



**FINAL REPORT
COMMENTS WELCOME**

**LABOR MARKET REGULATION AND LABOR DEMAND IN COLOMBIA:
1976 – 1996**

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1976 – 1996¹**

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¹ This paper is part of a regional research project sponsored by the InterAmerican Development Bank. We are grateful to Daniel Hamermesh, Carmen Pagés and Juan Mauricio Ramírez for comments and suggestions, and to Jairo Augusto Núñez for his valuable help in processing the data for this project.

1. INTRODUCTION

Colombia is one of the five Latin American countries that have engaged in significant labor reforms during the 1990s². A new labor law was enacted in 1990, as part of a comprehensive reform package that liberalized the economy in many dimensions. Under the new regime, labor contracts were made more flexible and job security provisions were substantially modified. The level and the uncertainty of severance payments were reduced. However, as we will see, dismissal costs tied to tenure were increased.

The reform did not alter the 9% payroll tax earmarked for labor training by *SENA* (2%), social welfare programs for the unprotected childhood by *ICBF* (3%), and family subsidies provided by the privately managed *Cajas de Compensación* (4%). Moreover, the 1993 Social Security reform increased employers' mandatory contributions for health and pension programs. The combined effect of both reforms resulted in an overall increase in payroll taxation, which was not levied on workers in the form of lower wages. Meanwhile, unemployment rates increased from to 15.8% in 1998 from less than 8% in 1994.

Thus, Colombia's reform of labor market legislation provides a useful source of temporal variability to study the effects of payroll taxation on labor demand, and of dismissal costs on turnover. Apart from a complete description of the institutional and regulatory changes, this paper analyzes the effects of overall payroll taxation on labor demand. Kugler and Cárdenas (1998) discuss the effects of changes in job security provisions, such as severance payments and other dismissal costs, on labor turnover.

The paper starts by describing and measuring the costs implied by the regulation. It then estimates labor demand equations in order to measure the relevant short and long run price and

output elasticities. More specifically, the econometric exercise is aimed at responding two sets of questions: First, did the relevant elasticities change after structural reform? Or in other words, did trade liberalization increase the responsiveness of labor demand to changes in relative factor prices?² And, moreover, did the elasticities of substitution between skilled and unskilled labor change as a result of the reform process? Second, what would happen to labor demand if payroll taxes are reduced? Is there room for a new generation of labor market reform in order to raise labor demand and reduce the unemployment rate? And if so, what should be included in that reform?

The estimations are based on two types of data. First, we use quarterly time series on aggregate and sectorial employment for the period 1982:1-1996:4 obtained from the National Household Surveys. Second, we use the Annual Manufacturing Survey in order to construct two panels of data. One of the panels is based on the annual information obtained from 2570 manufacturing firms for the period 1978-1991. The other panel uses aggregated data of 91 manufacturing sectors (according to the 4-digit CIIU classification) for the period 1978-1995.

The results indicate that own wage elasticities are relatively low in absolute terms. Therefore, a reduction in payroll taxes has to be substantial in order to have a significant impact in employment generation. The paper also finds that the skilled and unskilled labor are substitutes in production. Moreover, the degree of substitutability has increased in recent years. Finally, output elasticities are low, particularly in the case of the manufacturing sector. Therefore, the reduction in unemployment does not depend alone on higher output growth. Moreover, the results indicate that the demand for labor is more elastic in downturns than during

² The other countries are Argentina (1991), Guatemala (1990), Panama (1995), and Peru (1991). See Lora (1997).

³ Trade can make labor demand more elastic by making output markets more competitive and by making domestic labor more substitutable with foreign factors. Or in the words of Hicks (1964, p. 242), "the demand for anything is likely to be more elastic, the more elastic is demand for any further thing which it contributes to produce".

expansions.

The paper proceeds as follows. Section 2 discusses the institutional and regulatory framework, with special attention to the changes introduced in the 1990 labor reform. Section 3 shows the stylized facts in the labor market during the 1976-1996 period. The discussion of the data is useful in order to lay out the main hypotheses of the paper. Section 4 deals with the incidence of payroll taxation or, in other terms, the endogeneity of wage and non-wage labor costs. The analysis relies on the estimation of Mincer-type wage equations in order to test whether higher payroll taxes have been transferred to workers in the form of lower basic wages. Section 5 presents the analytical framework in order to estimate static labor demand equations with the time series data. Section 6 presents the results of estimating the determinants of labor demand in a dynamic framework that considers explicitly the impact of the regulations on the path of employment adjustment. Sections 7 and 8 present the results of labor demand estimations based on the two panels of manufacturing data (establishment-level and sectorial-level, respectively). Section 9 concludes with a brief summary of the main results.

2. INSTITUTIONAL FRAMEWORK: RECENT CHANGES

As mentioned in the introduction, the regulation of the labor market in Colombia has registered important changes during the 1990s. This section summarizes key aspects of the 1990 labor reform and the reform to the social security system that was enacted in 1993⁴.

- Severance pay was the highest non-wage labor cost under the previous regime. The worker was entitled to one-month salary per year of work, based on the current salary at the time of exit. Partial withdrawals were allowed and deducted in nominal terms from the final payment, implying a form of “double retroactivity” (with an estimated cost of 4.2% of the total wage

⁴ See Lora and Henao (1995), Cárdenas and Gutiérrez (1996), Lora and Pagés (1997), and Guash (1997).

- bill)⁵. The new legislation eliminated this extra cost in all new labor contracts and introduced a monthly contribution (9.3% of the basic salary⁶) to a capitalized fund in the workers' name accessible in the event of separation or retirement. Thus, the reform effectively reduced the level of severance payments. It also eliminated the employers' uncertainty about the cost of severance payments.
- The reform increased above, the reform decreased the payroll tax carried by firms.
- The reform increased the indemnity paid to workers dismissed without "just cause". Workers with less than a year of tenure on the job receive 45 days' wages. Workers with more than one year of tenure receive 45 days for the first year plus an additional amount for each extra year. This implies an increase relative to the old regime. For example, in the event of separation, a worker with more than 10 years of tenure on the job used to receive 30 days for each extra year (after the first). As can be seen in Table A1, the new legislation increased the indemnity to the equivalent of 40 days' wages per additional year⁷. Although the legal definition of "just cause" was widened, the reform increased the costs of dismissal.
- The reform increased pension contributions from 8% of the basic salary to 10%.
- However, the right of workers with more than 10 years tenure to sue for reinstatement was eliminated. Prior to the reform, successful plaintiffs could oblige firms to rehire workers with back pay.
- Workers earning more than 10 minimum wages were allowed to opt for a new contract ("integral salaries") with higher wages instead of severance pay and other benefits (such as a mandatory bonus equal to 15 days' wages). In a survey conducted by Fedesarrollo in 1994, manufacturing firms reported that less than 2% of the employees had this type of contract.
- Labor contracts for less than one year were allowed (renewable up to three times under the same terms⁸), provided that all benefits are paid in proportion to the duration of the contract, so that labor costs are the same.

⁵ Apart from tenure, the real cost of termination of employment increased with the frequency of partial withdrawals, uncertain to the employer.

⁶ Equivalent to a month's salary (plus interest) per year.

⁷ Based on the highest salary during the last year of employment.

- Legal restrictions on the creation of labor unions were lifted. In particular, the Ministry of Labor lost discretionary powers in this regard. Also, it is now unlawful for employers to discourage the creation of labor unions. A minimum of 25 workers is still necessary to form a union.
- As mentioned above, the reform did not alter the 9% payroll tax earmarked for labor training, social welfare programs for the unprotected childhood and other privately provided subsidies. It is likely that, in this case, distortions in the labor market arise as a result of weak linkages between benefit entitlements and payroll taxes paid by the individual worker⁹.
- The 1993 social security and health reform (Law 100) increased total contributions for health from 7% of the basic salary (until 1994) to 8% in 1995 and 12% afterwards. As before, one-third of the total contribution has to be paid by the employer.
- The same Law increased pension contributions from 8% of the basic salary to 11.5% in 1994 (April), 12.5% in 1995, and 13.5% in 1996 and after. Workers earning more than four minimum wages pay an additional percentage point. Much of the contribution is levied on firms which now pay 10.1 percentage points, as opposed 4.3 before the reform¹⁰.

Table 1 and Figure 1 summarize the effects of labor and social security reform on non-wage labor costs. For workers with contracts signed prior to 1990, the total non-wage labor cost paid by the firm (as a percentage of the basic salary) raised from 47.1% in 1990 to 56.2% in 1996 (and thereafter). For workers with contracts signed after 1990, employers now pay 52% of the basic salary in contributions. In exchange for higher salaries, these contributions are substantially lower (33.8%) in the case of employees hired under the “integral salary” contract.

⁸ The fourth renovation has to be made for at least one year. See Farné and Nupia (1996).

⁹ Of course, if the linkage between payroll taxes is weak or if the external benefits of social security programs are significant, then partial or complete finance by general revenues may be appropriate. See Kesselman (1995).

¹⁰ Law 100 (1993) eliminated the monopoly of the Social Security Institute (ISS) in the provision of health and pensions. The coverage of health services was extended to the whole family and to low income groups that were unattended under

For the purpose of the analysis, we divide non-wage costs into three relatively arbitrary categories: First, “deferred wages” which include vacations, extra bonuses, pension and health contributions. These deferred wages affect the total labor cost but do not have an impact on the path of employment adjustment. Second, severance payments, which in addition to the direct impact on labor costs affect the dynamics of employment adjustment¹¹. Third, payroll taxes paid by the employer with benefits that cannot be fully internalized by the employee (e.g., *ICBF*, *SENA*, and *Cajas*). The economic response to these three types of non-wage costs may be different. In the case of deferred wages the employee can offset part of the cost by adjusting the wage. This may not be the case of payroll taxes earmarked for the provision of public goods. In the fourth section we analyze the possible effect of deferred wages on current wages by estimating a Mincer-type income equation. The hypothesis is that the employer may transfer non-wage costs to workers through lower wages.

The upper panel of Figure 1 shows the evolution of severance payments, as well as health and pension contributions for an average worker as percentage of the basic wage between 1976 and 1996¹². The middle panel shows the evolution of payroll taxes. These taxes increased by one percentage point in 1982 (earmarked to *SENA*) and again by an equal amount in 1989 (earmarked for *ICBF*). Vacations and extra bonuses have remained constant throughout the period. The bottom panel adds all these costs together. The cumulative effect shows an increasing trend until 1990. After the 1990 labor reform, non-wage labor costs fell as a result of the changes introduced to the legislation related to severance payments. However, since 1994 these costs have increased sharply as a result of the 1993 health and pension reforms.

the previous system. In relation to the pension system, employees were given the option of choosing between the old pay-as-you-go system or the new fully funded system provided by private pension funds.

¹¹ Strictly speaking, severance payments are also deferred wages.

¹² Workers under “integral salaries” are excluded. After 1991 we ignore workers under pre-1990 contractual terms.

3. TIME SERIES DATA: STYLIZED FACTS

Figure 2 displays the unemployment rate for the period 1976-1998. After reaching a peak in March 1986 (14.6%), unemployment rates declined steadily until 1994 when they were under 8%. Unemployment rates have increased sharply since 1995. The figure for June 1998 (15.8%) is the highest since 1976. This paper argues that part of the part of the recent surge in unemployment can be attributed to the effects on labor demand of the increase in the relative cost of labor combined with greater (in absolute value) price elasticity. The increase in the relative price of labor has been the result, among other things, of changes in labor market regulation. However, this is not the only explanation. As we will argue, the 1990 labor reform has also caused greater employment volatility in response to demand shocks. This has been the result of greater flexibility in the creation and destruction of jobs (a point which is also addressed in Kugler and Cárdenas, 1998).

This paper assesses the role of these factors by using information on output, employment (skilled and unskilled) and wages for Colombia's seven largest cities. The information is available for seven sectors: (1) manufacturing, (2) electricity and gas, (3) construction, (4) retail, restaurants and hotels, (5) transportation and communications, (6) financial services, and (7) personal and government services. The data come from the quarterly National Household Survey (NHS), which has been conducted uninterruptedly since 1976. Output data come from the quarterly GDP series processed by DNP.

Employment and Production

Table 2 displays some basic descriptive statistics on urban employment for the period 1976-1996. Manufacturing and personal and governmental services provide 29% and 25% of the urban jobs, respectively. We use information only for wage earners, which account for 64% of the total urban workers (62% before the 1990 labor reform). However, there are sharp differences across sectors. In manufacturing, 76% of the workers earn a monetary wage, while in retail and restaurants only 50% of the workers do.

We use a measure of skill that includes college graduates plus all of those with some university education (all workers with 12 or more years of schooling). By using this definition, the group of more educated workers represented 23% of urban employment on average between 1992 and 1996. According to Figure 3, this group's share in total urban employment has increased steadily since 1976, reflecting the greater educational attainment of the population. Indeed, average years of schooling have increased continuously during the past two decades. As can be seen in Table 2, skilled workers represent more than 30% of total employment in public utilities, financial services, and personal and government services. These shares have increased significantly since 1992.

Figure 4 describes the evolution of employment and production in the Colombian urban sector. It is interesting to note that after 1991 skilled employment has been more dynamic than unskilled employment in most sectors. This has been particularly true in the case of manufacturing, where employment of unskilled workers has fallen in absolute terms since 1993. The same trend is observed in the construction sector after 1994. These two sectors combined employ approximately 35% of the unskilled wage earners in the urban regions.

Factor Prices

Information about wages of skilled and unskilled workers also comes from the National Household Survey. It is well known that this survey suffers from several methodological problems¹³. The main difficulties with the raw data are related to i. Top-coding problems in reported incomes; ii. Measurement errors on the part of the surveyors¹⁴. Top coding problems are present in most of the surveys. Until September 1993 the questionnaire allowed up to six digits for monthly incomes, so that higher end incomes were increasingly underestimated¹⁵. In fact, in June 1993 the number of truncated earnings represented 0.9% of the surveyed population. Since September 1993 seven digit incomes were allowed, but even then a fraction of the surveyed individuals reported the top coded income. Since March 1996 the surveys no longer have limits on the maximum income reported. In order to correct for truncated incomes we used a procedure based on the estimation of the maximum level of income for the individuals whose incomes are truncated. Once that level is estimated we fit an exponential function to distribute the incomes of the truncated population¹⁶.

It is important to mention that wage information in the NHS corresponds to the income received by the worker, and not to the total labor cost paid by the employer (which is the relevant price in the estimation of labor demand). Therefore, it is necessary to quantify non-wage labor costs and construct a measure of the total labor cost. Figure 1 summarizes all non-wage labor

¹³ Cárdenas and Gutiérrez (1996) and Núñez and Jiménez (1997) describe in detail these problems and survey the alternative solutions that have been proposed in the literature.

¹⁴ These errors refer to the fact that many workers report a weekly (or by-weekly) payment of their salary, but express their salary in monthly terms. We found that in 10 surveys the monthly incomes of some workers had been overestimated due to the fact that a monthly salary had been (wrongly) multiplied by the frequency of payment. We dealt with this problem by identifying outliers in groups with similar socioeconomic characteristics.

¹⁵ At the 1993 exchange rate, the maximum allowed monthly income (Col\$999.998) was equal to US\$1,200.

¹⁶ See Núñez and Jiménez (1997) and Bernal et al. (1998) for details. The procedure is relatively ad hoc, but has better statistical properties than alternative methodologies. According to these studies, when top-codes are artificially imposed on the incomes of an untruncated survey the use of a lognormal distribution results in an overestimation of the Gini coefficient by 2.44%. In contrast, the degree of overestimation is only 0.07% when the alternative procedure is used.

costs, expressed as a percentage of the basic salary. This includes severance payments, payroll taxes, and contributions for health and pensions on the part of the employer.

It is not entirely clear whether income reported by the individuals surveyed in the NHS includes benefits such as vacations, mandatory bonuses and severance payments. Nonetheless, it is probably safe to assume that individuals report their basic pre-tax salary, without benefits. In order to obtain the total labor cost we add the non-wage labor costs measured in Figure 1 to the basic salary reported in the NHS. In order to add the two components we need to assume the independence of wage and non-wage costs. As discussed below, the results of the next section give support for this assumption. Finally, the overall cost is then deflated using the Producers Price Index. The procedure is identical for skilled and unskilled workers alike¹⁷. For completeness, we also report the user cost of capital measured according to a standard methodology described in Cárdenas y Gutiérrez (1996)¹⁸.

Figure 5 shows the evolution of real factor costs by sector. There are two key insights: First, the real cost of skilled labor has increased faster than the real cost of unskilled labor; Second, the cost of labor has increased faster than the cost of capital since the early 1990s. In fact, the user cost of capital decreased considerably during the period 1992-1994 as a result of the reduction in the interest rate and the real currency appreciation. As shown in Table 3 the average annual growth in real labor costs between 1992 and 1996 was 11.4% for skilled workers and 8.4% for unskilled workers. These rates are substantially higher than the average for the pre-

¹⁷ As mentioned in Section 2, workers with high remuneration (over 10 minimum wages) under 'integral salaries' contracts have much lower non-wage costs (33.8% of the basic salary vs. 52% in contracts with full benefits). However, the NHS survey does not provide information on the contract type so we assume that all workers are paid full benefits. This is probably a correct assumption due to the fact that less than 2% of workers in manufacturing had this type of contract in 1994 (according to a survey conducted by Fedesarrollo).

¹⁸ Our measure of the user cost of capital is higher than the one obtained by Pombo (1997), who estimates the depreciation rates (and the corresponding tax deductions) for different asset types in the manufacturing sector.

reform period. In sum, labor costs increased in an unprecedented way after 1990, especially in the case of skilled workers.

4. Endogeneity of Wage and Non-wage Costs

As mentioned above, our measure of total labor costs ignores the incidence of payroll taxation on wages. Several authors have argued in favor of the endogenous nature of wages. As discussed in Newell and Symons (1987) for the European context and in Gruber (1995) for Chile, ignoring this issue can be misleading when making policy recommendations. The relationship between wages and payroll taxes can be analyzed by estimating an equation of the wage rate as a function of the payroll tax rate and a constant. If the coefficient on the payroll tax rate variable is equal to -1 , then taxes are fully shifted into wages. This is the procedure used by Gruber (1995).

In this section we adopt a somewhat different procedure. We estimate the determinants of nominal wages for each worker based on information from the National Household Surveys. Every two years the NHS includes a special module on informality. In that module, workers report whether they are covered by the social security system. We use the June surveys for 1988, 1992 and 1996 in order to assess for possible changes after the labor reform. Table 4 shows the percentage of workers with health coverage for four different years. According to this information, the share rose to 60% in 1996 from 47% in 1984.

In particular, we estimate a Mincer-type income equation in order to understand whether an individual's wage, given certain personal characteristics, is negatively affected when the individual is registered in the social security system (i.e., makes pension and health contributions). In other words, if employer transfer non-labor cost to the worker then the fact that

the individual is registered in the social security system would have a negative impact on the basic wage (after controlling for other personal characteristics that may affect wages)¹⁹.

In particular, we estimated the following equation:

$$\ln w_i = \beta_0 + \sum_i \beta_i pers + \beta_3 dumss + \beta_6 mw + \beta_7 dumss * mw + \sum_i \beta_i sec + \sum_i \beta_i city + \varepsilon_i \quad (1)$$

where *pers* is a vector of personal characteristics that include average years of schooling, gender, and experience; *dumss* is a dummy variable which takes a unitary value when the individual is registered in the social security system (i.e. the employer pays social security contributions); *mw* is a dummy variable that controls for individuals that earn the minimum wage²⁰ (payroll taxes cannot be transferred to these workers in the form of lower wages); *sec* is a vector of dummy variables that account for 9 economic sectors and *city* is a vector of dummy variables for each of the seven main cities.

Table 5 presents the results of the estimations of equation (1). The adjustment of the regression is high (R-squares are around 0.55) given the total number of observations (approximately 25.000 depending on the year). The personal characteristics variables appear with the correct sign and are statistically significant. In particular, returns to education are positive (but low) and the coefficient is highly significant. The positive coefficient of the dummy variable for gender indicates that given other personal characteristics, labor income is higher for men than for women. In turn, experience has a positive but decreasing impact on wages. The dummy variables that account for the economic sectors and the city of location also come out significant.

Turning to the variables of interest for this exercise, for a given set of personal characteristics workers covered by the social security system have higher wages than uncovered

¹⁹ Ribero and Meza (1997) and Sánchez and Núñez (1998) have estimated Mincer-type income equations for Colombia.

workers do. This is of interest because it indicates that employers do not transfer social security contributions to workers in the form of lower wages. According to the sign of the coefficient, individuals that earn the minimum wage have lower incomes than what would be predicted by their personal characteristics. This is less true in the case of workers that earn the minimum wage and that are registered in the social security system.

In sum, the evidence suggests that payroll contributions do not have a negative impact on wages. Therefore, the results of this section provide the necessary support in order to measure total labor costs as the sum of wage and non-wage costs. Based on this measure we now turn to the estimation of the labor demand equations.

5. STATIC LABOR DEMAND: TIME SERIES

The purpose of this section is to measure the own wage elasticities of the demand for labor, as well as the elasticities of substitution between different factors of production²¹. The literature is rich in terms of functional forms that can be used for the estimation. If changes in the elasticity of substitution are of interest, the Generalized Leontief (GL) function is a common choice. The GL specification is also normally used when information is available for more than two factors of production²².

The derived factor demands from a GL cost function (see Appendix 1) can be written as:

$$\frac{x_{it}}{y_t} = \sum_j b_{ij} \left(\frac{p_{jt}}{p_{it}} \right)^{\frac{1}{2}} + \alpha_i y_t + \gamma_i t. \quad (2)$$

²⁰ For the purpose of this exercise, the minimum wage in 1988 was \$28,000, in 1992 \$72,000 and in 1996 \$155,000.

²¹ Defined as the effect of a change in relative factor prices on relative input use of the two factors, holding output and other factor prices constant.

²² See Hamermesh (1986).

where x_{it} is the quantity of factor i used in period t , y_t is output in period t , p_{it} is the price of input i in period t , and t is a time trend. Changes in the input-output ratio can be the result of: (a) changes in relative factor prices; (b) changes in the scale of production (if the production function is not homothetic); and (c) technological change. Diewert (1971) has shown that the GL cost function corresponds to a fixed coefficients technology (no factor substitution) if $b_{ij} = 0$ for all $i \neq j$. Also, the production function exhibits constant returns to scale if $\alpha_i = 0$ for all i (i.e., the function is homothetic). Clearly, factor-augmenting technological change does not occur if $\gamma_i = 0$ for all i . Based on the estimated b_{ij} 's, we then calculate the own wage elasticity for factor i (η_{ii}) as:

$$\eta_{ij} = -\frac{y \sum_{j \neq i} b_{ij} (p_j / p_i)^{1/2}}{2x_i} \quad (3)$$

In turn, the Hicks-Allen partial elasticities of substitution between input i and input j ($\sigma_{ij} = \sigma_{ji}$) can be easily calculated. The appropriate expressions in the case of the GL technology are (s_j is the cost share of input j):

$$\sigma_{ij} = \frac{\frac{y}{2x_i} b_{ij} \left(\frac{p_j}{p_i} \right)^{1/2}}{s_j} \quad (4)$$

for all $i \neq j$. In this case, the elasticity of substitution is not constant across time. In fact, as can be observed in equation (4), its value depends on the inputs quantities and prices. Finally, the elasticity of input i with respect to output is given by:

$$\varepsilon_i = 1 + \frac{\alpha_i y^2}{x_i} \quad (5)$$

Thus, when the technology exhibits constant returns to scale the output elasticity is equal to one.

RESULTS

This section summarizes the main results of the estimation of static labor demand equations with quarterly data from the urban Household Surveys. The estimation is carried for both the manufacturing sector and seven largest metropolitan cities. In both cases, we estimate a system of two equations for the demand of skilled and unskilled labor. The equations use the number of hours worked as the dependent variable.

MANUFACTURING

Table 6 presents the results on the factor demands for skilled and unskilled labor. According to the GL specification, the system of two equations describing the behavior of the input-output ratios was estimated using a (Gauss) Full Information Maximum Likelihood Procedure (FIML). In order to correct for first order serial autocorrelation of the error the lagged residuals were added to each equation (AR1).

The system was estimated with and without the symmetry restrictions ($b_{ij} = b_{ji}$). Conveniently, Theil has shown that minus twice the log of the likelihood ratio (i.e. maximum of the likelihood function imposing symmetry over the maximum of the likelihood function in the unconstrained case) has a Chi-square (Π^2) distribution (with degrees of freedom equal to the number of restrictions imposed)²³. The test rejected the null hypothesis of symmetry. Also, in the estimations the coefficient γ_i came out not significantly different from zero rejecting the hypothesis of factor-augmenting technological progress.

²³ See López (1980).

The estimated b_{ij} 's (excluding the trend term from the equations) are significantly different from zero, rejecting the existence of a fixed proportion technology (a Leontief production function). Importantly, the signs of the coefficients indicate that the two types of labor are substitutes. The hypothesis of constant returns to scale is also rejected at high levels of significance. The estimated α_i coefficients are all positive and significant. This implies that both employment/output ratios increase as the scale of production is expanded (i.e. the production function is non-homothetic).

Based on the estimated b_{ij} 's we then compute the relevant elasticities that, according to the formulae, are time dependent. We report the elasticities for three periods: 1980-1985, 1986-1991, and 1992-1996. The two types of labor show a decreasing degree of substitutability. Own wage elasticities are negative. For the 1992-1996 period their value is around -0.35 for skilled workers and -0.4 for unskilled workers. This means that a 10% reduction in wages is related to a 3.5-percent increase in the demand skilled and 4-percent increase in the demand for unskilled labor²⁴.

Output elasticities are positive during the whole period but have decreased with time. In particular a 1-percent increase in production is related to a 2% increase in skilled labor demand and a 1-percent increase in unskilled labor demand.²⁵

SEVEN METROPOLITAN AREAS

Table 7 shows the results of the estimation in the case of the demand for hours worked by skilled and unskilled labor (without capital) in the seven largest metropolitan areas. Besides

²⁴ The results using a CES function are somewhat different. In this case, a 10% decrease in wages is related to a 0.8% increase in skilled labor demand and a 1.7% increase in unskilled labor demand respectively. Again, the two types of labor show increasing substitutability, just as in the case of capital and unskilled labor. On the other hand skilled labor and capital are complements. These results are available upon request.

changes in relative prices, we added a demand shifter in the equation. In particular we introduced the investment rate for the urban economy into equation (2), in order to assess any possible changes in labor demand holding constant relative prices.

Again, the Wald test rejected the null hypothesis so we estimated the b_{ij} 's without symmetry restrictions. The coefficients turned out significantly different from zero, rejecting the existence of a fixed proportion technology. The estimated α_i coefficient for skilled employment is positive and significant. This implies that skilled employment/output ratio increases as the scale of production is expanded (i.e. the production function is non-homothetic). Based on the estimated b_{ij} 's we computed the relevant elasticities. The two types of labor show a decreasing degree of substitutability as can be seen in Figure 6. On average, the elasticity of substitution between skilled and unskilled employment was 0.93 between 1976 and 1996.

Own-wage elasticities are higher in this case than in the manufacturing sector. In particular, a 10% decrease in wages is related to a 4.5% increase in skilled labor demand and a 5.1% increase in unskilled labor demand. In the case of unskilled labor, the own-wage elasticity has increased in absolute value during the post-reform period from 4.6 to 5.1. On the other hand, output elasticities are positive. A one-percent increase in output is related to a 1.8% increase in skilled labor demand and a one-percent increase in unskilled labor demand. Higher investment rates increase both skilled and unskilled labor demand. Yet, this effect has been slightly higher in the case of skilled employment.

Finally, we estimated equation (1) adding a dummy for the post reform period (alone and interacted with the relative prices). The coefficients on these variables did not turn out significant. This means that the effects of the reforms are already captured in the changes in relative prices or

²⁵ The results when splitting up into two subsamples (after and before the reform) are statistically insignificant.

in the demand shifter that was added to the equation. The results (not reported) on these regressions are available upon request.

6. DYNAMIC LABOR DEMAND: TIME SERIES

The existence of adjustment costs of changing employment (net changes) and changes in firing and hiring (gross changes) implies that firms do not adjust instantly to changes in the variables mentioned in the previous section. To capture this issue, we estimated a dynamic labor demand equation that is derived in Appendix 2:

$$n_t = c + \alpha_0 y_t + \alpha_1 y_{t-1} + \beta_0 [w_t + nw_t] + \beta_1 [w_{t-1} + nw_{t-1}] + \gamma_t n_{t-1} + u_t \quad (6)$$

where n is employment, y is a rolling autoregression forecast of production, w is a rolling autoregression forecast of basic wages, nw are non-wage labor costs that do not affect the path of employment adjustment, and u is an error term. Non-wage labor costs include vacations, bonuses, health and pension contributions and payroll taxes (all added as % of basic wage). In turn, γ_t is a measure of the costs of adjustment, which depends on the regulations that affect the path of employment. Following Burgess and Dolado (1989) we interact different types of regulation with n_{t-1} . In particular, we assume that:

$$\gamma_t = \gamma_0 + \gamma_1 RI_t + \gamma_2 R2_t \quad (7)$$

where RI denotes severance payments (expressed as a percentage of the basic salary) and $R2$ denotes dismissal costs (indemnity for dismissal without just cause expressed in terms of the number of monthly wages for workers with 10 or more years in the firm²⁶). As mentioned in Section 2, severance payments fell as a result of the 1990 labor reform, while the indemnity for

²⁶ This variable is taken as a proxy for dismissal costs for all workers. Although desirable, we were unable to redefine the dependent variable in order to measure employment of workers with 10 or more years in their current job only.

unjust dismissal increased²⁷. These two changes in the regulation should have had opposite effects on the costs of adjustment. The reduction in severance payments should have reduced the costs of adjustment (a reduction in γ), while the increase in dismissal costs should have worked in the opposite direction. Importantly, the 1993 pension and health reform increased labor costs but should not have affected the costs of adjustment.

This formulation useful in order to asses the impact of a one-unit increase in the costs of regulations on the level of employment (the β 's) and that of this increase in the cost per worker on the path of employment adjustment (the γ 's). In the former case, we can infer the impact or short-run multiplier coefficient (β_0) and the long or equilibrium multiplier ($\beta_0 + \beta_1$). Moreover, we can test whether these multipliers changed as a result of the structural reforms. This can be done as a quasi-natural experiment by including a post-reform dummy interacted with wages and the lagged employment measure.

6.1. Econometric Results

Table 8 presents the results of the estimation of equation (7), with quarterly data from the household surveys. In order to avoid potential endogeneity in the shocking variables, we used rolling-regression (i.e. continuously updated) forecasts of the product demand and wages instead of their actual values. In the case of output, the forecast is based on fourth order autoregression. Wages are forecasted with a third order autoregression.

The first three columns show the results of estimating (7) for total urban employment. Unfortunately, we cannot include R1 and R2 in the same regression due to collinearity of the variables. The results are of interest. The first three columns indicate that the product elasticity of

²⁷ Although the elimination of the right to sue for reinstatement with back pay should have reduced the expected firing

employment is 0.57, while the wage elasticity is zero in the short run (impact) but -0.16 in the long run. The results also suggest that the changes in the regulations did not have an impact on adjustment costs. In fact, the coefficient on lagged employment indicates that quarterly changes in employment are on average only 40% of the desired adjustment, irrespective of the changes in the regulation.

The remaining regressions separate skilled and unskilled employment. The results suggest that output and price (in absolute value) elasticities are larger for skilled workers. The costs of adjustment were not affected by changes in the regulations regarding severance payments and dismissal costs for either type of worker. Moreover, when a post-reform dummy was interacted with the wage variables the estimated coefficient did not come out significant. This result gives support to the point made in the previous section, suggesting that structural reform did not affect the price elasticity of labor demand. In this sense, structural reforms did have an impact on labor demand through its effect on relative prices alone²⁸.

In sum, the results of this section suggest that regulations add to static labor costs rather than to the dynamics of employment adjustment. Therefore, in the next two sections we will revisit the static labor demand estimations, using micro data. Before we move in that direction we present the results of some simulation exercises based on the dynamic labor demand estimation. The simulations are illustrative of the effects of different changes that could be introduced to labor legislation.

6.2. Simulations

costs.

²⁸ Slaughter (1997) has found that labor demand has been growing less elastic over time in the U.S.

In this section, we perform a simulation exercise in order to assess how changes in payroll taxes and labor costs affected employment growth in Colombia. For this purpose, we used equations (3), (4) and (5) in Table 8 to estimate what would have happened to employment had health and pensions contributions not been increased during the 1993 labor reform.

Figure 7 shows the fitted value of employment according to the dynamic labor demand specifications presented in Table 8. Panel A shows the results in terms of total employment, while panel B and C report unskilled and skilled employment, respectively. As employment is in logs, the difference between the two lines represents the percentage change. According to this information also presented in Table A2, during the last quarter of 1996 total employment would have been 1.3% higher if health and pensions contributions had not changed during 1993. Similarly, unskilled employment would have been 1.85% higher and skilled employment 2.2% higher.

Figure 8 depicts the results of a similar exercise. In this case we simulate what would have occurred if the 9% payroll tax had been eliminated in 1993. In this case, employment would have been 1.3% higher during the last quarter of 1996, compared to what actually happened. The figures for unskilled and skilled employment are 1.8% and 0.9%, respectively.

7. LABOR DEMAND IN A PANEL OF MANUFACTURING ESTABLISHMENTS

This section presents some results of the estimation of a homogeneous labor demand equation with a balanced panel of Colombian manufacturing firms. The panel was obtained from the Annual Manufacturing Survey (MAS) and includes 2570 firms throughout the period 1978-1991. The total labor cost was obtained directly for the surveys by adding wages and other

benefits (*prestaciones*). In the specification of the model we follow Bentolila and Saint Paul (1992). In particular, we estimate:

$$n_{it} = \alpha_0 + \alpha_1 n_{i,t-1} + \alpha_2 w_{it} + \alpha_3 p_{it} + \alpha_4 k_{it} + \alpha_5 dy_{it} + \alpha_6 t + \varepsilon_{it} \quad (8)$$

where n_{it} is the log total employment by firm i at time t , w_{it} is the log of wage paid by the firm deflated by the producers' price index, p_{it} is the log of the price of intermediate goods consumed by the firm (also deflated by the producers' price index), k_{it} is the log of stock of capital, dy_{it} is the growth rate in gross production by the firm, and t is a time trend.

The results are reported in Table 9. The first and second columns show the results of the estimation with least squares and instrumental variables, respectively. In the latter, we use the lagged values of employment and intermediate goods' prices as instruments (both at time $t-2$), as well as the contemporaneous growth rate in government consumption and the stock of capital. The results confirm the negative but low value (in absolute terms) of the short-run wage elasticity of labor demand in the manufacturing sector (around -0.05). However, the long-run value of this elasticity is substantially higher in absolute terms (-2.27). The long-run elasticity with respect to other inputs' prices is positive (1.36), suggesting labor and intermediate goods are substitutes in production.

Growth in gross output seems to have a statistically significant effect on employment. Indeed, the results of the estimation indicate that a one-percentage point increase in the rate of output growth results in a 0,24-percentage growth in employment. This result is in line with the time series evidence of the previous section. In order to correct heteroskedasticity problems we controlled for fixed effects by adding 28 sectorial dummy variables to the equation. The results remained virtually unchanged.

Finally, we interacted the list of regressors with a dummy variable that captures differential responses to the business cycle. The dummy variable takes a unitary value when output growth for the firm is over 4% and zero when growth is below 2%. If the growth rate is between 2% and 4%, the assigned value at time t depends on growth at $t-1$. If growth accelerated, then the dummy variable takes a unitary value. Conversely when growth decelerates.

The results suggest that the wage elasticity of labor demand decreases (in absolute terms) during expansions, while the elasticity with respect to the price of intermediate inputs increases. Thus, an increase in the cost of intermediate goods induces greater substitutability *vis-à-vis* labor during expansions than during recessions. Lagged employment shows the expected result, lower inertia in expansion, and the coefficient is highly significant. Lastly, the results suggest an asymmetric labor demand response to the business cycle conditions. The impact of output growth on employment is larger during recessions than during expansions.

In sum, labor demand elasticities derived from establishment data are lower (in absolute value) than the ones obtained with aggregate data for the manufacturing sector. This is true both in the case of own wage and output elasticities. The results of this section also indicate that the demand for labor is more elastic in downturns than during expansions. This could explain why unemployment rates rise very rapidly but take a long time to fall, a pattern that has been found in Colombia. Unfortunately, we cannot test the hypothesis of structural change (after 1991) with establishment data (the information has not been made available yet). In the next section we tackle this issue with more aggregated data from the Annual Manufacturing Survey, which is available until 1995.

8. LABOR DEMAND IN A PANEL OF 92 MANUFACTURING SECTORS

This section estimates equation (8) using data from 92 industrial sectors (corresponding to the 4-digit CIU classification) from 1978 to 1995. In this case, the log of value added replaces the growth rate in gross production. The results are presented in Table 10 where all the variables are in logs. The first column presents the basic equation estimated by ordinary least squares. The second column corrects fixed effects and the third column uses instrumental variables, where lagged values of employment, intermediate goods' prices (both at time $t-2$) and the stock of capital (at time $t-1$) as well as the contemporaneous values of the stock of capital and of wages are the instruments.

The estimated real wage elasticity is higher (-0.6) in absolute terms than the value estimated with the firm-level data. Using IV the long-run wage elasticity is -1.43. The elasticity with respect to input prices is on average -1.2 depending on the method of estimation. Contrary to the firm-level results, the negative sign suggests that labor and intermediate goods are complements in production. Value added has a positive and statistically significant effect on employment. According to these results, a one-percent increase in value added results in a 0.45 percentage growth in employment.

Finally, the last three columns in Table 10 show the results when the basic equation is interacted with a dummy variable equal to 1 from 1992 to 1995 (and 0 otherwise) in order to assess for possible changes in the coefficients after the implementation of structural reform. The coefficient on lagged employment indicates that employment has been more flexible since 1992 (lower inertia).

On the other hand, the elasticity with respect to total wage seems to have decreased (in absolute value) after 1991. Similarly, the response of employment to changes in value added virtually disappeared during the post-reform period. The elasticity with respect to material prices

turns out to be positive during the post-reform period, indicating that labor and intermediate goods are substitutes in production. Interestingly, the positive response of employment to the capital stock increased significantly after the new labor regulation was implemented.

Table 11 shows two-year intervals estimations of equation (8). The results are not clear-cut but suggest that the own-wage elasticity has been declining since 1979. A similar pattern can be found for the value-added elasticity. However, the sharp fluctuations in these elasticities prevent us from deriving strong conclusions from these results. With the time series data we were unable to detect any structural change in the elasticities, so that the results of this section should be taken with caution.

9. CONCLUSIONS

This paper has analyzed the determinants of the demand for labor in Colombia using data for the manufacturing sector and for urban economy (seven largest metropolitan areas). The paper places special emphasis on the measurement of own wage elasticity in order to estimate the effects of payroll taxation on employment generation. The paper also analyses the impact of structural reform, through their direct impact on the costs of employment as well as through their effect on the relevant elasticities.

The estimated wage elasticities are summarized in Table 12. Using the quarterly time series obtained from the National Household Surveys these elasticities range from -0.45 to -0.52 , depending on the type of labor. However, when the elasticities fall (in absolute terms) when the estimation uses a dynamic framework. In this case, the long run own-wage elasticity is -0.16 .

In the case of the manufacturing sector the elasticities are somewhat lower. Using the time series data they range between $-0,35$ (skilled) and -0.40 (unskilled). In a panel of 91 manufacturing sectors the estimated value is -0.6 (in the short run) and -1.43 (in the long run). These results change dramatically in a regression that uses establishment data. In this case the short run elasticity is only -0.05 .

Output elasticities are larger. In the static labor demand framework the estimates are close to 2 for skilled workers and 1 for unskilled labor. In the dynamic specification they are 1 for skilled and 0.6 for unskilled employment. Again, the elasticities fall when panel data is used.

The paper also analyses the impact of changes in the regulations on adjustment costs. The conclusion is that changes in severance payments and costs of dismissal, associated with the 1990 labor reform, did not affect the path of employment adjustment. Using this framework, we also conclude that structural reforms did not change the relevant elasticities. This means that the main effect of regulatory changes affected labor demand though their direct impact on labor costs. Since these costs have increased it is likely that the net effect of labor, health and pension reforms has been a reduction in employment generation. According to the estimated elasticities in the dynamic framework, an elimination of the 9% payroll taxes could result in a 1,3% increase in employment in the urban areas.

Using a panel of manufacturing establishments we also concluded that the wage elasticity of labor demand increases (in absolute terms) during contraction. The impact of output growth on employment is also larger during recessions than during expansions. In this sense, we found an asymmetric labor demand response to the business cycle conditions. Lastly, we did not find evidence of a significant effect of structural reforms (i.e. trade liberalization) on the relevant

labor demand elasticities. We conclude that the effects of reforms on labor demand were the result of changes in relative prices alone.

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Appendix I. Generalized Leontief (GL) Cost Function

The GL cost function can be written as:

$$(A1) \quad C(P, Q, t) = Q \sum_i \sum_j b_{ij} p_i^{1/2} p_j^{1/2} + Q^2 \sum_i \alpha_i p_i + Qt \sum_i \gamma_i p_i$$

where Q denotes output and p_i is the price of input i (t is time). The function is homogeneous of degree one in prices and does not impose symmetry, concavity or homotheticity. Assuming price-taking behavior in factor prices and using Shephard's Lemma one can derive cost-minimizing input demand functions:

$$(A2) \quad X_i = \frac{\partial C}{\partial p_i} = \sum_j b_{ij} [p_j / p_i]^{1/2} Q + \alpha_i Q^2 + \gamma_i Qt$$

where X_i is the quantity demanded of input i . Factor demands can be expressed in terms of input-output ratios:

$$(A3) \quad \frac{X_{ii}}{Q_i} = \sum_j b_{ij} [p_{jj} / p_{ii}]^{1/2} + \alpha_i Q_i + \gamma_i t + \mu_{ii}$$

Appendix 2. Analytical Framework for the Dynamic Labor Demand Estimations

A Cobb-Douglas production function can be written as:

$$(A4) \quad Y_t = AN_t^\alpha K_t^{(1-\alpha)}$$

where A denotes a technological parameter, L the level of total employment, K the capital stock and α the proportion of employment in production.

First order conditions can be written as:

$$(A5) \quad W_t = \frac{\delta Y_t}{\delta N_t} = \alpha AN_t^{*\alpha-1} K_t^{1-\alpha}$$

Expressing equation (A5) in logarithms:

$$(A6) \quad \ln W_t = \ln \alpha A - (1-\alpha) \ln N_t^* + (1-\alpha) \ln K_t$$

Rearranging terms:

$$(A7) \quad \ln W_t = \ln Y_t + \ln \alpha A + \ln A + \alpha \ln N_t^* - (1-\alpha) \ln N_t$$

If lowercase letters denote logs, then (A7) is equivalent to:

$$(A8) \quad n_t^* = \frac{c + y_t + w_t}{(1-\alpha)}$$

$$(A9) \quad n_t^* = c + \alpha y_t + \beta w_t$$

An adjustment equation satisfies:

$$(A10) \quad n_t - n_{t-1} = (1-\lambda)(n_t^* - n_{t-1}) + \varepsilon_{t-1}$$

Rearranging terms:

$$(A11) \quad n_t^* = \frac{n_t - n_{t-1}}{(1-\lambda)} + n_{t-1} - \frac{\varepsilon_{t-1}}{(1-\lambda)}$$

Substituting (A9) into (A11):

$$(A12) \quad \frac{n_t - n_{t-1}}{(1-\lambda)} + n_{t-1} - \frac{\varepsilon_{t-1}}{(1-\lambda)} = c + \alpha y_t + \beta w_t$$

Rearranging terms:

$$(A13) \quad n_t = (1-\lambda)c + \alpha(1-\lambda)y_t + (1-\lambda)\beta w_t + \lambda n_{t-1} + \varepsilon_t$$

We now suppose firms have rational expectations and n_t^e satisfying the following condition:

$$(A14) \quad n_t^e = (1-\lambda)n_t + \lambda n_{t-1}^e$$

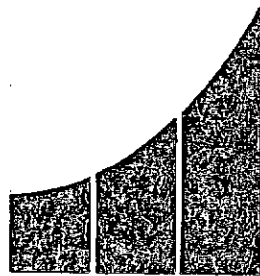
where superscript e denotes expectations. Substituting recursively for e_{t-s}^e , we can obtain:

$$(A15) \quad n_t^e = \frac{(1-\lambda)}{(1-\lambda L)} n_t$$

where L is the lag operator. Then (A13) can be rewritten as:

$$(A16) \quad n_t = (1-\lambda)c + \alpha y_t - \alpha \lambda y_{t-1} + \beta w_t - \lambda \beta w_{t-1} + \lambda n_{t-1} - \lambda^2 n_{t-2} + \varepsilon_t - \lambda \varepsilon_{t-1}$$

which is the estimated equation.



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