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The Real Exchange Rate and Employment in China

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Abstract

We examine the impact of real exchange rate fluctuations on sectoral and regional employment in China from 1980 to 2008. In contrast to theoretical predictions, employment in both the tradable and non-tradable sectors contracts following a real appreciation. Our results are robust across different sub-samples, levels of sectoral disaggregation, and are more pronounced for regions with higher export exposure. We attribute our findings to the importance of services as intermediate input in exportable production. We test this channel of exchange rate transmission using regional input-output tables linked with employment data at the region-sector level. The results of this paper have important implications for China's labor market adjustment should the Chinese RMB strengthen in the future. To mitigate the costs of short-run labor market adjustment, appropriate demand management and structural reforms in the non-traded sectors should play an important role.

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I. INTRODUCTION

How does employment across sectors adjust in response to reallocative shocks? In open economies, the real exchange rate plays a particularly important role in determining the relative profitability of sectors that produce for foreign versus domestic consumers, and those that use imported versus domestic inputs. The resulting implications of exchange rate fluctuations for the labor market at the sectoral and aggregate level is a key area of interest.

This paper examines the implications of real exchange rate fluctuations for employment using data at the sectoral and regional level in China from 1980 to 2008. China has long moved to the forefront of attention due to its fast increase in economic importance and in particular its role in world trade. In recent years, the international community has been intensifying pressure on the Chinese government to appreciate its currency in order to correct global imbalances and to generate more domestic demand. This pressure has been growing further since the start of the financial crisis. More recently, policy makers in China have themselves started to indicate willingness to readjust the currency peg as the country recovers from the crisis.[2] Most of the policy discussion has so far focused on the implications of a revaluation of the Chinese Yuan for global imbalances and manufacturing employment in trading partner countries such as the US.

So far, much less attention has been directed towards the Chinese labor market and its potential to adjust to the transformation that a significant real appreciation might entail. There are only a few existing studies on the impact of the real exchange rate on Chinese manufacturing employment (see Hua, 2007) that point to evidence of employment losses in the manufacturing sector following a real appreciation. However, to our knowledge, there is no existing study on the effect of the real exchange rate on other (non-manufacturing) sectors of the Chinese economy. Intuitively, a real appreciation decreases output and employment in tradable sectors, but it should benefit non-tradable sectors by lowering the relative costs of imported inputs. Furthermore, a real appreciation should also trigger a reallocation of production resources to non-tradable sectors as the relative price and profitability of non-tradable production increases. Given that employment outside manufacturing makes up more than 80 percent of total employment in China, an analysis that seeks to gauge the full effect of real exchange rate fluctuations on the whole economy has to take into account non-manufacturing sectors. Our paper aims to fill this gap.

We first use national employment and wage data at the sectoral level and show that movements in the real exchange rate are associated with sizable changes in employment and wages in all sectors of the economy. Most surprisingly, we find that a real appreciation lowers employment growth in tradable sectors (mostly manufacturing), as well as non-tradable sectors (mostly transport, utilities, and wholesale/retail trade). Next, we investigate whether this relationship holds for regional employment at the province level. We find that it does: estimating the impact of the real exchange rate on each of three broad industries across provinces, we find that a real appreciation (depreciation) decreases

[2]See e.g. “Beijing remains divided over currency peg”, *The Financial Times*, March 8th 2010.

(increases) employment growth in the secondary industry (which includes tradable manufacturing) as well as tertiary industry (which comprises exclusively non-tradable services). Depending on the specification, a 10 percent real appreciation lowers employment growth by 0.4 to 1.4 percentage points across sectors except for agriculture. Moveover, the negative employment effect of a real appreciation tends to be more pronounced than the positive effect of a real depreciation, and it is reinforced by a larger regional exposure to exports. We show robustness of our findings to the inclusion of different aggregate, industry-specific, and regional variables that could be correlated with the real exchange rate and demonstrate stability of the main finding across different sample periods. We apply panel OLS and Instrumental Variable estimation methods that control for potential endogeneity of the real exchange rate, as well as seemingly unrelated regression (SUR) techniques to control for correlation across industries and regions.

We interpret our results by pointing to the interdependent structure of production across sectors. In particular, since services play an important role as intermediate input for industrial production, their output and employment can co-move with the export sector even following an asymmetric shock. In our last empirical exercise, we test this channel of transmission using employment data and input-output tables at the region-sector level, which represents the highest degree of disaggregation used in this paper. We find that regions and services sectors in which a relatively high share of production serves as intermediate input to tradable sectors (mostly to manufacturing) experience a stronger negative impact of a real appreciation. Again, we apply different methods to control for potential endogeneity of the aggregate real exchange rate, including a general method of moments procedure that exploits the disaggregate level of the dataset.

It is important to emphasize that our paper does not seek to argue whether the Chinese real exchange rate is over or undervalued. While this is an important and contentious issue, we cannot resolve it based on our findings. Instead, we provide empirical evidence showing that movements in the exchange rate have significant effects even for sectors that do not have any (direct) international exposure, and that the direction of their adjustment does not follow the theoretical prediction based on relative prices. This poses additional challenges for policy makers in designing measures to minimize welfare costs of employment adjustments.

We design our empirical strategy much in line with recent work on exchange rates and labor markets. Panel regressions using manufacturing industry data are used e.g. by Branson and Love (1988), Revenga (1992), Gourinchas (1998), Campa and Goldberg (2001) for the US, by Burgess and Knetter (1998) for the G-7 countries, and recently using firm-level data by Nucci and Pozzolo (2010) for Italy. Rajan and Subramanian (2008) estimate the impact of foreign aid and real appreciation on manufacturing employment for a set of low income countries. The paper by Goldberg et al. (1999) considers also non-manufacturing sectors and their responses to real exchange rate movements in the US, and Moser et al. (2010) investigate the impact of exchange rate shocks on job turnover in both manufacturing and services in Germany. The empirical results tend to confirm the theoretical prediction that employment in manufacturing declines (increases) when the real exchange rate appreciates (depreciates). The magnitude of the employment and wage response, however, differs greatly across countries and concepts of measurement (net employment vs. gross job flows), whereas the employment response of non-manufacturing sectors is not clearly established. In particular, it is even less clear through which channels exchange rate shocks affect employment outcomes in services sectors.

While the focus of the literature has been mainly on the U.S. labor market due not least to data availability, more and more attention is now also directed to emerging markets such as China. Most existing work has been examining the structural transformation process that followed various reforms and privatization waves in China in the last few decades, see e.g. the volume by Brandt et al. (2008). The impact of the real exchange rate on manufacturing employment has been studied by Hua (2007), while the impact on other sectors of the Chinese economy has not yet been examined. To our knowledge, our paper is also the first to link regional input-output data with regional sector-level employment in China. This combination of data is particularly well-suited to study the impact exchange rates on employment as it exploits the variation in employment as well as industrial input-output structure across regions and sectors, while being less prone to endogeneity issues present for aggregate data.

The paper is organized as follows. In section 2, we develop a partial equilibrium model of the labor market that captures the various channels of exchange rate movements on sector-specific labor demand. We then briefly describe the different datasets used in section 3, with further details given in the Appendix. Section 4 presents the empirical methodology and summarizes the estimation results of the effect of the real exchange rate on regional/sectoral employment and wages. In Section 5, we discuss the interpretation of our results and test the transmission channel of exchange rates on non-tradable employment. In section 6, we outline direction for future research and conclude.

II. Theory

We formulate a theoretical framework that will guide our empirical analysis on exchange rates and labor markets. We focus on the effect of exchange rate fluctuations on labor demand in different sectors, and distinguish the different adjustments of tradable compared to non-tradable sectors. In principle, the real exchange rate affects both revenues and costs of each sector. Sectors that have a high export orientation suffer from a real appreciation through a downward shift in the demand curve for their products, triggered by a loss of competitiveness both in foreign and domestic markets. However, sectors that rely on imported foreign inputs also benefit from a real appreciation that lowers their marginal cost. The net effect of an appreciation on employment in tradable sectors is therefore a priori not pinned down and depends on the relative strength of the two effects. However, for non-tradable sectors (such as transportation, construction or services), the first channel is by definition not present. Therefore, all else equal, we should expect a real appreciation to unambiguously increase employment and output in non-tradable sectors.

Consider a representative firm in the tradable sector that maximizes profits every period by choosing the optimal amount of output and inputs. For simplicity, we assume producers to be perfectly competitive, that is, they face a given demand curve, although the theoretical results also carry over if producers have some price-setting power. The profit function of a producer in a tradable sector (T) is given by:

$$\max_{q^T, L^T, K^T, Z^{*T}} \pi^T = p^T(Y, Y^*, e)q^T - w^T L^T - rK^T - \frac{s^*}{e} Z^{*T} \tag{1}$$

subject to the production technology

$$q^T = Q^T(L^T, K^T, Z^{*T}) = (L^T)^\alpha (K^T)^\beta (Z^{*T})^{1-\alpha-\beta} \tag{2}$$

The average output price faced by the producer, $p^T(Y, Y^*, e)$ is subject to an upward shift with an increase in domestic (Y), or foreign (Y^*) income, and with a real depreciation (lower e). Capital (K) and labor (L) are used as inputs along with imported foreign inputs (Z^*). In the case of China, imported inputs comprise mostly industrial commodities and machinery/equipment, and account for up to 50 percent of total input costs in some sectors.[3] The factor costs (in domestic prices) are given by the wage w^T, the real interest rate r and the imported input price $\frac{s^*}{e}$.

The solution of the producer problem yields the familiar first order conditions (FOCs) which prescribe that the marginal revenue product of each factor be equal its marginal cost:

$$p^T \frac{\partial Q^T}{\partial L^T} = w^T, \; p^T \frac{\partial Q^T}{\partial K^T} = r, \; p^T \frac{\partial Q^T}{\partial Z^{*T}} = \frac{s^*}{e}. \tag{3}$$

Using this and the constant return to scale property of the production function, we can represent optimal labor demand in the tradable sector to be:

$$L^T = \frac{Q^T}{w^T} \left[p^T(Y, Y^*, e) - \beta r \left(\frac{\partial Q^T}{\partial K^T} \right)^{-1} - (1 - \alpha - \beta) \frac{s^*}{e} \left(\frac{\partial Q^T}{\partial Z^{*T}} \right)^{-1} \right] \tag{4}$$

This optimal labor demand condition, along with the law of one price ($p^{*T} = ep^T$) allows us to derive the labor demand elasticity with respect to the real exchange rate to be:

$$\frac{\partial L^T / L^T}{\partial e / e} = \frac{1}{\alpha} \left[\eta^e + (1 - \alpha - \beta) \left(\frac{\partial Q^T}{\partial Z^{*T}} \right)^{-1} \right] \tag{5}$$

The real exchange rate affects labor demand through the competitiveness channel (captured by the price elasticity with respect to the exchange rate $\eta^e < 0$) and imported input channel (proportional to the imported input share in production $1 - \alpha - \beta$). A real appreciation (increase in e) has a negative effect on employment through the first channel, with the magnitude depending on the absolute value of the elasticity η^e, and a positive effect on

[3] See e.g. CICC (2010).

employment through the second channel, which increases with a higher imported input share $(1-\alpha-\beta)$. Using the FOCs in equation (3), we can further show that the former effect dominates, i.e the employment elasticity with respect to a depreciation is positive, if $\eta^e < -1$.

We log linearize the optimal labor demand condition (4) and use (5) to obtain the first order approximation to labor demand:

$$L_t^T = a_0^T + a_1^T Y_t + a_2^T Y_t^* + \left[a_{3,1}^T \left|\eta^e\right| + a_{3,2}^T (1-\alpha-\beta)\right] e_t + a_4^T w_t^T + a_5^T r_t + a_6^T s_t^* \quad (6)$$

We assume that labor supply to the tradable sector is positively related to the sectoral wage w_t^T as well as other observed and unobserved factors that shift labor supply to a sector H_t^T, including labor force growth, labor mobility and preferences. To first order approximation, labor supply can be written as:

$$L^T = b_0 + b_1 w_t^T + b_2 H_t^T \quad (7)$$

Labor market clearing yields the following system of employment and wage equations:

$$L_t^T = c_0^T + c_1^T Y_t + c_2^T Y_t^* + \left[c_{3,1}^T \left|\eta^e\right| + c_{3,2}^T (1-\alpha-\beta)\right] e_t + c_4^T r_t + c_5^T s_t^* + c_6^T H_t^T \quad (8)$$

$$w_t^T = d_0^T + d_1^T Y_t + d_2^T Y_t^* + \left[d_{3,1}^T \left|\eta^e\right| + d_{3,2}^T (1-\alpha-\beta)\right] e_t + d_4^T r_t + d_5^T s_t^* + d_6^T H_t^T \quad (9)$$

where the coefficients of interest that measures the impact of the exchange rate are $c_{3,1}^T, d_{3,1}^T < 0$ and $c_{3,2}^T, d_{3,2}^T > 0$.

Employment and wages in non-tradable (N) sectors are derived in the same way, except that by definition, demand for non-tradable goods only depends on domestic income, so that the inverse demand function for a representative producer in N is given by $p^N(Y)$. Therefore, the real exchange rate only affects labor demand through the second channel of imported inputs. The log-linearized equilibrium employment and wage in the N sector is given by:

$$L_t^N = c_0^N + c_1^N Y_t + c_2^N (1-\alpha-\beta) e_t + c_3^N r_t + c_4^N s_t^* + c_5^N H_t^N \quad (10)$$

$$w_t^N = d_0^N + d_1^N Y_t + d_2^N (1-\alpha-\beta) e_t + d_3^N r_t + d_4^N s_t^* + d_5^N H_t^N \quad (11)$$

and the coefficients that measure the impact of the real exchange rate are given by $c_2^N, d_2^N > 0$.

Equations (8) to (11) form the basic structure for our estimation in the remainder of the paper. Where possible, we will exploit the heterogeneity across geographic regions and sectors to obtain different measures of trade exposures and estimate the resulting exchange rate elasticities. It can be shown, as in e.g. Campa and Goldberg (2001), that the higher the export share of a tradable sector, the larger is its price elasticity with respect to exchange rates $|\eta^e|$, as a larger share of the sector's demand faces foreign competition. That is, for a given sector s:

$$\left|\eta^e_{s,t}\right| = kX_{s,t}, \;\; X_{s,t} = \frac{Exp_{s,t}}{p^T Q^T_{s,t}}$$

On the other hand, the larger the imported input share, the larger is $(1-\alpha-\beta)$ and the stronger is the *positive* employment effect of a real appreciation as it reduces producers' marginal costs. The coefficients $c^T_{3,2}, c^N_2$ and $d^T_{3,2}, d^N_2$ capture this positive exchange rate effect on labor demand across sectors. We will use data on region and sector-specific export and import shares to examine these channels.

III. DATA

We collect data from various sources including China's National Bureau of Statistics (NBS), the provincial/municipal Statistical Yearbooks, the Census and Economic Information Center (CEIC), the International Financial Statistics (IFS), and the World Economic Outlook (WEO) database. In this section, we highlight the basic properties of the different sectoral and regional datasets we use. Further details of the data are summarized in the Appendix.

A. The Real Effective Exchange Rate

Figure 1 graphs the logarithm of the real effective exchange rate from 1980 to 2008 (taken from IFS). During this 29 year period, the striking trend is the persistent real depreciation by more than 100 percent from 1980 to 1994, followed by a relatively mild appreciation and stabilization until 2002. Figure 2 displays both the real effective exchange rate and the average USD/RMB rate from 1980 to 2008. This real effective exchange rate is computed as a weighted average of bilateral nominal exchange rates and price index differentials, where the weights are updated periodically and derived from trade (import and export) shares in the main product categories with all trading partners.[4] We can clearly see that most of the movement in the real effective exchange rate is driven by the nominal bilateral exchange rate between the Chinese RMB and the US Dollar.

In the first phase from 1980 to 1994, China pursued a multiple-exchange-rate regime: an official rate existed for non-commercial operations, a commercial rate for so-called "priority imports", and different swap rates for exports earnings. The real effective exchange rate depicted in Figure 1 is a weighted average of the multiple rates that co-existed up to 1994 and in fact, each one of them exhibited a strong depreciating trend during that period. During the same time, exports and imports (as well as other current and capital account transactions) were not driven by market forces but largely controlled by the government (see the review in McKinnon and Schnabl, 2008). These restrictions as well as the multiple rate system were finally abolished in 1994. The consolidated nominal exchange rate remained virtually fixed at

[4] A detailed description is provided in Bayoumi et al. (2005)

around 8.2 Yuan/Dollar from then until 2005. Of course, the real effective exchange rate still exhibits fluctuations due to changes in trading patterns and inflation differentials.

We carry out our regressions using different sub-samples. Although we do look at long samples starting from 1980 for comparison, most of the analysis is done with data starting 1994 or later to avoid spurious results being driven by the shift in exchange rate and capital account regime.

B. Sectoral Data

We start our empirical analysis using aggregate sectoral data. This part of the analysis is of a more descriptive nature as the level of sectoral disaggregation and source of variation is very coarse and data quality very limited. First, we look at sectoral employment data from 1980 to 2002. This series was discontinued after 2002 as the NBS changed the sector classification as well as the definition of employment in 2003. We first use this old sectoral employment data as it has various advantages. The first one is its definition of employed persons, which is in line with ILO convention: it includes all persons of 16 years of age and above who are engaged in economic activities and earn remuneration for more than one hour in the reference week. There are 16 sectors in this old classification system. A detailed description of the industry and sector classifications is given in Table 1. We refer to this dataset as the *Employment* data. [5] For the real average wage series by sector, we use the Real Wage Index series that also corresponds to the old sector classification system (series label CGAHT from the CEIC database).

The second sector-level data we use is the employment and wage series according to the new sector classification system by NBS (see Table 1). This new classification system - roughly in line with the ISIC Rev. 3 classification - was introduced in 2003 and extended back to data from 1990 for consistency. The major drawback of this data is the employment definition: instead of employed persons, the new series is called ”total number of employees in urban units” and only includes employees of state-owned units, urban collective-owned units and other ownership units. It excludes workers in private enterprises and self-employed individuals, who together make up the most dynamic part of the Chinese labor market in the recent past. However, this *Employees* series is available until 2008, whereas the old *Employment* series only until 2002. In our empirical analysis, we use this *Employees* series to check for robustness of our results, and explore whether there is any systematic difference between the adjustment of the state-owned sector and the aggregate economy.

To capture the effective exposure of each sector to real exchange rate fluctuations, we interact the aggregate real effective exchange rate with sector-specific export and import shares. This methodology has been used by several studies on exchange rates and labor markets such as

[5] It is worth mentioning that NBS adjusted total employment data since 1990 on the basis of the 5th national population census, but not at the sector level. Young (2003) mentions that linking the old data (prior to 1990) with the new data (from 1990 on) at the aggregate level can generate spurious employment growth. We only use sectoral data without the adjustment made by NBS, and therefore do not have the structural break in 1990. This data is also recommended by Young (2003) for better consistency across years.

Campa and Goldberg (2001), Gourinchas (1998). Sector-specific trade values are only available starting in 1993 from the the *China Statistical Yearbook* and so combining this with the first *Employment* data gives us too short a sample. As for output data (to construct sector-specific trade shares), there is no corresponding sector-level output covering the same period. NBS only records real and nominal output for more broadly defined sectors. For example, output data are available for the industry sector, which includes mining, manufacturing, and production and supply of utilities. Therefore, in the second part of our sectoral analysis using the *Employees* data, we group sectors based on availability of output data. Using this method we can extend the sample to 2008 and compute corresponding trade weights.

To provide a descriptive first impression of the data, Figure 3 shows the time series of Employment in some major sectors together with the real effective exchange rate (REER). Figure 3 is based on the first (old) sector classification. Since all employment series exhibit very strong trends, we show the series in growth rates in the top chart of Figure 3. We can see that there is strong co-movement between the sectors, and a negatively correlation with the REER. That is, employment in all sectors appear to grow stronger in periods of real deprecation and vice versa. The same observation holds for the series after linearly detrending in the bottom chart of Figure 3. Both observations - the co-movement among sectors as well as the negative relation with the REER - are even more pronounced for detrended series. Figure 4 plots the Employees series (excluding private units and self-employed individuals) under the new sector classification. We again observe a strong co-movement and a negative correlation of sectoral employment growth with REER.

C. Regional Data

The third dataset we use to examine the effects of real exchange rate movements is (primary, secondary, tertiary (see Table 1)) broad-industry-level employment data reported by different regions in China. The data is taken from the *CEIC China Database* for the period 1993 to 2008, and supplemented by data for 1988 to 1992 taken from different editions of the *China Statistical Yearbook* published by NBS. As of today, there are 31 regions in China (including 22 provinces, 5 autonomous regions, and 4 directly administered municipalities). However, Chongqing only became a directly administered municipality in 1997, and previously was part of Sichuan province. We merged all data for Chongqing with Sichuan after 1996 to maintain consistency with the earlier sample. We thus have data for 30 regions from 1985 to 2008. For each region and year, we have annual data on total employment in each of the 3 industries (primary, secondary and tertiary), real output by each industry, as well as total regional exports and imports. The sector components of each industry is given in Table 1.

Chinese regions differ a lot in their industrial structure as well as openness to trade. Table 2 provides an overview of the regional average employment and trade shares over the sample period. It is evident that employment in agriculture has been declining in most regions while employment in secondary and tertiary industries has been increasing. The degree of openness varies considerably by region, with Guangdong having by far the highest export share of over 82 percent (in terms of regional GDP), which is why it is often dubbed the “workshop of the world". In general, coastal provinces are more export-oriented than regions further inwards: Figure 5 shows a map of Chinese regions, their total export incomes as well as industrial structure. We exploit the regional variation in export and import intensities to construct a region-specific export and import real exchange rate. This added dimension of variation allows us to shed more light on the nature of employment adjustment to real exchange rate movements. Moreover, we are able to estimate each industry-specific equation using regional data and therefore gain more insight on the heterogeneity of adjustment to real exchange rate changes across regions.

Figure 6 shows regional employment in the secondary industry (mostly tradable) and the tertiary industry (all nontradable services) for some selected regions. All 8 regions show strong co-movement between the two industries, consistent with the plots of sectoral employment above. We will exploit the regional variation in industry-specific employment to estimate the effect of the real exchange rate for different industries.

D. Input-Output Tables and Regional Sector data

We collect both national and regional input-output tables from NBS. The national input-output tables are available for the years 1995, 1997, 2000, 2002, and 2005, which are taken from different editions of the *China Statistical Yearbook*. For the regional input-output tables we only have data for 2002 taken from *China input-output tables 2002* published by the NBS. National tables are computed for 23 sectors, regional ones for 42 sectors of economic activity which roughly correspond to the ISIC Rev. 3 two-digit classification, and the values of intermediate usage are calculated in current producer prices. Each table also provides sectoral gross output values, which are the sum of total intermediate usage from all sectors and the value-added. The share of intermediate usage in gross output value indicates the interconnection between sectors. The regional input-output tables cover 30 regions in China, not including Tibet. To be consistent with the regional employment data, we merge the input-output table for Chongqing with Sichuan. A more detailed analysis of input-output tables is given in Section V.

At the most disaggregated level of our empirical analysis, which also forms the core of our work, we combine the regional input-output data with region-sector-level employment data to analyze how differences in regional production structure affect employment adjustment to real exchange rate variation across sectors. We collect employment data at the detailed sector level for each region from the respective provincial Statistical Yearbook for the years 2003 to 2008 to obtain the largest degree of cross sectional variation.

IV. Empirical Analysis

A. Analysis with Sectoral Data

For most employment, output, and exchange rate series, we could not reject the hypothesis of a unit root using the univariate Dickey-Fuller as well as several panel unit root tests (allowing for autoregressive lags and panel specific time trends). We then proceed to test for panel co-integration using the method of error-correction in Westerlund (2007) and could not find any evidence for co-integration. Therefore, we decide to use first differences throughout the analysis in this section.[6]

We start with the panel regressions using sectoral data for both employment growth and real wage growth. In a first step, we constrain all sectors to respond symmetrically to the real exchange rate as follows:

The estimation equation for the employment is

$$\Delta \ln(L_{it}) = \alpha_i^0 + \alpha^1 \Delta \ln(L_{it-1}) + \alpha^2 Z_t + \alpha^3 \Delta \ln(e_t) + \varepsilon_{it} \tag{12}$$

where L_i is employment in the *i*th sector; *e* is the real effective exchange rate (REER); and Z is a vector that includes all other aggregate variables. We include a lagged dependent variable to allow for gradual employment response that is due to e.g. labor adjustment costs. Consistent with the theoretical model from section 2, we include the following aggregate variables: China's real GDP (Y), the world demand for Chinese exports for which we use aggregate world imports (Y^*), the working age population of 15 to 64 years (H), the relative price of oil (s^*), the real interest rate (r), and a time dummy for the year 1998. The reason is that from 1998 onwards, NBS excludes *Xiagang* workers[7] from all employment data. This estimation equation corresponds to an average between the theoretical employment equations (8) and (10)[8]:

$$L_t = \tilde{c_0} + \tilde{c_1} Y_t + \tilde{c_2} Y_t^* + \tilde{c_3} e_t + \tilde{c_4} r_t + \tilde{c_5} s_t^* + \tilde{c_6} H_t$$

where a ˜ denotes average coefficient across tradable and non-tradables sectors. Table 3 and table 4 summarize the regression results for sectoral employment growth. For all panel regressions, we use both OLS and the generalized least squares (GLS) method to control for heteroskedasticity and cross-sectional correlation among panels. Table 3 regressions use the old Employment dataset, which has 15 sectors and covers the period from 1980 to 2002. All regression equations include a full set of sector fixed effects.

In table 3, the estimated coefficients for the REER are negative in all columns with values ranging from -0.04 to -0.14. This implies that an appreciation (depreciation) of the real exchange rate by 10 percent decreases (increases) employment growth by 0.4 to 1.4 percentage points on average across all sectors. To see if this negative relationship is stable across sub-samples, we repeated the same regression for the whole period as well as

[6]Since unit root tests have low power against the alternative hypothesis, we also ran all regressions on detrended levels and found that the result are broadly confirmed.

[7]*Xiagang* refers the workers laid-off from SOEs who remain registered with reemployment centers.

[8]In these pooled aggregate estimating equations, the impact of trade shares are absorbed into the coefficient on the REER.

sub-samples starting from 1990 and 1994 to exclude the double exchange rate regime. As shown in column (3) to (6), the negative effective is even larger for the more recent period. To explore heterogeneity in the response to the REER across sectors, in column (6), we add the joint effect of the REER and a tradable sector dummy which includes agriculture, manufacturing, and mining. In terms of the theoretical equations in section 2, we are estimating an equation that nests both equations (8) and (10):

$$\begin{aligned} L_t &= \tilde{c_0} + \tilde{c_1} Y_t + \tilde{c_2} Y_t^* + \tilde{c_{3,1}} (I_{i \in T}) e_t + \tilde{c_{3,2}} e_t \\ &\quad + \tilde{c_4} r_t + \tilde{c_5} s_t^* + \tilde{c_6} H_t \end{aligned}$$

where $I_{i \in T}$ is an indicator function that equals one if sector i is tradable. This is the same specification as above, except that in addition to the average coefficient on e, we also include a tradable-specific coefficient $\tilde{c_{3,1}}$ which should be unambiguously negative according to the model.

We find that the coefficient on the REER is broadly unchanged while that on the tradable-interacted REER is insignificant. This result implies that the negative effect of a real appreciation on employment is not restricted to the tradable sector only, as one would expect, but is rather shared by both tradable and non-tradable sectors.

Table 4 reports the regressions using the new sectoral Employees dataset, which has the broader 7 sectors, includes only urban unit employees, and covers the more recent period from 1989 to 2008. Most results are broadly consistent with those in table 3. In particular, a real appreciation (depreciation) of 10 percent leads to about 0.7 percent decrease (increase) in employment growth, which is in the range of estimates in Table 3. However, for the urban units, the coefficient on REER interacted with tradable dummy is significantly negative for both sub-samples while the symmetric REER variable becomes insignificant (columns 2 and 5). As discussed above, an advantage of these urban unit employee series is that we can compute sector specific real exchange rates by interacting the REER variable with the sector-specific (lagged) export shares (columns 3 and 6). Doing that, we find that contrary to previous results, sectors with higher export shares experience a stronger negative effect from real appreciation. This finding could be driven by the fact that large manufacturing/mining companies have been mostly state-owned, so they are more strongly represented in the Employees database.

B. Analysis with Regional Data

The preceding aggregate sector analysis revealed some interesting pattern in sectoral adjustment, but offered only limited variation due to the short sample and/or small number of sectors at a very aggregate level. Hence we only consider the previous results as giving us a sense of the conditional correlation between employment and the real exchange rate, but do not draw any causal interpretation solely based on them. This should be done using more micro-level data that explores heterogeneity at a more disaggregated level.

Unfortunately, we do not have firm-level data for all major sectors in China for a comparable time period in order to investigate the pattern at the most micro level. In an effort to explore in more detail the question of sectoral adjustment with available data, we adopt the strategy of exploiting regional variation in sectoral employment.

In the remainder of the paper, we estimate the following baseline equation for industry specific employment across 30 regions (as described in Data section above):

$$\begin{aligned}\Delta\ln(L_{irt}) &= \gamma_{ir}^{0}+\gamma_{i}^{1}\Delta\ln(L_{irt-1})+\gamma_{i}^{2}\Delta\ln(L_{it})+\gamma_{i}^{3'}Z_{t} \\ &\quad+\begin{cases}\gamma_{i}^{4}\Delta\ln(e_{t}) \\ \quad\text{or} \\ \gamma_{i}^{5}\Delta\ln(e_{t})X_{r,t-1}+\gamma_{i}^{6}\Delta\ln(e_{t})M_{r,t-1}\end{cases} \\ &\quad+\varepsilon_{irt}\end{aligned} \tag{13}$$

where L_{ir} is employment of the *i*th industry in the *r*th region; γ_{ir}^{0} measures the region and industry specific fixed effect, and L_i is China's total employment in industry *i*. At the regional level, in particular to obtain a sufficiently long time series, we only have a sectoral breakdown into 3 broad sectors (see detailed description in Table 1): the primary sector, which is mainly agriculture, the secondary sector, which includes all tradable industrial sectors, and the tertiary industry, which comprises all services.

The vector Z_t contains the same aggregate variables that may be correlated with the REER as in the sectoral regression, namely aggregate domestic and world demand, the relative price of oil, the real interest rate, and a dummy variable for year 1998 (*xiagang* workers) and year 1990 (census re-classification as mentioned in Section 2). Thus in comparison with the previous sectoral regression, we allow the coefficient on each variable to vary by industry and also include the industry-specific, aggregate employment growth L_{it}, as well as regional real GDP growth.

There are many different sources of real exchange rate volatility one can think of. We do not take a stance on what sources of volatility we are capturing. The real exchange rate could be driven by productivity growth, changes in propensity to consume imports, or exchange rate intervention policies etc. Any of these shocks will also have an effect on employment and activity through other channels than the real exchange rate, in particular through their impact on income/demand. However, we try to separate these aggregate effects that take place at the same time as sectoral/reallocational effects due to real exchange rate changes by controlling for regional, national, and sectoral GDP and employment.

We first run a panel OLS regression for each industry separately. Table 5 and Table 6summarizes the results for each of the three industries for the long (1988-2008) and short (1994-2008) sample. Not surprisingly, the REER does not have any significant effect on regional employment in the primary sector as the evolution of this sector has been mainly driven by other structural phenomena. As for the secondary industry, an appreciated REER has a negative effect on employment growth. The estimate lies in the range of the aggregate sectoral results, but is less significant (only at the 10 percent level). Most interestingly, the coefficient estimate for REER is again, negative for the tertiary (non-tradable) sector, and significant at the 5 percent level in the more relevant recent sample. Thus, using regional-level variation, we also find that a real appreciation (depreciation) also hurts employment in services across all regions and that this negative effect is even slightly more pronounced than for tradable sectors.

Since the dependent variables in the regional regressions are at the provincial or municipality level, it is reasonable to expect that the aggregate REER is not prone to endogeneity problems once the aggregate macroeconomic conditions are controlled for (as we do in Z_t). However, to test this identification assumption, we also apply an instrumental variable approach as follows: We instrument the growth in aggregate REER by the change in the Japanese Yen/US dollar nominal exchange rate, which is arguably exogenous to any given Chinese region. At the same time, we expect it is correlated with Chinese REER as the Chinese RMB is pegged to the US dollar. We also use a second instrument, namely the US nominal interest rate (measured by the 3-month T-Bill rate). The US monetary policy stance is arguably not influenced by factors driving Chinese regional employment, but is certainly correlated with US and global variables that influence the Chinese REER. The results of the 2SLS regression results for the sample period starting from 1994 are summarized in Table 7.

First, a look at the bottom half of the table confirms that both instruments are very strongly correlated with the REER: a stronger US dollar against the Japanese Yen is associated with a real effective appreciation. The correlation is between 0.6 to 0.7, implying that the Chinese REER moves closely with the US dollar. In addition, an increase in the US interest rate is associated with a strengthening of the Chinese REER (except for industry 3). Using both instruments, we find that the validity of the instruments cannot be rejected by a Hansen test of over-identifying restrictions. As for the second stage, the results are very close to the OLS estimates. In fact, the negative effect of REER on employment in the secondary and tertiary industry have a similar magnitude and significance level as under OLS, which is why a Hausman-Wu test cannot reject the hypothesis of exogeneity for the REER. We can therefore carry on the analysis by using REER as the independent variable in the regional OLS regression.

Working with data at such a broad sectoral level for each region as we do, there is another problem we need to address: it is very likely that employment growth is correlated across industries for any given year and region, which would render the covariance matrix of the residual term of the system in Table 5, Table 6, and 7 be non-diagonal. Thus in the following, we apply the method of Seemingly Unrelated Regressions (SUR) to estimate all three equations jointly. This allows us to increase efficiency of the OLS estimation and test for the diagonality assumption of the residual covariance matrix.

Table 8 reports results of the baseline SUR for the whole sample from 1988-2008 as well as the short sample starting from 1994. Consistent with the sectoral results, the coefficient on the REER is again negative and significant at 1 percent level, both for Industry 2 (which includes the tradable manufacturing and mining sectors) and Industry 3 (which only comprises non-tradable services). In fact, the negative impact on non-tradable employment is even slightly larger than on tradable employment: a 10 percent real appreciation (depreciation) reduces (increases) Industry 2 employment by 1.1 percent, and Industry 3 employment by 1.2 to 1.3 percent. We also perform a formal Wald test on the hypothesis that the coefficient on the REER is equal in both industries and find a very high p-value of more than 50 percent.

The Chi square statistics of the Breusch-Pagan test with 3 degrees of freedom on the cross equation restriction is very large in both samples, indicating strong cross-equation correlations of the residuals and hence strong support for using the SUR approach. Table 9 includes the first and second lag of the REER in the regression to examine the dynamic pattern of adjustment. We find that most adjustment in the tertiary sector occurs in the same year, while that of the secondary sector is more persistent.

The estimating equation (13) also introduces further variation in the regional export and import shares to construct time-varying, region-specific export and import real exchange rates. According to the theoretical prediction in section 2, the negative effect of an appreciation should be stronger the higher the export orientation of a sector, while the positive effect is stronger the higher is the imported input share. Unfortunately, we do not have sufficient data on regional and industry-specific exports and imports in China. We approximate the export orientation of Industry 2 in each region by the regional export share, and the imported input intensity by the regional import share.[9]

To this end, we interact the REER variable with the lagged, region-specific export share $X_{r,t-1}$ and lagged import share $M_{r,t-1}$ in each year (both as percentage of regional GDP).[10] We expect the coefficient on $\Delta \ln(e_t) X_{r,t-1}$ to be negative for Industry 2, as it reflects the usual negative demand effect of a real appreciation on tradable output due to export and import competition. However, if imported inputs are used in production, then an appreciation can also lead to a positive employment effect due to cheaper production costs that acts like a positive supply shock. We expect this positive effect to be stronger, all else equal, in regions that have a relatively high import share, i.e. the coefficient on $\Delta \ln(REER_t) M_{r,t-1}$ should be positive.

Table 10 reports the result of the SUR regression using region-specific export and import exchange rates. Consistent with our expectation, the coefficient on the export REER is significantly negative, while that on the import REER is significantly positive.[11] These two channels work to offset each other and might explain why the negative effect of the REER was only found to be weakly significant in Table 6. For Industry 3, the coefficient is negative on the export REER and not significant for import REER. The coefficient on the export

[9] What we are implicitly assuming with this approximation is that the industry share in GDP and exports of each region is constant during the sample period.

[10] To compute exact region-specific REER, we would need to have the composition of trading partners for each region and year, which is unfortunately not readily available. Our construction of region-specific REER implicitly assumes the same composition of trading partners for each region as for the whole country.

[11] Qualitatively similar results have also been obtained for manufacturing employment in the US in Goldberg et al. (1999).

REER is slightly smaller in magnitude for industry 3 than for industry 2, but a formal test of the null hypothesis that the two coefficients are equal cannot reject equality at any acceptable significance level (p-value 55 percent). This sheds some light on the pattern of non-tradable employment adjustment to real exchange rates: it implies that the negative effect of a real appreciation on non-tradable employment is stronger for regions and years with a relatively high export share. The last 3 columns in Table 10 additionally include industry-specific time trends. The results are hardly changed, implying that the estimated effect of the REER is not driven by other aggregate variables that drive the employment trend in Industry 3 across regions.

Finally, we exploit the high degree of variation in the regional data to explore potential asymmetry between appreciation and depreciation periods. Table 11 shows that for whole sample as well as the second half of the sample starting from 1994, it is the negative effect of appreciation that matters most for employment contraction in both tradable and non-tradable industries. This presents some challenge to a model-based interpretation, but can be rationalized for example in the presence of asymmetric adjustment costs (i.e. higher costs for upward compared to downward adjustment in labor demand).

To sum up, the most surprising result is the sizable negative effect of a real appreciation on employment in non-tradable sectors, which stands in contrast to common theoretical prediction as discussed in the theory section. Apart from the positive effect of cheaper imported inputs, a real appreciation also tends to lead to a higher relative price of non-tradable goods (i.e. higher internal exchange rate), which should reallocate labor and other factors to non-tradable sectors and hence boost employment in these sectors. The results in this paper suggest that the reallocation of labor across sectors in response to sector-specific shocks is still limited in China. This could be due to various frictions that prevent an efficient distribution of production factors. However, reallocation frictions alone should not lead to a contraction of non-tradable employment following a real appreciation. The following section explores other potential explanations that could lie behind our main findings.

V. Transmission Channel

In the following, we highlight some channels for the real exchange rate to affect employment in non-tradable sectors that are not present a standard model. One possible channel could be due to learning spillovers from export sectors to the rest of the economy as in Aizenman and Lee (2008) or Korinek and Serven (2008). The idea is that exporting sectors absorb knowledge and technology from abroad which in turn enhances the organizational and management capital in other sectors of the economy. Therefore, an appreciation that reduces the size of the exporting sector also reduces the productivity growth in other sectors of the economy. However, this learning channel is likely to operate over a long time horizon, while our results have uncovered a response within the same year.

A. Sectoral Input-Output pattern in China

Another channel that we believe is of more immediate importance is the degree of structural interdependence that can lead to spillovers across sectors. A large share of output from sectors such as transportation, business services, and retail/wholesale trade is used as intermediate input in manufacturing industries. This inter-sectoral input-output structure can lead to a pattern of co-movement and a qualitatively similar response of manufacturing and service sectors to a real exchange rate shock. Table 14 gives an overview of the output shares of nontradable sectors that serve as intermediate input in tradable sectors' production at the aggregate level in China. It is evident that a large share of output of each non-tradable sector (except for construction) serves as input for tradable sectors. In particular, from 30 up to 70 percent of gross output from the banking, transport, wholesale/retail trade and the utility sectors are used on average in tradables. Thus, if a real appreciation leads to a contraction in tradable sectors, the ensuing negative effect on demand for intermediate input can lead to a decrease in employment in non-tradable sectors as well. A similar pattern based on the regional input-output tables is summarized in Table 15. The shares of intermediate usage in the banking, transport, wholesale/retail trade and the utility sectors are, on average, in the range from 30 to 60 percent. Table 16 has the summary statistics of the regional distribution of intermediate input shares of all non-tradable sectors from the regional input-output tables. Many sectors such as ”IT Services” and ”Wholesale/Retail Trade” have a large regional dispersion in terms of linkage intensity with tradable sectors, which will serve as an important source of variation in our following analysis.

Furthermore, the shares of intermediate usage in the service sectors are positively correlated with the importance of the tradable sectors in each region's economy. This is illustrated by Figure 7, which shows a strong positive correlation between the tradable sectors' share in the regional gross output value and the regional intermediate usage of wholesale/retail trade in tradable production. That is, the larger the relative size of the tradable sectors, the stronger is the interdependence between other services sectors (such as wholesale/retail) and tradables, therefore the larger is the potential impact of exchange rate fluctuations on the services sectors. Given the strong weight of manufacturing production in Chinese exports, another implication is that more open regions (with a large relative share of tradables) should experience stronger negative effects on services sectors from an exchange rate appreciation. This result is consistent with the empirical result we found earlier in our previous SUR analysis. In the remaining part of the paper, we test for this transmission channel explicitly using regional input-output tables.

B. Empirical test of sectoral dependence

To incorporate the intermediate input channel for non-tradable sectors, we extend the theoretical framework in section 2 in the following way. Consistent with the input-output table definition, gross output of any firm in the non-tradable sector is used as direct domestic consumption (Q_c^N) at price p_c^N or as intermediate input for tradable production (Q_i^N) at price p_i^N[12]:

$$p^N Q^N = p_c^N(Y)Q_c^N + p_i^N(Q^T(e))Q_i^N$$

As before, we assume that demand for non-tradable consumption depends on domestic income. Additionally, demand for intermediate nontradable services depends on activity in the tradable sector, which in turn depends on the real exchange rate. Following similar steps as in section 2, we can now derive employment in the non-tradable sector to be:

$$L^N = \frac{Q^N}{w^N}\left[p_c^N(Y)\frac{Q_c^N}{Q^N} + p_i^N(e)\frac{Q_i^N}{Q^N} - r\beta\left(\frac{\partial Q^N}{\partial K^N}\right)^{-1} - \frac{s^*}{e}(1-\alpha-\beta)\left(\frac{\partial Q^N}{\partial Z^{*N}}\right)^{-1}\right]$$

and the employment elasticity with respect to the real exchange rate becomes:

$$\frac{\partial L^N/L^N}{\partial e/e} = \frac{p^N}{\alpha}\left[\eta_i^e shr_i - (1-\alpha-\beta)\left(\frac{\partial Q^N}{\partial Z^{*N}}\right)^{-1}\right] \tag{14}$$

where $shr_i = \frac{p_i^N Q_i^N}{p^N Q^N}$ is the share of gross output value in non-tradable production that serves as intermediate input in tradable sectors and $\eta_i^e < 0$ is the elasticity of intermediate input demand with respect to the real exchange rate. The model therefore predicts that the intermediate input relation between sectors introduces a channel that can lead to a contraction in the non-tradable sector following a real appreciation, i.e. through the term $\eta_i^e shr_i < 0$. All else equal, this effect is stronger the higher the share of nontradable output that serves as input for tradables shr_i.

We test this prediction using regional employment data linked with regional input-output tables. Unlike the SUR analysis, we use regional employment at the detailed sector level according to the new classification system (see sectors summary in last column of Table 1). We focus on all non-tradable sectors, which gives us 16 sectors in total (leaving out Agriculture, Mining and Manufacturing). This regional data is only available from regional Statistical Yearbooks from 2003 to 2008. An advantage of this regional as opposed to aggregate employment data is that for most regions, employment figures cover all types of enterprises (including privately owned ones). The regional input-output tables are as of 2002. They are available at more detailed 42 sector level but can be grouped in a straightforward way to 16 sectors consistent with the regional employment data. Leaving out Tibet, Hainan, Shandong, for which regional employment data was missing, and merging Chongquing with Sichuan, this leaves us with data for 28 regions, 16 sectors, and 6 years. Hence unlike the

[12]We abstract from intermediate input to other non-tradable sectors because 1. the input share of services to sectors other than manufacturing is on average less than one third that to manufacturing and 2. including them does not change the main theoretical prediction

previous datasets, we now have a panel with many cross-section units and few years, allowing us to explore different regression techniques. The baseline estimating equation is:

$$\ln L_{irt} = \gamma^0 + \mu_r + \gamma_1 \ln Y_{rt} + \gamma_2 \ln H_{rt} + \gamma_3 Z_t + \gamma_4 \ln e_t \cdot shr_{ir} + \varepsilon_{irt} \qquad (15)$$

We estimate the equations in detrended log levels as the short time series now does not cause problems with non-stationarity, as well as in first differences. As before, we control for regional GDP (Y_{rt}) as a determinant for regional demand, regional population (H_{rt}) to control for labor supply determinants, and national aggregate variables (or time fixed effects, depending on specification) in Z_t that might be correlated with the $REER$. We include regional fixed effects to control for unobservable regional heterogeneity and cluster the standard errors at the regional level. Table 12 summarizes the estimates of equation (15) as well as some variations.

Column 1 shows that an appreciation of the aggregate real exchange rate leads to lower employment in non-tradable sectors across regions, conditional on national and regional economic conditions. This result is consistent with our previous findings in the paper, but it is only significant at the 10 percent level. However, when we interact the aggregate REER with the region-sector-specific intermediate input to tradables shr_i as defined above, the coefficient becomes strongly significant and the non-interacted REER becomes insignificant (column 2 onwards). In particular, since the interacted REER now varies by time and region-sector observations, we can include a full set of time dummies to control for any aggregate effects not sufficiently captured by the variables in Z_t. Column 3 shows that time effects do not affect the estimate of our coefficient of interest.

Columns 4 assumes a random (region-sector) error component model and performs a GLS estimation that accounts for heterogeneity across region-sector observations. That is, we assume:

$$\varepsilon_{irt} = \mu_{ir} + \epsilon_{irt}$$

so that conditional on the time and region fixed effects, the sector-region-specific effect is randomly distributed and not correlated with other explanatory variables. This imposed structure allows us to gain efficiency compared to OLS but does not change the result. Neither does the alternative GLS estimate in column 5 which allows for first-order autocorrelation in the error terms, although the estimator does detect a significant coefficient of first order autocorrelation of 0.513. In column 6, we include the REER interacted with the lagged regional export share as in the SUR estimates before and find that the coefficient on this export exchange rate is now insignificant. This suggest that the negative effect of a real appreciation for non-tradable employment which was reinforced by stronger export orientation we found in previous SUR estimates - the term $REER \cdot X_{r,t-1}$ - is indeed driven by the input-output interdependence across sectors as captured here.

As a final robustness check, we now allow the region-sector-specific effect in the error term to be correlated with explanatory variables. However, instead of including a third region-sector fixed effect, which takes out more than 90 percent of variation in our coefficient of interest

$\ln e \cdot shr_{ir}$, we first difference the estimating equation (15). We also allow for lagged employment as an explanatory variable to account for the first-order autocorrelation found in with GLS. We use the system GMM estimator of Blundell and Bond (1998) by assuming that lagged employment and regional population are pre-determined, aggregate time effects are exogenous and the remaining variables, in particular the real exchange rate term, are allowed to be endogenous. The results in column 7 indicate that there is a high degree of dynamic adjustment in employment and that regional GDP now has a weak positive effect on employment in non-tradable sectors. However, the main finding is that the negative effect of a real appreciation through the channel of intermediate input to tradable sectors is still present and significant at the 5 percent level. The Arellano Bond test reveal no further autocorrelation in the residuals and the Hansen test cannot reject our identification assumption.

Finally, table 13 performs the same set of estimations as table 12, but using lagged values of regressors to avoid any remaining simultaneity bias. The effect of the REER through the intermediate input channel is in fact even stronger across all specifications. In particular, the GMM estimate of the REER term is now very close to the GLS/OLS estimates of about -0.2 and significant at the 1 percent level. This estimate is also economically significant: for non-tradable sectors with an average intermediate input share to tradables, a 10 percent real appreciation leads to 0.9 percent lower employment growth within 2 years. Services sectors with higher intermediate input shares to tradable production, which as we saw, are more concentrated in regions with higher manufacturing/export shares, are predicted to experience larger employment losses. Note that this drop in employment is predicted to take place above and beyond any negative effect due to loss of competitiveness in tradable sectors.

VI. CONCLUSION

This paper shows that a real appreciation has a strong negative employment effect in both tradable and more surprisingly, non-tradable sectors of the Chinese economy. This finding is surprising as theory predicts that a real appreciation should lead to an expansion of the non-tradable sector and a contraction in the tradable sector. The result is confirmed across different datasets exploiting sectoral as well as regional variation, and it is robust to the inclusion of other aggregate variables as well as to an instrumental variable identification of the real exchange rate. Using regional variation in sectoral employment, we find that the real exchange rate affects employment in the secondary (tradable) industry both through the export demand as well as the imported input channel, which partially offset each other. Yet surprisingly, regions with a higher export share also experience a more negative effect of a real appreciation on employment in the tertiary (services) industry. We explain this symmetric response across sectors with the importance of services as intermediate input in manufacturing industries. Using regional employment and input-output data at detailed sector level, we show that services sectors that are more connected with tradable sectors within the region experience a stronger employment contraction following a real appreciation which is transmitted through the intermediate input channel.

The results of this paper have important implications for labor market adjustment in China following a revaluation of the Renminbi in the future. If the revaluation leads to a real appreciation, and this, in turn, to an employment contraction across all sectors of the economy, then it is difficult to expect domestic demand to increase. Of course, a rebalancing towards service sectors could simply take time, such that job gains over the long-term might still be positive.[13] However, the short-run costs as captured in this paper could still be very large, requiring appropriate policy action. A real appreciation should therefore be accompanied by other macroeconomic policy measures to support domestic demand and structural reforms to enhance the productivity of non-manufacturing sectors of the economy in order to decouple those sectors from demand swings in exports. Moreover, there are many other reasons that call for a careful design of a policy package to accompany a real appreciation in China: authors such as Blanchard and Giavazzi (2005) have also argued that large regional inequalities and households' strong needs for precautionary savings imply that the right policy for rebalancing growth should include increase in the supply of services, in particular in the social services and health care sectors.

To further analyze the welfare consequences, one has to gain deeper understanding of the economic transmission channels across sectors in the economy. We have focused our analysis on the inter-sectoral input-output structure in China. However, our findings do not preclude other channels of inter-sectoral spillovers such as learning or technology diffusion between tradable and non-tradable sectors. Finding other ways and data to shed light on the transmission channel of the exchange rate on different sectors and in different countries, in order to gain a more complete insight into the mechanisms of labor market adjustment are promising avenues for future work.

[13]See IMF (2010) for an analysis on rebalancing in China and its dynamic path.

References

Aizenman, J., and J. Lee, 2008, "The real exchange rate, mercantilism, and the learning-by-doing externality," *NBER Working Paper*, No. 13853.

Bayoumi, T., J. Lee, and S. Jayanthi, 2005, "New Rates from New Weights," *IMF Working Paper*, No. 05/99.

Blanchard, O., and F. Giavazzi, 2005, "Rebalancing Growth in China: A Three-Handed Approach," *MIT Working Paper Series*, No. 05/32.

Blundell, R., and S. Bond, 1998, "Initial Conditions and Moment Conditions in Dynamic Panel Data Models," *Journal of Econometrics*, Vol. 87, pp. 115-143.

Brandt, L., and T.G. Rawski, 2008, *China's Great Economic Transformation* (Cambridge University Press).

Branson, S., and J. Love, 1988, "United States Manufacturing and the Real Exchange Rate," *Misalignment of Exchange Rates: Effects on Trade and Industry.* R. Marston (edt.), University of Chicago Press.

Burgess, S., and M. Knetter, 1998, "An International Comparison of Employment Adjustment to Exchange Rate Fluctuations," *Review of International Economics*, Vol. 4, No. 2, pp. 121-138.

Campa, J.M., and L.S. Goldberg, 2001, "Employment versus Wage Adjustment and the US Dollar," *The Review of Economics and Statistics*, Vol. 83, No. 3, pp. 477-489.

CICC, 2010, "RMB Outlook and industry implications," *Macroeconomy Report*, (March). China International Capital Corporation Ltd.: Beijing.

Frankel, J., and S.J. Wei, 2007, "Assessing China's Exchange Rate Regime," *Economic Policy*, (April).

Goldberg, L., J. Tracy, and S. Aaronson, 1999, "Exchange Rates and Employment Instability: Evidence from Matched CPS Data," *American Economic Review*, Vol. 89, No. 2, pp. 204-210.

Goldberg, L.S., and J. Tracy, 2000, "Exchange Rates and Local Labor Markets," *International Trade and Wages.* Robert Feenstra (edt.), Chicago University Press: Chicago.

Gourinchas, P.O., 1998, "Exchange Rates and Jobs: What Do We Learn from Job Flows?," *NBER Macroeconomics Annual*, Vol. 13, pp. 153-222.

Hua, P., 2007, "Real exchange rate and manufacturing employment in China," *China Economic Review*, Vol. 18, pp. 335-353.

IMF, 2010, "People's Republic of China, Selected Issues," *Asia Pacific Department.* International Monetary Fund: Washington, DC.

McKinnon, R., and G. Schnabl, 2008, "China's Exchange Rate Impasse and the Weak U.S. Dollar," *CESifo Working Paper*, No. 2386.

Moser, C., D. Urban, and B. Weder di Mauro, 2010, "International competitiveness, job creation and job destruction - An establishment-level study of German job flows," *Journal of International Economics*, Vol. 80, pp. 302-317.

Nucci, F., and A.F. Pozzolo, 2010, "The exchange rate, employment and hours: What firm-level data say," *Journal of International Economics*, Vol. 82, pp. 112-123.

Rajan, R., and A. Subramanian, 2008, "Aid and Manufacturing Growth," *Journal of Development Economics.* forthcoming.

Revenga, A. L., 1992, "Exporting Jobs? The impact of Import Competition on Employment and Wages in U.S. Manufacturing," *The Quarterly Journal of Economics*, Vol. 107, No. 1, pp. 255-284.

Westerlund, J., 2007, "Testing for Error Correction in Panel Data," *Oxford Bulletin of Economics and Statistics*, Vol. 69, No. 6, pp. 709-748.

Young, A., 2003, "Gold into Base Metals: Productivity growth in PRC during the Reform period," *Journal of Politial Economy*, Vol. 111, No. 6, pp. 1220-1261.

Appendix: Data

Industry and sector classifications in China

China classifies its economy into three industries: primary industry, secondary industry, and tertiary industry. Under each industry, the economy is separated into different sectors. In 2003, China began to use the new sector classification standards, which contain 19 2-bit code sectors and differ from the old sector classification standards, which contain 16 2-bit code sectors. Our sector-level analysis uses old sector classification covering period from 1980 to 2002. In order to have longer series of data, we group some sectors for broad sector-level analysis, which covers period from 1980 to 2008. All historical industry and sector classifications are summarized in table 1 together with the broader sector classification. Our definition of tradable sectors include agriculture, manufacture, and mining.

Employment and Employees

Employment data are collected from both NBS and CEIC (unit: million person). The total numbers of employed persons at year-end by sector are available from 1980 to 2002. The same employment data are also available by region and industry from 1985 to 2008. The numbers of employed persons in urban units (Employees) at year-end by sector, which do not include those in private enterprises or self-employed individuals, are available from 1988 to 2008 and taken from NBS.

Wages

The real wage indices by sector (under old classification) from 1980 to 2002 are from CEIC (1978 = 100). CEIC China Database also provides the real wage indices by region from 1993 to 2008. For the second sectoral analysis using broad sectoral data, we construct real wage using weighted average of nominal wage by sector from NBS and then deflated by CPI. Employment numbers are used as the weights in the calculation.

GDP

Both CEIC and NBS provide the regional GDP indices as well as the broad sectoral GDP indices from 1980 to 2008. The gross domestic product at current prices by sector from 1980 to 2002 are collected from NBS (unit: billion RMB).

Working age population

The demographic data are collected from UN Population Data base. Data are collected every five years, so we interpolate them to get annual data. We use population aged from 15 to 64 as the working age population.

Exchange rate

We use real effective exchange rate from IFS, which is constructed as a weighted average of exchange rates with each trading partner, adjusted for relative changes in consumer prices.

Interest rates

We use the lending rate from IFS, deflated by the CPI to get a measure of the (ex-post) real interest rates. For the US interest rate, we use annual average of the 3-month T-Bill rate.

Oil price

The average oil prices are collected from WEO (published on October 2009). To compute the relative oil price, we deflate it using China's CPI.

World Imports

World imports are in billions of USD collected from WEO (published on October 2009).

Table 1. Chinese industry and sector classification

Old classification			New classification		
Industry	Broad sector	Sector	Industry	Broad sector	Sector
Primary Industry	Agriculture	Agriculture, Forestry, Animal Husbandry, and Fishery	Primary Industry	Agriculture	Agriculture, Forestry, Animal Husbandry, and Fishery
Secondary Industry	Industry	Mining	Secondary Industry	Industry	Mining
		Manufacturing			Manufacturing
		Production and Supply of Electricity, Gas, and Water			Production and Supply of Electricity, Gas, and Water
	Construction	Construction		Construction	Construction
Tertiary Industry	Transportation	Transport, Storage and Post	Tertiary Industry	Transportation	Transport, Storage and Post
	Sales & Catering	Wholesale and Retail Trade and Catering Services		Sales & Catering	Wholesale and Retail Trades
					Hotels and Catering Services
	Banking	Financial Intermediation		Banking	Financial Intermediation
	Real Estate	Real Estate		Real Estate	Real Estate
	Others	Geological Prospecting and Water Conservancy		Others	Management of Water Conservancy, Environment and Public Facilities
		Social Services			Services to Households and Other Services
		Health Care, Sports and Social Welfare			Information Transmission, Computer Services, and Software
		Education, Culture and Arts, Radio, Film and Television			Leasing and Business Services
		Scientific Research and Polytechnic Services			Scientific Research, Technical Services and Geologic Prospecting
		Government Agencies, Parties Agencies and Social Organizations			Education
		Others			Health, Social Security and Social Welfare
					Culture, Sports and Entertainment
					Public Management and Social Organizations

Table 2. Regional summary statistics

Province	**Avg. employment growth**			**Avg. real output growth**			**Avg.**
	Ind. 1	Ind. 2	Ind. 3	Ind. 1	Ind. 2	Ind. 3	**Export share**
Anhui	-0.005	0.041	0.046	0.049	0.144	0.125	0.060
Beijing	-0.023	0.005	0.054	0.044	0.094	0.126	0.220
Fujian	-0.004	0.052	0.050	0.061	0.167	0.142	0.336
Gansu	0.010	0.007	0.039	0.054	0.095	0.130	0.147
Guangdong	-0.006	0.051	0.044	0.053	0.157	0.134	0.822
Guangxi	0.001	0.023	0.070	0.061	0.134	0.115	0.023
Guizhou	0.007	0.017	0.081	0.049	0.122	0.126	0.104
Hainan	0.002	0.022	0.042	0.088	0.137	0.132	0.354
Hebei	-0.003	0.026	0.033	0.055	0.122	0.128	0.074
Heilongjiang	0.021	-0.021	0.026	0.058	0.091	0.109	0.089
Henan	0.009	0.039	0.046	0.062	0.134	0.133	0.036
Hubei	-0.014	0.007	0.047	0.049	0.138	0.127	0.050
Hunan	-0.004	0.020	0.056	0.048	0.121	0.117	0.045
Inner Mongolia	0.005	-0.008	0.032	0.068	0.139	0.135	0.048
Jiangsu	-0.036	-0.010	0.036	0.025	0.100	0.119	0.531
Jiangxi	-0.009	0.032	0.051	0.053	0.137	0.122	0.053
Jilin	0.005	-0.020	0.029	0.070	0.115	0.128	0.073
Liaoning	0.007	-0.020	0.029	0.056	0.103	0.120	0.200
Ningxia	0.008	0.036	0.045	0.059	0.108	0.108	0.092
Qinghai	0.007	0.008	0.042	0.034	0.110	0.102	0.019
Shaanxi	0.002	0.008	0.046	0.054	0.120	0.124	0.007
Shandong	-0.007	0.031	0.050	0.056	0.147	0.131	0.169
Shanghai	-0.036	-0.010	0.036	0.025	0.100	0.119	0.531
Shanxi	0.006	0.002	0.025	0.034	0.109	0.106	0.113
Sichuan	-0.013	0.005	0.040	0.047	0.130	0.114	0.012
Tianjin	-0.010	-0.006	0.024	0.064	0.118	0.116	0.425
Tibet	0.001	0.046	0.054	0.050	0.130	0.153	0.365
Xinjiang	0.007	0.000	0.043	0.077	0.104	0.130	0.101
Yunan	0.010	0.027	0.053	0.055	0.120	0.127	0.065
Zhejiang	-0.028	0.042	0.054	0.045	0.164	0.139	0.323
National	-0.001	0.031	0.049	0.040	0.111	0.097	0.242

All employment and output growth averages are taken over the sample period of available data for each province, in most cases 1985 to 2008. Average export shares are taken as total value of exports over provincial GDP, from 1993 to 2008. Figures for Sichuan include Chongqing.

Table 3. Cross-sector panel regression for employment growth: 1980 - 2002, 16 sectors

	(1) 1980-2002	(2) 1980-2002	(3) 1994-2002	(4) 1994-2002	(5) 1994-2002 (GLS)	(6) 1994-2002 (GLS)
REER	-0.038**	-0.037*	-0.082***	-0.060**	-0.083***	-0.160***
	(0.015)	(0.019)	(0.000)	(0.023)	(0.010)	(0.059)
REER X tradable dummy		-0.001		-0.118		0.011
		(0.042)		(0.124)		(0.070)
Lagged sectoral employment	0.048	0.048				
	(0.098)	(0.098)				
China's real GDP	0.357**	0.357**	1.719***	1.719***	1.564***	2.396***
	(0.127)	(0.127)	(0.000)	(0.000)	(0.074)	(0.313)
World demand	0.139*	0.146*	0.010***	-0.014	0.023***	0.017
	(0.068)	(0.076)	(0.000)	(0.034)	(0.008)	(0.050)
World demand X tradable dummy		-0.036		0.131		0.027
		(0.084)		(0.180)		(0.062)
Working age population	2.159***	2.158***	-3.962***	-3.962***	-3.690***	-5.961***
	(0.440)	(0.438)	(0.000)	(0.000)	(0.330)	(1.395)
Relative oil price	-0.013	-0.013	-0.031***	-0.031***	-0.032***	-0.033***
	(0.013)	(0.013)	(0.000)	(0.000)	(0.002)	(0.010)
Real interest rate	0.039	0.039	0.077***	0.077***	0.057***	0.180***
	(0.069)	(0.070)	(0.000)	(0.000)	(0.013)	(0.055)
N	352	352	128	128	128	128
No. sectors	16	16	16	16	16	16

Note: Standard errors in parentheses; *, **, and *** indicate significance at the 10, 5, and 1 percent level, respectively. Each regression includes a full set of sector dummies. Columns (4), (5) and (6) include a linear trend and no population growth due to lack of (census) data.

Table 4. Cross-sector panel regression for employment growth: 1990 - 2008, 8 sectors

	(1) 1990-2008	(2) 1990-2008	(3) 1990-2008	(4) 1990-2008	(5) 1994-2008	(6) 19904-2008
REER	-0.059*	-0.024		-0.062**	-0.035	
	(0.034)	(0.036)		(0.026)	(0.037)	
REER X tradable dummy		-0.095***			-0.192***	
		(0.032)			(0.058)	
REER X lagged sectoral export shares			-0.264***			-0.271**
			(0.091)			(0.124)
Lagged sectoral employment	0.276***	0.225***	0.207***	0.124***	0.120**	0.117**
	(0.073)	(0.070)	(0.068)	(0.041)	(0.055)	(0.047)
China's real GDP	0.501**	0.530**	0.575**	1.456***	1.371***	1.460***
	(0.249)	(0.243)	(0.236)	(0.143)	(0.189)	(0.175)
World demand	0.077	0.059	0.070	0.108***	0.093***	0.063**
	(0.055)	(0.056)	(0.054)	(0.024)	(0.032)	(0.030)
World demand X tradable dummy		0.126***	0.133***		0.127***	0.153***
		(0.042)	(0.042)		(0.048)	(0.040)
Working age population	-0.425	-0.380	-0.137	1.957***	1.216	1.954***
	(1.980)	(1.944)	(1.852)	(0.747)	(1.005)	(0.748)
Relative oil price	-0.017	-0.025	-0.029	-0.007	-0.012	0.009
	(0.019)	(0.019)	(0.018)	(0.008)	(0.011)	(0.009)
Real interest rate	-0.412	-0.432	-0.507*	-1.181***	-1.079***	-1.059***
	(0.310)	(0.303)	(0.294)	(0.132)	(0.172)	(0.164)
N	144	144	144	112	112	112
No. sectors	8	8	8	8	8	8

Note: Standard errors in parentheses; *, **, and *** indicate significance at the 10, 5, and 1 percent level, respectively. Each regression includes a full set of sector dummies. Columns (4), (5) and (6) include a linear trend and no population growth due to lack of (census) data.

Table 5. Regional panel regression by industry OLS: 1988-2008

	(1) Reg Emp Ind 1	(2) Reg Emp Ind 2	(3) Reg Emp Ind 3	(4) Reg Emp Ind 1	(5) Reg Emp Ind 2	(6) Reg Emp Ind 3
REER	-0.042*	-0.046	-0.103			
	(0.024)	(0.031)	(0.089)			
Regional REER				-0.045	-0.045	-0.066
				(0.029)	(0.036)	(0.091)
Emp Ind i	0.406***	0.007	-0.702**	0.415***	0.022	-0.599*
	(0.085)	(0.119)	(0.308)	(0.096)	(0.118)	(0.315)
Regional real GDP	-0.015	0.125**	0.026	0.003	0.118*	-0.038
	(0.020)	(0.051)	(0.077)	(0.023)	(0.063)	(0.085)
China's real GDP	0.024	0.360*	0.364	-0.012	0.302	0.436*
	(0.206)	(0.198)	(0.249)	(0.216)	(0.205)	(0.247)
World demand	0.033	0.295***		0.031	0.315***	
	(0.061)	(0.060)		(0.070)	(0.087)	
Regional population	0.186	-0.072	-0.121	0.091	-0.108	-0.105
	(0.110)	(0.145)	(0.151)	(0.062)	(0.135)	(0.152)
Relative oil price	-0.013	-0.041	0.061*	-0.011	-0.050	0.057*
	(0.018)	(0.029)	(0.032)	(0.019)	(0.039)	(0.032)
Real interest rate	0.039	0.117	-0.758***	0.035	0.112	-0.731***
	(0.073)	(0.075)	(0.121)	(0.077)	(0.079)	(0.119)
N	592	592	548	550	550	529
adj. R^2	0.210	0.386	0.326	0.211	0.420	0.340

Note: "Reg Emp Ind i" stands for regional employment in industry i, "Emp Ind i" is total employment in industry i, "Regional REER" is country's REER adjusted by region's CPI. Standard errors in parentheses; *, **, and *** indicate significance at the 10, 5, and 1 percent level. Each equation includes a full set of regional dummies, a dummy for 1990 and 1998, and lagged dependent variables.

Table 6. Regional panel regression by industry OLS: 1994-2008

	(1) Reg Emp Ind 1	(2) Reg Emp Ind 2	(3) Reg Emp Ind 3	(4) Reg Emp Ind 1	(5) Reg Emp Ind 2	(6) Reg Emp Ind 3
REER	0.012	-0.101*	-0.117**			
	(0.021)	(0.056)	(0.045)			
Regional REER				-0.001	-0.106*	-0.101**
				(0.023)	(0.054)	(0.045)
Emp Ind i	0.051	0.219	0.920*	-0.006	0.239	0.929*
	(0.157)	(0.289)	(0.448)	(0.158)	(0.300)	(0.454)
Regional real GDP	-0.079**	0.301***	0.072	-0.081**	0.253**	0.061
	(0.034)	(0.097)	(0.079)	(0.034)	(0.107)	(0.065)
China's real GDP	-0.409	0.603	0.775	-0.506	0.606	0.849
	(0.266)	(1.176)	(0.624)	(0.293)	(1.176)	(0.615)
World demand	-0.070	0.213**		-0.070	0.222**	
	(0.042)	(0.085)		(0.042)	(0.083)	
Regional population	0.002	-0.044	-0.143	0.006	-0.039	-0.142
	(0.059)	(0.230)	(0.153)	(0.057)	(0.227)	(0.155)
Relative oil price	0.007	-0.039	-0.018	0.006	-0.040	-0.018
	(0.008)	(0.036)	(0.016)	(0.008)	(0.036)	(0.016)
Real interest rate	-0.090**	0.137	-0.089	-0.087**	0.157	-0.089
	(0.037)	(0.142)	(0.186)	(0.036)	(0.141)	(0.182)
N	410	410	390	405	405	385
adj. R^2	0.212	0.444	0.398	0.209	0.457	0.403

All notes from Table 5 apply.

Table 7. Regional panel regression by industry using 2 SLS: 1994-2008

	(1) Reg Emp Ind 1	(2) Reg Emp Ind 2	(3) Reg Emp Ind 3
REER	0.003	-0.096*	-0.147**
	(0.030)	(0.055)	(0.066)
Emp Ind i	0.068	0.207	0.893***
	(0.226)	(0.193)	(0.310)
Regional real GDP	-0.078*	0.301***	0.078
	(0.041)	(0.081)	(0.083)
China's real GDP	-0.318	0.644	0.678*
	(0.360)	(0.653)	(0.406)
World demand	-0.082*	0.211**	
	(0.043)	(0.084)	
Regional population	-0.000	-0.045	-0.144
	(0.076)	(0.152)	(0.146)
Relative oil price	0.018	-0.038	-0.019
	(0.015)	(0.028)	(0.018)
Real interest rate	-0.102**	0.137*	-0.099
	(0.042)	(0.079)	(0.134)
N	410	410	390
adj. R^2	0.212	0.444	0.397
		First stage	
YEN/USD	0.638***	0.708***	0.567***
	(0.043)	(0.042)	(0.042)
US Interest rate	0.030***	0.036***	-0.008**
	(0.003)	(0.003)	(0.004)
Overid. (p-val)	0.585	0.452	0.186
Wu-Hausman (p-val)	0.362	0.886	0.574

Note: ”Reg Emp Ind i” stands for regional employment in industry i, ”Emp Ind i” is total employment in industry i. Standard errors in parentheses; *, **, and *** indicate significance at the 10, 5, and 1 percent level. Each equation includes a full set of regional dummies, a dummy for 1990 and 1998, and lagged dependent variables. First stage panel reports the coefficient estimate of REER on the excluded instruments: the nominal Japanese yen USD exchange rate and the US interest rate (3-moth T-Bill rate). Overid. p-value is from a Hansen overidentification test, the Wu-Hausman p-value tests the hypothesis that the REER is exogenous in the second stage regression.

Table 8. SUR results for employment growth rates (I)

	(1) 1988-2008			(2) 1994-2008		
	Reg Emp Ind 1	Reg Emp Ind 2	Reg Emp Ind 3	Reg Emp Ind 1	Reg Emp Ind 2	Reg Emp Ind 3
REER	-0.038*	-0.111***	-0.150***	0.019	-0.105***	-0.133***
	(0.021)	(0.028)	(0.036)	(0.021)	(0.040)	(0.036)
Emp Ind i	0.055	0.382***	0.082	0.091	0.206	0.578**
	(0.155)	(0.121)	(0.262)	(0.191)	(0.158)	(0.274)
Regional real GDP	-0.027	0.129**	0.021	-0.065	0.258***	0.093
	(0.040)	(0.051)	(0.066)	(0.041)	(0.081)	(0.078)
China's real GDP	-0.216	-0.052	-0.268	-0.299	0.882	0.693**
	(0.153)	(0.169)	(0.230)	(0.310)	(0.548)	(0.347)
World demand	0.015	0.208***		-0.081*	0.184**	
	(0.042)	(0.052)		(0.041)	(0.075)	
Regional Population	0.108	-0.013	-0.099	-0.011	-0.021	-0.151
	(0.098)	(0.126)	(0.161)	(0.073)	(0.145)	(0.139)
Relative oil price	-0.019	-0.038**	0.048***	0.020	-0.036	-0.014
	(0.014)	(0.018)	(0.018)	(0.013)	(0.025)	(0.017)
Real interest rate	0.049	0.087	-0.571***	-0.117***	0.184**	-0.208*
	(0.046)	(0.059)	(0.091)	(0.042)	(0.082)	(0.122)
N	548			390		
adj. R^2	0.290	0.451	0.385	0.295	0.504	0.454
Chi2	116.304			61.675		

Note: "Reg Emp Ind i" is the regional employment for industry i. "Emp Ind i" is the total employment for industry i. Standard errors in parentheses; *, **, and *** indicate significance at the 10, 5, and 1 percent level. Each equation includes a full set of regional dummies, a dummy for 1990 and 1998, and lagged dependent variables.

Table 9. SUR results for employment growth rates (II)

		(1) 1994-2008	
	Reg Emp Ind 1	Reg Emp Ind 2	Reg Emp Ind 3
REER	0.032	-0.147***	-0.130***
	(0.022)	(0.043)	(0.041)
REER (t-1)	0.048*	-0.070	-0.019
	(0.025)	(0.050)	(0.049)
REER (t-2)	0.063***	-0.144***	0.025
	(0.024)	(0.043)	(0.041)
Emp Ind i	-0.138	0.066	0.799**
	(0.216)	(0.166)	(0.337)
Regional real GDP	-0.051	0.202**	0.085
	(0.041)	(0.082)	(0.078)
China's real GDP	-0.406	0.591	0.715**
	(0.316)	(0.566)	(0.355)
World demand	-0.107	0.290**	
	(0.070)	(0.119)	
Regional Population	-0.013	0.005	-0.165
	(0.072)	(0.144)	(0.139)
Relative oil price	0.024	-0.067**	-0.018
	(0.015)	(0.029)	(0.018)
Real interest rate	-0.148***	0.299***	-0.135
	(0.043)	(0.088)	(0.129)
N	390		
adj. R^2	0.311	0.519	0.458
Chi2	64.551		

All notes from Table 8 apply.

Table 10. SUR results for employment growth rates (III)

	(1) 1994-2008			(2) 1994-2008		
	Reg Emp Ind 1	Reg Emp Ind 2	Reg Emp Ind 3	Reg Emp Ind 1	Reg Emp Ind 2	Reg Emp Ind 3
$REER \cdot X_{r,t-1}$	0.167	-0.711**	-0.655**	0.229	-0.880***	-0.711**
	(0.155)	(0.312)	(0.307)	(0.155)	(0.312)	(0.310)
$REER \cdot M_{r,t-1}$	-0.133	0.453*	0.209	-0.166	0.543**	0.238
	(0.125)	(0.252)	(0.248)	(0.125)	(0.250)	(0.248)
Regional real GDP	-0.065	0.259***	0.096	-0.050	0.215***	0.077
	(0.040)	(0.081)	(0.078)	(0.040)	(0.080)	(0.079)
China's real GDP	-0.465**	1.632***	0.934***	-0.202	0.895**	0.617
	(0.208)	(0.410)	(0.338)	(0.230)	(0.456)	(0.427)
World demand	-0.077**	0.131*		-0.053	0.070	
	(0.038)	(0.073)		(0.039)	(0.074)	
Regional Population	0.002	-0.075	-0.170	-0.016	-0.025	-0.153
	(0.071)	(0.144)	(0.142)	(0.071)	(0.143)	(0.142)
Relative oil price	0.015	-0.014	-0.004	0.016	-0.018	-0.010
	(0.012)	(0.024)	(0.017)	(0.012)	(0.024)	(0.018)
Real interest rate	-0.102**	0.155*	-0.427***	0.009	-0.149	-0.527***
	(0.041)	(0.083)	(0.079)	(0.060)	(0.119)	(0.112)
N	390			390		
adj. R^2	0.295	0.502	0.436	0.306	0.516	0.439
Chi2	68.147			66.485		

All notes from Table 8 apply.

Table 11. SUR results for employment growth rates (IV)

	(1) 1988-2008			(2) 1994-2008		
	Reg Emp Ind 1	Reg Emp Ind 2	Reg Emp Ind 3	Reg Emp Ind 1	Reg Emp Ind 2	Reg Emp Ind 3
REER X appreciation	0.298**	-0.433**	-0.466**	0.181*	-0.445**	-0.725***
	(0.131)	(0.170)	(0.217)	(0.109)	(0.219)	(0.213)
REER X depreciation	-0.229***	0.116	0.030	-0.097	0.160	0.245*
	(0.077)	(0.099)	(0.128)	(0.073)	(0.145)	(0.144)
Regional real GDP	-0.012	0.126**	-0.004	-0.047	0.221***	0.071
	(0.039)	(0.051)	(0.065)	(0.040)	(0.081)	(0.079)
China's real GDP	0.087	-0.129	-0.616**	-0.133	0.668	0.210
	(0.155)	(0.200)	(0.257)	(0.236)	(0.470)	(0.437)
World demand	0.034	0.227***		-0.051	0.084	
	(0.039)	(0.052)		(0.040)	(0.076)	
Regional Population	0.074	-0.020	-0.031	-0.025	0.003	-0.130
	(0.097)	(0.126)	(0.161)	(0.071)	(0.143)	(0.140)
Relative oil price	0.007	-0.066***	0.003	0.025*	-0.042	-0.046**
	(0.016)	(0.020)	(0.023)	(0.013)	(0.026)	(0.021)
Real interest rate	0.304***	-0.191	-0.854***	0.084	-0.274	-0.790***
	(0.091)	(0.119)	(0.142)	(0.084)	(0.168)	(0.155)
N	548			390		
adj. R^2	0.305	0.453	0.398	0.308	0.516	0.455
Chi2	106.396			63.632		

All notes from Table 8 apply.

Table 12. Results with regional I-O tables and sectoral employment, contemporaneous regressors, dependent variable: $\ln L^N_{ir,t}$

	(1) OLS1	(2) OLS2	(3) OLS3	(4) GLS1	(5) GLS2	(6) GLS3	(7) GMM
REER	-0.403*	-0.297					
	(0.236)	(0.299)					
REER $\cdot shr_{ir}$		-0.216***	-0.216***	-0.224***	-0.214***	-0.228***	-0.156**
		(0.036)	(0.036)	(0.031)	(0.067)	(0.029)	(0.063)
REER $\cdot X_{r,t-1}$						0.055	
						(0.066)	
Regional real GDP	-0.351*	-0.264	-0.267	-0.267	-0.278**	-0.130	0.081**
	(0.180)	(0.169)	(0.169)	(0.169)	(0.130)	(0.152)	(0.039)
China's real GDP	0.882***	0.746***					
	(0.246)	(0.227)					
Regional Population	0.356	0.307	0.303	0.303	0.284	0.243	0.017
	(0.379)	(0.406)	(0.409)	(0.409)	(0.193)	(0.385)	(0.025)
Relative oil price	0.003	0.001					
	(0.036)	(0.037)					
Real interest rate	-0.327	-0.277					
	(0.289)	(0.366)					
$\ln L^N_{ir,t-1}$							0.936***
							(0.031)
Time effects	No	No	Yes	Yes	Yes	Yes	Yes
Region effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-Sector effects	No	No	No	No	No	No	Yes
N	2032	1944	1944	1944	1944	1620	1620
R^2/Stats	0.458	0.427	0.427	0.437	0.437	0.448	AR(2): 0.369
rho_ar					$\hat{\rho} = 0.513$		Hansen: 0.180

Notes: Standard errors in parentheses; *, **, and *** indicate significance at the 10, 5, and 1 percent level. shr_{ir} denotes the sector-region-specific intermediate input to tradables as share of gross output value. Standard errors in column (1)-(4), (6) are clustered at the regional level. GLS1 performs a random effects GLS estimator on sector-region pairs, GLS2 controls for 1st order autocorrelation in the residuals. GMM performs a two-step system GMM estimator allowing for lagged employment and sector-region fixed effects; lagged employment and regional population are assumed to be pre-determined and the time effects strictly exogenous, remaining variables are allowed to be endogenous. AR(2) denotes the p-value of test for no autocorrelation in the residuals (of the levels), Hansen denotes the p-value of the over-identification test.

Table 13. Results with regional I-O tables and sectoral employment, lagged regressors, dependent variable: $\ln L^N_{ir,t}$

	(1) OLS1	(2) OLS2	(3) OLS3	(4) GLS1	(5) GLS2	(6) GLS3	(7) GMM
REER(t-1)	-0.267	-0.163					
	(0.313)	(0.302)					
REER(t-1) $\cdot shr_{ir}$		-0.223***	-0.223***	-0.220***	-0.216***	-0.226***	-0.193***
		(0.036)	(0.036)	(0.032)	(0.067)	(0.031)	(0.066)
REER(t-1) $\cdot X_{r,t-2}$						0.052	
						(0.054)	
REER(t-1) $\cdot M_{r,t-2}$						0.072	
						(0.105)	
Regional real GDP (t-1)	-0.305	-0.131	-0.131	-0.131	-0.084	-0.114	0.015
	(0.196)	(0.151)	(0.151)	(0.151)	(0.120)	(0.177)	(0.024)
China's real GDP (t-1)	0.789**	0.564*					
	(0.359)	(0.305)					
Regional Population (t-1)	0.461	0.391	0.391	0.391	0.371**	0.041	0.013
	(0.299)	(0.313)	(0.313)	(0.313)	(0.158)	(0.329)	(0.023)
Relative oil price (t-1)	0.080	0.060					
	(0.065)	(0.065)					
Real interest rate (t-1)	0.566	0.530					
	(0.511)	(0.507)					
$\ln L^N_{ir,t-1}$							0.950***
							(0.029)
Time effects	No	No	Yes	Yes	Yes	Yes	Yes
Region effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-Sector effects	No	No	No	No	No	No	Yes
N	1695	1620	1620	1620	1620	1296	1620
R^2/Stats	0.465	0.436	0.436	0.448	0.448	0.454	AR(2): 0.367
					$\hat{\rho} = 0.464$		Hansen: 0.279

All notes from Table 12 apply.

Table 14. National Intermediate Input Usage in Tradable Sectors

Input Sector			**Year**		
	1995	1997	2000	2002	2005
Banking and insurance	0.426	0.372	0.348	0.304	0.310
Construction	0.004	0.009	0.008	0.005	0.007
Real estate	.	.	.	0.202	0.233
Public utilities and resident service	0.120	0.172	0.157	.	.
Transportation and Post	0.399	0.423	0.357	0.381	0.384
Wholesale and retail trades	0.548	0.394	0.364	0.327	0.360
Utility	0.706	0.730	0.738	0.590	0.607

Note: Each cell entry equals the share of gross output value of each input sector that serves as intermediate input for the tradable sectors, Source: NBS *Input-Output Tables*, authors' calculations.

Table 15. Intermediate input usage in tradables by region in 2002

Region	Banking	Transport	Trade	Utility	% of Tradables
Anhui	0.262	0.423	0.331	0.669	0.587
Beijing	0.087	0.192	0.081	0.726	0.366
Fujian	0.371	0.593	0.441	0.463	0.604
Gansu	0.290	0.263	0.161	0.426	0.471
Guangdong	0.228	0.375	0.276	0.438	0.607
Guangxi	0.749	0.383	0.187	0.701	0.560
Guizhou	0.364	0.546	0.231	0.649	0.523
Hainan	0.217	0.210	0.041	0.689	0.471
Hebei	0.316	0.529	0.450	0.506	0.646
Heilongjiang	0.274	0.442	0.310	0.489	0.585
Henan	0.168	0.364	0.359	0.501	0.670
Hubei	0.291	0.490	0.418	0.442	0.611
Hunan	0.329	0.532	0.407	0.592	0.549
Inner mongolia	0.205	0.265	0.166	0.450	0.533
Jiangsu	0.387	0.511	0.512	0.413	0.678
Jiangxi	0.394	0.378	0.277	0.354	0.514
Jilin	0.300	0.229	0.233	0.932	0.587
Liaoning	0.414	0.454	0.387	0.541	0.597
Ningxia	0.874	0.628	0.200	0.896	0.519
Qinghai	0.972	0.520	0.078	0.893	0.432
Shaanxi	0.694	0.267	0.246	0.764	0.524
Shandong	0.267	0.569	0.528	0.500	0.656
Shanghai	0.202	0.211	0.435	0.712	0.571
Shanxi	0.414	0.548	0.184	0.346	0.535
Sichuan	0.441	0.413	0.186	0.533	0.523
Tianjin	0.400	0.325	0.346	0.865	0.599
Xinjiang	0.318	0.403	0.164	0.362	0.459
Yunnan	0.276	0.450	0.404	0.449	0.523
Zhejiang	0.500	0.535	0.422	0.662	0.675
Mean	0.379	0.415	0.292	0.585	
Min	0.087	0.192	0.041	0.346	
Max	0.972	0.628	0.528	0.932	

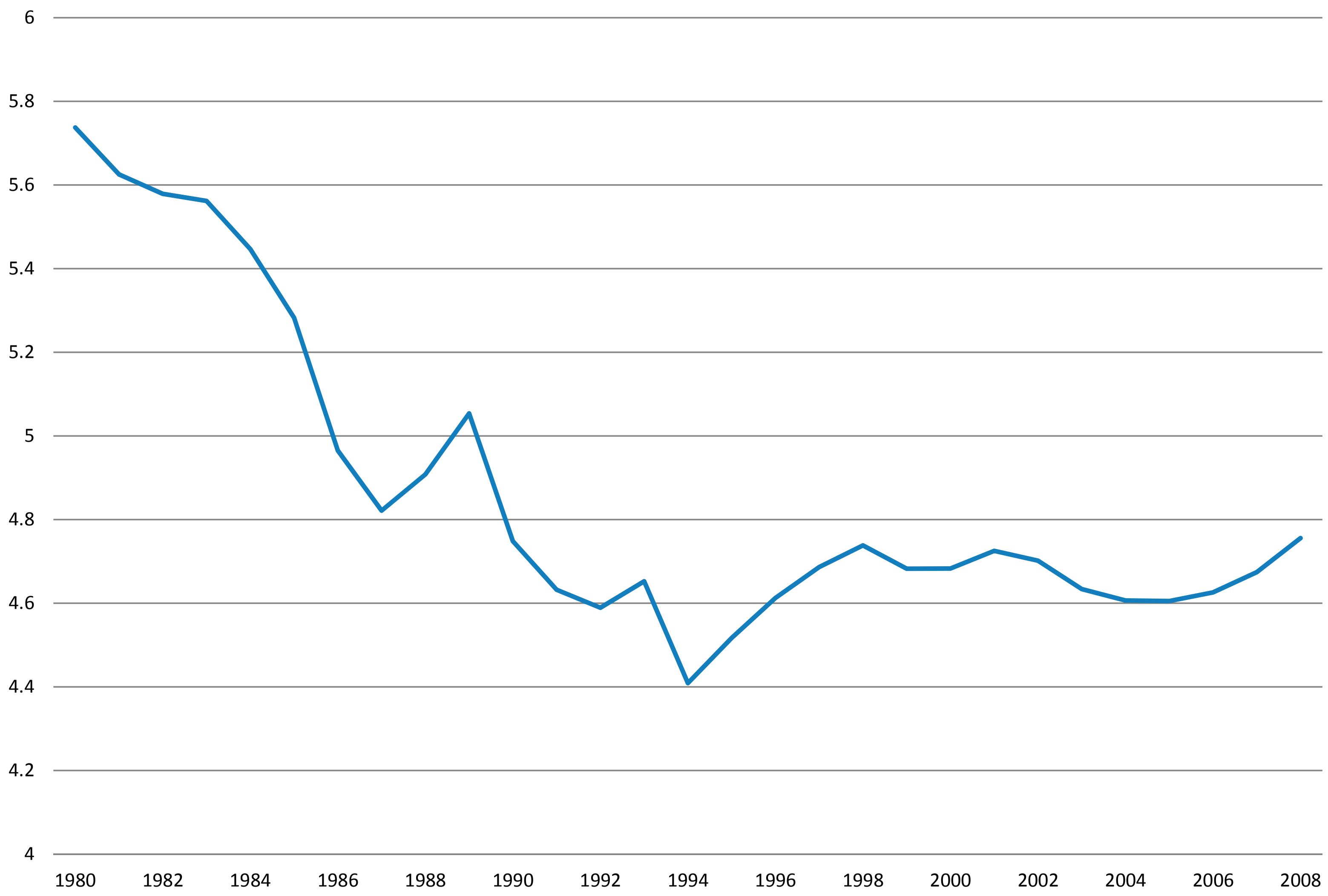
Columns ”Banking”, ”Transport”, ”Trade”, and ”Utility” report the shares of gross output value serving as intermediate input for tradable sectors in the *Banking and Insurance*, *Transport-Post-Communication*, *Wholesale and Retail Trade, Accommodation and Catering* and *Production and Supply of Power, Gas and Water* sector respectively; % of Tradables gives the share of the tradable sectors in each region’s total gross output value. Figures for Sichuan include Chongqing. Source: China input-output tables 2002, authors’ calculations.

Table 16. Regional distribution of nontradable intermediate input shares in tradable sectors.

Input Sector	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Banking and insurance	0.304	0.098	0.087	0.51
Construction	0.004	0.006	0	0.027
Education	0.035	0.022	0.008	0.084
Public management and social organizations	0.012	0.027	0	0.129
Health	0.02	0.018	0.001	0.06
IT Services	0.139	0.116	0.025	0.629
Real estate & Business Services	0.137	0.065	0.038	0.37
Scientific research	0.178	0.12	0.003	0.48
Public utilities & resident service	0.13	0.089	0.025	0.491
Transportation & post	0.395	0.129	0.192	0.595
Wholesale/Retail trade, hotel/catering	0.29	0.134	0.041	0.528
Utilities	0.481	0.105	0.289	0.688

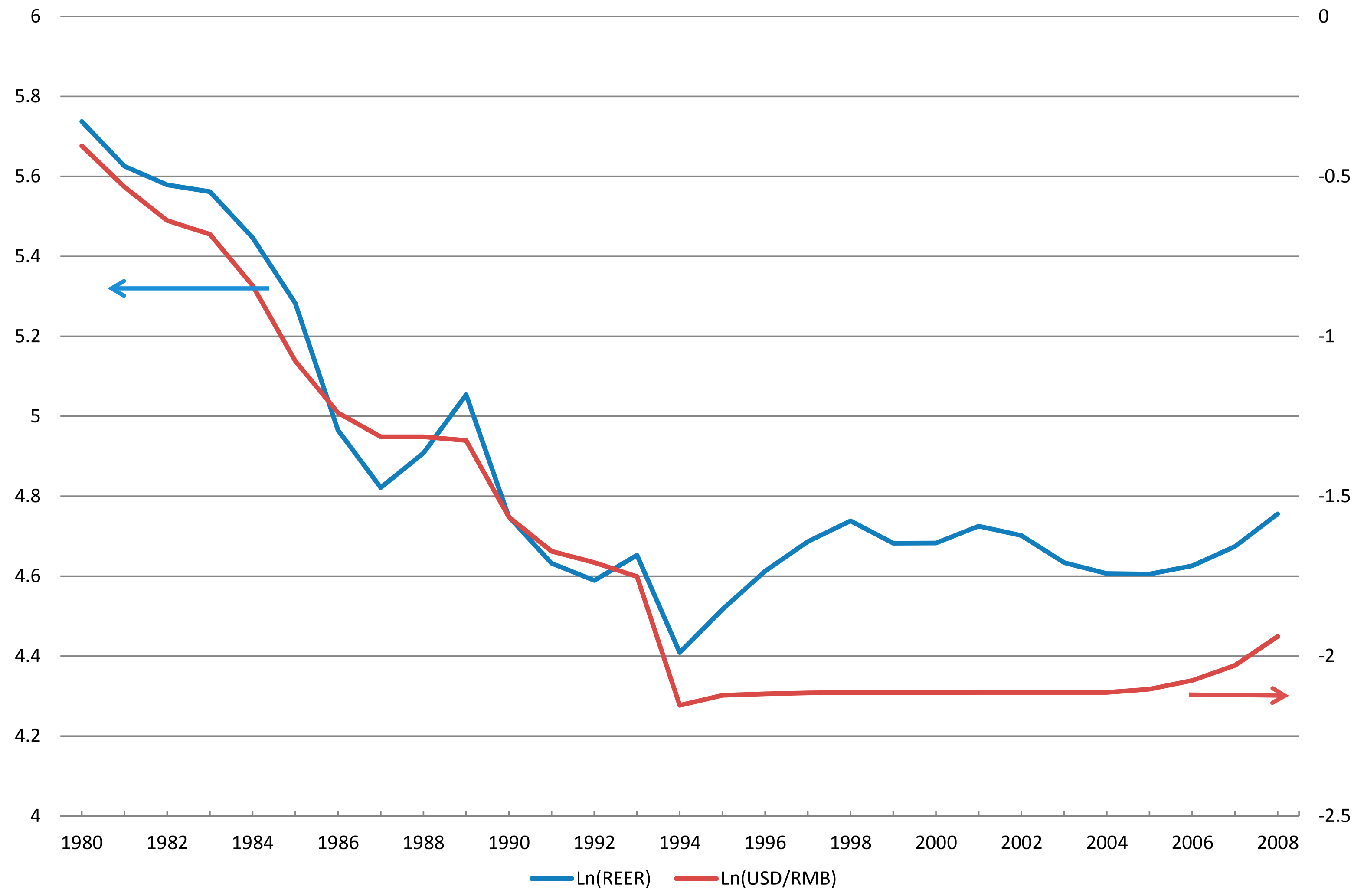
Note: Each cell entry equals the share of gross output value of each input sector that serves as intermediate input for the tradable sectors, Source: NBS *Input-Output Tables*, authors' calculations.

Figure 1. Logarithm of real effective exchange rate



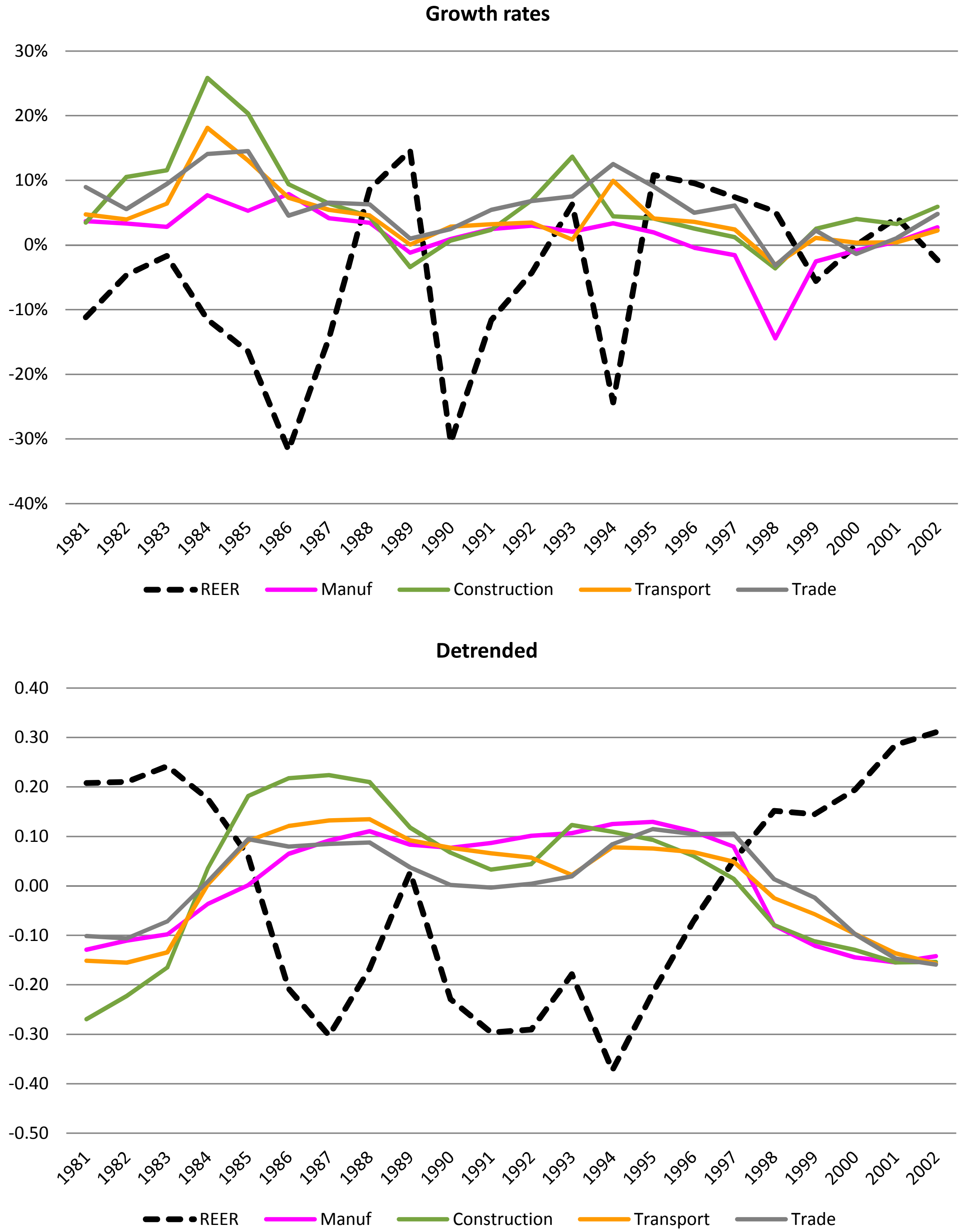
Source: IFS

Figure 2. Logarithms of real effective exchange rate and average USD/RMB rate



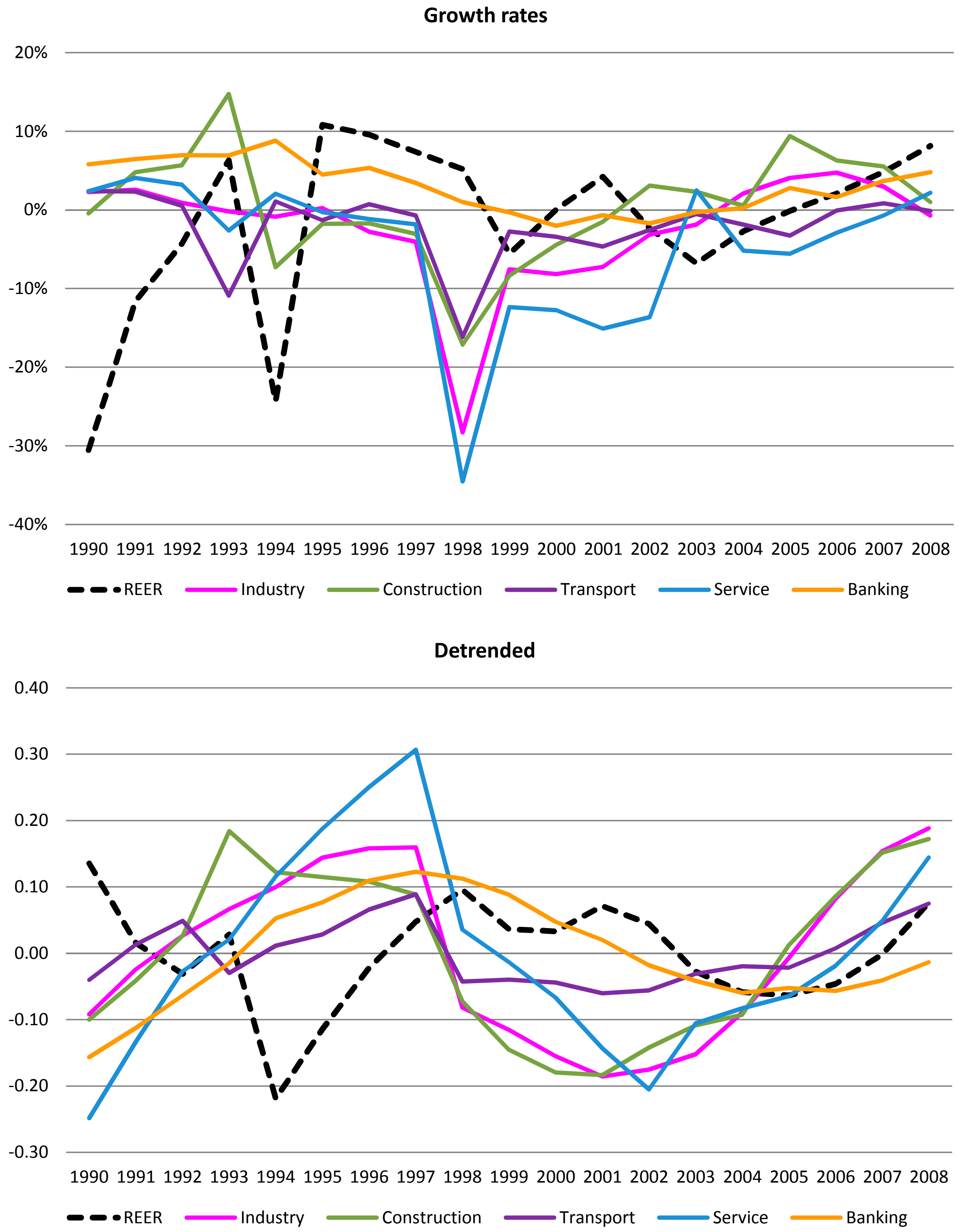
Source: IFS

Figure 3. Sectoral employment and the real exchange rate



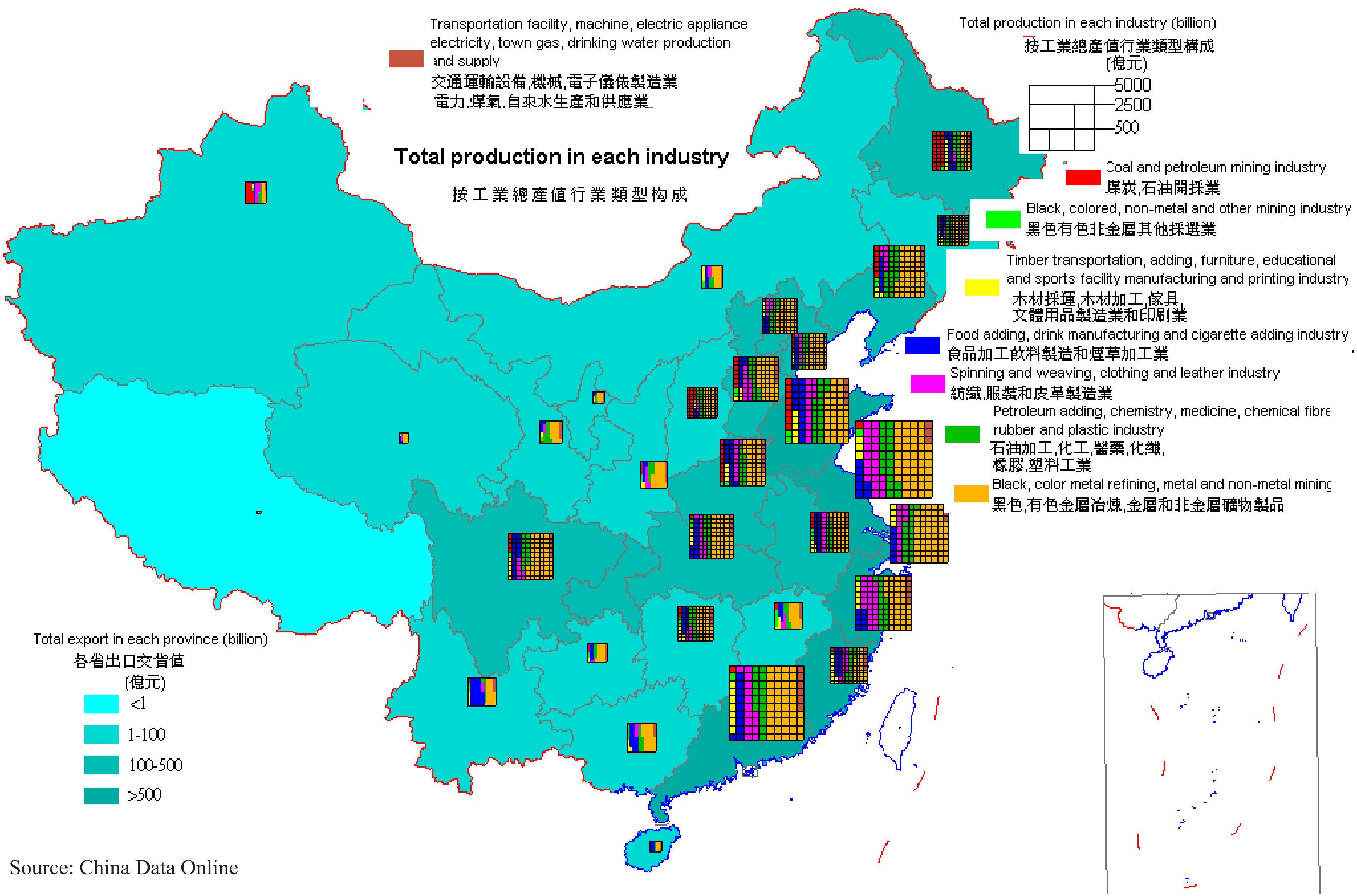
Source: CEIC China Database, IFS

Figure 4. Sectoral employees (urban units) and the real exchange rate



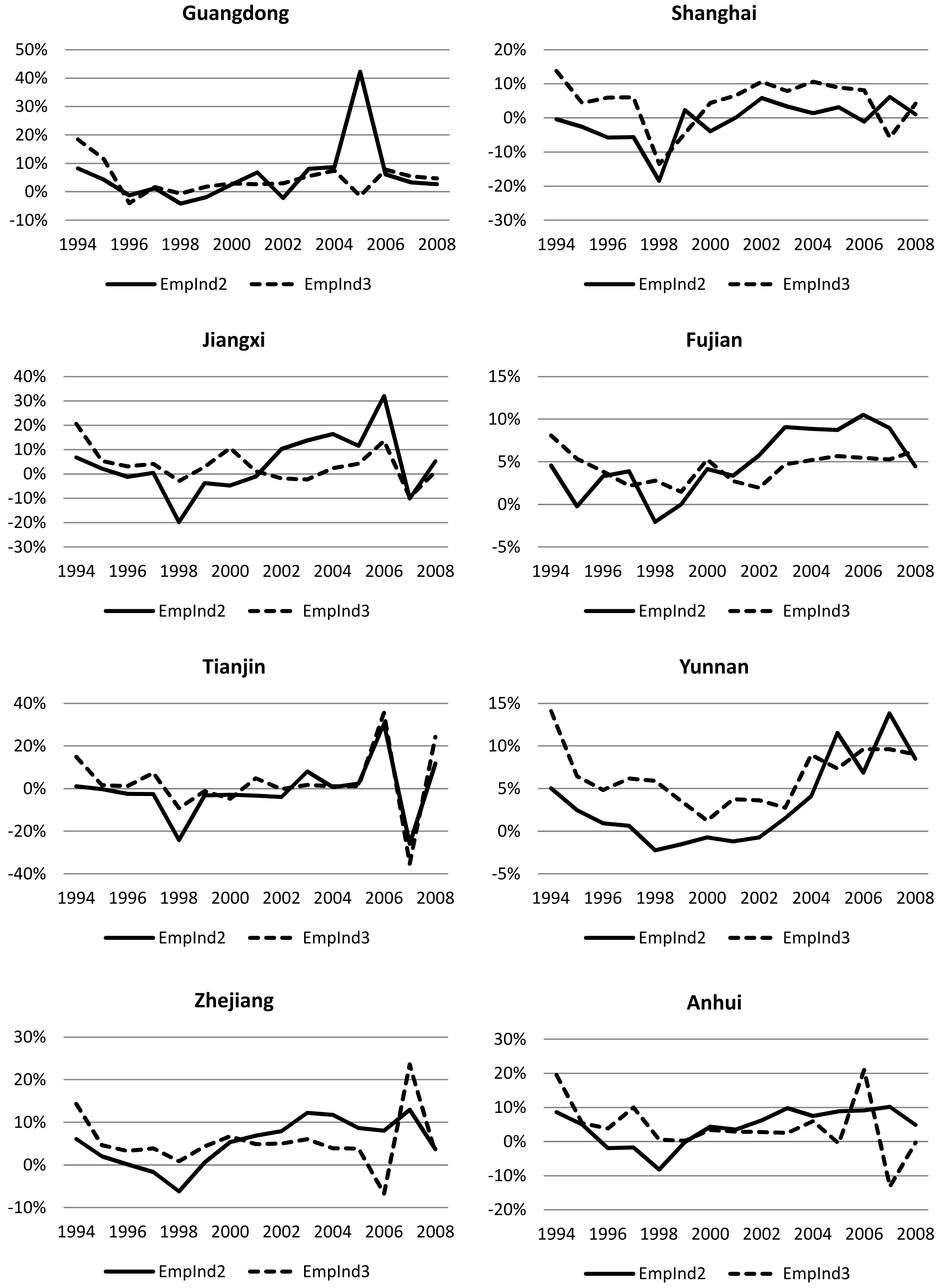
Source: CEIC China Database, IFS

Figure 5. China Regional Map



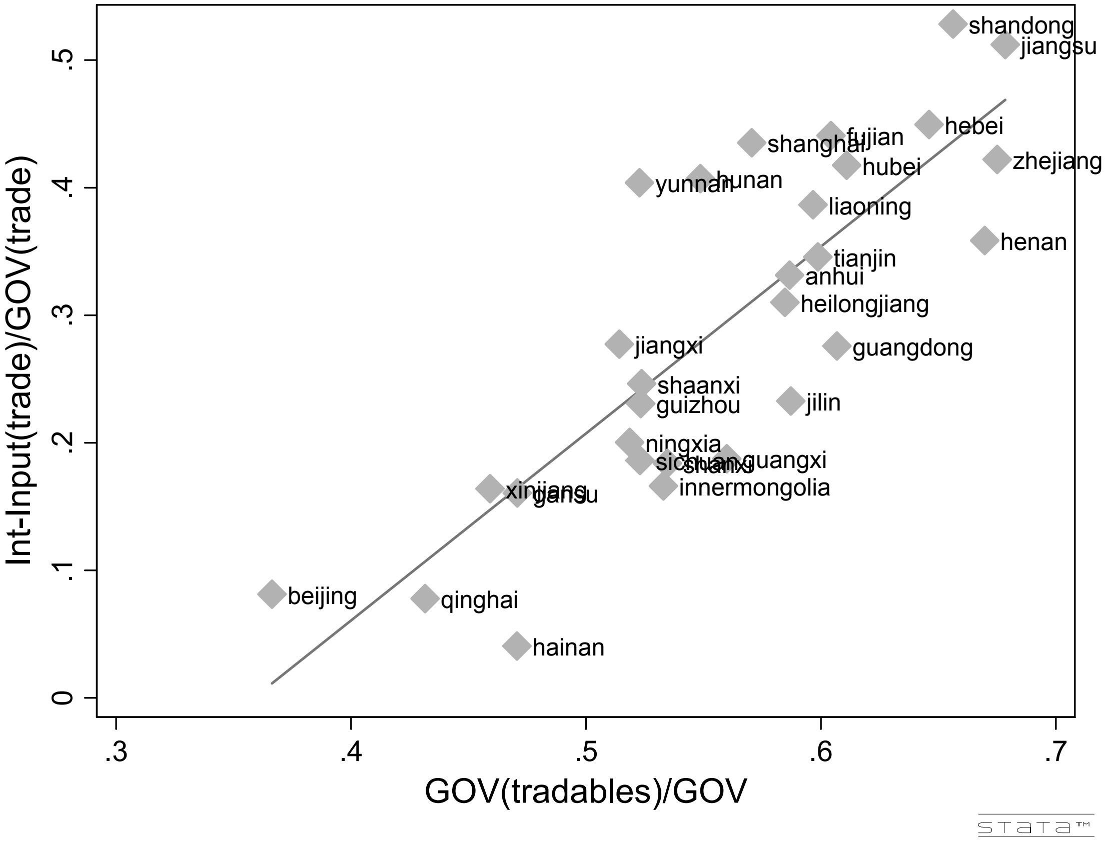
Source: China Data Online

Figure 6. Employment growth in secondary and tertiary industry for selected regions



Source: CEIC China Database.

Figure 7. Intermediate input to tradables of the Wholesale/Retail sector vs. regional openness.



Vertical axis shows intermediate input into tradable sectors as a share of the gross output value of the Wholesale/Retail/Catering Trade sector. Horizontal axis shows the tradable sectors' gross output value as a share of regional total gross output value. Source: China input-output tables 2002.