Wage setting in Colombian manufacturing industry: the impact of institutional and trade reforms*

Sonia A. Agudelo†
Universitat Autònoma de Barcelona

Hector Sala
Universitat Autònoma de Barcelona
and IZA‡

29 October 2014

Abstract

We show that wage setting in the Colombian manufacturing industry is not fundamentally driven by labor productivity as predicted by standard theoretical models. Although efficiency gains have exerted a significant and stable influence on wages in last decades, internal institutional arrangements –either the minimum wage or the price wedge between manufacturing and consumption prices– together with a higher exposure to international trade –connected to the increasing globalization of the Colombian economy– appear as the crucial drivers. Moreover, the process of structural reform materialized 1992 onwards has rendered wages less sensitive to payroll taxation but more to the price wedge. In contrast, the growing exposure to trade has a positive and stable influence on wages, and there is no evidence of structural change caused by the trade liberalization process. These findings lead us to question the political strategy followed to attain cost competitiveness in a context of growing exposure to international trade. Implementation of a *true* wage bargaining system is suggested as a critical policy target to prevent the disruptive economic consequences of the current wage setting mechanism and help rebalance the trade deficit.

JEL Classification: J30, F16, J31.

Keywords: Wage setting, Labor productivity, trade openness, Payroll taxes, Price wedge.

*Acknowledgments: We thank Pedro Trivín for insightful comments on earlier versions of this paper. Sonia A. Agudelo and Hector Sala are grateful for financial support received, respectively, from COLCIENCIAS and the Spanish Ministry of Economy and Competitiveness (grant ECO2012-13081).

†Departament d'Economia Aplicada, Universitat Autònoma de Barcelona, Edifici B, 08193 Bellaterra, Spain; tel: +34-93.581.11.53; email: soniaalexandra.agudelo@e-campus.uab.cat.

‡Departament d'Economia Aplicada, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain; tel.: + 34 93 5812779; email: hector.sala@uab.es.

1 Introduction

We study wage setting in the Colombian manufacturing industry before and after the process of structural reform materialized 1992 onwards. Along this process, relatively tight labor market and trade regulations in the seventies and eighties were superseded by more flexible labor market institutions and trade liberalization. In this paper we look at wage determination to investigate to which extent this policy reform process has effectively contributed to boost cost competitiveness.

Two structural and worldwide phenomena are critically shaping policy decisions. The first one is globalization. The second one goes in parallel and consists on a deindustrialization process taking place in many countries. Globalization implies a growing exposure to international trade that needs to be strategically handled bearing in mind the specific strengths and weaknesses of the economy in change. The manufacturing industry is the most exposed economic activity to this change, hence the need of a careful design of the policies that will allow industrial activities to cope.

On this account, Colombia provides an excellent experience to examine. It is one of the considered successful economies in Latin America which, in recent decades, embarked in an extensive liberalization program. The issue we assess here is whether this extensive program has been translated into an efficient mechanism of wage determination, at least at the industrial level. Our conclusion is that it has not. And the reason is twofold. First, because of the low connection between wages and productivity; and, second, because of the failure of the policy reforms to set up a *true* wage bargaining system and enhance the connection between wages and productivity.

To reach this general conclusion, the analysis is disaggregated in two periods. A first period, from 1974 to 1991, in which Colombia was essentially a closed economy; and a second period, from 1992 to 2009, in which Colombia underwent profound structural changes in parallel to the process of economic openness. Given the contrast between periods, performing the analysis by subsamples has the advantage of preventing our estimates from biases stemming from structural changes in the examined relationship between wages and their driving forces. In turn, the panel structure of the database grants enough degrees of freedom to safely conduct the two estimation exercises.

Our analysis provides a set of salient findings about wage setting in the Colombian Manufacturing industry.

The first one is the permanent low sensitivity of the net real wages to changes in labor productivity. In other words, labor productivity is not widely used as a determinant of the net real wage growth, which is in sharp contrast with the standard theoretical prediction of a one-to-one long-run relationship between wages and labor productivity (see

Judzik and Sala, 2013, for the simplest analytical case). The reason why this theoretical relationship is far from holding in the Colombian manufacturing industry is twofold. First, the adjustments of nominal wages are highly tied to the cost of living. Second, payroll taxes and other non-wage costs make up a significant part of total compensation. In this context, the relevant relationship, for firms, is between the gross real wages and labor productivity. This is the fundamental reason behind the low sensitivity of net real wages to changes in labor productivity.

On the contrary, wages' key drivers are related to internal institutional settings –either connected to minimum wages or to the price wedge between manufacturing and consumer prices– and openness to trade.

Regarding these institutional settings, our modelling strategy considers alternative specifications with either the minimum real wage or the price wedge. As we explain later, these variables can be considered two sides of the same coin capturing the close attachment of wages to the evolution of prices (with minimum wages growing according to prices). This leads us to specify the empirical model under two alternative settings, one with the real minimum wage and another one with the price wegde.

The second main finding is the high sensitivity of net real wages to changes in the real minimum wage and the price wedge (depending on the specification). This result provides empirical evidence that the adjustments of nominal wages are highly tied to the cost of living, which is critically driving the growth of net real wages in the manufacturing industry. Moreover, the long-run impacts of the real minimum wage and the price wedge reveal a structural change, which connected to the institutional and trade reforms.

In the specification with the real minimum wage, what we capture are the new settings that made nominal minimum wages to grow more in line than before with price inflation (full indexation), which caused a severe fall in the sensitivity of real net wages with respect to the real minimum wage.

A structural change is also present in the wage elasticity with respect to the price wedge, although in this case there is an increase (and not a fall) in the wage long-run sensitivity. The intuitive idea behind is that the increased exposure of the Colombian economy to the international markets has caused dramatic downward pressures on both consumer and producer prices.[1] However, being the industrial sector the most exposed to foreign competition, this pressure was asymmetric and relative prices fell down (as shown in Table 3). This caused higher pressure on net real wages arising from the firms' attempts to save their profitability in a growling liberalized environment. The more their selling prices went down, the more intensively they tried to compress compensation, hence their

[1] This fall is also due to the new Central Bank objective of controlling inflation 1991 onwards, when the Central Bank of Colombia became independent.

increased sensitivity to the price wedge in our second period of analysis.

The third main finding is the significant negative impact of payroll taxation on net wages. Two are the reasons by which payroll taxes may cause a fall in net real wages. The first one is to avoid an increase in total labor costs: firms try to lower net nominal wages to compensate the increase in payroll taxation and, therefore, there is a change in the composition of labor costs in response to the higher tax rates. The second mechanism consists in shifting the increase in payroll taxation to the selling prices to try to keep the profitability rates unchanged. This, however, was not feasible in Colombia in a situation of growing exposure to international trade.

The impact of payroll taxes on wages has been much lower after 1992 in spite that most of the increases in these taxes (paid by firms) took place in this period. That is, although the payroll tax shifting continued to be significant, firms started bearing a larger share of the payroll tax cost. This result provides evidence that some of the changes in the institutional environment have harmed the cost competitiveness of the industrial sector.

In this context, the explanation of the lower sensitivity of real wages to payroll taxation is twofold. First, the enhanced indexation of nominal wages to Consumer Price Index (CPI) inflation caused net real wages to be more responsive to the price wedge (with severe downward pressures on manufacturing prices resulting from the liberalization process) and less to payroll taxes. Second, it was gross wages, rather than net wages, who absorbed the bulk of the impact of the payroll tax rise (note that the gap between the growth rates of gross and net wages tripled from 0.21 to 0.65 percentage points, as shown in Table 3).

Whether the increase in the payroll taxes caused significant job cuts, or not, is something we cannot answer properly in this study. It is generally expected that the larger the extent of payroll tax shifting on net wages, the lower the negative consequences on employment. However, there is not yet a consensus in the literature on the fact that cutting payroll taxes increases employment (and vice-versa). Rather, the empirical evidence suggests that payroll taxation might have asymmetric effects on wages and employment. On one side, there are studies suggesting that payroll tax increases have negative effects on net wages and employment –Kugler and Kugler (2009), Beach and Baulfour (1983), and Hamermesh (1979); while, on the other side, there are even more studies showing that payroll tax rate cuts do not generate significant effects on employment, even though they have sizeable negative effects on net real wages –Cruces *et al.* (2010), Bennmarker *et al.* (2009), Bauer and Riphahn (2002), and Gruber (1997).[2]

The last finding is the significant positive impact of globalization on wages in 1974-1991

[2] There is also an issue related to the consequences of changes in social protection systems (and the corresponding taxation changes) on formal and informal employment. For Colombia this is studied in Camacho *et al.* (2014), who show that informal employment increased by 4 percentage points as a consequence of the government's expansion of social programs in the early 1990s.

and 1992-2009. This result has two specific ramifications. The first one is that irrespective of whether we deal with closed or open industries, this elasticity is in the range 0.07%-0.10%. The second one is the stability of the elasticity across periods of analysis around these values. This positive influence is interpreted along the lines of Arbache *et al.* (2004), who point to the skill-biased nature of in-flowing technology (through higher foreign direct investment and growing imports) to explain the greater demand of skilled labor, and the resulting pressure on relative wages.

The rest of this paper is structured as follows. Section 2 reviews some key features of the Colombian economy regarding the institutional setting and the trade liberalization process. Section 3 discusses the theoretical background on wage setting models and their empirical implementation in this paper. Section 4 presents the data and the econometric methodology. Section 5 shows the results. Section 6 concludes.

2 Labor market institutions and trade liberalization

2.1 Labor market reforms

The Colombian labor market is segmented. There is a massive informal sector accounting for around 50% of employment, and a formal sector accounting for the remaining 50%.[3] Within this context, the manufacturing industry is an economic activity with a relatively low incidence of informality close to 20%.[4]

Since 1990, a structural reform process has been developed in view, on one side, to enhance labor market flexibility and boost (formal) employment and expand, on the other side, the coverage of health and pension services.

To achieve the first target, Law 50 was passed in 1990 to lower firing, training and recruitment costs, and promote non-regular forms of employment. This was followed by Law 789 in 2002, which lowered the regulated costs of non-standard employment (for example, on weekend, night, and holiday working hours). The expectation was that such measures would contribute to render formal employment more attractive and boost job creation.

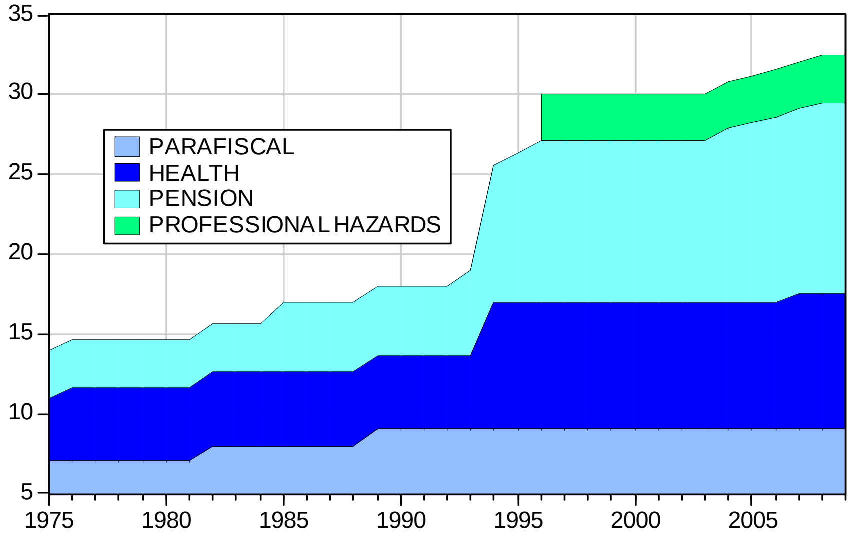
To expand the coverage of health and pension services, Laws 100 in 1993 and 797 in 2003 were passed to increase the Social Security revenues needed to expand the fledgling welfare state. The first of these laws increased the payroll tax rates covering the health and pension schemes, while the second one only focused on pensions. In this way, the total

[3] Value for thirteen metropolitan areas in year 2013 computed from data provided by the Gran Encuesta Continua de Hogares (GEIH).

[4] It was 18.7% in 2007, in contrast to close to 75.0% in trade and services (values based on data for thirteen metropolitan areas supplied by the GEIH).

payroll tax rate paid by firms moved from the existing 17% before these laws, to more than 30% since the mid nineties, and beyond afterwards. Figure 1 shows this evolution by distinguishing the four components in which payroll taxes are classified in Colombia: parafiscal, health, pension and professional hazards.[5]

Figure 1. Payroll taxes paid by firms. 1974-2009.



Source: Own calculation based on data from LEGIS' official annual reports.[6]

There is ample literature on institutions referring to the supposedly 'labor-unfriendly' impact of payroll tax rate increases. This common view may be one of the reasons why, without hardly any assessment on the estimated consequences of the previous measures, the government decided to lower first (by Law 1429 of Formalization and employment generation in 2010) and then eliminate the parafiscal and health contributions paid by firms (by Law 1607 in 2012).

One exception in the virtual lack of assessment of the consequences of the rise in payroll taxes is the work by Kugler and Kugler (2009). Their results show that a 10% increase in payroll taxes reduces wages of production workers by 1.46%, wages of nonproduction workers by 2.75%, production employment by 5.14%, and nonproduction employment by 4.38%.[7]

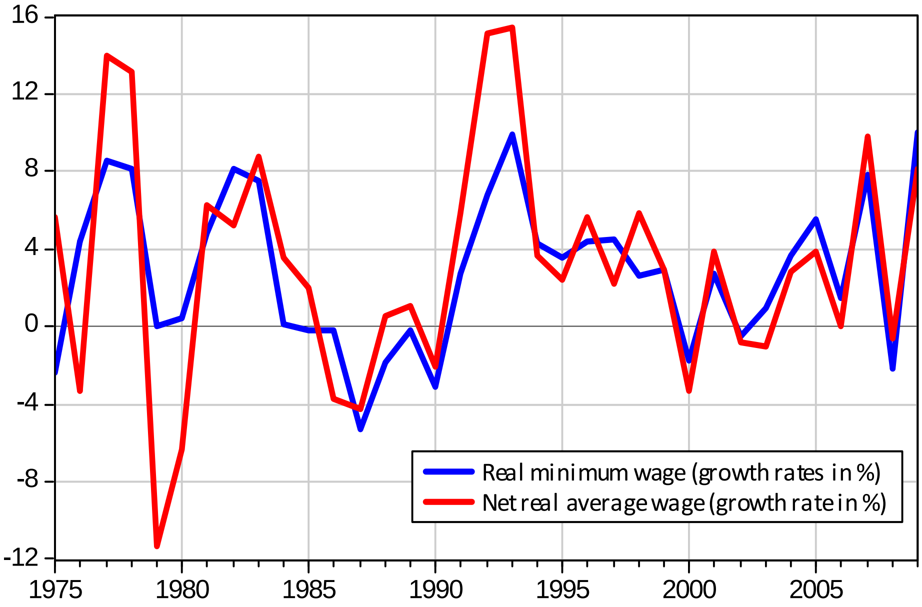
[5] The parafiscal contributions are payroll taxes which are only paid by firms. They have been used to finance the Family Compensation System, the National Service of Learning (SENA by its acronym in Spanish) and the Colombian Family Welfare Institute (ICBF by its acronym in Spanish). The health and pension payroll taxes correspond to contributions that firms and employees must shell out in a traditional social security system. The professional hazards are payroll taxes paid by firms that have been used to fund the General System of Occupational Risks, whose aim is to protect and assist workers from the effects of diseases and accidents that may befall them during or as a result of their work. In this study we take into account all payroll taxes paid by firms.

[6] *Cartilla Laboral*, years 1989-2009; and *Cartilla de la Seguridad Social*, years 1990-2009.

[7] Production workers (or employment) include workers in tasks strictly related to productive activities (usually called blue-collar), while nonproduction workers (or employment) include workers in administra-

Another critical labor market institution in Colombia is the minimum wage. Although the government had the power to set a minimum wage since 1945 (by Law 6), it was in 1949 when it was effectively implemented for the first time. The minimum wage is indexed on a yearly basis following the previous year CPI inflation rate. Its growth cannot be inferior to this rate,[8] which is the same irrespective of the economic sector (see Hofstetter, 2005, for details).

Figure 2. Real wages of the manufacturing industry 1974-2009.



Source: EAM for the net real wage and legislation published annually for the minimum wage.

In practice, it turns out that the real minimum wage operates as a sort of reservation wage which not only is a floor wage (in levels), but also a reference for wage increases in formal activities.

Finally, although the Colombian labor legislation recognizes unions as a part of the labor relations system, its role in wage-setting matters is nowadays minimal and essentially restricted to collective bargaining at the firm-level. Union density in Colombia is around 4%, while the coverage of collective agreements is less than 2% (data from ENS).

2.2 Trade reforms

In parallel to the labor market reform process, Colombia also embarked in a process of external liberalization in the 1990s. The first step in this process took place unilaterally

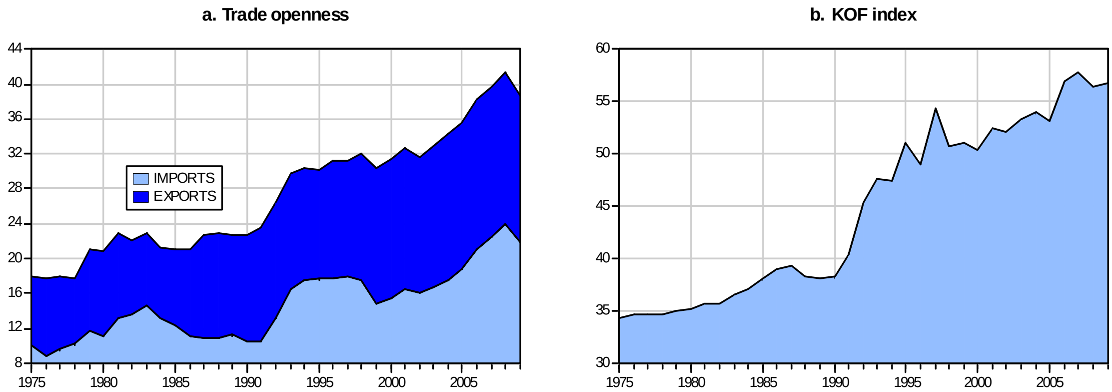
tive tasks (usually called white-collar). This is the distinction made by Kugler and Kugler (2009) because of the source data they work with.

[8] This was started by judgment C-815 of the Constitution Court in 1999 as a consequence of the loss of purchasing power of the minimum wage in the eighties and early nineties.

in 1990, when the political authorities increased the Colombian exposure to international trade by reducing, simultaneously, import controls and import tariffs. In this way, free imports (i.e., custom non-controlled imports) rose from 14.8% in 1985 to 96.7% in 1990, while the average customs duty rate was reduced from 38.9% in 1990 to 12.0% in 1995.

Also, between 1992 and 2004, Colombia enjoyed a new system of preferential tariffs to export to the US.[9] This system was superseded in 2004 by Free Trade Agreements (FTAs) between Colombia and a number of relevant trade partners such as the US, the European Union, Canada, Mexico, Korea, Chile, Salvador, Guatemala and Honduras.

Figure 3. Globalization in Colombia. 1974-2009.



Source: DANE for Trade openness; Dreher *et al.* (2008) for the KOF index.

As a consequence, trade openness (i.e., the ratio of exports plus imports over GDP) increased from below 25% in 1990 to more than 40% today (Figure 3a). Therefore, although Colombia is still considered a relatively closed economy, in the last two decades it experienced a significant change in its overall degree of globalization as measured, for example, by the KOF index (Figure 3b). From a value of 34.3% in 1975, this index only increased by 4 percentage points up to 1990 (34.2%). The steep slope thereafter reflects the liberalization process of the Colombian economy, which led the KOF index to reach 57% in 2009.

In this context, the manufacturing industry has been the most affected sector in Colombia, with a steady increase in the imports share that attained 90% of total Colombian imports in 2009 (see Figure A1a in the Appendix), and a share of exports above 60% of total exports, in contrast to a share of less than 15% in terms of GDP. Still more important, trade openness in this sector (i.e., the ratio of industrial exports and imports over total industrial output) doubled from an average of 48.2% in 1974-1991, to one of 96.8% in 1992-2009.

[9] The APTA was signed in December 1991. Through this agreement around 5,600 products were granted free access to the US market in exchange of a renewed focus on economic activities and jobs aiming at replacing the cocaine industry. This agreement was subsequently prolonged and extended, 2002 onwards, through the APTDEA.

Table 1 informs on the homogeneity of the opening process across sectors. All industries, but one,[10] were subject to this process, and there are no significant composition effects within the manufacturing industry in Colombia: the GDP share of the largest sector (S1 on food products and beverages) remained stable at 28-29%, while the five largest sectors (S1, S3, S12, S10 and S9) accounted for 62.2% the industrial GDP in the first period, and 65.9% in the second one.

Table 1. Trade openness and output shares by industries.

Sector	**Trade openness**		**Share in total industry GDP**	
	1974-1991	1992-2009	1974-1991	1992-2009
S2	5.1	29.2	2.6	0.7
S11	8.3	42.3	4.2	5.0
S1	9.7	28.2	28.4	28.9
S3	11.6	68.8	10.9	5.3
S12	13.3	22.1	5.8	7.3
S6	19.2	36.8	0.8	0.6
S7	23.1	39.5	3.7	3.8
S5	23.4	69.6	1.7	1.1
S14	24.5	60.3	3.7	2.8
S8	25.7	23.7	2.8	3.6
S4	29.2	39.2	3.0	3.6
S19	39.9	125	1.6	1.2
S10	47.6	79.8	12.8	15.4
S9	52.2	44.5	4.3	9.0
S18	59.7	151	4.1	3.2
S16	64.2	256	3.2	2.2
S13	71.9	111	4.0	3.9
S17	156	226	0.5	0.7
S15	232	387	1.9	1.7
Total	48.2	96.8	100	100

Notes: Definition of sectors provided in Table A1. All variables are expressed in percent.

Within this relatively homogeneous broad context, we acknowledge that some branches experienced particularly intensive opening processes. Two of them were already globalized in 1974-1991 (S15 on manufacture of machinery and equipment including manufacture of office, accounting and computing machinery, 232%; and S17 on manufacture of medical,

[10] The only exception is Sector 8, related to publishing and printing recorded media, just accounting for around 3% of total industrial GDP.

precision and optical instruments, watches and clocks, 156%), but reached degrees of trade openness of 387% and 226%, respectively, in 1992-2009. The three other ones departed from values much below, but also became fully opened industries in 1992-2009: S16 on manufacture of electrical machinery, radio, television and communication equipment, 256%; S18 on manufacture of motor vehicles, trailers and semi-trailers, and other transport equipment, 151%; and S19 on manufacture of furniture, 125%. This particularly intensive transformations are taken into account in our empirical analysis.

A related critical issue is that the leading role played by the manufacturing sector in the opening process of Colombia has been accompanied by a large deterioration of its international competitiveness. This is illustrated in Figure A1b, which shows a structural trade deficit that became much larger on averages ince the nineties.

3 Wage setting

3.1 Theoretical background

Standard wage setting models have been developed both in perfect and imperfect competition contexts.

A relevant example of a perfect competition wage setting model can be found in Kugler and Kugler (2009), where the market-clearing wage and employment levels are set to equate the demand and supply of labor. Firms choose employment by equating the gross marginal labor costs –net wage plus payroll taxes– with the marginal revenue of producing an extra unit of output. In turn, workers set their labor supply as a function of net wages and their prospective social security benefits received in exchange of the payroll tax paid by firms. This gives form to the tax/benefit linkage developed in Summers (1989). The outcome of this model is that wages are set as a function of the labor demand and labor supply elasticities with respect to wages, and also with respect to the payroll tax (paid by firms) and the valuation made by workers over the benefit received.

In a context of imperfect competition, the traditional classification distinguishes efficiency wage from collective bargaining models such as the insider-outsider or union models –Lindbeck and Snower (2001), Booth (2014). Within this vast strand of literature, the work by Prodecca (2011) provides an encompassing model in which a large number of identical unions and firms set real wages in a Nash bargaining framework. Empirically, her model states that the real wage is related to the following six fundamental variables: labor productivity (Y/N), the unemployment rate (u), the replacement ratio (BRR), union bargaining strength (η), payroll taxes/non-wage costs (τ^p), and income taxes (τ^i).

By solving the theoretical model in a Cobb-Douglas framework and log-linearizing the resulting expression, Prodecca (2011) obtains her core empirical equation:

$$\begin{aligned} \log(W_t) &= a_0 + a_1 \log\left(Y_{t/}/N_t\right) - a_2 \log(u_t) + a_3 \log(BRR_t) \\ &\quad + a_4 \log(\eta_t) + a_5 \log(\tau_t^p) + a_6 \log\left(\tau_t^i\right) + \varepsilon_t \end{aligned} \tag{1}$$

To study the Colombian case, this benchmark expression needs to be adapted at least for a twofold reason. First, because some institutional features that are generally considered as crucial in developed economies, are less relevant in Colombia. Consequently, we lack times series information to be included in the analysis. Second, because the benchmark model we have considered does not account for the role of the external sector which, as we have discussed, is likely to have affected wage determination in the manufacturing industry. On top of these reasons, some data is simply not available.

Therefore, we next discuss the adjustments and extensions we introduce to the benchmark equation (1).

3.2 Empirical implementation

The first adjustment concerns the unemployment rate. As stated, informal employment in Colombia is massive. This goes together with very limited statistics covering labor issues in non-urban areas. Consequently, the unemployment rate series available for the whole sample period is based on urban unemployment. We tested its role in a variety of specifications and we found it is essentially worthless to explain industrial net wages. The term $-a_2 \log(u_t)$ in equation (1) is therefore omitted. This is consistent with the findings in Iregui *et al.* (2012) for 1.305 firms examined during the first half of 2009 in a context of slowdown in economic activity, low inflation and rising unemployment. Iregui *et al.* (2012) show that Colombian firms consider some aggregate factors, the unemployment rate among them, as having minor relevance in defining nominal wage increases.

The second adjustment relates to the replacement ratio, which is essentially nonexistent in Colombia as a source of income for unemployed. There is a related in-kind benefit which was to a large extent improperly used (not as a true unemployment benefit) before the 2013 reform. This affects the term $a_3 \log(BRR_t)$, which is dropped from the analysis.[11]

The third adjustment refers to union power in whatever form (measures of trade union density, number of strikes or days lost due to labor conflicts). Although there is data since

[11] At this point, it is worth noting that although a system of unemployment benefits exists in Colombia since 2002 (by Law 789), it had to be restructured in 2013 to enforce its use in correspondence to its nature. This implies, in contrast to the emphasis placed by the literature on the wage impact of such benefits, that the unemployment benefit system in Colombia has been irrelevant as a determinant of wage setting.

the 1990s, any measure related to union power was not relevant as explanatory variable (see Section 5 for details). This questions the relevance of the term $a_4 \log(\eta_t)$.

A final adjustment is the exclusion of $a_6 \log(\tau_t^i)$ due to the lack of information on income taxes in consistent time series. One problem is that effective tax rates are not available. The other problem is that using the statutory rates would not be accurate given the features of our panel data. The reason is that the income tax scheme sets differentiated rates by income group, with low incomes subject to tax exemptions. Therefore, as we only have data on average wages across sectors, the use of statutory tax rates could distort the true effect of income taxation on wages.

The central institutional extension is the inclusion of the real minimum wage, which acts as a reference for real wages. This implies considering the new term $a_2 \log\left(W_t^{\min}\right)$, where $W_t^{\min}$ denotes the real minimum wage. A positive sign on $\hat{a}_2$ is expected.

This extension is consistent with the findings in Iregui *et al.* (2012), who show that nominal minimum wage increases and past inflation are considered as important factors by firms when adjusting their nominal wages. Their analysis also reveals that most firms adjust nominal wages annually at rates that are roughly equivalent to the observed rate of CPI inflation, and none of them cut wages.

A second extension is related to relative prices and seeks to capture the role exerted by the price wedge between manufacturing and total prices in wage setting. The variable we consider is π_t, the ratio of manufacturing prices (p_t^m) over consumption prices (p_t^c), and we expect a negative influence over net real wages. The reason is the following. Over time, manufacturing prices tend to grow less than consumption prices for a twofold reason. First, it is a capital-intensive sector subject to quick technological change and efficiency gains that are translated into lower prices (or higher quality at equal prices). Second, it is the most exposed sector to global competition and, as such, bears the most important downward pressure on prices. This forces firms to use labor compensation as a key adjustment mechanism to ensure competitiveness. In this context, given that nominal wages in Colombia are indexed to the CPI, the larger is the wedge between the two, the bigger is the tension in terms of the wage setting mechanism: while workers grade their net wages having as reference consumption prices, firms appraise their expected benefits as a function of manufacturing prices. Here is the wedge and the tension pushing real net wages down when the wedge increases.

An important remark here is that the real minimum wage and the price wedge can be considered two sides of the same coin capturing the close attachment of wages to the evolution of prices. The reason is the following. If nominal minimum wages are closely tied to consumption prices, then the ratio $(W_t^{\min}/p_t^m)$ will not differ that much in its evolution from the price ratio p_t^c/p_t^m, which is the inverse of our price wedge variable p_t^m/p_t^c. Having confirmed this empirically, our empirical models will take two alternative forms to avoid multicollinearity problems, one with the real minimum wages as explanatory variable, as in equation (2) below; and a second one considering the price wedge instead: equation (3).

A final extension is related to the external sector and consists on the inclusion of a measure of trade openness (op) through the addition of the new aggregate term $a_4 \log(op)$. The expected incidence of international trade, or globalization, on net wages is not clear. On one side, the literature is still far from reaching consensus on the causal relationship between exports and productivity (and thus wages). Some relevant studies argue that exports cause efficiency gains (and would thus boost wages), while some other claim that efficiency progress is what allows exports to increase.

In the case of Colombia, we have two pieces of information that make us look at the imports' side. First, exports have not led the opening process (see Figure 3a). Second, as shown by Figure A1a, the share of manufacturing exports has remained stable between 1965 and 2010. Hence, if the industrial imports of goods are the catalyst variable, then we should expect a positive influence on net wages for a twofold reason.[12]

First, on account of the positive relationship between wages and the import of intermediate goods, as demonstrated in Amiti and Davis (2011). This hypothesis is endorsed by the fact that two thirds of total industrial imports in Colombia consist on intermediate inputs. And second because, as pointed out by Arbache *et al.* (2004), one of the consequences of increasing trade openness is a rapid inflow of foreign technology as a result both of foreign direct investment and increased imports. In-flowing technology is skill-biased because it is mainly designed in industrialized economies which are relatively skill intensive. Thus, the acquisition of new technologies from developing countries is normally accompanied by a greater demand of skilled labor. On the positive side this causes an upward pressure on relative wages (which is the effect we are capturing), although there is also a negative consequence in terms of increased wage inequality.[13]

Overall, these empirical adjustments and extensions leave us with two versions of the empirical model. In the first version, we have the real minimum wages:

$$\log(W_t) = a_0 + a_1 \log\left(Y_{t/}/N_t\right) + a_2 \log\left(W_t^{\min}\right) + a_3 \tau_t^p + a_4 \log(op_t) + \varepsilon_t, \tag{2}$$

while in the second version we have the ratio of manufacturing prices over consumption

[12] Relevant studies claiming a negative relationship between imports and local wages point to massive imports of consumption goods in developed economies. For example, for the United States, Autor *et al.* (2013, 2014) show that wages/cumulative earnings were lower after the spectacular rising of the Chinese imports, mainly of consumption goods.

[13] Growing empirical evidence on the effects of globalization gives support to a positive relationship between trade liberalization and wage inequality in developing countries –see, for example, Caselli (2014), Meschi and Vivarelli (2009), and Attanasio *et al.* (2004).

prices:

$$\log(W_t) = a_0 + a_1 \log\left(Y_{t/}/N_t\right) + a_2 \log(\pi_t) + a_3 \tau_t^p + a_4 \log(op_t) + \varepsilon_t. \quad (3)$$

Given our previous discussion, we also control for specific intensities in the growing degree of openness to trade. Thus, in addition to the aggregate coefficient on trade openness, all equations are also estimated by controlling for the sectors with relative low and high trade exposures in the corresponding period of analysis. These controls are, respectively, op_{it}^l ($= op_{it}$ when $op_{it} < 100\%$) and op_{it}^h ($= op_{it}$ when $op_{it} \geq 100\%$),[14] and imply that equations (2) and (3) will be also estimated with $a_4^l \log\left(op_{it}^l\right) + a_4^h \log\left(op_{it}^h\right)$ instead of $a_4 \log(op)$. We believe this addition will help to minimize estimation biases potentially accruing from differences in the sensibility of wages to various degrees of trade openness.

To conclude, note that all coefficients will have to be interpreted as delivering elasticities, except a_3, which is a semi-elasticity capturing the direct impact (not in logs) of the payroll tax rates on net wages. It is in this context that we treat payroll taxes as the tax wegde between gross and net wages.

4 Empirical issues

4.1 Data

We use a panel database with a cross-section dimension of $N = 19$ sectors and a time dimension of $T = 36$ years covering the period 1974-2009.[15] Table 2 presents the variables and the corresponding sources.

Net average real wages per worker are obtained from the Annual Manufacturing Survey (Encuesta Anual Manufacturera, EAM), which is produced by the National Administrative Department of Statistics (Departamento Administrativo Nacional de Estadística, DANE). It is calculated as the real wage bill before taxes in sector i over paid employment in that sector. Labor productivity is computed as the real value added in sector i over total employment in that sector, where total employment includes paid and unpaid workers. It is also obtained from the EAM. As explained above, trade openness is computed as exports plus imports in sector i over output in that sector. It is also obtained from the EAM. Note that these are the three variables for which detailed homogeneous time series

[14] Wa take this threshold of 100% as it is considered a standard reference and, in any case, does not alter our classification relative to the average degree of openness in the Colombian industry (recall the average of 96.8% in 1992-2009).

[15] The detailed list of sectors is provided in Table A1, in the Appendix.

information across sectors exists.

Table 2. Definitions of variables.

Variables		Sources	Sub-indices
W_{it}	Net real wage	(1)	
Y_{it}	Real GDP	(1)	$i = 1, ..., 19$ sectors
N_{it}	Total employment	(1)	$t = 1, ..., 36$ years
$\frac{Y_{it}}{N_{it}}$	labor productivity	(1)	
op_{it}	Trade openness $\left[\frac{(exports+imports)_{it}}{output_{it}}\right]$	(1)	
op_{it}^{l}	Low trade openness $(= op_{it} < 100)$	(1)	
op_{it}^{h}	High trade openness $(= op_{it} \geqslant 100)$	(1)	
$W_t^{\min}$	Real minimum wage	(2)	
τ_t^p	Statutory payroll tax rates	(3)	
p_t^m	Manufacturing prices	(4)	
p_t^c	CPI deflator	(4)	
π_t	Relative prices $\left[\frac{P^m}{P^c}\right]$	(4)	
ϑ_t	National strikes	(5)	

Notes: All nominal variables are deflated by the manufacturing price index (base: June 1999).
(1) EAM; (2) Legislation published annually; (3) LEGIS; (4) DANE; (5) ENS.

Data on nominal minimum wages is collected from public information/legislation published annually. Similarly, the statutory payroll tax rates (including health, pension, professional hazards, and parafiscal contributions) are computed from information supplied by LEGIS in its official annual reports. Note, therefore, that we use statutory rates instead of any sort of effective tax rate. In this way, we avoid dealing with econometric problems related to the use of effective tax rates, namely the simultaneity in the determination of wages and payroll tax rates, and spurious variability in payroll tax rates. In turn, the number of national strikes is obtained from the national trade union institution (Escuela Sindical Nacional, ENS). Note, however, that this variable is only available from 1992 onwards and can only be used for the second part of the sample.

Finally, manufacturing prices and the CPI index are also taken from the DANE. These two indices are used to compute the ratio of relative prices.

All nominal variables are deflated with the manufacturing price index.

4.2 Stylized facts

Table 3 provides descriptive information on some crucial macroeconomic variables of interest. Subscript i denotes information corresponding to the average of the 19 sectors in which the Colombian industry is disaggregated. Detailed industry information is not available for the real minimum wage, manufacturing prices, the CPI index, and the payroll tax rate. All data is supplied for the two relevant periods of analysis –the slow transition between import substitution and trade liberalization in 1974-1991; and the institutional and trade reforms years of 1992-2009.

Table 3. Macro developments in the Colombian manufacturing industry.

	$\triangle Y_{it}$	$\triangle N_{it}$	$\triangle(Y_{it}/N_{it})$	$\triangle W_{it}$	τ_t^p	$\triangle\left[W_{it}(1+\tau_t^p)\right]$
1974-1991	4.38	0.58	3.80	1.87	15.7	2.18
1992-2009	4.30	-0.30	4.60	3.85	28.9	4.50
1974-2009	4.33	0.13	4.20	2.90	22.3	3.37
	$\triangle W_t^{min}$	$\triangle p_t^m$	$\triangle p_t^c$	$\triangle \pi_t$	op_{it}	$\triangle\left[\frac{W_{it}(1+\tau_t^p)}{Y_{it}/N_{it}}\right]$
1974-1991	1.75	21.2	22.1	-0.96	48.2	-1.61
1992-2009	3.59	9.0	11.2	-2.23	96.8	-0.10
1974-2009	2.70	15.0	16.5	-1.62	72.5	-0.83

Notes: $\triangle$ is the difference operator and indicates average of sectorial growth rates.
All variables are expressed in percent.

Since the mid-seventies until 2009, real economic growth of the Colombian manufacturing sectors was around 4.3% on average, with no significant differences between periods. In spite of these positive growth rates throughout, the industrial standstill in the seventies and the debt crisis in the eighties resulted in low employment growth rates (0.5 % on average in 1974-1991) and, thus, in high labor productivity growth rates (3.8% on average). In contrast, gross wages (i.e., the addition of net wages and statutory payroll taxes) grew at 2.2%, thus prompting an annual fall in the unit labor costs of 1.6% on average. Note also, that net real wages (payroll taxes excluded) and real minimum wages grew in line (at 1.9% and 1.8%, respectively) reflecting highly tied adjustments to the cost of living. These years were also characterized by high inflation rates, amounting to 22.1% if measured by the CPI, and 21.2% by manufacturing prices. As a consequence, the price wedge went down by 1 percentage point annually, on average.

The nineties were years of labor reform and trade liberalization processes, but also of deindustrialization and growing expansion of the services sector. They were followed, though, by the recovery of the manufacturing sector in 2000-2009 driven by a rising capital accumulation (boosted both by domestic and foreign direct investment)[16] and

[16] In the seventies and eighties, FDI represented 0.3% of the GDP on average, while between 1997 and 2007 it represented 3.8%. Source: DANE.

the substitution of domestic by imported raw materials. Altogether, these developments caused employment to fall (by 0.30% annually, on average) and resulted in the acceleration of the growth rate of labor productivity (4.6%), which was 0.8 percentage points larger than in 1974-1991. In turn, gross real wages grew in line with productivity (4.5% on average), thus denying further progress in real unit labor costs. Beyond productivity gains, it should be noted that upward pressures on gross real wages arose from increases in payroll taxes paid by firms, and from the acceleration in the increase of the price wedge, reflecting the speedier deceleration of inflation in manufacturing prices than in the cost of living.

These contrasted periods, both in terms of economic developments and policy agenda (as discussed in Section 2), lead us to the estimation of equations (2) and (3) by disaggregating years 1974-1991 from 1992-2009. Next we explain how this estimation is conducted.

4.3 Econometric methodology

Empirical equations (2) and (3) are extended in two directions. First, due to the relevance of adjustment costs in the wage setting, we consider the addition of lags of both the independent and explanatory variables. This enables us to perform a dynamic analysis and to compute short- and long-run effects of each explanatory variable on net real wage. Second, as we work with a two-dimensional panel data, we add fixed effects in order to control for unobserved heterogeneity among sectors.

Given the dynamic nature of the extended models, equations (2) and (3) will be estimated as Autoregressive Distributed Lag (ARDL) models taking the following general form:

$$\ln(W_{it}) = \alpha_i + \gamma \sum_{1}^{S} \ln(W_{i,t-s}) + \beta \sum_{1}^{V} \ln(X_{i,t-v}) + u_{it}, \qquad u_{it} \sim iid\left(0, \sigma_i^2\right) \tag{4}$$

where the subscripts i and t are sector and time indices, respectively; S and V represent the dynamic structure of the model; W is the dependent variable; α_i is a sectorial cross-section intercept, γ is the inertial (or persistence) coefficient; X is a vector of explanatory and control variables while β is the set of estimated parameters capturing their influence on the dependent variable; and u_{it} is the error term.

4.3.1 Unit root tests

As we deal with two dynamic panels, we must ensure that in both there is a long run equilibrium relationship among the variables. This implies testing that all variables are stationary $I(0)$ which, by definition, yields a long-run cointegrating vector.

Table 4. Unit Root Tests, 1974-1991.

Different variables across sectors				Common variables across sectors			
Method	W_{it}	Y_{it}/N_{it}	op_{it}	Method	W_t^{min}	π_t	τ_t^p
Null hypothesis: individual unit root process				Null hypothesis: variable is stationary			
MW	61.27	58.94	64.58	KPSS	0.43	0.14	0.08
	[53.203]	[53.203]	[53.203]		[0.463]	[0.146]	[0.146]
Result	I(0)	I(0)	I(0)	Result	I(0)	I(0)	I(0)

Notes: All variables are expressed in logs, except τ_t^p; KPSS tests computed using intercept and trend, except for W_t^{min}, which is computed using intercept; 5% critical values in brackets.

In order to check the order of integration of the variables, we perform a set of stationary and panel unit root tests depending on the type of variables to be dealt with. In particular, we use the Kwiatkowski, Phillips, Schmidt and Shin (1992) stationary-test –KPSS henceforth– for the variables that are common across sectors. For the variables that are sector-specific, we use the test proposed by Maddala and Wu (1999) –MW–, which is a panel unit root test based on Fisher's (1932) results.[17] The MW test assumes, under the null hypothesis, that all series are non-stationary, against the alternative that at least one series in the panel is stationary. We use the KPSS test because it is suitable for short time series and allows direct testing of the null hypothesis of stationarity.[18]

Table 5. Unit Root Tests, 1992-2009.

Different variables across sectors				Common variables across sectors				
Method	W_{it}	Y_{it}/N_{it}	op_{it}	Method	W_t^{min}	π_t	τ_t^p	υ_t
Null hypothesis: individual unit root process				Null hypothesis: variable is stationary				
MW	88.97	60.20	58.85	KPSS	0.11	0.11	0.14	0.22
	[53.203]	[53.203]	[53.203]		[0.146]	[0.146]	[0.146]	[0.463]
Result	I(0)	I(0)	I(0)	Result	I(0)	I(0)	I(0)	I(0)

Notes: All variables are expressed in logs, except τ_t^p; KPSS tests computed using intercept and trend, except for υ_t which is computed using intercept; 5% critical values in brackets.

On the other hand, we conduct the MW test because, in general, panel-based unit root tests have higher power than unit root tests when applied to individual time series.

[17]Using Monte Carlo simulations, Maddala and Wu (1999) conclude that the Fisher test is a better test than the Levin and Lin (1993) and the Im, Pesaran and Shin (2003) tests. They also highlight that the Fisher test is simple and straightforward to use.

[18]In fact, given the time dimension of our two panels $T = 18$, we do not conduct alternative unit root tests such as the Augmented Dickey Fuller (ADF) test or the Phillips Perron (PP) ones.

Moreover, this test has two attractive characteristics. First, it does not restrict the autoregressive parameter to be homogeneous across sectors under the alternative of stationarity. Second, the choice of the lag length and the inclusion of a time trend in individual ADF test regressions can be determined separately for each sector.

As noted in the last row of Tables 4 and 5, the overall conclusion drawn from these tests is that all variables are stationary $I(0)$. Hence, we can proceed with stationary panel data estimation techniques.

4.3.2 Estimation method

Given the panel structure of our database, models (2) and (3) are estimated by applying Ordinary Least Square (OLS) and Fixed Effects (FE). In doing so, we need to take care of potential endogeneity problems caused by three issues. First, by the introduction of lagged dependent variables in the set of regressors. Second, by the well-known simultaneity between net real wages and labor productivity. Third, by the potential correlation between relative prices and the error term, on account of the simultaneity of wage and price setting.

Regarding the first potential problem, it is well known that estimation by OLS gives rise to a "dynamic panel bias" (Nickell, 1981). The reason is that the estimated coefficient on lagged wages will be inflated by attributing some predictive power to it that actually belongs to the sector's fixed effect. A first intuitive response would then be to apply the within-groups (or fixed effects) estimator, but this does not fully offset the dynamic panel bias. This was explained by Nickell (1981), who pointed out that, when T is large and N is small, and $T > N$, this bias is likely to be insignificant; but when T is small and N is large –and, specifically, when $T < N$– the within (or fixed effect) estimator will be downward biased and inconsistent, even if there is no serial correlation of the error term. Although this may not be a highly relevant issue in our analysis (since we work with two periods in which T and N are similar, $T = 18$ and $N = 19$), we cannot discard the possibility of biases.[19] This is the reason why other estimation methods are also used.

To deal with dynamic panel bias, a common option is to use System GMM (SYSGMM), also known as the Blundell and Bond estimator (1998). However, as common among GMM estimators,[20] its consistency depends on N being relatively large. That is, if $N \to \infty$ grows sufficiently fast relative to T, then the Blundell and Bond estimator (1998) will be consistent. This does not correspond to our case, in which we deal with a panel with $T = 18$ and $N = 19$, implying that SYSGMM estimates will not yield dramatic consistency gains over the FE estimator. In this context, to check on the superiority of

[19] Judson and Owen (1999), for example, found biases equivalent to 20% even with $T = 30$.

[20] For example, the difference GMM estimator (Arellano and Bond, 1991) and the orthoghonal desviations estimator (Arellano and Bover, 1995).

the SYSGMM estimator, we use the rule of thumb suggested by Roodman (2009), which sets that good estimates of the true parameter should lie in, or be near, the range between the OLS and FE estimators.

On the other hand, the SYSGMM estimator has an important advantage over the OLS and FE estimators: the simultaneity between net real wages and labor productivity, as well as the potential correlation between relative prices and the error term, can be controlled by using differences of the variables themselves as instruments. Thus, as a first step and for comparison purposes, we estimate the models by OLS, FE and SYSGMM assuming wages, labor productivity, relative prices and trade openness as strictly exogenous. Then, we estimate the equations by SYSGMM, but assuming that labor and relative prices are not strictly exogenous (that is, they are either endogenous or predetermined).

Finally, in order to raise the efficiency of the FE estimator, we compute: (i) white cross-section standard errors (clustering by period) to correct for the possible presence of cross-section specific heteroskedasticity; and (ii) the white covariances matrix, whose estimates are robust to arbitrary heteroskedasticity and within cross-section serial correlation. Likewise, to increase the efficiency of the SYSGMM estimator, we estimate its two-step version.

5 Results

We first overview the results for each of the two periods; then an overall assessment is provided. Tables 5 and 7 present the general results, while Tables 6 and 8 focus exclusively on the resulting long-run elasticities.

To check on the expected superiority of the SYSGMM estimates, we resort to Roodman's (2009) "rule of thumb" and look at the estimated persistence coefficients. We also pay particular attention to Sargan's test for over-identifying restrictions, as well as to the Arellano and Bond test of no second order serial correlation of the error term. Recall that Sargan's test can be used as a test of instruments validity, and also as a test of structural specification. In turn, the Arellano and Bond test allows testing whether the GMM estimators are consistent. Both tests are used to select the best empirical specification in each period of analysis.

5.1 Wage setting before the reform process (1974-1991)

Table 5 presents all information on five blocks, but the OLS and FE ones are displayed just as benchmark references. For example, when the estimated persistence coefficients are compared to the SYSGMM* ones –assuming all explanatory variables as strictly exogenous– we find the latter to be in between and thus consistent with Roodman's (2009) "rule of thumb". This suggests that the SYSGMM* estimates are superior to those obtained by OLS and FE.

Turning to the SYSGMM** estimates, we do not find relevant statistical gains from instrumenting labor productivity and consider the price wedge as predetermined (compare, for example, specifications 13 and 16 and the small variability in the estimated labor productivity coefficients). Moreover, not only the persistence coefficients are not far away from their FE counterparts (columns 13 and 14, corresponding to equation (3)), but there is also a poor performance of Hansen's test.

In view of these results, we re-estimate specifications 15 and 16 by SYSGMM***; that is, still assuming relative prices as predetermined, but this time having labor productivity as exogenous instead of endogenous. The corresponding results, presented in columns 17 and 18, outperform the estimates in columns 11, 12, 15 and 16, as they deliver better over-identifying restrictions and serial correlation tests. In addition, all estimated coefficients are consistent with those obtained by SYSGMM* presented in columns 9 and 10.

[**Table 5 to be placed about here**]

These four sets of estimates (the ones presented in columns 9, 10, 17, and 18) provide a similar picture with highly significant labor productivity, real minimum wage, price wedge, payroll taxes and trade openness, all displaying the expected sign. And they even deliver reasonably robust long-run coefficients (presented below in Table 6). In this context, if we had to favor some particular specification, we would follow the Arellano and Bond test and choose the results in column 10. This is the specification with the best performance of this test, thus suggesting consistent estimates.

The corresponding long-run elasticities are presented in Table 6. Following, the results in column 10, the long-run elasticity of wages with respect to labor productivity is 0.40, implying that 40% of productivity gains are translated into a higher net compensation of workers. This value is far away from unity, which is the theoretical benchmark value, and leaves space for other potentially more relevant determinants related to the indexation of wages with respect to prices or, alternatively, to the price wedge.

The long-run elasticity of wages with respect to the real minimum wage is estimated at 0.85.[21] This implies that a 1% increase in real minimum wage causes net real wages to grow by 0.85% and captures the upward pressure that minimum wages exert on wages. The counterpart of this result is provided in the specification presented in column 18, in which the real minimum wage has been replaced by the price wedge. We find that

[21] The hypothesis of a unit long-run elasticity of wages with respect real minimum wage is rejected. The Wald test gives a p-value of 0.155.

the long-run elasticity of wages with respect to relative prices is -1.22, implying that a 1% increase in the ratio of manufacturing prices over consumption prices causes wages to decrease by 1.22%. In other words, from this alternative specification, we are able to gauge to what extent manufacturing firms are forced to reduce wages to regain competitiveness when the prices of manufacture goods become relatively more expensive (and vice-versa). Here, it is important to note that all wage elasticities (other, of course, than the ones on minimum wages and the price wedge) are stable (columns 10 and 18).

[**Table 6 to be placed about here**]

Regarding payroll taxation, the long-run coefficient of -0.06 implies that a 1 percentage point increase in payroll tax rates cause a reduction in net wages of around 6%. Recall that payroll taxes are argued to have a negative impact on labor demand because they represent an extra labor cost for employers. However, the decline in net real wages generates a compensation effect, which could even overcome the direct negative effects over employment were wages persistent enough.

The last finding is the scant influence exerted by the degree of international trade openness on wage setting. This result is not surprising given that in the seventies and eighties Colombia was a closed economy, and the industry was mainly based on manufactures that had a low international exposure. Of course, some branches had already high rates of trade openness (for example, the manufacture of machinery and equipment, S15, and medical instruments, S17), but they represented a minimal share of the industry (2.4%). Therefore, the dependency on imports of intermediate and capital goods, as well as the requirements of human capital in these sectors, did not cause specific impacts on net average wages in those years. In particular, the long-run elasticity of wages with respect to trade openness was 0.07 for these sectors, while for the rest the industry it was 0.10, indicating that a 1% increase in the degree of trade openness was causing net real wages to grow between 0.07% and 0.10%.[22]

In any case, this positive influence should be interpreted in connection to the works by Amiti and Davis (2011) and Arbache *et al.* (2004). That is, our result is on one side connected to the positive relationship between wages and the import of intermediate goods, which was large in the Colombian industry. And, on the other side, to the hypothesis of skill-biased technological change and the subsequent increase in skilled-labor wages, which is likely to apply to those manufacturing sectors more (and growing) exposed to international trade.

[22] The hypothesis that trade opennes in sectors with a low and high trade exposure has the same impact on wages is rejected. The Wald test gives p-value of 0.006 for the specification of column 10, and 0.016 for the specification of column 18 in Table 6.

5.2 Wage setting with enhanced labor flexibility, payroll taxation, and trade exposure (1992-2009)

The estimated models for years 1992-2009 are shown in Table 7. With respect to the results for the previous period, the first difference is that Roodman's (2009) "rule of thumb" cannot be confirmed since the persistence coefficients estimated by FE exceed those obtained by SYSGMM. Nevertheless, given that labor productivity and the price wedge are instrumented, we still prefer the SYSGMM estimates. Moreover, in this case we distinguish two extra specifications, in columns 19 and 20, where labor productivity is the only variable assumed as predetermined (note that in columns 17 and 18 only the price wedge is treated as predetermined).

In spite of this last set of results, the best specifications are obtained by SYSGMM** and presented in columns 14 and 16. They deliver a similar picture, but given the information obtained from the overidentifying restrictions and serial correlation tests, our selected results are those presented in column 14.

The most noticeable outcome is that the institutional and trade reforms have had a significant influence on the determinants of wage setting with one salient exception: labor productivity. According to our estimations, the sensitivity of real net wages with respect to labor productivity remained unaltered in 1992-2009, and stayed close to 0.40 in spite of the reform process.

Likewise, there is no statistical evidence of structural change in the wage elasticities with respect to trade openness, which remained around 0.07-0.10, as they were in 1974-1991. Following Amiti and Davis (2011), this is consistent with the stable and large share of imports of intermediate inputs, which has evolved around two thirds of total industrial imports in Colombia in both periods of analysis. However, the stability in the elasticity of wages with respect to trade openness does not support the predictions of the work by Arbache *et al.* (2004). According to them, liberalization processes in developing countries should rise the relative demand for skilled labor and thus lead to wage increases in this group. The fact that we are unable to identify such change should be interpreted as evidence that neither the rise in the relative demand for skilled labor nor the increases in net real wages of skilled labor in the Colombian industry were strong enough to push up significantly the average net real wage. On this account, it is worth noting that, in 1992-2009, the addition of the manufacturing industries with a degree of trade openness below 100% had still a share above 85% in terms of total industrial GDP.

[**Table 7 to be placed about here**]

In contrast, our analysis uncovers significant changes in the influence of other key determinants. First, the long-run elasticity of real minimum wages falls from 0.85 to

0.36. This lower sensitivity is reflecting two structural changes affecting the wage setting mechanism in Colombia. First, the fact that adjustments in both nominal wages and nominal minimum wages became more tied to CPI inflation since 1991. As a consequence, the intensity at which wage increases were driven by minimum wages went down relative to prices, which became more important in this period. This is related to the second source of structural change, which is the increased exposure to international markets and the resulting dramatic downward pressures on producer and consumer prices. As noted before, the asymmetric price response to these pressures caused a fall in the price wedge, whose consequences can be evaluated through the alternative empirical specification.

Viewed from this alternative specification (column 16), the impact of the increasing price wedge on wages becomes much higher with the trade liberalization, and shifts the long-run elasticity from -1.22 to -1.45. This is the natural outcome of a situation in which firms' selling prices are pushed down and they have to compress workers' compensation to protect their profitability. Thus, in the growing liberalized environment of 1992-2009, this increased sensitivity to the price wedge should come as no surprise.

[**Table 8 to be placed about here**]

Another novelty in this period is that net real wages became less sensitive to changes in payroll taxes (paid by firm) despite they were the object of a significant rise in the 1990s. This result is consistent with the previous ones. Recall that firms can shift the tax burden on workers through lower nominal net wages or higher prices. In a growing liberalized labor market, wage cuts become more feasible than rising prices (in an otherwise growing open environment), hence the preferred use of the first channel. However, the new situation of full indexation of nominal wages to the cost of living in the nineties was effectively introducing wage floors to firms. These wage rigidities, which prevented firms to shift the tax burden to the workers in the form of lower net wages, help to explain why the sensitivity of wages with respect to payroll taxes is substantially lower in this period.

These results are robust to the inclusion of variables related to union power, which are not significant in the analysis. Since data on union density and national strikes is only available since 1992, we have used these variables to conduct robustness checks (available upon request) on the results of the selected equation in 1992-2009.

6 Concluding remarks

We have studied the consequences of the structural change brought by the institutional and trade reforms carried out in Colombia during the nineties on the net real wages of the manufacturing industry.

We find no evidence of changes in the elasticity of net real wages with respect to labor productivity or trade openness which are, respectively, around 0.40 and 0.10 in both periods of analysis.

The first result suggests that the institutional measures undertaken by the government did not improve the scarce connection between workers' compensation and labor's efficiency progress. Taking the benchmark one-to-one relationship between wages and productivity, the failure to reduce this detachment in a growing globalized economy should be given priority from policy makers, as it generates distortions in the process of achieving competitiveness in the manufacturing sector. This is the main lesson that can be drawn from our study in terms of policy measures.

In turn, the second result goes in parallel with a stable and large share of imports of intermediate inputs and suggests, in particular, that the trade liberalization process has not exerted a relevant impact on the relative demand for skilled labor and/or that the increases in net real wages of skilled labor demand in the industry have not had a enough magnitude to push up significantly the average net real wage. If the Colombian economy continues to globalize at the same pace, this is likely to change and wages may tend to be more responsive. This is a further reason to strengthen the link between wage setting and productivity.

These findings call for a policy agenda in which wage indexation is reduced and a true wage bargaining system is brought in. This would allow workers' compensation to reflect more faithfully efficiency progress which, by all means, should be a critical target to solve the competitive problem of the Colombian industry and help, in this way, rebalancing the huge trade deficit attained with the liberalization program.

In terms of the increase in payroll taxation (paid by firms), we find the expected negative impact on net real wages, but we are unable to evaluate its net employment consequences. Our contribution here is the identification of a severe fall in the wage elasticity with respect to these taxes (from 0.06 to 0.01), which is the joint outcome changes in the institutional setting such as the enhanced indexation of nominal wages to CPI inflation, and the asymmetric downward pressures on manufacturing and consumption prices resulting from the liberalization process. The consequence of this lower tax shifting is a loss in firms' cost competitiveness which, although we have not dealt with it, may use employment as an instrument to offset this loss.

Finally, an additional impact of the trade reform on wage setting was expressed through the structural change in the elasticity of wages with respect to the minimum wage (or its counterpart, the price wedge), which came down from 0.85 to 0.36 (went up from -1.22 to -1.45). These changes in the elasticity have been interpreted as the second main consequence of the institutional transformation in terms of enhanced indexation of nominal wages to CPI inflation, and the asymmetric downward pressures on manufacturing and consumption prices resulting from the liberalization process.

Our results can be refined in a variety of directions. Further research should control for types of employment given that, both institutional and trade reforms, may have different effects on wages by type of worker. For example, regarding payroll taxes, international evidence suggests that there is less tax shifting for blue-collar than for white-collar workers. Beyond that, for developing countries there is growing empirical evidence showing that trade liberalization exerts a positive effect on high-skill labor wages, while there is no effect on low-skill labor wages.

Another research avenue is to aim at an individual assessment of how these reforms affected wage setting in each productive sector. In that case, the starting hypothesis would be that each sector's response is connected to its degree of exposure to international trade.

References

[1] Amiti, M. and D.R. Davis (2011): "Trade, Firms and Wages: Theory and Evidence, *Review of Economic Studies*, 79, pp. 1-36.

[2] Arbache, J., A. Dickerson, and F. Green (2004): "Trade Reforms and Wages in developing countries", *Review of Economics Studies*, 58, pp. 277-297.

[3] Arellano, M., and S. Bond (1991): "Some Test of Specification for Panel Data: Montercarlo Evidence and an Application to Employment Equations", *Review of Economics Studies*, 58, pp. 277-297.

[4] Arellano, M., and O. Bover (1995): "Another Look at the instrumental Variables Estimation of Error-components Models", *Journal of Econometrics*, 68, pp. 29-51.

[5] Attanasio, O., P. Goldeberg, and N. Pavcnik (2004): "Trade Reforms and Wage Inequality in Colombia", *Journal of Development Economics*, 74, pp. 331-366.

[6] Autor, D.H., D. Dorn, G.H. Hanson, and J. Song (2014): "Trade Adjustment: Worker Level Evidence", *Quarterly Journal of Economics*, 129(4), *forthcoming.*

[7] Autor, D.H., D. Dorn, and G.H. Hanson (2014): "The China Syndrome: Local Labor Market Effects of Import Competition in the United States", *The American Economic Review*, 103(6), pp. 2121-2168.

[8] Bauer, T. and R. Riphahn (2002): "Employment Effects of Payroll Taxes, an Empirical Test for Germany", *Applied Economics*, 34, pp. 865-76.

[9] Beach, C.M. and F.S. Baulfour (1983): "Estimated Payroll Tax Incidence and Aggregate Demand for labour in the United Kingdom", *Economica*, 50(197), pp. 35-48.

[10] Bennmarker, B., E. Mellander, and B. Ocker (2009): "Do regional payroll tax reductions boost employment?", *Journal of Labor Economics*, 16(1), pp. 480-89.

[11] Booth, A. (2014): "Wage Determination and Imperfect Competition", *IZA Discussion Paper No. 8034*, IZA, Bonn, Germany.

[12] Blundell, R. and S. Bond (1998): "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, 87, pp. 115-143.

[13] Camacho, A., E. Conover, and A. Hoyos (2014): "Effects of Colombia's Social Protection System on Workers' Choice between Formal and Informal Employment", *The World Bank Economic Review*, vol. 28 (3), pp. 446-466.

[14] Caselli, M. (2014): "Trade, skill-biased technical change and wages in Mexican manufacturing ", *Applied Economics*, vol. 46 (3), pp. 336-348.

[15] Cragg, M. and M. Epelbaum (1996): "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, 87, pp. 115-143.

[16] Cruces, G., S. Galiani and S. Kidyba (2010): "Payroll taxes, wages and employment: Identification through policy changes", *Labour Economics*, 17, pp. 743-49.

[17] Dreher, A., N. Gaston, and P. Martens (2008): *Measuring Globalisation – Gauging its Consequences*, New York: Springer.

[18] Fisher, R. A. (1932): *Statistical Methods for Research Workers*, 4th Edition, Edinburgh: Oliver & Boyd.

[19] Grossman, G. and E. Rossihansberg (2008): "Trading Tasks: A simple Theory of Offshoring," *The American Economic Review*, 98 (5), pp. 1978–1997.

[20] Gruber, J. (1997): "The Incidence of Payroll Taxation: Evidence from Chile", *Journal of Labor Economics*, 15(3), pp. S72-S101.

[21] Hamermesh, D. (1979): "New Estimates of the Incidence of the Payroll Tax", *Southern Economic Journal*, 45, pp.1208-1219.

[22] Hofstetter, M. (2005): "Política monetaria y la corte constitucional: El caso del salario mínimo", Documento CEDE 2005-36, ISBN/ISSN: 1657-5334.

[23] Im, K.S, M.H. Pesaran, and Y.Shin (2003): "Testing for unit roots in heterogeneous panels", *Journal of Econometrics*, 115, pp. 53-74.

[24] Judzik, D. and H. Sala (2013): "Productivity, deunionization and trade: wage effects and labour share implications", *International Labour Review*, 152 (2), pp. 205–236.

[25] Judson, R. A., and A.L. Owen (1999): "Estimating dynamic panel data models: A guide for macroeconomists", *Economic Letters*, 65, pp.9-15

[26] Kwiatkowski, D., P. Phillips, P. Smith, and Y. Shin (1992): "Testing the null hypothesis of stationary against the alternative of unit root: how sure are we that economic time series are not stationary?", *Journal of Econometrics*, 54, pp.159-178.

[27] Kugler, A. and M. Kugler (2009): "The labor market effects of payroll taxes in a middle-income country: evidence from Colombia," *Economic Development and Cultural Change*, 57 (2), pp. 335–358.

[28] Iregui, A., L. Melo and M. Ramírez (2012): "Wage Adjustment Practices and the Link between Price and Wages: Survey Evidence from Colombian Firms", *Lecturas de Economía*, 76, pp.17-53.

[29] Levin, A. and C. Lin (1993): "Unit Root Tests in panel data: New Results", *Discussion paper No. 93-56*, Department of Economics, University California at San Diego.

[30] Lindbeck, A., and D.J. Snower (2001): "Insiders versus Outsiders", *Journal of Economic Perspectives*, 15 (1), pp. 165-188.

[31] Maddala, G.S and S. Wu (1999): "A Comparative study of unit root tests with panel data and new simple test", *Oxford Bulletin of Economics and Statistics*, 61, pp. 631-652.

[32] Meschi, E., and M.Vivarelli (2009): "Trade and Income Inequality in Developing Countries" *World Development*, 37 (2), pp. 287-302.

[33] Nickell, S. (1981):"Biases in dynamic models with fixed effects", *Econometrica*, 49(6), pp. 1417-26.

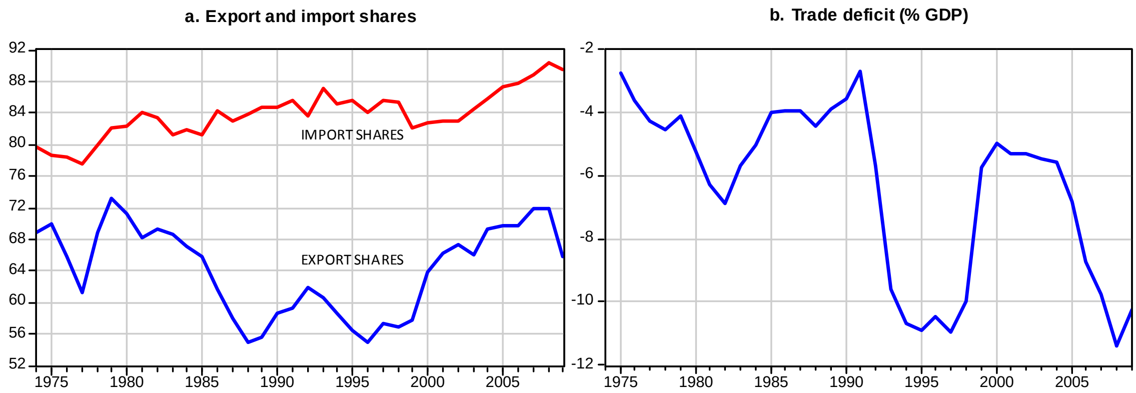
[34] Podrecca, E. (2011):"Labour market institutions and wage setting: evidence for OECD countries ", *Applied Economics*, 43, pp. 3671-3686.

[35] Roodman (2009): "How to do stabond2: An introduction to difference system GMM in Stata", *The Stata Journal*, 9 (1), pp. 86-136.

[36] Summers, L.H. (1989): "Some Simple Economics of Mandated Benefits", *The American Economic Review, Papers and Proceedings*, 79 (2), pp. 177-83.

7 Appendix

Figure A1. Export and import shares, and trade deficit of the manufacturing industry. 1975-2010.



Source: DANE.

Table A1. Sectors of the manufacturing industry.

Sector	Description
S1	Manufacture of food products and beverages
S2	Manufacture of tobacco products
S3	Manufacture of textiles
S4	Manufacture of wearing apparel; dressing and dyeing of fur
S5	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
S6	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
S7	Manufacture of paper and paper products
S8	Publishing, printing and reproduction of recorded media
S9	Manufacture of coke, refined petroleum products and nuclear fuel
S10	Manufacture of chemicals and chemical products
S11	Manufacture of rubber and plastics products
S12	Manufacture of other non-metallic mineral products
S13	Manufacture of basic metals
S14	Manufacture of fabricated metal products, except machinery and equipment
S15	Manufacture of machinery and equipment n.e.c.; and manufacture of office, accounting and computing machinery
S16	Manufacture of electrical machinery and apparatus n.e.c.; and manufacture of radio, television and communication equipment and apparatus
S17	Manufacture of medical, precision and optical instruments, watches and clocks
S18	Manufacture of motor vehicles, trailers and semi-trailers, and other transport equipment
S19	Manufacture of furniture; manufacturing n.e.c.

Note: Classification based on International Standard Industrial Classification, Rev. 3.

Table 5. Estimated wage equation, 1974-1991.

Dependent variable: W_{it}

	OLS				FE				SYSGMM*				SYSGMM**				SYSGMM***	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
W_{it-1}	0.62	0.62	0.63	0.61	0.34	0.34	0.29	0.29	0.49	0.50	0.45	0.48	0.39	0.33	0.50	0.49	0.50	0.51
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.001)	(0.016)	(0.002)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)
W_{it-2}	0.27	0.26	0.23	0.22	0.07	0.07	0.12	0.12										
	(0.001)	(0.001)	(0.004)	(0.005)	(0.105)	(0.101)	(0.001)	(0.001)										
Y_{it}/N_{it}	0.05	0.05	0.06	0.06	0.14	0.13	0.10	0.10	0.21	0.20	0.20	0.20	0.19	0.16	0.19	0.19	0.20	0.20
	(0.009)	(0.004)	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.001)	(0.010)	(0.004)	(0.039)	(0.016)	(0.082)	(0.057)	(0.002)	(0.001)
W_t^{min}	0.18	0.19			0.29	0.29			0.42	0.42			0.49	0.53				
	(0.002)	(0.001)			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)				
ΔW_t^{min}	1.58	1.50			0.84	0.84												
	(0.000)	(0.000)			(0.000)	(0.000)												
ΔW_{t-1}^{min}					0.49	0.50												
					(0.000)	(0.000)												
π_t			-1.32	-1.33			-1.35	-1.37			-0.98	-0.98			-0.72	-0.72	-0.61	-0.59
			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)			(0.001)	(0.002)	(0.001)	(0.001)
$\Delta\pi_t$			-0.24	-0.20			0.37	0.38										
			(0.149)	(0.238)			(0.005)	(0.005)										
$\Delta\pi_{t-1}$							-0.59	-0.59										
							(0.000)	(0.000)										
τ_t^p	0.01	0.01	-0.03	-0.03	0.01	0.01	-0.01	-0.01	-0.03	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
	(0.074)	(0.125)	(0.000)	(0.000)	(0.040)	(0.039)	(0.137)	(0.146)	(0.000)	(0.054)	(0.010)	(0.003)	(0.055)	(0.081)	(0.057)	(0.042)	(0.007)	(0.002)
op_{it}	0.00		0.01		-0.02		-0.03		0.04		0.03		0.04		0.02		0.03	
	(0.373)		(0.187)		(0.040)		(0.000)		(0.035)		(0.165)		(0.120)		(0.496)		(0.047)	
op_{it}^l		0.01		0.02		-0.01		-0.03		0.05		0.04		0.07		0.04		0.05
		(0.025)		(0.001)		(0.061)		(0.000)		(0.006)		(0.107)		(0.001)		(0.210)		(0.010)
op_{it}^h		0.01		0.01		-0.02		-0.04		0.03		0.03		0.03		0.02		0.03
		(0.224)		(0.084)		(0.010)		(0.000)		(0.011)		(0.128)		(0.000)		(0.357)		(0.007)
c	-1.05	-1.05	1.52	1.61	1.24	1.25	4.62	4.66	-0.50	-0.62	3.25	3.04	-0.15	0.17	2.82	2.85	2.66	2.54
	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.100)	(0.020)	(0.000)	(0.000)	(0.827)	(0.807)	(0.000)	(0.000)	(0.000)	(0.000)
$Obvs.$	304	304	304	304	304	304	304	304	323	323	323	323	323	323	323	323	323	323
R^2	0.95	0.95	0.95	0.95	0.98	0.98	0.98	0.98										
J									7	8	7	8	9	10	10	11	8	9
S									1.22	1.42	16.28	17.22	5.12	4.39	6.37	5.90	1.85	2.11
									(0.270)	(0.233)	(0.000)	(0.000)	(0.164)	(0.222)	(0.173)	(0.207)	(0.397)	(0.348)
H									0.37	0.45	3.62	3.93	8.42	8.69	7.10	7.61	1.07	1.19
									(0.545)	(0.501)	(0.057)	(0.047)	(0.038)	(0.034)	(0.131)	(0.107)	(0.587)	(0.552)
$AR(2)$									0.05	0.03	1.50	1.56	-0.12	-0.50	0.96	0.90	0.82	0.79
									(0.963)	(0.980)	(0.132)	(0.118)	(0.906)	(0.618)	(0.336)	(0.368)	(0.413)	(0.427)

Notes: All variables are expressed in logs, except Y_{it}/N_{it}. P-values in parenthesis. OLS: Ordinary Least Square. FE: Fixed Effects. SYSGMM: System GMM. **All explanatory variables are assumed as strictly exogenous. ** τ_t^p is assumed and π_t as predetermined. *** π_t is assumed as predetermined. *J*: Number of instruments. *S* : Sargan test. *H* : Hansen test. *AR(2)* : Arellano and Bond test.

Table 6. Long-run effects, 1974-1991.

	OLS				FE				SYSGMM*				SYSGMM**				SYSGMM***	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
$\xi_{W\_Y/N}$	0.42	0.41	0.40	0.39	0.23	0.23	0.17	0.17	0.40	0.40	0.37	0.38	0.31	0.24	0.38	0.36	0.40	0.40
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.001)	(0.000)	(0.091)	(0.052)	(0.062)	(0.043)	(0.000)	(0.000)
$\xi_{W\_W^{min}}$	1.67	1.52			0.49	0.49			0.82	0.85			0.79	0.79				
	(0.002)	(0.001)			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)				
ξ_{W_π}			-9.44	-8.24			-2.32	-2.33			-1.79	-1.89			-1.43	-1.41	-1.21	-1.22
			(0.000)	(0.000)			(0.000)	(0.000)			(0.033)	(0.020)			(0.015)	(0.022)	(0.013)	(0.016)
$\xi_{W\_\tau^p}$	0.08	0.06	-0.18	-0.16	0.02	0.02	-0.01	-0.01	-0.06	-0.06	-0.05	-0.05	-0.04	-0.03	-0.04	-0.04	-0.04	-0.04
	(0.189)	(0.228)	(0.001)	(0.000)	(0.055)	(0.054)	(0.170)	(0.178)	(0.010)	(0.000)	(0.114)	(0.062)	(0.129)	(0.155)	(0.048)	(0.042)	(0.009)	(0.003)
ξ_{W_op}	0.04		0.05		-0.03		-0.05		0.07		0.05		0.06		0.03		0.06	
	(0.328)		(0.150)		(0.054)		(0.000)		(0.000)		(0.147)		(0.132)		(0.510)		(0.077)	
$\xi_{W\_op^l}$		0.08		0.10		-0.02		-0.05		0.10		0.08		0.10		0.08		0.10
		(0.009)		(0.000)		(0.077)		(0.000)		(0.002)		(0.046)		(0.001)		(0.205)		(0.003)
$\xi_{W\_op^h}$		0.04		0.05		-0.04		-0.07		0.07		0.05		0.05		0.04		0.06
		(0.191)		(0.068)		(0.018)		(0.000)		(0.002)		(0.055)		(0.002)		(0.347)		(0.003)

P-values in parenthesis.

Table 7. Estimated wage equation, 1992-2009.

Dependent variable: W_{it}

	OLS				FE				SYSGMM*				SYSGMM**				SYSGMM***		SYSGMM****	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
W_{it-1}	0.69	0.70	0.66	0.66	0.51	0.51	0.53	0.52	0.45	0.44	0.33	0.32	0.46	0.45	0.31	0.30	0.34	0.33	0.31	0.31
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.006)	(0.014)	(0.011)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.003)	(0.002)
W_{it-2}	0.25	0.25	0.29	0.29	0.16	0.16	0.15	0.15												
	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)	(0.005)	(0.000)	(0.000)												
Y_{it}/N_{it}	0.02	0.02	0.02	0.02	0.05	0.04	0.07	0.07	0.18	0.18	0.22	0.22	0.21	0.22	0.24	0.25	0.22	0.22	0.24	0.24
	(0.085)	(0.131)	(0.100)	(0.125)	(0.017)	(0.019)	(0.002)	(0.002)	(0.009)	(0.009)	(0.003)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.005)	(0.000)	(0.000)
W_t^{min}	0.23	0.24			0.14	0.13			0.26	0.27			0.20	0.20						
	(0.000)	(0.000)			(0.002)	(0.004)			(0.000)	(0.001)			(0.000)	(0.000)						
ΔW_t^{min}					0.85	0.86														
					(0.000)	(0.000)														
ΔW_{t-1}^{min}					0.40	0.39														
					(0.000)	(0.000)														
π_t			-0.67	-0.67			-0.65	-0.64			-1.02	-1.08			-0.98	-1.01	-1.00	-1.04	-1.03	-1.07
			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\Delta\pi_t$			-0.56	-0.56			-0.41	-0.41												
			(0.000)	(0.000)			(0.000)	(0.000)												
τ_t^p	-0.02	-0.02	-0.02	-0.02	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02
	(0.000)	(0.000)	(0.000)	(0.000)	(0.771)	(0.735)	(0.000)	(0.000)	(0.057)	(0.057)	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)
op_{it}	0.00		0.00		0.01		0.03		0.02		0.03		0.03		0.03		0.02		0.03	
	(0.658)		(0.937)		(0.462)		(0.066)		(0.255)		(0.225)		(0.154)		(0.174)		(0.286)		(0.198)	
op_{it}^l		-0.01		0.00		0.01		0.02		0.04		0.06		0.05		0.06		0.05		0.06
		(0.327)		(0.870)		(0.635)		(0.121)		(0.126)		(0.065)		(0.055)		(0.046)		(0.073)		(0.075)
op_{it}^h		-0.01		0.00		0.01		0.03		0.03		0.05		0.04		0.04		0.04		0.05
		(0.357)		(0.904)		(0.384)		(0.052)		(0.113)		(0.073)		(0.057)		(0.044)		(0.079)		(0.077)
c	-1.08	-1.08	0.80	0.80	1.30	1.33	2.45	2.45	1.03	0.97	3.98	3.96	1.16	1.09	3.96	3.89	3.94	3.90	4.00	3.89
	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)	(0.030)	(0.000)	(0.000)	(0.022)	(0.041)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Obvs.$	342	342	342	342	342	342	342	342	342	342	342	342	342	342	342	342	342	342	342	342
R^2	0.97	0.97	0.97	0.97	0.99	0.99	0.99	0.99												
J									7	8	7	8	8	9	9	10	8	9	8	9
S									0.06	0.01	0.10	0.02	0.62	0.53	0.31	0.28	0.25	0.14	0.25	0.26
									(0.814)	(0.908)	(0.750)	(0.880)	(0.735)	(0.766)	(0.958)	(0.963)	(0.880)	(0.934)	(0.880)	(0.877)
H									0.10	0.02	0.09	0.02	0.15	0.11	0.42	0.28	0.75	0.49	0.75	0.18
									(0.754)	(0.880)	(0.758)	(0.892)	(0.926)	(0.945)	(0.935)	(0.964)	(0.687)	(0.781)	(0.687)	(0.913)
$AR(2)$									0.22	0.15	1.07	1.06	0.18	0.09	1.31	1.25	1.07	1.05	1.07	1.37
									(0.828)	(0.877)	(0.283)	(0.291)	(0.858)	(0.925)	(0.191)	(0.211)	(0.283)	(0.295)	(0.283)	(0.171)

Notes: All variables are expressed in logs, except τ_t^p. P-values in parenthesis. OLS: Ordinary Least Square. FE: Fixed Effects. SYSGMM: System GMM. **All explanatory variables are assumed as strictly exogenous. ** Y_{it}/N_{it} and π_t are assumed as predetermined. *** Y_{it}/N_{it} is assumed as predetermined . **** π_t is assumed as predetermined. J : Number of instruments. S : Sargan test. H : Hansen test. *AR(2)* : Arellano and Bond test.

Table 8. Long-run effects, 1992-2009.

	OLS				FE				SYSGMM*				SYSGMM**				SYSGMM***		SYSGMM****	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
$\xi_{W\_Y/N}$	0.42	0.42	0.49	0.49	0.14	0.14	0.20	0.20	0.32	0.32	0.33	0.33	0.38	0.39	0.35	0.35	0.33	0.33	0.34	0.35
	(0.000)	(0.000)	(0.000)	(0.000)	(0.035)	(0.041)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\xi_{W\_W^{min}}$	4.00	4.33			0.41	0.40			0.48	0.49			0.36	0.36						
	(0.055)	(0.088)			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)						
ξ_{W_π}			-13.51	-13.74			-1.98	-1.97			-1.53	-1.59			-1.41	-1.45	-1.51	-1.56	-1.49	-1.55
			(0.076)	(0.097)			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
$\xi_{W\_\tau^p}$	-0.27	-0.29	-0.38	-0.38	0.00	0.00	-0.03	-0.03	-0.01	-0.01	-0.02	-0.02	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
	(0.055)	(0.088)	(0.085)	(0.107)	(0.765)	(0.727)	(0.002)	(0.002)	(0.212)	(0.213)	(0.037)	(0.021)	(0.020)	(0.022)	(0.163)	(0.003)	(0.001)	(0.027)	(0.002)	(0.003)
ξ_{W_op}	-0.03		0.01		0.03		0.08		0.04		0.04		0.05		0.04		0.03		0.04	
	(0.687)		(0.936)		(0.472)		(0.056)		(0.229)		(0.208)		(0.146)		(0.163)		(0.253)		(0.191)	
$\xi_{W\_op^l}$		-0.18		-0.03		0.02		0.07		0.06		0.09		0.09		0.08		0.08		0.09
		(0.467)		(0.877)		(0.640)		(0.109)		(0.133)		(0.073)		(0.066)		(0.049)		(0.067)		(0.080)
$\xi_{W\_op^h}$		-0.12		-0.02		0.03		0.08		0.05		0.07		0.07		0.06		0.06		0.07
		(0.489)		(0.908)		(0.399)		(0.044)		(0.133)		(0.075)		(0.066)		(0.045)		(0.063)		(0.080)

P-values in parenthesis.