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Determinants of Labor Demand in Colombia
1976–1996

Mauricio Cárdenas and Raquel Bernal

4.1 Introduction

In spite of a labor reform introduced in 1990 as part of a reform package that liberalized the economy in many dimensions,[1] Colombia's urban unemployment reached an unprecedented 20 percent by the end of that decade. The 1990 reform made labor contracts more flexible, including a reduction in job security provisions. The most significant change took place in relation to severance payments, with the introduction of a system of individual accounts managed by specialized private funds. Under the old system, employers managed the funds, and employees were allowed to make partial withdrawals at any time. At the time of separation, those withdrawals were debited in nominal terms, adding to the costs faced by employers. In practice, the new system implied a reduction in the level and uncertainty of severance payments for firms. In fact, the initial effect of the reform was to lower nonwage labor costs to 42.9 percent of the basic wage, down from 47.1 percent during the late 1980s. However, the reform did not deal with other important areas of labor legislation, especially payroll taxation.[2]

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1. The reforms of the early 1990s were introduced mainly as a result of low growth during the 1980s, combined with an election turnout that gave President César Gaviria, a convinced reformist, a significant majority in congress.

2. The reform kept a 9 percent payroll tax earmarked for labor training by SENA (2 percent), social welfare programs for the unprotected childhood by ICBF (3 percent), and family subsidies provided by the privately managed *Cajas* (4 percent).

The reform package also included a social security law, enacted in 1993, which raised employers' mandatory contributions for health and pension programs. From the viewpoint of the labor market, this reform had important implications resulting from the significant increase in nonwage labor costs. In fact, by 1996 nonwage labor costs had risen to 52 percent of the basic salary, an increase of nearly 10 percentage points relative to their level in 1991.

This chapter analyzes the combined effect of these two reforms on labor demand.[3] The results indicate that the increase in labor costs resulting from the pension and health reform had a negative impact on labor demand. Thus, the chapter calls for a new generation of labor market reform in Colombia, aimed at reducing nonwage labor costs.

The chapter is structured in the following way. Section 4.2 discusses the institutional and regulatory framework governing the labor market, with special attention to the changes introduced in the 1990 and 1993 reforms. Particular emphasis is placed on measuring the nonwage costs implied by the regulation. Section 4.3 shows the main stylized facts in the labor market between 1976 and 1996. Section 4.4 deals with the incidence of payroll taxation on wages in a framework that analyzes the possible endogeneity of wage and nonwage labor costs. More specifically, the section tests whether higher nonwage costs faced by employers have been transferred to workers in the form of lower basic wages. The results suggest that firms do not lower wages when facing higher nonwage labor costs resulting from the legislation. The chapter then moves to the analysis of labor demand. Section 4.5 estimates standard labor demand equations with the time series data. The emphasis of the estimation is placed on the measurement of the own-wage elasticities, as well as the elasticities of substitution between different factors of production. It also tests for possible changes in the value of those elasticities, associated with the reform package of the early 1990s.[4] Section 4.6 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 4.7 and 4.8 present the results of labor demand estimations based on panels of manufacturing establishments and sectors, respectively. Section 4.9 concludes.

The main conclusions of the chapter are the following. First, labor demand elasticities in Colombia are around –0.5, a value that is not low[5] (in absolute terms) by international standards. *Ceteris paribus,* the increase in

3. Kugler (chap. 3 in this volume) analyzes the effects of changes in job security provisions, such as severance payments and other dismissal costs, on labor turnover.

4. Trade liberalization was an essential part of the package. As is well known, trade liberalization 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 (1963, 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."

5. This is assuming that all the increase in taxes and contributions implied an increase in labor costs.

labor costs, has resulted in a significant reduction in labor demand. The message is that the payoff, in terms of greater employment, of a reduction in payroll taxes is considerable. Second, adjustment costs of changing employment as well as wage elasticities were not affected by changes in the regulations regarding severance payments and dismissal costs. In this sense, structural reforms did have an impact on labor demand through its effect on relative prices alone. Finally, we conclude that the wage elasticity of labor demand increases (in absolute terms) during contractions. Hence, the increase in prices and the beginning of a recession had a significant effect on employment.

4.2 Labor Legislation: Recent Changes

As mentioned in the introduction, the regulation of the labor market in Colombia saw 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 1993.[6]

- Severance pay was the highest nonwage labor cost under the pre-1990 regime. Employees were entitled to one-month salary per year of work (based on the last salary). 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 percent of the total wage bill).[7] The new legislation eliminated this extra cost in all new labor contracts and introduced a monthly contribution (9.3 percent of the basic salary) to a capitalized fund in the workers' name, accessible in the event of separation or retirement. Thus, the reform effectively reduced the level and uncertainty of the costs associated with severance payments.
- The reform increased the indemnity paid to workers dismissed without just cause. Workers with less than one year of tenure on the job receive forty-five days' wages. Workers with more than one year of tenure receive forty-five days' wages for the first year plus an additional amount for each extra year, which implied an increase relative to the old regime. For example, in the event of separation, a worker with more than ten years of tenure on the job used to receive thirty days' wages for each extra year (after the first). As can be seen in table 4B.1, the new legislation increased the indemnity to the equivalent of forty days' wages per additional year.[8] Although the legal definition of *just cause* was widened, the reform increased the costs of dismissal.

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

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

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

- However, the right of workers with more than ten 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 ten minimum wages were allowed to opt for a new contract ("integral salaries") with higher wages instead of severance pay and other mandatory benefits (such as the especial bonus or *prima*). However, in a survey conducted by Fedesarrollo in 1994, manufacturing firms reported that less than 2 percent 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 terms),[9] provided that all benefits are paid in proportion to the duration of the contract.
- Legal restrictions on the creation of labor unions were lifted. In particular, the Ministry of Labor lost discretionary powers in this regard. Also, it became unlawful for employers to discourage the creation of labor unions. A minimum of twenty-five workers is still necessary to form a union.
- The 1993 social security and health reform (Law 100) increased total contributions for health from 7 percent of the basic salary (until 1994) to 8 percent in 1995 and 12 percent afterwards. One-third of the total contribution has to be paid by the employer (the same proportion as in the old system).
- The same law increased pension contributions to 13.5 percent in 1996 (14.5 percent for workers that earn more than four minimum wages) from 8 percent of the basic salary in 1993. The increase was implemented gradually. Contributions were first raised to 11.5 percent in April 1994 and then to 12.5 percent in 1995. Employers currently pay 10.1 percentage points of the total contribution, as opposed to 4.3 before the reform.[10]

Figure 4.1 summarizes the effects of labor and social security reform on nonwage labor costs. Total nonwage labor costs paid by the firm (as a percentage of the basic salary) rose to 52 percent after the 1993 pension reform from 42.9 percent after the 1990 labor reform. For the purpose of the analysis, we divide nonwage costs into three relatively arbitrary categories: (1) deferred wages, which include vacations, extra bonuses, pension, and health contributions. In theory, deferred wages affect the total labor cost but do not have an impact on the path of employment adjustment; (2) severance payments, which, in addition to the direct impact on labor costs,

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

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 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.

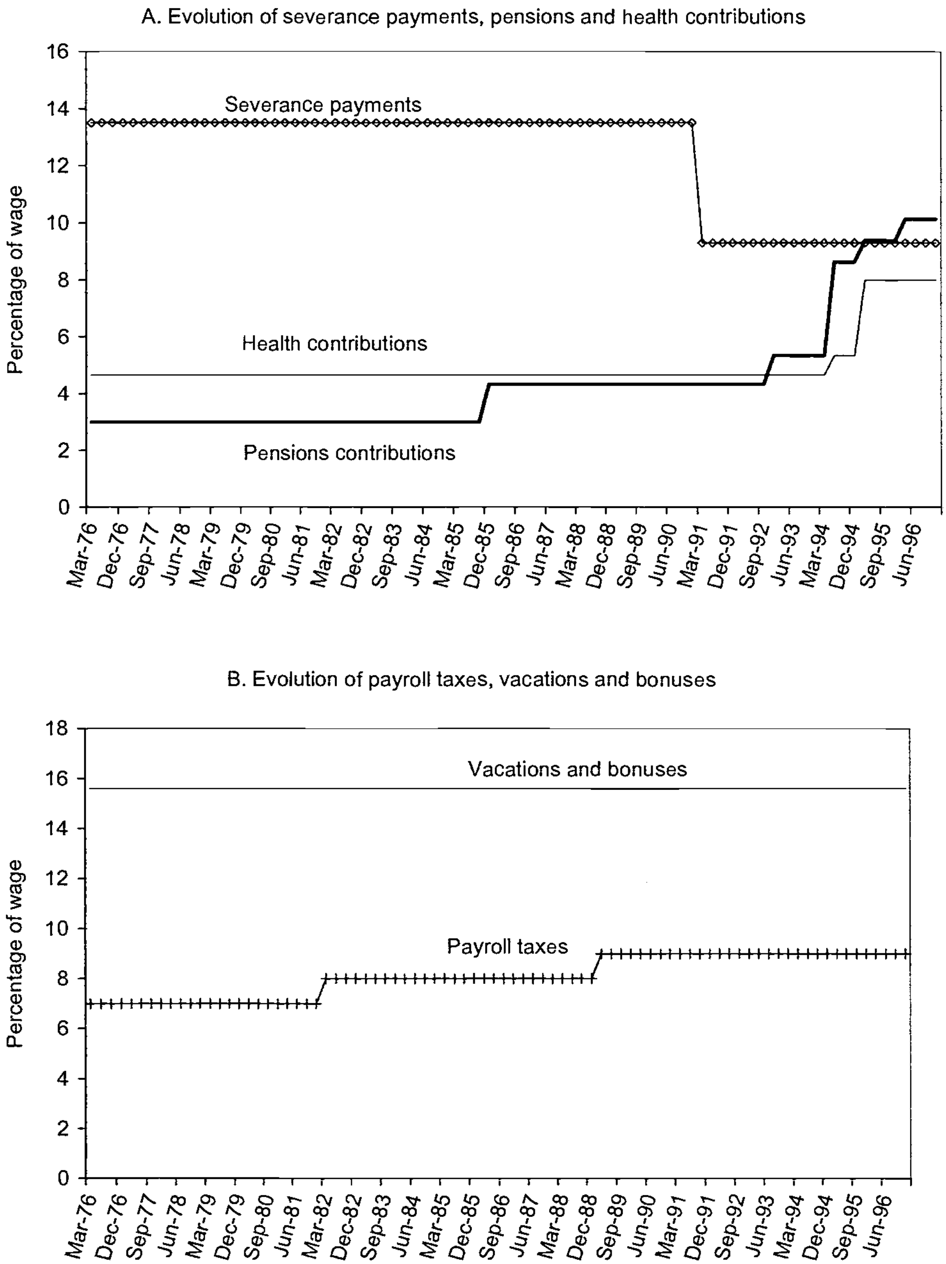


Fig. 4.1 Nonwage labor costs (as a percentage of wage)

Source: Ocampo (1987) before 1990 and Regulation Manuals.

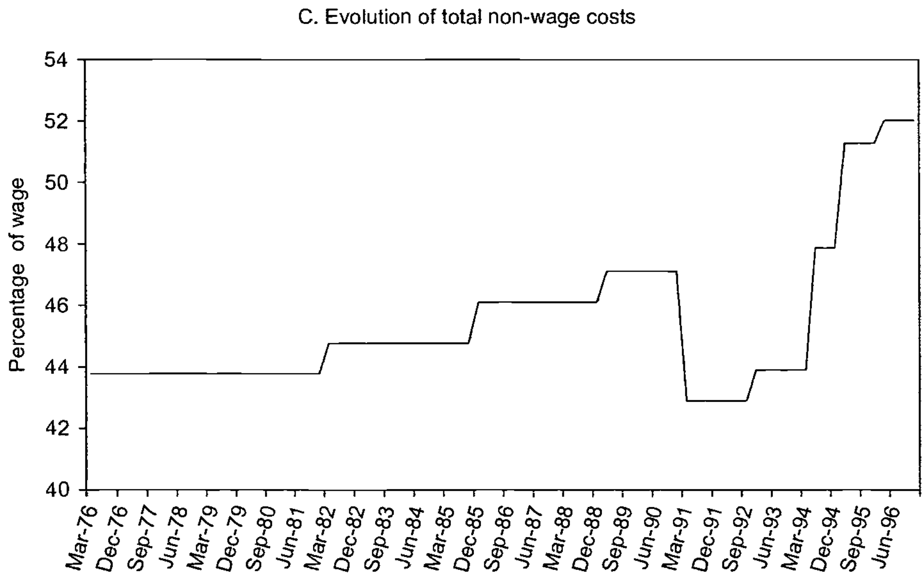


Fig. 4.1 (cont.) Nonwage labor costs (as a percentage of wage)
Source: Ocampo (1987) before 1990 and Regulation Manuals.

affect the dynamics of employment adjustment;[11] and (3) payroll taxes that fund programs with benefits that cannot be fully internalized by the employee (e.g., Instituto Colombiano de Bienestar Familiar (ICBF), Servicio National de Aprendizaje (SENA), and Cajas de Compensacion Familiar (Cajas)).[12] The economic response to these three types of nonwage costs may be different. In the case of deferred wages, the employer 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 nonwage costs to workers through lower wages.

The upper panel of figure 4.1 shows the evolution of severance payments, as well as health and pension contributions for an average worker, as a percentage of the basic wage between 1976 and 1996.[13] The middle panel shows the evolution of payroll taxes. These taxes increased by 1 percentage point in 1982 (earmarked to SENA) and again by an equal amount

11. Strictly speaking, severance payments are also deferred wages.

12. 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).

13. Workers under "integral salaries" are excluded. After 1991 we ignore workers under pre-1990 contractual terms.

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, nonwage 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.

4.3 Stylized Facts

Figure 4.2 displays the unemployment rate for the period 1976–1998. After reaching a peak in March 1986 (14.6 percent), unemployment rates declined steadily until 1994 when they were under 8 percent. Unemployment rates have increased sharply since 1995. The figure for September 2000 (20.5 percent) is the highest in the modern Colombian economic history. Although much of the explanation of greater unemployment is related to significant increases in labor supply, this chapter argues that labor demand cannot be ignored. In fact, the increase in the cost of labor—combined with a relatively high own-wage elasticity—had a negative impact on labor demand. However, this is not the only explanation. The 1990 labor reform has also caused greater employment volatility in response to economywide shocks. This has been the result of greater flexibility in the creation and destruction of jobs. Kugler (chap. 3 in this volume) addresses this issue in detail.

This chapter uses mainly data on output, employment (skilled and unskilled), and wages for Colombia's seven largest cities. These variables are 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 governmental services. The data come from the quarterly National Household Survey (NHS), which has been conducted without interruption since 1976. Output data come from the quarterly gross domestic product (GDP) series processed by Department of National Planning (DNP).

4.3.1 Employment and Production

Table 4.1 displays some basic descriptive statistics on urban employment for the period 1976–1996. Manufacturing and personal and governmental services provide 29 percent and 25 percent of the urban jobs, respectively. We use information only for wage earners, which account for 64 percent of the total urban workers (62 percent before the 1990 labor reform). However, there are sharp differences across sectors. In manufacturing, 76 percent of the workers earn a monetary wage, whereas in retail and restaurants only 50 percent of the workers do.

We use a measure of skill that includes high school graduates plus all of

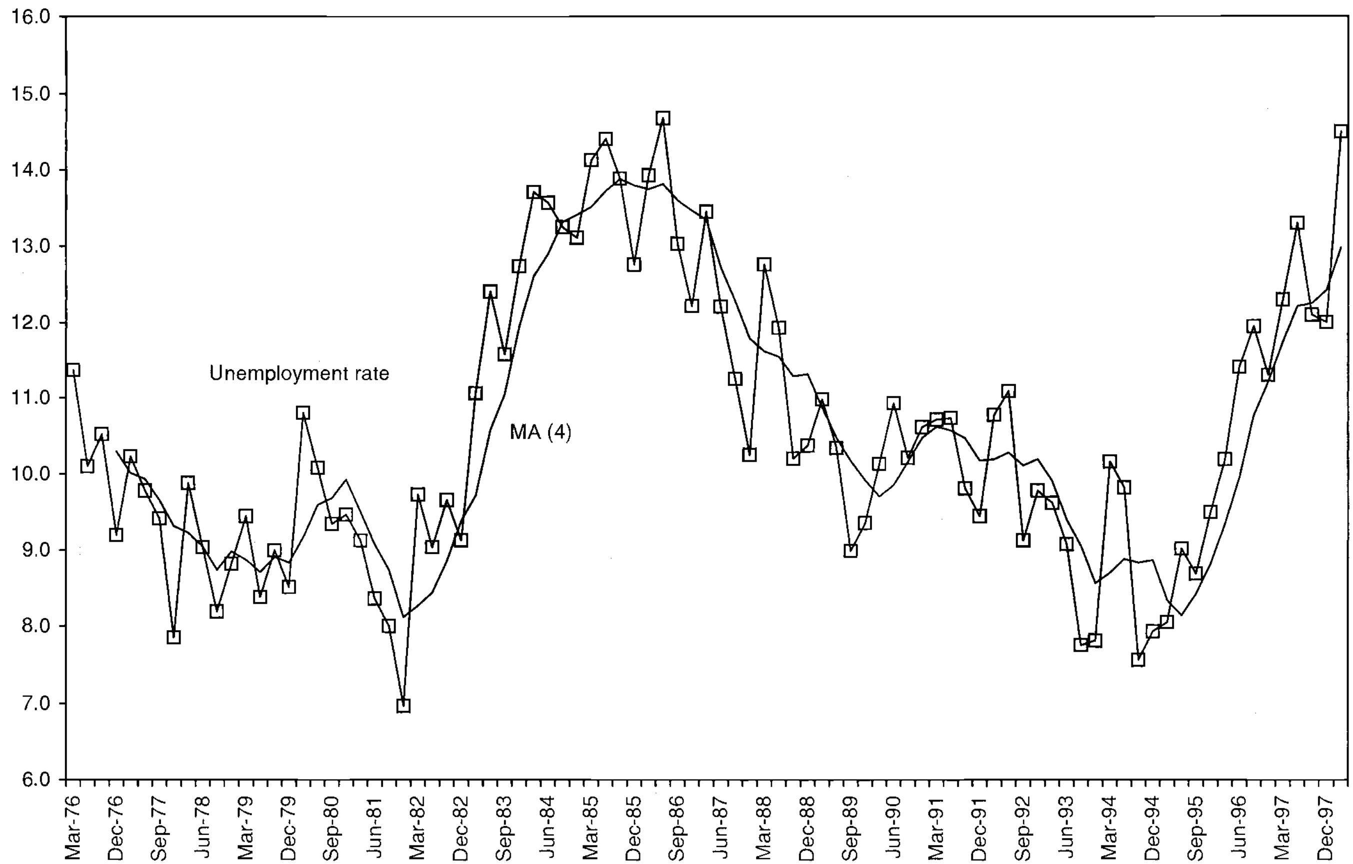


Fig. 4.2 Urban unemployment rate
Source: NHS.

Table 4.1 Urban Employment Shares

	Share in Total Employment		Share of Wage-Earners in Total Employment		Share of Skilled Workers in Total Employment		Skilled/Unskilled Employment	
Sector	1976–1991	1992–1996	1976–1991	1992–1996	1976–1991	1992–1996	1976–1991	1992–1996
Manufacturing	29.75	27.57	76.10	76.53	10.45	13.96	0.118	0.162
Electricity and gas	1.08	0.97	98.90	98.81	23.87	33.62	0.329	0.514
Construction	6.46	6.31	64.21	58.84	9.46	12.45	0.106	0.143
Retail, restaurants, and hotels	19.65	21.15	50.35	52.80	10.96	15.81	0.126	0.188
Transportation and communications	7.12	7.03	70.03	68.12	11.09	14.69	0.127	0.173
Financial services	8.48	9.47	77.36	79.23	30.10	37.95	0.443	0.615
Personal and government services	25.83	25.73	56.14	59.41	30.17	38.27	0.441	0.622
Total	98.36	98.23	62.66	64.06	17.63	23.28	0.218	0.304

Source: NHS.

those with some tertiary education (all workers with twelve or more years of schooling). By using this definition, the group of more educated workers represented 23 percent of urban employment, on average, between 1992 and 1996. According to figure 4.3, 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 4.1, skilled workers represent more than 30 percent of total employment in public utilities, financial services, and personal and governmental services. These shares have increased significantly since 1992.

Figure 4.4 describes the evolution of employment and production in the Colombian urban sector. It is interesting to note that after 1991 skilled employment has grown faster 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 percent of the unskilled wage earners in the urban regions.

4.3.2 Factor Prices

Information about labor income received by wage earners (skilled and unskilled) comes from the NHS. Given that this is not necessarily equal to the total labor cost paid by the employer (which is the relevant price in the estimation of labor demand), it is then necessary to quantify nonwage labor costs and construct a measure of the total labor cost. We do that by using the information contained in figure 4.1, which summarizes all nonwage labor 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 pretax salary, without benefits. In order to obtain the total labor cost we add *all* the nonwage labor costs measured in figure 4.1 to the basic salary reported in the NHS. Implicitly, this means assuming the independence of wage and nonwage costs. We do this based on the results of the next section, which support the idea that employees do not transfer higher nonwage costs imposed by the legislation through lower basic salaries. Finally, the overall cost is then deflated using the producer price index. The procedure is identical for skilled and unskilled workers.[14] For completeness, we also report the user cost of capital measured

14. As mentioned in section 4.2, workers with high remuneration (over ten minimum wages) under integral salaries contracts have much lower nonwage costs (33.8 percent of the basic salary versus 52 percent 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.

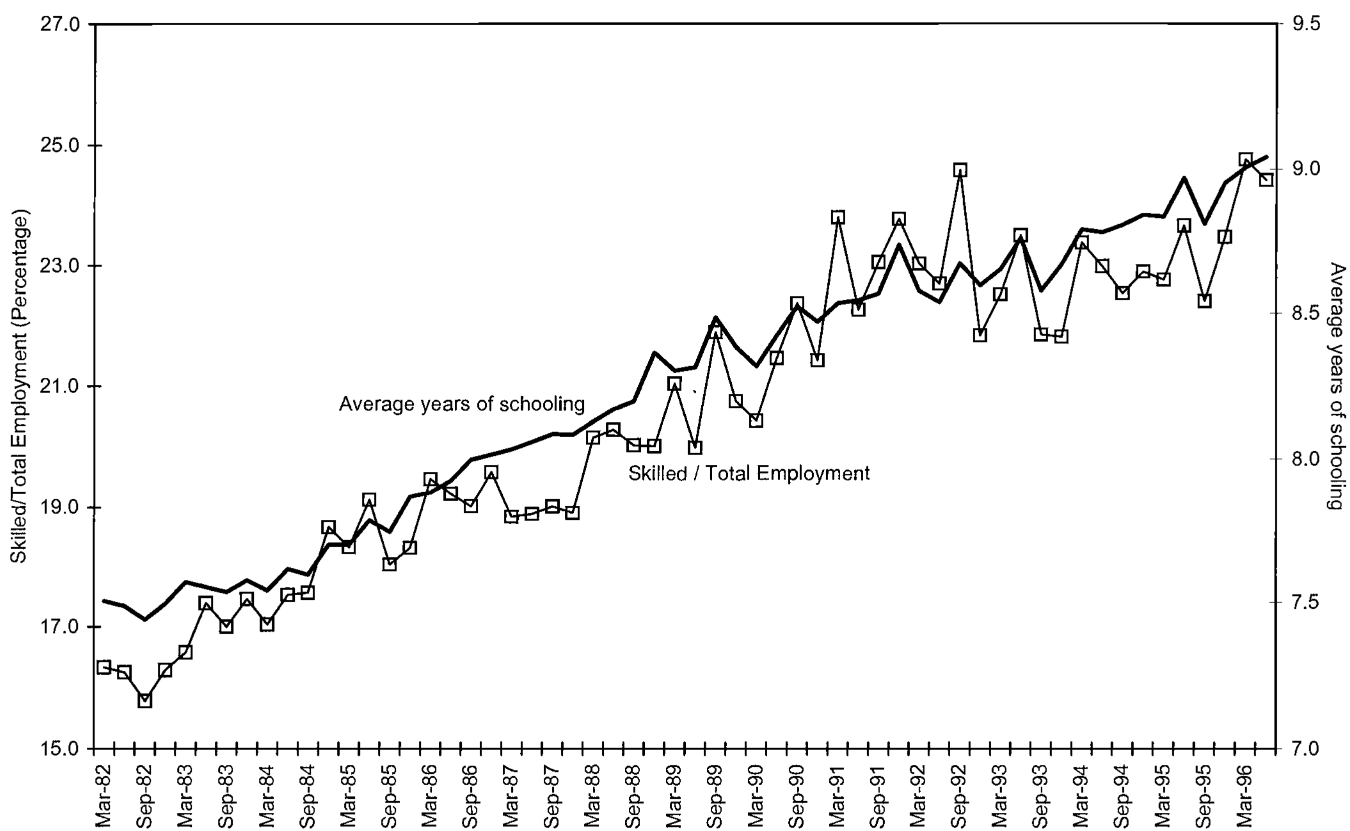


Fig. 4.3 Skilled to total employment ratio and average years of schooling

Source: NHS.

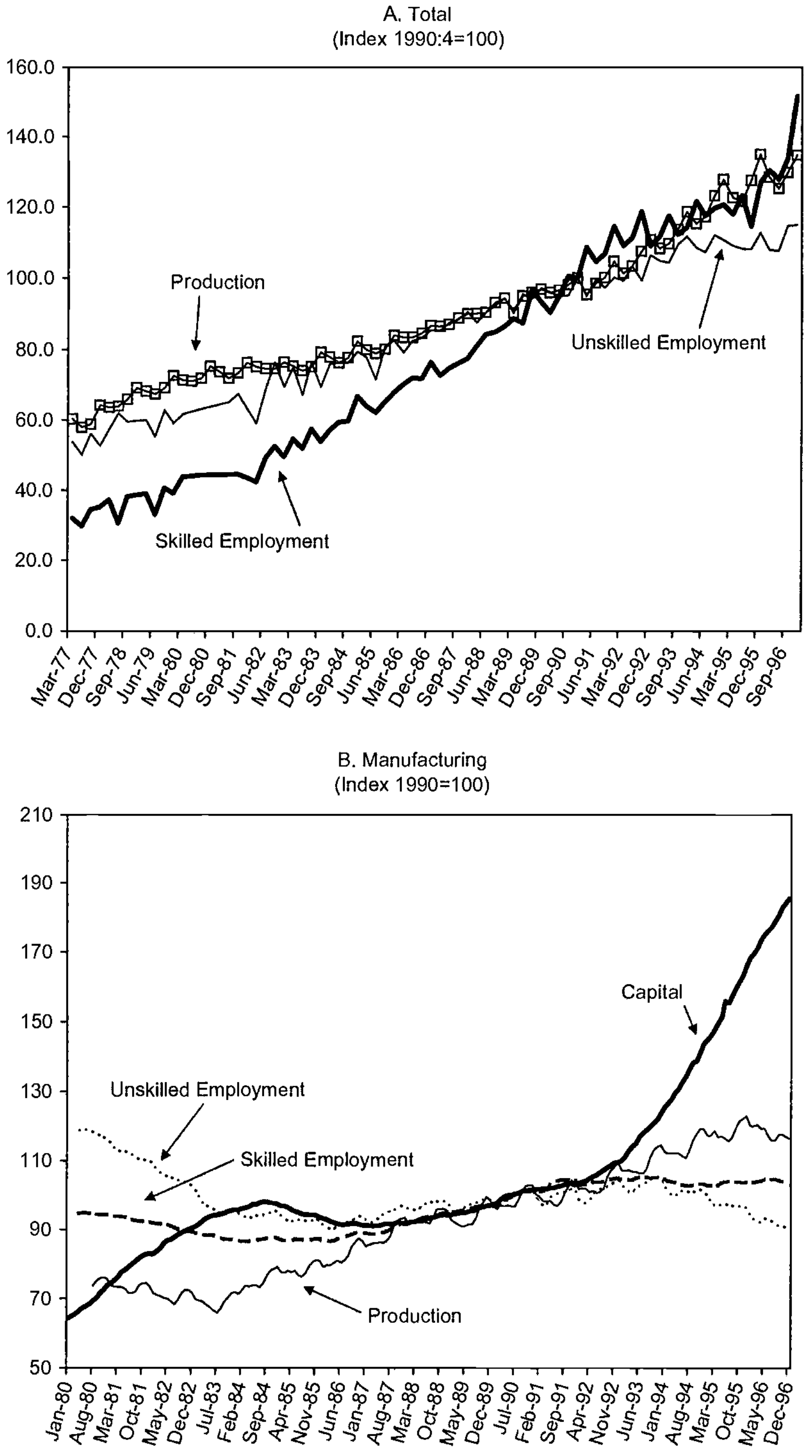
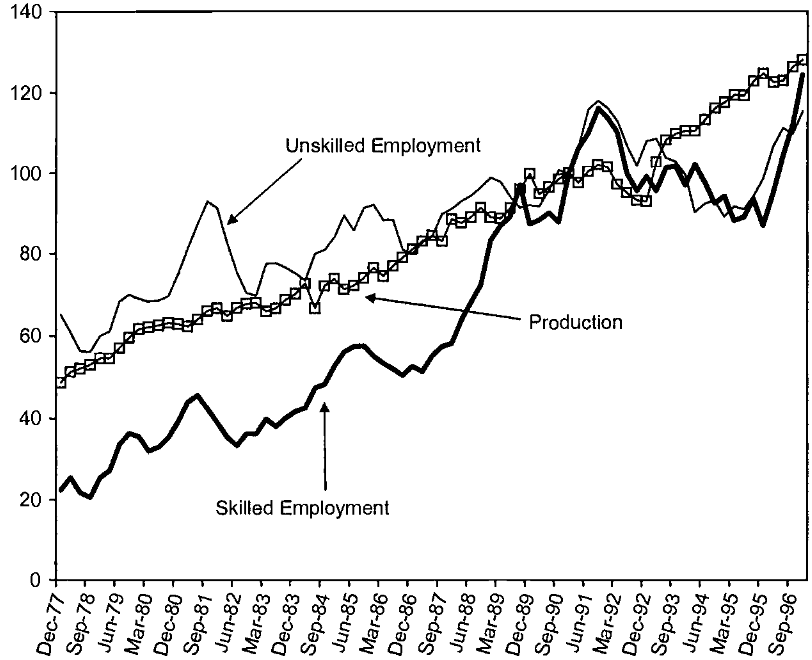


Fig. 4.4 Colombia: Urban employment and production
Source: NHS.

C. Electricity
(Index 1990:4=100)



D. Construction
(Index 1990:4=100)

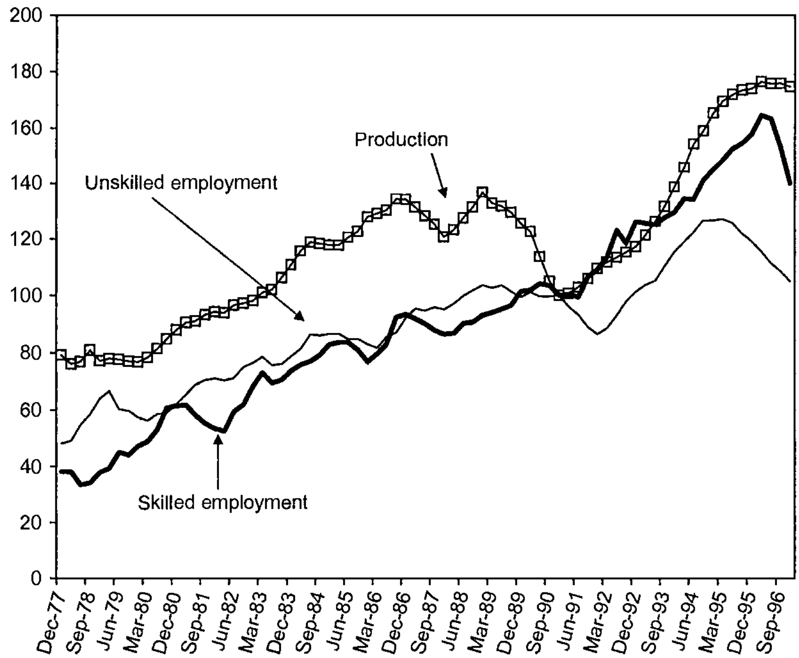
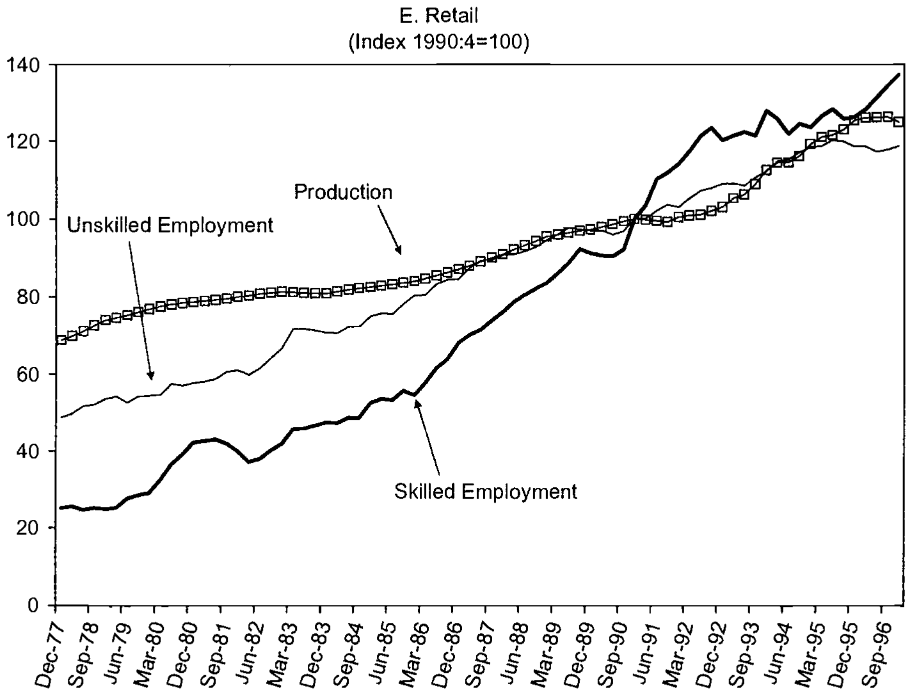


Fig. 4.4 (cont.)



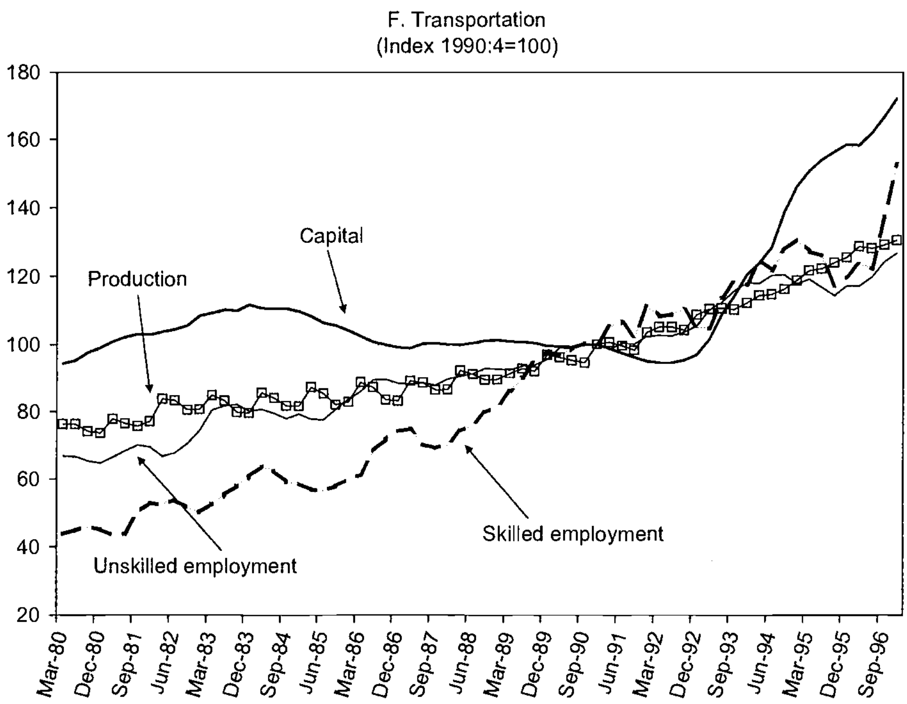
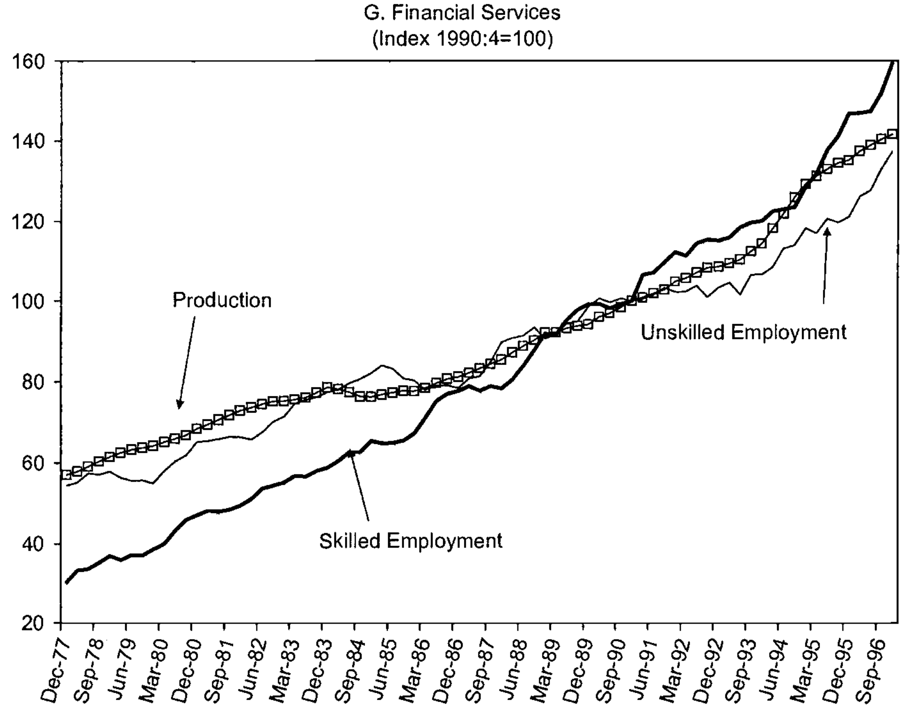


Fig. 4.4 (cont.) Colombia: Urban employment and production

Source: NHS.



G. Financial Services
(Index 1990:4=100)
160
140
120
100
80
60
40
20
Production
Skilled Employment
Unskilled Employment
Dec-77
Sep-78
Jun-79
Mar-80
Dec-80
Sep-81
Jun-82
Mar-83
Dec-83
Sep-84
Jun-85
Mar-86
Dec-86
Sep-87
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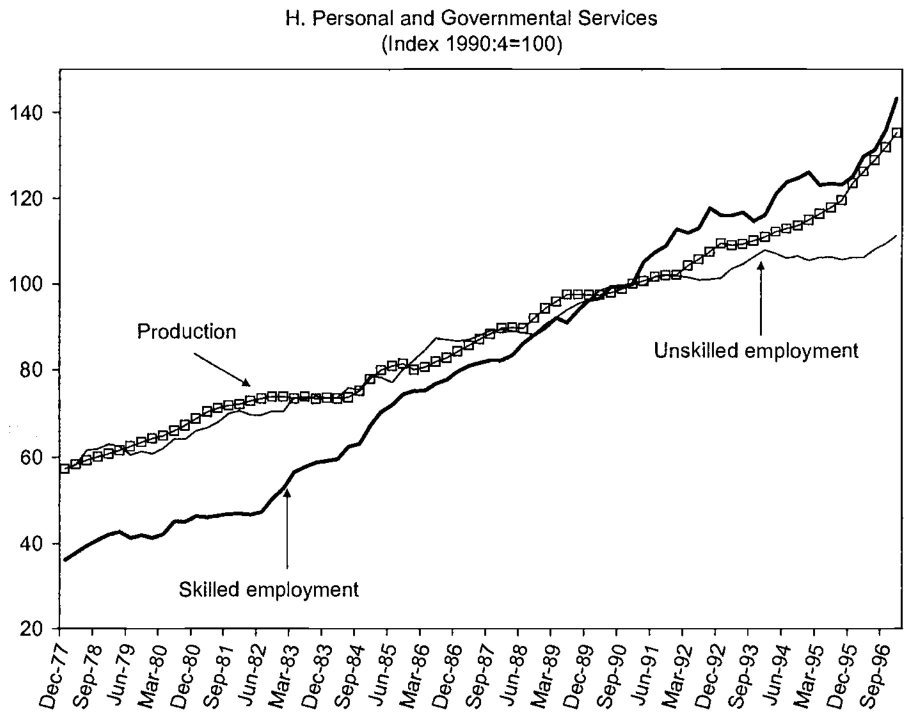
Mar-95
Dec-95
Sep-96



H. Personal and Governmental Services
(Index 1990:4=100)
140
120
100
80
60
40
20
Production
Skilled employment
Unskilled employment
Dec-77
Sep-78
Jun-79
Mar-80
Dec-80
Sep-81
Jun-82
Mar-83
Dec-83
Sep-84
Jun-85
Mar-86
Dec-86
Sep-87
Jun-88
Mar-89
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Dec-95
Sep-96

Fig. 4.4 (cont.)

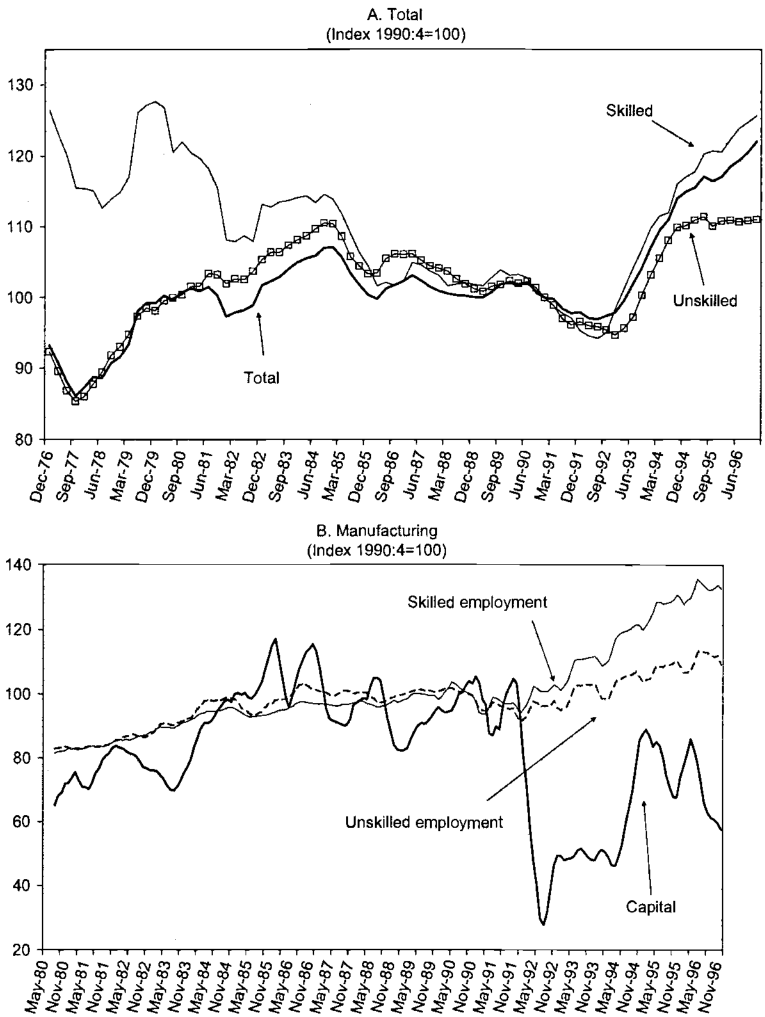


Fig. 4.5 Colombia: Real factor costs in the urban sector
Source: NHS.

according to a standard methodology described in Cárdenas and Gutiérrez (1996).[15]

Figure 4.5 shows the evolution of real factor costs by sector. There are three key insights for the 1990s: (1) the cost of labor increased significantly; (2) the cost of labor increased faster than the cost of capital; and (3) the

15. 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.

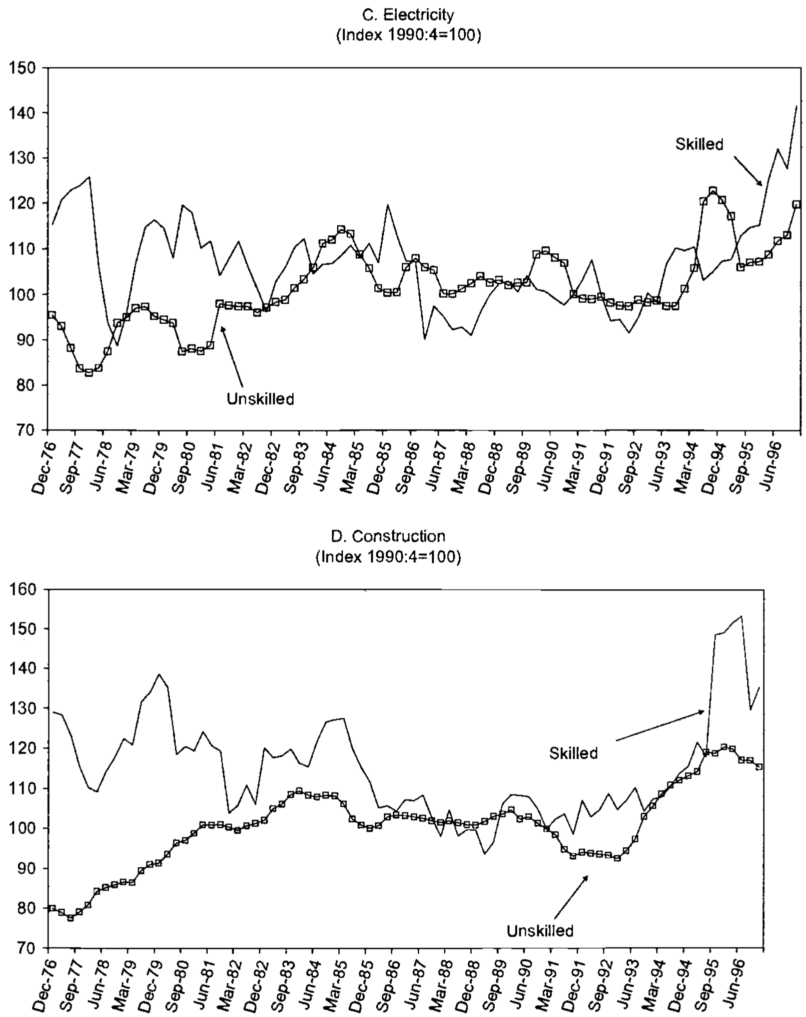
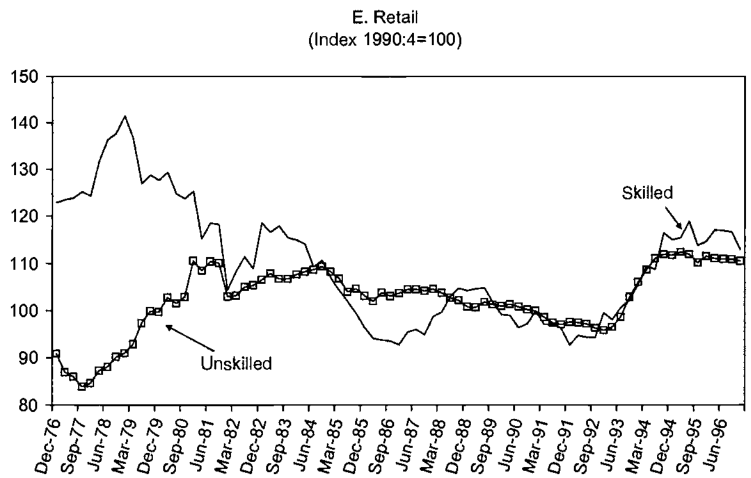


Fig. 4.5 (cont.)

cost of skilled relative to unskilled labor rose during this period. 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 4.2, the average annual growth in real labor costs between 1992 and 1996 was 11.4 percent for skilled workers and 8.4 percent for unskilled workers. These rates are substantially higher than the average for the prereform period. In sum, labor costs increased in an unprecedented way after 1990, especially in the case of skilled workers.



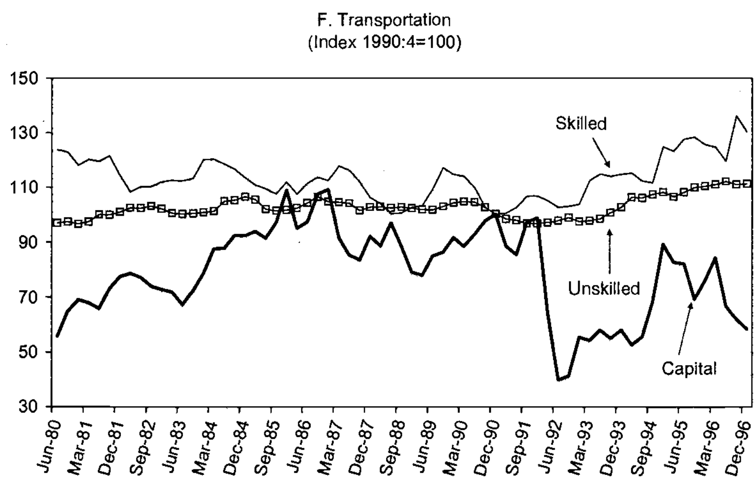
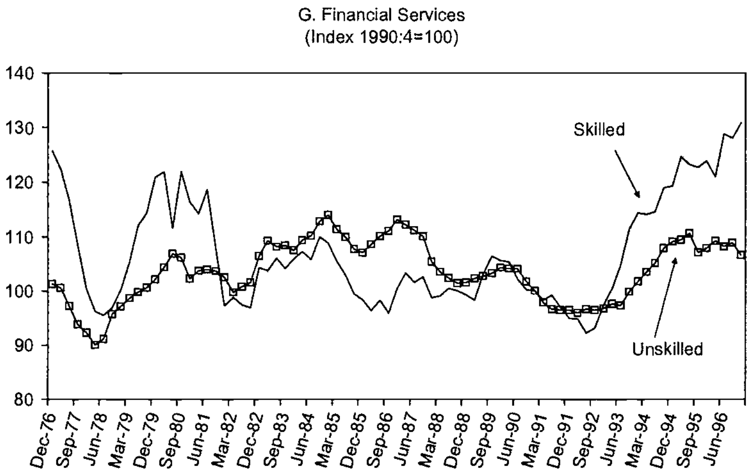


Fig. 4.5 (cont.)

4.4 Endogeneity of Wage and Nonwage Costs

As mentioned previously, we need to support our assumption that wage and nonwage costs can be added together, ignoring the incidence of payroll taxation on wages. Several authors have warned against this assumption, arguing that wages and nonwage costs are endogenously determined. This is the case in Newell and Symons (1987) for the European context and in Gruber (1995) for Chile. Their view is that ignoring this issue can be misleading when making policy recommendations.



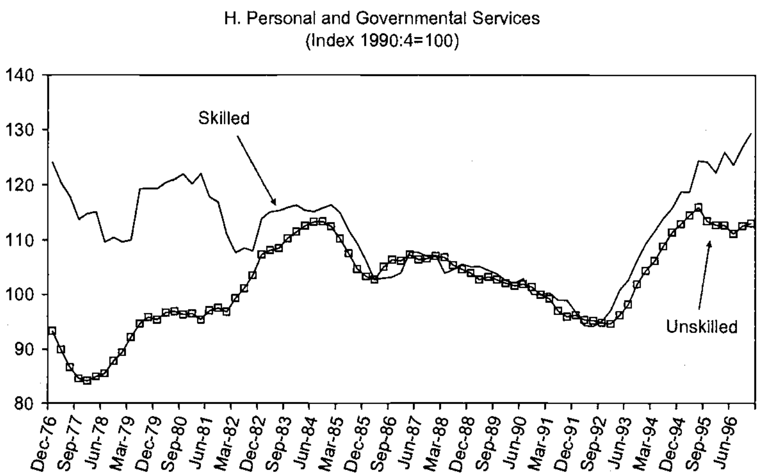


Fig. 4.5 (cont.)

There are different ways to deal with this potential endogeneity. Some authors estimate 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 they conclude that taxes are fully shifted into wages. This is the procedure used by Gruber (1995).

Here we adopt a somewhat different procedure. We estimate the determinants of wages based on information from the NHS. Every two years (in June) the NHS includes a special module on informality where workers re-

Table 4.2 Annual Average Growth in Total Real Labor Cost (%)

Sector	1977–1985	1986–1991	1992–1996	1977–1996
Unskilled Employment (less than 12 years of education)				
Manufacturing	1.80	–1.45	8.09	2.40
Electricity and gas	1.73	–0.20	10.93	3.45
Construction	3.03	–1.16	9.89	3.49
Retail, restaurants, and hotels	2.03	–1.08	8.08	2.61
Transportation and communications	2.23	–0.97	8.28	2.78
Financial services	1.11	–1.84	7.49	1.82
Personal and government services	1.58	–1.38	8.85	2.51
Total urban	1.65	–1.34	8.36	2.43
Skilled Employment (12 years of education or more)				
Manufacturing	–1.96	–2.78	11.85	1.25
Electricity and gas	3.58	–2.34	15.58	4.81
Construction	–0.32	0.55	13.41	3.37
Retail, restaurants, and hotels	–1.68	–0.59	10.04	1.58
Transportation and communications	0.73	–0.11	10.79	3.00
Financial services	–1.38	–0.56	12.83	2.42
Personal and government services	–1.14	–1.61	11.81	1.95
Total urban	–1.63	–1.71	11.36	1.59

Source: NHS.

port whether they are covered by the social security system. We use the data from the June 1988, 1992, and 1996 surveys (including the special module) to estimate a Mincer-type income equation. The regressions are based on data for each one of the surveyed workers and allow us to understand whether an individual's wage, given certain personal characteristics, is negatively affected when the individual contributes to the social security system.[16]

Our assumption is that if employers transfer the nonwage labor cost to employees, then workers that are registered in the social security system would have lower wages (after controlling for other personal characteristics that may affect wages) than those that are not registered in the social security system.[17] In particular, we estimated the following equation:

$$(1) \qquad \ln w_t = \beta_0 + \sum_i \beta_i \mathbf{pers} + \beta_5 \text{dumss} + \beta_6 \text{mw} + \beta_7 \text{dumss} \cdot \text{mw} + \sum_i \beta_i \mathbf{sec} + \sum_i \beta_i \mathbf{city} + \varepsilon_t,$$

where w_t is wage at time t, **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 regis-

16. The percentage of workers with health coverage rose to 60 percent in 1996 from 50 percent in 1988.

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

tered 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 wage[18] (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 7 main cities.

Table 4.3 presents the results of estimating 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 relatively higher for men. In turn, experience has a positive but decreasing impact on 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. 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 workers. This is of interest because it suggests that employers might not transfer social security contributions to workers in the form of lower wages. However, it is possible that social security contributions are proxying for self-selection and unobserved characteristics of the workers, biasing the results. Thus, it is unclear whether the results of this section provide the necessary support in order to use our measure—total labor costs, which is simply the sum of wage and nonwage costs (self-selection may be hiding the true effect of endogeneity bias). We take a pragmatic approach and estimate the labor demand equations with only wages and compare the results with regressions that include both wages and nonwage costs added together.

4.5 Static Labor Demand

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 production.[19] 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

18. For the purpose of this exercise, the minimum wage in 1988 (in Colombian pesos) was $28,000, in 1992 it was $72,000, and in 1996 it was $155,000.

19. The elasticities of substitution between different factors of production is 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.

Table 4.3 Mincer Income Equation

Log (Wages)	1988	1992	1996
Constant	10.0354	11.2707	12.0258
	(576.90)	(624.09)	(670.16)
Education	0.044	0.0182	0.0181
	(52.01)	(30.54)	(31.91)
Gender	0.1671	0.1688	0.1585
	(23.45)	(22.11)	(20.18)
Experience	0.019	0.0185	0.0172
	(24.37)	(21.57)	(20.36)
Experience^2	–0.0002	–0.0003	–0.0002
	(–20.53)	(–21.43)	(–18.80)
Dummy health coverage	0.0628	0.1421	0.1838
	(6.84)	(13.93)	(18.63)
Health coverage · minimum wage	0.2848	0.2342	0.1320
	(20.48)	(15.52)	(8.31)
Minimum wage	–1.0045	–1.1018	–1.0907
	(–107.65)	(–106.29)	(–99.55)
Agriculture	0.1267	0.1114	0.4358
	(5.08)	(3.73)	(1.28)
Mining	0.1865	0.4505	0.2378
	(4.13)	(3.73)	(3.90)
Electricity	0.0547	0.0398	0.1868
	(1.45)	(0.92)	(4.32)
Construction	0.0874	0.0602	0.0733
	(5.73)	(3.64)	(4.48)
Retail	–0.0095	0.0367	0.0449
	(–1.02)	(3.61)	(4.20)
Communications	0.0463	0.0751	0.0742
	(3.14)	(4.65)	(4.66)
Financial services	0.0951	0.1564	0.1545
	(6.28)	(9.78)	(9.85)
Government services	–0.0003	–0.0009	0.0413
	(–0.00)	(–0.09)	(2.38)
Other services	–0.1665	0.1180	0.4188
	(–0.43)	(0.70)	(2.38)
Barranquilla	–0.0083	0.0193	0.0374
	(–0.77)	(1.72)	(3.17)
Bucaramanga	0.0065	–0.0504	–0.0662
	(0.55)	(–4.05)	(–5.23)
Manizales	0.0264	–0.0646	–0.1159
	(1.59)	(–3.67)	(–6.77)
Medellin	0.0594	–0.0256	–0.0018
	(6.63)	(–2.50)	(–0.18)
Cali	0.0508	0.0250	0.0189
	(4.77)	(2.15)	(1.52)
Pasto	–0.1405	–0.1943	–0.0781
	(–9.22)	(–12.38)	(–4.87)
No. of observations	29,476	26,900	25,887
R^2	0.5504	0.5526	0.5269

Sources: NHS and authors' calculations.

common choice. The GL specification is also normally used when information is available for more than two factors of production.[20]

The derived factor demands from a GL cost function (see appendix A) can be written as

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

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: (1) changes in relative factor prices; (2) changes in the scale of production (if the production function is not homothetic); and (3) 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}, we then calculate the own-wage elasticity for factor i (η_{it}) as

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

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)

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

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

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

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

4.5.1 Results

This section summarizes the main results of the estimation of static labor demand equations with quarterly data from the NHS. The estimation

20. See Hamermesh (1986).

is first carried out with data for the manufacturing sector alone, based on 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. We then turn to the data for the seven largest metropolitan cities, using a similar framework but dropping capital as a factor of production. In both cases we deal with specifications that use relative input prices (skilled and unskilled labor), so the effects of nonwage labor costs vanish (percentage-wise, their impact is identical for each type of labor).

4.5.2 Manufacturing

Table 4.4 presents the results on the factor demands for skilled and unskilled labor.[21] 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., the maximum of the likelihood function imposing symmetry over the maximum of the likelihood function in the unconstrained case) has a chi-square (χ^2) distribution (with degrees of freedom equal to the number of restrictions imposed).[22] 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.

The estimated b_{ij} (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 and output ratios increase as the scale of production is expanded (i.e., the production function is nonhomothetic).

Based on the estimated b_{ij} we then compute the relevant elasticities that, according to the formulae, are time dependent. We report the elasticities for four periods: 1976–1981, 1982–1985, 1986–1991, and 1992–1996. The two types of labor show a decreasing degree of substitutability. Own-wage elasticities are negative.[23] For the 1992–1996 period their value is around –0.35 for skilled workers and –0.4 for unskilled workers. This means that a

21. In this case, we are using total labor costs as the relevant price, that is, salary plus nonwage costs.

22. See López (1980).

23. The change in the wage elasticities over the four periods of time considered here is statistically significant at 95 percent confidence level.

Table 4.4 Factor Demands for Skilled and Unskilled Labor in the Manufacturing Sector: GL Specification (1977:1–1996:4)

Employment	Constant	Relative Prices	Production	R^2	D.W.
Skilled	–0.7736***	0.7984***	1.0133***	0.79	2.04
	(–3.06)	(2.72)	(6.38)		
Unskilled	1.2058***	–0.2495***	0.0670	0.23	1.94
	(8.66)	(–2.24)	(1.15)		
	Price, Income, and Substitution Elasticities				
	1976–1981	1982–1985	1986–1991	1992–1996	
Own-wage elasticities					
η_{ee}	–0.593	–0.523	–0.431	–0.350	
η_{oo}	–0.487	–0.409	–0.390	–0.400	
Elasticity of substitution					
σ_{eo}	3.850	2.876	2.498	1.979	
Output elasticities					
ε_{ey}	2.204	2.008	1.986	1.968	
ε_{oy}	1.050	1.049	1.060	1.068	

Sources: NHS and authors' calculations.

Notes: o = unskilled employment; e = skilled employment; y = production. Employment in number of hours.

***Significant at the 1 percent level.

10 percent reduction in wages is related to a 3.5 percent increase in the demand skilled and a 4 percent increase in the demand for unskilled labor.[24] Output elasticities are positive during the whole period but seem to have decreased with time. In particular a 1 percent increase in production is related to a 2 percent increase in skilled labor demand and a 1 percent increase in unskilled labor demand.[25]

4.5.3 Seven Metropolitan Areas

Table 4.5 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.[26] Besides changes in relative prices, we

24. The results using a constant elasticity of substitution (CES) function are somewhat different. In this case, a 10 percent decrease in wages is related to a 0.8 percent increase in skilled labor demand and a 1.7 percent 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.

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

26. Table 4.5 shows the results in which total labor costs (salary plus nonwage costs) are used as the relevant price. However the same exercise was performed using wages only, that is, excluding nonlabor costs. In this case, results are fairly similar.

Table 4.5 **Factor Demands for Skilled and Unskilled Labor in the Seven Largest Metropolitan Areas: GL Specification (1977:1–1996:4)**

Employment	Constant	Relative Prices	Production	Demand Shifter	R^2	D.W.
Skilled	–0.8864***	0.9243***	0.7152***	0.0882***	0.92	2.24
	(–3.41)	(3.80)	(11.57)	(2.68)		
Unskilled	1.3739***	–0.485***	–0.026	0.0665***		
	(8.27)	(–3.43)	(–0.62)	(2.66)		
	Price, Income, and Substitution Elasticities					
	1976–1981	1982–1985	1986–1991	1992–1996		
Own-wage elasticities						
η_{ee}	–0.755	–0.642	–0.507	–0.445		
η_{oo}	–0.573	–0.497	–0.461	–0.515		
Elasticity of substitution						
σ_{eo}	1.147	0.982	0.822	0.798		
Output elasticities						
ε_{ey}	1.873	1.772	1.714	1.839		
ε_{oy}	0.979	0.978	0.975	0.966		

Sources: NHS and authors' calculations.

Notes: o = unskilled employment; e = skilled employment; y = production. Employment in number of hours.

***Significant at the 1 percent level.

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} 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 and output ratio increases as the scale of production is expanded (i.e., the production function is nonhomothetic). Based on the estimated b_{ij} we computed the relevant elasticities. The two types of labor show a decreasing degree of substitutability as can be seen in figure 4.6. 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 percent decrease in wages is related to a 4.5 percent increase in skilled labor demand and a 5.1 percent increase in unskilled labor demand.[27] In the case of unskilled labor, the own-wage

27. The corresponding own-wage elasticities in the case in which wages (excluding nonwage costs) are used as the relevant price are 4.3 percent and 5.0 percent.

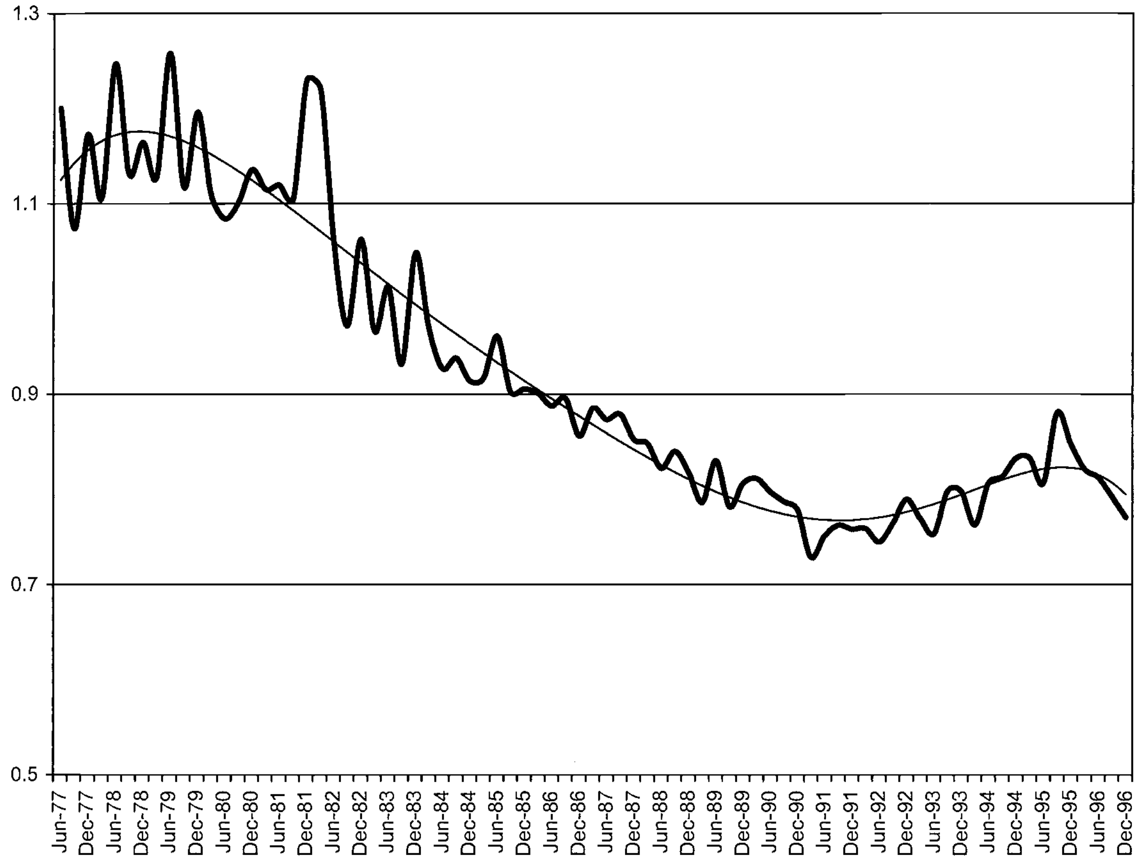


Fig. 4.6 Elasticity of substitution (standard GL function, seven metropolitan areas)

Source: Authors' calculations.

elasticity has increased in absolute value during the postreform period to 0.51 from 0.46 in the prereform period. On the other hand, output elasticities are positive. A one percent increase in output is related to a 1.8 percent 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 postreform 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 in the demand shifter that was added to the equation. The results (not reported) on these regressions are available upon request.

4.6 Dynamic Labor Demand

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 B:

$$(6) \quad n_t = c + \alpha_0 y_t + \alpha_1 y_{t-1} + \beta_0(w_t + \mathrm{nw}_t) + \beta_1(w_{t-1} + \mathrm{nw}_{t-1}) + \gamma_t n_{t-1} + u_t,$$

where n is employment, y is a rolling autoregression forecast of production, w is a rolling autoregression forecast of basic wages, nw are nonwage labor costs that do not affect the path of employment adjustment, and u is an error term. Nonwage labor costs include vacations, bonuses, health and pension contributions, and payroll taxes (all added as percent of basic wage). Alternatively, we also estimate equation (6), ignoring nonwage labor costs. 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

$$(7) \qquad \gamma_t = \gamma_0 + \gamma_1 \mathrm{R1}_t + \gamma_2 \mathrm{R2}_t,$$

where R1 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 ten or more years in the firm).[28] As mentioned in section 4.2, severance payments fell as a result of the 1990 labor reform, while the in-

28. 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 ten or more years in their current job only.

demnity for unjust dismissal increased.[29] 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_t), 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 is useful in order to assess the impact of a one-unit increase in the costs of regulations on the level of employment (the βs) and that of this increase in the cost per worker on the path of employment adjustment (the γs). In the former case, we can infer the impact or short-run multiplier coefficient (β_0) and the long or equilibrium multiplier $(\beta_0 + \beta_1)/(1 - \gamma_t)$. 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 postreform dummy interacted with wages and the lagged employment measure.

4.6.1 Econometric Results

Table 4.6 presents the results of the estimation of equation (6) with aggregated quarterly data from the NHS. 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.[30]

The first three columns show the results of estimating (6) 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 employment is 0.57, while the wage elasticity is zero in the short run (impact) but –0.37 in the long run. The same regression was performed ignoring nonwage costs (available upon request). The estimated elasticities are practically identical. 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 percent 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 (also in the regression without nonwage costs). The costs of adjustment were not affected by changes in the regulations regarding severance payments and dismissal costs for either type of worker.

29. However, the elimination of the right to sue for reinstatement with back pay should have reduced the expected firing costs.

30. In both cases we chose the highest order with a significant coefficient.

Table 4.6 Dynamic Labor Demand Estimations (1977:02–1996:04)

	Total Employment			Skilled	Unskilled	Skilled	Unskilled
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.0156	0.0156	0.0156	–0.0364	0.2143***	–0.1005**	0.2143***
	(0.44)	(0.44)	(0.44)	(–0.36)	(4.18)	(–1.96)	(4.18)
Production$_t$	0.5666***	0.5666***	0.5666***	1.0237***	0.6041***	1.0250***	0.6041***
	(2.84)	(2.84)	(2.84)	(4.17)	(2.95)	(4.17)	(2.95)
Production$_{t-1}$	–0.0342	–0.0342	–0.0342	–0.1125	0.0365	–0.1123	0.0365
	(–0.17)	(–0.17)	(–0.17)	(–0.44)	(0.18)	(–0.43)	(0.18)
Own Wages$_t$	0.0175	0.0175	0.0175	0.0877	0.1224	0.0880	0.1224
	(0.18)	(0.18)	(0.18)	(0.74)	(1.22)	(0.74)	(1.22)
Own Wages$_{t-1}$	–0.1636*	–0.1636*	–0.1636*	–0.2237*	–0.0385	–0.2254*	–0.0385
	(–1.70)	(–1.70)	(–1.70)	(–1.81)	(–0.38)	(–1.81)	(–0.38)
Other type of Employment Wages$_t$				0.1215	0.1222	0.1211	0.1222
				(0.98)	(1.24)	(0.98)	(1.24)
Other type of Employment Wages$_{t-1}$			–0.2538**	0.3684***	–0.2563**	–0.3684***	
				(–2.05)	(–3.70)	(–2.07)	(–3.70)
$R^1_t \cdot E_{t-1}$	0.0334			–0.0680	0.0089		
	(0.73)			(–0.92)	(0.17)		
$R^2_t \cdot E_{t-1}$		–0.0364				0.0607	–0.0097
		(–0.73)				(0.82)	(–0.17)
Dum91 · E_{t-1}			–0.0104				
			(–0.73)				
E_{t-1}	0.5760***	0.6459***	0.6095***	0.4679***	0.3025***	0.4070***	0.3211***
	(4.95)	(5.39)	(5.64)	(4.11)	(2.52)	(2.43)	(2.46)
R^2	0.9790	0.9790	0.9790	0.9847	0.9699	0.9847	0.9699
DW	2.63	2.63	2.63	1.96	2.42	1.98	2.42

Sources: NHS and authors' calculations.

Notes: No. of observations = 75. R^1 indicates severance payments. R^2 indicates dismissal costs, which equals –0.3445755 for col. (1); –0.4125953 for col. (2); –0.3741357 for col. (3); –0.2555911 for col. (4); –0.12028674 for col. (5); –0.2317032 for col. (6); and –0.12358227 for col. (7).

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Moreover, when a postreform 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 alone.[31]

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 microdata. 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.

4.6.2 Simulations

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 4.6 to estimate what would have happened to employment had health and pensions contributions not been increased during the 1993 labor reform.

Figure 4.7 shows the fitted value of employment according to the dynamic labor demand specifications presented in table 4.6. Panel A shows the results in terms of total employment, while panels 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 4B.2, during the last quarter of 1996 total employment would have been 1.3 percent higher if health and pensions contributions had not changed during 1993. Similarly, unskilled employment would have been 1.85 percent higher and skilled employment 2.2 percent higher.

Figure 4.8 depicts the results of a similar exercise. In this case we simulate what would have occurred if the 9 percent payroll tax had been eliminated in 1993. In this case, employment would have been 1.3 percent higher during the last quarter of 1996, compared to what actually happened. The figures for unskilled and skilled employment are 1.8 percent and 0.9 percent, respectively.

4.7 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

31. Slaughter (1997) has found that labor demand has been growing less elastic over time in the United States.

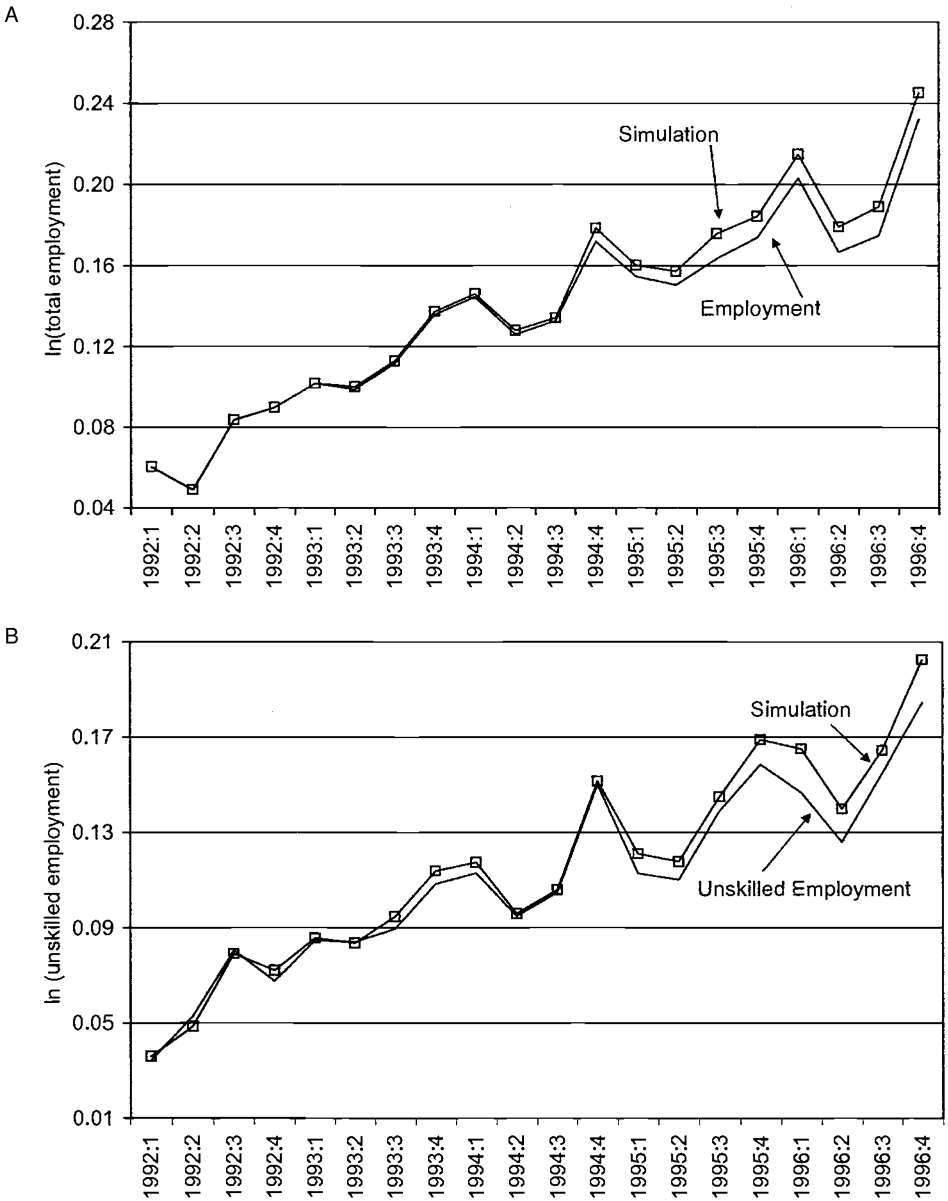


Fig. 4.7 ***A,*** **Total employment and simulation employment assuming no increases in health and pensions contributions;** ***B,*** **unskilled employment and simulated unskilled employment assuming no increases in health and pensions contributions;** ***C,*** **skilled employment and simulated skilled employment assuming no increases in health and pensions contributions**

Sources: NHS and authors' calculations.

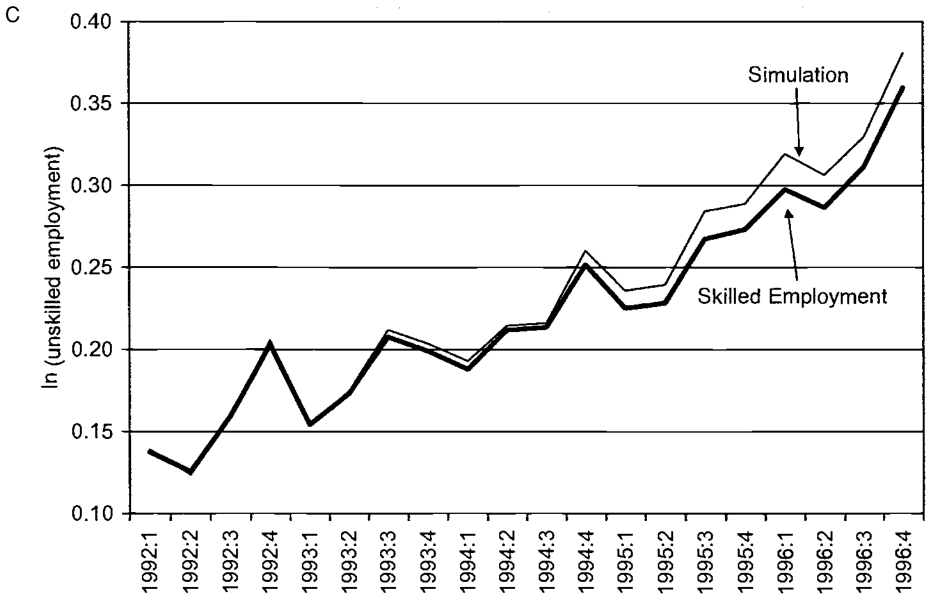


Fig. 4.7 (cont.)

(EAM) and includes 2,570 firms throughout the period 1978–1991.[32] 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

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

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 (including benefits) deflated by the producer price index (common to all firms), p_{it} is the log of the price of intermediate goods consumed by the firm (also deflated by the producer 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 4.7. 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

32. The dataset consists of annual observations at the firm level.

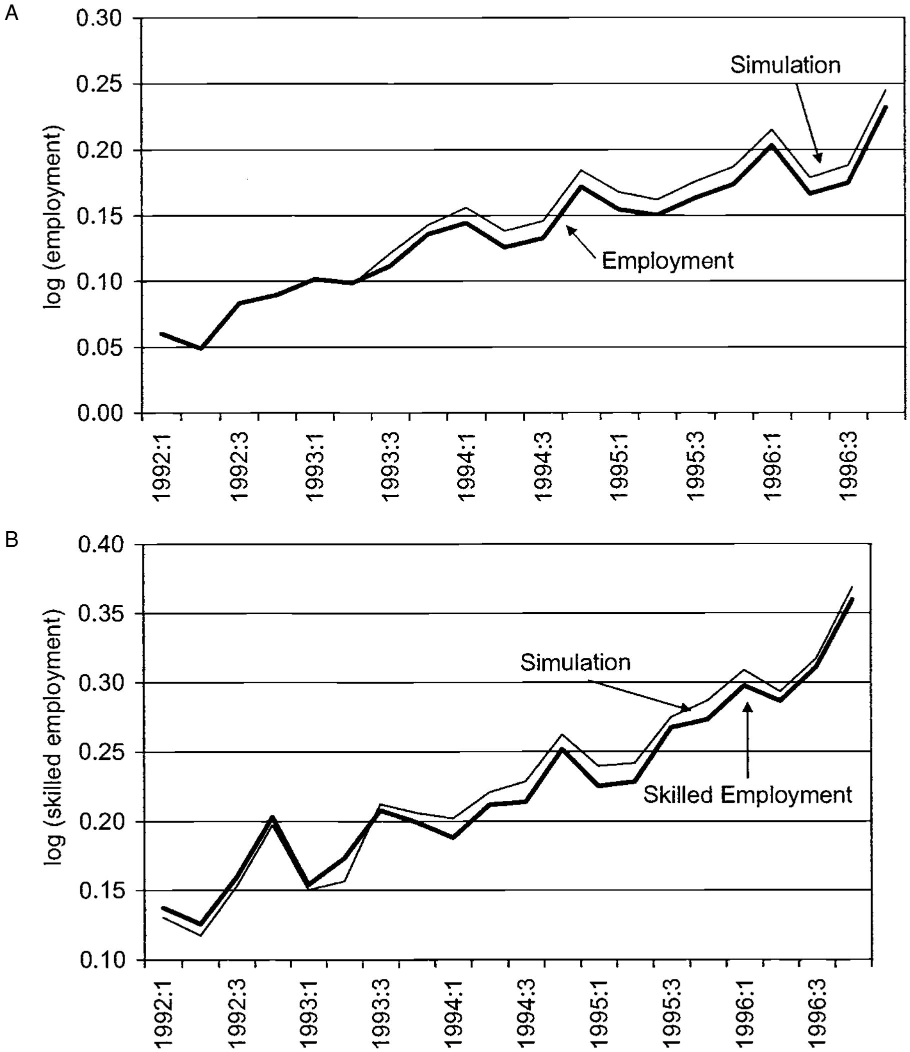


Fig. 4.8 ***A*, Total employment and simulated employment assuming elimination of 9 percent payroll tax; *B*, skilled employment and simulated skilled employment assuming elimination of 9 percent payroll tax; *C*, unskilled employment and simulated unskilled employment assuming elimination of 9 percent payroll tax**

Sources: NHS and authors' calculations.

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 1 per-

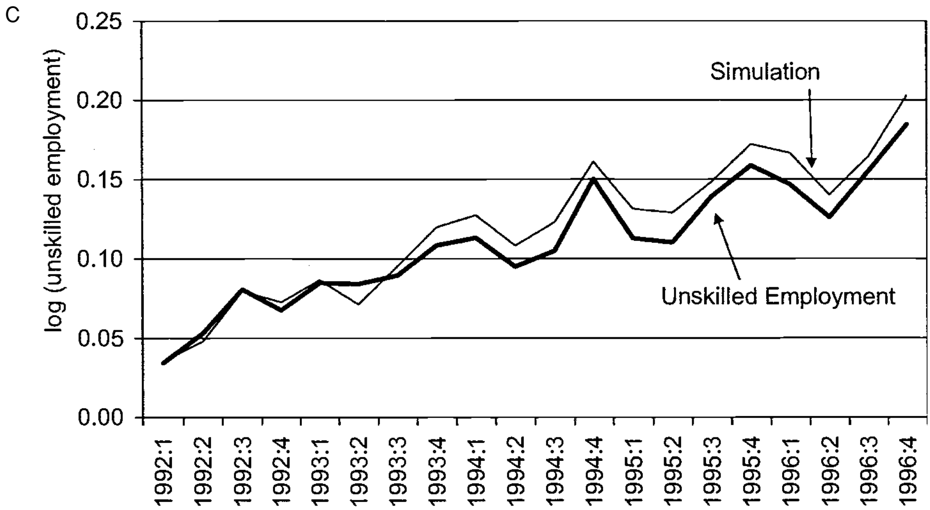


Fig. 4.8 (cont.)

centage 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 twenty-eight 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 percent and zero when growth is below 2 percent. If the growth rate is between 2 percent and 4 percent, the assigned value at time t depends on growth at $t-1$.

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. Last, 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 ex-

Table 4.7 Labor Demand Estimation Results: Firm Level

	Basic Model			Interacted with BC	
	OLS (1)	IV (2)	OLS + Di (3)	IV (4)	IV + Di (5)
Employment (t – 1)	0.964	0.978	0.965	0.987	0.988
	(526.20)	(492.76)	(476.46)	(349.27)	(331.77)
Labor cost	–0.050	–0.051	–0.062	–0.054	–0.070
	(–18.19)	(–17.76)	(–19.08)	(–17.86)	(–20.13)
Price of materials	0.024	0.030	0.047	0.024	0.051
	(3.78)	(4.27)	(5.15)	(2.43)	(3.83)
Capital stock	0.025	0.018	0.027	0.015	0.018
	(20.99)	(14.38)	(19.49)	(8.60)	(9.19)
Growth in production	0.245	0.243	0.242	0.262	0.263
	(58.45)	(56.22)	(56.18)	(40.88)	(41.02)
Year	–0.001	0.000		0.001	0.001
	(–2.24)	(1.19)		(1.91)	(2.06)
Employment (t – 1) · BC				–0.022	–0.022
				(–5.51)	(–5.66)
Labor cost · BC				0.003	0.003
				(2.06)	(1.99)
Price of materials · BC				0.013	0.011
				(0.99)	(0.85)
Capital stock · BC				0.009	0.009
				(3.29)	(3.44)
Growth in production · BC				–0.063	–0.065
				(–6.84)	(–7.05)
Adj. R^2	0.965	0.966	0.966	0.966	0.966

Notes: Di refers to the 28 sectorial dummies; OLS indicates ordinary least squares; IV indicates instrumental variables; and BC is a business cycle dummy described in the text.

plain why unemployment rates rise very rapidly but take a long time to fall, a pattern that has been found in Colombia.

4.8 Labor Demand in a Panel of Ninety-Two Manufacturing Sectors

This section estimates equation (8) using data from ninety-two industrial sectors (corresponding to the four-digit Clasificación Industrial Internacional Uniforme [CIIU] classification) from 1978 to 1995. In this case, the log of value added replaces the growth rate in gross production. Total labor costs (wages plus nonlabor costs) are used as the relevant price variable.[33] The results are presented in table 4.8, 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,

33. The same exercise was performed using wages only as the relevant price. Results are virtually identical and are available upon request.

Table 4.8 **Labor Demand Estimations Panel of Manufacturing Sectors (1978–1995)**

	Basic Equation			Structural Change		
	OLS (1)	Fixed Effects (2)	IV (3)	OLS (4)	Fixed Effects (5)	IV (6)
Employment (*t* – 1)	0.7476***	0.4417***	0.5767***	0.7791***	0.5165***	0.6119***
	(52.31)	(21.48)	(6.00)	(62.47)	(28.36)	(7.48)
Total wage	–0.2903***	–0.1413***	–0.6056***	–0.2432***	–0.2029***	–0.4746***
	(–11.57)	(–3.57)	(–4.04)	(–11.84)	(–6.02)	(–4.38)
Input prices	–0.2208***	–0.3755***	–0.5197***	–0.3068***	–0.4986***	–0.777***
	(–5.59)	(–7.81)	(–3.90)	(–6.84)	(–9.68)	(–3.69)
Capital stock	0.0289***	0.0212	–0.0198	0.0351***	0.0595***	0.0118
	(2.85)	(0.69)	(–1.58)	(4.52)	(2.55)	(0.93)
Value Added	0.2154***	0.2953***	0.4465***	0.1777***	0.2593***	0.3683***
	(18.94)	(22.12)	(4.52)	(17.77)	(21.45)	(4.71)
Year	–0.0007	–0.0021	0.0001			
	(–0.48)	(–1.25)	(0.07)			
D · Employment (*t* – 1)				–0.8045***	–0.6102***	–0.5939***
				(–26.50)	(–20.28)	(–5.77)
D · Total wage				0.1721***	0.1424***	0.4223*
				(5.29)	(4.37)	(1.75)
D · Input prices				0.3620***	0.4321***	0.9379***
				(5.97)	(7.12)	(3.24)
D · Capital stock				0.9964***	0.7764***	1.0687***
				(29.64)	(22.33)	(5.73)
D · Value Added				–0.1720***	–0.1513***	–0.4244***
				(–7.64)	(–6.60)	(–1.94)
R^2	0.9705	0.9763	0.9622	0.9825	0.9833	0.9778

Sources: NHS and authors' calculations.

Notes: No. of observations = 1,502. OLS indicates ordinary least squares; IV indicates instrumental variables; and D is a dummy variable for the period 1992–1995.

***Significant at the 1 percent level.

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 wages are the instruments.

The estimated real-wage elasticity is higher (–0.6)[34] in absolute terms than the value estimated with the firm-level data. Using instrumental variables (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 1 percent increase in value added results in a 0.45 percentage growth in employment.

Finally, the last three columns in table 4.8 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 postreform period. The elasticity with respect to material prices turns out to be positive during the postreform 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.

4.9 Conclusions

This chapter has analyzed the determinants of the demand for labor in Colombia's urban sector (seven largest metropolitan areas) using different sources of data. The main focus of the chapter is to estimate the own-wage elasticities of labor demand in order to quantify the effects of payroll taxation on employment generation. This is a critical area for policy design, given the abnormal levels of unemployment that the country is facing.

Some have argued that the relevant elasticities are low, discouraging policymakers from undertaking major reforms. The common belief is that the efficiency gains associated with labor reform are relatively weak, while the political costs of changing current labor legislation are very high. This chapter argues that, quite on the contrary, the payoff of reducing labor costs is substantial.

34. This elasticity is equal to –0.61 in the case in which nonlabor costs are excluded from labor costs.

Table 4.9 **Labor Demand Elasticities: Summary of Results**

	Own-Wage Elasticity			Output Elasticity		
	Skilled	Unskilled	Total	Skilled	Unskilled	Total
Quarterly Time Series (1976:1–1996:4)						
–Static labor demand						
+Manufacturing	–0.350	–0.400		1.968	1.068	
+7 metropolitan areas	–0.445	–0.515		1.839	0.966	
–Dynamic labor demand						
+7 Metropolitan areas						
Estimated with total labor cost	–0.255	n.s.	–0.374	1.024	0.604	0.567
Estimated with wages only	–0.310	n.s.	–0.395	0.999	0.597	0.522
Manufacturing Panel Data (annual)						
+2570 establishments (1978–1991)			–0.05/–2.27			0.240
+91 sector (1978–1991)			–0.60/–1.43			0.440

Sources: NHS and authors' calculations.

Notes: n.s. = not significant. Numbers separated by a solidus indicate short run and long run, respectively.

In order to reach that conclusion, the chapter analyzes the impact of recent changes in the costs of employment and measures their impact on labor demand. The estimated-wage elasticities are summarized in table 4.9. Using the more reliable quarterly time series obtained from the NHS these elasticities range from –0.45 to –0.52, depending on the type of labor. However, the elasticities fall (in absolute terms) when the estimation uses a dynamic framework. In this case, the long-run, own-wage elasticity is –0.37.

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 ninety-two 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, although its long-run counterpart is –2.27.

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 chapter also analyzes 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 through 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 percent payroll taxes could result in a 1.3 percent increase in employment in the urban areas. Of course, the impact is much greater when the elasticities derived from the static exercise are used. In this case, a 10 percent reduction in labor costs could result in a 5 percent increase in labor demand.

Using a panel of manufacturing establishments, we also concluded that the wage elasticity of labor demand increases (in absolute terms) during contractions. 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. Last, 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.

Appendix A

Generalized Leontief (GL) Cost Function

The GL cost function can be written as

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

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:

$$X_i = \frac{\partial C}{\partial P_i} = \sum_j b_{ij}\left(\frac{p_j}{p_i}\right)^{1/2} Q + \alpha_i Q^2 + \gamma_i Qt, \tag{A2}$$

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

$$\frac{X_{ti}}{Q_t} = \sum_j b_{ij}\left(\frac{p_{jt}}{p_{it}}\right)^{1/2} + \alpha_i Q_t + \gamma_i t + \mu_{it} \tag{A3}$$

Appendix B

Analytical Framework for the Dynamic Labor Demand Estimations

A Cobb-Douglas production function can be written as

$$Y_t = AL_t^{\alpha}K_t^{(1-\alpha)}, \tag{A4}$$

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

$$W_t = \frac{\delta Y_t}{\delta N_t} = \alpha A L_t^{*\alpha-1}K_t^{1-\alpha}. \tag{A5}$$

Expressing equation (A5) in logarithms, we get

$$\ln W_t = \ln \alpha A - (1-\alpha)\ln L_t^* + (1-\alpha)\ln K_t. \tag{A6}$$

Rearranging terms, we get

$$\ln W_t = \ln Y_t + \ln \alpha A + \ln A + \alpha \ln L_t^* - (1-\alpha)\ln L_t. \tag{A7}$$

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

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

$$l_t^* = c + \alpha y_t + \beta w_t. \tag{A9}$$

An adjustment equation satisfies

$$l_t - l_{t-1} = (1-\lambda)(l_t^* - l_{t-1}) + \varepsilon_{t-1}. \tag{A10}$$

Rearranging terms we get

$$l_t^* = \frac{l_t - l_{t-1}}{(1-\lambda)} + l_{t-1} - \frac{\varepsilon_{t-1}}{(1-\lambda)}. \tag{A11}$$

Substituting (A9) into (A11), we get

$$\frac{l_t - l_{t-1}}{(1-\lambda)} + l_{t-1} - \frac{\varepsilon_t}{(1-\lambda)} = c + \alpha y_t + \beta w_t. \tag{A12}$$

Rearranging terms, we get

$$l_t = (1-\lambda)c + \alpha(1-\lambda)y_t + (1-\lambda)\beta w_t + \lambda l_{t-1} + \varepsilon_t. \tag{A13}$$

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

$$l_t^e = (1-\lambda)l_t + \lambda l_{t-1}^e, \tag{A14}$$

Table 4B.1 **Dismissal Costs (number of monthly wages)**

Years of Tenure	Old Regime	New Regime
5	4.2	4.2
10	10.5	13.5
15	15.5	20.2
20	20.5	26.8

Table 4B.2 **Case without Increases in Health and Pension Contributions (%)**

	Total Employment	Unskilled Employment	Skilled Employment
1993:2	0.1	0.0	0.1
1993:3	0.1	0.5	0.4
1993:4	0.1	0.6	0.4
1994:1	0.1	0.4	0.5
1994:2	0.2	0.1	0.3
1994:3	0.2	0.1	0.3
1994:4	0.7	0.2	0.9
1995:1	0.6	0.8	1.1
1995:2	0.7	0.8	1.1
1995:3	1.2	0.6	1.7
1995:4	1.1	1.0	1.6
1996:1	1.2	1.9	2.2
1996:2	1.3	1.4	2.0
1996:3	1.4	1.0	1.9
1996:4	1.3	1.8	2.2

Source: Authors' calculations.

Table 4B.3 **Case with Elimination of 9 Percent Payroll Taxes (%)**

	Total Employment	Unskilled Employment	Skilled Employment
1993:2	0.2	0.2	0.5
1993:3	1.0	0.6	1.0
1993:4	0.7	1.2	0.7
1994:1	1.2	1.4	1.4
1994:2	1.2	1.3	0.9
1994:3	1.3	1.8	1.5
1994:4	1.2	1.1	1.1
1995:1	1.3	1.8	1.5
1995:2	1.2	1.9	1.3
1995:3	1.3	0.9	0.8
1995:4	1.3	1.4	1.4
1996:1	1.2	2.0	1.1
1996:2	1.2	1.4	0.7
1996:3	1.3	0.9	0.6
1996:4	1.3	1.8	0.9

Source: Authors' calculations.
Note: Eliminating mandatory bonuses would be equivalent to eliminating payroll taxes.

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

$$l^e_t = \frac{(1-\lambda)}{(1-\lambda L)} l_t, \tag{A15}$$

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

$$l_t = (1-\lambda)c + \alpha y_t - \alpha\lambda y_{t-1} + \beta w_t - \lambda\beta w_{t-1} + \lambda l_{t-1} - \lambda^2 l_{t-2} + \varepsilon_t - \lambda\varepsilon_{t-1}, \tag{A16}$$

which is the estimated equation.

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