

# **Factor Adjustment and imports from China and India: Evidence from Uruguayan Manufacturing\***

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## *Abstract*

This note studies the impact on the adjustment process of Uruguayan manufacturing firms' capital, and unskilled and skilled labor demands associated with increasing import penetration from China and India. The adjustment process is defined as the percentage of the gap between desired (optimal) and actual factor employment levels closed by the firm. Desired factor levels are obtained from a counterfactual profit maximization exercise in the absence of adjustment costs. Results suggest that adjustment costs are quite large in the Uruguayan manufacturing sector as firms tend to adjust only a small share of the gap between desired and actual levels. The growing import penetration from China and India is associated with higher adjustment costs on the elimination (firing of workers) of unskilled employment, but lower adjustment costs on the creation of unskilled employment. The adjustment process of capital and skilled workers does not seem to be affected by the growing presence of Chinese imports, whereas adjustment costs seem to be higher for skilled labor and capital in those sectors exposed to higher import competition from India. The opportunity costs in terms of economic efficiency and employment can be quite large.

Keywords: Adjustment costs, China, India, Latin America, Uruguay

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## **1. Introduction**

Over the last two decades exports of China and India have grown three times faster than world trade. They represented 2 percent of world trade in 1984, 3.6 percent in 1994 and 7.6 percent by 2004. While their overall importance is still relatively small<sup>i</sup>, there are little signs that this trend is slowing down. Moreover, in some industries their joint shares in world markets can be much higher. For example, it reaches 24 percent for textiles, apparel and footwear (ISIC 32).

The importance of China and India as a share of Uruguay imports has grown even faster. While they jointly represented less than 0.9 percent of Uruguayan imports in 1984, their share of Uruguayan imports in 2004 reached 6.3 percent (see Figure 1).<sup>ii</sup> And again, in some industries the share of China and India in Uruguay's imports is much higher: 24 percent for textiles, apparel and footwear (ISIC 32) and 37 percent for manufacturing industries not elsewhere classified (ISIC 39) –see Table 1.

The rapid growth of imports from these two unskilled abundant countries (China and India) is likely to impose factor adjustments in the Uruguayan manufacturing industry, especially for unskilled workers, but also for skilled workers and capital. The extent of factor adjustment will depend on the size of adjustments costs, which will in turn determine the impact of China and India's rapid growth on factor unemployment, and more importantly economic efficiency.

The objective of this paper is to provide an assessment of the impact that the growing importance of China and India as a source of competition for Uruguayan manufacturing firms had on the factor adjustment of unskilled and skilled labor, as well as capital. Are sectors exposed to more competition from China and India subject to larger adjustment costs? Are adjustment costs more important in the presence of surpluses, when the firm needs to reduce its current level of employment, or in the presence of shortages, when the firms needs to increase its current level of employment? How does the impact of the growing presence of China and India differ for the adjustment of skilled, unskilled workers and capital? The answer to these questions will provide some light to whether more attention needs to be paid to facilitating factor adjustment as exposure to Chinese

and Indian competition increases, and whether the focus should be on hiring versus firing costs, capital versus labor, skilled versus unskilled workers, etc.

The literature on trade and adjustment costs generally focuses on what are called social adjustment costs measured by the impact of trade reforms on factor unemployment. Magee (1972) and Baldwin et al. (1980) measure the number of workers falling in unemployment after a trade reform in the US, as well as the duration of their unemployment to provide estimates of the adjustments cost associated with the unemployment spell. Their estimates suggest that social adjustment costs represent only 4 to 12 percent of the welfare gains associated with the reforms. Matusz and Tarr (1999) in a review of the literature confirmed that the measured net labor employment effect of trade reforms is generally small.

It is tempting to extrapolate these conclusions to the case of the Uruguayan manufacturing sector facing rising competition from China and India. But there are two problems with this. First, most of the existing literature reviewed by Matusz and Tarr (1999) focuses on adjustment costs in the labor markets of developed countries. Regulation of factor markets in Uruguay can be significantly more stringent than in the average OECD country. According to World Bank (2006), Uruguay ranks 111<sup>th</sup> out of 155 countries in terms of easiness for starting a business, and 85<sup>th</sup> in terms of overall business climate.<sup>iii</sup> Second, and more importantly, by focusing on the impact on unemployment (or employment levels) to capture factor adjustment costs, the literature assumes that firms are always at their desired levels of employment. If this is not the case, the small measured impact of trade opening on unemployment does not necessarily imply that adjustment costs are small, but rather that firms may be reluctant to fire or hire when subject to trade shocks, due precisely to the presence of very large factor adjustment costs faced by firms (hiring and firing costs, training, loss of firm specific human or physical capital, etc...). Putting it differently, one should expect trade reforms to have little impact on unemployment levels in the presence of large factor adjustment costs faced by firms (or private adjustment costs in Matusz and Tarr, 1999 terminology). In the extreme case where adjustment costs are infinite, there would be no impact of trade on employment, and the earlier literature would have concluded that there are no (social) adjustment costs. True, but there are very large opportunity costs in

terms of production efficiency (and probably employment) due to the fact that firms face infinite factor adjustment costs.

In this paper, we are interested in assessing the extent to which factor adjustment is prevented by the presence of adjustment costs and whether the rising importance of China and India matters for the ease of factor adjustments among Uruguayan firms. To do this we follow Caballero, Engel and Haltiwanger (1997) approach to the estimation of factor adjustment functions, which was recently applied by Casacuberta and Gandelman (2006) to a panel of Uruguayan manufacturing firms. The idea is simple. Without adjustment costs, the level of factor employment chosen by firms depends only on current shocks and future expectations. In the presence of adjustment costs, it also depends on past factor employment decisions and the gap between the current level of factor employment and the “desired” level. The extent of factor adjustment is measured by the extent by which the gap between actual and desired levels gets closed. In the absence of adjustment costs, the gap would get fully closed, whereas in the presence of prohibitive adjustment costs, the gap will remain unchanged.

A key step in this methodology is the construction of this “desired” level of factor employment. For labor, we exploit the fact that hours are easily adjustable while the level employment is not, and assume that in the absence of frictions firms have an optimal level of hours per worker. This assumption has substantial empirical support and has been already used by Caballero, Engel and Haltiwanger (1997) and Casacuberta and Gandelman (2006) to estimate factor adjustment functions. For capital we assume that if plants did not face costs of adjusting their capital, the technology is such that they would always keep the same capital to energy ratio (as in Casacuberta and Gandelman, 2006). The optimal number of hours, energy and materials demanded by each firm as the optimal amount hired of the less flexible factors of production (skilled and unskilled workers and capital) are derived using a textbook firm maximization problem. Finally, in order to answer the questions raised earlier, once the adjustment functions for each factor are obtained, we then explore the potential heterogeneity of factor adjustment for firms exposed to different levels of import competition from China and India.

Results suggest that factor adjustment cost could be quite larger in the Uruguayan manufacturing sector –replicating the results of Casacuberta and Gandelman (2006).

Firms that had a factor surplus equal to 50 percent of its current level of employment would generally only cut between 10 and 20 percent of the shortage or surplus depending on the factor. Similar values are obtained for firms facing a factor shortage of 100 percent. Factor adjustment also tends to show lumpiness, i.e., a larger proportion of the gap, between observed and desired levels of factor employment, is closed in the presence of large surpluses or shortages. In the case of very large factor surpluses, adjustments are larger for skilled workers and capital, suggesting larger adjustment costs for unskilled workers. For small factor shortages and surpluses, adjustment costs faced by firms when hiring workers (search, recruiting and training costs) are smaller than those faced when firing workers (severance payments and negative effects on the moral of other employees). Thus low levels of volatility are desirable as they will lead to higher levels of employment. On the other hand, for large shortages and surpluses, adjustment costs faced by firms when hiring workers are larger than those faced when firing workers. Thus high levels of volatility may be costly in terms of employment.

Firms exposed to higher levels of competition from China tend to face higher adjustment costs when firing unskilled workers, but smaller adjustment costs when hiring unskilled workers. In order to take full advantage of the efficiency gains associated with the reallocation of workers to more productive firms, it would be important to address the high costs of firing workers for firms subject to large levels of import competition from China. For the other two factors there is not a large differences in adjustment costs between firms exposed to Chinese competition and those that are not exposed.

For firms exposed to high levels of competition from India, factor adjustments differ for unskilled, skilled workers and capital. In the case of skilled workers, factor adjustments are smaller when facing significant import competition from India, suggesting larger adjustment costs both on the firing and hiring of skilled workers—at least for relatively large factor shortages. For unskilled workers we observed a similar pattern to the one observed for firms subject to import competition from China (except for very large shortages or surpluses). Capital adjustment is smaller for firms subject to higher import competition from India in the presence of surpluses, suggesting higher capital adjustment costs also.

Section 2 describes the empirical methodology to estimate adjustment functions and the role played by the growing importance of China and India has on factor adjustment. Section 3 describes the data and Section 4 provides the results. Section 5 concludes.

## 2. Estimating firms' factor adjustment<sup>iv</sup>

In the traditional model without adjustment costs, the employment (capital) choice of the firms depends only on current shocks and future expectations. In the presence of adjustment costs, it also depends on past employment (capital) decisions and in the gap between the actual level of employment (capital) and the “desired” level. We will use the notation  $U^*$ ,  $S^*$  and  $K^*$  and  $U$ ,  $S$  and  $K$  for the desired and actual levels of unskilled and skilled labor, and capital, respectively.

The extent of factor adjustment in percentage terms is defined as the ratio between the changes in factor employment levels and the average between its past and present values (which allows for entry and exit of firms), following Davis and Haltiwanger (1992), and Davis *et al* (1996).<sup>v</sup> Using the notation  $\Delta$  for the rates of growth, we have

$$\begin{aligned}\Delta U_{jt} &= \frac{U_{jt} - U_{jt-1}}{\frac{1}{2}(U_{jt} + U_{jt-1})} \\ \Delta S_{jt} &= \frac{S_{jt} - S_{jt-1}}{\frac{1}{2}(S_{jt} + S_{jt-1})} \\ \Delta K_{jt} &= \frac{K_{jt} - K_{jt-1}}{\frac{1}{2}(K_{jt} + K_{jt-1})}\end{aligned}\tag{1}$$

Before a firm adjusts its factors of production, the employment (capital) shortage at time  $t$  can be defined as the difference between the desired level of employment (capital) at time  $t$  and the actual level at time  $t-1$ . Paralleling the previously defined growth rates, the shortage rate is expressed as a fraction of the average between the present desired level and the past observed level. More formally, factor shortages ( $ZU_{jt}$ ,  $ZS_{jt}$ ,  $ZK_{jt}$ ) are given by:

$$\begin{aligned}
ZU_{jt} &= \frac{U_{jt}^* - U_{jt-1}}{\frac{1}{2}(U_{jt}^* + U_{jt-1})} \\
ZS_{jt} &= \frac{S_{jt}^* - S_{jt-1}}{\frac{1}{2}(S_{jt}^* + S_{jt-1})} \\
ZK_{jt} &= \frac{K_{jt}^* - K_{jt-1}}{\frac{1}{2}(K_{jt}^* + K_{jt-1})}
\end{aligned} \tag{2}$$

We then define the adjustment function of each factor as the share of the gap that is actually closed, following Eslava *et al.* (2005) and Casacuberta and Gandelman (2006). Hence adjustment functions ( $AU_{jt}$ ,  $AS_{jt}$ ,  $AK_{jt}$ ) are given by:

$$\begin{aligned}
AU_{jt} &= \frac{\Delta U_{jt}}{ZU_{jt}} \\
AS_{jt} &= \frac{\Delta S_{jt}}{ZS_{jt}} \\
AK_{jt} &= \frac{\Delta K_{jt}}{ZK_{jt}}
\end{aligned} \tag{3}$$

The next step is to characterize such adjustment functions in terms of the shortages in all three factors. It is relevant to consider the case in which the adjustment function in each of them is not independent of the shortages observed in the other two. We follow a parametric strategy in which we allow capital and labor shortages to depend on their own shortage, on the other factors shortages and on interactive terms. The adjustment functions are not restricted to be linear and we allow for different intercept and slope for shortages and surpluses (or *negative shortages*). We do so because the causes of adjustment costs are different in the creation and destruction side. For instance, hiring new employees entails search, recruiting and training costs while firing current

employees is associated with severance payments and eventual effects on the moral of the remaining employees.

Rearranging equation (3), and solving for the observed factor adjustment, we obtain the basic specifications omitting the asymmetric interactions for positive shortages. They are:<sup>vi</sup>

$$\begin{aligned}
\Delta U_{jt} &= ZU_{jt} \left[ \lambda_0 + \lambda_1 ZS_{jt}^2 + \lambda_2 ZS_{jt} ZK_{jt} + \lambda_3 ZW_{jt} ZU_{jt} + \lambda_4 ZU_{jt}^2 + \lambda_5 ZU_{jt} ZK_{jt} + \lambda_6 ZK_{jt}^2 \right] \\
\Delta S_{jt} &= ZS_{jt} \left[ v_0 + v_1 ZS_{jt}^2 + v_2 ZS_{jt} ZK_{jt} + v_3 ZS_{jt} ZU_{jt} + v_4 ZU_{jt}^2 + v_5 ZU_{jt} ZK_{jt} + v_6 ZK_{jt}^2 \right] \\
\Delta K_{jt} &= ZK_{jt} \left[ \kappa_0 + \kappa_1 ZS_{jt}^2 + \kappa_2 ZS_{jt} ZK_{jt} + \kappa_3 ZS_{jt} ZU_{jt} + \kappa_4 ZU_{jt}^2 + \kappa_5 ZU_{jt} ZK_{jt} + \kappa_6 ZK_{jt}^2 \right]
\end{aligned} \tag{5}$$

In their paper Casacuberta and Gandelman (2006) found that non-linear terms and interaction terms were often significant explanatory variables for the adjustment process of Uruguayan manufacturing firms, and therefore we also used them here. A positive and statistically significant non-linear coefficient would indicate that a firm with a larger gap between desired and actual factor levels adjusts more. This suggests the presence of fixed adjustment costs. These fixed costs cause the adjustment decisions to be lumpy. The significance of the interaction terms indicates that shortages of other factors are relevant to understand the adjustment process. A negative sign of the interaction term implies that large shortages of one factor lead to less responsiveness in the adjustment of other factors when these exhibit shortages, and larger responsiveness when other factors exhibit surpluses.

Finally, in order to assess whether firms subject to more import competition from China and India face different adjustment functions we interact in the right-hand-side of (5) the shortage of each factor with the share of imports coming from either China or India, allowing again for different slopes for positive and negative shortages.<sup>vii</sup> If the interactions are significant it would suggest that firms subject to stronger competition from China and India face different adjustment costs. If the sign is negative it will suggest that adjustment is smaller (larger adjustment costs) in the presence of shortages and larger (smaller adjustment costs) in the presence of surpluses.

In order to estimate (5) we need first an estimation of the desired level of factor employment, i.e., the level of employment in the absence of adjustment costs. These estimates are borrowed from Casacuberta and Gandelman (2006). It consists in solving the profit maximization problem faced by each firm in the absence of adjustment costs, and deriving its optimal (or desired) factor demand.<sup>viii</sup> The parameters of the production function and total factor productivity at the firm level are estimated using Levinsohn and Petrin's (2003) methodology to control for selection and simultaneity problems (i.e., in a panel the econometrician only observes surviving firms, and factor demand depend on their productivity). For a more detailed description of how desired levels of employment are obtained, see section 3 of Casacuberta and Gandelman (2006).

### **3. Data**

We use annual establishment level observations from the Manufacturing Survey conducted by the Instituto Nacional de Estadística (INE) for the period 1982-1995 (INE has not made publicly available any of the surveys after 1995). The survey-sampling frame encompasses all Uruguayan manufacturing establishments with five or more employees.

The INE divided each four digit International Standard Industrial Classification (ISIC) sector in two groups. All establishments with more than 100 employees were included in the survey; the random sampling process of firms with less than 100 employees satisfies the criterion that the total employment of all the selected establishments must account at least for 60% of the total employment of the sector according to the economic Census (1978 or 1988).

The data for the whole period are actually obtained from two sub sample sets: from 1982 until 1988 and from 1988 until 1995. In 1988 the Second National Economic Census was conducted. After that, the INE made a major methodological revision to the manufacturing survey and changed the sample of establishments. The statistical analysis was also performed controlling for the sample of origin. Firms entering the sample in 1988 behave similarly than firms from the old sample in terms of factor adjustment.

In total, there are 627 different establishments present in at least one period. There are 208 starting in 1982, of which just 185 make it to 1995. The 1988 sample, is composed of 304 establishments included for the first time in that year, and 254 from the old sample not all of which are to be followed in subsequent years.

To construct the establishment capital stock series, we follow a methodology close to Black and Lynch (1997). The 1988 Census reports information on the capital stock. We use machinery capital. We avoid overestimation of the amount of depreciation by calculating an average depreciation rate by industrial sector and year. The resulting depreciation rate is then used for all firms within each sector yearly. We further exclude the value of assets sold in our measure of capital, assuming assets have been totally depreciated at that point. Thus, the equation for estimating the capital stock for years later than 1988 is:

$$K_{jit} = K_{jit-1} + I_{jit} - \delta_{it} K_{jit-1} \quad (6)$$

with

$$\delta_{it}^x = \frac{\sum_j D_{jit}}{\sum_j K_{jit}} \quad (7)$$

where  $j$  indexes firms;  $i$  the industrial sector,  $t$  the year.  $K$  is the capital stock;  $I$  is amount invested;  $\delta$  is the depreciation rate; and  $D$  is depreciation in pesos.

For years before 1988, the equation is reversed and each year's capital is obtained by subtracting each year's investment and applying a depreciation factor. The depreciation rate before 1988 was not available and was estimated using 1988 data. We ran a simple OLS model for the log of total depreciation conditional on the log of gross output, capital stock, total hours and electricity usage. Using this model we predicted the before 1988 depreciation levels.

$$K_{jit-1} = (K_{jit} - I_{jit}) \cdot \left( \frac{I}{1 - \hat{\delta}_{jit}} \right) \quad (8)$$

The share of imports from China and India were obtained at the 5 digit level of the SITC classification from United Nation's Comtrade, and filtered into the 4 digit level of the ISIC to match the industry description of the Manufacturing survey. The evolution of the import shares is shown in Table 1. Note that on average imports from China are two to eight times larger than imports India.

#### 4. Results

The results of the estimation of the adjustment functions in (5) including the interaction terms for positive shortages and the share of imports from China and India are reported in Table 2 for the interaction with China's import share, and Table 3 for the interaction with India's import share.<sup>1</sup>

The significance and positive coefficient in front of the variable Positive Shortage for skilled and unskilled labor indicates that there are asymmetries in terms of adjustment for these two factors (in the case of capital the coefficient is positive, but small and insignificant). Its positive value suggests that –everything else equal—it is easier to adjust in the presence of shortages (when the desired level is larger than the actual level): hiring adjustment costs are smaller than firing costs.

However, the interaction of the dummy Positive Shortage with factor shortages is also negative and significant, which suggests that the slope of the adjustment function is also different for factor shortages and surpluses. The negative coefficient suggests that the slope of the adjustment function is smaller for shortages than for surpluses. Thus, it is possible that factor adjustment is larger for very large surpluses (e.g., firm exit) than for very large shortages (e.g., firm entry), in spite of the fact that adjustment functions have a higher intercept for positive shortages (in the case of skilled and unskilled labor).

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<sup>1</sup> We also run it with the interaction of the joint China and India import share. Results were statistically not different from the ones reported in Table 2 for China, due probably to the relative larger size of Chinese imports.

Adjustment always increases with the size of the shortage as all the coefficients on factor shortages are positive and statistically significant (except sometimes for those of other factor shortages, more on this below). This illustrates the lumpiness of the adjustment process: a larger percentage of the gap is closed in the presence of large shortages or surpluses.

Interaction terms with other factor shortages are not always significant, suggesting that other factor shortages do not necessarily affect the adjustment process. However, when they are significant, they always have a negative coefficient, suggesting that it is harder to adjust in the presence of other factor shortages (all these results are consistent with what was obtained by Casacuberta and Gandelman, 2006).

#### **4.1 Are adjustment costs different when facing import competition from China and India?**

Let's start with the estimates for China in Table 2. For skilled labor, none of the interaction terms with the import share from China are significant, suggesting that the adjustment costs for firms facing strong competition from China is not different from those of firms facing no competition from Chinese imports. The presence of China, however, is felt on the adjustment cost of unskilled workers. Both interaction terms with shortages and shortages interacted with the Positive Shortage dummy are significant. But they have different signs. In the case of shortages the coefficient is negative, suggesting that the adjustment is smaller (and adjustment costs larger) for unskilled workers in the presence of surpluses. However, when interacted with the Positive Shortage dummy the coefficient is positive, and larger than the coefficient on shortages, suggesting that in the presence of positive shortages the adjustment is larger: it is easier to hire unskilled workers. In the case of capital only the interaction with the Positive Shortage dummy is significant. It is positive suggesting that firms subject to strong competition from China find it easier to adjust in the presence of capital shortages.

Note that we do not imply causality here as it is possible that smaller adjustment costs allow for higher import penetration from China. However, one may wonder why the adjustment costs are smaller in the presence of shortages and larger in the presence of surpluses when firms are exposed to import competition from China. One potential

explanation lies on the perceived volatility of Chinese imports. If these are perceived to be more volatile than imports from other regions (because it is a new player in world markets with, a relatively more distant trading partner, with large cultural and business practices differences), then one would expect firms to be more reluctant to fire workers and more willing to hire workers when exposed to more import competition from China rather than from more established and better understood trading partners. The data confirms this with a coefficient of variation for imports from China and India which is twice the coefficient of variation of imports from the rest of the world.

Results for India in Table 3 suggest that the adjustment of all factors varies in the presence of stronger import competition from India. Because a number of interactions with India's import shares are significant, and have different signs, it is difficult to assess the direction of this heterogeneity by simply looking at the sign of the coefficients. More generally, the statistical significance of the coefficients does not necessarily imply that the differences in adjustment are economically meaningful.

In order to assess how important are these differences in adjustment in the presence of import competition from China and India, we simulate the predicted adjustment using the coefficients reported in Tables 2 and 3 for different levels of factor shortages and surpluses, as well as different levels of import competition from either China or India. Because interaction terms with other factor shortages are sometimes insignificant for the purpose of this exercise we set them all to zero. We then plot the predicted adjustment for different levels of factor shortages in Figures 2 to 4 for China and Figures 5 to 7 for India.

In Figures 2 to 7 negative shortages (surpluses) in the horizontal axis indicate that the past level of factor employment is above the desired one. Hence to close this gap the firm needs to reduce the employment level of this factor (fire some of this factor). For positive shortages, past levels of factor employment are below the desired one and to close the gap the firms need to increase the employment of this factor (hire some of this factor). As argued when discussing equation (2) factor shortages varies between -2 (exit of the firm) and +2 (entry of a new firm). However note that reasonable values of factor shortage or surplus are between -0.66 and 0.66. This corresponds to a factor shortage of 100 percent (the firm's desired level of factor employment is twice its current level) and

a factor surplus of 50 percent (the firm's desired level of factor employment is half its current level). The vertical axis measures the percentage of the gap that was closed, and it varies between 0 and 1.

Figure 2 confirms that in the case of firms subject to strong competition from China the adjustment of skilled labor is not different from those of firms not subject to import competition from China. Figure 3 also confirms that the adjustment cost of unskilled workers faced by firms subject to competition from Chinese imports is larger in the presence of unskilled labor surpluses, but smaller in the presence of large unskilled labor shortages. Figure 4 also confirms that in the case of capital, the adjustment cost in the presence of shortages is smaller for firms subject to import competition from China.

Figures 5 to 7 confirm that there are important differences in the adjustment costs faced by firms subject to import competition from India. Figure 5 suggests that for relatively small shortages or surpluses (between -0.66 and 0.66) of skilled labor the adjustment cost is larger for firms facing higher competition from India. For unskilled workers we observed a similar pattern (at least for relatively small shortages and surpluses) to the one observed for unskilled labor when firms were exposed to import competition from China (see Figure 3 and 6). For capital, adjustment costs seem to be larger in the presence of large surpluses –see Figure 7.

#### **4.2 How large are factor adjustment costs?**

In the previous subsection, we have shown that adjustment costs tend to be larger for firms subject to import competition from China and India except for unskilled workers in the presence of surpluses. For other factors, adjustment costs are either unchanged when subject to import competition from China and India, or adjustment costs tend to be larger.

Moreover, the size of these adjustment costs can be quite large. For example, a firm that would like to double the level of all factors (factor shortage = 0.66, see equation (2)) would only actually increase its level of skilled workers by 20 percent, its level of unskilled workers by 30 percent and its level of capital by 10 percent (see Figures 2 to 7 for values of factor shortage = 0.66). This suggests strong adjustment costs on the hiring side for Uruguayan manufacturing firms. Similarly for a firm that would like to cut all

levels of factor employment by half (factor shortage = - 0.66), it would only reduce its level of skilled workers by 5 percent (10 percent of 50 percent), its level of unskilled workers by 10 percent (20 percent of 50 percent) and its level of capital by 5 percent (10 percent of 50 percent) –see Figures 2 to 7 at factor shortage equal to -0.66. Again, this signals some important adjustment costs, which would have important consequences on unemployment levels and economic efficiency.

Finally, a quick look at Figures 2 and 3 for China and 5 and 7 for India confirms, as suggested earlier, that the intercepts of adjustment functions are higher for both unskilled and skilled workers, but the slopes tend to be smaller. Thus, for very small shortages and surpluses, the overall adjustment is larger on the creation side (positive shortages), but for very large shortages and surplus the adjustment is smaller on the destruction side (surpluses).

This has some interesting implications. In the presence of small volatility in terms of economic activity (with mean zero to make the argument simpler), the fact that adjustment costs are larger on the destruction side (firing workers) than on the creation side (hiring workers) suggests that the overall impact of small volatility in employment is positive. It allows more efficient firms to expand rapidly while less efficient firms are more reluctant to fire their workers. However, in the presence of large volatility, the opposite is true and the adjustment cost is smaller on the destruction side (firing workers) than on the creation side (hiring workers). The impact on employment is therefore likely to be negative.

In terms of policy targeting the fact that adjustment costs are larger on the destruction side (firing workers) for small shortages and surpluses, but larger on the creation side for very large shortages and surpluses (firm entry and exit), also has some interesting implications. Policies should concentrate on reducing the adjustment costs faced by firms when firing workers (e.g., severance payments, mobility of pension schemes), and on the adjustment costs faced by firms trying to enter the market. According to World Bank, 2006, among other procedures, Uruguayan firms need to deposit the equivalent of 151% of the national income per capita to obtain a business registration number. This is six times higher than the average level in LAC. This ranks Uruguay on 116<sup>th</sup> position in a total of 155 countries in terms of easiness to start a business.

## 5. Concluding Remarks

Adjustment costs faced by capital, skilled and unskilled labor are non trivial in the Uruguayan manufacturing sector, which has consequences in terms of factor unemployment and economic efficiency. For skilled and unskilled labor, they tend to be larger in the presence of small surpluses (when the firms need to fire workers) than in the presence of small shortages (when the firm needs to hire workers). However, for large surpluses and shortages (e.g., exit and entry of firms), adjustment costs are larger on the entry side. These results suggest that in order to introduce more efficiency and generate more employment in the Uruguayan manufacturing sector, policies should focus at reducing adjustment costs for those firms that would like to fire workers (severance payments, mobility of pension schemes, etc...) and those that would like to enter the market (reduction of the number of bureaucratic procedures required, the number of days it takes, and the cost of the business registration license).

These asymmetries in adjustment costs for small vs. large shortages and surpluses have some interesting implications in terms of employment. In the presence of small levels of volatility we are likely to experience reductions in unemployment, whereas for large levels of volatility we are likely to experience increases in unemployment. This underscores the importance of credible and stable economic policies, which do not allow for large economic volatility.

The growing importance of China and India in world markets, and in the Uruguayan manufacturing sector seems to be increasing the need for addressing the adjustment costs of all factors in the presence of factor surpluses, but in particular unskilled labor. Adjustment costs faced by firms subject to strong Chinese and Indian competition seem to be particularly large for firms that would like to reduce the level of unskilled labor employment. For firms experiencing factor shortages, however, adjustment costs seem to be smaller when subject to import competition from China and India (except perhaps for small shortages of skilled labor when subject to import competition from India).

What can explain the asymmetry between shortages and surpluses, for the impact of the growing importance of China and India on factor adjustment costs? One potential explanation lies on the perceived volatility of Chinese and Indian imports. If these are

perceived to be more volatile than imports from other regions (because it is a new player in world markets with, a relatively more distant trading partner, with large cultural and business practices differences), then one would expect firms to be more reluctant to fire workers and more willing to hire workers when exposed to more import competition from China rather than from more established and better understood trading partners. The data confirms this with a coefficient of variation for imports from China and India which is twice the coefficient of variation of imports from the rest of the world. Addressing the causes of these volatility (which can sometimes be policy induced, e.g., antidumping duties, non-tariff barriers, etc.) is likely to help reduce the adjustment cost in the presence of surpluses. An alternative explanation lies on the degree of substitution between domestically produced goods and Chinese and Indian goods. Other studies (Facchini *et al.*, 2006) have found that in Latin America, and the Southern Cone in particular, this elasticity tend to be higher than the elasticity of substitution between domestically produced goods and imports from the rest-of-the-world. If this were the case, the increase in import penetration from China and India could be signaling new market opportunities, and increase the amount of information available for domestic firms regarding the domestic market potential. This would reduce the adjustment cost for firms experiencing factor shortages. Similarly, for firms experiencing factor surpluses, the information regarding the growing domestic market potential is likely to make them more reluctant to reduce their factor employment in the presence of adjustment costs on the destruction, but also the creation side.

## References

Baldwin Robert E., John Mutti and J. David Richardson (1980), “Welfare effects on the United States of a significant multilateral tariff reduction”, *Journal of International Economics* 10, 405-423.

Black S. and L. Lynch (1997), “How to compete: the impact of workplace practices and information technology on productivity”, NBER working paper #6120.

Caballero, R., E. Engel and J. Haltiwanger (1997) “Aggregate employment dynamics: building from microeconomic evidence”, *American Economic Review* 87 (1): 115-137.

Casacuberta, Carlos and Nestor Gandelman (2006), "Protection, openness and factor adjustment: evidence from the manufacturing sector in Uruguay", Policy Research Working Paper #3891, The World Bank.

Casacuberta, Carlos, Gabriela Fachola and Nestor Gandelman (2004) "The Impact of Trade Liberalization on Employment, Capital and Productivity Dynamics: Evidence from the Uruguayan Manufacturing Sector", Research Department WP R-479, Inter American Development Bank.

Davis, S., and J. Haltiwanger, (1992) "Gross job creation gross job destruction and employment reallocation", *Quarterly Journal of Economics*, 107(3)

Davis, S., J. Haltiwanger, and S. Schuh, (1996) *Job creation and destruction*, MA: MIT Press

Eslava, M., J. Haltiwanger, A. Kugler and M. Kugler, (2005) "Factor adjustment after deregulation: panel evidence from Colombian plants", NBER working paper #11656.

Facchini, Giovanni, Marcelo Olarreaga, Peri Silva and Gerald Willmann, (2006) "Substitutability and protectionism: Latin America's trade policy and imports from China and India", mimeo.

Levinsohn, J., and A. Petrin, (2003) "Estimating production functions using inputs to control for unobservables", *Review of economic studies*, Vol 70 (2).

Magee, Stephen (1972), "The Welfare Effects of Restrictions on US Trade"; *Brookings Papers on Economic Activity* 3, 645-701.

Matusz, Steven and David Tarr (1999), "Adjusting to trade policy reform", Policy Research Working Paper #2142, The World Bank.

World Bank (2006), *Doing Business*, The World Bank, Washington DC

Table 1: Share of imports from China and India by industry

ISIC code	Industry description	1983	1984	1985	1986	1987	1988	1989	1990	1991	1993	1994	1995
31	Food & Beverage	0,0%	0,1%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
32	Textiles & Apparel	7.9%	0,9%	0,6%	2,1%	2,6%	2,3%	2,2%	5,7%	1,5%	3,9%	5,8%	6,8%
33	Wood & Furniture.	0,5%	0,0%	0,0%	0,1%	0,0%	0,0%	0,4%	0,2%	0,2%	0,7%	0,7%	0,8%
34	Paper & Products	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%
35	Chemicals	0,1%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,1%	0,2%	0,3%	0,6%	1,0%
36	Non-metallic miner.	0,9%	0,1%	0,0%	0,0%	0,1%	0,2%	0,4%	0,3%	0,8%	0,6%	0,6%	1,6%
37	Basic metal ind.	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%
38	Machinery	0,2%	0,2%	0,3%	0,3%	0,4%	0,4%	0,6%	0,5%	0,7%	1,1%	2,0%	2,2%
39	Other manuf.	2,0%	1,9%	1,4%	1,3%	2,0%	2,3%	4,6%	3,0%	5,7%	4,5%	6,9%	9,3%
ISIC code	Industry description	1996	1997	1998	1999	2000	2001	2002	2003	2004			
31	Food & Beverage	0,3%	0,2%	0,3%	0,3%	0,5%	0,3%	0,5%	1,0%	1,1%			
32	Textiles & Apparel	7,6%	9,3%	10,3%	12,4%	13,8%	15,3%	16,2%	14,2%	17,2%			
33	Wood & Furniture.	0,9%	1,5%	1,5%	1,8%	2,7%	2,8%	2,9%	2,8%	4,6%			
34	Paper & Products	0,2%	0,3%	0,4%	0,4%	0,5%	0,4%	0,4%	0,4%	0,6%			
35	Chemicals	1.3%	1,5%	1,9%	1,9%	2,7%	4,2%	3,9%	5,3%	7,4%			
36	Non-metallic miner.	1.7%	3,1%	3,2%	3,9%	3,3%	5,2%	4,6%	3,8%	5,5%			
37	Basic metal ind.	0.1%	0,2%	0,3%	0,4%	0,8%	1,1%	1,2%	1,0%	1,2%			
38	Machinery	2.4%	2,7%	2,9%	3,7%	4,9%	5,6%	5,3%	6,8%	9,8%			
39	Other manuf.	12.3%	10,7%	10,3%	15,4%	18,9%	23,4%	20,8%	18,0%	27,6%			

Note: Source UN's Comtrade.

Table 2: Estimated parametric adjustment functions and China's imports<sup>a</sup>

	Skilled adjustment	Unskilled adjustment	Capital adjustment
Constant	0,07805 [0,02292]***	0,14387 [0,02274]***	0,06312 [0,02197]***
Positive Shortage <sup>b</sup>	0,11968 [0,03944]***	0,15604 [0,03653]***	0,03065 [0,03610]
(Shortage Skilled) <sup>2</sup>	0,18656 [0,01049]***	0,03108 [0,01208]**	-0,0037 [0,01227]
(Shortage Skilled) <sup>2</sup> *Positive	-0,09338 [0,01721]***		
(Shortage Unskilled) <sup>2</sup>	-0,00414 [0,01430]	0,10413 [0,01209]***	-0,03261 [0,01363]**
(Shortage Unskilled) <sup>2</sup> *Positive		-0,09534 [0,01897]***	
(Shortage Capital) <sup>2</sup>	-0,00942 [0,01102]	0,02626 [0,01001]***	0,18195 [0,00751]***
(Shortage Capital) <sup>2</sup> *Positive			-0,14658 [0,01375]***
(Shortage Skilled)*(Shortage Unskilled)	-0,04244 [0,01403]***	0,01477 [0,01249]	0,02543 [0,01625]
(Shortage Skilled)*(Shortage Capital)	-0,02915 [0,01272]**	-0,00913 [0,01401]	-0,00383 [0,01227]
(Shortage Unskilled)*(Shortage Capital)	0,02288 [0,01634]	-0,05743 [0,01208]***	-0,05466 [0,01088]***
Constant*China <sup>c</sup>	-0,44954 [0,36462]	0,46141 [0,36578]	-0,34021 [0,46811]
Positive Shortage*China	0,9443 [0,63399]	-0,06473 [0,55996]	-0,09696 [0,63970]
(Shortage Skilled) <sup>2</sup> *China	0,16794 [0,20034]		
(Shortage Skilled) <sup>2</sup> *Positive*China	-0,45834 [0,33521]		
(Shortage Unskilled) <sup>2</sup> *China		-1,13997 [0,16753]***	
(Shortage Unskilled) <sup>2</sup> *Positive*China		1,95618 [0,35506]***	
(Shortage Capital) <sup>2</sup> *China			-0,11391 [0,30230]
(Shortage Capital) <sup>2</sup> *Positive*China			0,84503 [0,41907]**
Observations	4861	4861	4861
Number of establishments	625	625	625
R-squared	0,30	0,31	0,38

<sup>a</sup>Regressions include firm fixed effects. Standard errors in brackets and are corrected for clustering within ISIC 4 digit industries. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

<sup>b</sup> Positive shortage is a dummy that takes the value 1 for all observations where there is a positive shortage.

<sup>c</sup> China is the share of imports from China in overall imports at the ISIC 4 digit level.

Table 3: Estimated parametric adjustment functions and India's imports<sup>a</sup>

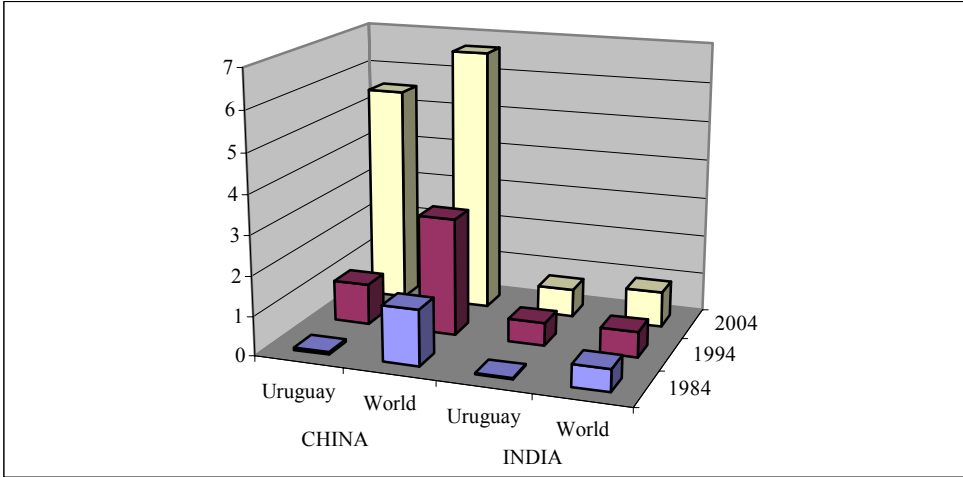
	White collar adjustment	Blue collar adjustment	Capital adjustment
Constant	0,08465 [0,02318]***	0,17366 [0,02346]***	0,0601 [0,02198]***
Positive Shortage <sup>b</sup>	0,12463 [0,03971]***	0,11988 [0,03740]***	0,03279 [0,03618]
(Shortage Skilled) <sup>2</sup>	0,17895 [0,01098]***	0,03111 [0,01226]**	-0,00178 [0,01229]
(Shortage Skilled) <sup>2</sup> *Positive	-0,09673 [0,01758]***		
(Shortage Unskilled) <sup>2</sup>	-0,00574 [0,01429]	0,06263 [0,01324]***	-0,03227 [0,01365]**
(Shortage Unskilled) <sup>2</sup> *Positive		-0,0394 [0,01952]**	
(Shortage Capital) <sup>2</sup>	-0,01233 [0,01106]	0,02589 [0,01015]**	0,18442 [0,00748]***
(Shortage Capital) <sup>2</sup> *Positive			-0,14435 [0,01379]***
(Shortage Skilled)*(Shortage Unskilled)	-0,04293 [0,01401]***	0,00781 [0,01263]	0,01954 [0,01634]
(Shortage Skilled)*(Shortage Capital)	-0,0263 [0,01282]**	0,0034 [0,01420]	0,00156 [0,01229]
(Shortage Unskilled)*(Shortage Capital)	0,02277 [0,01642]	-0,05985 [0,01225]***	-0,05533 [0,01086]***
Constant*India <sup>c</sup>	-2,00292 [1,17640]*	-2,61286 [1,18570]**	-0,05905 [1,13801]
Positive Shortage*India	0,03733 [1,88626]	5,63713 [1,87061]***	-0,66106 [1,61349]
(Shortage Skilled) <sup>2</sup> *India	2,3584 [0,96902]**		
(Shortage Skilled) <sup>2</sup> *Positive*India	0,2264 [1,51973]		
(Shortage Unskilled) <sup>2</sup> *India		3,43413 [0,90142]***	
(Shortage Unskilled) <sup>2</sup> *Positive*India		-4,50428 [1,07073]***	
(Shortage Capital) <sup>2</sup> *India			-1,11407 [0,57543]*
(Shortage Capital) <sup>2</sup> *Positive*India			1,48336 [0,78641]*
Observations	4861	4861	4861
Number of establishments	625	625	625
R-squared	0,30	0,29	0,38

<sup>a</sup>Regressions include firm fixed effects. Standard errors in brackets and are corrected for clustering within ISIC 4 digit industries. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

<sup>b</sup> Positive shortage is a dummy that takes the value 1 for all observations where there is a positive shortage.

<sup>c</sup> India is the share of imports from China in overall imports at the ISIC 4 digit level.

Figure 1: Share of China and India in Uruguay's imports and world markets



Source: UN's Comtrade

Figure 2: Adjustment functions of skilled workers: impact of Chinese imports

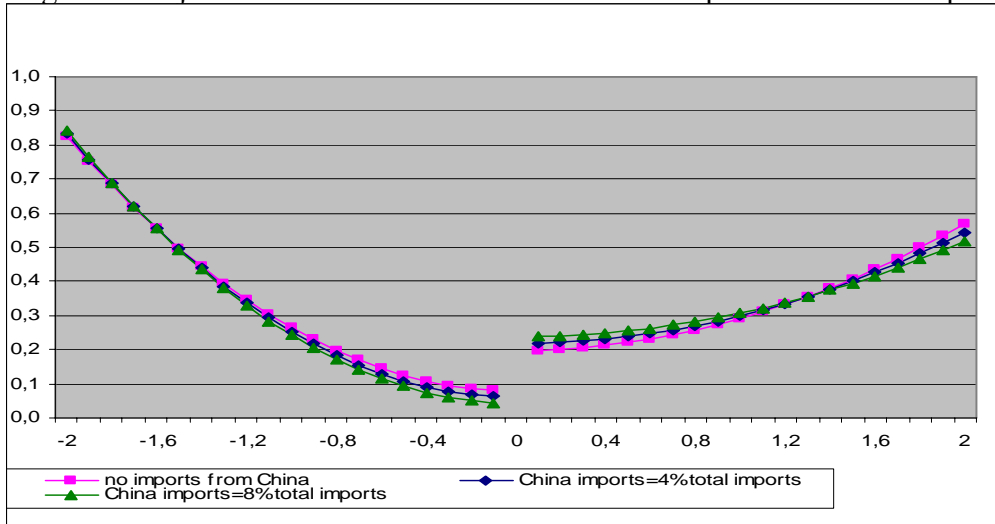


Figure 3: Adjustment functions of unskilled workers: impact of Chinese imports

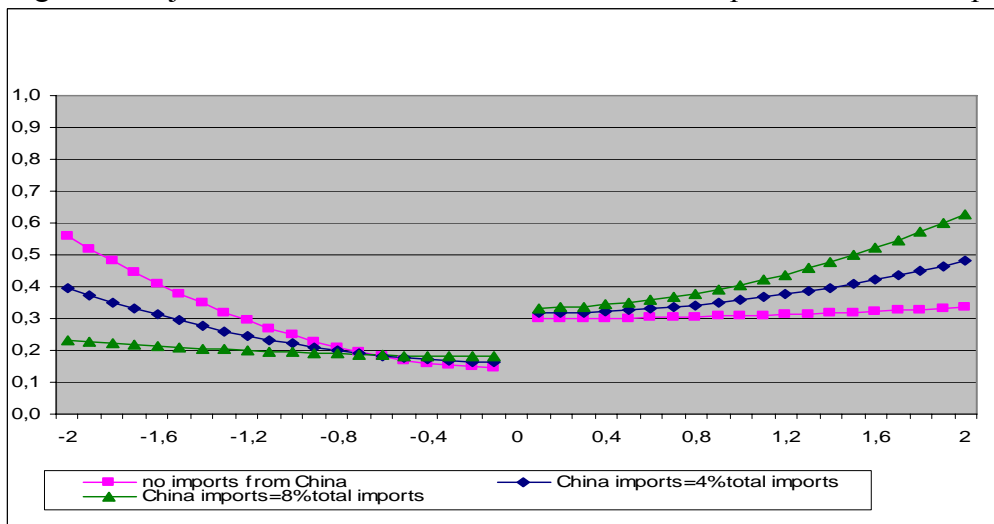


Figure 4: Adjustment functions of capital: impact of Chinese imports

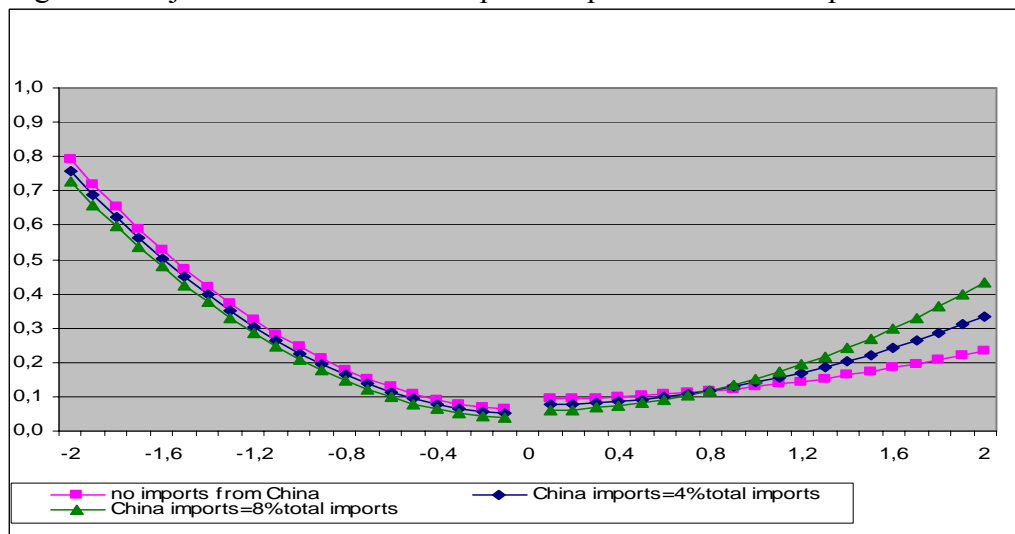


Figure 5: Adjustment function for skilled workers: impact of India's imports

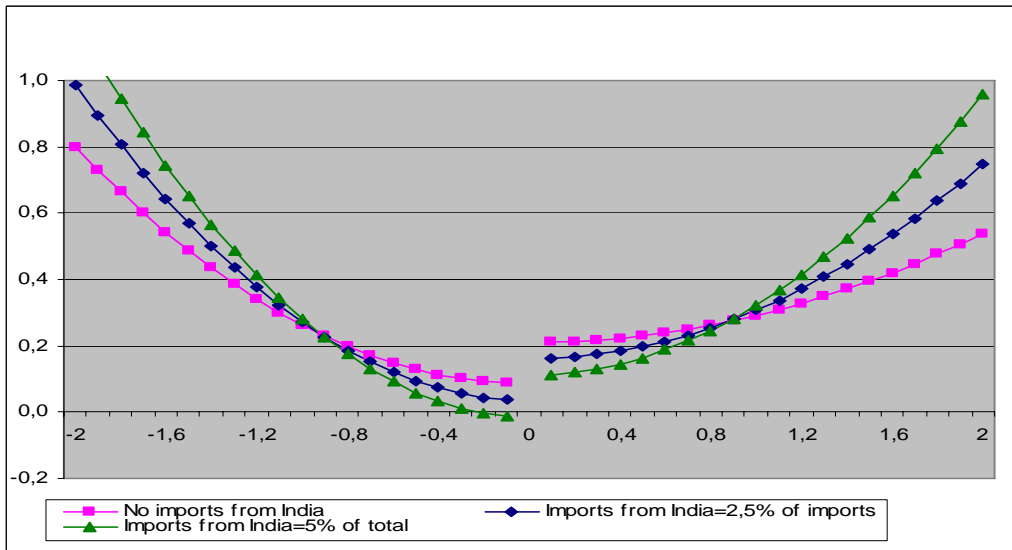


Figure 6: Adjustment function for unskilled workers: impact of India's imports

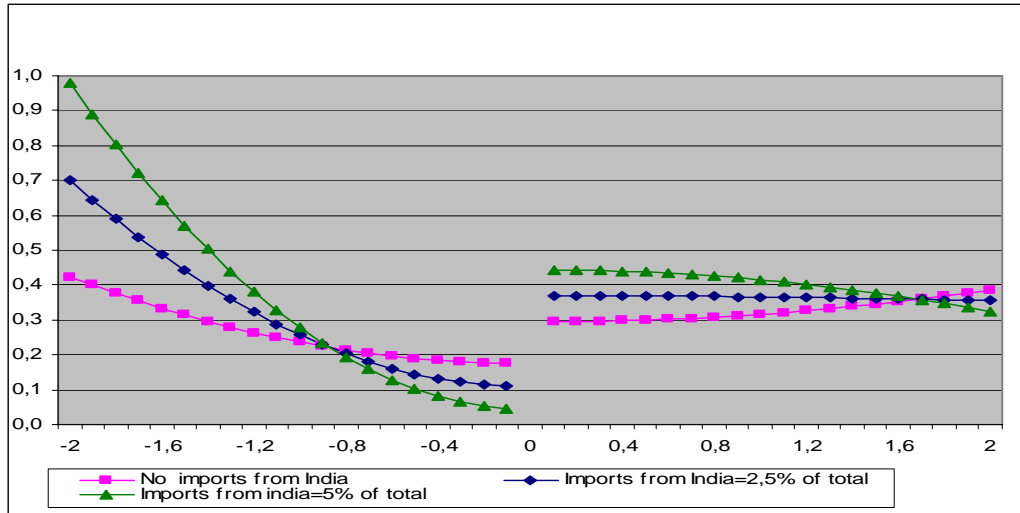
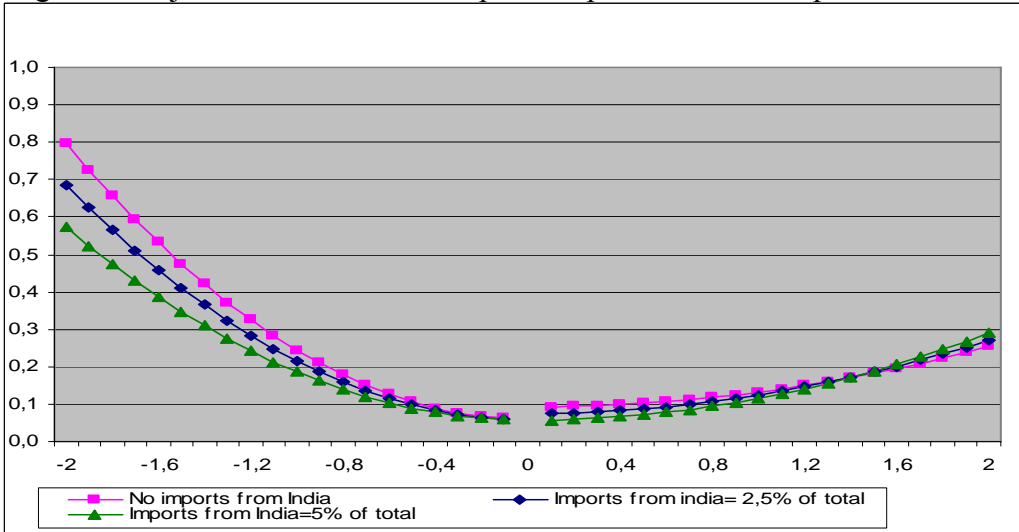


Figure 7: Adjustment function for capital: impact of India's imports



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<sup>i</sup> Note that China's share is seven times larger than India's share.

<sup>ii</sup> This was partly helped by the re-establishment of diplomatic relationships between Uruguay and China in 1988.

<sup>iii</sup> The presence of a relatively large informal sector which represents 50 percent of GDP, suggests that these regulatory barriers may be easily overcome in the informal sector.

<sup>iv</sup> This follows closely Casacuberta and Gandelman (2006).

<sup>v</sup> A feature of these growth rates is that they are bound between  $-2$  and  $2$ . They take the value  $-2$  when the firm exits and the value  $2$  when the firm enters. Note that there is a monotonic relation between the rates of growth so defined and the usual ones.

<sup>vi</sup> Note that factor shortages are squared for interpretation purposes. For positive shortages, an increase in this variable indicates that the (positive) factor shortage is increasing, whereas for negative shortages, an increase in this variable indicates that the (negative) factor shortage is declining.

<sup>vii</sup> This is identical to the approach followed by Eslava et al. (2005) to examine the impact of Colombian deregulation on factor adjustment, and Casacuberta and Gandelman (2006) to examine the impact of trade openness on factor adjustment in Uruguay.

<sup>viii</sup> This assumes separability between the production function and the factor adjustment functions.