Reallocation and Adjustment in the Manufacturing Sector in Uruguay

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Abstract

This note summarizes our research on factor reallocation and adjustment for capital, blue collar and white collar employment in the manufacturing sector in Uruguay between 1982 and1995. During this period a profound trade liberalization process took place, concomitant with changes in labor bargaining institutions and anti inflationary policies whose byproduct was a sizeable appreciation of the local currency.

1. Introduction

Microeconomic analysis of firm performance has boomed in recent years, due to the development of theories stressing firm heterogeneity beyond the former representative agent models, as well as the increased availability of large panel datasets assembling information on relevant firm level indicators. The adjustment costs literature has had a particularly strong development, both on the theoretical side as well as in empirical exercises. Some papers have started to analyze not only industrial economies- but also less developed ones, particularly Latin American countries.[1]

This note is based on our previous and current research on factor adjustment, protection and openness in Uruguay. Although the main concern is the same there is a first group of papers whose main focus is on factor (employment, capital) creation, destruction and reallocation[2] and a latter group of papers focused on adjustment functions.[3]

Besides characterizing the factor reallocation and factor adjustment process in the Manufacturing sector in Uruguay our research looks on how policies interact with these processes. Much of our effort was devoted to understand how trade liberalization impacted on allocation/reallocation of production factors and firm productivity. Besides changes in protection, we wondered how the factor flows were affected by other relevant variables like unionization, concentration and the irruption of China and India's as new relevant players of international trade.

In this note we report and discuss the main results of our work and suggest directions for continuing research.

2. Why is Uruguay an interesting case study?

After an early financial liberalization, Uruguay started to open its economy in the seventies. In the nineties the process was intensified, along with the signature of the

[1] See for instance Eslava et al. (2005).
[2] Casacuberta, Fachola and Gandelman (2004a, 2004b, 2005 and 2007).
[3] Casacuberta and Gandelman (2006 and 2009).

Mercosur treaty with Argentina, Brazil and Paraguay. Trade liberalization sought to continue and deepen the openness process, and reversing the anti-export bias that characterized previous import substitution policies. In 1991, with the signature of the Mercosur treaty a program of scheduled tariffs reductions began, that ended in 1995 with the establishment of an imperfect trade union. Through signing binding international treaties (Mercosur and World Trade Organization), the government significantly reduced its ability to provide discretionary protection.

Pervasive two digit inflation rates during the sixties and seventies eroded the confidence on the peso and dollarized the economy. In the early nineties a stabilization program based on an exchange rate anchor was launched, which considerably reduced inflation, but was accompanied by a significant real appreciation of the peso, especially vis-à-vis non Mercosur countries.

In the first half of the nineties, trade liberalization proceeded in the presence of strong – at least initially – unions and different industry concentration levels. Following the loss of democracy in 1973 and until 1984 unions were banned. After that, with the democratic recovery in 1985 and until 1991 tripartite (including worker, entrepreneur and government representatives) wage bargaining was set at the industry level with mandatory extension to all firms within the sector. This boosted the share of unionized workers. Beginning in 1992-1993, there was a shift towards decentralization and firm-specific bargaining that was reversed again in 2005 with new tripartite labor bargaining.

In 2002, Uruguay suffered a profound financial crisis triggered by contagion effects from the run on banks, massive currency devaluation, and gigantic default on sovereign debt that took place in next-door Argentina. In the wake of a run on its own exceedingly dollarized banking system, Uruguay's government was forced by the ensuing loss of international reserves to let the currency depreciate rapidly. It also rescued the banking system and intervened several failing banks, obtaining massive financial backing from the Washington-based multilateral agencies to that end. Eventually, the government also had to arrange for a market-friendly restructuring of the public debt. By 2004, Uruguay had regained access to the international capital markets and the economy started to recover.

3. Data

At the time we wrote the aforementioned papers, data availability was restricted to the Manufacturing sector. We used annual establishment level data from the Manufacturing Survey conducted by the Instituto Nacional de Estadística (INE) for the period 1982-1995, covering establishments with five or more employees. Constant prices measures of value added, materials and energy inputs were obtained using sector level price indexes from INE. The survey reports separately blue and white collar employment. Using the 1988 data from the economic census, an annual capital stock series was constructed using the perpetual inventory method.

Recently, new firm level data have become available for research. New data cover the 1997-2005 period, and more importantly extend the sector coverage. Besides the manufacturing sector, new data includes (according to ISIC Rev. 3): D-Manufacturing, E- Electricity, gas and water, G-Commerce, H-Hotels and restaurants, I-Transportation and communication services, K-Real estate and machine rentals, M-Educational services, N-Health services, and O-Other community, social and personal services. These data have not yet been used to study reallocation and adjustment costs.

4. Methodology

a. Factor reallocation

To measure factor flows, we follow Davis and Haltiwanger (1992) and Davis, Haltiwanger and Shuh (1996) and measure size for establishment *i* at time *t* as the average between factor used in period *t* and *t-1*, $\phi_{it} = \frac{X_{it} + X_{it-1}}{2}$. In turn the rate of growth is defined as $\Delta X_{it} = \frac{X_{it} - X_{it-1}}{\phi_{it}} = \frac{X_{it} - X_{it-1}}{\left((X_{it} + X_{it-1})/2\right)}$. These are not the usual rates of growth with the value observed in period t-1 in the denominator but there is a

monotonic relation between both of them. Denoting the traditional growth rate $g_{it} = \frac{X_{it} - X_{it-1}}{X_{it-1}}$, it can be shown that $g_{it} = \frac{2\Delta X_{it}}{2 - \Delta X_{it}}$.

There are several advantages of using these growth rates. They are symmetrical about 0 and restricted to finite values. Traditional growth rates attribute a plant birth a growth rate of positive infinity and a plant exit a growth rate of –1. With growth rates defined in relation to average employment (and not past employment), a plant birth and a plant exit correspond to 2 and –2 growth rates respectively.

Using these growth rates we compute summary factor flow statistics. For instance, for employment, Net creation (*Net*) is the change in total jobs, creation (*Pos*) is the sum of all newly created jobs (in the expanding plants), and destruction (*Neg*) is the sum of all destructed jobs (in contracting plants). Reallocation (*Sum*) summarizes the heterogeneity in plant level outcomes by adding the factor quantity destroyed and created in the period. Note that from these definitions reallocation is the sum of factor creation and factor destruction $Sum_t = Pos_t + Neg_t$.

Formally,

$$Net_t = \sum_i \phi_{it} \Delta X_{it}$$

$$Sum_t = \sum_i \phi_{it} \left| \Delta X_{it} \right|$$

$$Pos_t = \sum_i \phi_{it} max\left(\Delta X_{it}, 0\right)$$

$$Neg_t = \sum_i \phi_{it} \left| min\left(\Delta X_{it}, 0\right) \right|$$

b. Adjustment functions

To study adjustment costs we followed the methodological approach of Eslava *et al* (2005) to estimating adjustment functions. It is based on the observation that employment and capital are not generally at their desired levels when firms face adjustment costs. At any point in time there is a gap between the actual and the desired

levels. The adjustment function of employment (capital) is defined as the percentage of the employment (capital) gap that is actually closed when adjusting employment (capital) and is modeled as a function of the employment and capital gaps.

The desired rate of change ZX_{it} is defined, paralleling the previously defined growth rates, as a fraction of the average between the present desired level and the past observed level:

$$ZX_{it} = \frac{X^{*}_{it} - X_{it-1}}{\left(\left(X^{*}_{it} + X_{it-1}\right)/2\right)}$$

where X^{*}_{it} is the firm's desired level of factor of production X.

The desired rates of growth can be thought of as *shortages*, i.e. when $ZX_{it} > 0$, implying the firm desires a factor level higher this period with respect to that observed the period before (i.e. job/capital creation), or *surpluses*, i.e. $ZX_{it} < 0$ implying that the firm is willing to reduce its factor level with respect to last period's (i.e. job/capital destruction).

The adjustment function is defined as the fraction of the shortage that is actually closed by the firm. It is the ratio between the change in factor use and the shortage rate. Hence adjustment functions are defined as follows:

$$AX_{it} = \frac{\Delta X_{it}}{ZX_{it}}$$

A key methodological step in this procedure is the estimation of desired factor levels X^{*}_{it}. To do so, we first estimate the firm's frictionless factor levels, by a counterfactual profit maximization program. Our general framework is one of monopolistic competition in which firms have certain degree of market power. Our first step is to estimate the firm's frictionless factor demands. Frictionless levels correspond to input levels that the firm would choose in absence of adjustment costs, and are obtained from the firm's optimization problem.

A Cobb-Douglas technology was assumed, dependent on capital, blue collar employment and hours, white collar employment, energy, materials and a total factor productivity shock. While demands for all factors are obtained, it is assumed that in absence of adjustment costs for hours, energy and materials, the frictionless levels of those inputs coincide with the observed levels. This leads us to the three equations of the frictionless levels of capital, blue-collar employment and white collar employment as functions of the parameters of the model to be estimated and observed variables.

The productivity shock and production function parameters were recovered using the Levinsohn and Petrin (2003) methodology. We also estimated establishment level demand shocks using the inverse demand equation implicit in our monopolistic competition assumption. The inverse (log) demand function was estimated and the demand shock recovered as a residual.

Frictionless factor levels are not the same as the desired ones. Both differ in that the desired levels are those that would be observed if adjustment costs were momentarily removed, while frictionless levels are those that would hold in absence of adjustment costs in all periods. To obtain the desired factor levels Eslava et al. (2005) propose to follow Caballero and Engel (1993), who show that even with adjustment costs, under general assumptions the desired and frictionless factor demands are proportional.

Following Caballero, Engel and Haltiwanger (1995, 1997) the proportionality constants can be obtained as the ratio between the actual and frictionless factor levels, for the year where investment and employment growth take the median value for each of them. It implies that for a firm, in the year of the median employment growth and median investment, the desired and the actual adjustment coincide.

c. Protection, trade liberalization and other issues of interest

In the case of Uruguay we can reasonably argue that the usual endogeneity critique to the use of tariffs or changes in tariffs as explanatory variables does not apply. Uruguay is a minor player integrated with its much larger neighbor economies in Mercosur.

Hence the common external tariff and the changes in Uruguayan tariffs to converge to the trade block protection level are basically affected by Argentinean and Brazilian political players and beyond control for local firms. This conclusion can be drawn from Olarreaga and Soloaga (1998), an application of a Grossman and Helpman (1994) "protection for sale" model to the MERCOSUR common external tariff, in which it is shown that the customs union external tariff follows closely the Brazilian tariff structure.

In our econometric exercises we estimated the effect on reallocation and adjustment functions of various protection and trade liberalization measures. Making use of the particular institutional changes in Uruguay we could estimate the effect of unions in reallocation rates and how they increase or mitigate the effects of trade liberalization. By interacting these variables with reallocation and adjustment functions we also studied the impact of different sector concentration levels as well as the impact of China and India's import competition.

5. Results

a. Reallocation

We found that creation and destruction rates for employment and capital were relatively high and pervasive over time, both for white and blue-collar employment. Exits explained a sizeable part of destruction rates. Capital intensity increased, while relative capital labor price ratio fell, consistent with firms moving towards more capital intensive technologies.

Most of the excess reallocation (reallocation that was not required to accommodate changes in factor use, i.e. $Sum_t - |Net_t|$), was due to movements "within" rather than "between" sectors. Thus, reallocation rates seemed to be linked to establishment level heterogeneity rather than to aggregate shocks.

Larger and older firms tend to have more stable use of their factor of production. Most factor reallocation takes place in the smaller and younger firms. Larger firms create and destroy fewer jobs and less capital than the smaller ones. The latter effect is stronger than the former, implying that larger establishments had higher net creation rates.

Higher international exposure implied a slightly higher job creation and an important increase in job and capital destruction. Overall the opening of the economy is associated with larger reallocation rates.

There is agreement in the literature on the effects of Unions on wages, but their effect on other dimensions is less clear. We found that Unions were able to weaken the direct impact of trade liberalization by reducing job and capital destruction with almost no effect on creation. Therefore, we found unionization to be associated with more stable factor use, i.e. less reallocation. Industry concentration also was found to mitigate the destruction of jobs but had no effect on job creation or in capital dynamics.

The reallocation of production factors was accompanied by an increase in total factor productivity especially in sectors where tariff reductions were larger and unions were not present. Our result that unions were effective in reducing employment and capital destruction but inhibited productivity growth underscored the tradeoff between short term costs, as jobs are lost, and long term gains as productivity rise.

Over the fourteen years covered in our studies (1982-1995), blue and white collar net employment creation rates were similar, but there are two distinctive periods. In the first, under higher protection and government intervention in wage bargaining, blue collar net creation rates were higher than white collar rates. In the second period when substitution of labor for capital was stronger, protection was lower and employment bargaining was set at the firm level without government participation, more blue collar than white collar jobs were destroyed.

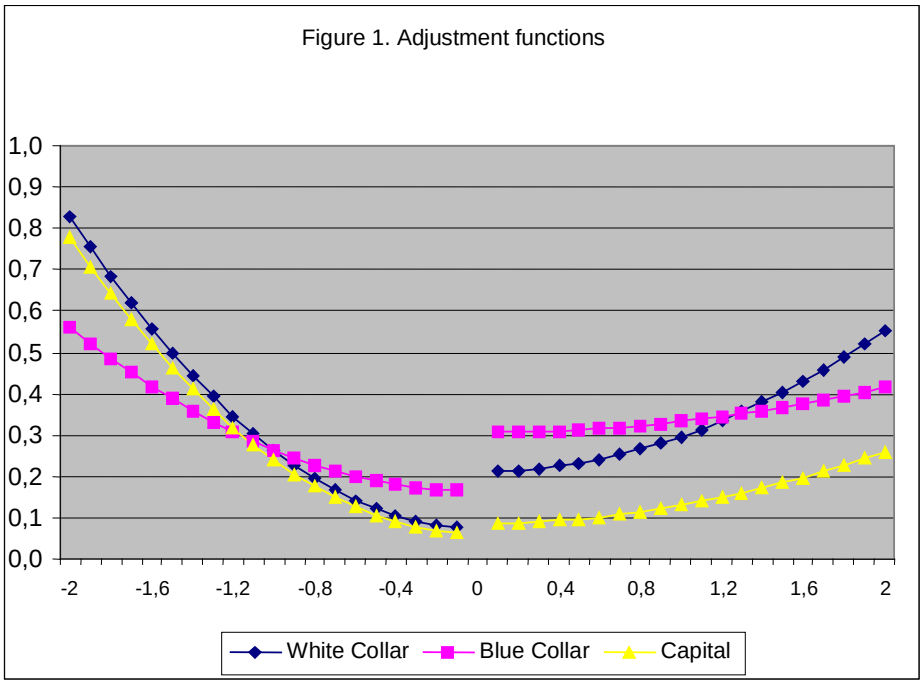
It is useful to put our results in perspective. Haltiwanger et al (2005) present evidence on job reallocation for a sample of Latin American countries in the same period experiencing similar tariff reductions and exchange rate appreciation processes than Uruguay. They report an average job reallocation rate of 21%, while Uruguay's 14%

remains the lowest among all. Are these relatively lower reallocation rates due to higher adjustment costs?

b. Adjustment functions

The estimation of the adjustment functions allows a graphical representation that illustrates our analysis. In the basic setup adjustment functions for white collar workers, blue collar workers and capital look like Figure 1. The percentage of adjustment is plotted as a function of the shortage/surplus. Negative desired rates of growth indicate that the past level of the input is above the desired one (there is a factor surplus), hence to close this gap the firm needs to decrease this factor, and finds itself in the job or capital destruction side. Conversely, positive desired rates of growth show a past factor level below the desired one (there is a factor shortage), hence if the firm wants to close the gap it will be in the factor creation side, i.e. it will invest or hire.

Figure 1 shows an asymmetric behavior in the adjustment process (both in the intercept and the slope of the adjustment functions). At small shortage levels, white and blue collar employment adjustment functions show an upward shift in the positive side. Firms tend to adjust a larger fraction of the gap between the desired and the actual employment when the observed levels are below the desired ones, i.e. the firm finds it easier to create labor than to destroy it except when the destructive adjustment is large. Note that for desired rates of growth in absolute value below 1, firms close a larger fraction of the gap of blue collar workers than of the gaps in other factors. A shortage of 1 or -1 corresponds to firms desiring to triplicate or reduce to one third their actual factor use. Therefore, for most firms, blue collar adjustment costs are lower than adjustment in other factors.



A firm that would like to cut all levels of factor employment by half (factor shortage = -0.66), would only reduce its level of white collar workers by 5% (10% of 50%), its level of blue collar workers by 10% (20% of 50%) and its level of capital by 5% (10% of 50%). On the contrary a firm that would like to increase its factors by 50% (factor shortage = 0.66), it would only increase its level of white collar workers by 12.5% (25 percent of 50 percent), its level of blue collar by 15% (30% of 50%) and its level of capital by 5% (10% of 50%). This suggests strong adjustment costs on the hiring and firing side for Uruguayan manufacturing firms.

The econometric estimations behind Figure 1 showed that shortages or surpluses of other factors are relevant to understand the adjustment process. The larger the shortages of one factor the less responsiveness in adjustment in the creation side of other factors but larger adjustment in the destruction side. If a firm whose desired level of two factors is above the current level, the larger the shortage in one factor the lower the adjustment in the other. For a firm desiring to have a lower level of two factors than their actual value, the larger the surplus in one factor the larger the adjustment in the other. This points against (in favor of) economies of scope in the adjustment cost function in the creation (destruction) direction. When firms want to hire more it is cheaper to adjust one factor at a time but when they want to reduce employment or scrap capital it is cheaper to reduce the use of both factors together.

Comparing the different factor adjustment functions, both in the creation and the destruction side, the slopes for white collar are larger than for blue collar labor. This may relate to differences in adjustment costs for each factor. Unions tend to be stronger in industries more intensive in blue collar labor inducing higher adjustment costs on the destruction side when employment surpluses are large; i.e. there will be lower adjustment when the desired rate of change is large in the destruction side. The white collar adjustment function has higher slope than blue collar adjustment on both sides. When the shortage is small in absolute value, adjustment is lower in white collar than in blue collar labor. Conversely, if the shortage is large in absolute value, a larger proportion of the gap is closed for white collars than for blue collars.

This may be because white collar labor includes workers with specific human capital, which is difficult to create. Therefore firms probably may be willing to accept small shortages without adjusting, but the adjustment will be fuller when the shortage becomes large in absolute value. For instance, consider a firm that has more clerks that needed, but they are familiar with the workings of the firm: if this shortage is not too large, the firm may prefer to keep these extra workers. On the other hand, if blue collars have less specific training, they may be more easily disposed. On the creation side, hiring an extra clerk implies higher training costs; hence the firm may prefer to use the existent workers more intensively if the shortage is small. If the shortage becomes large enough, the cost of the extra hours will be higher than the training cost of the newly hired white collar workers. These search and training costs include a fixed cost that can be covered only when the percentage of the gap closed is large enough.

Our analysis of the trade liberalization process and the impact of China and India imports was framed in terms of the changes in the intercept and the slope of the previously described adjustment functions.

Overall, we find that our period of analysis is particularly appropriate to evaluate the effect of tariff reductions on firm performance, since in those years tariff reductions were steady and of a significant magnitude. We analyzed the effect of changes as well as levels of import taxes (defined as simple averages of Harmonized System items by 4-digit ISIC class). The average tariff was reduced 43% to 14% between 1985 and 1995.

On average, annual tariff changes accelerated from –2.1% before 1990 to –3.0% thereafter.

In all of our regressions at least one policy interaction was significant. To evaluate the differences in adjustment with varying levels of trade liberalization we simulated the predicted adjustment using the estimated coefficients for different levels of changes in tariffs (0, 2, and 4 point reductions). While we find a negligible effect in capital adjustment, there is a pattern for both types of labor. For white collar and blue collar labor the fraction of the gap actually adjusted decreases in the creation side, while increases in the destruction side in presence of tariff reductions. For white collars this is produced by a change in the intercept while for blue collars it is produced by a change on the slope (both statistically significant).

Firms in sectors that experienced higher tariff reductions could adjust a larger proportion of their surpluses than those not so exposed. For white collars this result is present for low levels of desired rates of growth, while for blue collars the effect shows for higher desired rates of change. The change in the slope for white collars is not statistically significant, therefore changes in this case should be considered as parallel shifts. On the creation side it was the opposite: firms with lower tariff reductions adjusted a larger proportion of their shortages.

When instead of using the import tax change in the firm's sector we used the import tax level as a shifter of the adjustment functions, most policy interaction terms were statistically significant for blue collar and capital, while for white collar labor only the constant shifter for the creation side changed significantly. In this case we simulated the adjustment functions for tariff levels of 10, 20 and 30 percent points, and the results confirmed our previous finding: the effects of protection level were stronger for blue collar and capital than for white collar.

Lower tariff levels were associated to higher adjustment on the creation side, especially for blue collar jobs but also for white collar jobs and capital. Adjustment in the destruction side seemed not to change with tariff levels in the case of white collar adjustment functions. For capital and blue collar labor, higher tariff levels were

associated with lower adjustments in the destruction side, the opposite as in the creation side.

A possible explanation is that protected sectors are typically less competitive industries prone to reduce net employment even in the presence of trade protection. It can also be an indirect way to show that protection may in fact destroy jobs, rather than create them. If shocks to firm are iid, protection will lead to lower levels of employment, and this may have to do with firms' expectations. If there is a generalized positive demand shock, a firm in a highly protected sector will not adjust completely in the presence of adjustment costs (e.g., firing workers) unless the government has credibly committed to maintain protection. If there is any risk that the tariff will go down, the firm may be more reluctant to hire more workers than a similar firm in other sector not exposed to the risk of the government reducing tariffs. The same applies to the job destruction side. A highly protected firm that suffers a negative shock will be more likely to fire workers if the government's tariff is not a credible permanent policy.

Another interpretation is based on the fact that during the sample period there was a trend in tariff reductions in most industries, with the greatest reductions occurring in those industries initially most protected. These tariff changes were for the most part predictable in advance (especially after the signature of the Mercosur Treaty in 1990). The nature of factor adjustment due to such a predictable, and probably permanent, change in the economic environment is likely to be different from factor adjustment in response to fluctuations in demand or input prices over the business cycle. Firms would have incorporated expectations regarding how tariff reductions would affect the product demand curve they face and probably also input prices relevant to their factor employment decisions.

In this line, sectors that were initially more protected and foresaw downsizing would not have created jobs or capital even if they faced a temporary positive shock. The long run trend dominated their decisions and therefore more protection may be associated with less adjustment on the creation side. Similarly, firms in a highly protected sector that predicted lower levels of employment and capital in the medium run would have more likely destroyed factors in the face of a temporary negative shock since they knew that the general trend went that way. With a probably predictable trade liberalization trend,

tariff protection is associated with more adjustment on the destruction side and less in the creation side.

With respect to imports from China, the interaction terms for white collar workers with the import share were not significant, suggesting that the adjustment costs associated with this factor of production for firms facing strong competition from China are not different from those for firms that do not. The effect is felt on adjustment costs for blue collar workers. In the case of shortages the coefficient is negative, suggesting that the adjustment is smaller (and adjustment costs larger) for blue collar workers in the presence of surpluses. However in the presence of positive shortages the adjustment is larger: it is easier to hire blue collar workers. For capital, the only significant interaction suggests that firms subject to strong competition from China find it easier to adjust in the presence of capital shortages.

The analysis does not imply causality, since possibly smaller adjustment costs allow for higher import penetration from China. As 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. These may result from higher perceived volatility in Chinese imports when compared to imports from other regions. If this is so, firms would be more reluctant to fire workers and more willing to hire workers when exposed to more import competition from China than from more established and better-understood trading partners. Coefficients of variation for imports from China and India are twice the coefficient of variation for imports from the rest of the world.

Results for India suggest that adjustment functions for all factors change in the presence of stronger import competition from India. A number of interactions with India's import shares are significant, but their signs make difficult to assess the direction of this effect.

6. Conclusions and directions for future research

All in all, our micro data evidence supports some regularities present in previous literature on adjustment functions. Investment and job creation are not the result of smooth and continuous microeconomic decisions. Individual adjustment constraints

depart significantly from those implied by quadratic adjustment costs, and there are several sources of irreversibilities (technological, market-induced, increasing returns in the adjustment technology). The evidence provided seems to confirm a pattern that has important nonlinear features, hence consistent with such constraints. This impacts the use of all factors of production, particularly employment.

Adjustment costs faced by capital, white and blue collar labor are non trivial in the Uruguayan manufacturing sector, which has consequences in terms of factor unemployment and economic efficiency. The size of adjustment costs may reduce factor reallocation and dampen productivity gains.

Our main results confirmed the asymmetric nature of firms' adjustment process. Large shortages of one factor lead to less responsiveness in adjustment in the creation side of other factors and to larger adjustment in the destruction side.

We also assessed the effects of protection and trade liberalization on firms' adjustment process. The constraints arising from adjustment cost functions may become an important part of policy analysis. Our results point to a significant shift in adjustment functions for all production factors, associated with increased liberalization after the Mercosur treaty. Specifically, trade policy variables measured by tariffs levels and reductions in tariffs significantly shifted adjustment functions. Firms in less protected sectors have shown higher adjustment fractions in the creation side and lower in the destruction side, particularly for blue collar labor. Sectors facing larger tariff changes, adjusted less in the creation side, particularly for blue collars, and more on the destruction side. In the context of tariff reductions of Mercosur, more highly protected sectors were probably those that faced the largest tariff reductions. Overall the impact of higher international exposure on factors of production is stronger for blue collar workers than for white collar workers.

Though our work does not provide an empirical identification strategy to pinpoint the causal relationship between trade openness and adjustment costs, we believe our estimation results provide a powerful descriptive insight and valuable suggestions for the mechanisms behind observed firm behavior.

Our analysis also showed that adjustment costs faced by firms subject to strong Chinese and Indian competition seemed to be particularly large for firms that would like to reduce their levels of white collar workers. 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).

Finally, policies should be based on a wide look at the economy. Inference from the manufacturing sector may not be extendable to other sector of production. As new panel data on service sectors becomes available we should extend our empirical work to cover all sectors of activity.

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