Real exchange rate of RMB and Industrial Labor Market Adjustment of China

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Abstract

We investigate the association of RMB real exchange rate fluctuation with labor market adjustment of China. The empirical results show that employment is more responsive than wage to the real exchange rate fluctuations. Over 2 million to 4.5 million job opportunity will be lost with a 10% appreciation of RMB in one-step after controlling other variables. We also find that real exchange rate effects on employment are systematically related to export openness, import penetration, profit margin, and ownership characteristics of manufacturing industries. Although the real exchange rate effects on wage adjustment also depends on the export openness and import penetration of industries, however, the empirical results do not support that the impacts of real exchange rate movements on wage adjustment are associated with other characteristics of manufacturing industries.

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Risheng Mao
Institute of World Economics & Politics,
Chinese Academy of Social Sciences
No.5 JianGuoMenNei Avenue,
Beijing, China 100732
gilbertmao@gmail.com

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

1. Introduction

In this paper, we analyze the impact of RBM real exchange rate change on labor market adjustment in China. Our study differs from previous studies in several dimensions. We explore the relationship between real exchange movements, ownership characteristics and labor market adjustments for Chinese manufacturing industries. Institutional factors not only play important roles in wage and employment determination but also can substantially affect the pass-through effect of exchange rate on domestic price and output (Alexandre,*et al.*,2010). A special feature of Chinese labor market is the difference between the state own enterprises (SOEs) and non-state own enterprises (Non-SOEs). The SOEs labor market is less likely to be affected by the real exchange rate shock because wage determination and level of employment for SOEs are less market based and constrained by the government policy, also some SOEs are concentrated in monopolistic sectors with high profit margins. Equally, SOEs can more easily obtain financial support from the government and are less affected by budget constraints than Non-SOEs. This makes it possible for them to counteract negative effects of real exchange rate appreciation on output and employment; Non-SOEs are mainly composed of private and foreign enterprises. Although the labor markets for foreign and private manufacturing industries are all market based and competitive, foreign enterprises in manufacturing industries are more export oriented and import penetrated. They are thus more exposed to real exchange rate shocks than private enterprises, even though the average profit margin of foreign enterprises is higher than private enterprises. This implies that the labor market structure for private enterprises in manufacturing industries is more competitive and possibly more responsive to real exchange rate fluctuations than foreign enterprises and SOEs. We estimate the different impact of real exchange fluctuation on wage and employment adjustment of SOEs, private and foreign enterprises in low and high profit margin industries individually.

Also, due to different export and import share of partner countries for different manufacturing industries, we use industry-specific rather than aggregate real exchange rate for all industries evaluate the real exchange rate effect on labor market

adjustment. Using detailed bilateral trade data between China and 41 countries covering Chinese manufacturing industries from 1999 to 2009, we construct industry specific real effective exchange rates for 153 three digit industries respectively, corresponding to 450 four digit manufacturing industries. We estimate the responsiveness of wage rate and employment to real exchange rate movements taking into account different industrial characteristics. Thus, In contrast to most of previous related studies estimated the real exchange rate of RMB effects on real economy at an aggregate economic level; we employ a more representative sample covering detailed manufacturing industries of China over the periods 2001 to 2009 and explore the real exchange effects on labor market adjustment both in the short and long run.

This paper is organized as follows; section 2 provides the related literatures on exchange rate and labor market. Section 3 introduces theoretical background and derives empirical models. Section 4 describes data, summary statistics and identification methodology for the wage and employment equations. Section 5 presents empirical findings and discusses possible explanations. Section 6 concludes and provides some policy implication for our empirical results.

2. Literatures

The existing literatures investigating the impact of real exchange rate on labor market cannot provide conclusive empirical evidence that real exchange rate fluctuation is associated with significant employment and wage adjustment. Using data of U.S. for the 1970s and 1980s, Branson and Love (1988) found that real exchange rate of dollar appreciation would cause significant output and employment loss. Revenga (1992),using three and four digit manufacturing industries of U.S. over the 1977-1987 periods, also found that real exchange fluctuation have significant impact on employment and small but also significant impact on wage. Leung and Yuen (2007), using 21 manufacturing industries of Canada over the 1981-1997 period, also explored the real exchange rate effect on labor market adjustment, their empirical evidence indicate that exchange movements have a substantial impact on employment and that this impact increase with the trade openness, while the

exchange rate effect on real wages is estimated to be virtually zero. Using two digit industry level data of Japanese from 1975 to 1994, Dekle(1998) found that real exchange rate fluctuation has a sizeable effect on Japanese employment in the long-run, however, there is no any difference between the high and low export sectors in their responsiveness to exchange rates. Using 29 Chinese provincial level data over the period 1993–2002, Hua(2007) explored the three channels of real exchange rate of RMB fluctuation effect on employment in manufacturing industries and econometric evidence shows that there are significant negative employment effect of real exchange rate appreciation through all three channels, and the technological channel is most important.

There are also several studies provide empirical evidence that wage is more responsive than employment to real exchange rate movement and response of employment to exchange rate appreciation can be insignificant or positively significant. Using two decades of two digit and four digit industry level data of U.S., Campa and Goldberg (2001) found exchange rate have significant effect on industry wages, with the magnitude of wage effects rising as industries increase their export orientation and declining as imported input is intensively used, but they did not find a pronounced impact of real exchange rate on net employment. Goldberg and Tracy(2001) also provides supportive evidence that wage can be highly responsive to exchange movement during the job transition when considering labor supply effects caused by the exchange rate fluctuation. Burgess and Knetter(1998) explored the overall employment adjustment of manufacturing industries to the real exchange movement across G-7 countries and found, over the period 1972 to 1988, the response of employment to real exchange appreciation is negative and significant only in United Kingdom and Italy, but no significant those effect for Canada, France ,German , Japan, and the United States. Galindo,*et al*.(2007)used industrial panel dataset of 9 Latin American countries to explore the relationship between real exchange, dollarization and employment, and their empirical evidence supports the view that real exchange rate depreciations can promote employment growth, but this effect is reversed as liability dollarization increases. In industries with high liability

dollarization, the overall impact of real exchange rate depreciation can be negative.

In contrast to the above literatures which focus on exploring impact of real exchange rate on total or net employment, which may significantly understate the full magnitude impact of labor reallocation, several studies explored the real exchange effects on job creation , job destruction and gross job flows respectively to clarity the job market effect of real exchange rate more precisely. Kein, *et al.*(2003) used detailed firm level and industry level data of U.S. from 1973 to 1993 to investigate the real exchange effect on labor reallocation, and the estimated result indicate that trend real exchange rates significantly affect job reallocation but not net employment. Cyclical real exchange rates significantly affect net employment through job destruction only. Moser, *et al.*(2010) also employed the firm level data from 1993 to 2005 to estimate the real exchange rate effect on gross job flows in German. They found statistically significant but economically small effect of real exchange rate shocks on employment, contrary to the United States, the employment adjustment operates mainly through the job creation rather than the job destruction rate. Colantone(2006) employed a firm level data of Belgium over the time span 1996 -2002 to investigate the sectoral real exchange rate and trade openness effect on job reallocation at the industry level , which estimated result shows that real exchange rate variations do have a significant impact on sectoral job flows, and this impact is magnified by increasing levels of openness to trade. In particular, a real appreciation is found to lower net job growth through enhanced job destruction, while job creation is not significantly affected. Alexandre,*et al.*(2009) also investigate the real exchange rate and job flows from the perspective of trade openness and technology, and their estimation shows that employment in high-technology sectors is relatively immune to changes in real exchange rates, these appear to have sizable and significant effects on highly open low-technology sectors. The impact of exchange rates on these sectors occurs through employment destruction.

3. The exchange rate and labor market

In this section, we present a dynamic model to describe the equilibrium labor and wage adjustment to the real exchange rate shock. Theoretically, exchange rate

fluctuation affect the labor demand through two channels: an output channel, the real exchange shock can change the relative price of domestic and foreign sales thus the level of domestic output and employment will change accordingly; an imported input or import competition channel, an appreciation (depreciation) of real exchange rate can decrease (increase) the cost of imported input and price of final products, depending on the degree of substitutability between the domestic and imported goods, the output and employment of domestic can change differently, and more importantly, the degree of responsiveness of output and employment to exchange rate shock crucially depends on the pass through effects of exchange rate on domestic price and output. This should be sensitive to industries trade openness and to market competitive structure of industries (Campa and Goldberg, 2001). The competitive market structure matters because, in a competitive market, firms have little ability to set price and profitability of firms are most affected by the change of foreign price, while in a monopolistic competitive environment and with extensive production differentiation and market power, the exchange shock on output and employment can be counteracted by exerting the price setting ability. The trade orientation matters because exchange rate shocks and pass-through on foreign demand is positively related the export openness, while exchange rate shock and pass-through on output and employment through import channel also depends on the degree of import penetration and substitutability of production activity and import. Besides that, the regulatory environment also plays an important role, if the domestic industries is protected or supported by the government policy, the relative price, cost and market share of domestic industries may not change with exchange rate shock. Finally, labor market regulations may affect the speed of adjustment of employment to relative cost change caused by exchange rate shock, if the cost of labor hire or fire and output adjustment is large due to labor market regulation, firms are reluctant to make large change of employment level in an uncertain duration. All these factors together influence the response of employment and wage to real exchange shocks.

As a theoretical background for our empirical works, we establish the relationship between labor demand and real exchange rate mainly referring to Klein,

Schuh and Triest(2003), in the context of trade openness ,the exchange rate fluctuation influences the output demand for each industries in the following form,

$$Q_{it}^{D} = \delta_i Y_{it}^{\beta} \prod_{j=1}^{k} (E_{jt}^{-\lambda\Omega_i} Y_{jt}^{*\beta\Omega_i})^{\omega_{jt}^{i}} \qquad (1)$$

Where the Q_{it}^{D} is the output demand for industry i at time t, and δ_i is the idiosyncratic demand shock faced by the same industry, considering the output of domestic industries can be sold both in domestic and foreign market and determined by the income, Y_{it} represent the total domestic income for the same industry, and the multiplicative each foreign country total income Y_{jt} ,which contribution to the output demand is negatively related to bilateral real exchange rate E_{jt} , while the exchange rate and foreign income impact on the output demand is proportional to trade openness and other factors of the industry Ω_i . Those factors affect the pass-through of exchange rate and foreign income effect on domestic output demand. Finally, the contribution of each trading partner is weighted by its share in total sector trade ω_{jt}^{i} ,

Assume the cost function of industries i is

$$C_{it}(W, R; Q) = A_{it}^{-\mu} W_{it}^{\alpha} R_t^{1-\alpha} Q_{it}^{D} \qquad (2)$$

Where A_{it} is the total factor productivity of industries, W_{it} summary the average wage of industry i , while R_t is the unit cost of non-labor input and Q_{it}^{D} is the domestic output of industry i ,by Shepard's Lemma, the optimal labor demand for industry i is the partial derivative of cost function with respect to wage, that is,

$$L_{it}^{*} = \frac{\partial C_{it}(W_{it}, R_t; Q_{it}^{D})}{\partial W_{it}} = \alpha A_{it}^{-\mu} W_{it}^{\alpha-1} R_t^{1-\alpha} Q_{it}^{D} \qquad (3)$$

By combining the equation (1) and (3), we can derive the logarithm of optimal labor demand equation,

$$\begin{aligned} LnL_{it}^{*} = {} & Ln\alpha + Ln\delta_i - \mu LnA_{it} - (1-\alpha)Lnw_{it} + (1-\alpha)LnR_t + \beta LnY_{it} \\ & -\Omega_i \sum_{j=1}^{k} \omega_{jt}^{i} E_{jt} + \Omega_i \beta \sum_{j=1}^{k} \omega_{jt}^{i} Y_{jt}^{*} \end{aligned} \qquad (3)$$

Where $E_{it} = \sum_{j=1}^{k} \omega_{jt}^{i} E_{jt}$ is the trade weighted industry specific real exchange rate, and $Y_{it}^{*} = \sum_{j=1}^{k} \omega_{jt}^{i} Y_{jt}$ is the trade weighted industry specific foreign income.

Because of labor market regulation and adjustment cost, at any given time, the labor demand for industries is likely off its optimum schedule .Following Campa and Goldberg (2001), Dekel (1998), if the exchange rate follows a random walk and all exchange rate movements are permanent and the current exchange rate is the best predictor of all future exchange rate, we simply assume following employment adjustment equation holds,

$$LnL_{it} = \lambda LnL_{it-1} + (1-\lambda) LnL_{it}^{*} \qquad (4)$$

Then a general form for the labor demand is give by the reduced form expression,

$$LnL_{it} = \lambda LnL_{it-1} + (1-\lambda)\begin{pmatrix} Ln\alpha + Ln\delta_i - \mu LnA_{it} - (1-\alpha) Lnw_{it} + (1-\alpha) LnR_t \\ +\beta LnY_{it} - \Omega_i E_{it} + \Omega_i \beta Y_{it}^{*} \end{pmatrix} \qquad (5)$$

To evaluate real exchange rate effect on labor market comprehensively, we also need to consider the impact of real exchange rate shock on wage adjustment and introduce the labor supply conditions. According to previous related studies, Labor supply for the industry i at time t generally assumes the following form:

$$L_{it} = \left(\frac{w_{it}}{\Gamma_{2d,it}^{\varepsilon}} \right)^{\gamma} \qquad (6)$$

Where Γ is the prevailing wage in the rest of the economy, γ is a measure of labor supply elasticity ($\gamma > 0$) and ε is the cross-elasticity of labor supply between sectors i and the rest of the economy. We use aggregate average wage of 2 digit sectors to represent the prevailing wage in the rest of the economy, that is:

$$\Gamma_{2d,it} = \frac{TW_{2d,it} - TW_{it}}{TL_{2d,it} - TL_{it}} \qquad (7)$$

Where $TW_{2d,it}; TL_{2d,it}$ represent the total wage and employment for each two digit industries, while $TW_{it}; TL_{it}$ represent the total wage and employment for each four digit

industries.

Equating labor demand and labor supply equations, we can derive the employment and wages equation in equilibrium for industry i simultaneously, and we use the industry dummy to control for time invariant fixed effect,($Ln\delta_i$) and time dummy to control for other macroeconomic factors(LnR_t) , so the reduced form of wage and employment equation can be written as,

$$\begin{aligned} Lnw_{it} &= \alpha_0 + \alpha_1 LnY_{it} + \alpha_2 \Omega_i LnY_{it}^* + \alpha_3 Ln\Gamma_{2d,it} + \alpha_4 LnTFP_{it} + \alpha_5 \Omega_i (LnE_{it} + LnE_{it-1}) \\ &\quad + \alpha_6 LnL_{it-1} + f_i + f_t \\ LnL_{it} &= \delta_0 + \delta_1 LnY_{it} + \delta_2 \Omega_i LnY_{it}^* + \delta_3 Ln\Gamma_{2d,it} + \delta_4 LnTFP_{it} + \delta_5 \Omega_i (LnE_{it} + LnE_{it-1}) \\ &\quad + \delta_6 LnL_{it-1} + f_i + f_t \end{aligned} \tag{8}$$

Where f_i, f_t represent individual and time fixed effect of industries, it is clearly that impact of real exchange rate and total foreign income on labor market depends on the pass through factors, as our above analysis. Ω_i is determined by many factors ,including export openness, import input and import final products, labor market regulation and competitive structure of the industries . To check whether real exchange rate effect on labor market is affected by these factors, we specify $\Omega_i = \Omega_i(EXS_i, IMS_i, PRO, OWN_i)$, and EXS_i, IMS_i each represents average export openness and import penetration over the period 2001 to 2009 for industry i respectively , while PRO_i, OWN_i each represents average profit margin and ownership characteristics of industries over the same period. We use these two variables to explore relationship between competitive market structure, labor market regulation and real exchange rate effects on labor market adjustment. Considering the serious heterogeneity and stationary issue of estimation data, we use differenced equation instead of level equation to explore the net employment and wage effects, and because we focus on exploring the real exchange effect on labor market, to simplify the identification, only interaction variables generated by real exchange rate and Ω_i are added to the equations, so our final wage and employment equation for identification is

reduced to:

$$\begin{aligned}\Delta Lnw_{it} &= \beta_0 + \beta_1 \Delta LnY_{it} + \beta_2 EMO_i * \Delta LnY_{it}^{*} + \beta_3 \Delta Ln\Gamma_{2d,it} + \beta_4 \Delta LnTFP_{it} \\ &+\Omega_i \begin{pmatrix} EXS_i, IMS_i, \\ PRO_i, OWN_i \end{pmatrix} \left(\beta_5 \Delta LnE_{it} + \beta_6 \Delta LnE_{it-1}\right) + \beta_7 \Delta LnL_{it-1} + \nu_t + \omega_{it} \\ \Delta LnL_{it} &= \phi_0 + \phi_1 \Delta LnY_{it} + \phi_2 EMO_i * \Delta LnY_{it}^{*} + \phi_3 \Delta Ln\Gamma_{2d,it} + \phi_4 \Delta LnTFP_{it} \\ &+\Omega_i \begin{pmatrix} EXS_i, IMS_i, \\ PRO_i, OWN_i \end{pmatrix} \left(\phi_5 \Delta LnE_{it} + \phi_6 \Delta LnE_{it-1}\right) + \phi_7 \Delta LnL_{it-1} + \nu_t + \sigma_{it}\end{aligned} \tag{9}$$

Where ω_{it} , σ_{it} each represents the residual error of estimation for wage and employment equation and ν_t is the time dummy to control for macroeconomic factors.

4. Data , Summery Statistics and Model Identification

4.1 Data and summery statistics

This study relies on industry level data covering over 450 four digit manufacturing industries for different ownership enterprises from the time span 2001 to 2009. Data are drawn from industrial database supported by the Statistics Bureau of China. All industries in the sample provides over 65 financial accounts, including value added production, capital stock, export sales, total wage paid and employment, net profits of sales, etc. however, this database does not provides value of import for the detailed industries, which is a key variable to analysis the import penetration impact on employment and to construct the industry specific real effective exchange rate. To get the industry level data of imports and exports from the world and 41 bilateral trading partners of China, by referring to the correspondence table for HS and ISIC, the correspondence table for ISIC and code for manufacturing industries of China, we construct a correspondence table between the HS four digit codes for 1250 trade products and the three digit industries codes for 175 manufacturing industries of China, and to test the accuracy of correspondence table between products and industry, we check the reported export sales and the value of export measured by HS 4 digit trade products for the 153 three digit industries. Bilateral trade data classified at HS 4 digit product level between China and 41 trading partners from 1999 to 2009 are drawn from International Trade Statistics (ITS) and Comtrade database of United Nations. The real GDP data for 41 trading partners and the CPI index and bilateral nominal

exchange rate for China and 41 trading partners are all from International Financial Statistics, IMF. The value added production is deflated by the annual based 2 digit industry PPI index into constant price, while the average wage of industries is deflated by the annual based CPI index into constant price. All the data of price index are from the Statistical Yearbook of China. To investigate relationship between market competitive structure of industries and real exchange rate effect on labor market, we split the sample into low price over cost markup industries and high price over cost markup industries according to the average profit margins of industries over the period 2001 to 2009.

Figure 1 to 4 depict some selected three digit industry specific real effective exchange rate of RMB from the year 2001 to 2009, which shows that there is substantial heterogeneity in the behavior of real exchange rate at industry level, Although general trend of most of industry specific real effective exchange rates of RMB depreciate from 2001 to 2004 while appreciate from 2005 to 2009, however, the fluctuation of industry specific real exchange rate varies greatly both within and across two digit industries, the real exchange rate variation within chemical industries is small than food and sport article industries, and the real exchange rate trend for some specific three digit industries contradicts to most of other industries.

Figure 1 to 4 here

Table1 provides some summary statistics of the sample, including total employment, average wage paid, export sales, average profit rate for different ownership industries, which shows that growth rate of employment for SOEs is negative in the whole period while employment for private and foreign enterprises increase consistently during the same period, especially during the period of 2001 to 2004 when the real exchange of RMB depreciate rapidly. On the other hand, the average wage growth rate for SOEs is higher than Non-SOEs in during the period of 2001 to 2004. Although the average profit rate for SOEs is much smaller than Non-SOEs, the growth rate of profit rate for SOEs is more rapid than Non-SOEs, especially during the period of 2005 to 2009 when real exchange rate of RMB appreciates generally. The export volume and export openness for foreign enterprise

are both much higher than SOEs and private enterprises, while with the depreciation of RMB during the period of 2001 to 2004, the annual growth rate of export volume for Non-SOEs is overtake 50%, however, with the general appreciation of RMB during the period of 2005 to 2009, both the export volume and export openness for Non-SOEs declined substantially.

Table 1 here

4.2 Identification method for wage and employment equation.

To identify the wage and employment equations properly as we specify in section 2, it is not suitable to use the OLS and random estimators because the predetermined variables in employment equation and other endogenous variables in both wage and employment equations are correlated with the individual effects f_i, which will cause biased estimators. Although the fixed effect estimator can eliminate the individual effects f_i by transforming data into deviations from the within group mean, it is still biased because the group mean of predetermined and other endogenous variable is still correlated with mean of the error terms, especially under condition of the panel data with large N and small T. The frequently adopted measure to identify the dynamic panel model is the generalized moment method (GMM), Arellano and Bover（1991） developed the first-differenced GMM estimator ,which eliminates the individual effects by first differencing the data and use the lagged value of the level predetermined or endogenous and other exogenous variable as instruments. However, if the regressors are highly persistent or close to a random walk, the lagged level regressors are only weak instruments for the differenced regressors and therefore the difference GMM estimator has a poor finite-sample property. Arellano and Bover (1995); Blundell and Bond (1998) shows that the lagged first differenced regressors can also be used as instruments for the level equation, so the method by combining the sets moment conditions in a system containing both level and first differenced equations is developed as system GMM estimator, which is a more efficient estimator than the differenced GMM estimator.

However, considering the heterogeneity and stationary issues, we use the

difference GMM estimator instead of system GMM estimator to identify our wage and employment equation, and we specify lagged employment as predetermined variable in employment equation and average wage at aggregate two digit industries as endogenous variable in both wage and employment equations①. Moreover, we use the more efficient and robust two-step GMM instead of one step GMM estimator to identify the equation and correct the downward-bias of standard error under the condition of finite sample(Windmeijer,2006). To check the efficient and consistent estimated parameters, we test the second order autocorrelation of residual errors and verify the validity of the instrumental moment conditions for estimation.

5. Empirical Results

5.1 Trade openness, competitive structure of market and real exchange rate movement effects on employment

The dynamic employment equation is identified using two-step GMM estimators. The empirical results of exchange rate change effects on employment are reported in table2. All the estimations include time dummy to control for other macroeconomic effects on employment. Arellano-Bond tests in all estimated equations show that there are no second autocorrelation of residual errors, Sargan and Hansen tests of over identification restrictions also cannot reject the null hypothesis. Those tests all indicate that instruments and moment conditions used for estimation are valid. Column 1 of table 2 reports the estimation result using full sample, while column 2 and 3 present the empirical results using low and high profit margin industries respectively. The robustness checks for the systematic association of market competition structure with real exchange rate change effects on employment are reported in Column 4 to 6. The coefficients of lagged employment variable are positive and significant in most estimation. Those empirical results all indicate the employment level of manufacturing industries is dynamically determined and adjusted due to labor market frictions. The

① We specify variable $\Gamma_{2d,it}$ as endogenous variable because both wage and employment are simultaneously determined with the aggregate average wage level , and Durbin-Wu-Hausman (DWH) test can not reject the null hypothesis that variable $\Gamma_{2d,it}$ is endogenous when we applied the IV estimator. On the other hand, if we specify other variable as endogenous, the estimated results for many variables are contradict to theoretical predictions and more importantly the DWH test also does not support the hypothesis that other variables are endogenous.

estimation results also shows that domestic income change can have positive and significant effects on employment. The positive effects of foreign income on employment crucially depend on the trade openness of manufacturing industries. The employment level is also positively but not significantly associated with the average real wage of alternative and aggregate industries, while the total factor productivity change can have negative and significant effect on employment. All the estimation results for the above variables in table 2 fit well to the theoretical predictions.

The empirical results of concern are coefficients of real exchange rate variables. The estimation results, obtained using full sample in column1, indicate the negative impact of real exchange rate change on net employment is crucially associated with export openness of manufacturing industries. The magnitude of real exchange rate movement effects on net employment increases with export openness increase. However, the empirical results in column 1 also indicate real exchange rate effects on employment are not systematically related to import penetration of manufacturing industries. According to the coefficients of interactive variables and average value of export openness over the period of 2001 to 2010, the net employment level will decline about 3.17% in the short run and 7.47% in the long run with a 10% appreciation of RMB real exchange rate. This also means that, after controlling other variables, over 2 million to 4.5 million job opportunities will be lost with a 10% revaluation of RMB. In order to explore relationship between market competition structure and real exchange rate effect on employment, we split the whole sample into low price over cost markup industries and high price over cost markup industries according the average profit margins of manufacturing industries. The estimation result, obtained using low price over cost markup industries, in column 2 shows that appreciation of real exchange rate can have significant and negative effect on net employment of low price over cost markup industries through both export openness and import penetration channels. The empirical result in column 3 indicates that exchange rate change can only have negative effect on employment of high price over cost markup industries through export channel. According to the coefficient of interactive variables in column 2 and column 3, a 10% appreciation of real exchange rate will depress the net employment

level of low price over cost markup industries about 3% in the short run and 13.3% in the long run, while the net employment of high price over cost markup industries will drop 3.3% with a 10% appreciation of real exchange rate. The estimation results also imply that over 80% job opportunity lost will occur in low price over cost markup industries caused by revaluation of RMB in the long run. The coefficients of interactive variables in column 2 also indicate that the magnitude of real exchange movements on employment through export channel is larger and more important than those effects through import channel. The main reason is that real exchange rate effect on employment through import channel crucially depends on the association of import with domestic production activity, import input are more likely to be complimentary with the domestic output and employment while import final products and domestic output are more likely to be competitive and substitutable to each other , so there are two counteractive forces between overall import and domestic output or employment, the negative coefficients of interactive variables also imply that overall relationship between import penetration and domestic output or employment of Chinese manufacturing industries is competitive.

To testify the systematic relationship between industry competitive structure and real exchange rate movement effects on net employment, we also estimate the coefficients of interactive variables generated by average profit margins and real exchange rate after controlling other variables. According to the estimation results in column 4, 5 and 6 of table 2, the real exchange rate movement effects on net employment is also systematically associated with the profit margins of manufacturing industries, the responsiveness of net employment to real exchange rate fluctuations declines with the increase of profit margins in manufacturing industries. A 10% increase of profit margins will depress the negative impact of real exchange rate appreciation on net employment about 0.5% in the long run. These estimation results also indicate that the empirical results in column 2 and 3 are robust.

5.2 Ownership Characteristics and Impact of Real Exchange Rate Movements on Employment

The real exchange rate pass-through effects on labor market also depend on the

market regulation and institutional factors. In order to check whether institutional factors and labor market regulation can influence the real exchange rate change effects on Chinese labor market, we investigate the coefficients of interactive variables generated by employment percentage of SOEs, private enterprises, foreign enterprises in manufacturing industries with real exchange rate individually. The estimation results for ownership characteristics and real exchange movement effects on employment are reported in table 3. In column 1 of table 3, the empirical result show that revaluation of real exchange rate negative effects on employment decline with the increase of SOEs penetration rate, while the empirical results in column 2 and 3 indicate the negative effects of real exchange rate revaluation on employment will enhance with the increase of private and foreign ownership in the long run, and the employment of foreign enterprises in manufacturing industries are more responsive to real exchange rate change than private enterprises. After controlling more interactive variables in column 4 to 6, the empirical results do not change much and indicate the real exchange rate movement effects on employment are systematically influenced by the ownership characteristics of manufacturing industries. According to the coefficient of interactive variables in table 3, a 10% increase of SOEs penetration rate in manufacturing industries, the negative effects of real exchange rate appreciation on employment will reduce about 4% to 6.5% in the long run. While a 10% increase of private and foreign enterprises ownership in manufacturing industries will enhance the negative impacts of real exchange rate appreciation on employment about 5% and 10% respectively. All the above empirical evidences indicate that employment level of SOEs is less likely to be affected by real exchange rate fluctuations than Non-SOEs even if average profit margin of SOEs is much lower than Non-SOEs. First, the labor market of SOEs is less market based and employment level is more likely affected and constraint by government policy, SOEs are less sensitive to price change because they can more easily obtain financial support from government. Second, the labor adjustment cost of SOEs is higher due to more labor market regulations and higher percentage of formal employment; SOEs have to take more obligations to maintain the stability of labor market required by government policy.

Third, the average export openness of SOEs is much lower than that of private and foreign firms in manufacturing industries, thus, the output and employment level of SOEs are less likely influenced by real exchange rate fluctuations through export openness channel.

Although the labor markets of foreign and private firms in manufacturing industries are both market based, the product market is more competitive for private firms due to lower average profit margins and higher percentage of informal employment than foreign firms, on the other hand, the export openness of foreign enterprise is much higher than that of private firms, the employment level of foreign firms are more likely to be depressed by appreciation of real exchange rate. The coefficients of interactive variable in table3 show that the overall magnitude of exchange rate movements on employment of foreign enterprises is much higher than private enterprises. That empirical evidence also implies export openness is the most important channel that exchange rate movements take effect on employment in manufacturing industries.

5.3 Trade openness, competitive structure of market and impact of real exchange rate movements on wage.

To estimate the wage equation specified properly in section 4 and check the robustness of empirical results, we use both the fixed effect estimator and GMM estimator to identify the wage equation. The empirical results are reported in table4. The coefficients of lagged employment variable identify using different estimators are negative in most estimations but significant only when applying the fixed effect estimators. Those empirical results indicate that the average wage decline with the increase of employment in previous period. The coefficients of domestic income variables are all positive but significant only when using fixed estimator, while the coefficients of interactive variables generated by foreign income with trade openness are not positive and significant until we adopt the more robust GMM estimators. The coefficients of average wage level at 2 digit manufacturing industries are all positive and significant when we use different estimators. Those estimation results also imply that there are significant and positive wage spillover effects across different

manufacturing industries. The coefficients of total factor productivity variable are all positively significant and fit well to the theoretical predictions.

The coefficients of real exchange rate variables are not significant in all estimations, however they are positive when we use the fixed effect estimators but negative when applying the more robust GMM estimators. In order to check whether the impacts of real exchange rate movements on wage depends on the trade openness and industry competitive structure, we use the interactive variables to evaluate the association of real exchange rate effect on wage with trade openness. In column 1 and 5 of table 4, the empirical results obtained using fixed effect and GMM estimator respectively both indicate that real exchange rate movement effects on wage are not significant, however, In column 3, 4 , 6 and 7, we split the whole sample into low and high price over cost markup industries and estimate the wage equation using the subsamples individually, the empirical results obtained by applying fixed effect and GMM estimators all indicate that real exchange movement effects on wage are closely related to export openness. The empirical results also show that the magnitude of real exchange rate change effects on wage through export openness channel is larger in low price over cost markup industries, according to the coefficient of interactive variables obtained using more robust GMM estimator; a 10% appreciation of real exchange rate will depress the average wage of low price markup industries about 1.8% while the average wage of high price markup industries will also decline 0.5% with the same extent appreciation of real exchange rate through export channel. However, the empirical results of column 4 and 8 show that the impacts of real exchange rate appreciation on wage are not systematically related to the industry competitive structures. The coefficients of interactive variables generated by real exchange rate and average profit margin of each industry are not significant when applying both fixed effect and GMM estimators.

The coefficients of interactive variables generated by import penetration and real exchange are all positive and significant when applying the more robust GMM estimator. Those estimation results indicate that real exchange rate appreciation will enhance the average wage level of manufacturing industries through import channel

and real exchange change effects on wage are systematically related to import penetration. Those empirical results also imply that average productivity and thus the average wage level of manufacturing industries can be enhanced with the increase of overall import penetration. However, the magnitude of exchange rate effect on wage through import channel is very small, according to the coefficients of estimated variables; a 10% appreciation of real exchange rate of RMB will step up the average wage level only about 0.1% through import channels. Comparing the empirical results in table 2 and table 4, it is clearly that the magnitude of real exchange movement effects on employment is much larger than they are on wage both through export and import channels. The employment level is generally more responsive than average wage rate to real exchange rate fluctuations.

5.4 Ownership Characteristics and Impact of Real Exchange Rate Movements on Wage

Institutional factors and market regulation can also influence the pass-through effects of real exchange fluctuations on wage determination. Due to more government policy constraints and interventions, the wage rates of SOEs are also more likely to be immune to real exchange rate movements than those of Non-SOEs. In order to clarify whether the ownership characteristics of manufacturing industries can systematically affect the real exchange movement effects on wage, the interactive variables, generated by real exchange rate with employment percentage of SOEs, private and foreign enterprises individually, are also estimated in wage equation as we specify in section 4. Table 5 reports the related estimation results obtained using both fixed effects and GMM estimators. The fixed effect estimations show that only the coefficient of interactive variable generated by private employment percentage with real exchange rate is positively significant and all the coefficients of other interactive variable are not significant, while the more robust GMM estimators show that all the coefficients of interactive variables are not significant. The empirical results in table 5 strongly indicate that real exchange change effects on wage rate are not systematically related to the ownership characteristics of manufacturing industries. There is no significant difference between SOEs and Non-SOEs in the pass-through

effects of real exchange rate fluctuations on wage rates. The possible explanation for the empirical results in table 5 is that the real exchange rate movement effects on labor market adjustment take place mainly through employment adjustment rather than wage adjustment as the empirical results also implied in previous sections.

6. **Conclusion**

This paper has explored the real exchange rate effect on industrial labor market adjustment. Our empirical evidence shows that net employment is much more responsive to real exchange shocks than wage. The responsiveness of employment and wage adjustment all crucially depends on the trade orientation of manufacturing industries, and the impact of real exchange rate on employment adjustment is also closely associated with the labor market regulation, competitive structure of manufacturing industries, however, real exchange rate effect on wage adjustment is not systematically associated with labor market regulation and competitive structure of manufacturing industries. An one-step 10% appreciation of real exchange rate of RMB will cause over 2 to 4.5 million jobs loss in overall manufacturing industries of China, and those negative impact on employment of foreign enterprises is more substantial than state and private owned enterprises, and our studies also shows that the negative impact of real exchange rate appreciation on employment significantly depends on the market competitive structure of domestic industries. Upgrading the skill content and price setting ability of manufacturing industries can effectively counteract those negative impacts caused by real exchange rate appreciation, and more importantly, a moderate and dynamic adjustment strategy for RMB exchange rate is critically important to maintain the stability of job market for Chinese manufacturing industries.

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Table 1 Summery Statistics of Manufacturing Industries of China

Financial Index	OWNERSHIP	OBS.	MEAN	MIN.	MAX.	Annual Growth (%)	
						2001-2004	2005-2009
Employment	SOE	3961	21198	0	2539443	-6.55	-7.16
(Unit:1000 person)	Private	4126	36665	0	1646390	45.16	15.25
	Foreign	4080	38583	0	2128701	29.39	6.08
Average Wage	SOE	3766	16.29	0	133.21	12.5	18.87
(Unit:1000RMB/PER)	Private	4087	13.32	0.33	80.54	8.61	17.82
	Foreign	4007	22.34	1.46	1847.75	6.78	17.44
Total production	SOE	3961	6226239	0.00	5.77E+08	9.74	10.47
(Unit:1000RMB)	Private	4126	1.34E+07	0.00	7.01E+08	64.62	35.46
	Foreign	4080	1.77E+07	0.00	9.41E+08	41.5	15.78
Export Volume	SOE	3961	412585	0	8.71E+07	8.54	-0.97
(Unit:1000RMB)	Private	4126	1229004	0	8.27E+07	61.01	15.13
	Foreign	4080	7096389	0	7.24E+08	51.15	6.66
Profit rate	SOE	4165	-1.67	-241.51	58.39	-0.74	1.36
(Unit:%)	Private	4164	5.32	-9.9	19.04	0.18	0.33
	Foreign	4145	6.05	-16.5	48.49	0.47	0.3
Export Openness	SOE	4125	9.72	0	78.43	-0.56	-0.48
(Unit:%)	Private	4158	12.58	0	63.87	0.67	-1.48
	Foreign	4142	34.97	0	89.23	1.33	-2.41
Import Volume (Unit:1000 RMB)	ALL	3894	2.64E+07	0	6.78E+08	38.29	3.81
Import penetration (Unit :%)	ALL	3894	17.41	0	119.61	0.09	-2.02
Real Effective Rate (Unit:Year2005=100)	ALL	3883	102.12	60.68	216.43	-4.92	1.52

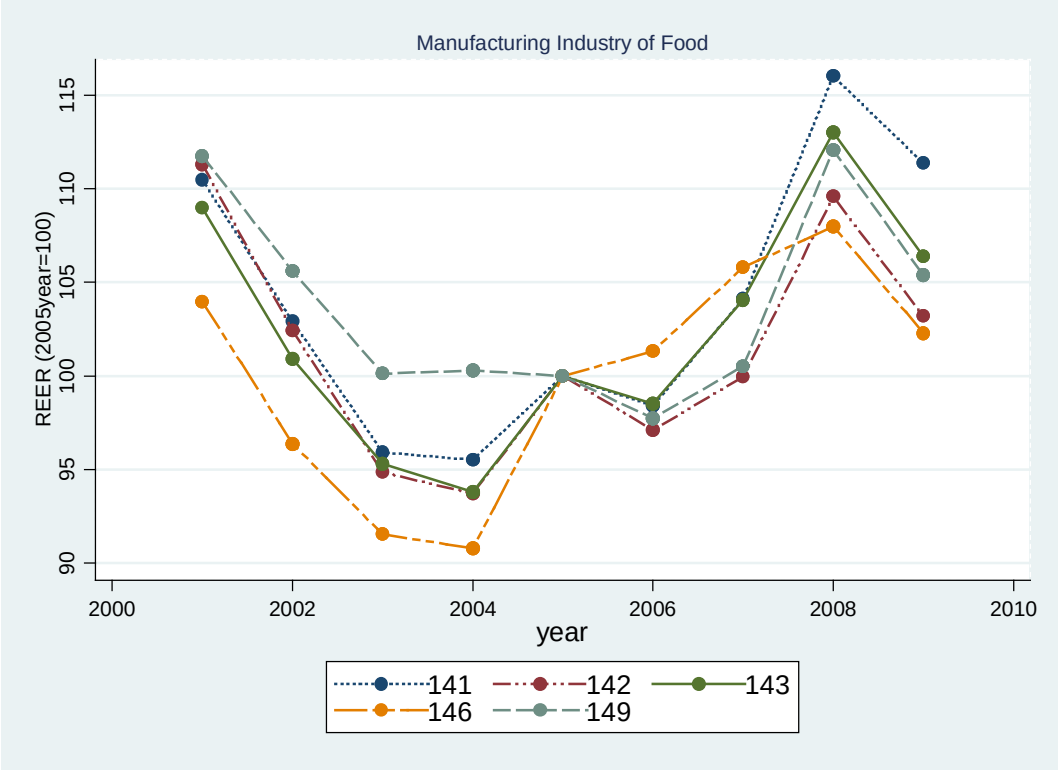

Figure 1

Figure 2

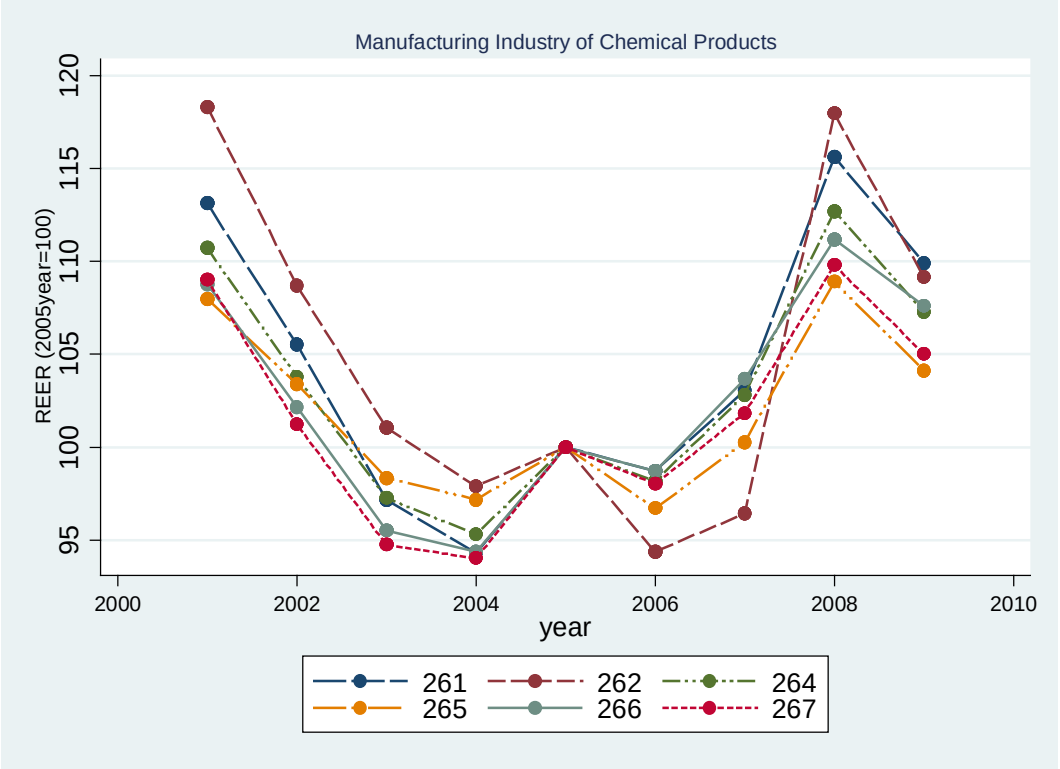

Figure 3

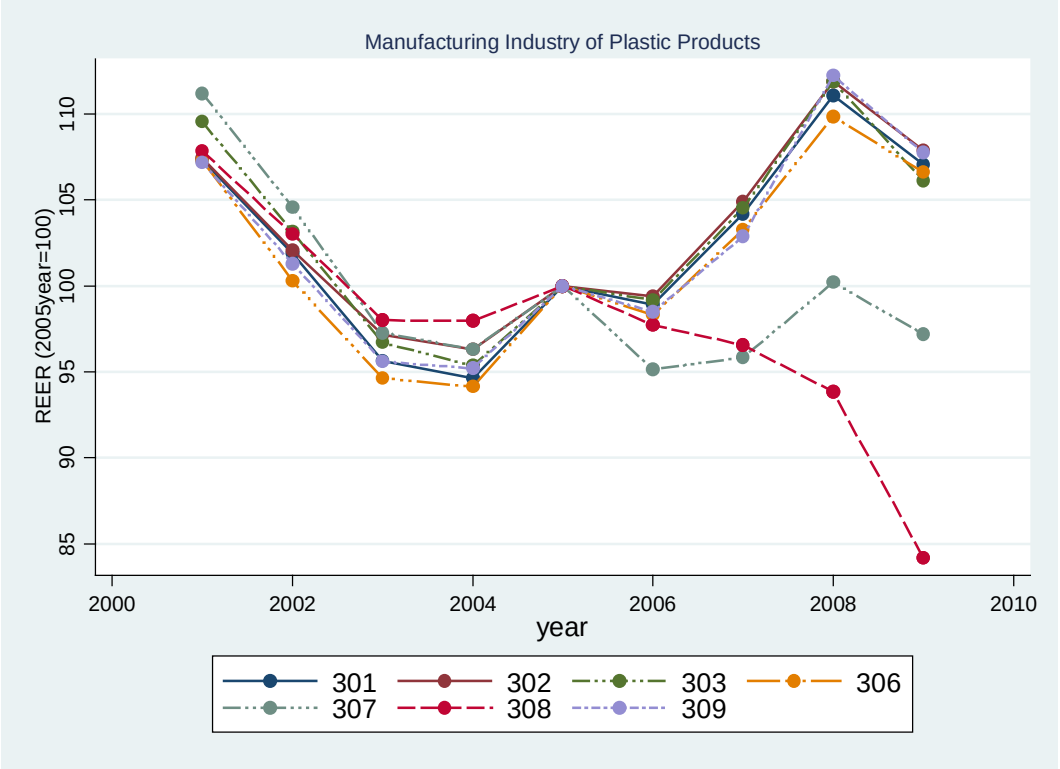

Figure 4

Table 2 Trade openness, Competitive structure and Real Exchange Rate and Employment Adjustment

VARIABLES	1	2	3	4	5	6
$\Delta LnL_{i,t-1}$	0.3248***	0.5371***	0.1234	0.3287***	0.3225***	0.3268***
	(0.106)	(0.203)	(0.103)	(0.111)	(0.103)	(0.107)
ΔLnY_{it}	0.6028***	0.5886***	0.6980***	0.6051***	0.6012***	0.6048***
	(0.046)	(0.076)	(0.045)	(0.046)	(0.046)	(0.046)
$EMO_i * \Delta LnY_{it}^*$	1.9801***	1.3474**	2.2405***	1.7602***	1.6153***	1.7655***
	(0.459)	(0.645)	(0.861)	(0.453)	(0.419)	(0.453)
$\Delta Lnwage_{2d,it}$	0.0388	0.0171	0.066	0.0461	0.0229	0.0471
	(0.047)	(0.096)	(0.055)	(0.046)	(0.047)	(0.046)
$\Delta LnTFP_{it}$	-0.5441***	-0.5510***	-0.6004***	-0.5469***	-0.5489***	-0.5468***
	(0.051)	(0.096)	(0.048)	(0.050)	(0.052)	(0.051)
$\Delta LnREER_{it}$	-0.0328	0.2468	-0.0628	-0.0542	-0.3612***	-0.0547
	(0.089)	(0.169)	(0.091)	(0.128)	(0.112)	(0.128)
$\Delta LnREER_{it} * EXS_i$	-1.4724***	-1.1194**	-2.0419**	-1.4565***		-1.4449***
	(0.357)	(0.477)	(0.836)	(0.369)		(0.370)
$\Delta LnREER_{it-1} * EXS_i$	-0.8691***	-1.1824***	-0.1772	-0.9829***		-1.0016***
	(0.301)	(0.360)	(0.563)	(0.296)		(0.293)
$\Delta LnREER_{it-1} * IMS_i$	-0.0059	-0.0355***	0.0004		-0.0083	-0.0064
	(0.010)	(0.012)	(0.008)		(0.011)	(0.010)
$\Delta LnREER_{it-1} * IMS_i$	0.0169	-0.0031	0.0092		0.0128	0.0158
	(0.014)	(0.011)	(0.013)		(0.014)	(0.014)
$\Delta LnREER_{it} * PRO_i$				0.0027	0.0202*	0.0028
				(0.012)	(0.011)	(0.011)
$\Delta LnREER_{it-1} * PRO_i$				0.0296***	0.0227***	0.0291***
				(0.010)	(0.009)	(0.010)
Observations	2,961	1,486	1,475	2,961	2,961	2,961
Number of id	456	227	229	456	456	456
AR1	0.001	0.007	0.11	0.002	0.002	0.001
AR2	0.68	0.692	0.896	0.729	0.458	0.666
SARGAN	0.521	0.539	0.141	0.434	0.533	0.473
HANSEN	0.751	0.408	0.341	0.732	0.776	0.731

Table 3 Ownership Characteristics, Real Exchange Rate and Employment

VARIABLES	1	2	3	4	5	6	7
$\Delta LnL_{i,t-1}$	0.3308***	0.3227***	0.3324***	0.3261***	0.3352***	0.3319***	0.2413***
	(0.108)	(0.104)	(0.107)	(0.106)	(0.110)	(0.107)	(0.051)
ΔLnY_{it}	0.6009***	0.5998***	0.5988***	0.6011***	0.6006***	0.5992***	0.6149***
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.048)
$EMO_i * \Delta LnY_{it}^*$	1.6354***	1.6932***	1.5021***	1.6228***	1.4638***	1.5955***	1.4821***
	(0.442)	(0.411)	(0.424)	(0.431)	(0.433)	(0.410)	(0.410)
$\Delta Lnwage_{2d,it}$	0.0177	0.0127	0.0237	0.0136	0.0241	0.0255	0.0332
	(0.048)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.048)
$\Delta LnTFP_{it}$	-0.5489***	-0.5520***	-0.5530***	-0.5528***	-0.5546***	-0.5571***	-0.6017***
	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.054)
$\Delta LnREER_{it}$	-0.2809**	0.0217	-0.1504*	0.0181	-0.1945	0.1262	0.3943
	(0.109)	(0.103)	(0.088)	(0.180)	(0.136)	(0.117)	(0.302)
$\Delta LnREER_{it} * SOE_i$	0.3199			-0.031	0.1564		-0.6028
	(0.281)			(0.354)	(0.332)		(0.549)
$\Delta LnREER_{it-1} * SOE_i$	0.4326***			0.3415*	0.3834**		0.3039*
	(0.161)			(0.175)	(0.168)		(0.173)
$\Delta LnREER_{it} * PVT_i$		-0.8566**		-0.8331**		-0.9078**	-1.2805**
		(0.341)		(0.418)		(0.362)	(0.552)
$\Delta LnREER_{it-1} * PVT_i$		0.5671**		0.5369**		0.6798***	0.5688**
		(0.248)		(0.253)		(0.259)	(0.240)
$\Delta LnREER_{it} * FDI_i$			-0.0552		0.007	-0.2447	-0.4585
			(0.258)		(0.295)	(0.268)	(0.407)
$\Delta LnREER_{it-1} * FDI_i$			-0.5506**		-0.5112**	-0.6479***	-0.5344**
			(0.229)		(0.234)	(0.227)	(0.241)
Observations	2,961	2,961	2,950	2,961	2,950	2,950	2,950
Number of id	456	456	453	456	453	453	453
AR1	0.002	0.002	0.002	0.002	0.002	0.002	0.000
AR2	0.509	0.501	0.819	0.48	0.786	0.819	0.655
SARGAN	0.527	0.585	0.43	0.555	0.391	0.434	0.103
HANSEN	0.779	0.801	0.737	0.786	0.7	0.706	0.221

Table 4 Trade openness, Competitive Structure , Real Exchange Rate and Wage Adjustment

	1	2	3	4	5	6	7	8
VARIABLES	FE	FE_LOW	FE_HIGH	FE_Check	GMM	GMM_LOW	GMM_HIGH	GMM_Check
$\Delta LnL_{i,t-1}$	-0.0390**	-0.0580**	-0.0135	-0.0386**	-0.002	-0.0218	0.0362	-0.0023
	(0.019)	(0.023)	(0.026)	(0.019)	(0.019)	(0.021)	(0.025)	(0.019)
$\Delta LnY_{i,t}$	0.0580**	0.0916***	0.0095	0.0584**	0.0591	0.0848*	-0.0189	0.0589
	(0.026)	(0.033)	(0.034)	(0.026)	(0.036)	(0.043)	(0.037)	(0.036)
$EMO_i * \Delta LnY^*_{i,t}$	-0.0485	-0.2081	0.3738	-0.0497	0.5844*	0.1706	1.1624*	0.6024*
	(0.477)	(0.608)	(0.638)	(0.480)	(0.351)	(0.474)	(0.668)	(0.361)
$\Delta Lnwage_{2d,it}$	0.4459***	0.4708***	0.4117***	0.1350***	0.4338***	0.4629**	0.3643*	0.1112***
	(0.056)	(0.088)	(0.071)	(0.029)	(0.147)	(0.210)	(0.192)	(0.040)
$\Delta LnTFP_{it}$	0.1364***	0.1080***	0.1852***	0.4440***	0.1111***	0.0394	0.2336***	0.4287***
	(0.029)	(0.040)	(0.039)	(0.056)	(0.040)	(0.052)	(0.039)	(0.147)
$\Delta LnREER_{it}$	0.0353	0.0872	0.0542	0.1336	-0.1335	-0.181	-0.1046	-0.1789
	(0.074)	(0.116)	(0.110)	(0.125)	(0.084)	(0.145)	(0.116)	(0.124)
$\Delta LnREER_{it} * EXS_i$	-0.2381	0.2615	-1.3877***	-0.3029	-0.0073	0.4501	-0.9918*	0.0208
	(0.358)	(0.472)	(0.508)	(0.367)	(0.306)	(0.360)	(0.521)	(0.307)
$\Delta LnREER_{it-1} * EXS_i$	-0.2329	-0.8258***	0.7369**	-0.2347	-0.0887	-0.6820**	0.6782*	-0.0779
	(0.211)	(0.270)	(0.355)	(0.219)	(0.233)	(0.310)	(0.354)	(0.242)
$\Delta LnREER_{it} * IMS_i$	0.007	0.0242**	-0.0023	0.0074	0.0162***	0.0207***	0.0108***	0.0162***
	(0.011)	(0.010)	(0.008)	(0.011)	(0.006)	(0.007)	(0.003)	(0.006)
$\Delta LnREER_{it-1} * IMS_i$	-0.0091	-0.0055	-0.0116	-0.0087	-0.0013	-0.0054	-0.0072	-0.0013
	(0.012)	(0.009)	(0.016)	(0.012)	(0.010)	(0.008)	(0.007)	(0.010)
$\Delta LnREER_{it} * PRO_i$				-0.0129				0.0058
				(0.015)				(0.012)
$\Delta LnREER_{it-1} * PRO_i$				-0.0021				-0.0016
				(0.008)				(0.008)
Observations	3,419	1,713	1,706	3,419	2,961	1,486	1,475	2,961
Number of id	456	227	229	456	456	227	229	456
AR1					0.000	0.001	0.000	0.000
AR2					0.303	0.547	0.446	0.303
SARGAN					0.275	0.714	0.477	0.278
HANSEN					0.644	0.486	0.617	0.655
R-squared	0.866	0.858	0.878	0.866				
F	654.3***	314.6***	390.1***	591.1***				

Table 5 Ownership Characteristics, Real Exchange Rate and Wage Adjustment

VARIABLES	FE	FE	FE	GMM	GMM	GMM
$\Delta LnL_{i,t-1}$	-0.0363*	-0.0355*	-0.0369*	-0.0007	-0.0022	-0.0049
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
ΔLnY_{it}	0.0555**	0.0529**	0.0521**	0.0593*	0.0588	0.0575
	(0.026)	(0.026)	(0.026)	(0.036)	(0.036)	(0.036)
$EM * \Delta LnY_{it}^{*}$	-0.213	-0.1866	0.0333	0.5262	0.5839*	0.5589
	(0.380)	(0.355)	(0.423)	(0.341)	(0.324)	(0.348)
$\Delta Lnwage_{2d,it}$	0.4419***	0.4415***	0.4503***	0.4374***	0.4264***	0.4302***
	(0.056)	(0.056)	(0.056)	(0.146)	(0.146)	(0.146)
$\Delta LnTFP_{it}$	0.1379***	0.1405***	0.1413***	0.1114***	0.1131***	0.1075***
	(0.029)	(0.029)	(0.030)	(0.040)	(0.040)	(0.040)
$\Delta LnREER_{it}$	0.0332	-0.2161**	0.0682	-0.0848	-0.2241*	-0.1507*
	(0.091)	(0.108)	(0.074)	(0.100)	(0.115)	(0.090)
$\Delta LnREER_{it} * SOE_i$	-0.3074			-0.2624		
	(0.314)			(0.327)		
$\Delta LnREER_{it-1} * SOE_i$	0.1251			0.1718		
	(0.275)			(0.304)		
$\Delta LnREER_{it} * PVT_i$		0.8384***			0.2998	
		(0.282)			(0.316)	
$\Delta LnREER_{it-1} * PVT_i$		-0.1778			0.0399	
		(0.206)			(0.187)	
$\Delta LnREER_{it} * FDI_i$			-0.4411			0.0582
			(0.360)			(0.329)
$\Delta LnREER_{it-1} * FDI_i$			-0.3308			-0.3015
			(0.269)			(0.257)
Observations	3,419	3,419	3,405	2,961	2,961	2,950
Number of id	456	456	453	456	456	453
AR1				0.000	0.000	0.000
AR2				0.299	0.293	0.346
SARGAN				0.292	0.211	0.286
HANSEN				0.610	0.558	0.626
R-squared	0.866	0.866	0.867			
F	726.0***	738.3***	750.4***			