



Documento de Trabajo

ISSN (edición impresa) **0716-7334**

ISSN (edición electrónica) **0717-7593**

Tariff and FDI Liberalization:

**What to expect from China´s
entry into the WTO?.**

Sebastián Claro

Tariff and FDI Liberalization: What to expect from China's entry into the WTO?*

Sebastian Claro

Universidad Católica de Chile

January 2002

Abstract

This paper presents a model that introduces foreign firms' competition in product and factor markets in an otherwise standard tariff liberalization setting. Pressures on factor markets from more advanced foreign firms undermine the competitive position of native enterprises. The final impact on native firms' employment, the country's comparative advantage and factor returns depend on the size and dispersion of the technology differences, the ability of native firms to imitate more advanced technologies and the final tariff structure. The case of China's entry into the WTO reveals the relevance of this feature, as the elimination of the dual economic structure is mandated by the WTO along with a fall in tariffs. The results show that in the short run the required process of FDI liberalization can generate a substantial impact on the factorial distribution of income and may imply a shift toward a more labor intensive mix of production, depending on the degree of technological imitations. However, nothing can be said with respect to the long run pattern of production. (JEL F1, F2. Key Words: Trade Liberalization, Technology Transfers, China, WTO)

*I am grateful to Laura Alfaro, Edgardo Barandiarán, Janet Currie, Sebastian Edwards, Simon Evenett, Arnold Harberger, William Hutchinson and specially Edward Leamer for comments, suggestions and criticisms. I have also benefited from comments of seminar participants at UCLA, LACEA 2001 meetings at Montevideo, Uruguay, EIIT 2001 conference at Purdue University and Universidad Católica de Chile. All errors are mine. Sebastian Claro, Phone (56 2) 686 4325 Fax (56 2) 553 2377 Address: Casilla 76, Correo 17, Santiago, Chile. (email: sclaro@faceapuc.cl).

”Earlier this month, also in Tianjin, disputes erupted between workers at a state-owned liquor company and its German partner, which wanted to sell factory parts for scrap metal. The workers blocked a truck, insisting that the profits from the metal were rightfully theirs. Late last year, workers at the formerly state-owned Red Lion Paint Factory in Beijing ended up in a near-fatal standoff with the management after a new private owner, a Chinese company from Shandong Province, wanted to close the plant and sell the land.” New York Times, August 31, 2000.

Trade liberalization studies usually emphasize the effects of tariff changes in the allocation of resources across sectors and factor returns. This horizontal view ignores that in many cases tariff liberalization is accompanied by the liberalization of Foreign Direct Investment (FDI). The opening of access of domestic markets to foreign production introduces competition in factor markets. This affects significantly the competitive position of native firms if foreign firms have more advanced technologies, in contrast with the case of competition only in product markets where technological differences are compensated by differences in the return of internationally immobile factors. As a consequence, FDI liberalization generates a movement of resources across firms within sectors - vertical movement - that may dominate the resource allocation and income distribution effects of pure tariff liberalization.

What features determine the final outcome of the liberalization process? Who gains and loses with the liberalization of FDI? How do technology transfers affect the evolution of the domestic economy and the final pattern of production? These are the main questions addressed in this paper. The answers depend on four elements: the size of the technology gaps between native and foreign firms, the dispersion of the productivity differences across sectors, the degree of technological imitation by native firms and the final tariff structure. The size of the technology gaps determine the size of the distortions removed from FDI liberalization and the shifts in factor demands by native and foreign firms. Technological imitation introduces an even greater pressure on factor markets by generating a rise in labor demand from native firms. The final impact on native production and employment depends on the relative size of the productivity and wage increases that follow. The dispersion of technology differences is relevant because it provides an upper bound for the distribution of potential gains of technological imitation. In

other words, in a process of overall convergence the firms that will benefit most are those in sectors where higher technology differences exist, as the productivity gains dominate the wage increases. Finally, while the FDI liberalization eliminates price distortions within sectors, the final tariff structure determines the degree of cross-industry distortions in relative prices.

This paper presents a simple multi-sector model where firms with different technologies coexist. Their coexistence is supported by alternative protective measures to the technologically less-developed firms. Specifically, I consider distortions in products and factor markets that introduce a gap between product and factor prices faced by native and foreign firms. In this setting, I compare the effects of a pure tariff reduction process with the effects of FDI liberalization where the same set of rules are established for all firms, regardless of their level of technological development or ownership structure. In other words, I focus on the case where the final tariff structure as well as labor market rules hold for foreign and native firms. This implies changes in relative prices across sectors, a rise in relative prices for foreign firms in every sector compared to native firms, as well as the equalization of wages. In the short run, these changes unambiguously generate a rise in real wages for native firms compared to a pure tariff liberalization case, causing a movement of resources from native to foreign firms across all sectors. In the long run, factor prices and the output mix are determined by the vector of factor endowments, relative prices and the technology frontier.

The model is used to estimate the effects of one of the most controversial liberalization cases in recent decades: China's entry into the WTO. The economic structure that characterizes China suggests that the consequences of FDI liberalization may easily dominate those of pure tariff liberalization. Although China started an important process of liberalization and transition to a "Socialist Market economy with Chinese Characteristics" in 1978,¹ significant distortions still exist that must be removed according to WTO principles.² In particular, China's tariff structure is still highly distorted, and the economic system is characterized by a dual structure where foreign firms are restricted from access to domestic markets in several aspects, creating a two-economy country. According to the paper's results, entrance into the WTO might have

¹See Lardy (1992, 1998), Naughton (1996), Feenstra (1998) and Sachs and Woo (1997) and the literature thereafter for a discussion of the transition process of China in the last two decades.

²See WTO (1995b, 1999) for formal aspects on WTO rules and accession procedures.

a significant impact on the production structure, the distribution of winners and losers of the liberalization and on the subsistence of the state as a relevant economic player.

China has had for the last 2 decades important policies to attract foreign investment. These policies have given foreigners special treatment in areas such as profit taxes policy and intermediate-inputs import tariff remission. At the same time, China have introduced important incentives for foreign corporations to export their production, and have imposed legal and de-facto restrictions to limit foreign access to domestic markets. Indeed, many of the benefits just mentioned are conditional on export performance. Foreign-owned enterprises (FIEs) are mainly located in Special Economic Zones (SEZs) where they can have easy access to foreign markets. In some cases FIEs serve as mere re-exporters of Hong Kong or Taiwanese production, adding small value to the process.³ At the same time, domestic firms (State-owned (SOEs) and Collectively-owned enterprises (COEs)) enjoy several protectionist measures but do not share many of the benefits directed at foreign firms. Native firms sell mainly in protected local markets and face some restrictions (specially SOEs) to access foreign markets directly. Within domestic firms increasing competition between SOEs and COEs has taken place. The latter, semi-private institutions operating without the straightjacket of China's government intervention, have crowded-out government production in the last years. To sustain its commitment with state employment and production the government has directed increasing amounts of credit to state-firms.⁴ A smooth opening of domestic markets has been taking place, but the biggest step has yet to be implemented: the removal of special protective policies for domestic firms in general and state-owned firms in particular.

These characteristics of the dual economic structure are not consistent with the WTO rules that prohibit special benefits for domestic firms. As stated by Naughton (1996), the integration process of China has advanced in many aspects but several additional elements are required to be considered part of WTO.⁵ In his words,

China's leaders have repeatedly reaffirmed that the long-range objectives of trade reform

³See Feenstra, Hai, Woo and Yao (1998).

⁴See Brandt and Zhu (2000).

⁵See also Megginson and Netter (2001) for a discussion about the expected impact of WTO and privatization in China.

are a more open trade regime and membership in the World Trade Organization (WTO). A prerequisite of the latter is "national treatment" for FIEs; that is, that they not be subject to legal requirements that they do not also apply to domestic firms. To this end, the Chinese have begun to take a number of steps to reduce, and ultimately eliminate the differences between the present export promotion and ordinary trade regimes. Some of these changes have been mentioned above: tax breaks on investment goods for FIEs are being phased out, other aspects of tax treatment are becoming more unified; and there are plans to reduce the scope of tariff exemptions for all entities, foreign and domestic....If implemented, these reforms will tend to unify the trade regimes, and the resulting system will be more open than the present dual regime.

Also,

It is important to note that further liberalization will not entail convergence to the extremely open regime under which FIEs in southern China currently operate. Instead, trade in both regimes will be subjected to a uniform set of rules that will make the domestic economy overall significantly more open to the world economy, but will impose more tariffs and regulations on certain traders than at present.

This paper argues that this opening process is very similar to the experience of East Germany during its unification with the West, as wage and technology differences on both sides of the wall generated significant pressures on the state-owned dominated production structure of the East. Output and employment costs in the case of East Germany were mostly associated with the movement of resources across firms with different technologies more than with a reallocation of labor across sectors.⁶

A key element in the argument is the existence of technology differences between domestic and foreign firms. I propose a simple methodology to estimate them and apply it to China. The results show that penetration of FIEs is greater in sectors with greater technology gap, and

⁶See Akerlof, Rose, Yellen and Hessenius (1991) and Dornbusch and Wolf (1994) for discussions of the unification process of Germany. See also Fisher and Sahay (2000) for a cross-country study on the impact of trade, FDI and macroeconomic reforms on the evolution of output in the aftermath of several east european liberalizations.

that productivity differences are higher in SOEs than in COEs, consistent with other results in the literature⁷. The estimation of the model for China reveals that a pure tariff liberalization tends to hurt native firms in labor intensive sectors, for these are the industries with larger tariffs reductions. However, in the aggregate, no significant pattern of change in the production structure follows from pure tariff variations. This result is altered if technological imitations take place. In this case, the gains in productivity not only benefit native firms in labor-intensive sectors but they also produce an overall shift toward a more labor intensive production mix. In the long run, nothing can be said with respect to the production structure, as two forces in opposite directions determine the shift in the pattern of comparative advantage.

The paper is divided as follows. Section 1 presents an overview of the Chinese economy with a special emphasis on the tariff structure and the characteristics of the dual economic system. Section 2 presents the model. Section 3 describes in detail the tariff and FDI changes that China's entry into the WTO demand. Section 4 reports the empirical results and section 5 concludes.

1 China's Economy

China is characterized by a labor force of more than 650 millions workers of which almost half are employed in the agriculture sector. Manufacturing, the target sector of this paper, employs nearly 97 million workers and represents about 40% of the total GDP. Table 1 shows the distribution of employment and value-added between state, collective and foreign enterprises for 3-digit ISIC manufacturing sectors⁸, revealing a high dispersion of FIEs penetration. What explains the different rates of penetration of foreign firms across industries⁹? Two are the main

⁷See Brandt and Zhu (2000) for an explanation of the output-inflation cycle in China based on the role of productivity growth in collective and state-owned enterprises, and the credit allocation policies associated with it.

⁸3-digit ISIC sectors are 28, but China's authorities keep records (at list public ones) for those industries aggregated in 23 categories, which are detailed in the table. Hereafter, all the analysis is done based on those 23 categories. Appendix 1 has a detailed discussion on the data sources.

⁹The data in Table 1 only refers to share in production, and says nothing with respect to where that production is sold.

answers offered. First, penetration is higher in sectors with greater technology gaps between native and foreign firms. I discuss this in detail in section 3. Second, FIEs penetration is higher in labor-intensive sectors. Given the incentives to FIEs to produce in China and export their production, the advantages generated by lower wages are greater in labor intensive sectors. Figure 1 plots the share of foreign production in total value-added in each industry against a measure of relative capital intensity. Specifically, the y-axis variable is the ratio of K/L in each sector divided by the average K/L ratio of foreign firms operating in the manufacturing sector, where K is the nominal level of total assets in each industry and L is the number of workers. Although imperfectly, this variable probably reflects well the relative capital stocks across sectors. The negative and significant relationship (-0.59 at 1%)¹⁰ reveals that foreign firms are located in China in order to enjoy low labor costs.

[Table 1]

[Figure 1]

The share in production does not point to the key aspect of the penetration of foreign firms in consumption. Although it is well documented that several restrictions, like export requirements, location restrictions, limits for domestic access and others, apply to foreign firms selling in local markets¹¹, it is necessary to examine the consumption penetration of foreign firms in order to assess the relevance of the dual economic system. Table 2 from Branstetter and Feenstra (1999) reports the share across regions of different supply sources: multinational firms, state-owned enterprises and imports. The share value for region k is calculated as $(Q_{ki} - X_{ki}) / (Q_k - X_k + M_k)$ for $i = \text{SOEs or FIEs}$, where $Q_{ki} - X_{ki}$ is production net of exports of firms type i in region k , and $Q_k - X_k + M_k$ is the total consumption in region k . Foreign firms' penetration in consumption is small in all regions except in SEZs where FIEs are mainly located. Aside from Beijing, Tianjin, Shanghai and, to a lesser extent Jianzu, a high penetration of SOEs coincides

¹⁰-0.54 excluding Tobacco industries. For sake of presentation, I exclude Tobacco industries from the analysis hereafter. Tobacco industry is almost completely dominated by state-owned firms, and so the data for collective and foreign firms are not reliable. A similar problem, although smaller, is present in Petroleum and Iron and Steel industries. More on this below.

¹¹See Branstetter and Feenstra (1999).

with a low penetration of FIEs.

[Table 2]

[Figure 2]

Figure 2 shows the tariff structure of China as of 1999 and figure 3 plots the nominal tariff levels against the K/L ratio detailed above.¹² The results are suggestive; China protects the labor intensive industries more.¹³ According to the Stolper-Samuelson view, this is not an unreasonable result if China is considered a labor intensive country. Another reading of figure 3 is that China protects those industries that export most.¹⁴ How can we explain this phenomenon? New trade theory would suggest economies of scale or the "import protection as export promoting" principle as an explanation for this "puzzle". I offer an alternative explanation. The main export sources in China are FIEs, that represent more than 50% of exports although they produce less than 20% of manufacturing output.¹⁵ As already noticed, FIEs have a clear bias towards labor intensive sectors. Protection is directed to state and collective firms and so exports of labor-intensive goods mainly come from an economic system that is not subject to the protection structure detailed in figure 3.¹⁶ This is the core of the dual economic system.

[Figure 3]

¹²See appendix 1 on Data Description for details about the calculation of 3-digit ISIC tariffs. The resulting tariffs are very similar to those reported for China in 1998 by Nicita and Olarreaga of the World Bank. The data set can be found on worldbank.org/wbi/trade/tradeandproduction. The correlation coefficient of both series is 0.98.

¹³The correlation coefficient of both series is -0,2, but when Beverages industries are excluded, the correlation rises to -0,47 significant at 5%.

¹⁴The correlation coefficient between a measure of relative K/L and net exports/output is 0.47 significant at 10% if Tobacco and Beverages are excluded.

¹⁵See 2000 Statistical Communique of the People's Republic of China on the 2000 National Economic and Social Development Report.

¹⁶The explanation for the high protection levels of labor-intensive industries in local markets (discussed in section 3) is related to technological differences between domestic and foreign firms.

Overall, China's tariff, production and consumption structure strongly support the relevance of the dual economic structure. On the one hand, FIEs are encouraged to produce within China using the local labor force. On the other hand, they are encouraged to export their production and are limited to sell their products in local markets. In other words, native enterprises (state and collective) are protected from external forces with either high tariffs or restricted access of FIEs to domestic markets, either explicitly or through illegal surcharges.

2 The model

Consider a simple general equilibrium production framework like Jones (1965, 1971) with two factors of production: labor and capital, which are internationally immobile. The economy consists of two tradable sectors that face international prices and produce with constant-return-to-scale technologies. Capital is firm-specific in the short run while in the long run it can move across sectors in search for higher rental rates.

2.1 Two Independent Economies

Consider first the case of two countries A and B . Define a_{fi}^c as the amount of factor f needed to produce one unit of output in industry i in country c . The equilibrium is characterized at any point in time by a labor market clearing condition (eq.(1)), full capital utilization conditions (eq.(2)) and zero profit conditions in each industry (eq.(3)).

$$\overline{L}^c = \sum_i a_{Li}^c Q_i^c \quad (1)$$

$$K_i^c = a_{Ki}^c Q_i^c \quad \forall i \quad (2)$$

$$p_i^c = a_{Li}^c w^c + a_{Ki}^c r_i^c \quad \forall i \quad (3)$$

where $\overline{L}^c$ is the total endowment of labor in country c , K_i^c is the capital stock in sector i , Q_i^c is total output, p_i^c is the product price and w^c and r_i^c are the returns to labor and sector-specific capital. The technology parameters a_{fi}^c are a function of the wage-rental rate ratio and of exogenous technical conditions. Differentiating expressions (1), (2) and (3) with respect to

product price changes and using the definition of the elasticity of substitution between labor and capital¹⁷ we obtain the following expressions for the short run wage and employment changes associated with a tariff liberalization that is transmitted through relative prices changes

$$\widehat{w}^c = \frac{\sum_i \lambda_{Li}^c \frac{\sigma_i}{\theta_{Ki}^c} \widehat{p}_i^c}{\sum_i \lambda_{Li}^c \frac{\sigma_i}{\theta_{Ki}^c}} \quad (4)$$

$$\widehat{L}_i^c = -\frac{\sigma_i}{\theta_{Ki}^c} (\widehat{w}^c - \widehat{p}_i^c) \quad (5)$$

where λ_{Li}^c is the share of employment in sector i in total employment in country c , σ_i is the elasticity of substitution between labor and capital in sector i and θ_{Ki}^c is the share of capital in sector i in total value-added. In the short run, the wage change is a weighted average of the product price changes. The weights depend on the response of the labor demand curve to price changes and on the relative size of each sector.¹⁸ As a consequence, the employment adjustment is such that sectors with smaller fall in tariffs end up expanding their employment. In the long run, the response of wages is completely determined by external competitiveness conditions, and the employment adjustment is mainly determined by the substitution possibilities between labor and capital, the relative price changes and the factor intensities in each sector. These are the traditional "horizontal" effects of a tariff liberalization. In a context like this, competition from technologically advanced foreign firms (country B) is totally reflected in relative product prices, and differences in the returns to L and K are the mechanisms that sustain the competitive position of firms in A .

2.2 Two Integrated Economies

Consider now the case where the two economies are partially integrated. With factor mobility, in the long run native firms (country A) with poor technologies are condemned to disappear. The main mechanisms are pressures in factor markets from competition of more advanced foreign firms (country B). With integrated factor markets, there are no factors which returns can

¹⁷With no technological change, $\widehat{a}_{Li} = -\theta_{Ki}\sigma_i(\widehat{w}_i - \widehat{r}_i)$ and $\widehat{a}_{Ki} = \theta_{Li}\sigma_i(\widehat{w}_i - \widehat{r}_i)$.

¹⁸Jones (1971) shows that $\sigma_i/\theta_{Ki} = (\widehat{a}_{Ki} - \widehat{a}_{Li})/(\widehat{w} - \widehat{p}_i)$. This is the elasticity of the marginal productivity of labor of the mobile factor, defined as positive.

adjust to support the competitive position of native firms. Can low and high technology firms coexist and receive similar profits?

Several interventions are possible to compensate native firms. First, it is possible to generate product price advantages, either through directed subsidies or restrictions to foreign firms to sell in protected product markets. In this case, differences in product prices compensate for differences in technologies. An alternative mechanism is to impose restrictions in factor markets. For example, labor laws that give preferences to native firms or that impose additional costs on foreign firms introduce a gap in wages that neutralizes the effects of technological differences in rental rates. A third possibility is that with totally integrated product and factor markets, capital owners of native firms are willing to accept lower rental rates. This may be the case for state-owned enterprises with some commitment to state production and employment.

I consider the presence of product price and wage distortions. Define the technology gap between native and foreign enterprises using the following notation: $a_{Li}^n = (1 + \delta_{Li})a_{Li}^f$ and $a_{Ki}^n = (1 + \delta_{Ki})a_{Ki}^f$ where n and f stand for native and foreign firms respectively, and $\delta_{Li}, \delta_{Ki} > 0$. Consider also the following wage distortion: $w^n = (1 + \pi_0)w^f$ with $\pi_0 < 0$. The following expression reveals the combination of tariff protection $\tau_i (= p_i^n/p_i^f - 1)$ and π_0 that compensates for technology differences in each sector¹⁹

$$\tau_i = h(\delta_{Li}, \delta_{Ki}) + \pi_0 \theta_{Li}^f \quad (6)$$

where $h(\delta_{Li}, \delta_{Ki}) = \theta_{Li}^f \delta_{Li} + \theta_{Ki}^f \delta_{Ki}$. Tariffs are increasing on the level of productivity differences.²⁰

I study the effects of a pure tariff liberalization on the native and aggregated economies, where there is a change in relative price across native industries while distortions between native and foreign firms within each industry remain. I compare them to the effects of a liberalization of FDI that removes of price and wage distortions, equilibrating the position of all firms regardless of their technology level or ownership structure.

The percentage change in wages as faced by native firms obtained by differentiating the new

¹⁹ Assuming that $\pi \cdot \delta \succ 0$.

²⁰ Appendix 2 shows that any technological gap between foreign and native firms can be compensated by a combination of price and wage gaps in order to sustain a unique return on capital across firms and industries.

aggregated labor market clearing condition is

$$\widehat{w}^n = \frac{g(p) - \sum_{i \in f} \lambda_{Li}^f \frac{\sigma_i}{\theta_{Ki}^f} \left(\frac{1+\pi_0}{1+\pi_1} - 1 \right)}{\sum_{i \in n} \lambda_{Li}^n \frac{\sigma_i}{\theta_{Ki}^n} + \sum_{i \in f} \lambda_{Li}^f \frac{\sigma_i}{\theta_{Ki}^f} \frac{1+\pi_0}{1+\pi_1}} \quad (7)$$

where $g(p) = \sum_{i \in n} \lambda_{Li}^n \frac{\sigma_i}{\theta_{Ki}^n} (\widehat{p}_i^n + \widehat{t}_i^n) + \sum_{i \in f} \lambda_{Li}^f \frac{\sigma_i}{\theta_{Ki}^f} \widehat{p}_i^f$, $\widehat{t}_i^n > 0$ is the multifactor productivity gain associated with the adoption of foreign technology by native firms²¹, $1 + \pi_1$ is the final ratio of native to foreign firms wages (equal to 1 if all distortions are removed). Price variations in equation (7) reflect both the change in tariffs for native firms and the homogenization of product prices for foreign firms. The corresponding change in wages relevant for foreign firms is $\widehat{w}^f = (1 + \widehat{w}^n) \cdot (1 + \pi_0)/(1 + \pi_1) - 1$.

A pure tariff reduction for native firms ($\widehat{p}_i^n < 0$ and $\widehat{t}_i^n = \widehat{p}_i^f = 0$ and $\pi_0 = \pi_1$) generates a fall in nominal wages. As in the case described in last section, the change in relative prices across industries induces a reallocation of employment across native firms. But unlike the situation where aggregate native employment remains constant (eq. 4), the less-than-one pass-through from prices to wages implies an overall movement of labor from native to foreign firms. Moreover, even if all tariffs fall in the same proportion, the increase in relative prices of foreign to native firms within each sector generates a movement of employment from native to foreign firms.

Equation (7) also shows that the liberalization of FDI ($\pi_1 < \pi_0$ and $\widehat{p}_i^f > 0$) induces a rise in real wages or cost-price squeeze for native firms in all sectors compared with the pure tariff liberalization, as two forces push in the same direction. First, the rise in prices for foreign firms (they have now access to the local market that is protected with the final tariff structure) generates a shift in foreign firms' labor demand pushing wages paid by native firms. Second, the shrinkage of the wage gap also increases wages paid by native firms. These two forces imply a fall in native employment and rental rates in all industries, unlike the tariff liberalization case where native employment in some industries may increase. The size of the technology gap between native and foreign firms is reflected on the initial price and wage distortions, and the real wage pressure on native enterprises from FDI liberalization is increasing on the level

²¹If $\delta_{Li} = \delta_{Ki} = \delta_i$ then $h(\delta_{Li}, \delta_{Ki}) = \delta_i$ and the multifactor productivity gain for native firms of adopting foreign technologies is given by $\widehat{t}_i = \delta_i / (1 + \delta_i)$.

technology differences.

The employment and rental rate responses to price and productivity shocks are given by

$$\widehat{L}_i = -\frac{\sigma_i}{\theta_{Ki}} (\widehat{w} - \widehat{p}_i - \widehat{t}_i) \quad (8)$$

$$\widehat{r}_i = \frac{1}{\theta_{Ki}} (\widehat{p}_i + \widehat{t}_i - \theta_{Li} \widehat{w}) \quad (9)$$

Although the rise in wages from FDI liberalization unambiguously diminishes native employment and capital rentability, technology transfers have the opposite effect. The net impact on native employment depends on the shift of labor demand caused by productivity gains and the rise in wages that follow. The condition for employment and rental rate in native firms in sector j to increase with economy-wide convergence is given by²²

$$\phi_j \widehat{t}_j^n > \theta_{Lj}^n \cdot \frac{\sum_{i \in n} \lambda_{Li}^n \frac{\sigma_i}{\theta_{Ki}^n} \phi_i \widehat{t}_i^n}{\sum_{i \in n} \lambda_{Li}^n \frac{\sigma_i}{\theta_{Ki}^n} + \sum_{i \in f} \lambda_{Li}^f \frac{\sigma_i}{\theta_{Ki}^f} (1 + \pi_0)} \quad (10)$$

where $\phi_i \in [0, 1]$ is the percentage of the maximum productivity increase $\widehat{t}_i^n$ that takes place. If $\phi_j \widehat{t}_j^n = \phi \widehat{t}^n$ for all native firms, then (10) always holds and technology transfers increase native employment in all sectors and benefits capital owners. In general, technology differences and the degree of imitation may vary across sectors, so (10) may hold only in some industries. Intuitively, in a process of overall convergence the most benefited sectors are those with higher productivity gains. Firms with small productivity increases have a rise in real wages. Similar forces determine the impact on rental rates. The effects on employment, wage and rental rates depend on the effective productivity gains and not on the productivity gap between native and foreign firms (that determine the potential or maximum technology gains). The size of the technology gap and its dispersion provide a bound for the inter-sectorial gains of imitation.

If the pressure on wages is high enough and technology transfers do not take place, the rental rate that maintains zero profits in native firms may become negative. The relevant decision becomes to scrap or not to scrap the capital. If the rental rate is lower than its opportunity cost, then it may be optimal to scrap the capital. If technological improvements in native firms take time and eventually support a positive return on capital, it might be in the interest of

²²(10) is calculated under the assumption that $\pi_1 = 0$.

capital owners to keep the assets idle until better technological possibilities create positive profit opportunities.

Another element that has important impact on the allocation of employment and factor returns is the final level of tariffs. Although the removal of distortions equalizes the relative prices across firms within each sector (for any final level of tariffs), the final tariff structure does distort the relative prices across industries, affecting the production structure and factor returns. Rewriting (7) as a function of δ_i (assuming Hicks-neutral technology differences), ϕ_i , π_0 and the initial and final tariff levels τ_{i0} and τ_{i1} for $\pi_1 = 0$ we get

$$\widehat{w}^n = \frac{\sum_i n_i \left(\frac{\tau_{i1} - \tau_{i0}}{1 + \tau_{i0}} + \phi_i \widehat{t}_i \right) + \sum_i f_i \tau_{i1} - \pi_0 \sum_i f_i}{\sum_i h_i + (1 + \pi_0) \sum_i f_i} \quad (11)$$

where $\sum_i n_i = \sum_{i \in n} \lambda_{Li}^n \sigma_i / \theta_{Ki}^n$ and $\sum_i f_i = \sum_{i \in f} \lambda_{Li}^f \sigma_i / \theta_{Ki}^f$. Regardless of the direction of the employment change for each type of enterprise within each sector, it is possible to calculate the derivative of the employment adjustment with respect to the sector-specific tariff level. In other words, the effect on employment in sector i of a tariff change that keeps constant the relative price between foreign and native firms in that sector but alters relative prices with respect to all other sectors. It is possible to show that

$$\frac{\partial \widehat{L}_i^n}{\partial \tau_{i1}} \geq 0 \quad \text{and} \quad \frac{\partial \widehat{L}_i^f}{\partial \tau_{i1}} > 0$$

An increase in the final tariff level in sector i keeping constant all other tariffs increases unambiguously the employment level in foreign firms. The effect on product prices always dominates the change in wages in foreign firms. This may not be the case for native firms, where a tariff change has a smaller marginal effect on prices and a greater marginal effect on wages. However, the conditions for $\partial \widehat{L}_i^n / \partial \tau_{i1} < 0$ are very extreme. In general, a marginal rise in τ_i increases both employment and rental rates in all types of enterprises.

The long run effects of FDI liberalization differ from the short run effects mainly because convergence in the long run is inevitable. Either native firms adopt foreign technologies and compete with foreign firms, or factors shift from local to foreign enterprises in order to get greater returns. In this context, the zero profit conditions for native and foreign firms are given

by (12) and (13) respectively.

$$\widehat{p}_i^n + \widehat{t}_i^n = \theta_{Li}^n \widehat{w}^n + \theta_{Ki}^n \widehat{r}^n \quad (12)$$

$$\widehat{p}_i^f = \theta_{Li}^f \widehat{w}^f + \theta_{Ki}^f \widehat{r}^f \quad (13)$$

where $\widehat{w}^n, \widehat{w}^f, \widehat{r}^n, \widehat{r}^f$ represent the changes in factor returns in native and foreign firms that keep zero-profits in all sectors. By definition, the set of equations in (12) is equal to the set in (13), revealing that the long run distribution of resources and factor returns are determined by the technology set, factor endowments and relative prices regardless of whether domestic firms adopt the new technologies by themselves or factors of production move to high-technology firms. In the latter case, foreign firms continue operating and there is an increase in labor and capital resources released from native firms. By Rybczynski theorem, this movement of resources does not alter the factor returns that keep foreign firms producing (as long as we remain producing in the same cone of diversification), and so (13) suffices to estimate the long run impact on factor prices. In a context where the number of goods is greater than the number of factors, the distribution of resources cannot be uniquely determined. In this case, the long run effect on factor returns can provide an idea of the direction of factor flows, as the relative change in factor returns implicitly reveals the factor intensity of the shrinking and expanding sectors (see Mussa (1974) and Neary (1978)).

3 Tariff and FDI liberalization in China

China is affected in two main ways with WTO accession. First, the WTO mandates a decrease in tariffs vis-a-vis the rest of the world. Second, the distortions that support the actual dual economic system have to be removed, imposing similar conditions for native and foreign firms.

3.1 Tariff Changes

The presence of intermediate inputs imply that the return to and allocation of L and K are determined by the evolution of value-added prices. In a perfectly competitive setting, the zero

profit condition in sector j implies that

$$p_j - \sum_{j \in I} a_j p_j = p_j^{va} = a_{Lj} w_j + a_{Kj} r_j \quad (14)$$

where p_j is the local product price (including any tariffs), a_f is the amount of factor $f = L, K$ required to produce one unit of output and p_j^{va} is the value-added price of product j . Totally differentiating (14) implies that

$$\frac{\widehat{p}_j - \sum_I \theta_I \widehat{p}_I}{1 - \sum_I \theta_I} = \widehat{p}_j^{va} = \frac{\theta_{Lj}}{1 - \sum_I \theta_I} \widehat{w}_j + \frac{\theta_{Kj}}{1 - \sum_I \theta_I} \widehat{r}_j \quad (15)$$

where θ_{Lj} and θ_{Kj} are the share of labor and capital costs in total output in sector j . Considering a tariff τ_j in sector j , variations in product prices assuming a complete pass-through are given by $\widehat{p}_j = \widehat{\tau}_j \cdot \tau_j / (1 + \tau_j)$. Data on tariff changes are obtained from the signed agreement with the United States as the basis for the proposed change in tariffs that the Chinese authorities have committed to.²³

[Figure 4]

[Figure 5]

Figure 4 shows the relative value-added price change for state-owned firms against the initial tariff level.²⁴ The strong negative association (-0.78) reveals that the sectors most affected with the tariff changes are the most protected ones.²⁵ This suggests that a pure tariff liberalization would induce a movement of native resources out of labor-intensive industries. Indeed, figure 5 shows that the correlation coefficient between value-added price changes and capital intensity is 0.31 (0.53 without Beverage industries). This represents the first important impact that entry into the WTO will likely have on China.

²³Unclassified Copy of US-China Bilateral Market Access Agreement as Released by USTR on March 14, 2000. Source, US-China Business Council. This agreement establishes a tariff reduction schedule until 2008.

²⁴Because of lack of information regarding usage of intermediate inputs in each sector in China, I calculated the share in cost of intermediate inputs from the ratio of output to value added. Assuming that all intermediate inputs are imported I applied the average tariff change as a measure of their price change.

²⁵A similar result not shown holds for collective firms, where the correlation between initial protection level and relative value-added price change in -0.84. COEs and SOEs differ in their usage of intermediate inputs.

3.2 Unification of Dual Economy

The unification of the dual system comprises several elements. First, it implies free access of foreign firms to local product markets. In terms of the model, it is assumed that FIEs gain access to protected product markets. Although labor-intensive industries face greater fall in prices as depicted in figure 5, they continue to be the most protected sectors (although not as intense as with the initial tariff structure). This implies that access to local product markets may benefit mostly foreign firms located in labor-intensive sectors. A second element is the elimination of any labor market distortion that may explain the premium paid to workers by foreign firms.²⁶ The paper takes an extreme (and perhaps unrealistic) position by assuming a complete equalization of wages between domestic and foreign firms. The results are not significantly altered by this assumption.²⁷

In the unification process, a fundamental issue is the existence of productivity differences across firms. I propose a simple methodology to estimate the technology gap between firms within each sector.

3.3 Measuring Technological Differences

Figure 6 depicts the unit value-added isoquants for a typical domestic and foreign firm in a given industry. Given the different observed techniques of production, and in order to distinguish between technique and technology differences, I adjust for differences in relative input prices across firms. In other words, I estimate the production technique in foreign firms if they face the same w/r ratio than native enterprises. There are two equivalent possibilities to figure out the productivity differences between firms. One alternative is to compare the cost of production

²⁶The initial wage differentials considered are $w_s/w_f = 0.68$ and $w_c/w_f = 0.85$ obtained from the 1997 and 1999 China Statistical Yearbook. See Appendix 1 for details.

²⁷As a general principle, I consider that the same set of rules for foreign and native firms are set. Strictly speaking, the WTO prohibits discrimination against foreign firms, but does not prohibit discrimination against native firms. In the alternative case where original preferences over FIEs are not altered (like tax exemptions and intermediate input tariff remissions) the results (not reported) show that even greater pressure on wages affects negatively employment and rental rates in domestic firms. This reveals an interesting dichotomy for China's authorities because the removal of preferences for foreign firms benefit workers but hurt the government itself.

after correcting for price differences, (i.e., the distance between AA' and BB' isocost lines). A second possibility is to consider the shift in X_N due to the adoption of foreign technology measured at native w/r . I follow the latter procedure, detailed in Appendix 3.

[Figure 6]

Table 3 reports for China the changes in multi-factor productivity in state-owned and collectively-owned firms due to the adoption of foreign technologies for two alternative cases. TFP 1 measures the productivity gains as if production functions were Leontief. In this case, I do not correct for differences in w/r ratios. TFP 2 reflects the productivity gains after correcting for differences in factor returns. The similarity of both series for each type of firm gives us confidence with respect to the robustness of the estimation. The results reported in the paper are based on TFP 2 and are not altered if TFP 1 is used. According to them, FIEs have technological advantages over state-owned enterprises in almost all industries, with the exception of Petroleum. The greatest gap is in Professional and Scientific Equipment industries and the smallest in Tobacco industries. Collective firms have more enhanced technologies than state-owned enterprises in all sectors but Beverages. The correlation coefficient between the productivity gaps in state and collective firms is 0.70, significant at 1%.²⁸

[Table 3]

Are these estimates for China reasonable? I argue yes for three reasons. First, the technology levels of COEs are greater than those of SOEs. As discussed above, there exist wide evidence that COEs have crowded out significantly state firms due to improved technologies.²⁹ Second, foreign firms' penetration in total production is greater in sectors where the technological advantage of foreign firms is greater (see figure 7). Comparing state and foreign firms, the correlation between the productivity gap and the share of foreign firms in total output is 0.85, significant at a 1% level. Similar results hold for collective firms. Finally, figure 8 shows that tariffs are higher in sectors with greater technology gaps. The correlation coefficient without

²⁸Compared to foreign firms.

²⁹See World Bank Report "China - Reform of State-Owned Enterprises" N°. 14924-CHA, Jefferson et.al., (1999) and Brandt and Zhu (2000).

Beverage industries is 0.41 significant at 10% (0.25 with Beverages). The tariff structure is the way China compensates for productivity differences, as equation (6) suggests.

[Figure 7]

[Figure 8]

4 Empirical Results

I consider a generalization of the model of section 2.2 that allows for three types of firms - state, collective and foreign - in each 23 3-digit ISIC manufacturing sector.

4.1 Short Run Effects

The first step is to estimate the equilibrium change in state, collective and foreign wages that depend on the tariff change (that equalizes product prices across firms in each industry) and on the equalization of wages across sectors.³⁰ The computation of the right hand side of (7) implies a 5.3% fall in foreign wages, and a 38.9% and 11.8% rise in state and collective wages respectively if full technology transfers take place. Otherwise, there is a fall in wages in foreign firms of 28.2% accompanied with a 5.2% rise in state wages and a 15.3% fall in wages paid by collective enterprises. In the short run workers are unambiguously benefited with technological convergence. Table 4 shows the estimations for changes in rental rates and employment in native firms for the two extreme alternative convergence criteria. Employment changes are computed using equation (8) and rental rate changes are estimated using equation (9).³¹

[Table 4]

³⁰This assumption is more reasonable if convergence takes place because full convergence makes wage differentials more difficult to explain. If technological transfers do not exist, then it might be possible that some gap in wages remains. In this case, there is a higher rise or smaller fall in wages for all firms. In any case, the results are not significantly affected by this assumption.

³¹The results are very similar if technological convergence is to the maximum level rather than foreign level (recall that in some industries collective enterprises have more enhanced technologies than foreign firms).

There are several implications. First, employment levels and rental rates in state-owned firms are higher with than without technology transfers in all sectors. This reveals that the potential productivity gains in SOEs more than compensate for higher wages. This is not the case for collective firms, where some sectors are hurt by overall productivity gains. This reflects that the labor market pressures from technological convergence in state firms dominate the productivity gains in collective firms, generating an important price-cost squeeze in the latter. Not reported, if only state firms have productivity increases, SOEs in all sectors but Tobacco, Petroleum and Iron & Steel have employment increases compared to a situation with no productivity gains. These are indeed the three sectors with smaller technology differences, as equation (10) suggests.

Second, the correlation coefficient of employment changes with and without technology transfers is 0.11 in state firms and 0.28 for collective firms. Similar low correlations hold for rental rate changes. This implies that technology transfers do have a significant impact on the distribution of employment within types of firms. In the case of state-owned enterprises, technology differences are such that convergence drives the state output mix toward labor-intensive sectors.

Third, figures 9 and 10 plot the change in aggregate sectorial employment with and without overall technological convergence (by adding the net effects for different firms in each sector) against a relative measure of capital intensity as described in section 1. Without convergence, no significant pattern of change in the production structure is expected, revealing that the labor-intensive bias of the tariff reduction is not big enough to generate a significant shift in employment toward capital intensive sectors. Besides, the effects of the fall in labor-intensive prices are neutralized by the wage equalization process and the increase in protection for foreign firms. Technology transfers alter this pattern, as the negative correlation in figure 10 suggests. In other words, productivity gains in native firms favor labor-intensive sectors and in the aggregate dominate the variations in relative prices.

[Figure 9]

[Figure 10]

Fourth, the aggregate response of employment in SOEs provides a good idea of dynamics of employment shifts. With no productivity gains, native employment falls by 5.4 million

workers, with a fall in state employment of 11.2 millions and a rise in collective employment of 5.7 millions. The drop in protection affects all native firms, but the subsequent fall in wages compensates the effect on collective firms. If productivity gains take place there is fall in native employment of 2.6 million workers, with a rise in state employment of 1.2 millions and a fall in collective employment of 3.8 million workers. In this case, the pressures on labor markets from technology transfers are compensated by the gains in productivity in state firms but dominate the smaller productivity gains in collective firms.

These results may underestimate the impact on state employment because they do not consider that in the pre-liberalization situation state-owned firms are receiving abundant subsidies from the government. These subsidies sustain the state production structure in competition with collective firms. Studies from the World Bank estimate these subsidies between 2% and 2.6% of GDP, implying a price subsidy between 29% and 42% of value-added price.³² This can be interpreted as if the technology differences between state and foreign firms were greater. In this case, the associated productivity gains are those reported in table 3 under column TFP 3. Without convergence, and assuming that entry into the WTO carries the elimination of all subsidies to SOEs, the fall in state employment is about 16 million workers. The distribution of the employment losses is similar than in the case with no subsidies. If technology transfers take place, the equilibrium is the one described in last paragraph, as the effects on smaller subsidies are completely compensated by greater productivity gains.

So far, it has been assumed that technology transfers are exogenous. If there are incompatibilities between local capital and foreign technologies, convergence is not possible. In that case, as discussed in section 2, the decision facing capital owners is whether to scrap the capital or not. Considering an opportunity cost of capital of zero, table 4 reveals that without convergence scrappage is anticipated only in Furniture industries. The experience of the German unification is illustrative because the government decided to keep subsidizing state firms

³²See World Bank Report N°14924-CHA "China - Reform of State-Owned Enterprises". Considering that state-owned value added is about 22% of total manufacturing that represents about 40% of GDP, a subsidy to state firms in manufacturing of 2% of GDP is equivalent to a price subsidy of 29% equal for all sectors. The qualitative results are not affected by the specific value of the initial subsidy.

with negative rentability to prioritize state employment over employment reallocation.³³ The situation differs if technology transfers are only possible through privatization. The value of capital in private hands (with better technologies) is greater than the value of capital for the government. The degree of competition in the privatization process determines who ultimately gains that difference. This problem is at the core of the liberalization discussion in Eastern Europe, as many privatizing processes have been delayed not only due to disputes over property rights but also due to lack of competition.

4.2 Long Run Effects

The presence of more goods than factors generates a mathematical indeterminacy of the production structure in the long run. As a consequence, the strategy used to estimate the long run effects on factor returns is the one proposed by Leamer (1998), who estimates a set of mandated wage and rental rate changes in order to keep zero profit conditions in all sectors. As discussed in section 2.2, in the long run productivity convergence is inevitable and the set of zero profit conditions of foreign firms suffices to estimate the long run changes in factor returns. Assuming that initially rental rates and wages are arbitrated across sectors within foreign firms, I estimate equation (13) across 23 ISIC industries where $\widehat{p}^f$ is the percentage change in value-added prices for foreign firms associated with the new tariff structure. The result is

$$\widehat{p}_i^f = -0.187 \cdot \theta_{Li}^f + 0.235 \cdot \theta_{Ki}^f + \varepsilon_i \quad (16)$$

The 18.7% fall in wages in foreign firms implies a long run rise in state-firms wages of 19% and a fall of 4.1% in collective wages. In the long run, liberalization benefits workers in state firms but hurt all the rest. This may contradict a priori the idea that the final tariff structure favors labor-intensive sectors. Measured by relative K/L , there is a mild negative association between capital intensity and tariff level. But the effects on factor returns are determined by the factor intensities measured with factor shares, that determine a fall in wages.³⁴

³³Akerlof et.al., (1991) present and defend this position as the optimal one. Dornbusch (1991) and Guitien (1991) argue that artificial protection for employment limits resource reallocation, jeopardizes the transformation process and has a negative welfare effect in the long run.

³⁴In the case of foreign firms, sectors with high K/L tend to pay higher wages ($\text{correl}(w_i, (K/L)_i) = 0.72$), so

Another implication of equation (16) is that wages fall compared to the short run equilibrium with technology convergence. This is a very significant result because convergence in the short run implies equalization of rental rates across firms within sectors even without capital movements. This reveals that in the long run the K/L released by shrinking sectors is lower than the K/L in expanding sectors, generating a fall in wages and rise in rental rates and implying a movement of resources toward capital-intensive sectors. This change in output mix is compared to the short run equilibrium with convergence and not to the pre-liberalization one. This is because the initial equilibrium presents differences in factor returns across firms within sectors, while the revealed resource movement from factor price changes is valid for differences in factor returns across sectors.

In general, the long run fall in wages suggests a movement of resources toward capital intensive sectors, contrasting with the movement depicted in figure 10. It is not possible to quantify the size of such movement. Moreover, there is a shift of labor and capital from native firms to foreign ones across all sectors, with a relative increase in L/K available with the enhanced technologies. By Rybczynski, this implies a shift in the production structure toward labor-intensive sectors, with no effect on factor returns. As a consequence, nothing can be said with respect to the long run pattern of comparative advantage.

5 Conclusion

Competition between domestic firms with foreign sources of production takes place in product markets, where information flows through changes in relative prices. As long as there is limited international mobility of factors, differences in productivity are traduced in differences in factor returns. The introduction of FDI generates a new place for competition: factor markets. If there are technology differences between firms, disadvantaged firms do not have degrees of freedom to adjust and are doomed to disappear. The most relevant element in a trade liberalization episode may not be the change in relative prices through tariff reductions, but the increasing access to foreign firms to produce locally.

The case of China and WTO provides a natural experiment for a liberalization process

the relationship between both measures of factor intensity is weak.

where the access of foreign firms to domestic markets may overcome the effects of tariff changes. Although important steps towards a market economy have taken place in the last two decades, important distortions remain. WTO demands from China a change in tariff structure but more importantly a break in the dual economic system. The projected results in terms of income distribution, production structure as well as the situation of public enterprises suggests that the challenges posed to China represent a crucial test for their whole liberalization effort.

Overall, the situation of China is similar to the one experienced by East Germany at the beginning of the 1990s during its unification process with the West. The encounter between backward firms in the East with the highly developed firms in the West was probably the most significant element in Germany's unification. And, according to the predictions in this paper, a similar challenge may be faced by inward-oriented China in its encounter with outward-oriented China.

References

- [1] Akerlof, George, A. Rose, J. Yellen and H. Hesselius (1991) "East Germany in from the Cold: The Economic Aftermath of Currency Union" Brookings Papers on Economic Activity, pp 1-87
- [2] Brandt, Loren and X. Zhu (2000) "Redistribution in a Decentralized Economy: Growth and Inflation in China under Reform" Journal of Political Economy 108(2), April, pp 422-39
- [3] Branstetter, Lee and R. Feenstra (1999) "Trade and Foreign Direct Investment in China: A Political Economy Approach" Mimeo UC Davis, March. Forthcoming Journal of International Economics.
- [4] China Statistical Yearbook. 1997 and 1999 issues.
- [5] Dornbusch, Rudiger (1991) "East Germany in from the Cold: The Economic Aftermath of Currency Union: Comments" Brookings Papers on Economic Activity, pp 88-92
- [6] Guitien, Manuel (1991) "East Germany in from the Cold: The Economic Aftermath of Currency Union: Comments" Brookings Papers on Economic Activity, pp 92-98.
- [7] Dornbusch, Rudiger and H. Wolf (1994) "East German Economic Reconstruction" in Blanchard, O, Froot, K and Sachs, J. eds. The transition in Eastern Europe. Volume 1. Country studies. NBER Project Report. Chicago and London: University of Chicago Press, 1994, pages 155-82.
- [8] Feenstra Robert (1998) "One country, Two systems: Implications of WTO entry for China" Mimeo, June.
- [9] Feenstra, Robert (2000) "World Trade Flows, 1980-1997" Center for International Data, Institute for government Affairs, UC Davis
- [10] Feenstra, Robert, W. Hai, W. Woo and Sh. Yao (1999) "US-China Bilateral Trade Balance: Its size and Determinants" Mimeo, American Economic Review, May. pp 338-43.

- [11] Fisher, Stanley and R. Sahay (2000) "The transition Economies After Ten Years" Proceedings of the conference organized by CADE, Poland 1999. Forthcoming
- [12] Jefferson, Gary; Singh, I; Xing. J and Zhang, Z (1999) "China's Industrial Performance: A Review of Recent Findings" In Enterprise Reform in China: Ownership, Transition and Performance, edited by Gary H. Jefferson and Inderjit Singh. New York, Oxford Univ. Press.
- [13] Jones (1965) "The structure of simple general equilibrium models" Journal of Political Economy 73, 557-72
- [14] Jones (1971) "A three factor model in theory, trade and history", in: J.N. Bhagwati et al., eds., Trade, balance of payments and growth: Essays in honor of C.P. Kindleberger (North-Holland, Amsterdam).
- [15] Lardy, Nicholas (1992) "Chinese Foreign Trade", China Quarterly (131), pp.691-720, September
- [16] Lardy, Nicholas (1998) "China's Unfinished Economic Revolution" Washington: Brookings Inst. Press.
- [17] Leamer, Edward (1998) "In search of Stolper-Samuelson Linkages between International Trade and Lower Wages" in Susan Collins (ed) Exports, Imports and the American Workers, Washington D.C: The Brookings Institution.
- [18] Megginson, William and Jeffrey M. Netter (2001) "From State to Market: A Survey of Empirical Studies on Privatization" Journal of Economic Literature Vol.XXXIX (June), pp.321-389
- [19] Mussa, Michael (1974) "Tariffs and the Distribution of Income: The Importance of Factor Specificity, Substitutability, and Intensity in the Short and Long Run" Journal of Political Economy 82(6) pp.1191-1203
- [20] Naughton, Barry (1996) "China's Emergence and Prospects as a Trading Nation" Brookings Papers on Economic Activity (2) pp 273-337

- [21] Neary, Peter (1978) "Short-Run Capital Specificity and the Pure Theory of International Trade" *The Economic Journal* 88, September, pp. 488-510
- [22] Sachs, Jeffrey and W.Woo (1997) "Understanding China's Economic Performance" Development Discussion Paper 575, HIID, March.
- [23] World Trade Organization (1995b) *Guide to GATT Law and Practice*, Geneva
- [24] World Trade Organization (1999) "Technical Note on the Accession Process" note by the Secretariat WT/ACC/7

APPENDIX 1: DATA DESCRIPTION

The data used consists of trade and production data. Production data is disaggregated at the 3-digit ISIC level and comes from the UNIDO data set and the 1997 and 1999 China Statistical Yearbook. Data of output, value added and employment is provided for enterprises with Independent Account Systems (IAS), that represent 69% of total manufacturing employment. The data are divided between state-owned enterprises (SOEs), collective and share holding enterprises (COEs) and foreign funded and enterprises funded overseas (FIEs). Output and value-added are detailed for each industry and type of firm (23 3-digit ISIC categories, see footnote 6). Sectorial employment is estimated using known average labor productivity, assuming constant ratios with 1998 urban sectorial employment and 1996 formal employment and considering that state firms are well represented by firms with IAS. Average sectorial wages are calculated considering average state, collective and foreign wages, assuming constant ratios with respect 1998 urban wages in state firms and matching with labor shares in value-added for 1996. Capital stock is proxied by total assets in balance sheets. Intermediate input usage is calculated using the ratio of output to value-added. The estimates presented in the paper are very robust to alternative assumptions required to complete the database used.

Trade data is available at the 4 digit SITC level from Robert Feenstra (2000), and is transformed into 3 digit ISIC level to make it comparable to the production series. Specifically, by assuming linearity between 5 and 4 digit SITC it is possible to use the concordance table between 5 digit SITC and 4 digit ISIC to transform the 4d SITC data into ISIC data. To estimate the tariff level at the 3 and 4 digit ISIC level, I used the tariff reduction schedule of China at the 10 digit HS for 1999 and the concordance table between HS10 and SITC5. The "theoretical" revenues for 1997 are obtained by multiplying the nominal tariff times the import level at the 5 and then 4 digit SITC. Although important tariff exemptions exist, the results are invariant to alternative taxable import vectors. By using the concordance table between 4 digit SITC and 4 digit ISIC it is possible to obtain an estimation of the trade and tariff structure compatible with production data.

APPENDIX 2: COMPENSATING FOR TECHNOLOGY DIFFERENCES

Consider an economy with x sectors and two types of firms: foreign f and native n . For simplicity, assume that all firms operate with Leontief production functions. Technologies of native and foreign firms are such that

$$\begin{aligned} a_{Li}^n &= (1 + \delta_{Li}) \cdot a_{Li}^f \\ a_{Ki}^n &= (1 + \delta_{Ki}) \cdot a_{Ki}^f \end{aligned}$$

where $\delta_{fi} > 0$ is the technology gap in factor $f = K, L$ between foreign and native firms in industry i . Consider also that all foreign firms are operating with zero profits. In other words, $\exists! r^f / p_i^f = a_{Li}^f w^f + a_{Ki}^f r^f \quad \forall i$. Consider a set (π, λ_i) such that $w^n = (1 + \pi)w^f$ and $p_i^n = (1 + \lambda_i) \cdot p_i^f$.

Proposition 1 *There exists a set $(\pi, \lambda_i) \forall i$ such that for any combination of technology gaps $(\delta_{Li}, \delta_{Ki})$, there exists a unique rental rate in the economy.*

Proof. The zero profit condition for foreign and native firms in each sector i are

$$p_i^f = a_{Li}^f w^f + a_{Ki}^f r^f$$

$$p_i^n = a_{Li}^n w^n + a_{Ki}^n r^n$$

The zero profit condition for native firms can be written as

$$(1 + \lambda_i) = (1 + \delta_{Li})(1 + \pi)\theta_{Li}^f + (1 + \delta_{Ki})\theta_{Ki}^f r^n / r^f$$

It follows that given $\delta_{Li}, \delta_{Ki}, \pi, \theta_{Li}^f$ and θ_{Ki}^f there exists a combination (π, λ_i) so that $r^n = r^f$ and zero profits hold for native firms. Given that r^f is the same across industries, there exists a vector $(\pi, \vec{\lambda}_i)$ such that there exists a unique rental rate in the economy. $\blacksquare$

APPENDIX 3: ESTIMATION OF TECHNOLOGY DIFFERENCES

1. Initial data requirement.

1. Measures of relative factor per unit of value-added requirements in different firms in each sector: a_{Lj}^F/a_{Lj}^n where a_{ij}^n is the amount of input i required to produce one unit of value-added in firm $n = (state, collective)$ in industry j .

2. Measures of relative wages and rental rates between foreign and native firms: w_j^F/w_j^S and r_j^S/r_j^F where f_j^m is the return to factor $f(labor, capital)$ in firm $m(foreign, state, collective)$ in sector j .

How do we compute these variables for the case of China?

$\theta_{Lj} = a_{Lj}^m w_j^m / p_j^m$ is the cost share of labor in total value-added in industry j , where p_j^m is the value-added price as defined above in section 3.1. It follows that

$$\frac{a_{Lj}^F}{a_{Lj}^n} = \frac{\theta_{Lj}^F p_j^F w_j^n}{\theta_{Lj}^n p_j^n w_j^F} \quad \text{and} \quad \frac{a_{Kj}^F}{a_{Kj}^n} = \frac{\theta_{Kj}^F p_j^F r_j^n}{\theta_{Kj}^n p_j^n r_j^F}$$

For the case of China, data exist on L_j^F/L_j^n , VA_j^F/VA_j^n and w_j^F/w_j^n so it is possible to estimate the ratio of value-added prices with the following formula

$$\frac{p_{vai}^F}{p_{vai}^n} = \frac{p_i^* - \sum_{i \in F} a_{Li}^F p_j^*}{p_i^*(1 + t_i) - \sum_{i \in n} a_{Li}^n p_j^*(1 + t_i)} = \frac{1 - \theta_{Lj}^F}{1 - \theta_{Lj}^n} \cdot \frac{1}{1 + t_i}$$

With this information, it is possible to estimate a_{Lj}^F/a_{Lj}^n . Additionally, by approximating capital stock with the value of total assets in the balance sheets, we calculate $a_{Kj}^F/a_{Kj}^n = K_j^F/K_j^n \cdot Q_j^n/Q_j^F \cdot p_j^F/p_j^n$ and from here the estimation of r_j^S/r_j^F follows.

At this stage, it is possible to estimate the productivity gains as if technologies were of Leontief types. By defining $a_{Lj}^n/a_{Lj}^F = (1 + \delta_{Lj}^n)$ and $a_{Kj}^n/a_{Kj}^F = (1 + \delta_{Kj}^n)$ it follows that

$$TFP1 = \theta_{Lj}^n \delta_{Lj}^n / (1 + \delta_{Lj}^n) + \theta_{Kj}^n \delta_{Kj}^n / (1 + \delta_{Kj}^n)$$

2. Correcting for differences in w/r ratios.

Next, we compare the wage-rental rate ratio between foreign and native firms in each sector and calculate the required change in $(w/r)^f$ in order to be equal to the ratio in native firms.

Let $w^n/w^F = \alpha$ and $r^n/r^F = \beta$. The relationship between foreign and native firms implies that

$$\frac{d(w/r)^F}{(w/r)^F} = \frac{(w/r)^n - (w/r)^F}{(w/r)^n} = \widehat{w}_j^f - \widehat{r}_j^f = \alpha/\beta - 1$$

It is now possible to estimate the new factor intensity ratios between foreign and native firms. By definition of the elasticity of substitution

$$\begin{aligned}\widehat{a_{Lj}^F} &= -\theta_{Kj}^F \sigma_j (\widehat{w}_j^f - \widehat{r}_j^f) \text{ and} \\ \widehat{a_{Kj}^F} &= \theta_{Lj}^F \sigma_j (\widehat{w}_j^f - \widehat{r}_j^f)\end{aligned}$$

It follows that the ratio of factor intensities between foreign and native firms for similar w/r is: $(a_{Lj}^F/a_{Lj}^n)' = a_{Lj}^F/a_{Lj}^n \cdot (1 + \widehat{a_{Lj}^F})$ and $(a_{Kj}^F/a_{Kj}^n)' = a_{Kj}^F/a_{Kj}^n \cdot (1 + \widehat{a_{Kj}^F})$. (The elasticity of substitution between labor and capital is assumed to be the same across different firms in the same industry, and its estimation is detailed in appendix 4.)

3. Estimation of TFP gains.

The final step is to compute the productivity gain in each native firm associated with technological convergence. By definition, $\widehat{TFP_j} = -\theta_{Lj}^n \widehat{a_{Lj}^n} - \theta_{Kj}^n \widehat{a_{Kj}^n}$. We estimate $\widehat{a_{Lj}^n}$ and $\widehat{a_{Kj}^n}$ such that $a_{Lj}^F/a_{Lj}^n = a_{Kj}^F/a_{Kj}^n = 1$. This implies

$$\begin{aligned}\widehat{a_{Lj}^n} &= \frac{1 - (a_{Lj}^n/a_{Lj}^F)'}{(a_{Lj}^n/a_{Lj}^F)'} \\ \widehat{a_{Kj}^n} &= \frac{1 - (a_{Kj}^n/a_{Kj}^F)'}{(a_{Kj}^n/a_{Kj}^F)'}\end{aligned}$$

APPENDIX 4: ESTIMATION OF ELASTICITY OF SUBSTITUTION

Consider a simple CES production function of the form $q = (aK^\rho + bL^\rho)^{1/\rho}$. When combining the first order conditions with respect to capital and labor, we get $\ln w/r = \ln b/a + (\rho - 1) \ln L/K$.

The estimation of this equation using 28 3-digit ISIC manufacturing cross-country data for 1996 from UNIDO provides an estimator of the elasticity of substitution $\sigma = 1/(1 - \rho)$. The database provides information on sectorial employment for each country, and sectorial capital stock in each country is calculated as the sum of capital accumulation for 20 years using a depreciation rate of 5%. Wages are estimated as total wage bill divided by the number of workers, and rental rate is estimated as value-added minus wage bill divided by capital stock. The results are detailed in table 5, which also reports the R^2 of each regression as well as the number of countries. For industries that comprise more than one 3-digit industry I use a simple average of the elasticities of substitution. The results are not affected by alternative aggregations.

[Table 5]

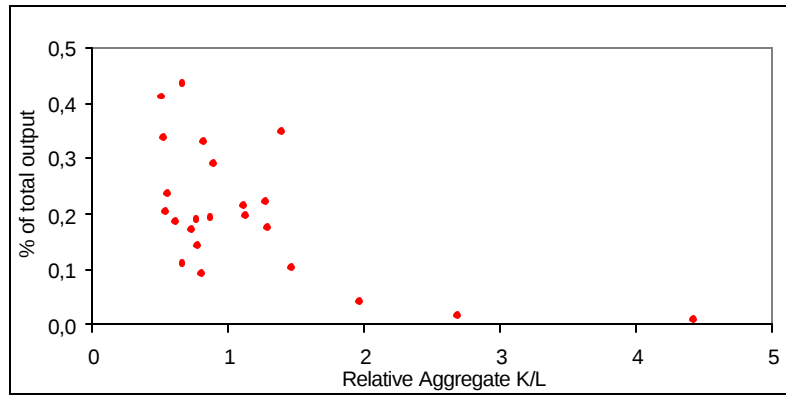


Figure 1: Foreign Firms' Production Penetration - China 1996

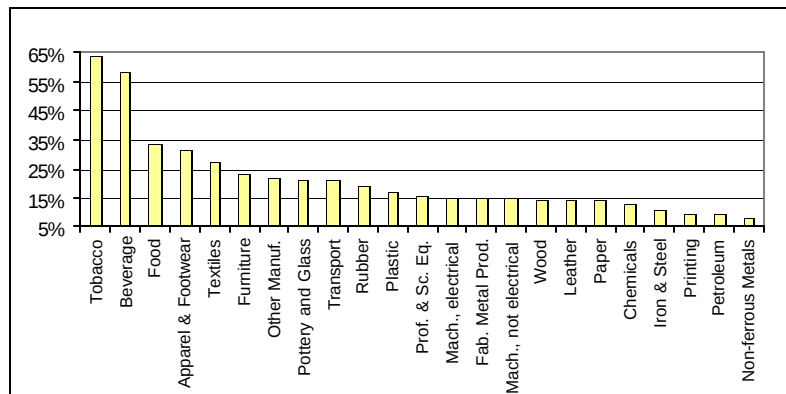


Figure 2: Initial Tariff Level

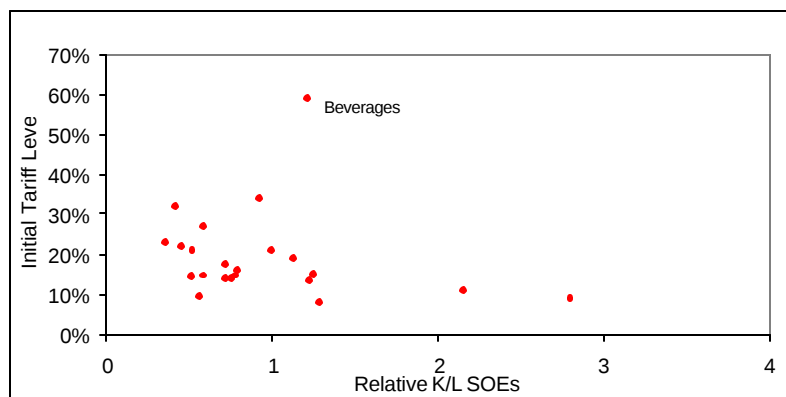


Figure 3: Protection and Factor Intensity

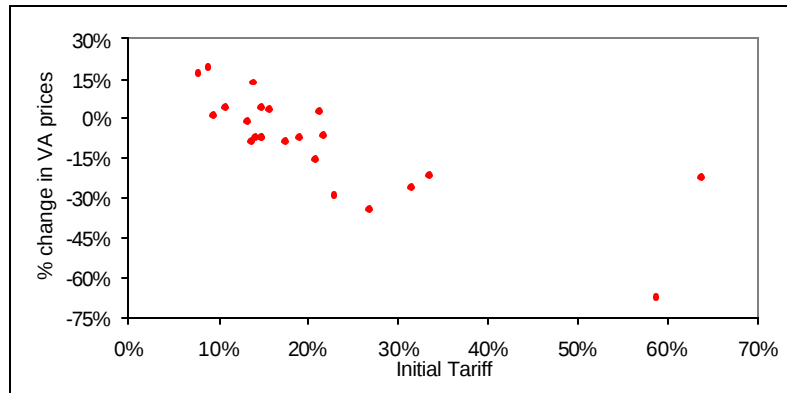


Figure 4: Protection and Tariff Reduction in China under WTO Agreement.

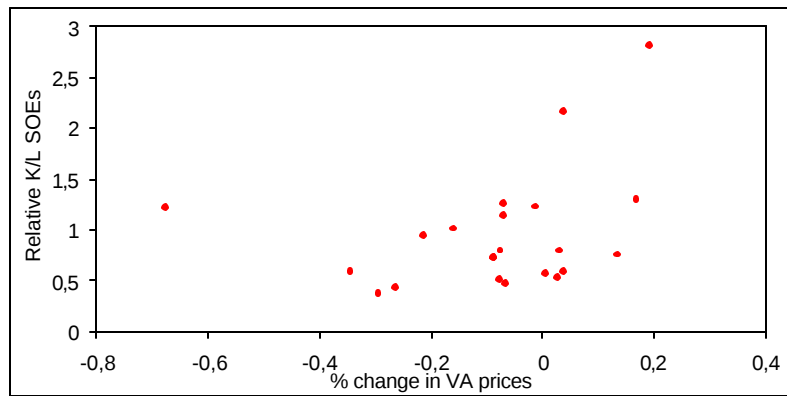


Figure 5: Value-Added Price changes and Factor Intensity

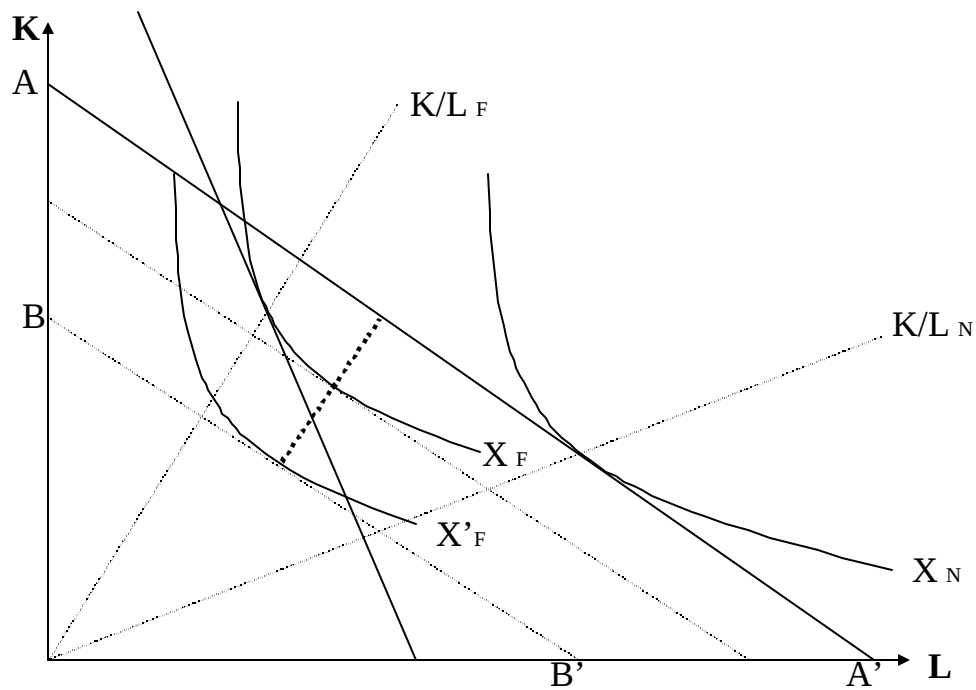


Figure 6: Measuring Technology Differences

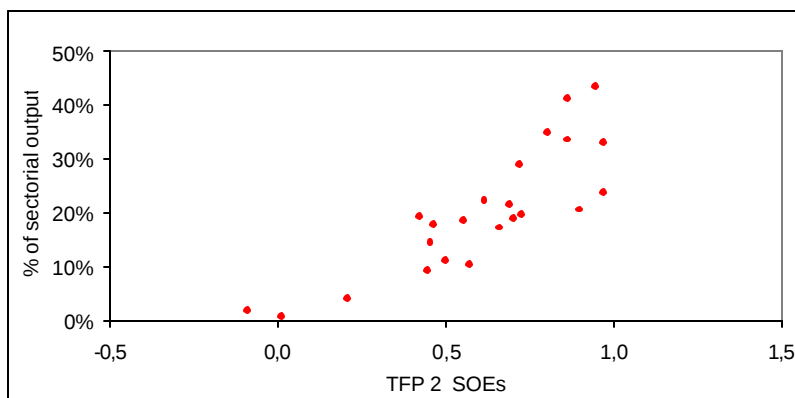


Figure 7: Foreign Firms' Penetration and Technology Gap

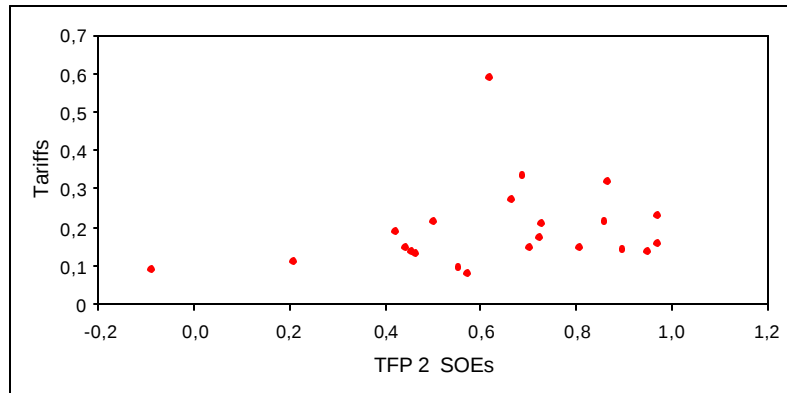


Figure 8: Technology Gap and Tariff Structure

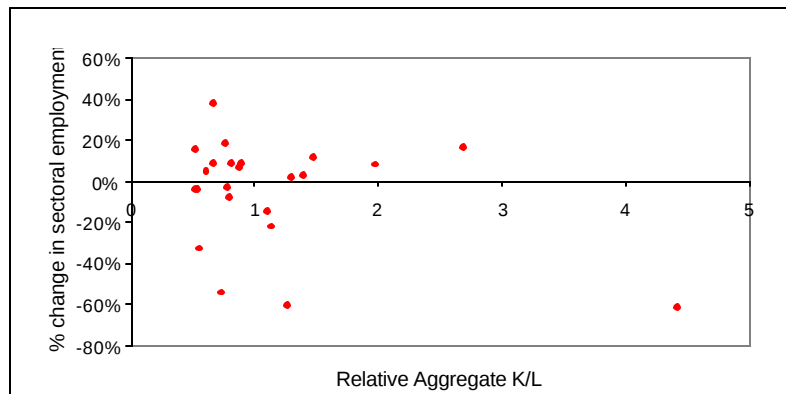


Figure 9: Employment Reallocation and Factor Intensities without Convergence

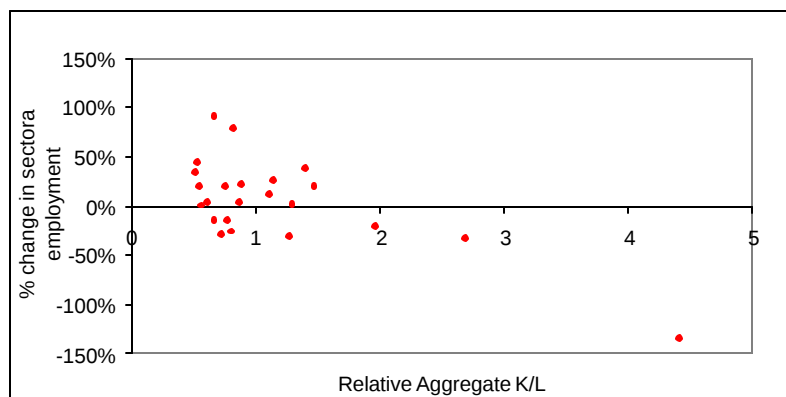


Figure 10: Employment Reallocation and Factor Intensities with Convergence

Table 1: China's Production Structure by Industry in 1996

Industry (ISIC Code)	Employment Share*	Output Share*	Share in Industry		
			State	Collective	Foreign
Food (311)	6%	7%	38%	41%	22%
Beverage (313)	2%	3%	52%	26%	22%
Tobacco (314)	0%	5%	98%	1%	1%
Textiles (321)	12%	7%	32%	51%	17%
Apparel & Footwear (322, 324)	4%	3%	6%	53%	41%
Leather (323)	2%	2%	7%	49%	43%
Wood (331)	1%	1%	15%	65%	20%
Furniture (332)	1%	1%	7%	69%	24%
Paper (341)	3%	2%	35%	51%	14%
Printing (342)	2%	1%	40%	41%	19%
Chemicals (351, 352)	10%	12%	44%	38%	18%
Petroleum (353, 354)	1%	4%	85%	13%	2%
Rubber (355)	1%	1%	35%	46%	19%
Plastic (356)	2%	2%	9%	61%	29%
Pottery and Glass (361, 362, 369)	11%	7%	28%	61%	11%
Iron & Steel (371)	5%	7%	75%	21%	4%
Non-ferrous Metals (372)	2%	2%	51%	38%	10%
Fabricated Metal Products (381)	4%	3%	13%	68%	19%
Machinery, except electrical (382)	12%	9%	39%	52%	9%
Machinery, electrical (383)	7%	10%	25%	40%	35%
Transport (384)	6%	6%	48%	33%	20%
Prof. & Sc. Equipment (385)	1%	1%	30%	37%	33%
Other (390)	3%	3%	7%	59%	34%

Source: China Statistical Yearbook 1997

* Based on firms with Independent Account Systems.

State: State-Owned Enterprises

Collective: Collective Owned and Share-Holding Enterprises

Foreign: Foreign Funded and Enterprises funded by Overseas Chinese from Hong Kong, Macao and Taiwan

Table 2: China's Consumption Structure by Region in 1995

Region	Output	Multinational Share	State-owned Share	Import Share
Beijing	1909	22%	56%	8%
Tianjin	2094	24%	28%	4%
Include OPC or SEZ				
Liaoning	4975	4%	39%	2%
Hebei	3996	7%	33%	1%
Shandong	8456	5%	27%	1%
Jianszu	11813	10%	18%	1%
Shanghai	5129	29%	29%	8%
Zhejiang	8088	8%	8%	1%
Fujian	2801	27%	7%	4%
Guangdong	9535	27%	0%	8%
Guangxi	1666	7%	36%	1%
Hainan	193	20%	5%	35%
Do not include OPC or SEZ				
Heilongjiang	2204	3%	65%	1%
Jilin	1429	6%	58%	5%
Inner Mongolia	782	5%	61%	2%
Shanxi	1754	2%	43%	1%
Henan	4715	4%	32%	1%
Anhui	3156	3%	29%	1%
Hubei	4103	4%	35%	1%
Jiangxi	1291	4%	50%	1%
Hunan	2451	3%	39%	1%
Guizhou	557	3%	64%	2%
Yunnan	1207	3%	64%	4%
Sichuan	4426	3%	37%	1%
Tibet	9	0%	73%	25%
Qinghai	149	1%	83%	1%
Shaanxi	1183	5%	56%	2%
Gansu	825	4%	65%	1%
Ningxia	198	9%	67%	1%
Xinjiang	803	2%	72%	1%

Source: Branstetter and Feenstra (1999)

Notes:

1. Output is measured in 100 million RMB, where 8 RMB ~ US\$ 1
2. Consumption shares estimated as in text, and do not sum to 100% because there are collective firms and other minor categories left out.
3. OPC stands for "Open Coastal Cities"

Table 3: Technological Gap between Native and Foreign Firms

Industry (ISIC Code)	State-owned Enterprises			Collective Enterprises	
	TFP 1	TFP 2	TFP 3	TFP 1	TFP 2
Food (311)	0,67	0,69	0,98	0,42	0,42
Beverage (313)	0,62	0,62	0,91	0,61	0,63
Tobacco (314)	-0,30	-0,01	0,28	-0,11	-0,07
Textiles (321)	0,62	0,67	0,96	-0,04	-0,01
Apparel & Footwear (322, 324)	0,78	0,88	1,17	0,61	0,63
Leather (323)	0,84	0,96	1,25	0,69	0,72
Wood (331)	0,79	0,91	1,20	0,00	0,04
Furniture (332)	0,79	0,99	1,28	0,03	0,07
Paper (341)	0,45	0,45	0,74	-0,13	-0,08
Printing (342)	0,55	0,56	0,85	-0,11	-0,09
Chemicals (351, 352)	0,46	0,47	0,76	0,08	0,08
Petroleum (353, 354)	-0,47	-0,12	0,17	-1,37	-0,71
Rubber (355)	0,42	0,42	0,71	0,21	0,22
Plastic (356)	0,65	0,73	1,02	0,27	0,27
Pottery and Glass (361, 362, 369)	0,50	0,50	0,79	-0,99	-0,65
Iron & Steel (371)	-0,04	0,18	0,47	-0,74	-0,33
Non-ferrous Metals (372)	0,57	0,57	0,86	-0,19	-0,15
Fabricated Metal Products (381)	0,69	0,71	1,00	-0,05	0,03
Machinery, except electrical (382)	0,43	0,44	0,73	-0,66	-0,27
Machinery, electrical (383)	0,79	0,81	1,10	0,72	0,73
Transport (384)	0,69	0,74	1,03	0,48	0,48
Prof. & Sc. Equipment (385)	0,86	0,98	1,27	0,74	0,76
Other (390)	0,74	0,88	1,17	0,42	0,42

TFP 1: Not correcting for differences in w/r

TFP 2: Correcting for differences in w/r

TFP 3: Considers a pre-liberalization subsidy for SOEs of 2.1% of GDP

Table 4: Short Run effects on Employment and Rental Rates

Industry (ISIC Code)	State-Owned Enterprises				Collective Enterprises				Foreign Enterprises	
	Rental Rate		Employment		Rental Rate		Employment		Employment	
	TC	NTC	TC	NTC	TC	NTC	TC	NTC	TC	NTC
Food (311)	51%	-31%	9%	-28%	26%	-18%	11%	-2%	57%	76%
Beverage (313)	-14%	-81%	-45%	-74%	-15%	-88%	-23%	-63%	34%	55%
Tobacco (314)	-27%	-24%	-139%	-61%	-40%	-33%	-110%	-37%	210%	271%
Textiles (321)	25%	-92%	-13%	-90%	-44%	-35%	-51%	-18%	29%	57%
Apparel & Footwear (322, 324)	91%	-68%	37%	-51%	52%	-31%	29%	-11%	36%	55%
Leather (323)	165%	20%	109%	13%	120%	26%	93%	36%	28%	50%
Wood (331)	184%	-37%	84%	-24%	-6%	-7%	-10%	5%	1%	18%
Furniture (332)	227%	-204%	133%	-148%	-32%	-34%	-31%	-13%	2%	25%
Paper (341)	35%	-16%	-3%	-17%	-25%	-7%	-30%	7%	-1%	24%
Printing (342)	73%	-3%	27%	-7%	-11%	6%	-18%	17%	2%	28%
Chemicals (351, 352)	48%	-3%	6%	-6%	5%	2%	-5%	12%	6%	24%
Petroleum (353, 354)	3%	21%	-29%	13%	-59%	22%	-56%	30%	20%	58%
Rubber (355)	34%	-11%	-4%	-12%	16%	-4%	3%	9%	21%	43%
Plastic (356)	91%	-23%	56%	-30%	21%	-6%	10%	10%	18%	47%
Pottery and Glass (361, 362, 369)	80%	-2%	38%	-6%	-83%	8%	-88%	22%	60%	94%
Iron & Steel (371)	16%	3%	-15%	-1%	-47%	17%	-38%	21%	6%	54%
Non-ferrous Metals (372)	100%	25%	36%	12%	-3%	20%	-9%	21%	-2%	15%
Fabricated Metal Products (381)	135%	2%	80%	-3%	6%	8%	-5%	20%	24%	52%
Machinery, except electrical (382)	34%	-20%	-5%	-24%	-49%	-5%	-58%	10%	7%	49%
Machinery, electrical (383)	89%	-12%	32%	-11%	87%	-4%	48%	7%	2%	18%
Transport (384)	73%	-33%	32%	-36%	40%	-14%	27%	1%	20%	46%
Prof. & Sc. Equipment (385)	188%	0%	99%	-3%	120%	13%	71%	19%	19%	37%
Other (390)	146%	-24%	98%	-27%	46%	-3%	31%	12%	34%	60%

Notes: TC means full convergence to Foreign Levels, NTC means no convergence

Table 5: Elasticity of Substitution Between Labor and Capital

Industry (ISIC Code)	$\rho-1$	σ	R-Square	n
Food Prod. (311, 312)	-1,32	0,76	0,58	32
Beverage (313)	-1,16	0,86	0,47	25
Tobacco (314)	-0,47	2,12	0,08	20
Textile (321)	-1,08	0,93	0,58	29
Apparel (322)	-1,42	0,70	0,63	26
Leather (323)	-1,16	0,86	0,57	20
Footwear (324)	-1,73	0,58	0,84	23
Wood (331)	-1,41	0,71	0,74	31
Furniture (332)	-1,23	0,81	0,77	23
Paper Prod. (341)	-1,24	0,80	0,69	30
Printing and Publishing (342)	-1,47	0,68	0,67	28
Chemicals (351)	-1,26	0,80	0,67	27
Other Chemicals (352)	-1,35	0,74	0,68	23
Petroleum Refineries (353)	-0,93	1,08	0,43	18
Misc. Prod. of Petroleum & Coal (354)	-1,08	0,92	0,56	13
Rubber (355)	-1,52	0,66	0,78	25
Plastic (356)	-1,69	0,59	0,81	21
Pottery (361)	-1,21	0,83	0,76	14
Glass (362)	-1,04	0,96	0,69	19
Other Non-Metallic Mineral Prod. (369)	-1,58	0,63	0,78	22
Iron & Steel (371)	-1,07	0,94	0,32	27
Non-Ferrous Metals (372)	-1,51	0,66	0,68	19
Fabricated Metal Prod. (381)	-1,09	0,91	0,71	31
Machinery except Electrical (382)	-1,05	0,96	0,43	23
Electrical Machinery (383)	-1,45	0,69	0,71	25
Transport Equipment (384)	-1,13	0,88	0,54	25
Professional & Scientific Eq. (385)	-0,98	1,02	0,55	21
Other Manufacturing Industries (390)	-0,73	1,38	0,39	24