table 1 , SOEs are less productive than private firms and have lower profit margins , and more likely to go bankruptcy with the increased market competition; The trade dependence for FIEs is higher than private firms. All these facts imply SOEs and FIEs are potentially more responsive to real exchange rate shocks than private enterprises.

The coefficients for other controlled variables in our estimated equations of Table 2 also make sense. Changes in total sales (ΔLnY_{it}) and profit margins (PRO_{it-1}) both have positive and statistically significant effects on employment and the lagged dependent variables accounting for adjustment process of labor force are positive and significant in columns 1 and 3; similarly, coefficients for average real wage rate alternative to the specific industry ($\Delta LnW_{it}{}^{*}$) are also positive but not significant in most specifications, which indicate that net employment for the specific industries potentially increase with an increase in average real wage rate of industries alternative to the specific industries , which fits well to the theoretical prediction. The variation of trade shares($EXS_{it-1}; IMS_{it-1}$) has no significant effects on employment after we control for other variables in different specifications. An increase in SOEs share (SOE_{it-1}) has negative and statistically significant effects on employment in manufacturing industries, while an increase in FIEs share (FIE_{it-1}) has significant and positive effects on employment and changes in private enterprise share (PVT_{it-1}) have no significant effects on employment, which all imply that job loss due to restructuring of SOEs and job creation due to the fast inflows of FIEs both contributing significantly to changes in net employment. The Sargan statistics and Hansen J statistics for over identifying restrictions testing for the validity of instruments and the values of the test for absence of second order serial correlation of residuals all consistently show the validity of our specifications.

Based on the estimated coefficients for interactive variables in column 1 of Table 2 and average rates of export openness and import penetration, we can calculate the elasticity of employment to real exchange rate fluctuations, the estimation results indicate that, after taking into account the dynamic adjustment of labor demand, a 1%

real appreciation (depreciation) of exchange rate will cause net employment in Chinese manufacturing industries drop (increase) 0.21% through foreign sales channel (export openness) ,while net employment will also drop (rise) about 0.16% through import penetration channel with a 1% real appreciation (depreciation); and the overall elasticity of net employment to RMB real exchange rate through trade channels is around 0.37 measured from our estimation results[①].

As indicated by our theoretical framework in section 2.1, the market competitive structure and ratio of capital to labor inputs also influence the impacts of exchange rate movements on labor market. Moreover, the estimation results in Table 2 present that the systematic links between the impacts of exchange rate movements on labor market with ownership structure is also potentially caused by the systematic variation of profit margins and ratio of capital to labor inputs for different ownership enterprises, in order to investigate the links between the impacts of exchange rate fluctuations on labor market with market competitive structure and check the robustness of estimation results in Table 2 , we use new specifications that include interactive terms of real exchange rate change with both trade shares and market power index, and interactive terms of real exchange rate change with both trade shares and ownership structure index, while the market power is positively associated with profit margins of manufacturing industries and the impacts of exchange rate on labor market are negatively associated with market power of firms within an industry as indicated by our theoretical framework, so the two following new interaction terms are specified to investigate the links between impacts of exchange rate on employment and market power variation, respectively:

$\Delta LnREER_{it} * EXS_{it-1} * (1 - PRO_{it-1})$

$\Delta LnREER_{it} * IMS_{it-1} * (1 - PRO_{it-1})$

On the other hand, change in real exchange rate can have larger effects on SOEs and FIEs, which is possibly due to the ratio of capital to labor inputs for SOEs and FIEs are both more capital intensive than private enterprises, comparing to private enterprises, SOEs are less productive and have lower profit margins, while FIEs have higher trade shares. Hence we also specify the following new interaction terms in the new

[①] Based on the estimation coefficients in column 1 of Table2, and taking into account the dynamic process of labor adjustment ,the elasticity of employment to exchange rate movements through export openness channel is equal to $0.6879 * (\frac{\overline{EXS}_{it-1}}{1-0.2901}) = 0.21$, and the elasticity of employment to exchange rate movements through import penetration channel is equal to $0.6189 * (\frac{\overline{IMS}_{it-1}}{1-0.2901}) = 0.16$, where $\overline{EXS}_{it-1}, \overline{IMS}_{it-1}$ denote the average ratio of export openness and import penetration lagged one period for 4 digit manufacturing industries, respectively.

estimation equations to further check the robustness of empirical results in Table 2,

$\Delta LnREER_{it} * EXS_{it-1} * SOE_{it-1}$

$\Delta LnREER_{it} * IMS_{it-1} * SOE_{it-1}$

$\Delta LnREER_{it} * EXS_{it-1} * (1 - PVT_{it-1})$

$\Delta LnREER_{it} * IMS_{it-1} * (1 - PVT_{it-1})$

$\Delta LnREER_{it} * EXS_{it-1} * FIE_{it-1}$

$\Delta LnREER_{it} * IMS_{it-1} * FIE_{it-1}$

All the above specifications are consistent with our theoretical framework and estimation results in Table 2, which indicate that the magnitude of the effects of a real appreciation on employment will increase with an increase in foreign sales rate, import penetration rate and shares of SOEs and FIEs, while the magnitude will decline with an increase in market power and share of private enterprises in manufacturing industries.

The coefficients for the above interaction terms specified in the new estimation equations are estimated and presented in Table 3, after controlling for other variables. The estimated coefficients for all interactive terms in the new specifications have the expected sign and statistically significant and the estimation results in Table 3 also fit well to our theoretical predictions and are consistent with the empirical results reported in Table 2. The responsiveness of employment to exchange rate change depends on trade shares, market power and ownership structure simultaneously for Chinese manufacturing industries, and the implications of estimation results is opposite to the assumption that job market for SOEs exhibit stronger rigidity and less likely to be affected by real exchange rate movements.

Table 3 is here

4.2 Trade openness, ownership structure and the effects of exchange rate movements on wage rates

The estimation results for wage equation specified in section 2.2 are reported in Table 4. The specifications for wage equation are all identified using IV/2SLS estimators. The coefficients for interaction terms measuring the effects of exchange rate change on wage rates through export openness and import penetration channels ($\Delta LnREER_{it-1} * EXS_{it-2}$; $\Delta LnREER_{it-1} * IMS_{it-2}$) are all negative and statistically significant in different specifications, which imply that the magnitude of the impacts on wage rates of exchange rate movements will increase significantly with a rise of foreign sales and import penetration rate. It is obvious that real exchange rate

movements have similar impacts on wage rates as on employment for Chinese manufacturing industries, and based on the estimated coefficients for interactive terms in column 1 of Table 4, we can derive that a 1% real appreciation (depreciation) will cause real wage rates drop (increase) 0.12% through foreign sales channel, and also drop(rise) 0.07% through import penetration channel, and overall elasticity of wage rates to real exchange movements through trade shares is around 0.19% ,which is relatively lower than the elasticity of employment to permanent real exchange rate change[①].

Table 4 is here

The estimation results for interaction terms of real exchange rate with variables representing ownership structure also consistently show that the impacts on wage rates of real exchange rate change are associated with variation of ownership structures, the coefficients measuring the effects of real exchange rate with the variation of SOEs shares ($\Delta LnREER_{it-1} * SOE_{it-2}$) are all insignificant for different specifications, which suggests that the response of wage rates to real exchange rate changes is insensitive to variation of SOEs share in manufacturing industries, while the coefficients for interaction term of exchange rate change with the share of private enterprises ($\Delta LnREER_{it-1} * PVT_{it-2}$) are all positive and significant in different specifications, the estimation results in Table 4 indicates that the negative (positive) impacts on wage rate of a real appreciation (depreciation) will decrease with an increase in shares of private enterprises in manufacturing industries after controlling for other interaction terms, which also suggests that the magnitude of those impacts will decline with an increase in the share of private firms and average real wage rate for private firms are less likely to be affected by real exchange rate fluctuations. The coefficient investigating the links between the impacts of exchange rate change with variation of FIEs shares ($\Delta LnREER_{it-1} * FIE_{it-2}$) are all negative and statistically significant in different specifications, which also suggests that the response of real wage rates to exchange rate will increase with an increase in FIEs shares in manufacturing industries.

The above estimation results in Table 4 also make sense that wage rates for FIEs and SOEs are more responsive to permanent real exchange rate movements than the wage rate for private enterprises, because our theoretical analysis in section 2.1 implies

① Based on the estimated coefficients in column 1 of table 4 , the elasticity of average real wage rates to real exchange rate through foreign sales is measured as , $-O.552 * \overline{EXS}_{it-1}$, and the elasticity through import penetration channel is measured as, $-O.3659 * \overline{IMS}_{it-1}$, where $\overline{EXS}_{it-1}$ and $\overline{IMS}_{it-1}$ represent the average ratio of export openness and import penetration lagged one period, respectively.

that industries with higher labor demand elasticity to wage rate have smaller adjustment of both wage rate and employment to exchange rate shocks ,while industries with less elastic product demands have more responsive wages and employment to exchange rate change, both the higher ratio of capital to labor input and lower price setting ability for SOEs indicate lower labor demand elasticity to wage and less elastic product demands , which also imply higher adjustment of labor market for SOEs to exchange rate shocks, and the higher trade dependence and higher ratio capital to labor inputs for FIEs suggest that the response of labor market for FIEs to exchange rate changes should also be larger than labor market for private enterprises.

The coefficients for other controlled variables in wage equations also make sense; An increase in total sales and profit margins both has positively significantly effects on real wage rate, and real wage rate is also positively associated with average real wage rates of industries alternative to the specific industry, which suggests there exists positively wage spillovers across different sectors. The variation of export openness and import penetration rate has no significant effects on real wage rate after controlling for other variables; the estimation results for variables representing ownership structures indicate that only the FIEs share changes have positive and significant effects on real wage rate in all specifications. The LM-statistics for under identification test and Hansen J statistics for over identification test all confirms the validity of instruments and the validity of our specifications in Table 4.

As the previous cases, market competitive structure and ratio of capital to labor inputs also potentially affect the pass-through effects of exchange rate movements on wage rates, and our estimation results in Table 4 do not support the assumption that the wage rate for SOEs are less likely to be affected by exchange rate fluctuations possibly due to its higher rigidity of labor market, while systematic linkage of the effects of exchange rate movements with ownership structure is also possibly due to the systematic difference in profit margins and elasticity of labor demand to wage between different ownership enterprises. To investigate the linkage of the effects of exchange rate on wage rate with market power and to further check the consistency and robustness of estimation results in Table 4, we also specify new interaction terms of exchange rate with both trade shares and profit margins, and interaction terms of exchange rate with both trade shares and ownership index as specified in section 4.1. The estimation results for different specifications with new interaction terms are reported in Table 5, the coefficients for interactive terms ($\Delta LnREER_{it-1} * EXS_{it-2} *$

$(1 - PRO_{it-2})$; $\Delta LnREER_{it-1} * IMS_{it-2} * (1 - PRO_{it-2})$) in column 1 and 2 of Table 5 are both negative and statistically significant, which indicates that magnitude of the effects of exchange rate movements on wage rate through trade share channels will increase with a decrease in profit margins just as our theoretical framework predicted in section 2.1, the coefficients for interactive terms of exchange rate with both trade shares and SOEs share ($\Delta LnREER_{it-1} * EXS_{it-2} * SOE_{it-2}$; $\Delta LnREER_{it-1} * IMS_{it-2} * SOE_{it-2}$) are all insignificant in table 5 and consistent with the empirical results in Table 4 , which all suggest that variation of SOEs shares in manufacturing industries are not significantly associated with the effects of exchange rate on wage rate through trade channels, while the coefficients measuring the links between the impacts on wage rate of exchange rate changes with the shares of FIEs ($\Delta LnREER_{it-1} * EXS_{it-2} * FIE_{it-2}$; $\Delta LnREER_{it-1} * IMS_{it-2} * FIE_{it-2}$) and one minus share of private enterprises ($\Delta LnREER_{it-1} * EXS_{it-2} * (1 - PVT_{it-2})$; $\Delta LnREER_{it-1} * IMS_{it-2} * (1 - PVT_{it-2})$) are all negative and statistically significant in column 4 to 7 of Table 5 , and all the estimation results indicate that the impacts on real wage rate of exchange rate movements through trade channels will increase with an increase in shares of FIEs and decrease with an increase in shares of private enterprises in the manufacturing industries, which are consistent with estimation results in Table 4 .

Table 5 is here

5. Conclusion

This study investigates the impacts on both employment and wage rates of real exchange rate movements in China, and highlights the links between the impacts on labor market of exchange rate fluctuations and ownership structure of Chinese manufacturing industries. Using a representative sample covering 456 narrowly defined 4 digit manufacturing industries over the period of 2001 to 2009, we find that impacts change on labor market of exchange rate movements are systematically associated with ownership structure of Chinese manufacturing industries. The labor market behavior of SOEs and FIEs are more responsive to exchange rate movements than is true for private enterprises. This is contrary to the common belief that the less export oriented and less market based SOEs are not responsive to real exchange rate fluctuations than private enterprises. It appears that FIEs are more likely to adjust wage and employment levels to counteract negative impacts of exchange rate appreciations on their profit margins, while private enterprises tend to adjust their price and profit

margins to keep a relatively stable labor market. SOEs are more prone to be driven out of the market with a real appreciation.

We find that RMB real exchange rate movements have relatively large effects both on wage rates and net employment. A 10% real appreciation in the RMB real exchange rate will cause net employment drop about 3.7%, and real wage rates will also decline about 1.9%, after taking into the dynamic adjustment of employment and controlling for other factors. In contrast to existing studies that stress the different impacts of exchange rate movements on labor market through foreign sales and import input channels, we stress that a real appreciation (depreciation) both have negative (positive) effects on labor market through foreign sales and overall import penetration channels, which implies that the impacts of exchange rate movements through import competition channel dominant the impacts of exchange rate movements through affecting cost of import inputs. Our estimation results also indicate that impacts of RMB real exchange rate movements on wage rates and employment are both systematically associated with export openness, overall import penetration and ownership structure of Chinese manufacturing industries.

Reference

Alexandre,F., P. Bacao, J. Cerejeira and M. Portela, 2010, Employment ,Exchange rate and Labor Market Rigidity, IZA Discussion Paper No. 4891.

Blundell, R. and S. Bond, 1998, Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics, 87, 115–143.

Branson, W. and J. Love, 1988, United States Manufacturing and the Real Exchange Rate. In: Marston, R.(Ed.), Misalignment of Exchange Rates: Effects on Trade and Industry. University of Chicago Press,Chicago, Illinois.

Buckley, P., C. Wang and C. Jeremy, 2007, The Impact of Foreign Ownership, Local Ownership and Industry Characteristics on Spillover Benefits from Foreign Direct Investment in China" International Business Review, 16(2), 142-158

Burgess,S.M. and M.M. Knetter, 1998, An International Comparison of Employment Adjustment to Exchange Rate Fluctuations, Review of International Economics, 6(1), 151-163.

Campa, J., and L. Goldberg, 1995, Investment, Exchange Rates and External Exposure," Journal of International Economics, 1995, 38, 297–320.

Campa, J., and L. Goldberg, 1999, Investment, Pass-Through and Exchange Rates: A Cross-Country Comparison," International Economic Review, 1999, 40(2), 287–314.

Campa, J. and L. Goldberg, 2001, Employment Versus Wage Adjustment and the U.S. Dollar. Review of Economics and Statistics, 83 (3), 477–489.

Chen, Ruo and M. Dao, 2011, The Real Exchange Rate and Employment in China,IMF Working Paper, 2011,WP/11/148.

Dekle,R.,1998, The Yen and Japanese Manufacturing Employment, Journal of International Money and Finance,17,785-801.

Goldberg, L., 2004, Industry Specific Real Exchange Rate for the United States, Economic Policy Review,10(1), 1-16.

Goldberg, L . and J. Tracy, 2001, Exchange Rates and Wages, NBER working paper w8137.

Hale, G. and C. Long, 2008, Did Foreign Direct Investment Put an Upward Pressure on Wages in China, Federal Reserve Bank of San Francisco Working Paper Series 2006-25

Klein, M.W., S. Schuh, and R. K. Triest, 2003, Job creation, Job destruction and the Real Exchange Rate, Journal of International Economics, 59, 239-265.

McKinnon, R.., 2005, Exchange Rate or Wage Changes in International Adjustment? Japan and China versus United States. ZEW-Centre for European Economic Research Discussion Paper No.05-064.

McKinnon, R. and G. Schnabl, 2006, China's Exchange Rate and International Adjustment in Wages, Prices and Interest Rates: Japan De'ja` *Vu*? CESifo Economic Studies, 52, 267-303.

Nucci, F. and A. F. Pozzolo, 2010, The Exchange Rate, Employment and Hours: What Firm Level Data Say? Journal of International Economics, 82, 112-123

Ping, Hua, 2007, Real Exchange Rate and Manufacturing Employment in China, China Economic Review, 18, 335-353.

Revenga, A., 1992, Exporting jobs? The Impact of Import Competition on Employment and Wages in U.S. Manufacturing, Quarterly Journal of Economics 107 (1), 255–284.

Roodman, D., 2009, How to do xtabond2: An Introduction to Difference and System GMM in Stata. 2009, The Stata Journal, 9(1), 86-136.

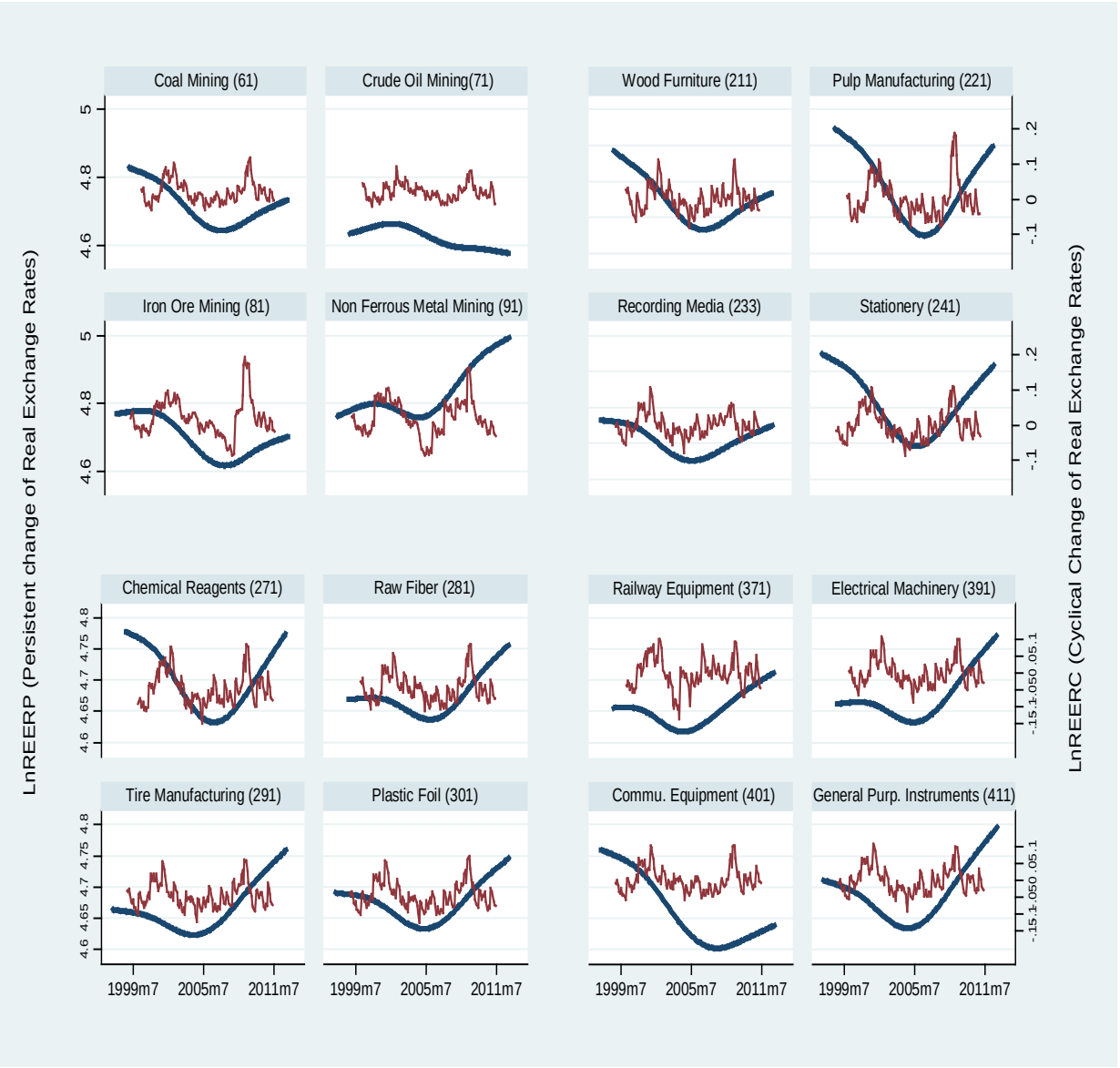
Windmeijer, F., 2005, A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators." Journal of Econometrics, 126, 25-51.

Table 1 Summery Statistics of Chinese Manufacturing Industries :2001-2009

Variables	Ownership	N	MEAN	Stand. Dev.	P25	P50	P75
Annual Average Employment (Unit:1000 PERSON)	All	3893	139289.80	324297.2	23372	60891	147314
	SOEs	3710	21360.98	111400.3	974	3641	13557
	Private	3856	37781.46	90624.54	4540	14441.5	36488.5
	FIEs	3811	38369.72	112147.5	3303	12481	35302
Annual Average Real Wage (Unit:1000RMB)	All	3892	16.68	8.80	11.08	14.78	19.92
	SOEs	3535	16.21	11.01	9.16	13.35	20.04
	Private	3822	13.24	5.58	9.35	12.00	16.34
	FIEs	3741	22.48	33.93	14.11	19.06	25.75
Total Sales (Unit:1000RMB)	All	3893	5.49E+07	1.48E+08	5.51E+06	1.65E+07	4.60E+07
	SOEs	3710	6.40E+06	3.33E+07	1.09E+05	4.98E+05	2.39E+06
	Private	3856	1.39E+07	3.69E+07	1.10E+06	3.76E+06	1.14E+07
	FIEs	3811	1.67E+07	4.62E+07	1.19E+06	4.70E+06	1.40E+07
Ratio of Capital to Labor (Unit:1000RMB)	All	3892	95.30	89.07	48.39	70.32	108.97
	SOEs	3535	115.64	246.15	50.37	78.35	128.86
	Private	3822	64.30	84.79	35.16	50.99	75.47
	FIEs	3741	166.23	449.89	58.44	98.17	168.00
Net Profit Rate (Unit: Percentage of net profit to total sales)	All	3893	5.57	4.04	3.67	5.21	6.99
	SOEs	3704	-1.40	35.82	-2.42	0.69	4.18
	Private	3856	5.32	3.12	3.76	5.03	6.48
	FIEs	3811	6.09	5.81	3.21	5.39	8.39
Export Openness (Unit: Ratio of foreign sales to total sales)	ALL	3892	0.21	0.21	0.06	0.14	0.33
	SOEs	3526	0.10	0.16	0.00	0.03	0.12
	Private	3821	0.13	0.16	0.02	0.06	0.18
	FIEs	3739	0.35	0.26	0.13	0.31	0.56
Import Penetration (Unit: Ratio of Import to total output plus import and minus export)	ALL	3893	0.18	0.20	0.02	0.11	0.25
Real Effective Exchange Rates for 3 digit Sectors （YEAR2005=100）	ALL	3882	102.12	8.25	97.18	100.00	105.78

Source: The statistics in Table 1 is calculated by authors based on the dataset from National Bureau of Statistics, China and the Comtrade Database from United Nations.

Figure 1 Monthly Movements of RMB Real Effective Exchange Rate by Industrial Sectors (1999:1-2011:6)



Notes: The smooth and thick lines in figure 1 represent the permanent components of real effective exchange rate movements for different industrial sectors, while the vibrating and thin lines represent the cyclical components of real exchange rate movements; the codes for 3 digit industrial sectors are in the parentheses.

Table 2 Employment Equations Estimation(Dependent Variable:ΔLnL_{it})

	1	2	3	4	5	6	7
ΔLnL_{it-1}	0.2901*	0.1846	0.3287**	0.1723	0.1494	0.2232	0.2075
	(0.123)	(0.130)	(0.125)	(0.133)	(0.121)	(0.130)	(0.127)
ΔLnY_{it}	0.4025***	0.4184***	0.3625***	0.4075***	0.3880***	0.4456***	0.4180***
	(0.094)	(0.095)	(0.092)	(0.082)	(0.085)	(0.098)	(0.104)
$\Delta LnW_{it}{}^{*}$	0.1667	0.2041	0.1808	0.2191	0.2283*	0.1182	0.1271
	(0.121)	(0.126)	(0.111)	(0.121)	(0.112)	(0.106)	(0.113)
EXS_{it-1}	0.0453	0.0322	0.0325	0.036	0.0189		
	(0.026)	(0.026)	(0.026)	(0.025)	(0.024)		
IMS_{it-1}	0.022	0.0196	0.0114			-0.0186	-0.0144
	(0.021)	(0.025)	(0.017)			(0.016)	(0.016)
PRO_{it-1}	0.2668*	0.3457**	0.1988	0.3698*	0.2854*	0.3900***	0.3996***
	(0.131)	(0.129)	(0.120)	(0.145)	(0.138)	(0.103)	(0.101)
SOE_{it-1}		-0.1622***		-0.1539***	-0.2178***		
		(0.037)		(0.037)	(0.041)		
PVT_{it-1}			-0.0448		-0.0701		0.0243
			(0.035)		(0.036)		(0.038)
FIE_{it-1}						0.0926**	0.0979***
						(0.030)	(0.027)
$\Delta LnREER_{it} * EXS_{it-1}$	-0.6879**	-0.6836**	-0.8097***	-0.7266**	-0.8485**		
	(0.243)	(0.264)	(0.236)	(0.272)	(0.271)		
$\Delta LnREER_{it} * IMS_{it-1}$	-0.6189*	-0.3573	-0.6690*			-0.382	-0.4216
	(0.329)	(0.267)	(0.305)			(0.265)	(0.270)
$\Delta LnREER_{it} * SOE_{it-1}$		-0.382		-0.5495**	-0.4828**		
		(0.243)		(0.275)	(0.238)		
$\Delta LnREER_{it} * PVT_{it-1}$			0.1688		-0.0524		0.2629
			(0.256)		(0.269)		(0.193)
$\Delta LnREER_{it} * FIE_{it-1}$						-0.4736**	-0.4665**
						(0.225)	(0.218)
No.of Industries	456	456	456	456	456	452	452
Observations	2960	2836	2943	2836	2820	2895	2895
AR(2)_P	0.936	0.506	0.871	0.504	0.688	0.642	0.661
Sargan_P	0.930	0.978	0.939	0.982	0.984	0.810	0.797
Hansen J_P	0.564	0.372	0.526	0.350	0.430	0.736	0.716

Notes: The employment equations are all identified with two-step system GMM estimators (Bludell and Bond, 1998). ΔLnL_{it-1}, ΔLnY_{it} and ΔLnW_{it}^{*} are set as endogenous variables based on the panel IV endogenous tests. The industry fixed effects and time dummies are all controlled in the above estimation equations. Robust standard errors are reported in parentheses to correct the downward bias of standard errors; ****, (**,*) indicates rejection of null hypothesis is significant at 1%, (5%, 10%).

Table 3 Employment Equations Estimation: Robustness Check (Dependent Variable:ΔLnL_{it})

	1	2	3	4	5	6	7
ΔLnL_{it-1}	0.2916**	0.2273**	0.2305**	0.2896**	0.2964**	0.2658**	0.2811**
	(0.124)	(0.109)	(0.113)	(0.117)	(0.122)	(0.103)	(0.106)
ΔLnY_{it}	0.4017***	0.4324***	0.4241***	0.4060***	0.3833***	0.4273***	0.4010***
	(0.094)	(0.081)	(0.087)	(0.094)	(0.089)	(0.096)	(0.099)
ΔLnW_{it}^{*}	0.1656	0.1619	0.1822	0.1503	0.1822	0.1428	0.158
	(0.120)	(0.119)	(0.120)	(0.122)	(0.123)	(0.110)	(0.106)
EXS_{it-1}	0.0459*	0.0573***	0.0583***	0.0635***	0.0667***	0.0283*	0.0294**
	(0.025)	(0.015)	(0.015)	(0.018)	(0.019)	(0.015)	(0.014)
IMS_{it-1}	0.0223	-0.0013	0.0007	-0.0051	-0.0002	-0.0127	-0.0083
	(0.021)	(0.014)	(0.014)	(0.015)	(0.015)	(0.014)	(0.014)
PRO_{it-1}	0.2670**	0.3888**	0.4067***	0.2866**	0.3541***	0.2958**	0.3285***
	(0.130)	(0.137)	(0.140)	(0.135)	(0.128)	(0.125)	(0.120)
SOE_{it-1}		-0.0790***	-0.0786***				
		(0.025)	(0.026)				
PVT_{it-1}				-0.0147	-0.0099		
				(0.020)	(0.021)		
FIE_{it-1}						0.0559**	0.0530**
						(0.021)	(0.021)
$\Delta LnREER_{it} * EXS_{it-1}$	-0.7037***						
$* (1 - PRO_{it-1})$	(0.252)						
$\Delta LnREER_{it} * IMS_{it-1}$	-0.7296**						
$* (1 - PRO_{it-1})$	(0.363)						
$\Delta LnREER_{it} * EXS_{it-1}$		-7.8174**					
$* SOE_{it-1}$		(3.273)					
$\Delta LnREER_{it} * IMS_{it-1}$			-3.084*				
$* SOE_{it-1}$			(1.772)				
$\Delta LnREER_{it} * EXS_{it-1}$				-1.1584***			
$* (1 - PVT_{it-1})$				(0.373)			
$\Delta LnREER_{it} * IMS_{it-1}$					-1.1094**		
$* (1 - PVT_{it-1})$					(0.430)		
$\Delta LnREER_{it} * EXS_{it-1}$						-1.1643**	
$* FIE_{it-1}$						(0.382)	
$\Delta LnREER_{it} * IMS_{it-1}$							-1.6341**
$* FIE_{it-1}$							(0.734)
No. of Industries	456	456	456	456	456	453	453
Observations	2960	2960	2960	2960	2960	2949	2949
AR2_P	0.941	0.927	0.920	0.845	0.925	0.718	0.709
Sargan_P	0.928	0.939	0.948	0.948	0.958	0.980	0.988
Hansen J_P	0.561	0.753	0.790	0.597	0.765	0.765	0.870

Notes: The employment equations are all identified with two-step system GMM estimators (Bludell and Bond, 1998). ΔLnL_{it-1}, ΔLnY_{it} and ΔLnW_{it}^{*} are set as endogenous variables based on the panel IV endogenous tests. The industry fixed effects and time dummies are all controlled in the above estimation equations. Robust standard errors are computed below the coefficients to correct the downward bias of standard errors; ****, (**,*) indicates rejection of null hypothesis is significant at 1%, (5%, 10%).

Table 4 Wage Equations Estimation (Dependent Variable:ΔLnL_{it})

	1	2	3	4	5	6
ΔLnL_{it-1}	-0.0462**	-0.0532**	-0.0447**	-0.0541**	-0.0605**	-0.0522**
	(0.017)	(0.018)	(0.017)	(0.019)	(0.019)	(0.019)
ΔLnP_{it}	0.0908***	0.1006***	0.0707**	0.0776**	0.0976***	0.0794**
	(0.027)	(0.028)	(0.027)	(0.029)	(0.029)	(0.029)
ΔLnW_{it}^{*}	0.4151***	0.4008***	0.4035***	0.4195***	0.4195***	0.3955***
	(0.088)	(0.088)	(0.095)	(0.094)	(0.088)	(0.095)
EXS_{it-1}	-0.0313	-0.0537	-0.0162	-0.0979	-0.0459	-0.0661
	(0.050)	(0.053)	(0.054)	(0.064)	(0.061)	(0.064)
IMS_{it-1}	0.0657	0.0545	0.0653	0.0996	0.0713	0.0839
	(0.059)	(0.060)	(0.062)	(0.062)	(0.059)	(0.062)
PRO_{it-1}	0.4293**	0.4400**	0.4508**	0.3833*	0.3728*	0.3475*
	(0.143)	(0.144)	(0.159)	(0.172)	(0.156)	(0.172)
SOE_{it-1}			0.069	0.037		0.0387
			(0.066)	(0.074)		(0.074)
PVT_{it-1}		-0.0648		-0.0596	-0.0423	-0.0674
		(0.054)		(0.058)	(0.054)	(0.058)
FIE_{it-1}				0.1132*	0.070	0.1044*
				(0.056)	(0.053)	(0.057)
$\Delta LnREER_{it-1} * EXS_{it-2}$	-0.5520***	-0.8186***	-0.5185***	-0.8721***		
	(0.182)	(0.212)	(0.183)	(0.220)		
$\Delta LnREER_{it-1} * IMS_{it-2}$	-0.3659*	-0.5489**	-0.4143		-0.4054*	-0.4047
	(0.192)	(0.201)	(0.216)		(0.193)	(0.211)
$\Delta LnREER_{it-1} * S0E_{it-2}$			0.0944	-0.0828		0.0102
			(0.236)	(0.235)		(0.256)
$\Delta LnREER_{it-1} * PVT_{it-2}$		0.6003**		0.3994*	0.4989**	0.4304**
		(0.209)		(0.203)	(0.189)	(0.192)
$\Delta LnREER_{it-1} * FIE_{it-2}$					-0.9556***	-0.9529***
					(0.197)	(0.207)
No. of Industries	452	451	447	441	446	441
Observations	2955	2937	2826	2767	2888	2767
Under Identification Test Klei.-P.rk LM statistics	234.69***	236.54***	204.41***	216.90***	244.19***	212.18***
Over Identification Test Hansen J(P.Value)	0.267	0.275	0.228	0.207	0.335	0.259
R-Squared	0.863	0.865	0.868	0.873	0.869	0.874
F_Value	949.61***	860.98***	818.50***	788.74***	848.04***	751.28***

Notes: The wage equations are identified with fixed effect/GMM2SLS estimators. ΔLnY_{it} and ΔLnW_{it}^{*} are set as endogenous variables based on the panel IV endogenous tests. The one and two term lagged level of endogenous variables and one term lagged and differenced endogenous variables are set as instruments for the differenced endogenous variables. The fixed effect of industries and time dummies are all controlled in the wage estimation equations. Robust standard errors are computed below the coefficients to correct the, heteroskedasticity and autocorrelation of error terms; ****, (**,*) indicates rejection of null hypothesis is significant at 1%, (5%, 10%).

Table 5 Wage Equations Estimation: Robustness Check (Dependent Variable:ΔLnL_{it})

	1	2	3	4	5	6	7
ΔLnL_{it-1}	-0.0463**	-0.0470**	-0.0475**	-0.0541**	-0.0559**	-0.0521*	-0.0544**
	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)
ΔLnP_{it}	0.0908***	0.0772**	0.0757**	0.1045***	0.1080***	0.0830***	0.0979***
	(0.027)	(0.026)	(0.026)	(0.027)	(0.027)	(0.028)	(0.028)
ΔLnW_{it}^{*}	0.4151***	0.4349***	0.4330***	0.4273***	0.4293***	0.4162***	0.4309***
	(0.088)	(0.093)	(0.095)	(0.086)	(0.086)	(0.086)	(0.089)
EXS_{it-1}	-0.0312	-0.0097	-0.0075	-0.055	-0.0361	-0.0522	-0.0397
	(0.050)	(0.054)	(0.054)	(0.053)	(0.053)	(0.061)	(0.061)
IMS_{it-1}	0.065	0.0817	0.0797	0.0874	0.0509	0.0609	0.0427
	(0.059)	(0.061)	(0.061)	(0.059)	(0.060)	(0.059)	(0.059)
PRO_{it-1}	0.4290**	0.4494**	0.4533**	0.4374**	0.4348**	0.3726**	0.3653**
	(0.143)	(0.160)	(0.160)	(0.143)	(0.143)	(0.157)	(0.157)
SOE_{it-1}		0.0731	0.0696				
		(0.065)	(0.065)				
PVT_{it-1}				-0.0592	-0.0593		
				(0.053)	(0.053)		
FIE_{it-1}						0.0762	0.0745
						(0.053)	(0.053)
$\Delta LnREER_{it-1} * EXS_{it-2} * (1 - PRO_{it-2})$	-0.5705**						
	(0.190)						
$\Delta LnREER_{it-1} * IMS_{it-2} * (1 - PRO_{it-2})$	-0.3954*						
	(0.208)						
$\Delta LnREER_{it-1} * EXS_{it-2} * SOE_{it-2}$		2.0196					
		(2.391)					
$\Delta LnREER_{it-1} * IMS_{it-2} * SOE_{it-2}$			-0.5533				
			(0.897)				
$\Delta LnREER_{it-1} * EXS_{it-2} * (1 - PVT_{it-2})$				-0.9426***			
				(0.255)			
$\Delta LnREER_{it-1} * IMS_{it-2} * (1 - PVT_{it-2})$					-0.6442**		
					(0.256)		
$\Delta LnREER_{it-1} * EXS_{it-2} * FIE_{it-2}$						-1.3418**	
						(0.525)	
$\Delta LnREER_{it-1} * IMS_{it-2} * FIE_{it-2}$						-1.0694***	-2.0265***
						(0.331)	(0.500)
No.of Industries	452	447	447	451	451	449	449
Observations	2955	2826	2826	2937	2937	2927	2927
Under Identification Test Klei.-P.rk LM statistics	234.21***	211.70***	212.92***	244.39***	240.87***	245.03***	247.69***
Hansen J (P_Value)	0.267	0.215	0.226	0.279	0.403	0.255	0.311
R-Squared	0.863	0.868	0.868	0.865	0.864	0.866	0.866
F_Value	949.61	923.63	927.28	961.79	958.66	910.06	969.30

Notes: The wage equations are identified with fixed effect/GMM2SLS estimators. $\Delta\ LnY_{it}$ and $\Delta\ LnW_{it}^{*}$ are set as endogenous variables based on the panel IV endogenous tests. The one and two term lagged level of endogenous variables and one term lagged and differenced endogenous variables are set as instruments for the differenced endogenous variables. The fixed effect of industries and time dummies are all controlled in the wage estimation equations. Robust standard errors are computed below the coefficients to correct the, heteroskedasticity and autocorrelation of error terms; ****, (**,*) indicates rejection of null hypothesis is significant at 1%, (5%, 10%).

Appendix

Referring to Goldberg (2004), the trade weighted and industry specific real exchange rate measured at monthly frequency for RMB is defined as,

$$REER_{im} = \sum_{j=1}^{k} \omega_{jt}^{i} RER_{jm}$$

Where the $REER_{im}$ is the trade weighted real effective exchange rate for industry i and at the month m, RER_{jm} represents the bilateral real exchange rate between China and its trade partner j at the month m; and the overall trade weight for the specific industry j at year t, which corresponds to the month m , is express as,

$$\omega_{jt}^{i} = 0.54 * \frac{\sum_{c=t-2}^{t-1} ex_{jc}^{i}}{\sum_{j=1}^{k}\sum_{c=t-2}^{t-1} ex_{jc}^{i}} + 0.46 \frac{\sum_{c=t-2}^{t-1} im_{jc}^{i}}{\sum_{j=1}^{k}\sum_{c=t-2}^{t-1} im_{jc}^{i}}$$

Where ex_{jc}^{i} represent value of export from China to its trade partner j in the specific sector i at the year c; and im_{jc}^{i} represent the value of import by China from its trade partner j in the specific sector i at the year c. To deal with the simultaneity bias between bilateral real exchange rate movements and values of bilateral trade, we use the average values of export and import lagged one and two years measure the trade weight, while the export share of total trade for China, over the period of 1997 to 2010 is 0.54, and the import share of total trade is 0.46, and the number of trade partners for China $k = 51$, and the trade partners includes,

Austria, Australian, Belgium, Brazil, Canada, Chile, Chinese Taipei, Denmark, Egypt, Finland, France , Germany, Greece, Hong Kong, Hungary, India, Indonesia Iran, Ireland, Israel, Italy, Japan, Korea, Macro, Malaysia, Mexico, Mongolia, Morocco, Netherland, New Zealand, Norway, Pakistan, Philippines, Poland, Portugal, Romania, Russia Federation, Saudi Arab, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Arab Emirates, United Kingdom, Ukraine, United States, Venezuela, Vietnam.

The total value of export from China to the above mentioned 51 trade partners overtakes 90% of total export of China over the period of 1997 to 2010, and the total value of import by China from the 51 trade partners is over 85% of total import of China during the same periods.