Factor Market Institutions and Factor Reallocation in Latin-America: the Case of Heterogeneous Workers

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Abstract

This paper seeks to deepen our understanding of the inter-relation between factor market institutions and the process of factor adjustment. In doing so, we take into account the possibility of heterogeneous but interrelated adjustments of different types of workers, as well as capital. To this end, we extend the analytical framework and empirical analysis of Eslava et al. (2005) to study the simultaneous adjustment of capital, qualified labor and unqualified labor in Latin America. Given our lack of access to the necessary micro data for countries other than Colombia, we develop a simulation environment that generates such data from aggregate information on economic activity and institutions and data on Colombian manufacturing establishments.

1 Introduction

The ability of firms to adjust their use of production factors in the face of shocks is considered a key ingredient for both active productivity growth and high levels of aggregate employment. In fact, several studies have confirmed, for different countries and periods of study, the more general finding that changes in the allocation of inputs and outputs across producers are an important source of productivity growth.[1]. The recognition of the importance of permitting dynamic factor adjustment processes has led to the development of a growing literature on such adjustment processes and the costs associated with them.

It is by now widely documented that firms face different types of costs of adjusting their use of factors, and that each of these types has different implications for the adjustment process. Cooper and Haltiwanger (2005), for instance, have shown that capital adjustment in the US is best described by a model

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[1]Some of those studies are Baily et al. (1992), Aw et al. (2002), Levinsohn and Petrin (1999), Bartelsman et al. (2004), and Eslava et al. (2004,2005).

that incorporates both convex and non-convex costs of adjustment, as well as irreversible investment. Models restricted to convex adjustment costs are incapable of explaining the lumpiness that capital adjustment exhibits. Caballero, Engel and Haltiwanger (1997), meanwhile, study employment adjustment, and find that it is also lumpy. Non-convex adjustment costs, and the resulting non-linearities of the adjustment process, are thus key ingredients to analyze factor adjustment.

In the policy arena, meanwhile, the debate in terms of factor adjustment and productivity growth has centered around the potential role of institutions as determinants of adjustment costs. The recognition of the importance of flexibility in factor markets, for instance, has been one of the main reasons behind large scale reform processes in many regions of the world. Latin America was no exception to this trend: good part of the comprehensive reforms implemented in the region during the 1990s was aimed at liberalizing factors markets. The theoretical literature has also paid attention to the potentially adjustment-impeding role of regulations. Bertola and Rogerson (1997) and Caballero and Hammour (1994) are two examples of theoretical studies dealing with the issue.

Almost all studies on factor adjustment (especially those that incorporate non-convex adjustment costs) and its relationship with market institutions have until now focused on only one margin of adjustment, either employment or capital. Factor demands, however, are clearly inter-related. Firms do not analyze different margins separately when considering how much to adjust in each of those margins and, as a consequence, the desired levels of different factors depend on one another. In this sense, adjustment costs in one factor market affect the demand for other factors, and factor adjustment should be ideally studied in a framework that considers the different margins simultaneously. This is particularly important when considering the effects of institutions, as de-regulation in one factor market may have effects on the demands of other factors, potentially reversing the conclusions on the desirability of certain policy changes.

Eslava et al. (2005) develop a framework where simultaneous and inter-related capital and employment adjustments are considered. They take advantage of unique database for Colombian manufacturing plants to implement their framework, which is highly demanding in terms of data. This paper attempts to extend their study to the more comprehensive case of the Latin American region, allowing also for differential adjustment between low- and high-skill workers. In the process, two methodological contributions are made. First, we extend the methodological framework to consider simultaneous and inter-related adjustments of white-collar labor, blue-collar labor, and capital. Second, given difficult access to the necessary micro data for other Latin American countries, we propose a simulation environment to generate such data from data on Colombian manufacturing establishments and data on aggregate economic performance and institutions for those other countries.

Separating the adjustment of production and non-production workers is important for two main reasons. First, for a firm, adjusting the use of highly qualified personnel is fundamentally different from adjusting the level of blue-collar workers. Both hiring and dismissal costs are presumably different between these two margins: separating a white-collar worker usually involves not only paying him/her a compensation, but also loosing match-specific capital, usually higher for highly qualified jobs. As a result of this, firms may also spend more resources screening for the best applicant when trying to fill vacancies that demand high-level skills. Several studies in fact document differences between the adjustment of skilled- and less-skilled labor (Foster1999, Nickell 1986), as well as differential effects of labor market regulations on workers in the two categories (Montenegro and Pages, 2005)

A second reason why this study emphasizes the difference between production and non-production workers is that the policy debate in Latin America has recently centered around the importance of shifting towards more skill-intensive production technologies to guarantee sustained productivity growth as well as competitiveness in international markets. A recent study by the World Bank, for instance, insists on the importance of such shifts: "Trade and FDI have facilitated (...) competitive pressures. (...) Hiring and training more educated workers is one way to respond to this pressure to become more productive" (De Ferranti et a., 2003, page 2). If a change in the skill mix of labor is desirable, the finding in Eslava et al. (2005) that employment adjustment became more flexible with the reforms of 1990s but only in the destruction side may not be worrisome, if it is driven by the destruction of low-skill jobs, and masking greater creation of white-collar jobs.[2] Thus, further decomposing employment changes is important to identify the effects of institutions.

We use our simulated data to estimate adjustment functions for a group of countries in Latin America. Our emphasis is on the effects of an indicator of the flexibility of market institutions on adjustment. Even for developed economies, the relationship between factor market institutions and outcomes in those markets is far for settled. For Latin America, the question is particularly interesting, as adjustment in the context of developing economies is an issue that only recently has received attention (Caballero, Engel and Micco 2005, Eslava et al. 2005, Casacuberta and Gandelman 2005).

After relating market institutions and factor adjustment processes for Latin America, we go back to the specific Colombian case, for which we have actual data, to see how the relationship between institutions and factor adjustment gets translated into employment outcomes. Furthermore, we use these higher quality data to try to decompose the effects of institutions into those related to three groups of regulations: trade regulations, labor market regulations, and a group of institutions that we relate to greater access of firms to financing.

Our findings for basic adjustment functions indicate, first, that firms substitute across the different margins of adjustment. This results in dynamic complementarities between the demands for different factors, and highlights the importance of studying the different adjustment processes in a unifying framework. Second, we find important differences between the adjustment of the three

[2] For other countries, some results have indeed shown a change after reforms in the composition of employment toward a higher skill level. Revenga (1995), for instance, shows that the Mexican trade liberalization of the late 1980s was accompanied by a shift of industrial employment toward non-production jobs.

factors. While allowing for non-linear adjustment is key for the case of high-skill jobs and capital, the same is not true for production workers, where the patterns of adjustment are consistent with convex adjustment costs. Moreover, for non-production workers non-linear adjustment is present only in the creation side, while the adjustment of production workers exhibits no important asymmetries between the creation and destruction sides. The capital adjustment function shows a deep contrast between investment and retirements: while there is active response to shortages in the form of capital purchases, firms facing surpluses of capital undertake almost no adjustment.

In terms of the effects of institutions, we also find interesting differential patterns for the two types of workers. While less restrictive institutions make the adjustment of non-production workers more dynamic on both the creation and destruction sides, for low-skill jobs they only stimulate consistently the destruction of jobs. This is consistent with the expected pattern of skill-biased change in the composition of the labor force when firms are faced with more competitive and flexible regulations. Interestingly, we find an increasing pattern of employment adjustment functions only for less regulated environments. This may suggest that non-convexities in the employment adjustment costs functions are mostly related to technological constraints rather than regulations: under more stringent regulations, the convex components of the adjustment cost function seem to dominate.

Using data for Colombia, we find that the evidence of de-regulation leading to more dynamic destruction of blue-collar labor and hiring of skilled workers is consistent with actual employment outcomes. Our measure of institutions shows a much less regulated environment in Colombia after 1990, capturing the structural reform process pursued in the country in the 1990s. When comparing employment outcomes for the 90s and the 80s, we find that the ratio between non-production and production employment grew over time. There are also higher job reallocation rates for both types of employment after 1990, but in the case of blue-collar workers the increase is due solely to greater job destruction (while for qualified workers both job creation and destruction rates grow).

In the capital adjustment margin, investment in response to capital shortages decreases with the level of strength of regulations. This is consistent with a reduction of adjustment costs generated by more flexible regulations. On the other hand, capital shedding is less responsive to surpluses in less regulated environments. This is possibly reflecting a pattern of substitution away from capital reductions into employment reductions, and thinner secondary markets for capital goods when the demand for such goods can be satisfied in more efficient first-hand markets.

The paper proceeds as follows. Section 2 describes the theoretical framework, while section 3 explains the methodology and data we use to apply such framework. It is in section 3 where, among other methodological issues, we present our proposed simulation environment to generate data for other countries. Section 4 describes our findings in terms of adjustment processes for different factors of production in Latin America, and their relationship with institutions. In section 5 we go back to the case of Colombia and conduct two exercises: compare our findings in terms of institutions and factor adjustment with actual employment outcomes, and try to decompose the effects of institutions into those stemming from trade regulations, labor market regulations, and financial regulations. Finally, section 7 concludes by summarizing our main results.

2 Theoretical Framework

2.1 Adjustment Functions

We follow the theoretical framework developed by Caballero, Engel and Haltiwanger (1995, 1997) to study factor adjustment in the presence of –possibly non-convex– adjustment costs. Eslava et al. (2005) extend that framework to take into consideration simultaneous adjustments of capital and labor, and here we use a similar extension to allow inter-related adjustments of capital, white collar employment and blue-collar employment.

Caballero, Engel and Haltiwanger base their methodological framework on the observation that firms facing adjustment costs are unlikely to demand each factor up to its "desired level", defined as the level the firm would choose in the absence of factor market frictions.[3] Inferences about the structure of adjustment costs can then be made by analyzing the relationship between actual and desired factor levels.

In this paper, we emphasize the difference between different types of employment. Plant j subject to costs of adjusting employment and capital will face shortages of white-collar workers, blue-collar workers, and capital, ZW_{jt}, ZB_{jt} and X_{it} at time t. The shortage of white collar workers is given by,

$$ZW_{jt} = \frac{Q_{jt}^{*} - Q_{jt-1}}{0.5 * \left(Q_{jt}^{*} + Q_{jt-1}\right)}, \tag{1}$$

where Q_{jt}^{*} is the desired level of white-collar employment ("qualified labor"), or the level of employment of white collar workers if adjustment costs are momentarily removed, and Q_{jt-1} is the initial observed white-collar employment[4]. Similarly, the shortage of blue-collar workers is:

$$ZB_{jt} = \frac{U_{jt}^{*} - U_{jt-1}}{0.5 * \left(U_{jt}^{*} - U_{jt-1}\right)} \tag{2}$$

where U_{jt}^{*} is the desired level of white-collar employment ("unqualified labor"), or the level of employment of blue-collar workers if adjustment costs are

[3] Some of those frictions may be related to the production technology, such as the need to stop production to install new machinery, while others arise from factor market institutions.

[4] We define all growth rates using the average between the current and past levels in the denominator. As pointed out by Davis, Haltiwanger and Schuh(1996), this yields growth rates that are symmetric to positive and negative changes, and bounded between 2 and -2. We use this type of measure for both "desired" and actual growth rates.

momentarily removed, and U_{jt-1} is the initial observed blue-collar employment. Finally, the capital shortage can be written as,

$$X_{jt} = \frac{K^*_{jt} - K_{jt-1}}{0.5 * \left(K^*_{jt} - K_{jt-1}\right)}, \tag{3}$$

where K^*_{jt} is the desired level of capital, or the level of capital if adjustment costs are momentarily removed, and K_{jt-1} is the initial observed level of capital.

Actual adjustment is defined as the difference in the actual level of a factor between periods t and $t-1$. That is, for white-collar employment, blue-collar employment, and capital, respectively:

$$\begin{aligned}
\Delta Q_{jt} &= \frac{Q_{jt} - Q_{jt-1}}{0.5 * (Q_{jt} + Q_{jt-1})}, \\
\Delta U_{jt} &= \frac{U_{jt} - U_{jt-1}}{0.5 * (U_{jt} - U_{jt-1})}, \\
\Delta K_{jt} &= \frac{K_{jt} - K_{jt-1}}{0.5 * (K_{jt} - K_{jt-1})}
\end{aligned}$$

Actual adjustments may thus differ from desired adjustments if, given adjustment costs, firms find profitable not to fully drive its use of each factor to the desired level. Note that our framework can accommodate entry and exit, but only in an accounting sense. One could incorporate entering plants as having $Q_{jt-1} = U_{jt-1} = K_{jt-1} = 0$, and similarly incorporate exiting plants as those that in the year after exiting have $Q_{jt} = U_{jt} = K_{jt} = 0$. We would then be imposing that both shortages and actual adjustments are equal to 2 for entering firms and -2 for exiting firms, so that these firms are perfectly able to adjust. In this sense, we cannot contribute much to the study of how entry and exit play into aggregate adjustment. We will therefore abstract from these issues by limiting our sample to that of pairwise continuers (plants that were in the sample both in t and $t-1$).

We define the adjustment hazard by the fraction of a given factor's shortage that a firm "closes", and denote those functions as AW for white collar workers, AB for blue collar workers, and AK for capital. We then model this fraction as a function of the shortages the plant faces in all adjustment margins, and call this the "adjustment function" for that factor. In other words, we define the white collar, blue collar, and capital adjustment functions as:

$$\begin{aligned}
AW(ZW_{it}, ZB_{it}, X_{it}) &= \frac{\Delta Q_{jt}}{ZW_{it}}(ZW_{it}, ZB_{it}, X_{it}) \qquad (4) \\
AB(ZW_{it}, ZB_{it}, X_{it}) &= \frac{\Delta U_{jt}}{ZB_{it}}(ZW_{it}, ZB_{it}, X_{it}) \\
AK(ZW_{it}, ZB_{it}, X_{it}) &= \frac{\Delta K_{jt}}{X_{it}}(ZW_{it}, ZB_{it}, X_{it})
\end{aligned}$$

We estimate these adjustment functions parametrically, allowing for non-linear adjustment. Inter-related factor demands are captured by the fact that the adjustment of one factor depends on shortages of all three factors. In particular, we permit a given factor's adjustment function to shift with other factors' shortages. We estimate:

$$\begin{aligned} AW(ZW_{it}, ZB_{it}, X_{it}) &= \lambda_W + \lambda_{W2}\left(ZW_{jt}\right)^2 + \lambda_{WB} ZB_{jt} + \lambda_{WX} X_{jt} \quad (5) \\ AB(ZW_{it}, ZB_{it}, X_{it}) &= \lambda_B + \lambda_{B2}\left(ZB_{jt}\right)^2 + \lambda_{BW} ZW_{jt} + \lambda_{BX} X_{jt} \\ AK(ZW_{it}, ZB_{it}, X_{it}) &= \lambda_X + \lambda_{X2}\left(X_{jt}\right)^2 + \lambda_{XB} ZB_{jt} + \lambda_{XW} ZW_{jt} \end{aligned}$$

The form of adjustment functions reveals details on the structure of adjustment costs. A simple partial adjustment model with quadratic adjustment costs generates actual adjustment rates that are a constant fraction of the desired rates. A white-collar employment adjustment function independent of ZW, a blue-collar employment function independent of ZB, and a capital adjustment function independent of X are thus consistent with quadratic adjustment costs. By contrast, the presence non-convexities in the adjustment costs functions would generate employment and capital adjustment functions that depend on the shortage of the "own" factor. For instance, firms facing fixed adjustment costs would be more responsive to large shortages than small shortages, implying an adjustment function increasing in the (absolute value) of the shortage or surplus.

The possible presence of fixed adjustment costs generate a potential problem for the estimation of adjustment functions. In the presence of such costs, firms go through periods of inactive adjustment, as adjustment is postponed until the firm faces large shortages or surpluses As a result, ΔQ_{jt}, ΔU_{jt}, and ΔK_{jt} may take values of zero or close to zero. The adjustment hazards are ill-defined in these cases (see equations 4), which makes it difficult to estimate (5). To address this difficulty, we estimate a transformed version of (5), given by:

$$\begin{aligned} grq_{jt}(W,B,X) &= W_{jt} * AQ_{jt}(W,B,X) \\ gru_{jt}(W,B,X) &= B_{jt} * AU_{jt}\,(W,B,X) \\ grk_{jt}(W,B,X) &= X_{jt} * AK_{jt}(W,B,X) \end{aligned}$$

Aggregate adjustment depends on both the plants' adjustment decisions, captured by the adjustment functions, and the location of plants in terms of shortages. The locations are summarized by the cross-section distribution of the shortages $f(ZW, ZB, X, t)$, so that the fraction of plants with shortages of white-collar workers between W and $W + \triangle W$ is approximately $f(ZW, ZB, ZX, t)\triangle W$, and similarly for the other type of employment and for capital. The aggregate change in employment and investment will be given by:

$$\begin{aligned}
\triangle Q &= \int\int\int ZW \ AQ(ZW.ZB, X, t) \ f(ZW, ZB, X, t) \ dZWdZBdX, \quad (6) \\
\triangle U &= \int\int\int ZB \ AU(ZW.ZB, X, t) \ f(ZW, ZB, X, t) \ dZWdZBdX, \quad (7) \\
\triangle K &= \int\int\int ZX \ AK(ZW.ZB, X, t) \ f(ZW, ZB, X, t) \ dZWdZBdX, \quad (8)
\end{aligned}$$

Since we are interested in the effect of institutions on adjustment processes, we extend the adjustment functions to try to capture these effects. We interact each term of the adjustment functions 5 with an index that captures labor market flexibility, financial liberalization and trade liberalization. The index is described in detail below.

2.2 Desired factor demands

To be able to estimate shortages and adjustment functions, we need to first determine the desired levels of capital and different types of employment. The desired levels are conceptually equivalent to the frictionless levels of employment and capital (those that the firm would choose in absence of adjustment costs), but can effectively differ from these due to measurement error. We thus assume that the desired demands can be proxied, up to a constant, by the frictionless demands. In particular, the desired and frictionless levels relate to each other as follows:

$$\begin{aligned}
Q^*_{jt} &= \overline{Q}_{jt} * \theta_{Qj}, \\
\widetilde{U}^*_{jt} &= \overline{U}_{jt} * \theta_{Uj}, \\
\widetilde{K}^*_{jt} &= \overline{K}_{jt} * \theta_{Kj},
\end{aligned}$$

where $\overline{Q}_{jt}$, $\overline{U}_{jt}$ and $\overline{K}_{jt}$ are the frictionless levels of employment and capital, and θ_{Qj}, θ_{Uj} and θ_{Kj} are the plant-specific employment and capital constants. The frictionless levels of different types of employment and of capital will be determined below by the first-order conditions of the firms' static optimization problem in absence of adjustment costs. As in Eslava et al. (2005), θ_{Qj}, θ_{Uj} and θ_{Kj} will be determined as the ratio between past and frictionless levels for the year in which median actual adjustment was observed at plant j. Median adjustment is here interpreted as reflecting replacement employment changes and replacement investment.

Both to determine the frictionless levels of employment and capital and to determine the plant-specific constants, we need to solve the firms' optimization problem and the resulting first-order conditions. The firm's production function is:

$$Y_{jt} = K^{\alpha}_{jt} \left(Q_{jt} H_{qjt}\right)^{\beta} \left(U_{jt} H_{ujt}\right)^{\rho} E^{\gamma}_{jt} M^{\phi}_{jt} V_{jt}, \quad (9)$$

where K_{jt} is capital, Q_{jt} is "qualified" employment, H_{qjt} are hours of white-collar workers, U_{jt} is "unqualified" employment, H_{qjt} are hours of blue-collar workers, E_{jt} is energy use, M_{jt} are materials, and V_{jt} is a productivity shock. We assume there may be adjustment costs on employment and capital, but not on hours, energy or materials.

There is an inverse demand for the product given by:

$$P_{jt} = Y_{jt}^{-\frac{1}{\eta}} D_{jt}, \tag{10}$$

where D_{jt} is a demand shock and where $-\frac{1}{\eta}$ is the inverse of the elasticity of demand.

Finally, the firm faces competitive factor markets, where total labor costs, capital costs, energy costs and materials costs are:

$$\begin{aligned}
\omega\left(Q_{jt}, H_{qjt}\right) &= w_{0t}^{q} L_{jt}\left(1 + w_{1t} H_{qjt}^{\delta}\right) \\
\omega\left(U_{jt}, H_{ujt}\right) &= w_{0t}^{u} L_{jt}\left(1 + w_{1t} H_{ujt}^{\delta}\right) \\
& \quad R_t K_{jt}, \\
& \quad P_{Et} E_{jt}, \\
& \quad P_{Mt} M_{jt},
\end{aligned}$$

where the wage function depends on the straight-time wage for each type of labor, w_{0t}^{q}, and w_{0t}^{u}, as well as on the overtime premium w_{1t}. The firm takes the user cost of capital, R_t, and energy and material prices, P_{Et} and P_{Mt}, as given.

In a frictionless environment, the firm maximizes revenues by choosing the level of each factor ignoring adjustment costs. The resulting First Order Conditions yield a system of seven equations in seven variables, one for each factor the firm can use (including hours of each type of worker). Since we assume the use of hours, energy, and materials can be changed without incurring in adjustment costs, $\overline{H}_{qjt}$, $\overline{H}_{ujt}$, $\overline{E}_{jt}$, and $\overline{M}_{jt}$ are equal to their observed values. The frictionless demands of these factors can then be treated as known. Therefore, the system is reduced to three equations and three unknowns: $\overline{Q}_{jt}$, $\overline{U}_{jt}$, and $\overline{K}_{jt}$. Letting $\widetilde{Y}$ represent the natural log of a variable Y, and denoting

$$\begin{aligned}
C_{jt} &= \left[\widetilde{w}_{0t}^{q} + \ln(1 + w_{1t}\overline{H}_{qjt}^{\delta}) - \ln\beta\right] \\
N_{jt} &= \left[\widetilde{w}_{0t}^{u} + \ln(1 + w_{1t}\overline{H}_{ujt}^{\delta}) - \ln\rho\right]
\end{aligned}$$

, the three-equation system can be written as

$$\begin{aligned}
\widetilde{\overline{K}}_{jt} &= \frac{\left(\frac{\eta}{\eta-1}\right)\left[\ln\left(\frac{\eta}{\eta-1}\right) - \widetilde{D}_{jt}\right] - \widetilde{V}_{jt} - \beta\widetilde{\overline{H}}_{qjt} - \rho\widetilde{\overline{H}}_{ujt} - \gamma\widetilde{\overline{E}}_{jt} - \phi\widetilde{\overline{M}}_{jt} + \left(\frac{\eta}{\eta-1}\right)\left[\widetilde{R}_t - \ln\alpha\right] - \beta\widetilde{\overline{Q}}_{jt} - \rho\widetilde{\overline{U}}_{jt}}{\left[\alpha - \left(\frac{\eta}{\eta-1}\right)\right]} \\
\widetilde{\overline{Q}}_{jt} &= \frac{\left(\frac{\eta}{\eta-1}\right)\left[\ln\left(\frac{\eta}{\eta-1}\right) - \widetilde{D}_{jt}\right] - \widetilde{V}_{jt} - \beta\widetilde{\overline{H}}_{qjt} - \rho\widetilde{\overline{H}}_{ujt} - \gamma\widetilde{\overline{E}}_{jt} - \phi\widetilde{\overline{M}}_{jt} + \left(\frac{\eta}{\eta-1}\right)C_{jt} - \alpha\widetilde{\overline{K}}_{jt} - \rho_{jt}\widetilde{\overline{U}}_{jt}}{\left[\beta - \left(\frac{\eta}{\eta-1}\right)\right]} \\
\widetilde{\overline{U}}_{jt} &= \frac{\left(\frac{\eta}{\eta-1}\right)\left[\ln\left(\frac{\eta}{\eta-1}\right) - \widetilde{D}_{jt}\right] - \widetilde{V}_{jt} - \beta\widetilde{\overline{H}}_{qjt} - \rho\widetilde{\overline{H}}_{ujt} - \gamma\widetilde{\overline{E}}_{jt} - \phi\widetilde{\overline{M}}_{jt} + \left(\frac{\eta}{\eta-1}\right)N_{jt} - \beta\widetilde{\overline{Q}}_{jt} - \alpha\widetilde{\overline{K}}}{\left[\rho - \left(\frac{\eta}{\eta-1}\right)\right]}
\end{aligned}$$

The solution to this system yields expressions for frictionless levels of capital and each type of employment expressed in terms of the parameters of the model, wages, interest rates, energy and materials prices, unobservable productivity and demand shocks, and the use of other factors: $\overline{H}_{qjt}$, $\overline{H}_{ujt}$, $\overline{E}_{jt}$, and $\overline{M}_{jt}$. The solution is given by:

$$
\begin{aligned}
\widetilde{\overline{K}}_{jt} &= \frac{\left(\frac{\eta}{\eta-1}\right)\left[\ln\left(\frac{\eta}{\eta-1}\right)-\widetilde{D}_{jt}\right]-\widetilde{V}_{jt}-\beta\widetilde{\overline{H}}_{qjt}-\rho\widetilde{\overline{H}}_{ujt}-\gamma\widetilde{\overline{E}}_{jt}-\phi\widetilde{\overline{M}}_{jt}+\left(\frac{\eta}{\eta-1}-\beta-\rho\right)\left[\widetilde{R}_t-\ln\alpha\right]+\beta C_{jt}+\rho N_{jt}}{\left[\alpha+\beta+\rho-\left(\frac{\eta}{\eta-1}\right)\right]} \\
\widetilde{\overline{Q}}_{jt} &= \frac{\left(\frac{\eta}{\eta-1}\right)\left[\ln\left(\frac{\eta}{\eta-1}\right)-\widetilde{D}_{jt}\right]-\widetilde{V}_{jt}-\beta\widetilde{\overline{H}}_{qjt}-\rho\widetilde{\overline{H}}_{ujt}-\gamma\widetilde{\overline{E}}_{jt}-\phi\widetilde{\overline{M}}_{jt}+\left(\frac{\eta}{\eta-1}-\alpha-\rho\right)C_{jt}+\alpha\left(\widetilde{R}_t-\ln\alpha\right)+\rho N_{jt}}{\left[\alpha+\beta+\rho-\left(\frac{\eta}{\eta-1}\right)\right]} \\
\widetilde{\overline{U}}_{jt} &= \frac{\left(\frac{\eta}{\eta-1}\right)\left[\ln\left(\frac{\eta}{\eta-1}\right)-\widetilde{D}_{jt}\right]-\widetilde{V}_{jt}-\beta\widetilde{\overline{H}}_{qjt}-\rho\widetilde{\overline{H}}_{ujt}-\gamma\widetilde{\overline{E}}_{jt}-\phi\widetilde{\overline{M}}_{jt}+\left(\frac{\eta}{\eta-1}-\alpha-\beta\right)N_{jt}+\beta C_{jt}+\alpha\left(\widetilde{R}_t-\ln\alpha\right)_t}{\left[\alpha+\beta+\rho-\left(\frac{\eta}{\eta-1}\right)\right]}
\end{aligned}
$$

These frictionless levels can be estimated numerically by obtaining the various parameters and unobserved variables as described below. The desired levels of capital and employment, used to calculate ZW_{jt}, ZB_{jt} and X_{jt}, are then:

$$
\begin{aligned}
\overline{K}_{jt} &= \exp\left(\widetilde{\overline{K}}_{jt}\right) \\
\overline{Q}_{jt} &= \exp\left(\widetilde{\overline{Q}}_{jt}\right) \\
\overline{U}_{jt} &= \exp\left(\widetilde{\overline{U}}_{jt}\right)
\end{aligned}
$$

3 Empirical implementation

Our theoretical framework is highly demanding in terms of data: we need information at the establishment level on factor use, production and prices (to separate demand and productivity shocks faced by the establishment). The availability of all these variables, especially prices, at such high level of disaggregation is extremely rare. We have access to a unique dataset containing all of this information for Colombian manufacturing establishments; We now describe the empirical implementation of our framework for this case, in which all the necessary information is available. In section 3.2, we describe an extension to simulate, from these original data, the necessary pieces of information for a set of countries within Latin America.

3.1 The Colombian case

Our data for Colombia are the same used by Eslava, Haltiwanger, Kugler and Kugler (2004, 2005). The information comes from the Colombian Annual Manufacturers Survey (AMS) for the years 1982 to 1998. Our unit of observation is thus the establishment or plant. The AMS is an unbalanced panel of all Colombian manufacturing plants with more than 10 employees, or sales above a certain limit (around US$35,000 in 1998). The AMS includes information for each plant on: value of output and average prices charged for each product manufactured (products are reported at the 8 digits ISIC level); overall cost and average prices paid for each material used in the production process; energy consumption in physical units and average energy prices; production and non-production number of workers and payroll; and book values of equipment and structures.

To implement the methodology explained above, we need measures of productivity and demand shocks as well factor use at the plant level. We estimate total factor productivity (TFP) for each plant using a capital-labor-materials-energy production function that separates labor into white- and blue-collar,and demand shocks for each plant using a standard inverse-demand function. Therefore, we need to construct physical quantities and prices of output and inputs, capital stock series, and labor hours. The construction of these variables and productivity and demand shocks is explained below. A more thorough description of the measurement of each variable can be found in Eslava, Haltiwanger, Kugler and Kugler (2004), while we provide below only key details.

Eslava et al. (2004) construct plant-level price indices for output, materials, and energy. Plant level output prices are constructed from Tornqvist indices, in turn generated as weighted averages of the price changes of the different goods produced by the plant. Materials prices are generated in a similar manner, while plant-level energy price indices are readily available in the AMS.

The availability of plant-level price data represents an enormous advantage with respect to other sources of data for three different reasons. First, in this context being able to separate demand and productivity shocks is key. Plant-level demand shocks can only be plausibly estimated if one can access plant-level output prices. Second, the use of more aggregate price deflators is a common source of measurement error. Finally, plant level input prices provide a valuable instrument in the estimation of production function.

Given prices for materials and output, the quantities of materials and output are constructed by dividing the cost of materials and value of output by the corresponding prices. Quantities of energy consumption are directly reported by the plant. The plant capital stock (which includes equipment and buildings) is constructed by recursively using a perpetual inventory method:

$$K_{jt} = (1 - \kappa) K_{jt-1} + \frac{I_{jt}}{P_{It}}$$

for all t such that $K_{jt-1} > 0$, where I_{jt} is gross investment, κ is the depreciation rate and P_{It} is a deflator for gross capital formation obtained from annual input-output matrices. For each plant, we initialize the series at the book value reported in the first year the plant appears in the sample. We use the depreciation rates calculated by Pombo (1999) at the 3-digit sectoral level Gross investment is generated from the information on fixed assets reported by each plant.

We can separate workers only into production and non-production categories. We denote non-production personnel as white collar-workers and production personnel as blue-collar workers, but it is important to emphasize that we are not directly measuring the level of education of each worker.[5] The level of disaggregation of employment reported by the AMS has varied over time: while in some years of the sample workers were divided in several categories, in others only production and non-production categories were reported. We generate a consistent classification over time by dividing workers in all years between production and non-production.[6]

Since the AMS does not have data on worker hours, we construct a measure of hours per worker of a given type of worker at time t for sector $G(j)$, to which plant j belongs, as,

$$\begin{aligned} H_{qjt} &= \frac{earnings^{q}_{G(j)t}}{w^{q}_{G(j)t}}, \\ H_{ujt} &= \frac{earnings^{u}_{G(j)t}}{w^{u}_{G(j)t}}, \end{aligned}$$

where $w^{q}_{G(j)t}$ is a measure of sectoral wages of white-collar workers at the 3-digit level from the Monthly Manufacturing Survey, $w^{u}_{G(j)t}$ is a similar measure for blue-collar workers. Also, $earnings^{q}_{G(j)t}$ and $earnings^{u}_{G(j)t}$ are measures of earnings per worker constructed using the AMS data for white-collar and blue-collar workers, respectively:

$$\begin{aligned} earnings^{q}_{G(j)t} &= \frac{\sum\limits_{j\in G} payroll^{q}_{jt}}{\sum\limits_{j\in G} Q_{jt}}. \\ earnings^{u}_{G(j)t} &= \frac{\sum\limits_{j\in G} payroll^{u}_{jt}}{\sum\limits_{j\in G} U_{jt}}. \end{aligned}$$

Table 1 presents descriptive statistics of the quantity and price variables just described, over the period covered by our sample (1982-1998). The quantity variables are expressed in logs, while the prices reported are log differences of the respective price index with respect to a yearly producer price index. The table also reports mean wages for production and non-production workers, in pesos of 1982. Below, we use these variables to estimate the production function and inverse-demand equation.

3.1.1 Productivity Shock Estimation

Total factor productivity for each establishment can be obtained as the residual from the production function, equation (9), after having estimated the corre-

[5] Results must be interpreted keeping this fact in mind, as some production workers may be more qualified than the standard idea of "blue-collar workers" would suggest. Production workers, however, are indeed less qualified as a group than non-production workers.

[6] Production workers includes the sub-categories of "workmen", "apprentices", and "production technicians". Unfortunately, we cannot separate these groups to analyze differences in their adjustment behavior, since for many years of the sample only production and non-production categories are reported. One

sponding factor elasticities. The log-based TFP can be calculated as:

$$TFP_{jt} = \log Y_{jt} - \widehat{\alpha} \log K_{jt} - \widehat{\beta}(\log L_{jt} + \log H_{jt}) - \widehat{\gamma} \log E_{jt} - \widehat{\phi} \log M_{jt}. \quad (11)$$

where $\widehat{\alpha}$, $\widehat{\beta}$, $\widehat{\gamma}$, and $\widehat{\phi}$ are the estimated factor elasticities for capital, labor hours, energy, and materials.

Factor demands are likely to be correlated with TFP, to the extent that at least part of TFP is known to the firm. As a result, OLS estimation of factor elasticities would yield biased estimates. Two different types of methodology have been proposed to address this problem. First, Olley and Pakes (1996) and Levinson and Petrin (2001) propose semi-parametric estimates, where TFP is assumed to be an invertible function of some observable. That observable is then used in the estimation to obtain consistent factor elasticities. On the other hand, production functions can be estimated using instrument variable techniques. The first type of methodology has the advantage of not having to choose instruments, which are frequently controversial, while the second approach has the advantage of not assuming an invertible relationship between TFP and any other variable.[7]

We use three different sets of factor elasticities and TFP measures, and reproduce our results for each of these sets to evaluate their robustness. First, we estimate the (log) production function using instrumental variable techniques. We initially use as instruments the same demand shifters and input prices (both materials and energy) used by Eslava et al. (2004). The use of demand-related instruments has been suggested, among others, by Shea (1993) and Syverson (2003). Our demand shifters include current and lagged measures of output in downstream industries, calculated using the yearly input-output matrices, as well as state's government spending. The results of this estimation are shown in column (2) of Table 2. Although these results are plausible, in that they are consistent with constant returns to scale and do not reject Sargan tests for the exogeneity of instruments, the coefficient on white collar employment is estimated very imprecisely. We try an alternative set of instruments, adding to the list an index of labor market institutions derived by Lora (2001),[8]. To the extent that this is an economy-wide index, it should not be affected by any individual plant's TFP. The results of this specification are reported in column (1) of Table 2. We now obtain a much more plausible and precise estimate of the elasticity for white-collar workers. Finally, we also use the factor elasticities

[7] For instance, Olley and Pakes (1996) propose an invertible relationship between investment and TFP, while Levinson and Petrin (2001) propose a similar relationship between TFP and variable inputs. Both proxies are firm choices which may be affected by demand shocks. To the extent that these shocks are not controlled for in the estimation, their effect would imply a non-invertible relationship between TFP and the proxy.

[8] For this estimation, we re-scale the index produced by Lora (2001). In his original formulation, the subindices included in the labor market institutions index take a value between 0 and 1, where 1 represents the highest level of flexibility in Latin America over his period of study, and 0 the lowest level. Our scale takes a value of 1 for the year of greatest flexibility in Colombia, and 0 when flexibility is lowest. The resulting labor institutions index is depicted in Figure 6.

generated by Rosales (2005) using the methodology suggested by Levinson and Petrin (2001) and a panel of plants derived from the AMS, similar to ours.

Our results on factor adjustment are robust to using any of the specifications just described. Therefore, in what follows we only report results using the factor elasticities in column (1) of Table 2.[9]

3.1.2 Demand Shock Estimation

We estimate establishment-level demand shocks as the residual of the (log) inverse-demand equation (10):

$$d_{jt} = \log \widehat{D_{jt}} = \log P_{jt} + \widehat{\varepsilon} \log Y_{jt}, \tag{12}$$

where ε is the inverse of the elasticity of demand, η. As OLS estimations of demand equations also yield biased coefficients, we follow the approach suggested by Eslava et al. (2004) to estimate demand elasticities. We conduct a 2SLS estimation where the TFP generated above, which varies across plants and years, is the instrument. We allow the demand elasticity to vary by three-digit sector.

Results of demand function estimation for each three-digit sector are reported in Table 3. Demand elasticities are estimated precisely for every sector, and are consistent with the assumption that each firm is able to charge a markup for every sector except for sector 362 (glass products). The implied demand elasticity for the average sector is close to 2.12. The results reported use as instrument the TFP measure generated with the factor elasticities reported in column (1) of Table 2. Results are similar if any of the other TFP measures is used.

3.1.3 Data on institutions

With all the information described above, we can generate the desired factor demands used in the estimation of adjustment functions. Since one of our purposes is to let the coefficients of those functions vary with measures of factor market institutions, we need such measures. We use the institutions index developed by Lora(2001) index as our measure of institutions affecting factor markets. The measure varies from 0 to 1 and is increasing in the degree of liberalization and flexibility; there is variation from year to year and also across countries in the Latin American region. Unfortunately, the indicator is only available since 1985, so we restrict our estimations of adjustment functions to the 1985-1998 period.[10]

[9] It is important to mention that adjustment results are not robust to using *any* set of factor elasticities. For instance, trials with factor elasticities consistent with increasing returns to scale yield very erratic patterns for both desired factor levels and adjustment. However, the three "plausible" sets of coefficients presented in table 2 yield remarkably similar results.

[10] We do use our full-set of data for Colombia, covering 1982-1998, to estimate production and demand functions. We do this to take maximum advantage of the variability in the data t identify factor and demand elasticities.

Lora's institutions index summarizes the degree of flexibility of labor market institutions, the degree of financial liberalization, and the degree of trade liberalization. Flexible labor market institutions should reduce the costs of adjusting employment, more developed financial markets open credit access to firms potentially reducing an important source of costs for adjusting (especially in terms of capital adjustment), and trade liberalization gives access to more convenient providers of capital goods and generates incentives to increase productivity (potentially making firms more willing to respond to shortages or surpluses). The institutions index for different Latin American countries is presented in Figure 4, which we discuss below.

3.2 Extending the data to the Latin-American case

The use of micro-level data has added a rich dimension to the study of factor adjustment. If one is interested in characterizing adjustment for a group of countries, however, it is hard to find micro-data that are consistent across observations. The limitation is even harder to overcome when the methodological framework is as demanding as ours in terms of data. We suggest here a simulation environment to generate, for different countries, measures of the fundamental variables needed for our analysis, as a function of aggregate processes in those countries.[11] We use that methodology to extend our study to a group of several Latin American countries, which are our main focus.

The methodological framework described in section 3 is based on measuring desired factor demands as functions of some "fundamentals" faced by each establishment: TFP, demand shocks, materials, energy use, and hours worked by white- and blue-collar workers. The simulation we propose in this section generates a distribution of these fundamentals for each of the countries included in the sample, as a function of aggregate shocks in the corresponding economy (measures of market institutions and a GDP index). Availability of data on those aggregate processes restricts our sample period to 1985-1998.

The simulation process described below amounts to asking what would have been, for instance, TFP_{it} for plant i if it was located not in Colombia but in country X. Once we have the fundamentals, we will be able to calculate distributions of desired factors, and investigate the effect of institutions on factor adjustment in each country. Our sample of countries, dictated by the availability of institutions and GDP data for the period of study, includes Argentina, Brazil, Chile, Peru, Mexico, Uruguay and Venezuela.

We start by decomposing any plant-level fundamental, P_{it}, into an aggregate component and an idiosyncratic component. The aggregate component is

[11] Obviously, if one could collect all the necessary data in a consistent manner for the countries of interest, this would generate much more reliable results. The task is very demanding, though, and the consistency of the data is frequently questionable. In a recent paper, Caballero, Engel and Micco (2005) are able to overcome good part of these difficulties and collect the data necessary to analyze employment adjustment for a set of countries in Latin America. However, our framework requires much more information. This is due in part to the fact that we are interested in simultaneously stdying adjustment in several margins.

calculated as the simple average of P_{it} for year t, while the idiosyncratic component is simply the residual of subtracting the aggregate component from P_{it}. Using data for Colombia, we model the aggregate component as a function of the index of institutions for Colombia, a GDP index, and an auto-regressive component:

$$P_t = \tau_0 + \tau_1 * P_{t-1} + \tau_2 * instit_t + \tau_4 * GDP_t + \varepsilon_t \tag{13}$$

where $\varepsilon_t \sim N(0, S)$. We fit this model for the Colombian case, and use the results to obtain $\widehat{S}$. We then generate random draws of a $N(0, \widehat{S})$ distribution and generate a series of (aggregate, economy-wide) $\widehat{P}_t$ for each country in the sample using these random draws and using the institutions and GDP indexes for the corresponding country.[12] The following precision is important: when estimating 13 using the Colombian data, we actually use data at the sector level. That is, the aggregate component is the average of P_{it} for the sector where plant i is located, and GDP_t is an index of that sector's production in year t.We do this to exploit as much variation in the data as we have for estimating 13. The cost of following this strategy when we later use these results to simulate an aggregate component (country-level) for other countries is that we make the implicit, not uncontroversial, assumption that each sector behaves as the average[13].

We then model the idiosyncratic component $p_{it} = P_{it} - P_t$ as a draw from a $N(0, s_t)$ distribution, where s_t varies by country and year as a function of the respective institutions index. To obtain s_t, we rely again in our data for Colombia. For each Colombian plant, we obtain the idiosyncratic component of each fundamental. We then run these components against an autoregressive component, and obtain the residuals:

$$p_{it} = \delta_o + \delta_1 * p_{it-1} + \upsilon_{it} \tag{14}$$

where $\upsilon_{it} \sim N(0, s_t)$. We use the $\widehat{\upsilon}_{it}$ to calculate $\widehat{s}_t$ and then model $\widehat{s}_t$ as:

$$\widehat{s}_t = \kappa_0 + \kappa_1 * GDP_t + \kappa_2 * institut_t + u_t \tag{15}$$

which we fit using again data for Colombia. We then use the estimated coefficients $\widehat{\kappa}_0$, $\widehat{\kappa}_1$, $\widehat{\kappa}_2$ and the institutions and GDP series for each country, to generate a series of $\widehat{s}_t$ for each country. Once we have the series of $\widehat{s}_t$ for a given country we generate the idiosyncratic component $\widehat{p}_{it}$ for each plant iterating on equation 14, where in each iteration υ_{it} is a new draw from $\upsilon_{it} \sim N(0, \widehat{s}_t)$.[14].

[12] To initialize the series (that is, to generate P_{1984}), we first generate $P_{1935} = \tau_0 + \varepsilon_{1935}$, where ε_{1935} is a random draw from $N(0, \widehat{S})$. We then iterate fifty times using equation 13, obtaining ε_t for each iteration as a new random draw from $N(0, \widehat{S})$, and fixing the aggregate level variables at GDP_{1985} and $institut_{1985}$ for all iterations (since 1985 is the first year for which we have these two measures).

[13] For other countries, we cannot simulate a separate aggregate component series for each country, since we only have data on institutions and GDP for other countries at the aggregate level.

[14] To initialize the p_{it} series, we first generate $p_{1935} = \delta_0 + \upsilon_0$, where υ_0 is a random draw from $N(0, \widehat{s}_{1985})$. We then iterate fifty times using equation 14 and a new draw of $N(0, \widehat{s}_{1985})$ as υ_{it} in each new iteration.

Here, again, we use sector level data when fitting equation 15, even though we later simulate $\widehat{s}_t$ for each country at the aggregate level (since for countries other than Colombia we only have $instit_t$ and GDP_t at the aggregate level).

Finally, we obtain fundamentals $\widehat{P}_{it} = \widehat{P}_t + \widehat{p}_{it}$ for each of N fictitious plants. Here, $\widehat{P}_t$ is the aggregate component generated for that country, and $\widehat{p}_{it}$ is the idiosyncratic component for plant i generated as explained above. Tables 4 and 5 describe results of the different steps of the simulation process. Results of models (13), (14), and (15) for each of the "fundamentals" are reported in columns (1), (2), and (3) of Table 4, respectively. Table 5 reports summary statistics of the simulated fundamentals for each country, and of the actual fundamentals for the Colombian case, for the 1985-1998 period. It is clear that the simulation environment described above generates large enough variability of the simulated fundamentals, both across countries and over time within each country, that we are not simply mimicking the Colombian data for the other cases. On the other hand, the figures are plausible, especially considering that we are not forcing the levels of any of these variables to any mean value. Focus, for instance, on the numbers for average hours worked by an employee. The mean value of these variables fluctuates between 1300 and 2200 hours per year, both reasonably plausible figures.

Having these fundamentals, we can calculate desired factor demands and factor gaps for production and non-production workers, as well as capital, for each plant in the "sample" of each country. Finally, we use these gaps to estimate adjustment functions for the region.

4 Factor adjustment functions

In what follows, we report our results in terms of shortages and adjustment functions for a pooled sample of all the Latin American countries we consider (including Colombia). We begin by describing the behavior of shortages over time. We then describe the shape of the different adjustment functions, and the relationship between adjustment in some margin and shortages in the other two margins. Finally, we examine how adjustment functions change with changes in institutions that affect factor markets.

Table 6 presents summary statistics for the shortages of capital and the different types of workers. We split the sample into two subperiods to try to identify patterns of variation over time. The most salient feature is that in the second subperiod (since 1991) the mean absolute values of shortages move closer to zero in all three margins, indicating that plants located closer to their desired levels than in the eighties. This is interesting when one considers that institutions become more flexible over time for almost every country of our sample (see figure 4, which we discuss in more detail below). The finding is thus consistent with the idea that less regulated markets reduce adjustment costs, encouraging plants to demand factors closer to their desired levels. It is also interesting to note that, on average, the use of blue collar workers was closer to its desired level than any of the other two margins. This suggests smaller adjustment costs for production workers than for other factors.

4.1 The shape of adjustment functions

Using these shortages and the observed adjustments, we estimate the adjustment functions captured in equations (5). Each function is estimated including plant fixed effects. We also introduce asymmetries between positive and negative adjustments to capture the possibility of differences between the costs of augmenting and the cost of contracting factor demands. This is done by interacting each regressor with a dummy that takes the value of 1 when the shortage of the same variable is positive, and 0 when it is not (that is, when the plant faces a surplus).

Results are presented in figures 1 through 3. To evaluate the statistical significance of the effects highlighted in this figures, we show the estimates in Table 7, but the qualitative features of the adjustment can be seen much more clearly in the figures. Figures 1a, 2a, and 3a depict, respectively, the adjustment of white-collar workers, blue-collar workers, and capital, as a function of the respective shortage. The distribution of the corresponding shortage is also shown (in grey). The thin solid line in each of these figures represents the case in which shortages of all other factors are set to zero. We focus first on these solid lines.

We observe that the adjustment of white-collar workers is slightly increasing in the corresponding shortage, $ZW > 0$. This pattern indicates the presence of non-convex costs of hiring this type of workers. We observe a much flatter pattern in the destruction side.[15] Furthermore, adjustment seems in general more dynamic in the positive side (that is, when faced with shortages), although the differences are not stark.

Some interesting differences appear for blue collar workers. The adjustment function is much flatter, and asymmetries between the creation and destruction are less clear than for white collar workers. The blue-collar employment adjustment function is consistent with convex costs of adjusting the use of this factor. One interesting exception appears in the tail of the distribution of blue-collar worker surpluses, which captures events of very large massive layoffs (close to plant closure). Adjustment is here modestly less dynamic than when surpluses are close to zero, and the difference is statistically significant (see Table 7). This suggest that massive layoffs can have additional costs no present for smaller adjustments, which override any fixed adjustment costs.

There are also important differences with the adjustment function for capital. Investment is clearly increasing in capital shortages while the shedding of capital is increasing in capital surpluses, suggesting important fixed costs of adjusting capital. Furthermore, notice a stark difference between capital purchases and retirements: adjustment is much more responsive to shortages than it is to surpluses; actually, there is almost no response to excesses of capital. These

[15] Although the negative side shows a slightly decreasing slope, an inspection of column (1) in Table 7 reveals that the non-linear term of the adjustment function in the destruction side is not statistically significant.

feature indicates an irreversible character of investment, and a thin secondary market for capital.

In short, nonlinearities are particularly important to explain the patterns of capital and white-collar employment adjustment, but play a much more modest role for the adjustment of less qualified employment. On the other hand, asymmetric costs between increasing and reducing the use of a factor are particularly important for capital adjustment.

4.2 Inter-related factor demands

Figures 1a and 1b depict the adjustment of white collar workers as a function of the shortage of this factor. The solid line in both panels, discussed above, represents the case in which all other shortages are held at a level of zero. Panel a allows the shortage of blue-collar workers to move to $\pm$ one standard deviation from zero, while holding X, the capital shortage, at zero. Panel b, meanwhile, allows X to move to $\pm$ one standard deviation, while holding ZB at zero.

Note that a shortage of some other factor (dashed black line) reduces the positive response to a shortage of white-collar employment. Similarly, a surplus in some other margin (dash-dotted grey line) reduces the shedding of white collar workers that occurs in the presence of surpluses of white-collar workers. Our results thus suggest some substitution between the adjustment of white-collar workers and adjustment in other margins.

The adjustment of capital and production workers follow patterns of interaction with other margins very similar to that described above for production workers. Figures 2a and 2b represent the relationship between the adjustment of production workers and shortages of non-production workers and capital, respectively. Meanwhile, figures 3a and 3b capture the interaction between capital adjustments and shortages on white-collar and blue-collar workers. In both cases, the creation (destruction) of a given factor is less responsive to shortages (surpluses) in its own margin in the presence of shortages (surpluses) of some other factor. These results thus reinforce the idea that plants substitute adjustment in one margin for adjustment of other factors. In turn, the substitutability between different types of adjustment suggests dynamic complementarities between the shortages of different factors; To the extent that a shortage of capital, for instance, reduces the hiring of production workers, it reinforces existing shortages of this type of employment. It is also important to highlight that adjustment in any of the two employment margins is much more responsive to desired adjustments in the other employment margin than in capital.

Our results are consistent with those reported by Eslava et al. (2005) for the case of Colombia. Without distinguishing between blue- and white-collar workers, these authors find that there is some degree of substitution between the adjustment of employment and the adjustment of capital.

4.3 Adjustment and institutions

We now turn to the question of how changes in institutions affect factor adjustment. This issue has also been addressed by Eslava et al. (2005), and we add here, first, an emphasis in the differences between the adjustment of production and non-production workers. The differential adjustment in these two margins in response to changes in institutions is a key question, as the policy discussion has recently centered around the need for policies that encourage firms to substitute blue-collar workers for a more qualified labor force (De Ferranti, 2003). We also exploit the cross-country variation in institutions to address the effect of institutions on adjustment at a more general level (rather than a specific country case).

The behavior of the institutions index over the period is presented in Figure 4 for each of the countries in our sample. We split the figure into two panels to facilitate reading it. The institutions index takes values between 0.3 and 0.7. There is a sharp increase of the index for every country in the sample, with the exception of Chile, over the period of study.[16] For many countries, the increasing shape is more marked in the nineties than the eighties. These features capture the fact that most Latin American countries went through deep reforms in many policy dimensions during the past decade. This nice feature of the data that provides us with rich time-variation, an advantage that is rare when using data on institutions.

Figure 5 presents adjustment functions that vary with the level of the institutions index. Panels a, b, and c refer to the cases of non-production workers, production workers, and capital, respectively. Solid lines are adjustment functions if the institutions index takes a value of 0.3, dashed lines show the case where the index is at an intermediate value of 0.5, and dotted faded lines are adjustment functions for an institutions index of 0.7.

From figure 5a, we see that the adjustment of white-collar workers becomes less dynamic as institutions become more restrictive (lower levels of the institutions index), both for creation and destruction. It is also the case that the non-linearity in the creation of white-collar jobs is particularly marked for high levels of the institutions index, which reflect more flexible institutions. The adjustment of production workers responds somewhat differently to changes in institutions. While it is true that the destruction of these jobs is also more dynamic in environments with less stringent institutions, the creation side is in general *less* dynamic in such environments, except for firms faced with very high shortages. As was the case for white-collar workers, the adjustment function in the creation side is increasing only for high levels of the reform index. Interestingly, more flexible institutions are much more effective at increasing job destruction for blue-collar workers than they are for the case of non-production workers.

[16]By construction, Chile acts as the benchmark case of flexible institutions on almost all dimensions included in the index. This is so because each subcomponent of the index is scaled between 0 and 1, where 1 is the "most reformed" case in Latin America, which happens to often be Chile.

The results thus suggest that factor market regulations play an important role in limiting employment adjustment processes, perhaps more so in the destruction than the creation side. The evidence also seems to imply that non-convexities in the employment adjustment costs functions are mostly related to technological constraints rather than regulations. This can be seen in the fact that the adjustment functions are increasing only in more flexible environments; In highly regulated countries, the convex components of the adjustment cost function seem to dominate, generating constant adjustment rates.

These two effects together suggest a dominant role of lower firing costs in more flexible labor markets. Such lower costs induce more firings. They also make hiring costs, which are likely to have more dominant fixed components, relatively more important. This could help explain the importance of nonlinearities in the creation side in more de-regulated environments.

Our results for employment adjustment are consistent with the findings reported by Eslava et al. (2005) for employment adjustment in Colombia in the face of market reforms. They find that, after reforms, employment adjustment becomes more flexible on the destruction side. On the creation side, meanwhile, more adjustment is only observed for large shortages, implying a marked non-linear shape of the adjustment function in the creation side after reforms.

In the capital adjustment margin, investment in response to capital shortages increases with the level of the institutions index. This is consistent with a reduction of adjustment costs generated by more flexible financial regulations. This result differs from that in Eslava et al. (2005), who find no significant effect of the reforms on investment for the case of Colombia.

On the destruction side, capital shedding is much less responsive to surpluses for high levels of the institutions index. Part of the explanation may be related to the greater dynamism of employment reductions when plants are faced with more flexible markets. As discussed above, there seems to be some degree of substitution between capital and employment adjustment. In particular, employment cuts (of either production or non-production workers) seem to induce less capital shedding. The greater responsiveness of employment adjustment to employment surpluses may thus be behind the reduced dynamism of capital shedding.

We now discuss some results for the specific case of Colombia. We will take advantage of the Colombian data to analyze how more flexible adjustment relates to actual market outcomes. We will also use the actual data to study the effects of institutions with greater detail.

5 Colombia: institutions, factor adjustment, and employment outcomes

The first part of this section briefly discusses our results on factor adjustment for Colombia, and relates them to labor market outcomes. We observe that, although patterns are broadly consistent with what we obtained for Latin America, the simulated data do not simply mimic the baseline Colombian data. Then, we make use of the more reliable Colombian data to decompose the effects of institutional changes on adjustment into those driven by labor, trade, and financial institutions.

5.1 Factor adjustment in Colombia

The basic shape of the adjustment functions in the Colombian case is generally consistent with what we obtained for Latin America.[17] Results, however, suggest more important fixed costs of hiring, in that the white- and blue-collar labor adjustment functions show more pronounced increasing patterns in the creation side. In terms of inter-related factor adjustments, substitution between the different adjustment margins is the most relevant feature of the results, as was also the case for the full Latin America sample.

We also re-estimate for Colombia the adjustment functions that allow coefficients to vary with the institutions index. We first re-scale the institutions index. The original scale rates each component of the index on a 0-1 interval, where 0 (1) refers to the least (most) flexible institutions in the sample of Latin American countries. Since here we deal only with Colombia, we re-scale each component such that 0 (1) refers to the least (most) flexible institutions for Colombia over the period.[18]. Figure 6 shows, among more disaggregate measures that we discuss below, the institutions index for Colombia. We observe a generally increasing pattern of the institutions index over the period, moving from 0.23 to 0.78 in a 0-1 scale. The index is particularly dynamic in the 1990s, as a result of the wave of reforms adopted during that decade.

The effects of institutions on our factor adjustment functions are, in general, also similar to those observed for Latin America. as Figures 7a, 8a, and 9a show. First, we also obtain that higher values of the institutions index are related to greater flexibility of white-collar labor adjustment, more dynamic destruction of blue collar labor and creation of capital, and less adjustment of capital in the negative side. Moreover, we also observe that more flexible institutions are related to greater creation of blue-collar labor only for plants faced with high shortages of this factor; in the case of small shortages higher values of the institutions index are actually related to less adjustment in the creation side. An interesting difference with the case of Latin America is that for Colombia we do not observe the reluctance of firms to lay-off large masses that our results suggest for Latin America. Consequently, we do not find either the non-linear

[17] We do not report the equivalent of Table 7 for the Colombian case, or of Figures 1 through 3, to avoid overcrowding the document with tables and figures. Those results are available from the author upon request.

[18] It would be ideal to have a measure of institutions expressed on an "absolute" scale, but the data we have available are expressed in relative terms. Given this limitation, when dealing with the specific Colombian case we prefer to use a benchmark within the same context, rather than a benchmark from the whole region which needs not be relevant for Colombia. The change in scale explains why the institutions index for Colombia reported in Figure 4 (and used when estimating adjustment functions for Latin America) differs from the index used in this section.

effect of institutions on labor destruction that we find for the Latin American case.

Overall, then, we find that more flexible institutions should in fact be related to mode dynamic labor adjustment, except possibly in terms of hiring of white-collar workers. These results are indeed consistent with actual labor market outcomes. Figure 10a shows the behavior of job reallocation rates over time for white-collar and blue-collar labor in Colombia. Job reallocation is defined as the sum of Job Creation and the absolute value of Job Destruction, and is thus an indicator how dynamic are adjustment processes in terms of jobs.[19] We observe that Job Reallocation rates for both types of employment grow significantly after 1990, precisely the period in which we observe sustained and large increases of the institutions index (Figure 6). This increase in reallocation rates is much larger for white-collar labor than blue-collar labor.

Decomposing Job Reallocation into Creation and Destruction rates (not reported), one observes greater creation and destruction rates for white-collar labor in the 1990s than in the previous decade. The Job Destruction Rate for blue-collar labor shows a similar pattern. However, Job Creation for blue-collar labor is actually less dynamic in the last years of the sample than it was in the initial years. This is also reflected in the relative use of the two types of labor: the ratio between production and non-production labor use (calculated as total labor hours in each of those categories) goes from 4.6 between 1982 and 1990 to 3.8 for the 1991-1998 period. It is interesting to note that this shift from production to non-production labor is not the result of a decrease in the relative wages of non-production workers. On the contrary, as figure 10b shows, the wages of non-production workers present an increasing pattern over the period, much more pronounced since 1991, while the wages of blue-collar workers remain stable over the sample period.

5.2 Differential effects of Trade, Labor and Financial institutions

Up to this point, we have used the word "institutions" to refer to a group of regulations that may affect factor adjustment processes. We have bunched together labor market institutions, trade rules, and financial and tax regulations. However, there is no reason to expect that adjustment should respond in the same way to all rules governing factor and goods markets. In fact, from the perspective of factor adjustment it would be interesting to analyze how each different measure to which firms are subject ends up affecting their behavior in terms of factor demands. Although our methodological framework is clearly insufficient to answer such ambitious question, we can at least take one step in

[19] A job is a position filled with a worker. Job Creation (Destruction) refers to the expansion (contraction) of the number of such positions. Following Haltiwanger, Davis and Schuh (1996), Job Creation can be measured as total employment gains at expanding and new establishments as a fraction of average employment. Similarly, Job Destruction can be measured as total employment losses at contracting and exiting establishments as a fraction of average employment. We follow this methodology to calculate Job Creation and Destruction rates.

that direction by decomposing our measure of institutions into a few big areas of government intervention, and investigating the differential effect on adjustment.

Our task involves letting the coefficients of the adjustment functions vary with each of these subcomponents of the institutions index. Since the resulting models are obviously far from parsimonious, we prefer to conduct this investigation solely for the Colombian case to avoid the use of simulated data for this, more demanding, estimations.

We begin by separating the institutions index in three "subindices", following the categories in which Lora (2001) classifies the different elements included in the index. First, there is a labor market component which summarizes the costs incurred by firms for four reasons: layoffs, hirings, social security contributions, and overtime work by its employees. Since the sub-index is decreasing in these costs, one would expect higher levels of the index to be associated with more flexible factor adjustment. The second type of institutions considered are trade regulations; this sub-index is decreasing in the average level and the dispersion of tariffs. Greater restrictions to trade may be associated with more limited access to efficient markets for capital goods, and may also generate, through restricted competition, less incentives for firms to undertake costly adjustment. Finally, we consider the remaining categories included in the overall institutions index. We associate these categories with institutions that may affect the efficient use of financial resources and thus generate less active adjustment: interest rate controls, reserve requirements, corporate tax rates, and the advance of privatization processes. We call this category "index of financial institutions", although not all of its components are regulations directed to the financial market. The evolution of the three types of institutions over the period of study is depicted in Figure 6.

We re-estimate the adjustment functions (5) including, simultaneously, interactions between each term of (5) and each of the three institutions indexes. Our results are summarized in figures 7, 8 and 9 for white-collar, blue-collar, and capital adjustment functions, respectively. Panels b of these figures report results for trade institutions, while keeping the other two subindices at their average levels for the period. Similarly, panels c and d report results for the labor index and the trade index, respectively, while keeping the other two indicators of institutions constant at their average levels.

Focusing first on panels b of these figures, our results suggest that more liberalized trade regimes are related to greater adjustment of white-collar labor in the creation side and greater adjustment of blue-collar workers in the destruction side. This is consistent with the idea that the greater exposure to competition associated to international trade induces firms in less developed economies, in particular Latin American countries, to use more skill-biased production processes (De Ferranti, 2003).[20] In terms of capital adjustment, openness to trade

[20] The fact that we observe only increased hirings of more skilled workers, rather than increased hirings and firings, may derive from the fact that our sample period covers only the first few years after transition to a regime of trade liberalization. Possibly, once the initial massive shift to more skill-biased technologies has settled, firms will show dynamic adjustment of skilled labor on both the creation and the destruction sides.

seems to be related to greater adjustment in the creation side and less adjustment in the negative side. Two potential explanations come to mind. First, greater competition may also be at work here, in the form of firms adopting more relatively capital-intensive technologies. Second, there may be potential reductions in capital adjustment costs coming from increased access to international markets; this may be consistent with less capital retirements if it induces a reduction of demand (and thus prices) in secondary capital markets. On the other hand, the effect of trade liberalization on capital adjustment is quite modest, suggesting a relatively minor role of increased access to international markets for capital goods.

In terms of labor market institutions (panels b of figures 7-9), we find that less stringent labor regulations indeed foster adjustment of both skilled and unskilled labor, on both the creation and destruction sides. An interesting exception is the destruction of blue-collar jobs, which is actually less dynamic in the face of less restrictive regulations. We interpret this result as a reflection of the fact, described above, that firms substitute adjustment between the two labor margins. If firing costs were initially more binding for white-labor workers, which is likely to be the case, the reduction of such costs will have an impact mainly on the destruction of skilled labor positions, which would in turn lead firms to substitute adjustment in the less skilled margin for the more skilled one. It is also interesting to note that, in terms of hiring of white collar workers, the effect of institutions is highly non-linear. While hiring of large pools of skilled workers become much more dynamic when labor regulations are removed, the effect on adjustment in the face of small shortages is quite modest. In this sense, the effect of labor regulations on hiring of skilled workers seems to be binding mostly when firms are faced with large shortages. This finding is also consistent with the fact that hiring of unskilled workers respond positively to labor market de-regulation, except in the range of large shortage, where the substitution effect (from blue- into white-collar labor adjustment) over-rides any positive effect of de-regulation on adjustment. The apparent role of these substitution effects highlights the relevance of considering all adjustment margins in a simultaneous manner, even if one is mainly interested in the dynamics for a specific factor.

Finally, the easing of financial and tax regulations is reflected in general in more flexible adjustment. This is not unexpected, since financial constraints may reduce resources available to firms to pay for adjustment costs. In the case of white-collar workers, we observe again the interesting finding that lifting these constraints stimulates hiring only when firms are faced with large shortages; the implication is that it is in this scenario when regulations that limit job creation are binding. Together with similar findings we reported above, this result reinforces the idea that hiring large pools of skilled workers is subject to particularly large adjustment costs stemming from regulations. The positive effect of financial de-regulation on adjustment is not present for hiring of blue-collar workers and retirements of capital in the face of small capital surpluses. The explanation may again be on a predominant role of the substitution between these adjustment margins and others, as well as thinner secondary markets for capital goods.

6 Conclusions

This paper studies the effect of a variety of regulations on factor adjustment processes. We do so in a framework that allows for simultaneous and interrelated adjustments of blue-collar labor, white-collar labor and capital in Latin America.

Our main findings are as follows. First, we find that firms substitute across the three different margins of adjustment. There are, however, important differences between the adjustment functions for the three factors. Allowing for non-linear adjustment is key for the case of high-skill jobs and capital, the same is not true for production workers, where the patterns of adjustment are consistent with convex adjustment costs. The capital adjustment function is consistent with irreversible investment and fixed costs of acquiring capital.

In terms of the effects of institutions, we find indications of a skill-biased change in the composition of the labor force when firms are faced with more competitive and flexible regulations. Our results also suggest that fixed adjustment costs for employment are mostly related to technological constraints rather than regulations: under more stringent regulations, the convex components of the adjustment cost function seem to dominate. Finally, we find evidence of a reduction of capital adjustment costs generated by more flexible regulations.

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Table 1: Descriptive Statistics Colombian Data

Variable	1982-1998
Output	**10.723** **(1.777)**
Capital	**8.462** **(2.124)**
White-Collar Labor Hours	**9.296** **(1.327)**
Blue-Collar Labor Hours	**10.748** **(1.164)**
Energy	**11.462** **(1.928)**
Materials	**9.929** **(1.887)**
Output Prices	**-0.112** **(0.593)**
Energy Prices	**0.382** **(0.487)**
Material Prices	**-0.031** **(0.458)**
White-Collar AdministrativeWages	**344.220** **(109.709)**
Blue-Collar Wages	**157.759** **(39.053)**
N	**95314**

Notes: This table reports means and standard deviations of the log of quantities and of prices deviated from yearly producer price indices. It also reports means and deviations of yearly white-collar and blue-collar wages in thousands of pesos of 1982. "N" corresponds to the number of observations that report positive output –some of those observations have missing values for some of the other variables.

Table 2: Production Function Equations

	Production Function 2SLS (1)	Production Function 2SLS (2)	Production Function Parameters (3)
Capital	**0.196** **(0.056)**	**0.312** **(0.181)**	**0.252**
White-Collar Labor Hours	**0.130** **(0.072)**	**0.012** **(0.230)**	**0.125**
Blue-Collar Labor Hours	**0.167** **(0.031)**	**0.154** **(0.041)**	**0.149**
Energy	**0.189** **(0.014)**	**0.171** **(0.027)**	**0.056**
Materials	**0.307** **(0.013)**	**0.282** **(0.038)**	**0.442**
Root Mean Square Error	**0.728**	**0.762**	
N	**41356**	**44514**	

Notes: This table reports results of estimating equation 11 using the data for Colombia (1982-1998).Standard errors are reported in parentheses. The regression uses physical output as the dependent variable, and capital, white-collar employment hours, blue-collar employment hours, energy, and materials as regressors, where all variables are in logs. The following variables are used to instrument the inputs: Shea's (1993) downstream demand instruments constructed as demand for intermediate output (calculated using the input-output matrix); one- and two-period lags of downstream demand; regional government expenditures, excluding government investment; and energy and material plant-level prices, deviated from the yearly PPI.

Table 3: Inverse Demand Equations

	Inverse Demand 2SLS				First Stage R-Squared
CIIU	Physical Output	Standard Error	Root MSE	N	Physical Output
311	**-0.151**	**0.003**	**0.415**	**12907**	**0.384**
312	**-0.224**	**0.008**	**0.560**	**2496**	**0.430**
313	**-0.261**	**0.020**	**0.579**	**1659**	**0.179**
314	**-0.307**	**0.061**	**0.813**	**101**	**0.254**
321	**-0.547**	**0.020**	**0.914**	**5433**	**0.130**
322	**-0.430**	**0.009**	**0.598**	**10709**	**0.232**
323	**-0.594**	**0.052**	**1.007**	**1237**	**0.119**
324	**-0.418**	**0.016**	**0.584**	**3043**	**0.203**
331	**-0.621**	**0.018**	**0.779**	**2137**	**0.399**
332	**-0.659**	**0.023**	**0.710**	**2752**	**0.251**
341	**-0.384**	**0.023**	**0.752**	**1737**	**0.181**
342	**-0.608**	**0.016**	**0.933**	**3842**	**0.329**
351	**-0.403**	**0.032**	**0.772**	**1364**	**0.130**
352	**-0.528**	**0.013**	**0.981**	**3975**	**0.349**
353	**-0.178**	**0.032**	**0.500**	**320**	**0.134**
355	**-0.454**	**0.028**	**0.854**	**840**	**0.326**
356	**-0.588**	**0.020**	**0.898**	**4231**	**0.190**
361	**-0.270**	**0.041**	**0.750**	**236**	**0.193**
362	**-1.326**	**0.223**	**2.305**	**818**	**0.042**
369	**-0.579**	**0.038**	**1.054**	**2760**	**0.094**
371	**-0.475**	**0.054**	**1.130**	**687**	**0.132**
372	**-0.478**	**0.074**	**1.007**	**337**	**0.147**
381	**-0.578**	**0.015**	**0.880**	**6310**	**0.224**
382	**-0.658**	**0.017**	**0.962**	**3761**	**0.342**
383	**-0.614**	**0.029**	**1.115**	**2101**	**0.226**
384	**-0.557**	**0.022**	**1.064**	**2717**	**0.272**
385	**-0.645**	**0.067**	**0.963**	**624**	**0.143**
390	**-0.655**	**0.026**	**0.933**	**1623**	**0.304**

Notes: This table reports results of estimating equation 12 using the data for Colombia (1982-1998). The dependent variable is the plant-level price minus the yearly PPI (all in logs). The two-stage least squares regression instruments physical output with the 2SLS TFP measure estimated using Column (1) in Table 2.

Table 4: Models of Fundamentals

Dependent Variable	Regressor	Model for Aggregate Component (1)	Model for Idiosyncratic Component (2)	Model for Standard Deviation of Idiosyncratic Error (3)
TFP	First Lag of TFP	**0.931** **(0.021)**	**0.916** **(0.002)**	
	Reform Index	**-0.160** **(0.081**		**0.242** **(0.061)**
	GDP	**-0.0002** **(0.0002)**		**3.6E-6** **(0.0001)**
Demand Shock	First Lag of Dshock	**1.003** **(0.002)**	**0.980** **(0.001)**	
	Reform Index	**0.024** **(0.060)**		**0.157** **(0.047)**
	GDP	**1.4 E-6** **(0.0001)**		**-3.5E-5** **(0.0001)**
White Collar Labor Hours	First Lag of White Collar Labor Hours	**0.790** **(0.030)**	**0.327** **(0.003)**	
	Reform Index	**-67.240** **(109.154)**		**4.8E-13** **(1.5E-12)**
	GDP	**-0.038** **(0.250)**		**2.8E-15** **(3.4E-15)**
Blue Collar Labor Hours	First Lag of Blue Collar Labor Hours	**0.873** **(0.023)**	**0.035** **(0.004)**	
	Reform Index	**146.873** **(97.746)**		**1.2E-12** **(2.3E-12)**
	GDP	**-0.070** **(0.223)**		**3.6E-15** **(5.2E-15)**
Materials	First Lag of Materials	**0.957** **(0.011)**	**0.974** **(0.001)**	
	Reform Index	**0.490** **(0.164)**		**-0.372** **(0.079)**
	GDP	**-0.0003** **(0.0004)**		**0.0005** **(0.0002)**
Energy	First Lag of Energy	**0.990** **(0.008)**	**0.945** **(0.001)**	
	Reform Index	**-0.008** **(0.137)**		**0.317** **(0.149)**
	GDP	**5.8 E-5** **(0.0003)**		**0.0001** **(0.0003)**

Notes: This table reports results of estimating equations (13) – (15) using the data for Colombia (1985-1998). Columns (1), (2) and (3) show, respectively, results for equations (13), (14) and (15).Standard errors are in parentheses.

Table 5 : Summary Statistics of Simulated Fundamentals for Latin American Countries

Market Fundamental	Col.	Arg.	Bra.	Chi.	Mex.	Per.	Uru.	Ven.
TFP	**0.886** **(0.773)**	**1.168** **(0.812)**	**1.211** **(0.780)**	**1.217** **(0.899)**	**1.129** **(0.795)**	**1.042** **(0.774)**	**1.151** **(0.801)**	**1.444** **(0.751)**
Demand Shock	**4.911** **(2.109)**	**-0.658** **(1.016)**	**-1.069** **(0.978)**	**0.030** **(1.133)**	**-1.352** **(0.989)**	**0.563** **(0.985)**	**-1.422** **(1.142)**	**-0.194** **(0.968)**
White Collar Labor Hours	**7.264** **(0.162)**	**7.200** **(0.171)**	**7.226** **(0.086)**	**7.159** **(0.095)**	**7.145** **(0.233)**	**7.219** **(0.120)**	**7.081** **(0.195)**	**7.262** **(0.082)**
Blue Collar Labor Hours	**7.580** **(0.111)**	**7.647** **(0.051)**	**7.424** **(0.091)**	**7.609** **(0.085)**	**7.708** **(0.047)**	**7.178** **(0.095)**	**7.435** **(0.107)**	**7.540** **(0.079)**
Materials	**10.020** **(1.888)**	**9.121** **(2.143)**	**7.927** **(2.211)**	**10.446** **(1.984)**	**8.633** **(2.266)**	**9.267** **(2.248)**	**10.130** **(2.090)**	**7.640** **(2.242)**
Energy	**11.496** **(1.945)**	**4.864** **(1.625)**	**5.100** **(1.524)**	**5.644** **(1.793)**	**5.729** **(1.568)**	**6.673** **(1.560)**	**5.020** **(1.592)**	**6.624** **(1.563)**
N					**78355**			

Notes: This table reports first and second moments of actual fundamentals for Colombia, and of simulated fundamentals for the othe seven Latin American economies considered, 1985-1998. All figures are in logs. The "N" is the number of plants to which simulated fundamentals were assigned, for each country. For Colombia, some plants present missing values of the actual measures for some of the plants.

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Table 6. Latin America: Moments of White-Collar Labor, Blue-Collar Labor and Capital Shortages, Before and After 1990.

	White-Collar Labor Shortages		Blue-Collar Labor Shortages		Capital Shortages	
	1985 - 1990	1991 - 1998	1985 - 1990	1991 - 1998	1985 - 1990	1991 – 1998
Mean	**0.213**	**-0.016**	**0.148**	**-0.047**	**0.252**	**-0.108**
Std. Deviation	**0.789**	**0.781**	**0.786**	**0.767**	**0.820**	**0.864**
N	**200424**	**273890**	**198563**	**273035**	**197666**	**271644**

Notes: This table reports first and second moments of desired adjustment in each of the three margins considered, for the sample of all Latin American countries under study. Desired adjustments, ZW, ZB, and X, are defined in equations (1) through (3).

Table 7. Latin America: White-Collar Labor, Blue-Collar Labor and Capital Parametric Adjustment Functions

"Shortage" refers to "own shortage"	White-Collar Labor Adjustment		Blue Collar Labor Adjustment		Capital Adjustment	
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	**0.162** **(0.002)**	**0.067** **(0.010)**	**0.125** **(0.002)**	**-0.048** **(0.008)**	**-0.006** **(0.002)**	**0.175** **(0.009)**
Constant × Pos. Shortage	**-0.005** **(0.004)**	**0.117** **(0.014)**	**-0.027** **(0.003)**	**0.319** **(0.012)**	**0.173** **(0.003)**	**-0.039** **(0.012)**
Shortage ^{2}	**-0.007** **(0.001)**	**0.021** **(0.005)**	**-0.011** **(0.0009)**	**0.054** **(0.004)**	**0.005** **(0.000)**	**-0.023** **(0.004)**
Shortage ^{2} × Pos.Shortage	**0.025** **(0.001)**	**-0.080** **(0.007)**	**0.022** **(0.001)**	**-0.127** **(0.005)**	**0.014** **(0.001)**	**0.023** **(0.005)**
ZW			**0.014** **(0.001)**	**0.010** **(0.005)**	**0.003** **(0.001)**	**0.003** **(0.006)**
Pos Shortage × ZW	**-0.037** **(0.001)**		**-0.048** **(0.001)**	**-0.0251** **(0.007)**	**-0.038** **(0.001)**	**-0.035** **(0.007)**
ZB	**0.042** **(0.001)**	**0.034** **(0.007)**			**0.013** **(0.001)**	**0.025** **(0.006)**
Pos Shortage × ZB	**-0.112** **(0.001)**	**-0.006** **(0.008)**			**-0.064** **(0.001)**	**-0.033** **(0.007)**
X	**0.019** **(0.001)**	**0.009** **(0.006)**	**0.009** **(0.001)**	**0.0320** **(0.005)**		
Pos Shortage × X	**-0.037** **(0.001)**	**0.004** **(0.008)**	**-0.017** **(0.001)**	**-0.006** **(0.006)**		
Inst. Index		**0.202** **(0.022)**		**0.375** **(0.017)**		**-0.384** **(0.018)**
Inst. Index × Pos. Shortage		**-0.279** **(0.030)**		**-0.771** **(0.025)**		**0.446** **(0.026)**
Shortage ^{2} × Inst. Index		**-0.062** **(0.011)**		**-0.138** **(0.009)**		**0.065** **(0.008)**
Shortage ^{2} × Inst. Index × Pos. Shortage		**0.242** **(0.014)**		**0.333** **(0.012)**		**-0.016** **(0.011)**
Inst. Index × ZW				**0.007** **(0.011)**		**-0.0002** **(0.012)**
Inst. Index × ZW × Pos. Shortage				**-0.055** **(0.015)**		**-0.004** **(0.015)**
Inst. Index × ZB		**0.017** **(0.014)**				**-0.025** **(0.012)**
Inst. Index × ZB × Pos. Shortage		**-0.241** **(0.019)**				**-0.074** **(0.016)**
Inst. Index × X		**0.023** **(0.013)**		**-0.042** **(0.010)**		
Inst. Index × X × Pos. Shortage		**-0.093** **(0.017)**		**-0.038** **(0.014)**		**455368**
R2	**0.085**	**0.086**	**0.057**	**0.059**	**0.080**	**0.082**
N				**455368**		

Notes: This table reports parametric adjustment functions estimated using equations (5). The white-collar labor shortage is estimated using equation (1), the blue-collar labor using equation (3) and the capital shortage using equation (3). The sample is a panel of pairwise ontinuining plants. The positive shortage dummy takes the value of 1 when the desired adjustment of the corresponding factor ("own shortage") is positive (there is a shortage) and the value of 0 when it is negative (there is a surplus). The institutions index takes values between 0 and 1 and it is increasing in the degree of liberalization and flexibility of institutions.

Figure 1.a: Latin-America: Estimated White Collar Employment Adjustment Function with Different Blue Collar Employment Shortages

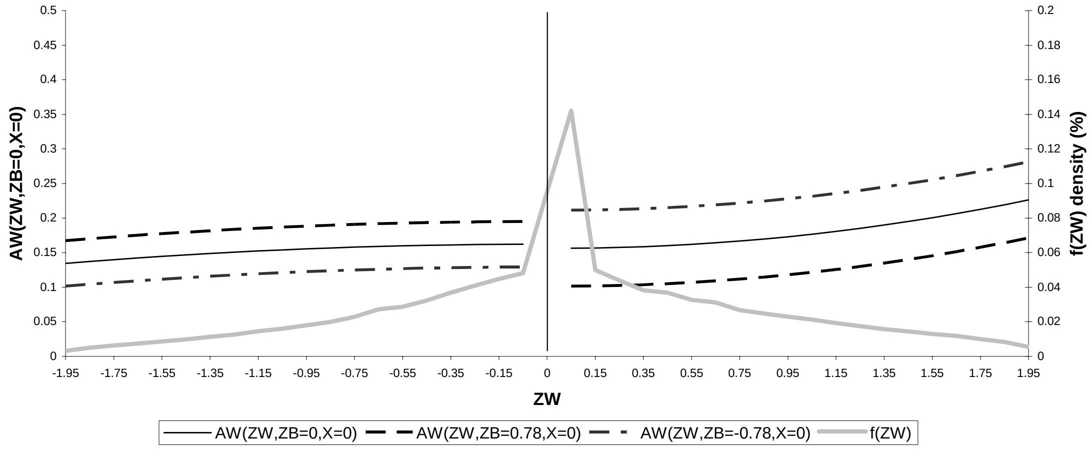

Figure 1.b: Latin-America: Estimated White Collar Employment Adjustment Function with Different Capital Shortages

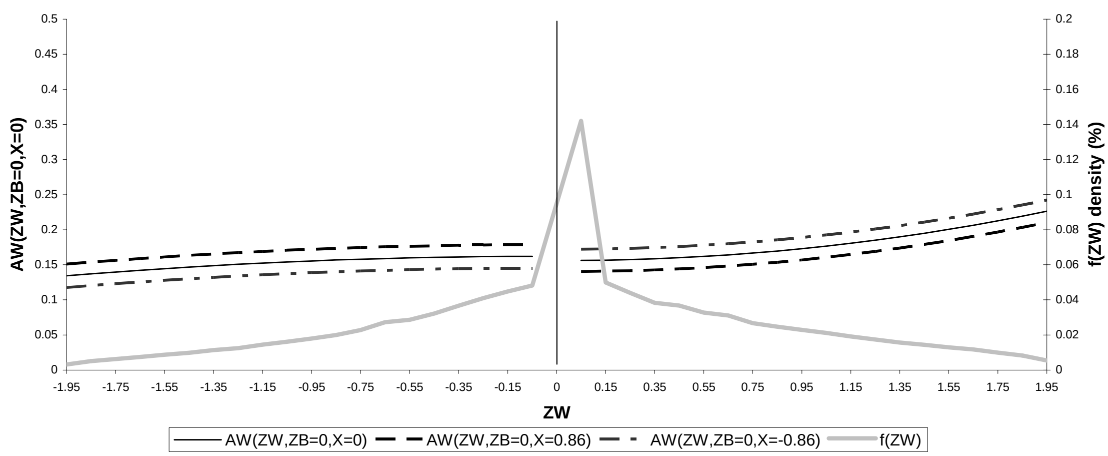

Figure 2.a: Latin-America: Estimated Blue Collar Employment Adjustment Function with Different White Collar Employment Shortages

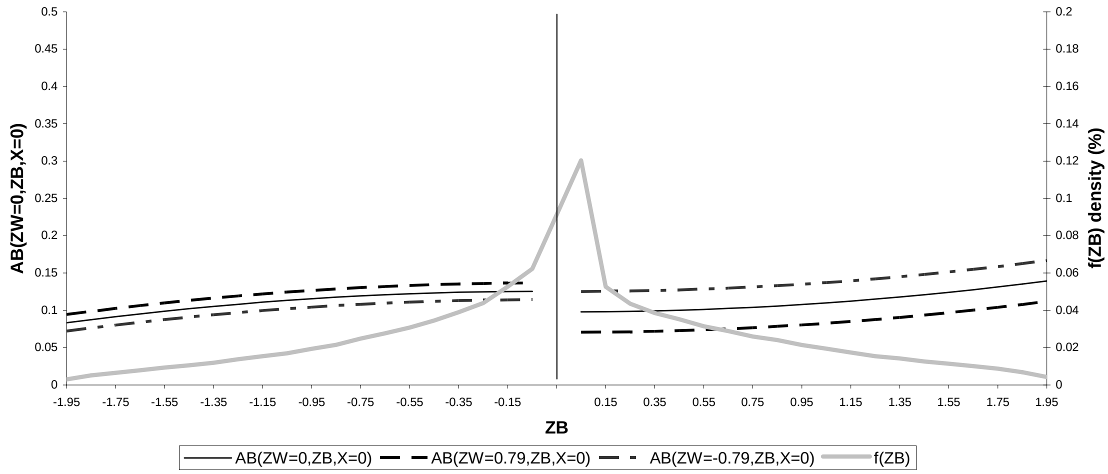

Figure 2.b: Latin-America: Estimated Blue Collar Employment Adjustment Function with Different Capital Shortages

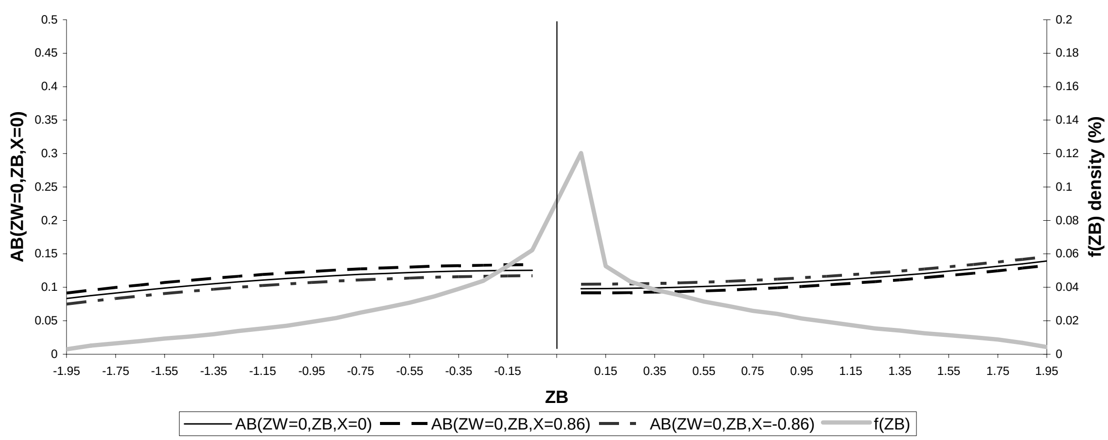

Figure 3.a: Latin-America: Estimated Capital Adjustment Function with Different White Collar Employment Shortages

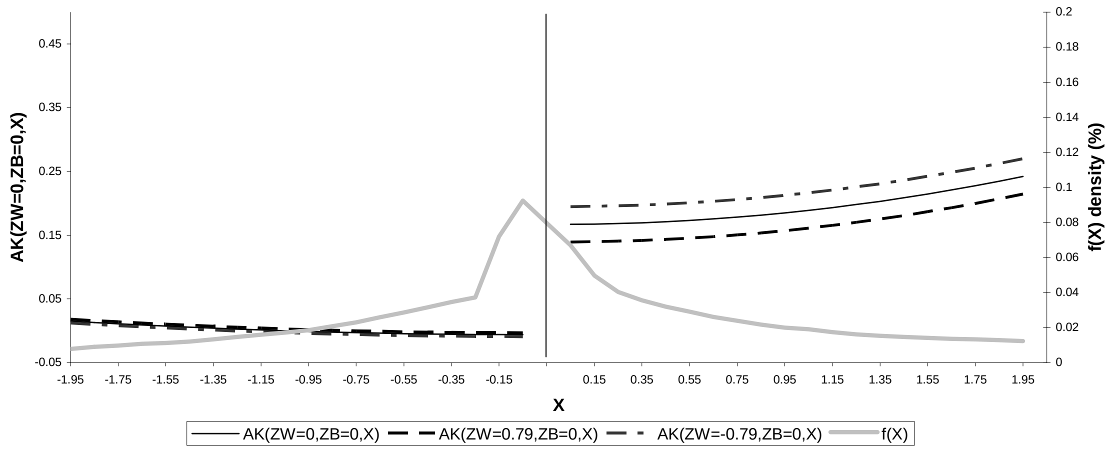

Figure 3.b: Latin-America: Estimated Capital Adjustment Function with Different Blue Collar Employment Shortages

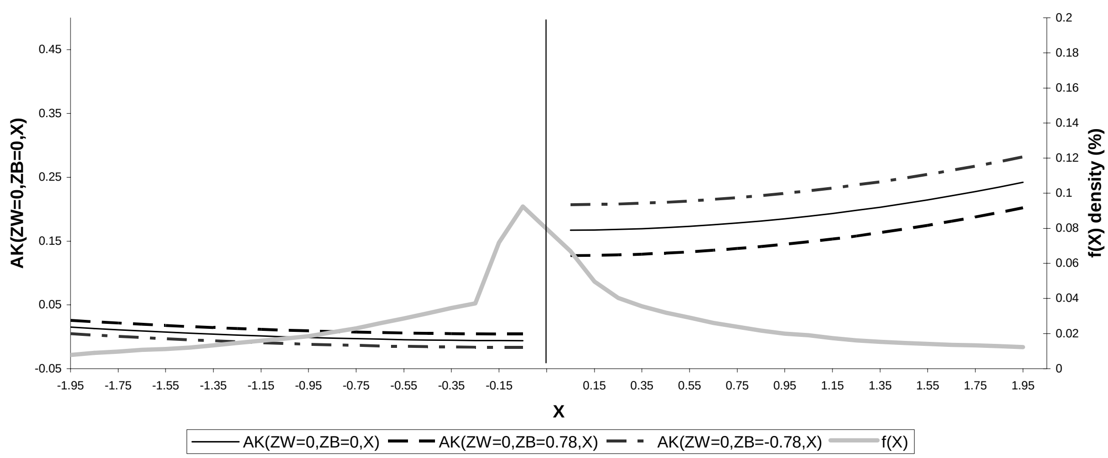

Figure 4: Institutions Index - Latin-American Countries

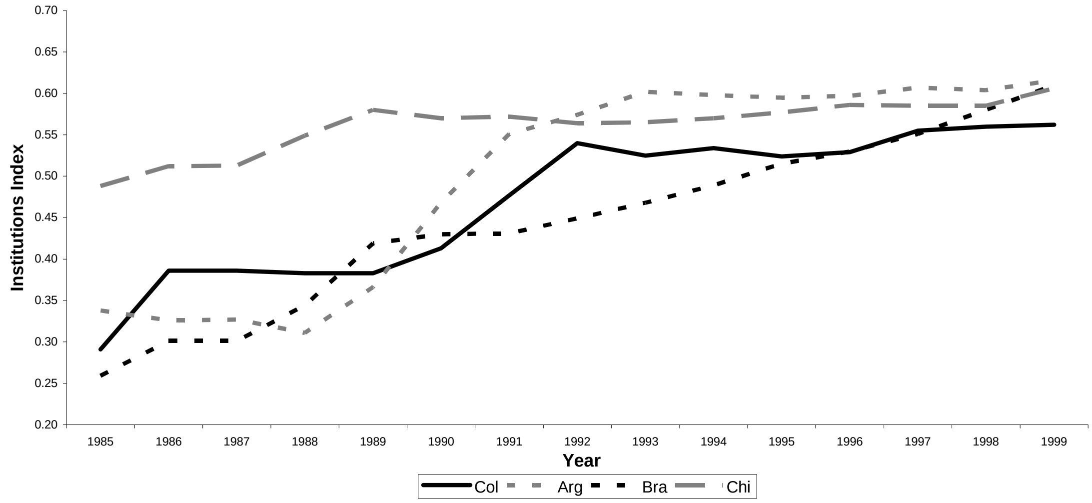

Figure 4(continued): Institutions Index - Latin-American Countries

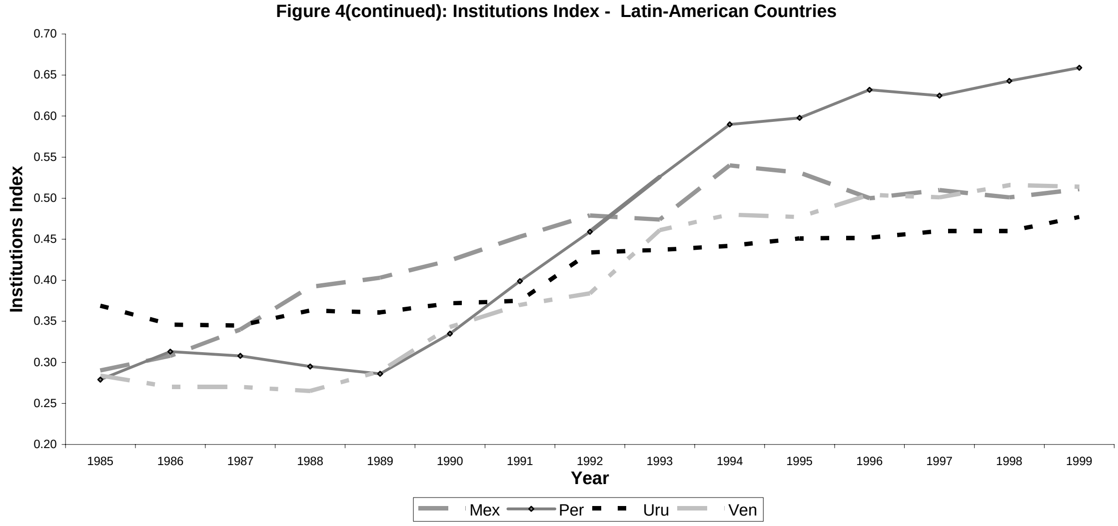

Figure 5.a: Latin-America: Estimated White Collar Employment Adjustment Function at Different Levels of Institutions Index (ZB=0, X=0)

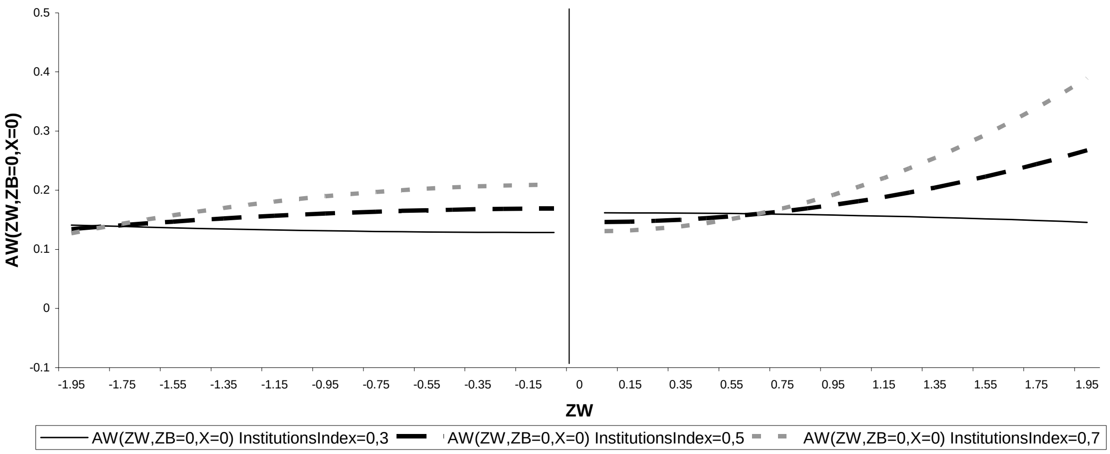

Figure 5.b.: Latin-America: Estimated Blue Collar Adjustment Function at Different Levels of Institutions Index (ZW=0, ZB=0)

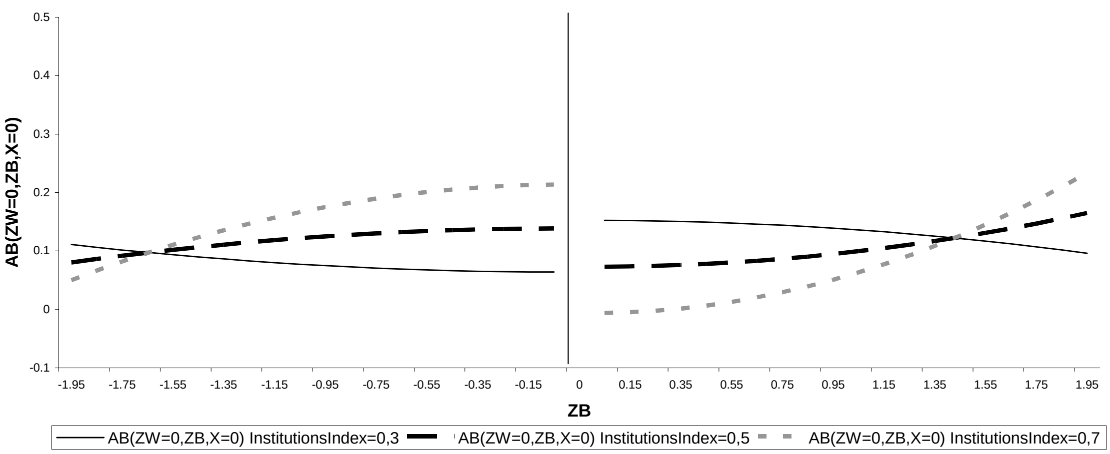

Figure 5.c: Latin-America: Estimated Capital Adjustment Function at Different Levels of Institutions Index (ZW=0, ZB=0)

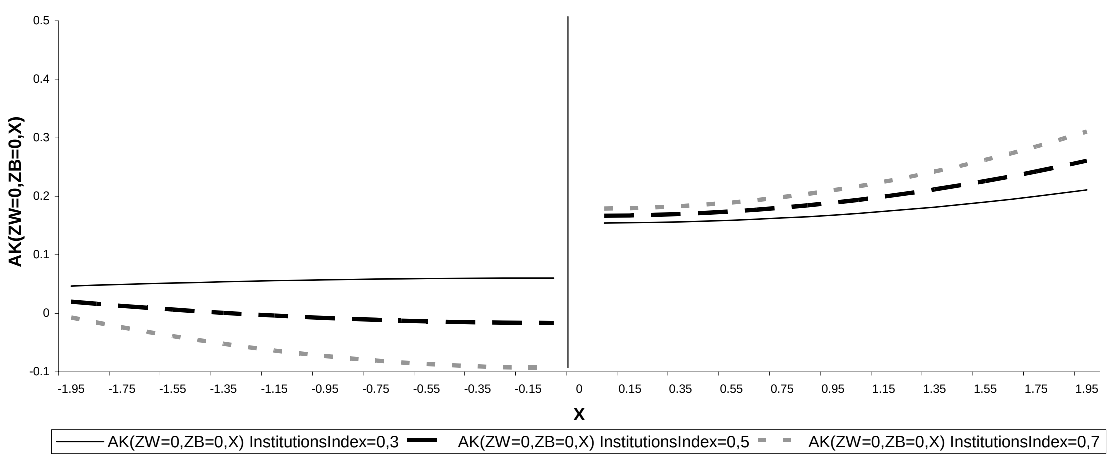

Figure 6: Colombia: Institutions, Labor, Trade and Financial Indices

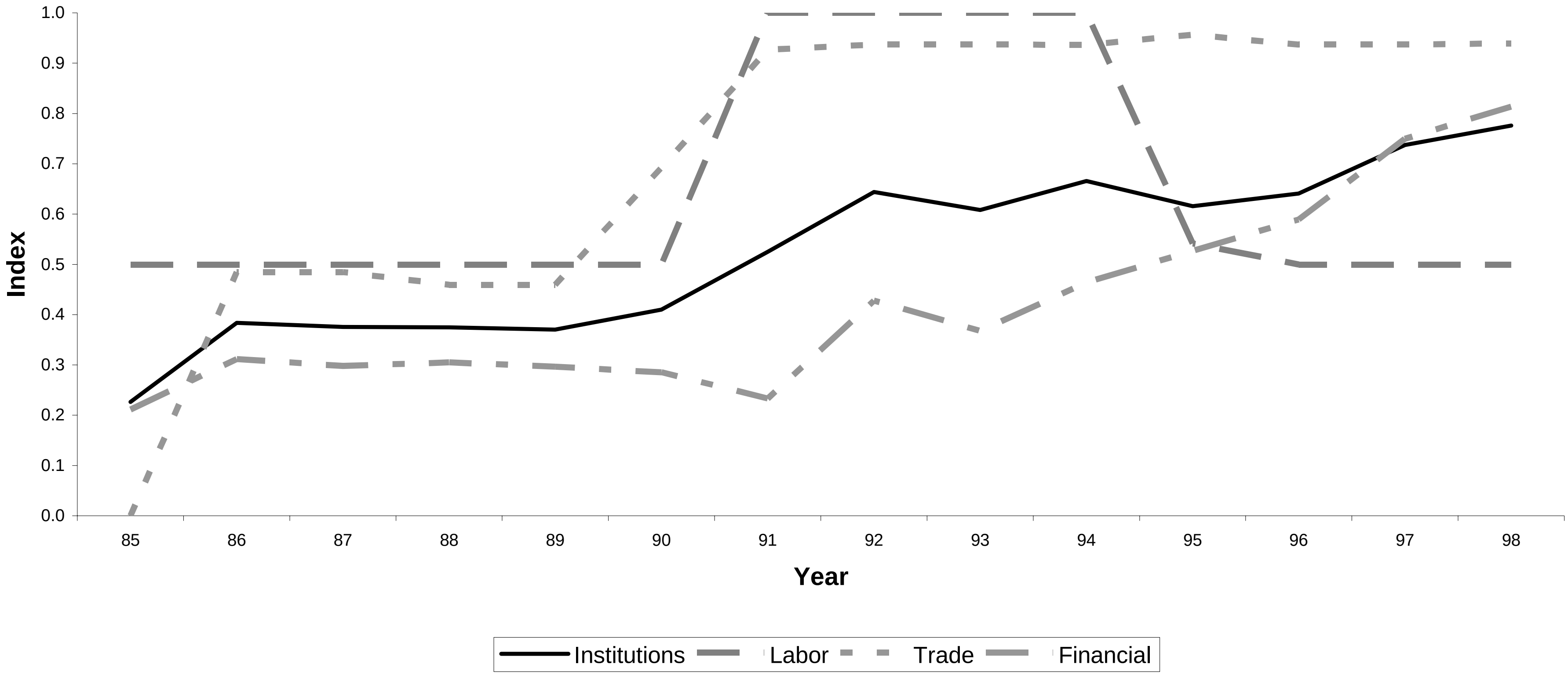

Figure 7.a: Colombia: Estimated White Collar Employment Adjustment Function at Different Levels of Institutions Index (ZB=0, X=0)

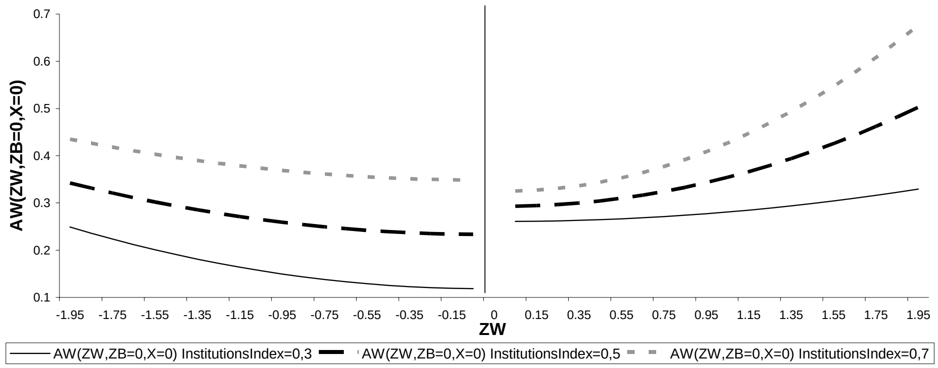

Figure 7.b: Colombia: Estimated White Collar Employment Adjustment Function at Different Levels of Trade Index (ZB=0, X=0, Labor Index=0.53, Financial Index=0.46)

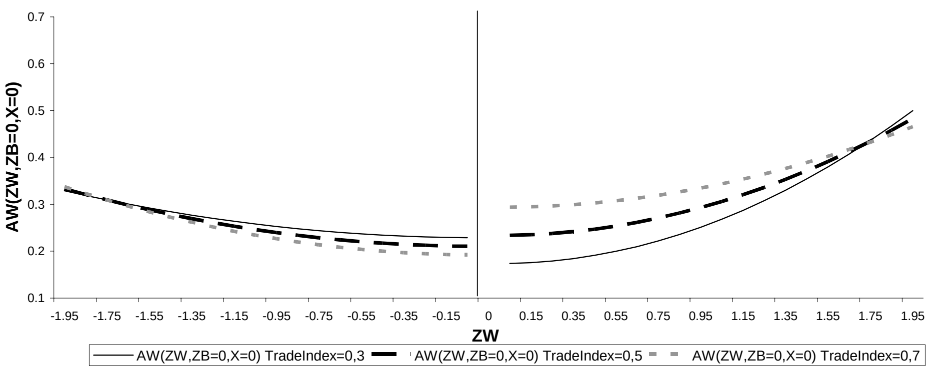

Figure 7.c: Colombia: Estimated White Collar Employment Adjustment Function at Different Levels of Labor Index (ZB=0, X=0, Trade Index =0.74, Financial Index=0.46)

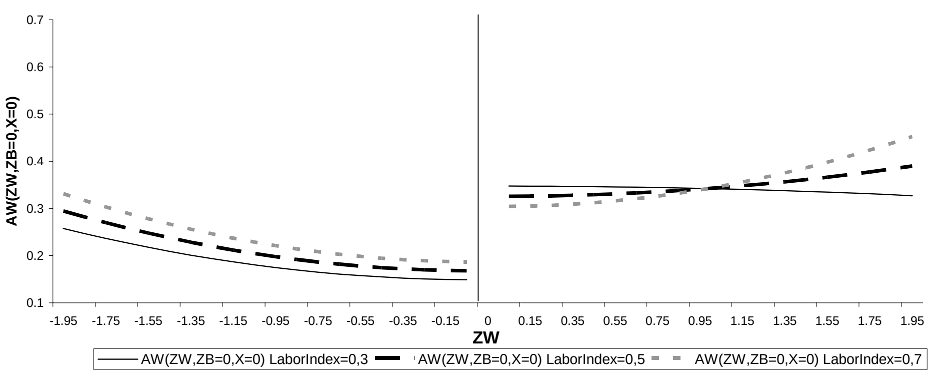

Figure 7.d: Colombia: Estimated White Collar Employment Adjustment Function at Different Levels of Financial Index (ZB=0, X=0, Trade Index =0.74, Labor Index=0.53)

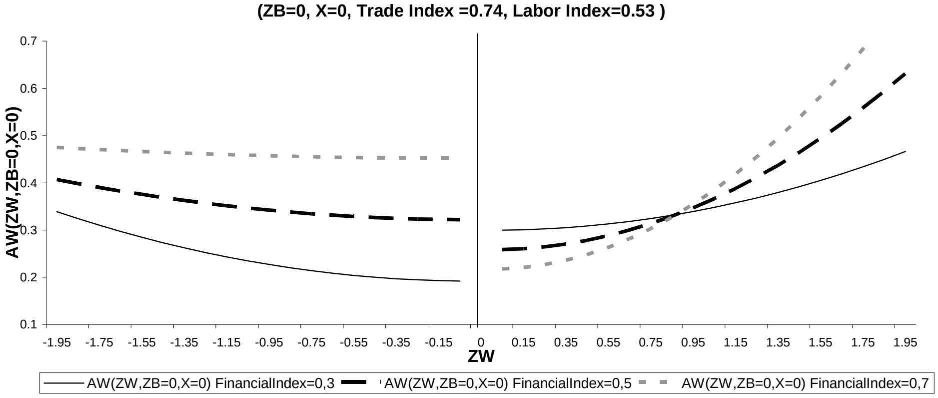

Figure 8.a.: Colombia: Estimated Blue Collar Adjustment Function at Different Levels of Institutions Index (ZW=0, ZB=0)

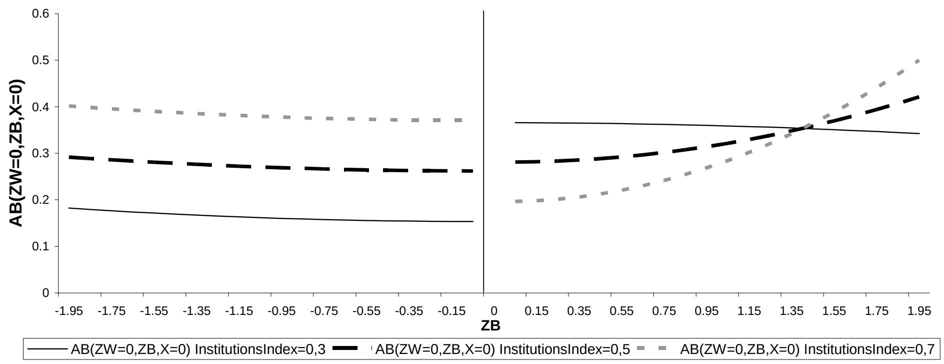

Figure 8.b: Colombia: Estimated Blue Collar Employment Adjustment Function at Different Levels of Trade Index (ZW=0, X=0, Labor Index =0.53, Financial Index=0.46)

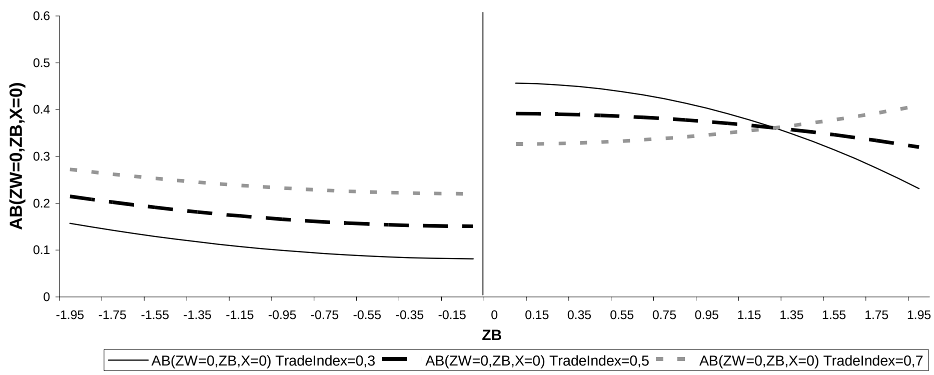

Figure 8.c: Colombia: Estimated Blue Collar Employment Adjustment Function at Different Levels of Labor Index (ZW=0, X=0, Trade Index =0.74, Financial Index=0.46)

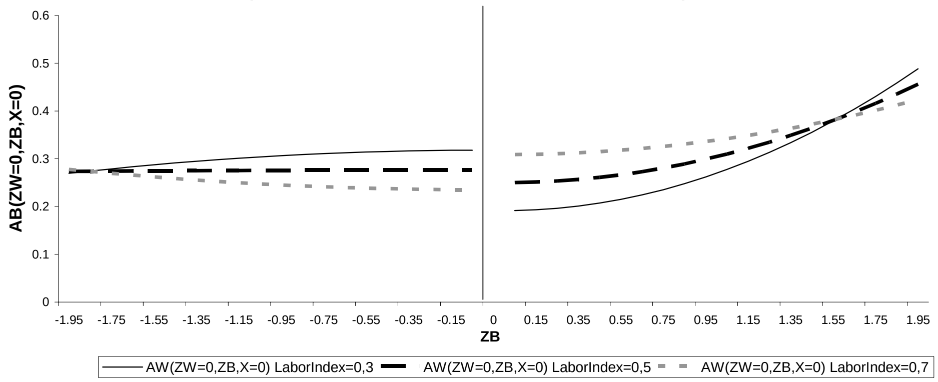

Figure 8.d: Colombia: Estimated Blue Collar Employment Adjustment Function at Different Levels of Financial Index (ZW=0, X=0, Trade Index =0.74, Labor Index=0.53)

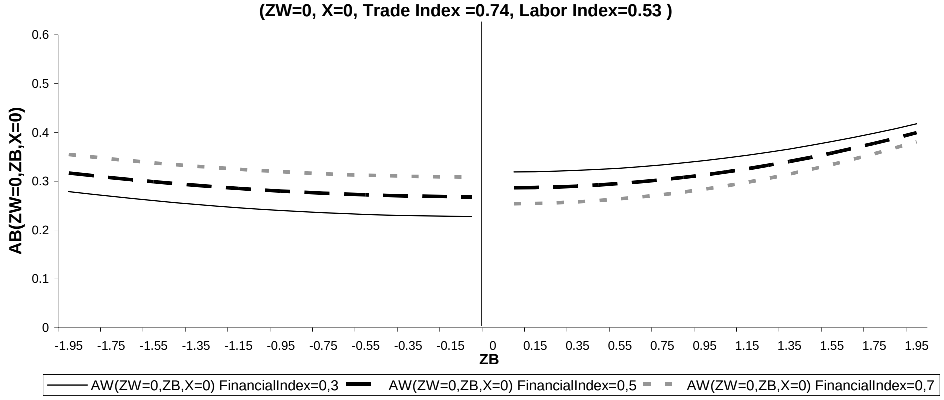

Figure 9.a: Colombia: Estimated Capital Adjustment Function at Different Levels of Institutions Index (ZW=0, ZB=0)

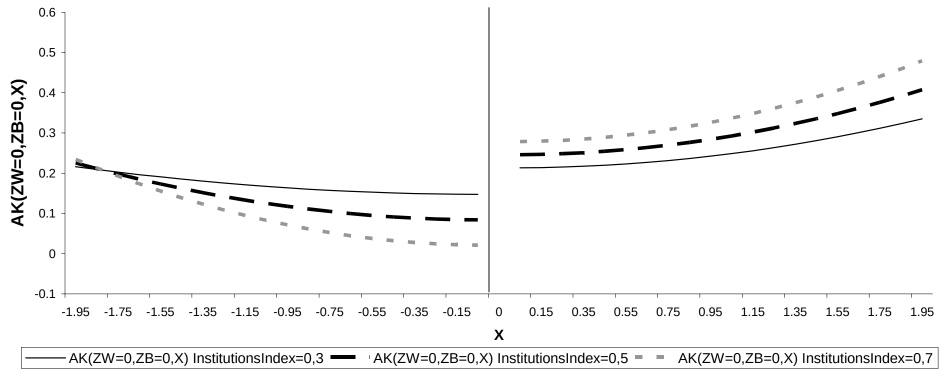

Figure 9.b: Colombia: Estimated Capital Adjustment Function at Different Levels of Trade Index (ZW=0, ZB=0, Labor Index =0.53, Financial Index=0.46)

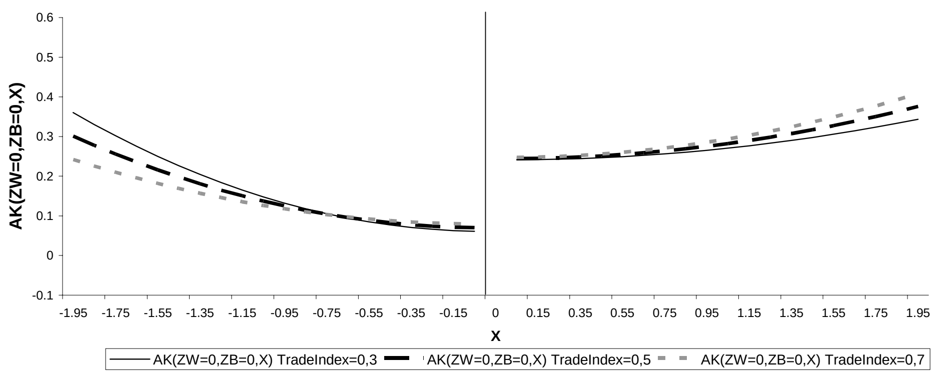

Figure 9.c: Colombia: Estimated Capital Adjustment Function at Different Levels of Labor Index (ZW=0, ZB=0, Trade Index =0.74, PTF Index=0.46)

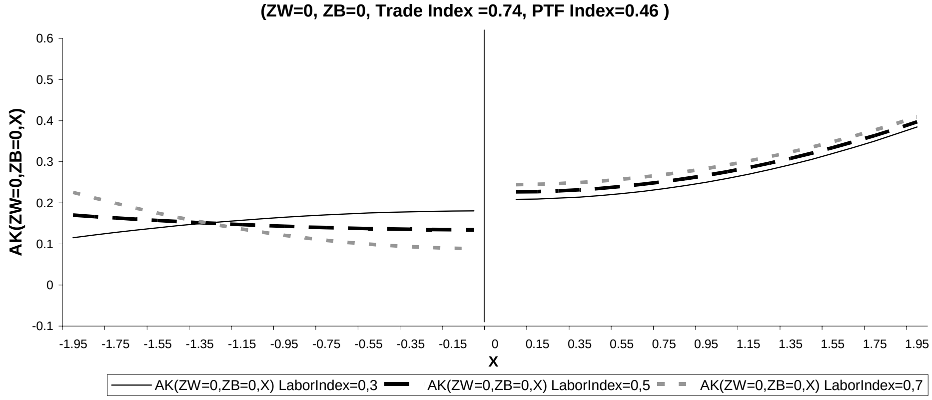

Figure 9.d: Colombia: Estimated Capital Adjustment Function at Different Levels of Financial Index (ZW=0, ZB=0, Trade Index =0.74, Labor Index=0.53)

Figure 10.a: Colombia: Job Reallocation (Three Year Moving Averages)

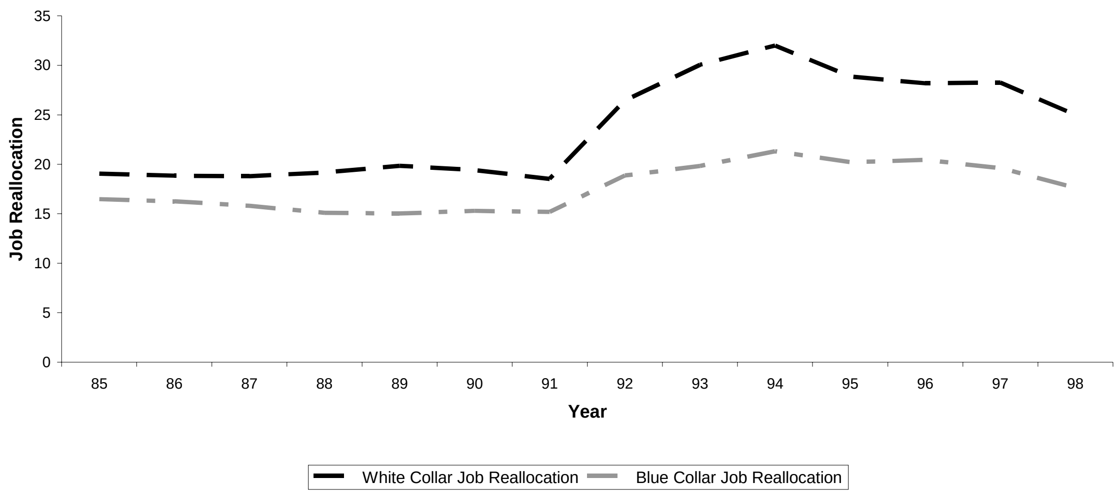

Figure 10.b: Colombia: Wages of White Collar and Blue Collar Workers