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Essays on Unions, Wages and Performance: Evidence from Latin America

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ESSAYS ON UNIONS, WAGES AND PERFORMANCE: EVIDENCE FROM LATIN AMERICA

BY
FERNANDO RIOS AVILA

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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University

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ABSTRACT

Unions are one of the most important institutions in labor markets, and are capable of affecting workers (wages) and employers (performance). Despite the relevance unions have had worldwide, most of the literature has concentrated on the economic effects of unions in the U.S. and other developed countries, with few studies concentrating on what unions do in developing countries.

Because developing countries have contrasting differences compared to developed countries, in terms of economic development, legal settings and institutions, it is possible that conclusions reached in the broader literature might not be appropriate in the framework of developing countries. This dissertation aims to fill this gap in the literature studying the economic effects of unions on wages and performance in selected developing countries in Latin America: Argentina, Bolivia, Chile, Mexico, Panama and Uruguay.

The first essay focuses on the impact of unions on wages distribution in Bolivia and Chile, using the novel Recentered Influence Function decomposition. Although both countries have considerably different levels of economic development and institutions, the estimations indicate unions have similar effects increasing wages and reducing wage inequality at the top of the distribution. These results are similar to those found replicating the methodology using U.S. data. The results suggest that the common economic and political forces that govern the role of unions as collective bargaining units transcend other contextual differences in these countries.

The second essay analyzes the impact of unions on economic performance of establishments in the manufacturing sector in Argentina, Bolivia, Chile, Mexico, Panama and Uruguay. Using an augmented Cobb Douglas production function, the essay finds that unions

have a positive, but small, effect on productivity, with the exception of Argentina. Analyses on alternative measures of performance show that, for most cases, the positive productivity effects barely offset the higher union compensation; that unions show no relationship with sales growth; and that unionized establishments usually reduce investment in capital and R&D. While no single narrative can explain all observed effects across countries, the results provide a step forward to understand the role of unions on economic performance in developing countries.

CHAPTER I

INTRODUCTION

Labor unions are one of the most important institutions that affect the labor market, capable of affecting worker outcomes (e.g., wages) and employer outcomes (e.g., productivity and other performance measures) (Freeman & Medoff, 1984). Unions are worker associations or organizations whose main goal is to improve the well-being of their members, which translates into higher wages, improved working conditions, and better employment protection. Unions are able to achieve these objectives through monopolistic bargaining rights, defined by law, which allow them to negotiate collective bargaining contracts for covered establishments. As the empirical literature indicates, through a combination of their role as monopolistic agents, their use of collective contracts and their intervention in the internal labor markets of the establishments, unions are able to raise wages of their members (Fuchs, Krueger, & Poterba, 1998; Jarrell & Stanley, 1990; Lewis, 1963, 1986), while also reducing wage dispersion among their workers (Freeman & Medoff, 1984; Freeman, 1980, 1982; Card ,1996,2001).

Unions also affect establishment performance. As workers' bargaining agent, unions may not only increase wages, but also create distortions in the production process, reduce managerial discretion, limit the adoption of new technologies, and affect establishments' investment and productivity. On the other hand, unions can potentially increase productivity by improving communication within establishment, lowering some labor related costs, and possibly lead management to adopt more effective personnel policies and methods of production, reducing so called "X-inefficiencies" (Freeman & Medoff, 1984). While most of the literature agrees that

unions have mostly negative effects on establishments' profitability and investment (Doucouliagos & Laroche, 2009, 2013; Hirsch, 1992), there is far less consensus on the effects unions have on productivity, with surveys or meta analyses tending to conclude that net effects on productivity, while variable, are on average near zero or slightly positive, but insufficient to offset higher compensation costs (Aidt & Tzannatos, 2002; Doucouliagos & Laroche, 2003; Hirsch, 2004).

The role of unions in labor markets has received plenty of attention by labor economists. There is a large literature that has studied the impacts of unions on wages and establishment performance for the U.S. and other developed economies, which arguably have similar economic and institutional settings. The literature, however, is limited regarding the role of unions in the framework of developing countries. Because developing countries are often characterized as having high levels of poverty, high inequality, weak institutions, high levels of corruption, large informal sectors, unstable business environments and less competitive markets, it is possible that effects typically associated with unions in the larger literature might not be applicable for developing economies.

As Freeman (2010) indicates, while some of the emerging studies in developing countries have found results similar to the broader literature, others have shown results that are difficult to reconcile with the broader union literature. Though some of the differences can be explain by unions' weakness and inability to fulfill their role as collective bargaining units, it is also possible that these differences can be explained by the economic and institutional characteristics of developing countries. However, because these studies differ not only with respect to the countries being analyzed, but also in their data and methodological strategies, the differences in results might not provide an accurate picture of differences in union effects. This dissertation

aims to expand the literature on unions in developing countries, providing new empirical evidence on the effects of unions on wage distributions (worker outcomes) and establishment performance (business outcomes), using standardized survey data for developing countries in Latin America.

The first essay of this dissertation focuses on the impact unions have throughout the wage distribution for two neighboring countries: Bolivia and Chile. These countries have contrasting characteristics in terms of the legal framework, poverty, income inequality, informality and economic development, with Chile being at a higher level of development than Bolivia. Using individual level data from the 2000 to 2009, the novel Recentered Influence Function Decomposition proposed in Firpo, Fortin and Lemieux (2007) is used to determine the impact unions have on wage premiums and inequality. Despite the fact that both countries have different economic and institutional settings, the results presented here indicate that unions have similar effects on the wage distribution, with an observed wage gap between 0.11 and 0.14 log points and a reduction of within wage inequality between 8 to 20%. These effects are comparable to those seen for the U.S., using similar data and methods. The results suggest that a combination of union governance and political economy, coupled with product and labor market forces, result in similar union-wage impacts that transcend other economic differences.[1]

The second essay focuses on the impact of unions from the employer perspective, studying the effects on performance at the establishment level across six Latin American countries: Argentina, Bolivia, Chile, Mexico, Panama and Uruguay. These countries are characterized as having historically strong unionized sectors that have had important roles on the development of their political and economic systems, and present a mixture of settings with different legal backgrounds and levels of economic development. Using standardized data from

[1] A shortened version of this essay is also available at Rios-Avila and Hirsch (forthcoming).

the World Bank Enterprise Surveys for 2006, this essay analyzes the effect unions have on performance with emphasis on productivity per worker. Although the data set provides rich information regarding establishments' characteristics, production cost structure and investment climate, there is substantial nonresponse on items of sensitive nature (e.g., investment). In order to overcome this limitation and improve the completeness and reliability of the data, a multiple imputation approach is used prior to estimation of the models.

Using an augmented Cobb Douglas production function, and multiple controls for establishment characteristics, the results indicate that unions have positive, but mostly small and not significant, effects on productivity, with the exceptions of Argentina, where establishment union coverage and productivity have a strong negative relationship, and Bolivia, where the data show no relationship with productivity. The analysis on profitability reveals that the boosts in productivity are not large enough to offset higher union production costs, with profitability more likely to be lower in unionized establishments. The results also indicate that unionization is not correlated with sales growth, and, with exceptions, are mostly negatively related to measures of investment and innovation. As with the evidence on wages, results from Latin America on unions and performance align reasonably well with evidence found for the U.S. and other developed economies.

CHAPTER II

UNIONS, WAGE GAPS AND WAGE DISTRIBUTIONS IN DEVELOPING COUNTRIES: CASE STUDIES FROM LATIN AMERICA

Introduction

Most of the empirical literature on union wage effects in developed countries agrees on two results. First, unions increase wages of union members, creating a wage differential with otherwise similar nonunion workers (referred to throughout as the union "gap") (Fuchs, Krueger, & Poterba, 1998; Jarrell & Stanley, 1990; Lewis, 1963, 1986). Second, unions reduce wage dispersion among their members, both within and across unionized establishments as compared to their nonunionized counterparts (Freeman & Medoff, 1984; Freeman, 1980, 1982; Card 1996, 2001).

The union wage literature traditionally explains these effects by emphasizing the role unions play as monopoly bargaining agents. In this role, unions are capable of creating a wage gap by generating a monopoly rent, if they have enough coverage of the work force. The literature also emphasizes the collective voice/institutional response face of unions, as they redirect their monopoly power into improving communication and reducing transaction costs in the internal labor markets (Freeman & Medoff, 1984; Kaufman, 2004). Unions are also known to affect wage distributions through the use of collective bargaining, adoption of formalized labor contracts and homogenization of the unionized labor force, which tend to standardize wages and reduce wage dispersion in the workplace (Freeman, 1980; Lewis, 1963).

Even though the literature on unions is large, most of it has focused on the U.S. and other developed economies, which arguably possess strong institutions, similar economic

environments, and roughly equivalent levels of economic wealth. If these aspects affect the role and strength unions have on the labor market, it raises the possibility that some of the conclusions typically found in the literature might not apply to other type of economies. Because developing countries are typically characterized by high levels of poverty, high inequality, weak institutional backgrounds, and large informal sectors and less competitive markets, it is possible that effects previously seen in the literature might not be applicable for these economies.

Although some of the emerging literature on unions in developing countries has found results similar to the broader literature (Freeman, 2010), some findings differ from those in developed countries. For instance, some of this literature finds union wage premiums that are much lower or higher than those found in developed countries, while others indicate that unions increase wage inequality among union workers (Arbache, 1999; Cassoni, Labadie, & Fachola, 2005; Schultz & Mwabu, 1998). While some of the observed differences in this literature can be explained by the weakness of unions in developing countries,[2] it is also possible that the wage effects are driven by other intrinsic characteristics of developing countries. Because these studies differ not only on nature of the countries analyzed, but also in their methodological strategies, differences in results across studies might not provide an accurate picture of the differences in union economic effects across countries.

This paper aims to provide new evidence on the impact that unions have on wage gaps and inequality using data for two neighboring countries in Latin America that are at different stages of economic development: Bolivia and Chile. These two countries, both characterized as having historically strong union organizations (Alexander & Parker, 2005; Ulloa, 2003), currently have similar rates of unionization in their formal labor markets (13%-14%). At the

[2] Freeman (2010) suggests the unions in developing countries are relatively weak compared to traditional unions because historically they have been primary involved in political activity rather than focusing on their role in collective bargain.

same time, they have contrasting characteristics in terms of the legal framework, poverty, income inequality, informality and economic development, with Chile being at a higher level of development than Bolivia. In this framework, this paper will provide some evidence on whether these differences affect the economic effects unions have on wages.

To analyze the effect of unions on the wage distribution, the novel Recentered Influence Function (RIF) decomposition introduced in Firpo, Fortin and Lemiux (2007) is applied to identify the overall and detailed decomposition of the raw union gaps, both in terms of wage and inequality gaps. Union wage gaps are identified at the mean and along the distribution (quantiles), while the effects on wage inequality are identified using the variance and interquantile union gaps.

The results indicate that despite the differences in economic settings, unions have similar impacts on the wage distributions in both countries, with magnitudes comparable to those found in the literature for developed countries. Controlling for worker and job characteristics, the estimations indicate average union wage gaps between 0.114 and 0.143 log points. The results also indicate that unions in both countries have a relatively homogenous impact across the wage distribution, except for decreases in the wage gaps in the upper tails of the distribution. In terms of wage inequality, unions have the potential to reduce log wage variance among union workers by up to 20%, while a more modest decrease is observed using the 90-10 interquantile difference (7%-8%). The results also indicate that most of the wage compression is located at the top of the distribution. Based on the detailed decomposition, unions appear to affect the overall wage structure similarly in both countries, with the exception being the effect on gender wage gaps. A replication of the methodology using U.S. data for 2007-2008 reveals that the pattern of union

effects found for Bolivia and Chile are broadly comparable to the pattern in the U.S., with the main difference being a higher average union wage gap (0.189) in the U.S.

The rest of the chapter is structured as follows. Section 1 presents a brief review of the literature on the effects of unions on wage distributions. Section 2 provides a description of the background, characteristics and legal framework of Bolivia and Chile. Section 3 describes data sources. Section 4 describes the methodological strategy, identifying its advantages and limitations. Section 5 presents the results and section 6 concludes.

1. How do unions affect wages?

By definition, unions are associations of employees whose main goal is to improve the well-being of their members. Their nature is defined by law, which provides them with monopoly bargain rights within covered establishments, allows them to organize and represent their members, and gives them the ability to negotiate collective contracts on their behalf that in turn affect the level and distribution of wages and benefits.

Freeman and Medoff (1984) describe two approaches that are commonly used to explain how unions affect wages in the labor market. The traditional microeconomic view is to consider unions as maximizing monopolistic agents that use the rights granted by law to obtain market power controlling the supply of labor, in the extreme doing so through the use of strikes or strike threats. They use this market power to raise wages and benefits for their members above competitive levels, extracting rents from employers (owners), with a likely tradeoff between wages and employment (membership). Lower profits in the long run may make firms unsustainable in competitive markets. Hence, unions are unlikely to maintain both above-competitive wages and employment in the long run absent either offsetting positive productivity

effects or if they operate in industries with heterogeneity in their (non-labor) cost structure (Hirsch, 2008). Such companies can survive in less competitive environments in which higher costs can be passed through to consumers.

In contrast to unions' monopoly face, their collective voice/institutional response (CV/IR) face emphasizes the role of unions as agents capable of improving communication between workers and employers and mitigating market imperfections and frictions at the establishment level, possibly providing higher wages associated with gains in technical and/or economic efficiency. In Freeman and Medoff's view, unions can benefit the workplace by providing "voice" to workers that can enhance the communication of workers' demands to employers, improving working conditions and contractual arrangements. At the same time, unions are able to monitor and enforce explicit (and to a lesser extent implicit) contracts between their members and employers, which can benefit employers as well as workers. And unions may help reduce potential costs associated with opportunistic behavior caused by incomplete contracts (Kaufman, 2004).

There is a strong consensus in the empirical literature that union wage gaps fall in the range of 10%-20% (Fuchs, Krueger, & Poterba, 1998; Jarrell & Stanley, 1990; Lewis, 1963, 1986). There are, however, discrepancies in the interpretation of such gaps in the presence of selection bias, omitted variables, and data quality issues. Freeman and Medoff (1984) and Hirsch and Addison (1986) report that cross-sectional estimates of union wage gaps tend to be higher (15%-25%) than longitudinal estimates (10%-16%). Lower longitudinal estimates, however, are also explained by the attenuation bias cause by measurement error with respect to changes in union status (Freeman, 1984). Hirsch (2004a) and Hirsch and Schumacher (2004) also show that the inclusion of imputed earners substantially understates the estimations of union wage gaps

because union status is not a match criterion used to assign donor earnings to earnings non-respondents. Studies that tried to correct for selection following Heckman-Lee type of models (Duncan & Leigh, 1980; Hirsch & Berger, 1984; Lee, 1978; Robinson, 1989), have been criticized in the literature due to the volatility of their estimations and arbitrary exclusion restrictions (Freeman & Medoff, 1984; Lewis, 1986) and their reliance on a single selection correction term that fails to account for two-sided selection (Card 1986).

Unions also affect wage dispersion, in at least three ways (Freeman, 1980; Lewis, 1963). First, even if unions increase wages by the same proportion (say 15%) throughout the distribution, with no effect on wage inequality among union members, this can increase or decrease economy-wide wage dispersion depending on where union workers are located in the overall wage distribution. If union workers tend to have lower (higher) than average wages, their wages would be pushed toward (away from) the mean, effectively reducing (increasing) overall wage dispersion.

Second, according to the standardization hypothesis of Freeman (1980), unions should be able to standardize wages within and across firms and establishments by reducing management discretion over compensation and by reducing returns (flatter β's) from observed characteristics such as education, experience or tenure. This might cause wage profiles to be flatter, with low-skill workers (high-skill) obtaining the highest (lowest) wage gaps, compressing wages toward the mean.

Finally, unions might affect wage dispersion by attracting a more homogenous set of workers. Higher homogeneity in the union worker pool can be expected because unions form in specific types of occupations and industries that require certain kinds of workers. Selection on unmeasured characteristics could also occur because workers with the highest skill level are less

likely to seek union jobs due to low union premiums, but also because employers will try to avoid workers with low skill sets (Abowd & Farber, 1982; Card, 1996; Hirsch, 1982; Hirsch & Schumacher, 1998). In both cases, the union workforce would be relatively homogenous in measured and unmeasured characteristics, leading to lower wage dispersion among union workers, even absent substantial effects on average wages.

The empirical literature on unions and wage inequality is in general agreement that unions reduce wage inequality, not only within the union sector, but also across the whole labor market. Freeman (1980, 1982), introducing a two-sector framework to analyze the impact on wage dispersion, finds that unions compress wage differentials across different demographics and skill levels generating a large and negative effect on within wage inequality, which is large enough to offset the increasing between sector dispersion effect. These results are consistent, albeit smaller, after controlling for individual fixed effects (Freeman, 1984). Subsequent literature (Card, 1996, 2001; Card, Lemieux, & Riddell, 2004; Hirsch, 1982; Hirsch & Schumacher, 1998) have also found that unions reduce wage inequality, mainly compressing wages from top to bottom, indicating that the long-run decline in private sector union density might be one of the main factors explaining the increasing wage inequality observed across time. Nevertheless, studies such as Lemieux (1998) and Card (1996) emphasize that controlling for unobserved heterogeneity reduces the equality enhancing effects of unions.

Unions in developing countries

The literature on the economic effects of unions in developing countries is limited. As Freeman (2010) states, one of the reasons for the sparse literature is the limited availability of adequate information. He also emphasizes that unions in developing countries are often "weak" because they are typically more involved with political activities than collective bargaining.

Although some results found among studies in developing countries fall within the standards of the literature, there are others that show rather different conclusions, as discussed below.[3]

Shultz and Mwabu (1998), analyzing survey data for South Africa in 1993, use a quantile regression approach to estimate the heterogeneity in union wage gaps. The authors report that African union workers could earn between 145% to 19% more than comparable nonunion workers, whereas for white workers the wage gaps were much lower, from 21% to -24%. Vallee and Thomas (1996) (Ghana), Terrel and Svejnar (1989) (Senegal) and Verner (1999) (Zimbawe), all report negative union wage gaps which, according to Freeman (2010), could be explained because these might not be standard unions but, rather, political worker fronts that are suffering from political pressures. Although reporting positive union wage gaps, studies such as Cassoni, et al. (2005) for Urugu, et alay, Arbache and Carneiro (1999) for Brazil and Lee and Na (2004) for Korea show relatively low union wage gaps, below 10%, that could be attributed to the weakness of the unions. These sets of results are suspicious since the reported wage gaps seem to be either too large to allow for unions to be sustainable, or too small to gather worker's support needed to maintain their existence as a collective bargaining unit.

As for unions and inequality, most of the literature in developing countries finds that unions reduce wage dispersion. Arbache (1999), however, who analyzes wage dispersion in Brazil for the early 1990s, finds that unionism, specifically in manufacturing, is positively correlated with higher wage dispersion. The author argues that it could be related to unmeasured heterogeneity across union workers in different sectors.

In general, although some findings for developing countries (not summarized here) are similar to those found in the U.S. literature, others show important differences that could be related to inherent characteristics of their economies. Unfortunately, the evidence is insufficient

[3] For a more comprehensive review of the literature refer to Freeman (2010)

to determine if the variation across studies is a consequence of institutional and economic differences between countries or a consequence of different strategies used across studies.

This paper will contribute to the literature in two respects. First, it will provide new evidence on two aspects of the effects of unions on wages, namely union wage gap and wage distribution effects, for two developing countries, Bolivia and Chile. To the best of my knowledge, there is no formal analysis that has been done for this topic in Bolivia, while only one other study exists for Chile (Landerretche, Lillo, & Puentes, 2011). Second, it will provide evidence whether institutional and economic differences have an important role on how unions affect wage distributions. This will be done by controlling for the same methodology and type of information in both countries, in order to reduce the effect that methodological differences could have on the estimation of union effects.

2. Unions in Bolivia and Chile: Background

Bolivia and Chile are neighboring countries located in South America. Both having been Spanish colonies, they share much in common in their history and heritage, yet they have followed different paths of economic development (Barrientos Quiroga, 2010). These countries inherited from their colonial past an extractive and agricultural economy, which marked the early development of their economies and their labor organizations. They both suffered periods of dictatorship and debt crises that affected their economic development from the 1970s through the early 1990s, during which unions, acting outside the law, played a crucial role representing, organizing and defending the working class against the dictatorship (Alexander & Parker, 2005; Ulloa, 2003). Union participation in political activities, however, may have weakened their

capacity to fulfill their role as workers' collective bargain agent in the labor market (Freeman, 2010).

After the debt crisis in the 1980s, both countries tried to promote the development of their economies following policies of industrialization, increased labor flexibility, reduction of the public sector and promotion of open market economies (Edwards, 1989). Chile was relatively successful in supporting a stronger industrial sector and creating well-functioning institutions that facilitated transition to a largely free market economy. Bolivia, in contrast, was less successful in establishing an environment supporting the transition to a free market economy and in creating an industrialized economy. These differences had an important impact on their economic growth and development. After more than 20 years of the debt crisis, Chile become one of the largest economies in the region, with a GDP per capita in 2009 of $6,077 (in U.S. dollars), which is almost six times the GDP per capita in Bolivia ($1,203), according to the World Development indicators (2011). With respect to poverty, while only 15% of the population in Chile is below the poverty line, more than 60% of the population in Bolivia is under that condition.

The differences that marked their economic success also had a profound impact on role unions have on their respective labor markets, on their ability respond to the changing economic settings and their capacity to engage and negotiate as collective bargaining units. In the following subsections a brief summary on the history of unions in each country is presented, followed up by a review of the legal background. In the final section, some hypotheses of the possible effects that the differences in the economic and institutional settings have on the role of unions are discussed.

2.1. Union history in Bolivia and Chile

Bolivia

According to Hudson and Hanratty (1991) and Carriere, Haworth and Roddick (1989), unions in Bolivia can be considered one of the most powerful and politically active set of unions in Latin America. Most of its power came from organized labor in the mining sector, the largest sector in the economy. Its figure of power is represented by the Central Obrera Boliviana (COB), which is a union confederation that centralizes and organizes the collective demands of unions in the country. Originally founded in 1952, it was created as a subordinate group of the Movimiento Nacionalista Revolutionario (MNR) to help organized the mining sector. Due to the growing power of the COB as labor unions' representative and coordinator, it became an autonomous institution that became the main opposition to the Bolivian state (Hudson & Hanratty, 1991; Mansilla, 1993), even when unions were forced to operate as clandestine institutions during the period of dictatorship (1971-1981).

The power held by labor unions, represented by the COB, reached its maximum during 1982-1985, a period marked not only by one of the worst economic crises to affect Bolivia, but also by large numbers of strikes, stoppages and diminished productivity. This period also marked the downfall of unions, which slowly lost public support as the economy deteriorated. By the end of 1985, a new economic model was followed, stopping the crisis, promoting the restructuration of the economy and the decentralization of the mining sector, deeply affecting the already weakened COB. Subsequent attempts from the government to restructure and decentralize the health care and education sector were successfully stopped by the intervention of the COB and other organized labor sectors. Despite their diminished power, organized labor remained a considerable political force in the creation of economic policies in the country. Still,

little is known about its role as a relatively decentralized bargaining agent at the workplace level throughout the Bolivian labor market. Following the entrance of a socialist/populist party to the government in 2006, a more active participation of unions in the economy was expected but, to date, their effects have not yet been observed.

Chile

The Chilean labor movement is one of the oldest in Latin America, being perhaps the first to organize nationwide and to obtain legal concessions from the State (Carrière, et al., 1989; Ulloa, 2003). Its growing power in the economy generated a process of selected repression from the government, which opted to create parallel organizations to support their policies. By 1936, the Confederacion de Trabajadores Chilenos (CTCH) would be created to organize and represent labor unions in the country, becoming a key ally for the government party until 1946, and years later it would be replaced by the Central Unica de Trabajadores (CUT). Although their primarily function was to support the political party in power, both the CTU and CTCH would constantly negotiate for better social protection, wages and working conditions.

The military coup of 1973 marked the restructuring of labor unions. Seeing the weaknesses of previous union-government alliances, the rights of association were eliminated and their leaders persecuted, leaving little if any space for the formation of new labor organizations. The Plan Laboral dictated in 1979 became one of the most important steps in the transformation of labor organizations and unions in Chile, reestablishing the rights of association and reintroducing bargaining rights, forbidding industry-wide bargaining, but allowing the formation of unions by firms, establishments, and among independent and transitory workers. These policies stimulated the creation of new types of unions focusing collective bargaining at a more decentralized level. At the same time, the military imposed a number of political and

economic changes ordering the opening of the economy to foreign trade, constraining public expenditures, and generating incentives to promote productivity and investment. This adaptation of the new economic model, market driven, seemed promising until the crisis in the 1980s. A decade later, when Chile was able to return to democracy in 1990, a new representation for organized labor was created, the *Central Unitaria de Trabajadores* (CUT), which constitutes the main representative and organization of the unions through today, playing an important role in organizing claims against the state. After the 1990s, nonetheless, the cannon of union structure changed, which resulted in a decline of affiliation to labor unions and the creation of a larger number of unions smaller in size, following a more decentralized bargaining system.

2.2. Legal framework

As of today, Bolivia and Chile have both ratified the International Labor Organization (ILO) conventions 87 (freedom of association and protection of right to organize) and 98 (right to organize and collectively bargain). The first convention guarantees all workers the right to form unions of their own choice and for employers to form employers' organizations, while the second provides the right of unions to negotiate work conditions in behalf of workers, protecting them against acts of anti-union discrimination.

Although both countries have ratified these standard conventions,[4] there are differences in the extent to which these standards are guaranteed in both countries. According to the OECD (1996) report, although there are some restrictions to the formation of unions, it is relatively easy to establish independent union organizations in Chile. They do not have noticeable restrictions on strikes and have an adequate enforcement and protection system for anti-union discrimination and collective bargaining. In Bolivia, the restrictions on association and union formation are relatively more significant, with political interference more widespread. Legal strikes are highly

[4] Bolivia ratified these conventions in 1965 (c87) and 1973 (c98), while Chile ratified them much later in 1999.

constrained (requiring 75% support) and general and solidary strikes are considered illegal, and even though discrimination against unions is prohibited, protection is considered inadequate and slow, mostly due to deficiencies related to enforcement (Ronconi, 2012).

According to the Labor Law in Bolivia, collective contracts constitute an agreement between an employer(s) and a union(s) in order to determine general work conditions. These contracts are binding for any current or future union member hired in the workplace, but are not mandatory for nonunion workers in the workplace. To be recognized, however, these contracts must be negotiated by unions that are recognized and approved by the *Ministerio de Trabajo* (Department of Labor). In Chile, collective bargaining and contracts are also recognized, but they can be negotiated by a group of workers regardless of their affiliation. Nonunion workers can benefit from union collective contracts only after complying with the costs of affiliation to that union. Collective bargaining, however, is prohibited in public institutions where more than 50% of the budget is financed by the state. Union contracts can include negotiated agreements on working conditions, as long as they do not limit employers' abilities to organize, direct and manage the establishment or firm.

The Bolivian law recognizes the rights of association to unions in different levels: workers or employers in the same firm, or in the same profession or occupation, or within different firms or occupations that are similar or interconnected. Public officials are not allowed to organize into unions, regardless of their condition. A union can be formed with at least 20 workers in case of professional or craft-based unions, or at least 50% of the workers in the case of unions within establishments or firms. As mentioned previously, for a union to be recognized, they must submit a request to and be approved by the Department of Labor, which has final authority as to whether or not a union is legally recognized. Unions are allowed to form

federations or confederations in benefit of their common interests, with legal recognition contingent on approval by the Department of Labor.

In Chile, the Law recognizes that all workers in the private sector and public firms have the right of free association in unions. To be recognized, these unions do not need any previous authorization, as long as they follow the statements dictated by law. Unions, as institutions, are also free to affiliate or disaffiliate to federations or confederations, either national or international. The law defines and recognizes four types of unions: Single-establishment unions, multiple-establishment unions, unions for independent workers, and unions for temporary workers. Single-establishment unions require a minimum of 8 workers to establish a union. In case of larger establishments (50 or more workers), multi-establishment unions, and unions for independent and eventual workers, at least 25 workers are required for the formation of unions.

2.3. Legal, economic and institutional settings and their effect on unions

In the previous subsections, a brief summary of the historical and legal background has been provided to describe the environment under which unions developed in both countries, and the effects that these settings could have on their roles in the labor market. Overall three broad conclusions can be reached. First, due to their historical and legal background, the bargaining system in Chile became highly decentralized (O'Connell, 1999), while a mixed bargaining system seemed to prevail in Bolivia, with bargaining allowed at different levels (unions, federations and confederations). A according to O'Connell (1999), more decentralized bargaining systems can improve productivity by internalizing tradeoffs between higher wages and changes in work rules and/or increased effort.[5] Due to lower coordination, however, decentralized systems can increase wage inequality compared to more centralized systems.

[5] Vergara (1998) describes that in many instances unions negotiate wage increases and benefits linked to specific productivity targets.

Nevertheless, extreme decentralization, or fragmentation as described in Anner (2008) and Caraway (2006), can potentially reduce bargaining power, creating smaller unions with little leverage for negotiation. Second, the legal structure in Bolivia provides unions with monopolistic power to engage in collective bargaining, which could have enhance their bargaining leverage. In comparison, unions in Chile might be relatively weaker because nonunion organizations can also negotiate collective contracts. And third, because restrictions and state intervention on the formation of unions are relatively stronger in Bolivia compared to Chile, a stronger and more wide-spread presence of unions in Chile than in Bolivia is expected, due to a lower cost of forming a union.

There are other factors that can further describe the strength unions have in their labor markets. As suggested by Dessy and Pallage (2003), the combination of relatively high levels of inequality, Bolivia with a Gini index for family income of 0.56 in 2008 and Chile 0.52 in 2009 (World Development Indicators 2011), and high levels of poverty (especially in Bolivia) have pushed the economic structure of these countries toward substantial dependence on sizable informal sectors. Gasparini and Tornaroli (2009) estimate that about 65.5% of the workforce in Bolivia was informal in 2002, compared to 37.5% in Chile in 2003.[6] As Anner (2008) describes, workers in the informal sector are difficult to organize because they do not have traditional employment relationships, and when they do, they are typically employed in small establishments that cannot unionize.[7] In this sense, larger informal sectors, as observed in Bolivia, are likely to be associated with less leverage for unions.

[6] In their study, a worker is defined as informal if (s)he is an unskilled, self-employed, salaried worker in a small private firm or a zero-income worker.

[7] This does not imply that unions in the informal sector do not exist. In fact, there are labor organizations in the informal sector, but their role in the labor market is different from traditional labor unions.

Other labor market institutions can also affect the strength and density of unions in the labor market. Checchi and Lucifora (2002) argue that economic settings that recognize and protect the rights of associations, and enable unions to offer benefits and services that the market does not provide, can create an environment for stronger and more widespread unions. Chile, for instance, offers unemployment insurance that reduces the potential benefits of job stability offered by unions, in contrast to Bolivia where no unemployment insurance is offered. The larger informal sector in Bolivia provides a partial substitute for unemployment insurance, also reducing the strength of their unions.

In terms of protection, both countries have ratified the ILO conventions on freedom of association. Chile, however, seems to be in a better position than Bolivia in terms of the perception and protection of workers' rights of association, suggesting the existence of stronger unions. For instance, according to the information reported in Ronconi (2012), during the 2000s, Chile had about twelve times more inspectors per worker than did Bolivia. In addition, according to the Worldwide Governance Indicators (2011), Chile ranked in the 74^{th} and 87^{th} percentiles in terms of voice accountability and the rule of law in 2009, much better performance than seen in Bolivia who ranked in the 47^{th} and 13^{th} percentiles.[8]

Overall, most of the economic, legal and institutional settings seem to indicate that unions in Chile should be stronger and more widespread than in Bolivia, which might also translate into higher earnings (union wage premiums). Still, some characteristics favor Bolivian unions. Ultimately, whether or not different economic and institutional settings affect the impact unions have on wages is an empirical question that this paper will aim to answer.

[8] Voice and accountability reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association and free media. Rule of law reflects perceptions on confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

3. Data and summary statistics

This paper uses two principal sources of information. For Bolivia, Household Surveys for the years 2002 through 2009 are used.[9] These surveys are collected annually by the National Institute of Statistics, where the samples are drawn based on the information from the Census 2001.[10] For Chile, the data used comes from the Social Protection Surveys for the years 2002, 2004, 2006 and 2009.[11] These surveys were created to obtain a panel that collects detailed data on job characteristics and job history information for one person in each household, who is followed across years.[12] These surveys are also nationally-representative.

For both countries, the surveys are pooled across years to provide more information for the analysis. Because the surveys from Bolivia are not completely independent from year to year, and the ones from Chile have a panel component, pooling information together creates a downward bias on the standard error estimates, but should not bias coefficient estimates (see Cameron & Trivedi, 2005). To provide a representative sample of the labor force that can potentially be unionized, the sample is restricted as follows. The analysis includes employed adults in the private sector (i.e., public administration is excluded), between 21 and 65 years old, whose occupation can be classified as salaried and hourly workers. It excludes jobs classified as self-employed, family workers and employers, as well as workers in the agricultural sector.

[9] These surveys were collected through the *Program for the Improvement of Surveys and the Measurement of Living Conditions in Latin America and the Caribbean (MECOVI* in Spanish) with the cooperation of the World Bank until 2004. Since 2005 it has been independently carried out by the national statistical office (INE). This initiative promotes the collection of adequate and high quality information about the living conditions of people in the region. The 2002 survey is better known as *Encuesta de Mejoramiento de Condiciones de Vida 2002*. The 2003-2004 is the *Encuesta Continua de Hogares.* And since 2005, they are denominated *Encuestas de Hogares*. All surveys can be access from the following website: http://www.ine.gob.bo/enchogares/enchogares.aspx.

[10] Due to the survey design, same areas, and in some cases households, are interviewed more than one year, generating an underlying correlation across years.

[11] These surveys were collected to obtain information of the labor market and the social protection system in Chile using longitudinal information. They were collected by the Universidad de Chile, and kindly provided by the Subsecretaría de Previsión Social in Chile.

[12] The survey for 2002 was originally structured to represent workers that were once affiliated to the pension system. Starting with the 2004 survey, they included a sample representing the labor force outside of the pension system.

Workers in the army and extraterritorial organizations are also excluded from the analysis. The final samples contain 9,614 and 17,182 individuals for Bolivia and Chile, respectively.

For the dependent variable, average wages per hour, measured by monthly labor earnings divided by average hours worked in a month, is used. Wages are measured in local currency and are adjusted by inflation using year 2009 as the base year. This measurement corresponds to self-reported earnings of the primary job only, and includes tips, commissions and overtime, but do not include other services or compensation such as health insurance. Based on the methodological description of the surveys, the rates of item nonresponse are negligible and should not affect the estimates (Hirsch and Schumacher, 2004). Following Freeman (1981) and Olson (2002), ignoring non-wage compensation such as health insurance might understate estimates on the impact of unions on total compensation, but because this information is not available in the surveys, this paper will only consider direct effects on labor earnings.

In both surveys individuals self-report if they are members of unions or other labor organizations, information that is used to classify workers by union status. Although this measure of membership does not necessary imply coverage by collective contracts, in absence of an alternative measure, the assumption is that they are covered. As mentioned in Hirsch (2004a), self-identification could attenuate estimates due to measurement error, but, with the available information, it is not possible to assess the severity of the bias.[13]

[13] As stated in Freeman (1984), measurement error bias is of particular interest in case of longitudinal studies, with less severe consequences for cross sectional ones.

Table 1. Descriptive Statistics

	Bolivia			Chile		
	Union	**Non union**	**Diff**	**Union**	**Non union**	**Diff**
Ln Wages/h	1.96	1.69	**0.27**	7.41	7.18	**0.24**
	(0.83)	(0.81)	**[10.81]**	(0.59)	(0.63)	**[17.93]**
Hrs week	52.12	50.26	**1.86**	46.78	46.15	**0.63**
	(20.01)	(18.17)	**[3.08]**	(10.55)	(10.93)	**[2.70]**
Sex	0.84	0.71	**0.12**	0.71	0.63	**0.07**
	(0.37)	(0.45)	**[10.80]**	(0.46)	(0.48)	**[6.94]**
Indigenous	0.25	0.19	**0.06**			
	(0.43)	(0.39)	**[4.59]**			
Yrs. Schooling	11.01	10.67	**0.35**	12.00	11.63	**0.38**
	(4.59)	(4.50)	**[2.48]**	(2.78)	(3.15)	**[6.02]**
Kids 0-6yr	0.81	0.77	**0.04**	0.43	0.46	**-0.02**
	(0.92)	(0.92)	**[1.37]**	(0.66)	(0.68)	**-[1.6]**
Kids 7-17yr	1.17	1.10	**0.07**	0.83	0.73	**0.09**
	(1.32)	(1.25)	**[1.79]**	(0.95)	(0.91)	**[4.41]**
Married	0.78	0.65	**0.14**	0.62	0.54	**0.08**
	(0.41)	(0.48)	**[10.72]**	(0.48)	(0.50)	**[7.35]**
Head Household	0.74	0.56	**0.18**	0.63	0.54	**0.09**
	(0.44)	(0.50)	**[12.98]**	(0.48)	(0.50)	**[8.19]**
N	1456	8158	9614	2473	14709	17182

Year	**Union Density**	**Union Density**
Average	12.9%	13.8%
2002	14.7%	10.9%
2004	11.1%	13.1%
2005	12.2%	
2006	12.7%	14.3%
2007	16.4%	
2008	12.3%	
2009	11.5%	16.3%

Note: Standard deviations in parenthesis. T-statistics are shown in brackets. Statistics shown in this table are calculated using the corresponding sample weights. Detailed information on unionization rates and market structure with respect to industry and occupation can be found in the appendix, Table A1.

Table 1 presents weighted sample means of the main explanatory variables using union classification for both countries. Bolivia and Chile show similar union density averages of 12.9% and 13.8%, respectively. Chile has experienced increasing unionization over time, while in Bolivia union density appears stable, although estimates vary from year-to-year due perhaps to modest sample sizes and survey sample frame differences in 2002 and 2007. In Bolivia and Chile, union workers receive a higher wage per hour, showing raw wage gaps of 0.272 and 0.236 log points for Bolivia and Chile respectively. On average, union workers work longer hours than

their counterparts, particularly in Bolivia.[14] In both countries, men constitute a larger share of the union workforce, even though in Chile women have higher labor force participation than in Bolivia. Union workers in both countries are slightly more educated and have about 2 more years of experience than their nonunion counterparts. Union workers are more likely to be married and to be head of households. Almost all differences are statistically significant at standard confidence levels.

4. Empirical strategy: Estimating the union wage and inequality gap

In an ideal world, the appropriate way to estimate the impact of unions on union and nonunion wage distributions would be observing wages in absence of unions in the economy, and compare them with those in the presence of unions. In the terminology of Lewis (1986), this corresponds to so-called wage "gains." Because wages absent the presence of unions in the economy cannot be observed, the literature has focused on union "gaps" rather than union gains, which analyzes the observable union-nonunion differentials (conditional on covariates), acknowledging that nonunion as well as union wages may be affected by unions' presence.[15] As in much of the literature, this paper will follow this strategy estimating wage gaps but not wage gains. This also implies that the results cannot be extended beyond the framework of the analysis since they do not correspond to a general equilibrium solution.

Since the purpose of this paper is to analyze and compare the impact of unions on the wage distribution, four measurements are used. To estimate the impact on relative union-nonunion wages, the mean wage gap and quantile wage gaps are used. On the other hand, to

[14] Although there is a concern that if union workers work for longer hours than their counterparts, one might spuriously obtain a lower union wage gaps, once we compare union and nonunion workers with similar characteristics (see Table 2), there is no statistical difference in terms of their hours worked.

[15] It is typically argued that unions may affect non-union wages due to threat effects or spillover effects, the former increasing and the latter decreasing non-union wages.

estimate the impact of unions on wage dispersion (inequality), measures of the variance and interquantile gap in log wages are estimated. The first measure has a long history and can be compared to union gap measures elsewhere in the literature. The second measure is used to explore whether union effects are heterogeneous by examining the impact of unions across the wage distribution. The third measure, the variance of log wages, is the principal statistic used in the literature and will provide a single summary measure of the overall impact of unions on wage inequality. Finally, the interquantile gaps will provide a more informative identification of where in the wage distribution unions have their largest effects. It will also provide an alternative to the variance, whose magnitude can be sensitive to values in the tails of the wage distribution.[16]

To evaluate and decompose the union gaps across the proposed statistics, the methodology proposed by Firpo, Fortin and Lemieux (2007) is applied. This methodology, a generalization of the Oaxaca-Blinder decomposition, provides two advantages over the standard methodology. First, it provides a semi-parametric estimate of the wage gaps for statistics beyond the mean, and second it allows controlling for observed differences in the distribution of characteristics that can be associated to the union's workforce.

This methodology involves two phases. The first involves the identification of an appropriate counterfactual that is used to compare union and nonunion wage distributions, assuming all other characteristics are kept constant. This counterfactual can be used to perform an overall decomposition of the union gap into portions explained by measured differences in worker, job, and location characteristics (a "composition" effect) and by differences in the coefficients ("returns") on the observables (a "wage structure" effect). The second uses the

[16] Household data in general is less informative regarding information in and near the tails of the wage distribution because of possible measurement error, extremely low or high values, as well as top or bottom coding sometimes used by statistical agencies or by researchers.

novel RIF (Recentered Influence Function) regression to obtain a linear approximation of the individual contributions of the observed variables on the composition and wage structure effects. The methodology, as well as its advantages and disadvantages, are described below.[17]

4.1. Overall decomposition: Reweighting procedure

Define g_k as the function that determines (log) wages ($w_{i,k}$) for each individual i in sector k, where k indicates the union ($k = u$) and nonunion status ($k = n$) of individual i. Assume this function depends on observed ($X_{i,k}$) and unobserved characteristics ($\epsilon_{i,k}$) such that:

$$w_{i,k} = g_k(X_{i,k}, \epsilon_{i,k}) \; for \; k = u, n \qquad (1)$$

Define $v_k = v(w_k)$ as a function that describes the distributional statistic of interest, i.e. mean or variance, of a vector w_k that contains the wages of all workers in sector k. Also define $v_c = v\left(g_n(X_{i,u}, \epsilon_{i,u})\right)$ as the counterfactual distributional statistic of the set of wages union workers would earn under the wage structure prevalent in the nonunion sector. Then the overall union gap can be defined and decomposed as:

$$\Delta v = v_u - v_n = (v_u - v_c) + (v_c - v_n) = \Delta S_v + \Delta X_v \qquad (2)$$

Where Δv is the raw difference in wages measured in terms of the statistic v. ΔS_v is the fraction of the overall gap that can be explained by differences in the wage structure across sectors (wage structure effect), and ΔX_v is the fraction that can be explained by differences on the characteristics across groups (composition effect).

Although neither the counterfactual wage distribution nor the associate statistic v_c can be directly observed, under the assumptions of ignorability (conditional on measured covariates) and overlapping support of the covariates (see Imbens & Wooldridge (2009) and Firpo, et al. (2007) for further discussion), the counterfactual distribution can be identified so that ΔS_v and

[17] Details on the procedure used in the detailed decomposition can be found in Firpo, Fortin and Lemieux (2007; 2009)

ΔX_v reflect the true wage structure and decomposition effects. Under the assumption of ignorability, it is required that after controlling for observed characteristics X, the distribution of the unobserved explanatory factors in the wage determination ϵ_k is the same across the union and nonunion sector. Consequences of violating this assumption are discussed in sections 4.3 and 5.4. The assumption of overlapping support requires that there needs to be an overlapping in the characteristics across sectors, and that no single characteristic can be observed only within one sector. Under these two assumptions, the counterfactual distribution statistic v_c can be estimated using all observations in the nonunion sector and the estimated weight ω_c:

$$\hat{v}_c = v(\omega_c * w_n) \quad (3)$$

Where ω_c is the weight each observation in the nonunion sector is given for the estimation of the counterfactual statistic v_c. This weight is defined as:

$$\widehat{\omega}_c(X) = \frac{\hat{p}(X)}{1-\hat{p}(X)} \quad (4)$$

where $\hat{p}(X)$ is the estimated conditional probability (propensity score) of being a worker in the union sector. Although this propensity score can be estimated using parametric and semi-parametric methods, as suggested in Firpo, et al. (2007), it will be estimated using a logit model where the dependent variable is union status, conditioned on observed characteristics X. This vector of characteristics X corresponds to the set of wage determinants, as described in equation 1. Once $\hat{v}_c$ is estimated, the overall wage decomposition is estimated using equation 2.

4.2. Detailed decomposition

Once the counterfactual distributions have been identified, one can further decompose the wage structure and composition effects identifying the contribution of each observed characteristic to each component. This can be done using Recentered Influence Functions regression (RIF-regressions), as proposed in Firpo, et al. (2009).

A RIF-regression is similar to a standard regression, except that instead of using the dependent variable, in this case log(wages), it uses the recentered influence function of the statistic of interest associated to that observation $RIF(w_{i,k}; v_k)$. The RIF function is technically defined as:

$$RIF(w_{i,k}; v_k) = v_k + IF(w_{i,k}; v_k) \quad (5)$$

where the influence function $IF(w_{i,k}; v_k)$ can be understood as the change the observation $w_{i,k}$ has on the empirical estimation of the statistic v_k.[18] In other words, the RIF function can be intuitively understood as a first order approximation of the overall contribution that each observation has on the estimation of the statistic v. Once this RIF variable for each observation is estimated, it can be used to obtain a linear estimation on the average marginal effect that each observed characteristic X has on the distributional statistic v. In the framework of wage decomposition and considering a linear approximation for the conditional expectation of the RIF in the form of:

$$E(RIF(w_i; v)|X) = X'\gamma,$$

three set of parameters are required to be estimated:

$$\hat{\gamma}_k = \left(\sum X_{i,k}{}' X_{i,k}\right)^{-1} \sum X_{i,k}{}' \, \widehat{RIF}(w_{i,k}; v_k) \text{ for } k = u, n \quad (6)$$

$$\hat{\gamma}_c = \left(\sum \hat{\omega}_c(X_{i,n}) \times X_{i,n}{}' X_{i,n}\right)^{-1} \sum \hat{\omega}_c(X_{i,n}) \times X_{i,n}{}' \, \widehat{RIF}(w_{i,n}; v_c) \quad (7)$$

Here $\hat{\omega}_c(X_{i,n})$ is defined in equation 4. Then, terms in the spirit of an Oaxaca-Blinder decomposition for any statistic v can be defined to provide a detailed decomposition of the wage structure and composition effects:

$$\Delta S_v = X_u'(\hat{\gamma}_u - \hat{\gamma}_c) \text{ and } \Delta X_v = (X_u\hat{\gamma}_c - X_n\hat{\gamma}_n) \quad (8)$$

[18] Technically, the influence function is defined as $IF(w_{i,k}; v_k) = \lim_{\varepsilon \to 0} \frac{v_\varepsilon - v_k}{\varepsilon}$, where v_ε is the associated statistic when the distribution of wages experience an infinitesimal shift toward the observation $w_{i,k}$. More details on the definition and properties of the IF and RIF function can be found in (Firpo, et al., 2009).

For the four statistics of interest in this paper, the corresponding RIF functions can be written as follows:

Mean: $RIF(w;\mu) = w$

Quantile for $\tau \in (0,1)$:$RIF(w;q_\tau) = q_\tau + \frac{\tau - \mathbb{I}[w \leq q_\tau]}{f(q_\tau)}$

Variance: $RIF(w;\sigma^2) = (w-\mu)^2$

Inter-Quantile: $RIF(w;q_{\tau 1} - q_{\tau 2}) = RIF(w;q_{\tau 1}) - RIF(w;q_{\tau 2})$

In the next section, the main advantages and limitations of this methodology are discussed, and its performance compared to alternative methodologies.

4.3. Advantages and limitations of the RIF decomposition methodology

The methodology described in the previous section possesses several advantages as compared to alternative methodologies used to estimate union wage gaps. Similar to an Oaxaca-Blinder decomposition (Blinder, 1973; R. Oaxaca, 1973), the RIF decomposition methodology allows for a differentiated wage structure for the union and nonunion sectors, relaxing the assumption that unions only shift the wage profile for all workers, which is the base assumption for standard Mincerian OLS and conditional quintile regressions.

As pointed out in Barsky (2002), one of the limitations of the Oaxaca-Blinder type of decomposition is that it depends on the linearity assumption of the conditional expectation to provide consistent estimates for the wage gap decomposition. Since the methodology used here relies on a reweighting procedure to decompose the wage gaps, and imposes minimum restrictions on the wage determination function, it overcomes this limitation with the additional advantage that it can be extended to analyze other distributional statistics beyond the mean. Furthermore, the use of reweighting strategy provides an additional advantage, being that it

reduces or eliminates any differences in the distribution of the observed wage determinants between union and nonunion workers.

Finally, although there are other methodologies in the literature that are able to estimate the wage decomposition for statistics beyond the mean (see Fortin, Lemieux and Firpo, 2011), the methodology described here is the only one that is able to provide a detailed decomposition to the contribution of specific variables into the wage structure and composition effect. One must consider, however, that the detailed decomposition also suffers from the identification problem stated in Oaxaca and Ransom (1999) and Yun (2005, 2008), since the contributions of the variables to the wage structure effect are not invariant to the choice of a baseline in the case of categorical variables, or affine transformation in the case of continuous variables.[19]

The main disadvantage of the RIF decomposition strategy is that it relies on the ignorability assumption to provide consistent estimates of the decomposition. This implies that once observations are matched in terms of observed characteristics, unmeasured characteristics should be randomly distributed between union and nonunion sectors. In other words, one would expect that there is no selection into the union sector, or that unionization is as good as exogenous, once conditioned on measurable variables. If unionization is not random, however, the estimations could be biased and inconsistent, depending on the type of union selection that prevails. This is a "criticism" that applies to most statistical methods in the literature.

The literature suggests union status is not an exogenous outcome (Lewis, 1986). In fact, as Abowd and Farber (1982) emphasize, the process of selection into union jobs might not be one-sided, but rather characterized by a two-sided selection process. In this framework, workers with relatively low skill sets might select themselves to be in the queue for union jobs, but firms choose to hire the best candidates among workers in the queue. Two strategies have been used to

[19] Although this problem is present for continuous variables, it typically has less severe consequences.

deal with this problem. Heckman-Lee selection approaches (Duncan & Leigh, 1980; Hirsch & Berger, 1984; Lee, 1978; Robinson, 1989) have been used to account for a one-sided type of selection into the union sector, while others have relied on the use of instrumental variables (Duncan & Leigh, 1985) to avoid the bias due to endogeneity. The former studies have been criticized in the literature (Freeman & Medoff, 1984; Lewis, 1986) because of their arbitrary exclusion restrictions and the volatility of their estimated results, whereas the latter strongly depends on finding appropriate instruments, which at best (i.e., even if a valid instrument) will only provide a proper union wage gap estimate for the population whose union status is affected by the instrument.

In the absence of a better methodology and data sets with measures that can properly account for selection, this analysis proceeds under the assumption of conditional exogeneity of unions status. Nevertheless, the consequences and expected bias that may result from ignoring unobserved heterogeneity are discussed further in section 5.4.

5. Results

5.1. Model Specification

As described in Section 4, to correctly identify the wage structure and composition effect of the union wage gap, it is necessarily to create an appropriate counterfactual that simulates the wage distribution that union workers would have faced under the wage structure observed in the nonunion sector. To construct this counterfactual wage distribution, one first estimates a propensity score $\hat{p}(X)$ using a logit model. The dependent variable in this model is union status, and the independent variables are the set of measured characteristics X that determines workers'

hourly wage (see equation 1). The intent is to provide an index measuring the likelihood of being a union member, conditioning on measured wage determinants.

Following the literature, the vector *X* contains a set of standard controls, including a set of demographic characteristics (sex, ethnicity, years of completed education and age), a set of household characteristics (number of children ages 0-6 and 7-17 in the household, currently married, and if he/she is designated head of the household), and a set of region and year fixed effects to capture differences across regions and years.[20] Since not all skill factors can be captured by these set of controls, broad occupation and industry fixed effects are included in the specification as proxies for worker skills and working conditions (Hirsch, 2004; Hirsch & Schumacher, 1998).[21]

An additional issue is to explore whether or not to include establishment size as a control in the specification.[22] According to Oi and Idson (1999) and Brown and Medoff (1989) there is strong evidence suggesting that firm size is an important determinant of wages, in part because they are able to pay higher wages and hire more highly skilled workers to match with higher levels of physical capital, as well as for other reasons not fully identified in the literature. As discussed in Hirsch (2004a), firm and establishment size are typically excluded from analyses of union wage effects because such data are not readily available in U.S. household data sets, and because it is difficult to disentangle the separate effects of employer size and unions on wages

[20] Following Blinder (1976), instead of using potential experience and its square as wage determinants, the specification includes age and its square, years of education and its square, and age times education to allow for a more flexible specification. Ethnicity is only available for Bolivia, and is defined by the language the individuals spoke during their childhood. In Bolivia, the 9 departments are used to create the region fixed effects, while in Chile it includes the 12 regions plus the metropolitan region.

[21] For Bolivia, 11 industry-dummies are included in the model, whereas for Chile, 7 industry-dummies are used. In both countries mining sector is used as base category. The difference on the number of sectors between countries is explained because Bolivia uses the classification established in ISIC rev3, whereas the information in Chile is industries are classified using ISIC rev2.

[22] In both surveys, information on establishment size is directly provided by workers. Workers are asked how many people are employed in the establishment in which they are currently working. Details on the classification and groups of firms respect to number of workers can be found in Table A1 in the appendix.

since the two are highly correlated (i.e., few small firms are unionized).[23] For the rest of the paper, employer size is excluded from the featured wage equation specifications in order to compare results to the broader literature. In Section 5.4 establishment size fixed effects are included in the specification to examine how sensitive are the estimated union wage gaps.

Table 2. Summary Statistics: Reweighted Sample

	Bolivia			Chile		
	Union	Non union	**Diff**	Union	Non union	**Diff**
Hrs. week	52.12	52.10	**0.01**	46.78	46.75	**0.03**
	(20.01)	(19.84)	**[0.02]**	(10.55)	(11.00)	**[0.13]**
Sex	0.84	0.84	**-0.01**	0.71	0.70	**0.00**
	(0.37)	(0.36)	**[0.49]**	(0.46)	(0.46)	**[0.18]**
Indigenous	0.25	0.24	**0.01**			
	(0.43)	(0.43)	**[0.40]**			
Yrs. Schooling	37.34	37.38	**-0.04**	12.00	12.00	**0.00**
	(10.18)	(10.12)	**[0.14]**	(2.78)	(2.79)	**[0.00]**
Kids 0-6yr	19.17	19.16	**0.01**	0.43	0.43	**0.00**
	(10.67)	(10.58)	**[0.02]**	(0.66)	(0.66)	**[0.33]**
Kids 7-17yr	11.01	11.07	**-0.05**	0.83	0.82	**0.00**
	(4.59)	(4.63)	**[0.38]**	(0.95)	(0.95)	**[0.11]**
Married	0.78	0.79	**0.00**	0.62	0.62	**0.00**
	(0.41)	(0.41)	**[0.13]**	(0.48)	(0.49)	**[0.21]**
Head Household	0.74	0.74	**0.00**	0.63	0.63	**0.00**
	(0.44)	(0.44)	**[0.26]**	(0.48)	(0.48)	**[0.19]**

Note: Standard deviations in parenthesis. T-statistics in brackets. Statistics shown in this table are calculated using sample weights.

Logit models of union status are estimated in order to obtain propensity scores that are then used to calculate the weights that identify the counterfactual union wage distributions under the nonunion wage structure.[24] To verify that the weighting procedure appropriately identifies the counterfactual distribution of wages, Table 2 provides statistics of the reweighted sample and the significance of differences between observed characteristics. Recalling the information shown in Table 1, all differences between union and nonunion workers were statistically significant, while for the reweighted sample, none is significant, indicating that the

[23] In studies accounting for employer size, union and size effects on the wage are both substantive, but not additive, with union effects in the largest firms being small. That is, both union and nonunion workers are paid more by large employers, with the union-nonunion gap being very modest.

[24] The marginal effects of the main demographic variables are shown in appendix Table A2.

counterfactual wage distribution is appropriate for the analysis. In the next section, the results with respect to the overall and detailed decompositions are discussed.

5.2. Overall union gap decomposition

The first results to be compared across countries are union-nonunion wage differentials. Table 3 shows the raw union wage gaps, and the decomposition of these gaps into a portion explained by the "wage structure" (coefficient differences) and explained by the "composition effect" (differences in endowments), both for the mean and quantile union wage gaps. The estimates indicate that Bolivia has a somewhat higher average raw union wage gap than does Chile (0.272 versus 0.236). This seems to be driven by the high raw wage gaps observed at the top of the wage distribution, and is possibly a reflection of the higher wage inequality observed in Bolivia (see Table 4). One can also observe that the raw wage gaps are relatively stable throughout much of the wage distribution. Such differences, although useful for reference, need not reflect the true impact of unions, because they combine the effects of a differentiated wage structure and the underlying heterogeneity in terms of endowments and job characteristics.

According to the overall decomposition, the estimates show that the average union wage gap (as measured by the wage structure effect) is similar for both countries, with a slightly larger union premium for Chile (0.143 log points) than for Bolivia (0.114 log points). The magnitude of these union premium estimates are consistent with those found in the literature for developed countries (Jarrell & Stanley, 1990; Lewis, 1986). It is also informative to note that the composition effect explains a larger share of the raw union wage gap in Bolivia than Chile (.158/.272 or 58% versus .093/.236 or 39%), indicating that much of the observed union wage advantage in Bolivia reflects union-nonunion heterogeneity in workers' measured attributes and not unusually high union bargaining power.

To observe the effect of unions across the wage distribution, the decompositions across selected quantiles are shown in Table 3 and Figure 1. The results indicate that estimates of the median (Q50) union wage gaps are somewhat higher than the mean estimates, with a median union gap of 0.146 log points (versus 0.114 mean) in Bolivia, and 0.175 log points (versus 0.139 mean) in Chile. For Chile, the median gap estimate is slightly lower than the mean gap reported in Landerretche, et al (2011).[25] In Bolivia, unions have an increasing but relatively homogenous effect on union wages across much of the distribution, before falling sharply in the right tail of the distribution. For the upper section of the wage distribution, the union wage gap estimate falls below zero in Bolivia (an insignificant -0.06 log points). In Chile, the overall pattern is much the same, although the union gap gradient is somewhat flatter before falling to an insignificant 0.04 log points in the upper tail.

The almost zero estimates of the union wage gap in the far right tail of the wage distribution fall outside conventional expectations since a near-zero union premium should provide little or no incentive for workers to become or remain unionized. Such estimates can be understood, however, in a double selection framework seen in Abowd and Farber (1982) and Card (1996), which suggests positive selection by employers in the lower tail and negative selection into the applicant queue by workers in the upper tail of the skill distribution. In other words, because union workers in the upper tail of the wage distribution are likely to have low unmeasured skill characteristics as compared to their nonunion counterparts with similar measured attributes, they are better off working in the union sector than they would be in the nonunion sector.

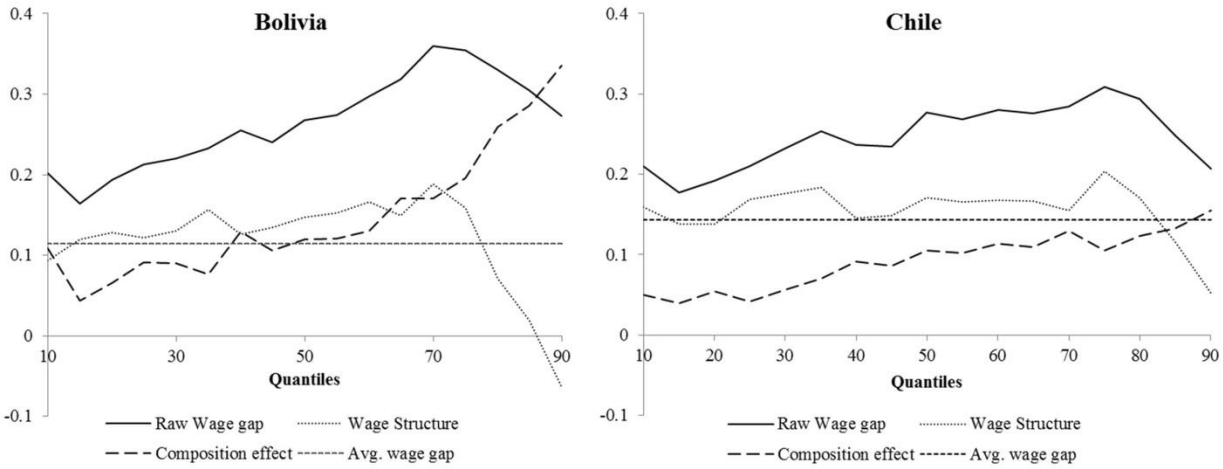
[25] Landerretche, et al (2011), also using the Social Protection Survey 2004-2009 from Chile, estimates a panel model and reports a union wage differential of 0.193 log points.

Table 3. Union Wage Gaps: Overall Decomposition

Bolivia	**Mean**	**Quantiles**				
		Q10	**Q25**	**Q50**	**Q75**	**Q90**
Total change	0.272***	0.202***	0.213***	0.267***	0.355***	0.273***
	(0.032)	(0.034)	(0.037)	(0.042)	(0.034)	(0.080)
Wage structure	0.114***	0.093**	0.122***	0.147***	0.159***	-0.063
	(0.027)	(0.043)	(0.038)	(0.033)	(0.040)	(0.078)
Composition effect	0.158***	0.109***	0.091***	0.120***	0.196***	0.336***
	(0.027)	(0.032)	(0.030)	(0.025)	(0.040)	(0.053)
Chile						
Total change	0.236***	0.210***	0.210***	0.276***	0.309***	0.207***
	(0.018)	(0.021)	(0.018)	(0.028)	(0.036)	(0.042)
Wage structure	0.143***	0.159***	0.168***	0.171***	0.204***	0.052
	(0.014)	(0.023)	(0.017)	(0.022)	(0.028)	(0.044)
Composition effect	0.093***	0.050***	0.041***	0.105***	0.105***	0.155***
	(0.012)	(0.012)	(0.012)	(0.015)	(0.021)	(0.033)

Note: * p<0.1 **p <0.05 *** p<0.01. Bootstrap standard errors in parenthesis. Detailed decomposition are shown in Table A3 and A4 of the appendix. The identification of the wage structure and composition effect uses the preferred specification as described in section 5.1.

Figure 1. Union Wage Gaps: Quantile Decomposition



Inequality gaps

In addition to increasing wages, unions typically reduce wage inequality among their members, in large part due to reducing wage returns with respect to observed (and possibly unobserved) characteristics. The evidence shown in Table 3 suggests that unions have a relatively homogenous impact on wage levels over much of the distribution, which implies

modest effects on wage inequality. The lower wage returns observed in the upper tail of the distribution, however, may well be large enough to reduce wage dispersion among union workers.

The results provided in Table 4 indicate that wage inequality in Bolivia is substantially higher than in Chile. The interquantile statistics show that differences between the countries are particularly large in comparing the medium-low (Q5010) wage gaps, whereas inequality in the upper tails of the distributions are rather similar across countries. A naïve interpretation of the raw variance and Q9010 gaps indicate that unions are unable to reduce wage inequality in Bolivia, while they seem to marginally reduce wage inequality in Chile. Because these statistics do not control for the degree of heterogeneity among workers, they might understate the equalizing effect of unions. To analyze the magnitude and direction of the union effect, Table 4 presents the decomposition in terms of log wage variance and interquantile wage differences into their wage structure and composition effects.

As suspected, after controlling for observed characteristics, the wage structure effect has a significant impact, reducing wage inequality in both countries. For instance, if union workers would face the wage structure of the nonunion sector, wage inequality (measured by variance) would be an estimated 16% (Bolivia) and 24% (Chile) higher than is currently observed. The Q9010 statistic, which measures the wage gap reduction between high and low wages, is also consistent with a reduction of wage inequality, albeit with a more modest estimate of 7-8% (unlike the variance, the Q9010 measure is less sensitive to the far left and right tails of the distribution).

Table 4. Union Inequality Gaps: Overall Decomposition

Bolivia	**Variance**	**Inter Quantile**		
		Q5010	**Q9050**	**Q9010**
Nonunion	0.659	0.914	1.099	2.013
Union	0.689	0.977	1.102	2.079
Total change	0.030	0.065	0.005	0.07
	(0.034)	(0.045)	(0.081)	(0.082)
Wage structure	-0.107***	0.054	-0.210**	-0.156*
	(0.041)	(0.049)	(0.083)	(0.084)
Composition effect	0.137***	0.011	0.216***	0.226***
	(0.029)	(0.023)	(0.046)	(0.054)
Chile				
Nonunion	0.397	0.515	0.968	1.483
Union	0.349	0.576	0.902	1.478
Total change	-0.048***	0.067**	-0.070*	-0.003
	(0.017)	(0.028)	(0.040)	(0.047)
Wage structure	-0.078***	0.012	-0.119**	-0.107**
	(0.017)	(0.027)	(0.047)	(0.051)
Composition effect	0.030***	0.055***	0.049	0.104***
	(0.011)	(0.015)	(0.030)	(0.034)

Note: * p<0.1 **p <0.05 *** p<0.01. Bootstrap standard errors in parenthesis. Detailed decomposition are shown in Tables A5 and A6 of the appendix. The identification of the wage structure and composition effect uses the preferred specification as described in section 5.1.

The Q5010 and Q9050 provide useful information on where in the wage distribution unions are able to reduce overall inequality. Although estimates are small and insignificant, on average union wage effects below the median slightly increase overall wage inequality (0.054 in Bolivia and 0.012 in Chile). What is perhaps surprising, particularly for Bolivia where inequality is higher than in Chile, is that unions do not seem to reduce inequality over the lower half of the distribution. Instead, the entire equalizing effect comes from wage compression in the top half of the distribution (-0.210 for Bolivia and -0.119 for Chile). In Bolivia, union wage compression is completely offset by the large measured heterogeneity of workers in the upper portions of the distribution. In Chile, there is less worker heterogeneity in the top half of the distribution and it is more than offset by union compression effects on the wage structure. In short, in both countries unions have a substantial wage compression effect, but this occurs primarily in the top half of the wage distributions and to a large extent offsets the relatively

greater endowment heterogeneity in the union sector that would otherwise have led to even higher wage inequality.

5.3. Detailed decomposition

This section explores in greater detail differences in specific union and nonunion wage equation coefficients (the wage structure) on observed union-nonunion wage differentials.[26] Although this analysis is informative in understanding how differences in wage structure affect the union and nonunion wage distributions, one must be cautious because the identification problems inherent in standard Oaxaca decompositions (Oaxaca and Ransom 1999) also affects the RIF decompositions.[27] In addition, although most of the estimates in the detailed decomposition are not statistically significant, possible due to the relatively small samples, they still provide information on the direction and magnitudes of union-nonunion differences in the wage structure. Except for age, education, gender and race, no analysis will be done for other wage determinants since there is no clear theory on how or why their effects differ across sectors (household characteristics), or because interpretation of results is difficult due to the identification problem (industry and occupation). Table 5 summarizes the detailed decomposition for the wage levels and inequality gaps for Bolivia and Chile respectively, and Figure 2 presents the contribution to the wage structure effect of the main variables of interest.

The first variables to be considered are gender and racial wage gaps. Since one of the mechanisms that unions have to reduce wage inequality is the use of collective contracts, it is likely that for union establishments, within the same positions (given the same worker tenure),

[26] Although age and education interactions were used to estimate the counterfactual wage distributions, only linear terms of age and education are used to estimate their detailed contribution to the wage structure effect. This will provide a first order approximation of the overall effect these variables have on the union wage gap. This is similar to the strategy described in Firpo, Fortin and Lemieux (2007), where the propensity score is estimated using a specification that is more flexible than the one used for the detailed wage decomposition.
[27] See section 4.3

there should be no contractual wage differences associated with gender or ethnicity (there may be differences in access to well-paying positions). The estimations shown in Table 5 provide some weak evidence of this effect. The estimations indicate that at the mean and median the gender wage gaps are smaller in the union sector in Bolivia (-0.053;-0.047), but with no particular difference in Chile (-0.018; 0.009), although neither case is statistically significant. This also implies that, holding other characteristics constant, being a man in Bolivia reduces the average union wage premium 0.05 log points, whereas this difference is almost zero in Chile. Each country, however, exhibits a different profile across the wage distribution, as seen in Figure 2. In Bolivia, the estimates associated with gender indicate that men earn a considerably lower union wage premium than women (-0.21 log points) in the lower end of the wage distribution. Conversely, the estimated union wage gap men earn relative to women increases substantially at higher levels of the wage distribution, with the exception at the top quantile. In Chile, there is practically no significant differences on the union wage premiums by gender for wages below the median; however, for the upper section of the wage distribution, men seem to earn lower union premiums than women.

This contrast in the effects across the wage distribution is also seen in union effects on wage inequality. In Bolivia gender increases wage inequality among union workers, by increasing male/female union wage differentials for lower wages, but having marginal effects in the upper section of the distribution. In Chile, gender is associated with lower wage inequality among union workers, mainly because it compresses wages from the top, reducing gender wage differentials in the union sector. It has a smaller effect in the bottom of the distribution. In terms of ethnicity, only available in Bolivia, the results are somewhat inconsistent with expectations.

Even though the estimates are small, the ethnicity penalty is larger in the union sector, but it is still associated with lower

With respect to human capital, namely years of schooling and age (as a proxy for potential experience), one might also expect unions to flatten associated returns for both characteristics, this being one of the main channels through which unions might reduce wage inequality. In Bolivia and Chile, the estimates at the mean and medians show that union workers receive slightly flatter returns to education. The decomposition across quantiles, shown in Table 5 and Figure 2, complements the story, indicating that workers with low wages are rewarded with higher returns to education in the union sector, compressing wages from the bottom, whereas among workers with high wages, education receives flatter returns in the union sector. Such effects are most likely caused by the two-sided selection process with respect to education, where groups with high measured skills (high education), receive lower wage premiums because they possess relatively lower unmeasured skills (Hirsch & Schumacher, 1998). Although both countries show similar patterns, they are much stronger in Bolivia, where education is consistently related to lower wage inequality using the variance and the interquantile difference measures. In Chile, these effects are smaller, which translates into a strong inequality reducing effect as measured by the Q9010 interquantile gap, but a smaller reduction based on the variance measure.

Table 5. Detailed Decomposition of Wage Structure Effects: Bolivia and Chile

	Wage gap						Inequality gap			
Bolivia	**Mean**	**Quantiles**					**Variance**	**Inter quantile**		
		Q10	**Q25**	**Q50**	**Q75**	**Q90**		**Q5010**	**Q9050**	**Q9010**
Total change	0.272***	0.202***	0.213***	0.267***	0.355***	0.273***	0.030	0.065	0.005	0.070
Wage structure	0.114***	0.093**	0.122***	0.147***	0.159***	-0.063	-0.107***	0.054	-0.210**	-0.156*
Sex (male=1)	-0.053	-0.217**	-0.196**	-0.047	0.078	-0.063	0.205**	0.17	-0.015	0.154
Indigenous(=1)	-0.021	-0.014	0.005	-0.017	-0.003	-0.037	-0.02	-0.003	-0.02	-0.024
Yrs of schooling	-0.033	0.117	0.043	-0.014	-0.11	-0.112	-0.156	-0.13	-0.098	-0.228
Age	0.015	0.09	0.121	0.214	0.08	-0.577**	-0.503***	0.124	-0.791***	-0.666**
Occupation	0.161*	0.003	0.05	0.018	0.354*	0.292	0.288*	0.016	0.274	0.289
Industry	-0.142	-0.089	-0.14	-0.027	0.247	-0.218	-0.122	0.062	-0.191	-0.129
Household charac.	0.008	-0.004	-0.069	-0.1	0.003	0.152	0.171*	-0.096	0.253	0.156
Year	-0.109	-0.118	-0.097	-0.098	-0.108	-0.137	0.065	0.02	-0.04	-0.019
Region	-0.034	-0.104	-0.025	0.079	0.009	-0.142	-0.001	0.183**	-0.221**	-0.038
Constant	0.32	0.43	0.429	0.138	-0.392	0.778	-0.034	-0.291	0.64	0.349

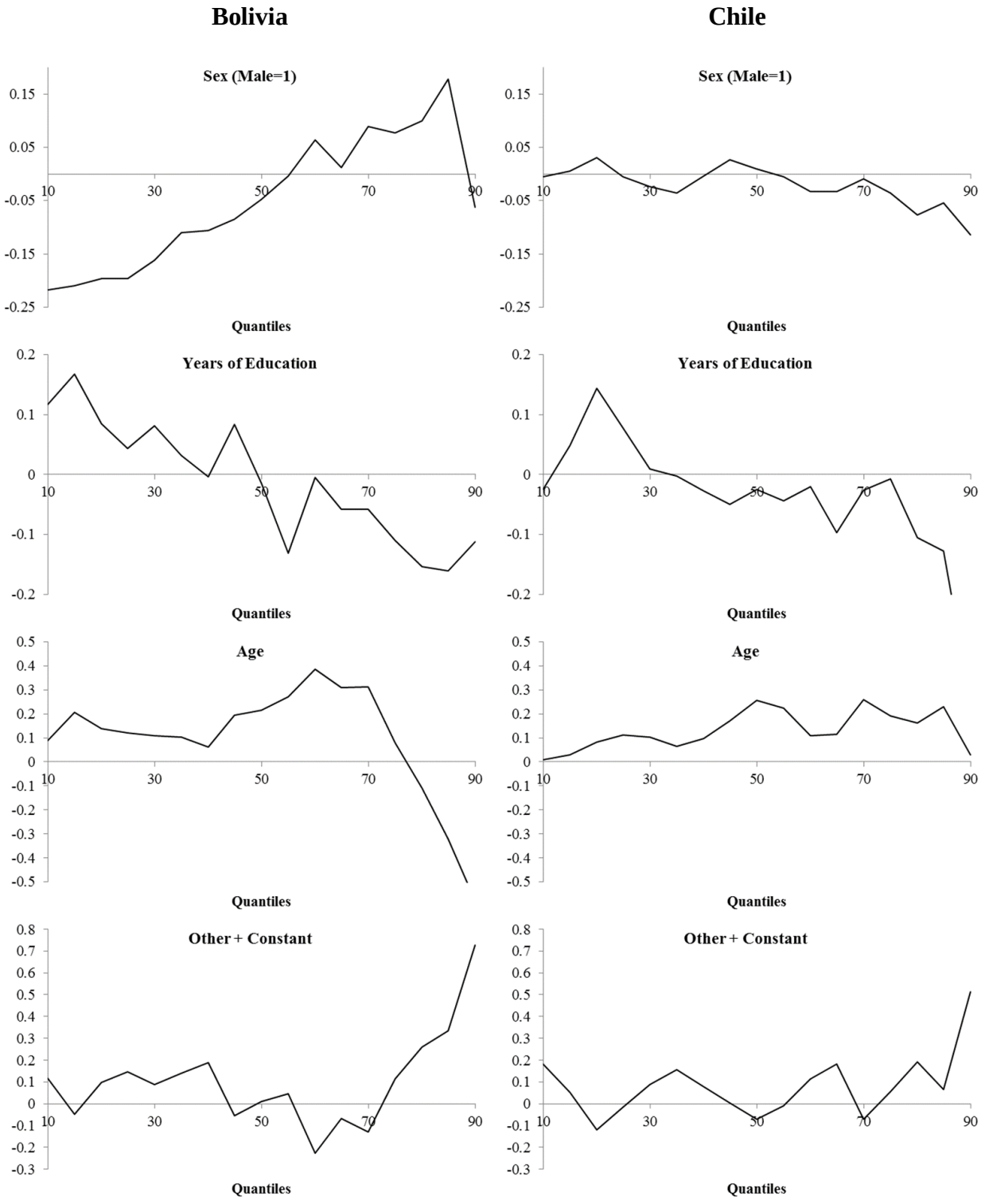
	Wage gap						Inequality gap			
Chile	**Mean**	**Quantiles**					**Variance**	**Inter quantile**		
		Q10	**Q25**	**Q50**	**Q75**	**Q90**		**Q5010**	**Q9050**	**Q9010**
Total change	0.236***	0.210***	0.210***	0.276***	0.309***	0.207***	-0.048***	0.067**	-0.070*	-0.003
Wage structure	0.143***	0.159***	0.168***	0.171***	0.204***	0.052	-0.078***	0.012	-0.119**	-0.107**
Sex (male=1)	-0.018	-0.005	-0.006	0.009	-0.036	-0.115*	-0.041	0.015	-0.124*	-0.109
Yrs of schooling	-0.073	-0.025	0.078	-0.024	-0.007	-0.378	-0.041	0.000	-0.354	-0.353
Age	0.114**	0.009	0.112**	0.256***	0.193*	0.030	0.034	0.248***	-0.226	0.022
Occupation	0.128*	-0.079*	-0.007	-0.032	-0.019	1.048***	0.403***	0.047	1.080***	1.127***
Industry	-0.029	-0.024	-0.095	-0.121	-0.260*	0.403*	0.112	-0.097	0.524**	0.427*
Household charac.	-0.037	-0.010	0.044	-0.020	-0.074	-0.112	-0.036	-0.009	-0.093	-0.102
Year	0.002	-0.037	0.009	-0.003	0.011	0.064	0.031	0.034	0.067	0.100
Region	0.025*	0.008	0.006	0.018	0.066**	0.086**	0.033**	0.010	0.068*	0.078*
Constant	0.031	0.322*	0.028	0.087	0.331	-0.974**	-0.572***	-0.235	-1.061**	-1.296***

Note: * p<0.1 **p <0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors. Detailed decomposition including composition effects are shown in Table A3 and A5 in the appendix. The identification of the wage structure and composition effect uses the preferred specification as described in section 5.1. The effects of head of the household, currently married and number of children are aggregated into the household characteristics.

In terms of experience, here using age as proxy, one might also expect to observe flatter associated returns in the union sector, which translate into lower wage inequality. The estimates shown in Table 5 indicate that wage differences by age have a positive contribution to the union wage premium throughout much of the distribution. However, the contribution of experience to the wage structure effect in both countries has a distinctive inverse U-shape, where union workers near the bottom and top of the distribution receive lower returns to experience compared to workers in the middle of the wage distribution. Although the estimates are, for the most part, not statistically significant, the shape of the returns to experience suggest that unions increase inequality at the lower end of the wage distribution, but compress wages at the top. The wage compressing effect is stronger in Bolivia, where experience reduces overall wage inequality (-0.503 contribution to the variance). In Chile, however, neither effect dominates the other, with a negligible effect on overall wage inequality (a 0.003 contribution to the variance).

Other wage determinants (i.e. household characteristics and fixed effects for occupation, industry, region, and year) have similar impacts on the wage structure across the wage distribution in both countries. As shown in Figure 2, the combined effects of the other wage determinants, including the constant, indicate a relatively homogenous and small effect on the union wage premium for most of the wage distribution, but an increasing impact on the wage premium for the upper tail, around the 70^{th} quantile. Overall, these effects appear to increase wage inequality due to unionization in the top of the wage distribution, while reducing it slightly in the bottom.

Figure 2: Detailed Quantile Decomposition: Contributions to the Wage Structure Effect



5.4. Sensitivity

As explained in section 4.3, ignoring unobserved heterogeneity can have important consequences on the identification of the wage structure and composition effects. Depending on the nature and characteristics of this unobserved heterogeneity, however, it could have different effects on the estimated decompositions. In this section, two possible cases, one-sided selection and two-sided selection, are discussed, and an example to the sensitivity for one-sided selection, caused by omitted variable, is shown.

The first possibility is that heterogeneity comes from a one-sided type of selection process, similar to the description in Lee (1978). Under this framework, if the unobserved characteristic is positively correlated to wages and unionization, ignoring this variable will create an upwards bias on the union wage gap along the whole distribution. This happens because union status would be capturing part of the explanatory power of that unmeasured characteristic. In terms of wage inequality, unless the wage gap bias is substantially different across the wage distribution, one might not expect any substantial changes on the union inequality gaps.

To show how sensitive the decompositions can be to the presence of unmeasured characteristics, in the framework of one-sided selection, establishment size fixed effects are added to the specification.[28] This variable is chosen because it is positively correlated to wages, possibly capturing some productivity measures (Brown & Medoff, 1989; Oi & Idson, 1999), but also because it is correlated to higher unionization (see Table A1 in appendix).[29] These results are shown in Table 6. As expected, for both countries, after including establishment size the estimated union effect on wage gaps fall up to 50%. With respect to union inequality gaps, small

[28] Establishment size is measured using self-reported information on the number of employees working at the workplace.

[29] Although firm size is an important determinant of the wage structure, as previously discussed, it was not included in the preferred specification because firm size is highly correlated with union status and is typically excluded from the wage equation when estimating union wage premiums.

and insignificant changes are observed. These suggest that our previous results may overstate the size of union wage gaps (wage structure), but not union inequality gaps, if the unobserved heterogeneity would follow a one-sided selection process.

A second and more likely type of heterogeneity is due to two-sided selection, as described by Abowd and Farber (1982), Card (1996) and Hirsch and Schumacher (1998). In this case, the unmeasured attributes (e.g., skills) are most likely to be positively correlated with unionization for workers with low measured qualifications (e.g., schooling), but negatively correlated for workers with highly measured qualifications. This will cause an overstatement of the wage structure effect of unions in the lower part of the distribution and understate it at the top of the distribution. As pointed out earlier, this might explain the small (and negative) wage gaps observed in the upper section of the wage distribution in Bolivia and Chile. It also suggests that the estimated effects of unions in decreasing inequality are overstated. Nevertheless, under this type of framework, the mean and median estimates can be expected to provide reasonable approximations of the average union wage effect.

Table 6. Decomposition Sensitivity: Adding Establishment Size

	Mean	Quantiles			Variance	Inter quantile	
		Q10	Q50	Q90		Q5010	Q9050
Bolivia							
Total change	0.272***	0.202***	0.267***	0.273***	0.030	0.065	0.005
Wage structure	0.076***	0.073*	0.103***	-0.111	-0.118***	0.03	-0.214***
Composition	0.196***	0.129***	0.164***	0.384***	0.148***	0.035	0.220***
Chile							
Total change	0.236***	0.210***	0.276***	0.207***	-0.048***	0.067**	-0.070*
Wage structure	0.079***	0.113***	0.086***	-0.006	-0.069***	-0.026	-0.092**
Composition	0.157***	0.097***	0.190***	0.212***	0.021	0.093***	0.022

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors. The identification of the wage structure and composition effect uses the preferred specification plus establishment size fixed effect. Detailed decomposition including composition effects are shown in Tables A7 and A8 in the appendix.

5.5. Union wage gaps in the U.S.: A comparison with Bolivia and Chile.

The analysis presented so far has been intended to provide some evidence on whether in different economic environments, developing Bolivia and more developed Chile, unions have similar estimated effects based on the use of similar data and methodology. To help generalize these results further, the same methodology and similar specification are used to obtain estimates for the U.S., where much of the prior research on unions has been conducted.

To this effect, data on private sector wage and salary workers from the Current Population Survey (CPS) monthly outgoing rotation group earnings files for the years 2007 and 2008 is used. Based on Hirsch and Schumacher (2004), the sample excludes observations with imputed earnings in order to avoid substantial attenuation in estimates of union wage gaps and dispersion. The real wage (in 2008 dollars) is calculated as the reported straight-time wage for hourly workers who do not receive tips, overtime, or commissions (TOC), and as usual weekly earnings (inclusive of TOC) divided by usual weekly hours for all salaried workers and hourly workers receiving TOC. The CPS includes 167,443 workers, 7.4% of whom are union members, lower density that that seen for Bolivia or Chile.[30]

[30] Official union density rates for all private sector wage and salary workers in the U.S., based on the full CPS-ORG sample (inclusive of those with imputed earnings) and the use of CPS sample weights, were 7.5% and 7.6% in 2007 and 2008. (Hirsch & Macpherson, 2012)

Table 7. Overall Wage Inequality Decomposition: U.S. as Compared to Bolivia and Chile

	Mean	Quantiles					Variance	Inter quantile		
		Q10	Q25	Q50	Q75	Q90		Q5010	Q9050	Q9010
U.S.										
Non union	2.825	2.104	2.343	2.741	3.210	3.659	0.392	0.637	0.919	1.555
Union	3.010	2.357	2.670	3.021	3.344	3.597	0.241	0.663	0.576	1.240
Total change	0.184***	0.253***	0.325***	0.279***	0.134***	-0.062***	-0.151***	0.026**	-0.341***	-0.316***
Wage structure	0.189***	0.189***	0.245***	0.259***	0.191***	0.055***	-0.066***	0.070***	-0.204***	-0.134***
Composition effect	-0.005	0.064***	0.080***	0.020***	-0.057***	-0.117***	-0.085***	-0.044***	-0.137***	-0.181***
Bolivia										
Non union	1.692	0.724	1.139	1.638	2.169	2.737	0.659	0.914	1.099	2.013
Union	1.964	0.927	1.355	1.904	2.526	3.006	0.689	0.977	1.102	2.079
Total change	0.272***	0.202***	0.213***	0.267***	0.355***	0.273***	0.030	0.065	0.005	0.070
Wage structure	0.114***	0.093**	0.122***	0.147***	0.159***	-0.063	-0.107***	0.054	-0.210**	-0.156*
Composition effect	0.158***	0.109***	0.091***	0.120***	0.196***	0.336***	0.137***	0.011	0.216***	0.226***
Chile										
Non union	7.178	6.547	6.761	7.062	7.518	8.03	0.397	0.515	0.968	1.483
Union	7.414	6.761	6.985	7.337	7.824	8.239	0.349	0.576	0.902	1.478
Total change	0.236***	0.210***	0.210***	0.276***	0.309***	0.207***	-0.048***	0.067**	-0.070*	-0.003
Wage structure	0.143***	0.159***	0.168***	0.171***	0.204***	0.052	-0.078***	0.012	-0.119**	-0.107**
Composition effect	0.093***	0.050***	0.041***	0.105***	0.105***	0.155***	0.030***	0.055***	0.049	0.104***

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors. The identification of the wage structure and composition effect uses the preferred specification as explained in section 5.1.

In Table 7, the results of reweighted RIF-regressions decompositions are shown for the U.S. and compared to those previously presented for Bolivia and Chile. The estimated mean union wage gap for the U.S. is 0.189 log points, as compared to 0.114 for Bolivia and 0.143 for Chile.[31] As seen in prior studies, union wage gaps in the U.S. tend to be higher than in most other developed economies. In contrast to Bolivia and Chile, the average characteristics of union and nonunion workers in the U.S. are very similar, producing a composition effect with a near zero contribution in explaining the raw union wage gap. Across the wage distribution, the estimated union wage gap takes on an inverted-U shape, with estimates up to 0.259 log points at the median, but with a flat slope in the lower half of the distribution and falling off steeply in the right tail.[32] These results are qualitatively similar to those seen for Bolivia and Chile, presumably due to some combination of two-sided selection and union wage compression effects, as discussed previously.[33]

Turning to the union wage inequality gap estimates, results shown in the right side of Table 7 indicates that unions in the U.S. have remarkably similar wage structure effects on inequality as compared to Bolivia and Chile. Based on the log wage variance measure, the union compression effect is -0.085 in the U.S., as compared to -0.107 and -0.078 in Bolivia and Chile. Using the inter-quantile Q9010 measure, the U.S. wage structure effect estimate is -0.155, as compared to an identical -0.155 for Bolivia and -0.120 for Chile. As compared to Chile, American unions appear to have greater success in compressing wages from the top toward the

[31] Hirsch and Macpherson, who provide U.S. union gap estimates from the CPS for 1973 forward using a time-consistent methodology (necessitating less detailed controls than used here), report private sector gap estimates of 0.195 and 0.186 for 2007 and 2008, respectively. (Hirsch & Macpherson, 2011)

[32] Card, Lemieux and Riddell (2004) find similar results showing that wage differentials were much larger among workers with lower wages after controlling for education and age.

[33] Using comparable methodologies, Firpo, Fortin and Lemieux (2009) find similar union wage gaps for the U.S. with mean union wage gap of 0.179, and wage gaps of 0.103 (Q10), 0.399 (Q50) and -0.013 (Q90) across quantiles using CPS 2003-2005, and a log variance reduction of 0.045.

middle of the distribution, but with more limited effects in the lower portions of the wage distribution. With the available information, it is not possible to know how much of the differences in estimates across countries are due to two-sided selection not captured by the set of measured wage covariates. A notable (but not surprising) difference between the U.S. and the two Latin American countries is that the composition of the union worker pool in the U.S. is far more homogenous (in measured characteristics) than its nonunion pool, thus contributing to the far lower observed wage inequality in the union than nonunion sector. Stated alternatively, in the U.S. wages are compressed both because of a union wage structure effect and because of compressed worker attributes. In Bolivia and Chile, union effects on inequality are similar to those in the U.S., but, in contrast, worker attributes in their union sectors are more dispersed than in their nonunion sectors.

6. Discussion and conclusion

Because of the differences in their history, legal structures, and economic and institutional settings, one could have expected to see substantial differences in terms of union wage gap and inequality effects in the two countries, along with differences with the U.S. and other highly developed economies. Many of the background settings suggested that Chilean unions should be stronger, with a larger presence in the labor market, and more able to obtain higher union wage premiums for their members than Bolivian unions. At the same time, the higher decentralization of the bargaining system in Chile compared to Bolivia, tied to lower levels of inequality, suggests that unions should have a larger role reducing wage inequality in Bolivia than in Chile. The evidence presented here, however, shows that there is a remarkable consistency of union wage effects across the three countries, with effects that are far more

notable for their similarity than for any differences. The one notable difference is the higher mean union wage gap in the U.S. than in Bolivia and Chile.

Using similar data and methodologies, we find considerably similar estimates of the average union log wage gaps for Bolivia (0.114) and Chile (0.143), which are consistent with the findings in the broader literature for the U.S. and elsewhere. Our estimate of the U.S. gap is somewhat higher, at 0.189 (this is higher than most U.S. estimates because it is restricted to the private sector and excludes imputed earners). The differences in the estimates may in part be related to differences in union strength between developed and developing countries. With respect to wage inequality, no consistent differences in patterns across the countries are observed, unions having roughly similar and substantial impacts in reducing union relative to nonunion wage inequality in all three countries, mainly compressing wages from the top of the distribution.

These results are not completely unexpected. In the private sector, wage premiums below, say, 10% may be too low for unions to create an incentive to organize workers and maintain members' support over time. If the wage premium it is too high, say in excess of 25%, union establishments would find it difficult to survive over time, absent large offsetting union effects on productivity and/or a product market environment sheltered from competition, and such union premiums would not be consistently observed. Large union premiums would attract a large queue of workers wanting union jobs, but would retard the creation and sustainability of such jobs.

The results in this paper do not imply that differences in countries' history, legal frameworks, and institutional and economic settings have no effect on the role unions and bargaining systems have on wage determination. In fact, each of these individual factors may

play a role in how unions affect wages, but they are difficult to isolate, measure, or incorporate into statistical analyses. What the analysis and results in this study suggest is that the common economic and political forces that govern the role of unions as collective bargaining agents produce similar impacts on wages, largely transcending differences in these nations' legal and economic backgrounds.

CHAPTER III

UNIONS AND ECONOMIC PERFORMANCE IN DEVELOPING COUNTRIES: CASE STUDIES FROM LATIN AMERICA

Introduction

One of the most contentious theoretical and empirical debates in the literature on unions has been on how unions affect a firm's performance, particularly in terms of productivity and profitability. While most of the literature agrees that unions have mostly negative effects on an establishment's profitability and investment, little consensus has been reached on the effects that unions have on productivity (Doucouliagos & Laroche, 2003, 2009, 2013; Hirsch, 2004).[34] To some extent, the uncertainty surrounding these issues reflects the limited availability of data to address the relationship between unions and performance, but it also reflects the underlying heterogeneity in union effects across establishments, industries, and countries.

On the one hand, unions are expected to reduce productivity by creating distortions and frictions in the labor market, reducing managerial discretion, and limiting or distorting capital investment and the adoption of new technologies. On the other hand, unions can increase productivity by improving communication within establishments, lowering some labor related costs, and possibly helping establishments and managements to adopt more efficient personnel and production policies (Freeman & Medoff, 1984). Such distortions caused by unions might

[34] The meta- analysis in Doucouliagos and Laroche (2003) finds evidence for positive but small effects for the U.S, with negative effects for the U.K. Later analyses for the U.S. also find that unions have a negative and significant effect on profits (Doucouliagos and Laroche 2009), while also decreasing investment and innovations (Doucouliagos and Laroche 2013). The review of the literature of Hirsch (2004b), however, indicates that, except for Brown and Medoff (1978), the evidence for the U.S. suggests unions have a negative effect on productivity, profits and investment, with few exceptions.

affect productivity by improving technical efficiency, possibly through "shock effects" resulting from higher compensation, or by changing the mix of inputs in the production function.[35]

This mixture of effects is also evident in the empirical literature. In the meta-analysis of Doucouliagos and Laroche (2003), the evidence suggests unions are on average associated with slightly higher productivity. Yet many studies find negative union productivity effects (Aidt & Tzannatos, 2002), with positive correlations being the exception, while authors such as Kuhn (1998) indicates that negative productivity effects are only observed in environments of union-management conflict.

Although there is a reasonably large literature for several developed economies, there is little evidence for "what unions do" for (firm or establishment) productivity in developing economies. As Freeman (2010) indicates, the research for developing economies is limited because data for this type of research is typically inadequate, but also because unions in developing countries have been weak and unable to fulfill their role as bargaining agents in their economies. Nevertheless, because businesses in developing economies face different types of obstacles, such as restrictions on the access of capital, unfavorable institutions, high levels of corruption, less competitive markets, and unstable business environments, compared to those in developed countries, it is not clear how unions will affect productivity.

The purpose of this chapter is to expand the literature by analyzing the impact of unions on productivity and other measures of performance for six countries in Latin America, namely Argentina, Bolivia, Chile, Mexico, Panama, and Uruguay. These countries represent a mix of settings with different legal backgrounds, economic development levels, and a large enough presence of unionization among their manufacturing sector that permit a comparative analysis on

[35] In principle, one would want to obtain an estimate of union-nonunion differences in technical efficiency, measuring output per unit of labor (Q/L) or output across all inputs (total factor productivity), controlling for measurable differences in all inputs (capital, labor quality, etc.).

the productivity effects of unions. In most of these countries, the unionized sectors have historically played important roles in the development of their political and economic systems. The market reforms that took place in Latin America after the debt crises of the 1980s and 1990s created economic environments that mostly weakened union bargaining power in the public sector, forcing unions toward a more active role as bargaining units in the private sector. These reforms created considerable heterogeneity in the economic and labor relation environment in which unions currently operate, suggesting that a cross-country study may prove valuable to better understand the relationship between unions and performance.

Using data from the World Bank Enterprise Survey, modified Cobb-Douglas production functions are estimated to determine the impact of unionization on establishment productivity, controlling for various measures of establishment characteristics, management and organization, labor force structure and innovation. Due to considerable levels of non-reporting in the survey, a "principled" multiple imputation approach is used to improve the completeness and reliability of the data. The preferred model indicates that unions have slightly positive but mostly insignificant effects on productivity, with Chile and Panama showing the largest union-productivity effects, although in neither case is the result significant. In contrast, the productivity estimates for Argentina are negative and statistically significant across all specifications.

The analysis of profitability indicates that in most countries the small gains in productivity are not large enough to offset the higher wage costs faced by unionized establishments. In two countries, the wage and productivity evidence are not closely aligned. For example, in Argentina, where large negative union effects were found for productivity, profit estimates indicate only small negative effects. In addition, in Bolivia, estimates indicate the

presence of unions is not correlated with productivity but that there are positive impacts on profitability. It is not clear whether these results reflect imprecision or bias in the estimations, or if they are driven by other factors reducing non-labor costs. For most countries, unionization does not appear to be associated with sales growth. Unionization, however, is negatively associated with measures of capital investment and innovation for most countries.

The rest of the paper is structured as follows. The first section presents a review of the empirical literature, with emphasis on the research done for Latin America. The second section presents a brief description of the history of unions in Latin America and describes the legal framework under which unions operate in each country. The third and fourth sections describe the data and the empirical strategy. The fifth and sixth sections present the main results on productivity analysis and robustness checks. Section seven presents the results for alternative performance measures, and section eight concludes.

1. How do unions affect productivity?

1.1. Theoretical background

There is a large theoretical literature that has explored the potential costs and benefits of unions in terms of firm performance and productivity. Examples include Brown and Medoff (1978), Addison (1982), Addison and Barnett (1982), Freeman and Medoff (1984), Hirsch and Addison (1986), Turnbull (1991) and, more recently, Hirsch (2004b) and Kaufman (2004). This literature has identified various channels through which unions can have positive and negative effects on productivity, suggesting that the net effect of unions on productivity remains an empirical question.

According to the "two faces" approach, popularized in Freeman and Medoff (1984), a union's potential effects on performance and productivity can be described using the monopoly face – following standard microeconomic theory – and the collective voice/institutional response framework – from the industrial organization literature. The traditional approach analyzes unions as monopolistic agents (a monopoly face), stressing the negative aspects of unions and the distortions they create compared to the perfect competition model. Within this framework, unions extract monopoly gains from the employers, which translate into compensations above competitive levels for their members. Unions do that by constraining the labor supply, moving firms up their labor demand curve, either through bargaining power (e.g., the strike threat) or withholding of labor.

This mechanism might cause productivity to decrease because it might temporarily reduce/stop firm effective production capacity. It is also possible that through the bargaining process, a union might impose the adoption of inefficient contractual work rules and reductions in managerial discretion that may increase the cost of reacting to economic shocks in dynamic economic environments (Hirsch, 2008).[36] Furthermore, union rent-seeking behavior can further reduce long run productivity by imposing a pseudo "union tax" on returns, limiting the adoption of new technology and reducing investment (Connolly, Hirsch, & Hirschey, 1986; Hirsch, 1991, 2004).

Constraints in labor supply caused by unions might also generate wage/prices distortions that could produce inefficient resource allocation, forcing firms to shift toward a suboptimal mix of inputs in the production function. This may cause (small) deadweight welfare loss and

[36] Although there is plenty of anecdotal evidence regarding inefficient union work rules, it seems unlikely that such inefficiencies would be long lived, particularly in markets with high levels of competition where such practices are difficult to maintain. There is no systematic evidence relating the interactions between union governance, dynamism, and productivity.

potentially lower overall labor productivity. This type of distortions might spuriously increase production per worker if firms shift their input mix toward higher capital intensity and/or higher skilled workers, without necessarily generating losses (or gains) of technical efficiency at the establishment level. These types of distortions, however, are less likely to be observed to the extent that unions tax the quasi-rents from capital, reducing incentives to increase investment.[37] Besides, although high union wages opens the possibility to employ workers with higher skills, such outcome is unlikely, given repeated bargaining (Hirsch, 2004; Wessels, 1994).

The "collective voice/institutional response" face of unions, as described in Freeman and Medoff, puts more emphasis on the positive aspects of unions and their potential roles enhancing operations and labor relationships within establishments. For instance, because unions are legally protected, they can freely express their member preferences in the workplace, improving communication between employers and employees, inducing managers to alter methods of production and adopt more efficient personnel policies. The improvements in communication provided by the presence of unions can reduce potential transaction costs associated with turnover, training and recruiting, as well as reduce costs of monitoring and enforcement in the workplace (Allen, 1984; Kuhn, 1982, 1985). The presence of unionization and pressure for higher wages can also increase productivity through shock effects, reducing the so called "X-inefficiency" through improved operations in order to offset higher wages, which could have persisted in the absence of unions (Addison & Hirsch, 1989; Hirsch & Addison, 1986; Kaufman, 2004).

As Freeman and Medoff emphasize, the positive outcomes derived from the union's collective voice are constrained to a positive and cooperative relationship between management

[37] For theory on unions and quasi-rents, see Grout (1984) and Baldwin (1983). For the earliest empirical test, see Connolly, Hirsch and Hirschey (1986).

and organized labor. For instance, Kleiner (2002) finds that in the Aircraft industry, overall productivity was considerably lower during periods of conflicts between management and union leaders. Similarly, on its review of the literature, Kuhn (1998) indicates that studies with negative union effects are also cases characterized by having conflicts between unions and management. In addition, Black and Lynch (2001) find that negative union productivity effects are mainly driven by unionized plants using traditional management systems, while positive productivity effects are found among those (few) union establishments that adopt "best-method" human resources practices such as incentive pay (Bloom & Van Reenen, 2011).

1.2. Empirical evidence

Consistent with the theoretical background, the empirical evidence shows considerable variability in the measured effects of unions on productivity. Such variation, however, are attributed to the uniqueness of the interactions between unions, management and economic environments across firms, industries, countries and time periods. As in other aspects on the literature of unions, the inherited endogeneity of the unionization process has made the identification of causal effects on productivity and profit difficult in the literature (Lewis 1963, Freeman and Medoff 1984, Hirsch and Addison 1986, and Hirsh 2004). The strategy in these studies has been to compare unionized versus non-unionized firms, using cross-section or panel data, to identify the impact that unions had on productivity, profitability, and employment, among other characteristics. There are, however, a handful of studies, using event study analysis and regression discontinuity approaches, have been able to provide estimates closer to what one might believe to be causal effects (see for example Lee and Mas, 2004, 2012 and Sojourner, et al, 2012).

The seminal paper on unions and productivity by Brown and Medoff (1978), which established the methodology subsequently used in most of the literature, is one of the few studies that indicates a large and positive effect on productivity (22-24%). These results, however, were not supported by subsequent reviews of the literature due to serious data limitations (discussed by the authors) (Freeman & Medoff, 1984; Hirsch, 2004b; Hirsch & Addison, 1986).

The rough consensus on U.S. studies is that union productivity effects are, on average, small and non-significant (a nearly zero or a small positive effect) and highly variable across different economic settings. When positive, they are too small to fully offset union wage effects, which is reinforced by a rather consistent findings of lower profitability among union companies (for a survey and references, see Hirsch, 2004b; Doucouliagos and Laroche, 2003, 2009; and Fuchs, et al. ,1998). Some international evidence for other developed countries corroborates the results indicating that that unions have negative effects on profitability, and mostly negative effects on productivity, except for in industries with high competition, or good relationships between management and unions (for example, see Aidt and Tzannatos, 2002).

Beyond the scope of developed countries, the literature on the economic effects of unions is limited. As pointed out by Freeman (2010), due to the limited data available and weak role that unions have had as bargaining units, little is known about how unions affect productivity in developing countries. A brief summary of the relevant literature in developing Latin American countries is provided.[38]

In studying unions in Mexico, and using establishment level data, Fairris (2005, 2006) finds that unionized establishments have higher productivity and similar profitability as their nonunion counterparts, which they attribute to more training in unionized establishments. They report, however, that such enhancing effects on productivity have fallen, from 21% in 1992 to

[38] A more comprehensive review of the literature can be found in Freeman (2010)

only 11% in 1999. Menezes-Filho, et al. (2005), using firm-level surveys for manufacturing firms in Brazil, find that unions are correlated with lower levels of profitability (returns to sales) and investment (investment rate), but that they have a concave relationship (inverse U shape) with productivity, indicating that some level of unionization can have a positive impact on performance, with evidence suggesting that the impact is larger in firms with profit sharing.

Saavedra and Toledo (2005), find evidence for Peru that union firms have lower profits (-17.5% lower than nonunion firms). They also find a negative union correlation with productivity, although such results are not robust to inclusion of firm characteristics. They hypothesize that the negative effect could be explained by the history of conflicts between labor and management. They also present some weak evidence that the negative effects on profitability seem to have declined, possibly as consequence of the 1992 Collective Bargaining Law that greatly reduced union density and bargaining power in the country.

Cassoni, et al. (2005), using panel establishment level information for the manufacturing sector in Uruguay, find a positive effect on productivity and productivity growth, which disappears when indirect effects of employment changes are controlled for. They also find that unions are positively related to profit levels with a negative correlation with respect to profit growth. Given the economic framework after the 1990s, the authors argue that improvements in productivity might be explained by increased labor stability and lower turnover, and to a lesser extent improved cooperation and labor morale. Finally, Urizar and Lee (2005) study the effects of unions on productivity among coffee producers in Guatemala using a small survey of 37 producers for the years 1992- 2000. Using measures of actual coffee production, they find that becoming unionized decreases productivity by 10-20 percent. Such results are not observed after including fixed firm effects, probably because few producers became unionized in the sample.

This chapter will mainly analyze the effects of unions on productivity, focusing on the role of unions across six developing countries, namely Argentina, Bolivia, Chile, Mexico, Panama and Uruguay, in the private manufacturing sector. These countries are at different levels of economic development and display important differences in their legal structure and workplace environment. Although there are other studies that have analyzed the economic effects of unions for particular economies, this paper contributes to the literature by providing a comparable cross-country analysis that can provide further insights on the economic effects of unions. Moreover, no previous study of has examined union effects on productivity for four of these countries – Argentina, Bolivia, Chile and Panama.

2. Unions in Latin America: Background

There is a substantial literature focused on the development of unions in Latin America, most of which has taken a historical and legal approach describing the evolution of the labor movements and changes in the legal framework in these countries. In this section, I provide a brief overview of important features in the development of unions in Argentina, Bolivia, Chile, Mexico, Panama and Uruguay, as well as a description of the legal framework in which unions operate in each of these countries. This overview does not pretend to be exhaustive; more comprehensive analyses can be found elsewhere (Alexander & Parker, 2005; Anner, 2008; Carrière, Haworth, & Roddick, 1989; Cassoni, Allen, & Labadie, 2004; Cassoni, et al., 2005; Hudson, 1994; Hudson & Hanratty, 1991; Hudson & Meditz, 1992; Meditz & Hanratty, 1989; Merrill & Miró, 1997; Murillo, 2000; Murillo & Schrank, 2005; O'Connell, 1999; OECD, 1996; Ulloa, 2003).

2.1. History

Most countries in Latin America have been characterized as having unions play a strong role in the political arena, both as a principal opposition institution and principal supporter of political parties in power (Carrière, et al., 1989). The economic and political development of unions in Latin America is to no small degree a story of union alliances with and subordination to various political parties. Argentina, Bolivia, Chile, Mexico, Panama and Uruguay are no exception. Such alliances, however, developed in different ways across these countries.

The alliances between unions and the Peronist Party in Argentina and the Partido Revolucionario Institucional (PRI) in Mexico became long-lasting relationships that benefited the unions for decades. In Bolivia and Chile, alliances between government and unions were more fragile, with unions becoming sufficiently strong to play important roles not only as the main ally of a ruling party, but also their main opposition. In Panama, unions were typically weak and had little political influence, but during the government of Omar Torrijos (from 1968-1978), the president supported the establishment of alliances to empower the formation of stronger and more active unions, promoting reforms in favor of workers. In Uruguay, where little if any coordination had existed between unions and the government, unions played a major role in the democratization process during the 1980s. Countries where strong alliances developed between unions and government often adopted protectionist policies that reinforced these alliances. As characterized by O'Connell (1999), these political alliances became the pillar on which unions were able to negotiate benefits for their members, but reduce their role as collective bargaining agents in the labor market, particularly in the private sector.

The era of dictatorships in Latin America, between the 1970s and late 1980s, produced a major setback for the development of unions. With the exception of Panama, where unions

become stronger during the dictatorship, unions in other countries were dissolved and their leaders persecuted. Except for unions allied with the ruling government, most types of labor organizations were outlawed. In Argentina, Bolivia and Mexico, although unions were persecuted and declared illegal, they remained active as political entities opposing the dictatorship. In Chile, while unions were initially disbanded and members were persecuted, by the end of the 1970s, following their *Plan Laboral,* the right of association was reestablished, reforming the role of unions as a decentralized collective bargaining unit operating in a newly-adopted neoliberal economy. Finally, in Uruguay, the military regime outlawed union activity and granted rights of dismissal to employers in case of strikes, producing massive layoffs of workers engaged in such activities. These actions effectively eliminated substantive union activities for almost a decade. In 1981, unions were allowed to resurface, with close control from the government intended to reduce the politicization of their activities.

With the return of democracy throughout the region, unions returned to their economic and political activities, in some cases having as much strength as in the pre-dictatorship era. The debt crisis that affected Latin American countries in the 1980s, however, marked a change in the economic system for most of the countries in the region. In an attempt to overcome the crisis, many countries attempted a series of market reforms that moved their economies from a centralized, protectionist market driven by large governments, to a more flexible and open market oriented environment with smaller governments. These changes greatly reduced the leverage that unions had in influencing government policies, forcing them to rely more on their role as workers' collective bargaining agents with the private sector (O'Connell, 1999). Perhaps paradoxically, although many market driven policies were adopted to favor more flexible labor and product markets, a series of union-friendly reforms were also adopted during the 1980s and

1990s in an attempt to retain union support (Murillo & Schrank, 2005). Anner (2008) observes, however, that such reforms seemed not able to strengthen the role of unions as bargaining agents but, rather, fragmented an already weakened institution.

2.2. Legal Background

As described by Murillo (2000, 2001), Murillo and Schrank (2005), Anner (2008) and O'Connell (1999), the aftermath of the debt crisis that hit Latin America in the 1980s and the return to democracy transformed the role that most unions had from one of an important political actor toward one as a more active labor market agent. Unions across the region had to adapt to a more flexible labor market, transitioning from a state-union relationship toward a firm-union one. In conjunction with the market reforms, however, a series of union-friendly reforms were also observed across the regions as an attempt to empower and transform the new role of unions (Anner, 2008; Murillo & Schrank, 2005). Such a combination of legal responses, coupled with the traditional background that unions had in their respective countries, brought about considerable heterogeneity in the way unions operated across the countries. Table 8 summarizes some of the most important characteristics that describe the conditions under which unions operate in selected countries.

Similar to the experience worldwide, many Latin America countries have shown a decline in unionization rates, despite union-friendly reforms. This has been the case in Bolivia, Mexico and Panama. In Chile and Uruguay, however, union density rose in 2000-2006 following earlier declines. In Argentina, union density increased substantially following their economy's recovery from financial crisis in the early 2000s and labor reforms in 2004.

Anner (2008) argues that decline of unions in the region can be explained by three factors. First, the broader market-oriented reforms that were adopted not only weaken unions by

eliminating protectionist policies, reducing the importance of the public sector as main employer, but also by contributing to the growth of an informal sector that largely operates outside the scope of traditional unions.[39] Second, the reforms that favor the formation of unions and collective bargaining were limited and unable to counteract the effect of reforms increasing the flexibility of employment laws. And third, in some countries there was inadequate protection and enforcement systems, incapable of defending workers' rights to organize or protect them from anti-union discrimination.

With the exception of Uruguay, and to a lesser degree Chile and Panama, the bargaining system across these six countries is characterized by substantial state intervention. In most of the countries, the state typically intervenes in the bargaining system by providing official recognition and authorization if unions want to engage in bargaining negotiations or want to declare a strike. In Argentina, while "regular" unions can be formed freely, only one union (the one with the most representation) in a specific industry and/or area is recognized. In Bolivia and Mexico, unions can be formed freely, but need to be officially authorized by the Department of Labor in order to operate and negotiate with the employers. In Bolivia, only one union per establishment is allowed, while in Mexico, more than one can be created, although only the largest union can engage in collective bargaining. In Chile and Panama, there is little intervention of the state on the formation of unions other than a notification to the authorities, although in Panama only one union per establishment is allowed. In Uruguay there are no formal norms regulating the formation and activities of unions, which provides considerable freedom on the formation of unions. In most countries freedom of association is guaranteed for all workers except for public officials or workers in public administration.

[39] This doesn't imply that workers in the informal sector do not form other types of labor organizations similar to unions. Those organizations, also referred as unions, have characteristics that differ from the traditional role of unions, and are not considered in this research.

Table 8. Descriptive Evidence on Unions and the Bargaining System

	Argentina	Bolivia	Chile
GDP per capita 2006 (in US$)	5485.5	1230.5	8912.2
%manufacture	22.27	14.38	13.20
Union density			
1990-1995	28.7	30.9	13.6
1995-2000	25.6	16.4	11.3
2000-2006	37.6	12.9	13.8
ILO conventions			
C87:Freedom of association	1960	1965	1999
C98:Right to organize and Collective bargain	1956	1973	1999
Freedom of association	All workers except for Military personnel	All workers but public administration	All workers but public administration
Restrictions	One union per industry and geographical area recognized.	One union per establishment.	More than one union per establishment allowed
	Most representative union is recognized	Needs government authorization.	Unions are auto-matically recognized
Union formation	Needs to represent at least 20% of the workers	At least 20 workers are needed for professional unions. And 50% for firm unions.	Small firms (less than 50 wrks) need 8 workers to form a union. Otherwise, at least 25 workers are needed.
Collective bargain	Allowed at regional, provincial or firm level	Allowed for Unions, Federations and Confederations.	Firm level bargain is recognized. National level bargaining is voluntary.
	Contracts need to be approved by the Ministry of Labor		Worker associations (non-unionized) can engage into collective bargaining.
Access to financial information	Yes	No	No
Right to strike	Right to strike is recognized	Right to strike is recognized. Requires 3/4 support.	Right to strike is recognized, except in public sector. Requires simple majority support.
	Only unions that are registered have the right to strike	Strikes in public sector, general strikes and solidary strikes are illegal.	
Protection	Adequate	Inadequate	Adequate

Notes: GDP per capita and Manufacture as % of GDP were obtained from the World Bank Indicators (2012). Union Density Information is obtained from Household surveys, Anner (2008), Hayter and Stoevska (2011), Cassoni, et al. (2005), and information from the OIT. Characteristics of the bargaining systems were obtained from the countries labor codes, O'Connell (1999), Anner (2008); Murillo and Schrank (2005), Ronconi (2012), Anner (2008b) and Murillo (2000, 2001).

Table 8. Descriptive Evidence on Unions and the Bargaining System (continued)

	Mexico	Panama	Uruguay
GDP per capita 2006 (in US$)	8830.8	5201.6	5907.3
%manufacture	18.7	7.1	17.0
Union density			
1990-1995	22.4	14.2	17.3
1995-2000	21.0	11.0	14.7
2000-2006	16.4	12.0	19.0
ILO conventions			
C87:Freedom of association	1950	1958	1954
C98:Right to organize and Collective bargain	Not recognized	1966	1954
Freedom of association	No prior authorization is required to create a trade union.	All workers but public officials administration	There exist few regulations on unions
Restrictions	Unions require officially authorization. More than one union per firm allowed, but only the most representative is recognized	Only one union per establishment.	No noticeable restrictions
Union formation	Unions need at least 20 workers	Unions require 40 members.	There are no minimum of requirements
Collective bargain	Employers have the obligation to engage into collective bargaining with unions at request.	Worker associations (non-unionized) can engage into collective bargaining.	Collective bargaining usually at industry level.
Access to financial information	No	Yes	No
Right to strike	Right to Strike recognized. Requires simple majority. Strikes in the Public sector requires 2/3 support	Right to Strike recognized in case of working conditions improvements. Requires simple majority.	No noticeable restrictions
Protection	Inadequate	Mostly adequate	Adequate

Notes: GDP per capita and Manufacture as % of GDP were obtained from the World Bank Indicators (2012). Union Density Information is obtained from Household surveys, Anner (2008), Hayter and Stoevska (2011), Cassoni, et al. (2005), and information from the OIT. Characteristics of the bargaining systems were obtained from the countries labor codes, O'Connell (1999), Anner (2008); Murillo and Schrank (2005), Ronconi (2012), Anner (2008b) and Murillo (2000, 2001).

The restrictions on the formation of unions have also shown significant heterogeneity in terms of minimum requirements of representation. Uruguay, given its virtual absence of a legal framework for unions, does not have any restriction in terms of the number of workers required to form a union. Panama, in contrast, requires at least 40 workers to form a union, perhaps the

strongest restriction for the formation of unions. In Bolivia, Mexico and Chile the requirements in terms of workers is similar, with a minimum of 20-25 needed to form a union. Chile has a more flexible requirement for smaller firms (less than 50 workers) where only 8 workers are needed to form a union. In Argentina, a union needs 20% of the represented workforce to create a union, but needs to represent the majority of the workers in the industry/area to be able to engage into bargaining and call strikes.

The collective bargaining system across countries is also characterized by its heterogeneity, from a highly centralized system as in Argentina to a decentralized system in Chile. The bargaining system in Mexico is also highly centralized, not because representation is highly centralized as in Argentina, but because of considerable coordination between unions and the state (O'Connell, 1999). Uruguay historically had a centralized bargaining system, but as Cassoni, et al. (2005) describe, it has slowly been moving toward more decentralized bargaining at the firm level. In Chile and Panama, a decentralized bargaining system prevails where nonunion organizations can also request that they collectively bargain. In Chile, establishment and firm level bargaining is encouraged, while bargaining at higher levels (multiple firms) is at the discretion of employers. In Bolivia, a mixed bargaining system prevails since any union, federation or confederation, can request collective bargaining. Typically, confederations and federations are involved in the negotiation of minimum wages, wage increases and mandated benefits at the national level that may affect the whole workforce. Nevertheless, as mentioned by Carrière, et al. (1989), Bolivian unions have never been known to be strong in terms of negotiations at the decentralized level. It is worth mentioning that unions in Argentina and Panama are the only ones that have access to financial information before they engage in collective bargaining. Mexico is the only country among the six to be studied that has not

ratified the International Labor Organization convention regarding collective bargaining (ILO convention 98).

The right to strike is recognized for all the six countries, but with different levels of restrictions. For most countries, 50% support of union members is needed to strike, with the exception being Bolivia where 75% is needed. In all countries, only those unions that are recognized by the state can strike. In Bolivia and Panama, coordinated work stoppages, either solidarity or general strikes, are prohibited.

Bargaining systems in these countries can also be characterized by their protection of the rights to freedom of association. According to the evaluation made in the report of the OECD (1996), Argentina, Chile and Uruguay have an adequate system to protect unions, while Bolivia and Mexico are considered inadequate. Similar characterizations are also described in the Annual Survey of Violations of Trade Union Rights (ITUC, 2007). In this report, Bolivia is described as providing inadequate protection against anti-union discrimination due to a sluggish and inefficient legal system. In the case of Panama, except for the excessive requirements to form a union, protection is deemed adequate except in export-processing zones. The report also indicates that Mexico has serious problems that undermine bargaining rights, job security, freedom of association and rights to strike among unions. In terms of enforcement capacity, the information reported in Ronconi (2012), who analyzes evidence on enforcement of labor laws in Latin America, shows that in the 2000s, Bolivia and Mexico had the lowest number of inspectors per capita, while Chile, Panama and Uruguay, have by far the best enforcement capabilities in the region.

3. Data and imputation strategy

The present analysis uses data from the Enterprise Survey, concentrating on six selected Latin American countries (see Table 9). The information was collected during 2006 by the World Bank as part of the first wave of data collection for Latin American countries. The Enterprise Survey provides a standardized establishment level data set, using a representative sample of establishments in the private sector.[40] The survey focuses on the non-agricultural economy, excluding the public sector, targeting establishments with 5 or more workers. The sample was constructed using stratified random sampling, based on industry, establishment size and region, which also depend on the size of each country's economy.[41] The survey provides considerable information regarding different aspects of the business environment, investment climate and establishment characteristics. This information can then be used to identify different aspects of establishment performance, market competition, managerial characteristics and labor force structure, among other things.

The six countries in this analysis were selected for having a large enough presence of unionized (and not unionized) establishments in the sample.[42] Although there is information available for other industries, i.e., services and others, the study concentrates on manufacturing because only for this sector is there information on capital. Much of the literature on unions and performance in developed economies has likewise focused on manufacturing.

[40] According to the methodological notes provided at http://www.enterprisesurveys.org/Methodology, the Enterprise Survey is answered by business owners and top managers, and in some cases, by human resources managers. The regions with major economic activity in each country were selected for interview. The data can be accessed at http://www.enterprisesurveys.org.

[41] Further details on the implementation and survey structure can be found in the implementation notes for the Latin America Enterprise Surveys Data Set.

[42] Among the selected countries, Bolivia had the lowest share of unionized establishments, with 14.1% of the sample being unionized, while the largest share was in Argentina with 91% being unionized. In other countries in the region, for example, Ecuador, El Salvador, Nicaragua, Honduras, Paraguay and Peru, less than 5% of the interviewed establishments were unionized. No information on unionization was available for Venezuela.

Table 9. Sample Size by Country and Eligibility

Economy Size	Countries	Sample size (manufacture)	Eligible	Complete
Small	Bolivia	359	298	215
	Panama	238	185	112
	Uruguay	317	251	136
Middle	Argentina	623	540	294
	Chile	627	564	409
Large	Mexico	1,113	974	802
	All	3,277	2,812	1,968

Notes: Prepared from the information of the Enterprise Survey 2006: Eligibility is assessed on whether or not the observation reports information on Sales. Complete data refers to cases when all the basic information (sales, capital and labor) is available for analysis.

An important limitation of the Enterprise Survey data set is a relatively high non-response incidence, particularly regarding information that is sensitive or difficult to access.[43] Table 9 presents a summary of the total number of establishments available in the survey per country, and the potential sample size based on alternative criteria for data item completeness. The minimum eligibility criteria is to restrict the data to those observations with no more than 500 permanent workers, those that reported total sales last year and those with information about unions.[44] These criteria reduce the sample by almost 14% (call this the "eligible sample"). The sample is reduced by 40% when one requires that establishments have complete information not only on sales and union status, but also capital and production cost, which are fundamental for a productivity analysis.

[43] The absence of information for certain items in the survey could be reported as missing due to the subject's refusal to answer, they did not know the information asked or the question was not applicable for the establishment.
[44] In the whole sample, only 98 observations correspond to establishments with more than 500 permanent workers. These observations are excluded from the analysis because there are not enough observations for union and non-union establishments to provide reliable comparison groups in most countries (Mexico is the exception), potentially biasing the estimates. In regressions not shown here, it was observed that some of the estimations were sensitive to the inclusion of these large establishments to the sample.

Even though the analysis could be conducted removing the incomplete cases, there are various problems that could arise from working with such a restricted sample. As Little and Rubin (2002) indicate, case-wise deletion can provide valid inferences only if the share of deleted cases is small or if the data are missing completely at random (MCAR).[45] If this is not the case, the missing information might be systematically different from the observed data, and inferences obtained from a complete set might be significantly biased.

If the systematic differences in the data can still be captured by the rest of the observed characteristics, a second alternative to the case-wise deletion is to use a reweighting approach. Under the assumption that the information is Missing at Random (MAR), this strategy suggests that it is possible to find an appropriate reweighing scheme using a well specified probabilistic model of missingness, so that the distribution of the characteristics of the complete sample can be used to mimic that of the full sample. This way, estimations obtained using this strategy should correct observed sample differences between observed and the missing data. The problem with these two methodologies, in the framework of this paper, is that using the completed case sample implies a large average loss of information (40%). Even with the reweighted strategy, the high incidence of missing data might still generate inconsistent estimates, if the reweighting scheme is not appropriate or if the MAR assumption is grossly violated.

A third alternative, used in this paper, is to use a Multiple Imputation (MI) approach, which is a flexible simulation based technique used for handling missing information. The imputation process is based on the assumption that all the missing information are "missing at

[45] In the nomenclature of Little and Rubin (2002), data are missing completely at random if the probability of being missing does not depend on any observed or unobserved data. A weaker condition is missing at random (MAR) or ignorable non-response, which means that outcomes are the same for missing and non-missing observations once one conditions on measureable covariates.

random" (MAR) in the sense of Little and Rubin (2002). Similar to the reweighted approach, this implies that the probabilistic process that characterizes the missingness of information can be explained entirely by the observed information. Under this assumption, this approach uses all information available to create multiple samples with independent imputations for the unobserved data. Each imputed sample can be independently analyzed and the results across imputed samples combined to provide a single multiple imputation result.

The advantage this procedure has over a simple imputation approach is that MI introduces new information to the system, by using the empirical distribution of the missing variables. Because this strategy uses all available information, observations with partial missing information are still considered to characterize the missingness and imputation equations. The next section describes the specification and implementation details of the MI strategy used in the paper, while details on the process are explained in appendix B.

3.1. Multiple imputation: Implementation

Since the principal analysis of the paper relies on three main variables--sales, labor and unionization--the working sample is restricted to those establishments with complete information on these three variables. Because most large establishments in the sample are either unionized or non-unionized, which can cause a bias on the estimations, the sample is constrained to observations with at most 500 permanent workers. Given that the interest is to characterize establishments in the private sector, establishments owned by the public sector (more than 50%) are excluded of the analysis. To avoid any bias caused by establishments that recently started their economic activities, the sample is restricted to establishments with at least 3 years of operation in the market. Finally, in order to avoid biases due to errors and inconsistencies within

the data set itself, some minor edits of the data set are implemented.[46] This reduces the working sample from 3,277 to 2,812 enterprises across the 6 countries.

In order to maintain a minimum level of consistency on the imputations across the countries, the specification of the missing information process is kept constant across countries, except for characteristics of region and industry.[47] Regarding other characteristics, the imputation model includes variables, such as market competition, establishment ownership structure, infrastructure characteristics, production policies, investment in research and development (R&D) and physical capital, labor force characteristics and level of unionization at the establishment level. All imputation models are estimated using weights provided in the survey to obtain results representative at the national level. Given that the missingness across the variables of interest is assumed to follow an arbitrary pattern, iterative chained equations (ICE) are used to obtain imputed values given the observed data. While some of the literature recommends that 5-10 imputed samples are enough to obtain appropriate inferences (Rubin, 1987), there are arguments that some applications may need more imputations to obtain stable results (Horton & Lipsitz, 2001). Given the incidence of missing information, 50 imputed samples are used to provide the main results. Results using fewer imputations are also provided to show the stability of results. Finally, following the literature an examination of the imputed data suggests that 20 iterations for the burn-in period are sufficient to achieve convergence on the system (van Buuren, 2007).[48]

[46] In some instances, information such as wages, sales or costs are either too high or too low, compared to other information within the establishment and compared to other similar establishments that can be interpreted as typos on transcription. Depending on each case, the values were inflated or deflated (reducing the excess of zeroes), or change the value to missing data.

[47] The regions with major economic activity are selected for interviews in each region. The industry fixed effects correspond to the ISIC codes 15-37 (ISIC Rev.3.1). A complete list of the variables that are used in the imputation process can be found in the appendix C.

[48] Appendix D provides a plot of the means and standard deviations of the main imputed variables used to analyze the stability of the processes.

One cannot rule out the possibility that part of the information in the dataset is "missing not at random" (MNAR), depending in part on unobserved and unmeasured characteristics, potentially introducing non-ignorable response bias. Graham, et al. (1997) show that the sensitivity of results to the observed missing process is frequently small in the multiple imputation framework. Moreover, they indicate that even under such circumstances, the MI approach might provide better inferences than working with samples with complete reported data.

Table 10. Multiple Imputation Summary

Variable	Method	Complete	Imputed	% Imputed	Total
Nr of workers in t-1	PMM	2623	189	6.7%	2812
Cost of labor as share of sales	PMM	2563	249	8.9%	2812
Cost of electricity as share of sales	PMM	2572	240	8.5%	2812
Cost of communications as share of sales	PMM	2570	242	8.6%	2812
Cost of materials and inputs as share of sales	PMM	2479	333	11.8%	2812
Cost of fuel as share of sales	PMM	2441	371	13.2%	2812
Cost of transportation as share of sales	PMM	2460	352	12.5%	2812
Cost of water as share of sales	PMM	2408	404	14.4%	2812
Cost of rentals as share of sales	PMM	2453	359	12.8%	2812
Log Nr of workers in t-1	OLS	2623	189	6.7%	2812
Log sales in t-1	OLS	2288	524	18.6%	2812
Log wages production workers	OLS	2721	91	3.2%	2812
Log wages non production workers	OLS	2589	223	7.9%	2812
Log capital (book value)	OLS	1961	851	30.3%	2812
Log capital (market value)	OLS	2346	466	16.6%	2812
Log materials and Inputs	OLS	2441	371	13.2%	2812
Log salaries	OLS	2574	238	8.5%	2812

Note: the complete set of the variables and imputations are shown in appendix C. OLS imputation uses linear predictions to obtain the imputed values. PMM is a predictive mean matching algorithm that uses the value of the closest observation (using predicted means) to impute missing information.

Table 10 presents a summary of the imputations for some of the most important variables in the study. As one can observe, information regarding capital, a fundamental variable in the analysis, has one of the largest incidence of missing information, with 30.3% of missing

information in the case of book value of capital, and 16.6% in the case of hypothetical or market value. Among production costs, the costs of electricity and communication have the lowest missing rates (8.5% and 8.6%), while costs of fuel and water have the highest rates of missing information (13.2% and 14.4%).

3.2. Summary Statistics

Table 11 presents the summary statistics combining imputed samples and using weights provided in the sample. There are a total of 2,812 individual establishment observations distributed across the 6 selected countries. Most of the countries have an incidence of unionization across establishments of between 20-30%.[49] The exceptions are Bolivia, that has one of the lowest shares of unionized establishments in the sample (13.4% or 7.0% weighted), and Argentina, that has more than 90% of establishments reporting some level of unionization.

Across all countries, there are some consistent characteristics that distinguish union from non-union establishments. Unionized establishments are larger (in terms of number of workers) than their counterparts and operate for longer hours per week. With the exception of Chile, unionized establishments show a more intensive use of their installed capital. It is possible that longer hours of operation and more intensive use of capital are attributed to the desire to increase utilization of the fixed-cost capital in industries with high capital intensity.

Except for Argentina, unionized establishments have higher levels of sales per capita than their counterparts, and with the exception of Argentina and Mexico, unionized establishments have higher levels of capital intensity.[50,51] Unionized establishments are on average older as

[49] An establishment is classified as unionized if any share of their workforce is considered to be part of a union.
[50] Per capita measures are calculated dividing the variables of interested by the total number of permanent workers plus equivalent temporary workers in the establishment.
[51] Capital per capita is calculated using hypothetical or "market value" of capital. It represents the value that the establishment estimates they could receive for the machinery and equipment, considering its productivity and compared to similar equipment in the market. Following the directions from the questionnaire manual

compared to their non-union counterparts.[52] With the exception of Argentina, companies owned by foreign capital are more likely to be unionized, but establishments where the main shareholder owns more than 50% of the company are less likely to be unionized. In all countries but Panama, unionized establishments are more likely to have some type of certification for production quality. Similarly, unionized establishments are on average more likely to invest in physical capital and research and development.

In terms of workforce characteristics, unionized establishments are more likely to have an ongoing training program, with larger shares of the workforce trained. Apart from Chile, unionized establishments are characterized by larger shares of productive workers but, at the same time, such establishments are also less likely to employ workers with more than 7 years of education. With respect to temporary workers, there is little pattern across countries, although the shares of this type of workers are generally low, except in Bolivia and Panama.[53]

(http://www.enterprisesurveys.org/~/media/FPDKM/EnterpriseSurveys/Documents/Methodology/Questionnaire-Manual.pdf), hypothetical capital is the preferred measure for capital intensity.

[52] There is no information available on when unions formed within the establishment.

[53] Full-time temporary or seasonal employees are defined as all paid short-term (i.e. for less than a fiscal year) employees with no guarantee of renewal of employment contract) and work 40 hours or more per week for the term of their contract.

Table 11. Summary Statistics

	Argentina		Bolivia		Chile	
	Non union	Union	Non union	Union	Non union	Union
Nr of establishments	46	494	258	40	415	149
Share	8.5	91.5	86.6	13.4	73.6	26.4
Share weighted	11.0	89.0	93.0	7.0	71.9	28.1
Union density (% unionized)		68.50%		5.80%		13.00%
Log sales per capita	10.58	10.46	8.79	9.66	10.41	10.77
Nr of equivalent permanent workers	22.73	58.27	28.07	143.03	40.69	115.24
Log capital (market value) per worker	9.13	8.99	7.75	8.83	8.84	9.22
Cost of labor as share of sales	19.1%	24.3%	23.1%	19.9%	24.7%	21.9%
Cost of inputs as share of sales	37.3%	42.7%	39.0%	37.1%	42.5%	42.1%
% Level of utilization of facilities	66.6%	70.2%	62.5%	63.7%	72.3%	68.5%
Avg hrs. of operation per Week	70.03	62.33	59.12	82.05	64.23	81.51
%Sales coming from manufacture	93.5%	93.4%	97.4%	98.7%	95.1%	98.1%
%Sales subcontracted	17.4%	8.7%	12.1%	13.5%	6.9%	4.9%
Age of firm	25.01	35.19	21.76	29.60	25.94	41.30
Exp. top manager	30.39	27.65	21.15	19.73	26.53	24.14
Owned by foreign capital	5.5%	5.0%	3.9%	28.7%	2.1%	7.1%
>50% own by largest shareholder	93.8%	75.2%	84.8%	65.2%	90.1%	80.6%
Quality certification	16.5%	24.8%	8.6%	38.4%	19.8%	37.1%
New production or process	79.4%	80.1%	83.7%	93.7%	78.3%	74.9%
Investment in R&D or capital	75.2%	75.4%	62.0%	79.4%	77.9%	82.6%
% with no training program	72.4%	47.3%	42.2%	30.8%	60.7%	41.4%
% with 1-33% trained wf	0.9%	13.5%	20.6%	11.1%	21.0%	20.4%
% with 34-66% trained wf	0.2%	8.6%	17.0%	22.3%	8.2%	17.8%
% with 67-100% trained wf	26.5%	30.5%	20.1%	35.7%	10.1%	20.5%
Share prod Workers	63.2%	73.7%	65.0%	72.3%	70.7%	65.8%
Share skill Workers	53.6%	55.7%	68.6%	61.2%	54.7%	64.1%
% with 7+ yrs avg worker education	99.7%	97.6%	81.6%	70.0%	98.5%	94.0%
Share temporary workers	10.5%	5.6%	28.3%	14.9%	9.0%	5.8%

Note: The averages are calculated using survey weights and all imputed data. [a]The Share of seasonal workers is defined as number of total temporal workers divided by total number of permanent and temporal workers.

Table 11. Summary Statistics (Continued)

	Mexico		Panama		Uruguay	
	Non union	Union	Non union	Union	Non union	Union
Nr of Establishments	639	335	148	37	181	70
Share	65.6	34.4	80.0	20.0	72.1	27.9
Share weighted	72.6	27.4	78.9	21.1	79.4	20.6
Union Density (% unionized)		21.00%		12.30%		10.80%
Log sales per capita	9.69	9.95	10.15	10.53	9.94	10.30
Nr of equivalent permanent workers	24.72	69.59	32.94	80.79	21.90	45.88
Log capital (market value) per worker	8.31	8.27	8.90	10.36	8.64	8.91
Cost of labor as share of sales	25.6%	24.5%	20.8%	23.5%	21.3%	19.0%
Cost of inputs as share of sales	26.9%	26.7%	34.3%	39.9%	47.4%	46.4%
% Level of utilization of facilities	73.9%	73.8%	71.8%	79.6%	65.9%	64.9%
Avg hrs. of operation per Week	60.69	67.45	55.81	67.79	70.35	88.36
%Sales coming from manufacture	96.4%	99.0%	93.4%	91.0%	96.8%	96.5%
%Sales subcontracted	8.5%	13.2%	5.6%	10.1%	9.4%	8.0%
Age of firm	17.61	22.71	23.30	35.52	27.41	33.70
Exp. top manager	16.90	19.02	22.08	26.14	25.29	26.70
Owned by foreign capital	1.6%	6.6%	8.0%	9.2%	2.7%	13.1%
>50% own by largest shareholder	84.5%	73.2%	89.2%	76.4%	82.7%	64.6%
Quality certification	9.8%	25.9%	11.2%	7.7%	6.6%	14.5%
New production or process	26.3%	57.0%	73.8%	65.9%	70.9%	82.0%
Investment in R&D or capital	22.6%	48.9%	63.9%	78.8%	56.0%	64.6%
% with no training program	87.2%	49.5%	58.3%	38.9%	76.8%	47.5%
% with 1-33% trained wf	1.9%	5.1%	15.2%	14.6%	10.1%	24.7%
% with 34-66% trained wf	4.4%	14.3%	10.7%	23.7%	4.9%	6.7%
% with 67-100% trained wf	6.5%	31.2%	15.7%	22.8%	8.3%	21.1%
Share prod Workers	72.8%	74.4%	66.2%	71.1%	72.8%	74.0%
Share skill Workers	85.3%	78.1%	74.4%	78.7%	56.4%	57.7%
% with 7+ yrs avg worker education	13.3%	10.6%	94.8%	93.7%	64.9%	58.2%
Share temporary workers	4.1%	6.0%	16.6%	18.9%	7.8%	7.0%

Note: The averages are calculated using survey weights and all imputed data.[a] The share of seasonal workers is defined as number of total temporal workers divided by total number of permanent and temporal workers.

4. Econometric strategy

To determine the effects of unions on productivity, the starting point is the basic model developed by Brown and Medoff (1978). This is a variant of a Cobb-Douglas production function that distinguishes between two types of workers (non-union and union). Assuming constant returns to scale, the production function can be written as follows:

$$Q_i = A_i K_i^{\alpha} \left(L_{i,n} + cL_{i,u}\right)^{1-\alpha} \quad (1)$$

where Q represents a measure of output or productivity, K is the level of capital, L_n and L_u are nonunion and union workers respectively, all measured at the establishment level *i*; A is the constant of proportionality that depends on the measurement units of capital, labor and output, and accounts for other characteristics that determine productivity; and "α" and "1-α" are the output elasticities with respect to capital and labor, assuming constant returns to scale. In this framework, 'c' reflects the productivity differences between union and non-union labor. After some manipulation, equation (1) can be linearized and written as:

$$\log q_i = \log A + a * \log k_i + \delta * P_i \quad (2)$$

where $q = \frac{Q}{L}$ and $k = \frac{K}{L}$ are measures of labor productivity and capital per capita, $P = \frac{L_u}{L_u + L_{nu}}$ is the share of unionized workers in the establishment, and L is total number of workers in the firm $L = L_u + L_{nu}$. Here δ represents the overall impact that unions have on establishment labor productivity, once we control for capital intensity.

Since equation (2) is rather restrictive since it assumes constant returns of scale, a more flexible specification is used, following a general form of a translog specification for the production function (Christensen, Jorgenson, & Lau, 1973). Thus, after including an error term, and additional controls for productivity, the specification to be estimated can be written as follows:

$$\log q = \alpha_0 + \alpha_1 * \log k + \alpha_2 * \log L + \alpha_3 \log K^2 + \alpha_4 \log L^2 + \alpha_5 \log K \log L +$$

$$\delta P + X'\beta + e \qquad (3)$$

Although specifications similar to this have been widely used in the literature, there are important limitations that need to be considered (for details on the discussion see Brown and Medoff 1978 and Hirsch and Addison 1986). First, the measurement used as proxy for labor productivity can affect the estimations on the productivity impacts. While physical units of production per capita are preferable, this paper, as in most of the literature, uses value added, which is defined as annual sales minus production costs on materials, electricity and water, divided by total labor force. The potential problem with this measure is that the estimated impact of unions on productivity might confound effects on both prices and quantity. In relatively non-competitive product markets or in industries that are highly unionized (i.e., most firms pay wages close to or at union levels), higher union wages can be shifted to consumers in the form of higher prices and hence higher value added. According to Hirsch (2004b), such a problem might not be severe for firm or establishment level studies, since price effects can be mitigated by controlling for industry fixed effects and measures of market competition.

A second problem of this specification is that it assumes union and nonunion establishments share the same production function, except for the productivity parameter associated to unions. This ignores the possibility that the sectors have different production functions and factor elasticities. Although this problem could be solved by introducing a full set of interactions in the model, the identification of the parameters might require richer information (in particular larger sample sizes) than what is available. While this problem could be more serious when using a restrictive functional form, the flexibility one obtains using a translog production function (equation 3) would help reduce the severity of the problem. Furthermore, in

order to increase the flexibility of the production function, additional controls for infrastructure use, labor characteristics and investments are included in the specification.

Perhaps the most vexing problem is the potential endogeneity of establishment unionization. This can be caused either by omitted information or reverse causality. Establishments with and without unionized workers might differ systematically in other unmeasured aspects, such as management quality, workers attributes, or performance history, among other things, and not controlling for these specific factors would create inconsistent estimations. According to Clark (1984), however, one might not expect unionization and sales to be simultaneously determined, since unionization should have happened long before the interview of the survey, and current sales should not determine unionization status. Nevertheless, concerns with respect to the inter-temporal effects of unionization remain. If union productivity effects do not fully offset union wage effects, profits will be lower and businesses will be less likely to survive. This survivor bias should lead to overstate union productivity effects since businesses with detrimental union effects on performance are least likely to remain in the sample (Addison and Hirsch 1989). Although concerns related to inter-temporal effects cannot be addressed, since the analysis uses cross sectional data, the preferred specifications include variables such as age of the firm, manager experience and ownership characteristics, that would help capture some aspects of managerial quality in the firm, as well variables correlated with investment policies, and workforce structure, that would ameliorate the estimates.

Although there are alternative methodologies that could be used to better identify the effects of unions on productivity, available data do not provide enough information to exploit time variation, or adopt an instrumental variable approach. The rich information the data set

used in this paper, however, allows for a very flexible and detailed specification of the production function that can mitigate the bias of otherwise unobserved characteristics. Nevertheless, because some unobserved factors related to productivity might remain, the estimations and inferences must be considered with care, and should not be interpreted as causal effects. To test how sensitive are productivity estimates to the controls, different specifications are used to control for aspects related to market competition, establishment characteristics and organization, and innovation policies. Though the estimates here presented are "descriptive" in nature, the evidence is informative, as they are the first step to identify how unions affect productivity in developing countries.

5. Results

The estimated model follows the specification shown in equation (3). The natural logarithm of value added per worker is used as the productivity measure, where value added is measured as total sales in the last fiscal year minus production costs in water, electricity, fuel, materials and intermediate inputs. Value added taxes are included in the sales measurement. For observations where production costs exceed the value of total sales, total cost is constrained and controlled for using a dummy.[54] For the production factors, employment is measured as the total number of permanent workers plus the equivalent number of seasonal workers, while capital is measured as log of the market value (hypothetical capital) of machinery and equipment (including vehicles).[55] In addition, the basic model includes controls for region and (1 digit) industry fixed effects. The main variable of interest, union density, is included as a share

[54] Overall, only 1.3% of the observations fall within these characteristics.

[55] Equivalent seasonal workers are measured as the total number of temporary workers multiplied by the average time a temporal worker participates in the establishment in a year. As described in the survey manual, information collected on the market value (hypothetical value) of capital is recommended to be used as the best approximation for capital intensity in the establishment.

between 0 and 1, which indicates what share of the permanent labor force in the establishment is unionized.

Table 12. Effect of Unions on Establishment Productivity, by Country

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
Avg. % unionization in union establishments	77.0%	82.5%	46.2%	76.8%	58.2%	52.2%
%Workforce unionized	-0.389+	0.160	0.167	0.095	0.256	0.178
	(0.026)	(0.695)	(0.353)	(0.555)	(0.467)	(0.448)
Log capital pc	-0.777	0.316	-0.45	-0.086	-0.248	-0.114
	(0.306)	(0.421)	(0.194)	(0.650)	(0.490)	(0.717)
Log total labor force	-0.427	-0.792	-0.443	0.19	0.045	0.522
	(0.425)	(0.150)	(0.357)	(0.548)	(0.951)	(0.549)
Log K log L	-0.012	0.161*	-0.005	-0.015	-0.001	-0.034
	(0.878)	(0.004)	(0.914)	(0.595)	(0.986)	(0.520)
Log K^2	0.033	-0.027	0.027	0.017	0.012	0.008
	(0.380)	(0.250)	(0.122)	(0.115)	(0.546)	(0.606)
Log L^2	-0.001	-0.124	0.000	-0.031	-0.031	0.029
	(0.983)	(0.162)	(0.998)	(0.395)	(0.646)	(0.813)
Constant	13.648*	6.917*	11.143*	7.987*	10.390*	8.291*
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
$\delta VA_{pc}/\delta K$, at means	-0.006	0.207	0.203	0.250	0.043	-0.026
$\delta VA_{pc}/\delta L$, at means	0.196	-0.104	-0.055	-0.068	0.093	0.409
Observations	540	298	564	974	185	251

Note: ^ p<0.1, + p<0.05, * p<0.01. P-values in parentheses. All models are estimated using sample weights. All models include region and broad industry fixed effects.

5.1. Basic Model

Table 12 presents the results of the basic specification which controls only for production factors, and region and industry fixed effects. These basic results show that for most countries in our sample, unions have a positive but weak correlation with productivity. In the absence of endogeneity, the point estimates indicate that, on average, if a nonunion establishment unionizes it could increase productivity per worker between 0.077 log points (approximately 8%) to up to 0.149 log points (15%).[56] Although the point estimates are economically sizable, the results also

[56] The average marginal effect is obtained by multiplying the union coefficient estimate by the average unionization rate among union establishments (i.e. Marginal effect in Bolivia: 82.5%*0.16=0.132 log points).

indicate that there is considerably large heterogeneity on the effects of unions across establishments, producing estimates of the effect that are not significant at conventional levels (p-values are high). The only exception corresponds to Argentina; this estimate not only shows that unions have a large negative impact on productivity (-0.389*77%=0.299 log points), but also that the results are statistically significant. It should be kept in mind that different from other countries in the sample, most of Argentina's manufacture establishments are unionized.[57]

Given the type of production function used here, the coefficients for capital and labor are more difficult to interpret than in the standard Brown and Medoff model. To ease interpretation, at the bottom of Table 12, the derivatives with respect to labor and capital are obtained and evaluated at the mean. The parameters are consistent with respect to the expectations for Bolivia, Chile and Mexico. In Argentina, Panama and Uruguay, however, the estimates are somewhat inconsistent with the expectations as the marginal effect of capital is almost zero, with a positive marginal effect from Labor. Although these results are worrisome, they remain consistent across different specification, and should not to be crucial for the main focus of the analysis.

5.2. Sensitivity to Additional Controls

As mentioned earlier, the model estimated in Table 12 has many shortcomings as it does not take into account other characteristics that can explain productivity or that can differ between unionized or non-unionized establishments. In Tables 13 and 14, estimations using richer specifications are provided. In Table 13 presents results of the union productivity effect only, to show how sensitive the estimates are to additional controls, while Table 14 presents the results of the full specification model.

[57] The estimates of the basic specification using the basic Brown and Medoff (1978) model are shown in appendix E. The results are comparable to the estimations of Table 5, except for Bolivia, where the Brown and Medoff basic model predicts a much larger (and not plausible) productivity relationship.

The first factor to be considered is the effect of market competition on union effects. Controlling for the level of competition should improve the estimates by accounting in part for differences in prices caused by union effects on labor costs. The second row of parameters shown in Table 13 provides the estimates after adjusting for the level of competition the establishment faces, defined by the number of competitors in the market. It shows that while in Chile and Uruguay, adjusting for market competition greatly reduces the effect that unions have on productivity, with the estimates for Uruguay becoming negative. In Chile, these results seem to be driven by the impact that some competition (2-5 competitors in the market) has on sales and productivity (see Table 14). In Uruguay, although the same characteristics can be observed for the partial model (not shown here), after controlling for other factors, competition seems to have a small and not significant impact on productivity.

The next factors to be considered are adjustments to the production function. While one of the assumptions is that all of last year sales come from manufactured goods produced using full capacity of the resources during the last year, such an assumption might not be accurate. On the one hand, some establishments could show higher (lower) productivity because they operate longer (shorter) hours per week. In a similar manner, given the specific conditions of the market, establishments could have different use of the production capacity of their infrastructure. On the other hand, although the assumption is that all sales are self-produced, some establishments might subcontract production to smaller units, while others might generate sales via services. In both cases, they might overstate productivity in the establishment, as these sales structures might not be reflected in their cost structure in materials. In order to control for these factors, variables for the level of utilization of capital, log hours of operation per week, share of sales not from manufacture and share of sales sub-contracted are included in the specification.

Results in line 3 of Table 13 show that the union coefficients increases (in absolute value) following these productivity adjustments. Chile and Uruguay show the most drastic changes on productivity, to the extent that using these controls revert the negative impact observed when competition controls were included in the specification. Modest positive changes are observed for all other countries. The results in Table 14 show that the parameters for these controls are consistent with the expected signs, as all parameters have either positive or negative and non-significant coefficients, with the exception of Uruguay and Log hours of operation.

A third set of factors that could be correlated with union status, as well as production capacity, are the experience, management quality and organization within the establishment. The summary statistics show that unionized establishments are "older," more likely to be part of larger firms, and more likely to be owned by foreign capital. Controlling for these factors has a strong impact on the union estimates, reducing the productivity relationship in Bolivia, and increasing it in Chile, to almost significant levels (p=12.5%). According to the results shown in Table 14, the main reason that might explain this fall in the union-productivity relationship in Bolivia is that most of the positive effect was driven by foreign owned companies, which is positively related with union status. For Chile, on the other hand, it seems that the source of productivity trade-off comes from the returns to establishment age. According to the results in Table 14, Chile is the only country for which younger establishments, which are less likely to be unionized, are more productive than older ones, thus helping to explain the observed changes in estimates. For the rest of the countries, the results in Table 14 are consistent with the expectations. Being part of a larger firm and being owned by foreign capital have a positive impact on productivity, which can be traced to better managerial policies among multinational companies compared to among local establishments in Aitken, et al. (1996).

In terms of management quality and organization, these characteristics are controlled for by including variables describing of ownership and managerial experience. Argentina and Panama show the largest positive change on estimates of the union-productivity relationship when these controls are included to the specification. These results could be indicating that, in Argentina and Panama, unionized establishments have relatively more inefficient management (compared to non-union establishments), which was previously putting downward pressure on productivity. This can be directly observed in the results of Table 14 which suggest that the strong relationship between productivity and decision strength of the largest shareholder (i.e. if a single shareholder owes more than 50% of the company) is the main factor explaining the impact on the union-productivity relationship. Although not reflected in the union-productivity relationship, the results in Table 14 also suggest that female owned establishments are less productive, similar to the results obtained in Bruhn (2009).

Although some of the previously discussed controls could arguably be described to be unaffected by the presence of unions, aspects such as investment policies, training and workforce structure are more likely to be affected by unions presence in the establishment. In the interest of disentangle the direct effect that unions may have on productivity, different variables that control for these characteristics. As seen in Table 14, most controls have the expected positive impact on productivity, with the exception of Bolivia, where the introduction of new technological procedure or product has a negative and significant impact on productivity. Under the assumption that unions have a negative impact on investment (rent seeking behavior), controlling for investment should have a positive impact on the union-productivity relationship. The results on Table 13, however, indicate that controlling for these factors have no significant impact on the union estimates, despite the differences that were observed in the summary statistics.

Because unions are often associated with lower turnover due to some combination of higher wages and collective voice, unionized establishments might be more likely to provide more training, since they can receive some of the returns of such investment through higher productivity. Although human capital upgrades, due to higher training, are legitimate sources of productivity enhancements, such improvement might not necessary generate improvements in technical efficiency. In general, union establishments are more likely to have an active training program with larger coverage among their employees. Including training as a control variable in the estimations (see Table 14) shows that, on average, training has a positive, mostly not significant, impact on productivity, with the exception of Bolivia that shows a negative but non-significant effect on productivity. Adding these controls to the specification (see Table 13) has the expected negative effect on the union-productivity relationship in Bolivia and Panama, indicating it is an important channel through which unions operate in these countries. For the rest of the countries, negative, but small, changes on the estimates are also observed.

One last aspect that unions can influence within the establishment is the structure of the labor force and differences in workforce composition and characteristics within union versus nonunion establishment. As shown in the last row of Table 13, these controls have little impact on the productivity estimates, with the most substantial change being the productivity increase in Bolivia (from a negative 10% to an almost zero effect), and decrease in the coefficients in Chile.

Table 14 provides more comprehensive results (i.e., coefficients on the controls) for the full specification shown in the last line of Table 13. The coefficients on control variables, as seen in Table 14, are somewhat consistent across countries and expectations, despite the reasonably high collinearity between some measures such as workforce education, share of skill workers, and workers training. Along these lines, higher worker education and larger share of

skill workers has a positive impact on productivity, and when negative, it is not significant. The results also show that seasonal workers are less productive than full time workers, except in Argentina, where is positive but not significant. The coefficients on the share of production workers might be regarded as puzzling, but it seems likely that such estimates reflect the positive impact of non-production workers on productivity, as seen from similar results in Black and Lynch (2001). Finally larger shares of female workers in the establishment are negatively correlated with productivity for most of the countries.

Although there is limited evidence on union's productivity effects for these countries in the literature, those which exist appear consistent with the results found here. Using information from a national survey of manufacturing in Mexico in 1999, Fairris (2006) finds that unionized establishments are about 11% more productive than their counterparts (compared to the 9% estimate here). In the case of Uruguay, Cassoni, et al. (2005) finds a modest 5.7% effect, qualitatively similar to the 12% (0.12 log points) found here. These similarities increase the confidence in the results shown in Table 13.

Table 13. Effect of Unions on Establishment Productivity, Sensitivity to Specifications

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
%Workforce unionized	-0.389+	0.160	0.167	0.095	0.256	0.178
Basic model	(0.026)	(0.695)	(0.353)	(0.555)	(0.467)	(0.448)
%Workforce unionized	-0.388^	0.190	0.038	0.114	0.286	-0.083
+Competition	(0.054)	(0.662)	(0.832)	(0.447)	(0.401)	(0.763)
%Workforce unionized	-0.328+	0.232	0.156	0.145	0.280	0.117
+Productivity adjustments	(0.028)	(0.609)	(0.316)	(0.382)	(0.419)	(0.578)
%Workforce unionized	-0.322+	-0.013	0.251	0.101	0.305	0.072
+Firm characteristics and ownership	(0.034)	(0.976)	(0.125)	(0.535)	(0.393)	(0.755)
%Workforce unionized	-0.264^	-0.034	0.219	0.073	0.407	0.114
+ Management and organization	(0.058)	(0.930)	(0.170)	(0.620)	(0.242)	(0.570)
%Workforce unionized	-0.273^	-0.05	0.254	0.049	0.461	0.092
+Investment policy and technology	(0.090)	(0.891)	(0.117)	(0.732)	(0.178)	(0.683)
%Workforce unionized	-0.279^	-0.101	0.251	0.026	0.378	0.073
+Training	(0.097)	(0.797)	(0.118)	(0.863)	(0.272)	(0.787)
%Workforce unionized	-0.257+	-0.009	0.173	0.093	0.349	0.117
+Labor force structure	(0.049)	(0.981)	(0.281)	(0.539)	(0.295)	(0.558)
Observations	540	298	564	974	185	251

Note: ^ p<0.1, + p<0.05, * p<0.01. P-values in parentheses. All models are calculated using all controls specified in the previous model. All models are estimated using the sample weights, and include region and broad industry fixed effects.

Table 14. Effect of Unions on Establishment Productivity, Full Specification

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
%Workforce unionized	-0.257+	-0.009	0.173	0.093	0.349	0.117
	(0.049)	(0.981)	(0.281)	(0.539)	(0.295)	(0.558)
Competition						
Establishment has 2-5 competitors	0.044	-0.342	0.443+	-0.359*	-0.009	-0.425
	(0.850)	(0.331)	(0.013)	(0.002)	(0.970)	(0.268)
Establishment has 5 or more competitors	-0.105	-0.209	0.154	-0.287+	0.138	-0.368
	(0.718)	(0.509)	(0.323)	(0.016)	(0.645)	(0.217)
Establishment faces international market	-0.047	-0.206	0.029	0.341	0.127	0.046
	(0.822)	(0.510)	(0.908)	(0.261)	(0.765)	(0.876)
Capacity and Utilization						
Level of utilization of capital	0.008*	0.006^	0.002	0.002	-0.001	0.016*
	(0.004)	(0.060)	(0.236)	(0.210)	(0.890)	(0.003)
Log hours of operation per week	-0.245	0.148	-0.128	0.062	0.152	-0.239^
	(0.230)	(0.454)	(0.165)	(0.643)	(0.569)	(0.086)
%Sales not from manufacture	-0.014	1.203	0.927+	0.796	1.326^	-1.012
	(0.972)	(0.288)	(0.041)	(0.240)	(0.058)	(0.418)
%Sales that are subcontracted	-0.246	0.275	0.190	0.116	0.206	-0.430
	(0.224)	(0.408)	(0.357)	(0.619)	(0.614)	(0.201)
Firm Characteristics						
Owned by foreign capital (>50%)	0.227	0.727+	0.239	-0.117	0.335	0.182
	(0.472)	(0.013)	(0.274)	(0.540)	(0.280)	(0.734)
Establishment part of larger firm	0.150	-0.311	0.073	0.084	0.107	0.220
	(0.343)	(0.307)	(0.541)	(0.440)	(0.750)	(0.620)
Age of the establishment	0.009	0.028	-0.010	0.027*	0.002	0.006
(Years since beginning of operation)	(0.236)	(0.107)	(0.111)	(0.000)	(0.896)	(0.524)
$Age^2/100$	-0.006	-0.009	0.007	-0.029*	-0.007	-0.0004
	(0.101)	(0.587)	(0.173)	(0.000)	(0.711)	(0.960)
Management and Organization						
>50% own by largest shareholder	0.128	-0.234	0.031	-0.036	0.541^	-0.034
	(0.439)	(0.378)	(0.751)	(0.653)	(0.051)	(0.845)
Any of the main owners female	-0.043	-0.331^	0.052	-0.214*	0.366^	-0.264
	(0.683)	(0.066)	(0.615)	(0.004)	(0.071)	(0.223)
Experience top manager	0.018	0.028^	0.007	0.000	-0.039	-0.009
	(0.254)	(0.069)	(0.456)	(0.982)	(0.253)	(0.780)
$Experience^2/100$	-0.042+	-0.097*	-0.023	-0.005	0.076	-0.002
	(0.013)	(0.010)	(0.170)	(0.760)	(0.246)	(0.965)
Public or private	-0.057	0.303	0.150	0.173^	0.283	0.311
Share holding company=1	(0.686)	(0.280)	(0.160)	(0.080)	(0.263)	(0.138)
Investment and Innovation						
Uses foreign company technology	0.312+	-0.064	0.162	0.180	0.422	0.005
	(0.044)	(0.829)	(0.255)	(0.308)	(0.233)	(0.989)
Product quality certification	0.027	0.165	0.150	0.356*	0.514	0.567+

	(0.877)	(0.578)	(0.114)	(0.001)	(0.110)	(0.022)
Introduced new process or product	0.366+	-0.409+	0.211+	0.055	0.130	0.137
	(0.018)	(0.028)	(0.036)	(0.510)	(0.545)	(0.436)
Invested in capital or R&D	0.144	0.053	-0.027	0.156^	-0.003	-0.038
	(0.216)	(0.755)	(0.821)	(0.088)	(0.989)	(0.811)
Training						
1-33% workforce trained	-0.006	-0.275	0.070	0.137	0.472	0.201
	(0.982)	(0.308)	(0.519)	(0.471)	(0.123)	(0.472)
34-66% workforce trained	0.588*	-0.249	0.191	-0.008	0.043	0.322
	(0.001)	(0.284)	(0.293)	(0.960)	(0.873)	(0.409)
67-100% workforce trained	0.200	-0.219	0.121	0.067	-0.174	-0.280
	(0.127)	(0.109)	(0.375)	(0.597)	(0.543)	(0.143)
LF characteristics						
Avg education 4-6 yrs	-0.088	0.174	0.055		-0.271	
	(0.385)	(0.631)	(0.689)		(0.199)	
Avg education 7-12 yrs		0.126		0.167^		
		(0.614)		(0.094)		
Avg education 13+ yrs		0.006		0.365+		0.341
		(0.984)		(0.045)		(0.169)
Share of production workers	-0.882+	-0.448	-0.179	-0.291	0.377	-1.518*
	(0.016)	(0.161)	(0.632)	(0.261)	(0.503)	(0.000)
Share of skill workers	-0.088	-0.148	0.098	0.340+	-0.146	-0.118
	(0.461)	(0.536)	(0.449)	(0.022)	(0.675)	(0.604)
Share of seasonal workers	0.868	-0.843+	-0.499	-1.240	-0.257	-0.831
	(0.419)	(0.017)	(0.335)	(0.119)	(0.826)	(0.477)
Share of female workers	-0.670+	-0.601+	-0.483+	0.182	0.090	-0.313
	(0.037)	(0.020)	(0.035)	(0.320)	(0.796)	(0.569)
Constant	13.614*	7.422*	11.527*	7.361*	7.495*	10.519*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Observations	540	298	564	974	185	251

Note: ^ p<0.1, + p<0.05, * p<0.01. P-values in parentheses. The base categories for competition are those firms facing none or 1 other establishment in the market. For training, the base category corresponds to establishments with no training programs. For education, the base category corresponds to workers with 3 or fewer years of education for Bolivia and Mexico, 7 to 12 years for Argentina, Chile and Panama, and 4-6 years of education for Uruguay. All model are estimated using sample weights, and include region and broad industry fixed effects.

5.3. Interpretation

Taken as a whole, Table 13 results suggest that unions are associated with positive union productivity effects in four of these six Latin American economies, but that there is a lot of heterogeneity in the relationship both within and across countries (the former seen by the low significance levels of results). The results also provide some evidence that the union-

productivity estimates are reasonably robust to richer specifications that take into account typically unobserved establishment characteristics. Using the most complete model as the preferred specification (last row), the most negative results indicate that unions have no effect on productivity in Bolivia (practically zero), a negative and significant estimate in Argentina (-0.284), and a large positive, but insignificant, effects in Chile and Panama, while estimates for Mexico and Uruguay are positive and consistent across specifications, but not highly significant.

Taken at face value, the estimate found for Argentina indicates that output per worker among a fully unionized establishment is 25 log points lower than a nonunion establishment. Were we to obtain such a result in any of the other countries, the obvious question would be how union establishments could survive in the marketplace given lower productivity and (presumably) higher compensation. Argentina, however, is a special case compared to other countries in the region. As seen previously in summary statistics, there are very few establishments in the sample that are *not* unionized, and those non-union establishments that exist tend to be rather different (relatively younger and smaller). From the results presented in Table 13, in Argentina, productivity adjustments and the management and organization characteristics are the main factors affecting union-productivity relationship, generating a negative bias on the estimations.

As Kuhn (1998) and others have argued, negative effects on productivity have been typically found in cases where unions and management are known for a high degree of conflict, which might explain the results observed in Argentina. In Table 15, two aspects of labor regulations and the perception of management are presented. About 44% of establishments in Argentina consider that labor regulations are serious or very serious obstacles for the operation of the establishment, compared to 21% (Uruguay) or lower in other countries in the sample.

Similarly, 60% of establishments declare that labor regulations have affected their hiring and firing decisions; 44% believe they have affected both aspects, which is almost twice as high as in other countries. [58]

Table 15. Perception of Labor Regulations

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
Labor regulations and H/F decisions						
Hire decision affected	8.4	2.2	5.4	0.7	4.3	13.6
Fire decision affected	7.2	3.3	12.6	1.9	6.9	2.1
Hire and Fire affected	44.5	9.3	19.4	3.5	6.1	17.3
Labor regulation as obstacles						
No obstacle	8.1	52.3	29.8	49.6	56.8	38.7
Minor obstacle	12.6	13.8	24.0	25.4	15.9	9.1
Moderate obstacle	34.4	20.2	26.2	19.1	18.8	30.4
Serious obstacle	26.9	7.5	15.6	3.8	7.5	14.0
Very serious obstacle	17.9	3.7	4.4	0.7	0.7	7.0

Note: All information reflects the weighted share of establishments within each category for each country.

Another possible explanation for the negative association between productivity and unionization is the operating structure of unions in Argentina. As described in O'Connell (1999), Argentinian unions are highly centralized and protected by the government, which provides unions fewer incentives to achieve optimal and efficient bargaining deals, potentially harming productivity of firms. As noted in Anner (2008), unions in Argentina also have access to financial information of the employers, which can be used during bargaining. On the one hand, access to financial information can have negative effects on productivity by reducing establishment's flexibility to arbitrarily transfer resources to investment or other types of production purchases, increasing the negative effects of union rent seeking behavior (Connolly, Hirsch, & Hirschey, 1986; Hirsch, 1991). On the other hand, having access to the financial information may also allow unions to better internalize the cost of increasing wages, providing

[58] For more details on establishment perceived obstacles, taxes, regulations, and other topics, including comparisons to countries in the region can be found in the Country Profiles, and accessed at http://www.enterprisesurveys.org/Reports.

an incentive to engage in collective contracts with productivity premium clauses. In an environment of conflict, it is less likely that unions use this information to internalize the effects of higher costs, but, rather, to reduce long term investment as they redirect establishment resources toward higher wages. This eventually leads to the observed negative productivity effects. Nevertheless, given the unique situation of Argentina, there is little reason to suspect that unionized establishments will be highly disadvantaged in the domestic market, since non-union establishments are the exception and union establishments compete primarily with other union establishments.

The positive impact of unions seen in Chile can be associated with the decentralized collective bargaining system that exists between unions and establishments. As Campero (2001) and Vergara (1998) describe, the decentralized bargaining system in Chile has allowed establishments to negotiated wage increases and benefits linked to specific productivity targets, a possible mechanism that could produce the estimated productivity effects. This evidence is consistent with the hypothesis of O'Connell (1999), who indicates that a decentralized collective bargained system can increase productivity by allowing unions to internalize the effects they may have on establishments and facilitating their input in production process decisions. That said, it should be noted that once labor force structure characteristics are taken into account, the union-productivity relationship falls considerably and becomes insignificant.

As seen in Table 13, in the remaining countries, unions appear to have a positive but insignificant effect on productivity (Bolivia is an exception). All these countries indicate that labor regulations are less of a problem than in Argentina. To some extent, this may account for the positive union-productivity effects found in the rest of the economies. It can be argued that the decentralized bargaining system in Panama, as in Chile, explains its large positive union

productivity estimates, but large heterogeneity within Panama makes these estimates insignificant. In Bolivia, Mexico and Uruguay, where union productivity estimates are smaller, there are no specific reasons that might lead one to expect a highly positive or negative union effect. Uruguay has transitioned from a highly centralized bargaining system to one favoring firm-level negotiations that try to incorporate productivity clauses in their contracts (Cassoni, et al., 2005; O'Connell, 1999). These changes, however, do not seem to produce strong positive productivity estimates (of course we cannot observe what productivity differences would be in the absence of this transition).

Estimates for Mexico are consistent with findings in Fairris (2005, 2006), yet the combination of a centralized bargaining system, and conflict between employers and unions reflected in the violation of unions rights, might suggest we could expect unions to have a negative productivity impact. Although Fairris indicates that the union productivity effect in Mexico can be explained by better training, the results presented here show that even after controlling for training, union's productivity relationship remains positive.[59] Finally, in the case of Bolivia, where a combination of centralized and decentralized bargaining system is used, the results of the full specification show that unions have no net effect on productivity. The results also shown that much of the positive union productivity effects is driven by establishment characteristics, in particular the type of ownership; its inclusion as a control has a substantial effect on estimates of union productivity. It could also be the case that the presence of unionized establishments might be too limited (as compared to the other countries analyzed) to generate substantive pressure for productivity enhancements.

[59] Although Fairris (2006) acknowledges that there are other possible explanations for the higher productivity effects observed among unionized establishments, they do not elaborate further on alternative explanations.

6. Robustness

6.1. Unionization measurements

One concern with respect to estimates of the union productivity effects is that union density might be measured with error because employers may not have complete information on union membership within their workforce and report instead a "guestimate" of density. This implies that a categorical union measure of some coverage, or an approximate density rate (say from 1 to 50; 51 to 100 percent, with zero unionization the omitted base group), may contain less measurement error than does a continuous measure of union density.

Table 16 presents estimates using alternatives measures of unionization within establishments, using the same controls as in the full specification (Table 14). Although these results are very informative regarding nonlinear effects of unions, one must keep in mind for countries like Bolivia and Panama there are not enough observations for some of the cells, making the interpretation of their coefficients difficult.

Table 16. Effect of Unions on Establishment Productivity: Alternative Union Measures

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
(1)						
%Workforce unionized	-0.257+	-0.009	0.173	0.093	0.349	0.117
	(0.049)	(0.981)	(0.281)	(0.539)	(0.295)	(0.558)
% unionization	77.0%	82.5%	46.2%	76.8%	58.2%	52.2%
Avg effect on productivity	-0.194	-0.007	0.082	0.071	0.198	0.066
(2)						
Union dummy	-0.347*	0.0331	0.017	0.094	0.138	0.138
	(0.008)	(0.922)	(0.851)	(0.423)	(0.585)	(0.465)
(3)						
Less than 50% unionized	-0.205	0.213	-0.055	0.156	0.010	0.226
	(0.232)	(0.773)	(0.609)	(0.374)	(0.978)	(0.362)
More than 50% unionized	-0.379*	0.003	0.177	0.074	0.290	0.032
	(0.005)	(0.994)	(0.153)	(0.558)	(0.391)	(0.873)

Note: ^ p<0.1, + p<0.05, * p<0.01. P-values in parentheses. All models are estimated using the full specification shown in Table 14.

In the first part of Table 16, the results from the full specification model are used as reference point for the estimated effects, it also includes information on the average unionization rate within establishments that are unionized, in order to estimate the average union effect on productivity (assuming the true union effect is linear in density), which can be compared to the results with the alternative measurements. The first alternative measure uses a dummy for unionization, and its coefficient can be directly interpreted as an average union productivity effect comparing union and nonunion establishments. Some of the estimates are consistent with the estimated average union impact observed in row 1, but not all. In Argentina, the average productivity effects using dummies is larger, in absolute value, than in the preferred specification. In Chile, on the other hand, while the previous estimate was showing a large and positive impact on productivity, the estimates using a dummy indicate that the effect is practically zero. This shows that there is some heterogeneity (nonlinearity) in the effects of unions across different levels of unionization, an outcome resulting in part from the small number of establishments over some ranges of union density.

An alternative strategy, shown in the third section of Table 16, is to estimate the union effects using dummies for different levels of unionization density in the establishment. In Argentina, regardless of the level of unionization, the estimates on the unionization are strongly negative. The negative impact, however, is larger for establishments with higher unionization rates. In Bolivia, establishments with more than 50% of unionization do not show any difference in productivity compared to nonunionized establishments. Although the dummy for establishments with less than 50% of unionization shows a positive estimate, it should be interpreted with care, since there are very few observations in this category.

In Chile, using dummies to identify different levels of unionization shows that the union-productivity relationship is not linear. Establishments with low rates of unionization show negative (although not significant) impacts on productivity, while unions with high levels of unionization show positive estimates of productivity, similar to the ones found using the unionization rate index. Similar results are found for Panama, where establishments with low unionization levels are just as productive as their counterparts, while establishments with high unionization rates are more productive, although the estimates are not significant. Finally, Uruguay and Mexico show patterns that are similar to those observed for Bolivia, where establishments with low unionization rates have higher productivity than those with high unionization rates. Although for Bolivia, Mexico and Uruguay, all results are not significant, they are indicating that low levels of unionization can have a positive impact on productivity.

6.2. Sensitivity to Imputations

An important concern regarding the multiple imputation methodology used here is that if the "missing function" is incorrectly specified, the estimated results might be biased or inconsistent, and will not show the true relationship between unions and productivity. It could also be the case that the number of iterations and choice of numbers of imputed samples are not sufficiently large to draw consistent inferences from the data. To test the sensitivity of the results, three procedures are used to provide alternative estimates of productivity. These are presented in Table 17.

The first row shows estimates using the preferred full specification that includes all imputed samples. The second and third rows show results using the first and last 25 imputed samples. As expected, the results are quite consistent across different number of imputations, which indicates that the imputation models and specifications are internally consistent.

In the fourth and fifth rows, estimations using the complete sample are presented. The fourth row corresponds to a simple case-wise deletion, while the fifth row uses a reweighted scheme, where observations are weighted using the inverse probability of have a complete response. For the first inverse probability weighting strategy, all the information (i.e., all exogenous variables) used in the MI procedure is used, while the logit model is estimated using a stepwise deletion strategy, to prevent over specification of the model.[60] Although these methods of case-wise deletion can generate substantial bias on the estimations due to the large losses of information (Rubin, 1987), if their estimations are similar to the ones obtained using the multiple imputation technique, one can be more confident of the robustness of the results.

Table 17. Effect of Unions on Establishment Productivity: Alternative Imputation Methods

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
%Workforce unionized	-0.257+	-0.009	0.173	0.093	0.349	0.117
	(0.049)	(0.981)	(0.281)	(0.539)	(0.295)	(0.558)
First 25 imputations						
%Workforce unionized	-0.261+	0.0112	0.174	0.0993	0.362	0.119
	(0.048)	(0.978)	(0.273)	(0.511)	(0.310)	(0.520)
Last 25 imputations						
%Workforce unionized	-0.252^	-0.0294	0.172	0.0875	0.336	0.115
	(0.051)	(0.938)	(0.291)	(0.567)	(0.283)	(0.594)
List-wise deletion						
%Workforce unionized	-0.359+	-0.284	0.211	-0.003	0.266	-0.123
	(0.023)	(0.431)	(0.367)	(0.980)	(0.547)	(0.655)
Reweighted scheme (IPW)						
%Workforce unionized	-0.468+	-0.39	0.315	-0.027	0.486	-0.0681
	(0.022)	(0.219)	(0.106)	(0.811)	(0.217)	(0.747)
Obs. complete cases	294	215	409	802	112	136
Observations	540	298	564	974	185	251

Note: ^ p<0.1, + p<0.05, * p<0.01. P-values in parentheses. The regression here uses the same specification as in regressions in Table 14, after deleting observations with incomplete information.

As observed in Table 17, for most of the countries there are not important differences between the results using the completed data without weights and those using the inverse probability weights. All else the same, the IPW results are preferred since they take into account

[60] When all available information is used in the estimated model, the predictions tend to over inflate the inverse probability weights, putting too much weight for specific observations.

information from missing establishments. For Argentina, Chile, Panama, the results are similar in magnitude, with IPW results being somewhat larger than the MI results. For Bolivia, Mexico and Uruguay, however, the list-wise deletion and IPW present estimates that indicate negative effects on productivity.

Although some results using list-wise deletion and IPW strategies differ substantially from the MI strategy, they are not statistically significant. Furthermore, given that the MI estimations are consistent with productivity estimates found elsewhere for Mexico and Uruguay, they remain as the preferred results. Nevertheless, given that we expect, and appear to find, heterogeneity in the impact of unions across industries and establishments, coupled with the small sample sizes of establishments providing complete information, it is not surprising that the estimates are sensitive to variation in the estimation sample.

7. Profitability, profit growth and investment

The evidence provided so far indicates that unions have, on average, positive effects on productivity for most the countries in the sample, with the exceptions being Argentina and Bolivia. It is possible that these productivity enhancements are insufficient to compensate the higher costs imposed by unions (mainly wage costs), which could translate into lower profitability, lower sales growth, and/or lower investment. To provide some empirical evidence on how unions affect performance outcomes beyond productivity, additional models are estimated using different measurements of economic performance, controlling for the same variables as in the productivity equations. While the results cannot be interpreted as causal effects, they can be considered partial effects (correlations) from unions, after accounting for other measurable covariates. The results are presented in Table 18.

The first aspect of interests is to analyze the effect unions have on profitability. For this analysis, a price-cost margin index is used as measurement of profitability, and measures the percent of profit obtain per dollar in sales. Following Hirsch and Connolly (1987), along with other studies in the broader industrial organization literature, in addition to the controls used in the full specification productivity model, the profits equation also controls for the log of the capital-sales ratio. According to the results, in Argentina and Chile unionization is negatively related to profitability, with similar impacts in the two countries (-5.4% Chile and -9.1% in Argentina). Considering how different the union impacts on productivity are in these two countries (Chile being positive and Argentina negative), one might not have expected similar impacts on profitability. Chile's estimated positive productivity effect, coupled with the estimated union wage premium seen in Rios-Avila and Hirsch (forthcoming), should lead to a positive association between union density and the price-cost margin. We do not have an estimate of the union wage gap in Argentina, but the large negative productivity effect should be more than sufficient to guarantee lower profitability.

In Chile, although unions are able to increase productivity, it seems that unionized establishments face larger production costs, apart from those associated with higher labor costs, thus reducing profitability. The profitability results for Argentina suggest that unionized establishments are able to limit their costs. Bolivia is an interesting case, since the estimates show that unionized establishments make about 8 cents more per dollar of sales (this result is not significant). Alternative regressions (not shown here) indicate that while union seem to have no effect on productivity (value added), they are negatively associated with sales, which implies that unionized establishments face lower costs structures. It is also possible that is reflecting the fact that unionized establishments in Bolivia are substantially larger than their counterparts, and as

such enjoy economies of scale that the specification is not able to control for. Evidence from Rios-Avila and Hirsch (forthcoming) shows that union workers in Bolivia earn modest wage premiums. A positive productivity effect strongly suggests that non-labor costs are relatively lower for union than nonunion establishments. For Mexico, Panama and Uruguay, unionized establishments seem to be doing, on average, about the same as their nonunion counterparts, with no important differences in profitability. Based on the evidence presented by Fairris (2003), Falaris (2008) and Cassoni, et al. (2005), unions in these countries generate modest wage gaps (0.07 in Uruguay, 0.15 in Mexico and about 0.20 in Panama), which are plausibly offset by the union productivity effects.[61]

A second measure of interest that can be used to analyze performance is sales growth. For this specification, sales growth is calculated using a three year sales growth between last fiscal year sales, and sales 3 years ago. While this measurement will not reflect the trend of profits in the firm, it can provide an approximation for the long term effects unions have on profits. The results in Table 18 show, however, that there is no clear relationship between sales growth and unionization, with all estimates being non-significant. Since this measure of sales growth relies on self-declared information of past performances, the imprecision of these estimates is not surprising.

Finally, the third measure of performance of interest is related to investment and innovation. On the one hand, the literature indicates that unionized establishments tend to reduce investment, by reducing investment returns in the market (i.e. rent seeking behavior) or by increasing managerial frictions (monopoly face of unions). On the other hand, other authors argue that unions might not reduce and even increase investment, as it reduces "X-inefficiencies"

[61] In Mexico and Panama, the results are based on household data from 1996 and 1997 respectively. In Uruguay, the estimates were obtained using establishment level surveys from 1988 to 1995.

(Machin & Wadhwani, 1991), improving the returns to investment (their evidence of a positive union effect is for the U.K.). More recently, in an analysis of studies for the U.S., U.K., Canada and Germany, Doucouliagos and Laroche (2013) have found that unions are negatively correlated with investment, consistent with unions taxing quasi-rents of capital reducing the incentives to invest in long term investment. The relationship however seems to be related to the level of labor regulations in the country.

To empirically assess the impact of unions on investment and innovation, three variables are used as proxies. The first one indicates if the establishment has introduced a new product or production process in the last three years, the second one indicates if the establishment had any investment on physical capital, while the third one captures if there has been any investment on Research and Development.[62] Although the full specification is used for the estimation, all variables regarding innovation (see Table 14) are excluded from the model. In addition, given that innovation can be a function of the profits trend, controls for whether sales have gone up during the last year is included in the specification.

According to the results obtain in Table 18, unionized establishments in Argentina and Mexico, countries with the most centralized bargaining systems in the sample, are significantly more likely to introduce a new or better production process/product in the market. As seen in Table 14, these types of innovation had a large positive and important effect on productivity. This implies that, to some extent, unionized establishments in Argentina are able to maintain modest losses in profitability, compared to their counterparts, because the indirect gains on productivity (via innovation) offset some of the effects of being unionized. For other countries, only the results for Chile seem consistent with the expectations, with a negative relationship

[62] Although data on resources investment on physical capital and research and development exists, these variables have substantial missing information. In contrast, variables indicating whether or not establishments invested have minimal missing information, thus more adequate for the analysis.

between unions and innovation. For Bolivia, Panama and Uruguay, the estimates are small and not significant.

In terms of investment, both physical capital and R&D, most of the estimates show the expected signs. Argentina, Bolivia, Chile and Uruguay show that unions are negatively related to capital investment, in particular in Uruguay. At the same time, the estimates in Chile and Uruguay show that unions have a negative but sizable effect on the probability of investing in R&D. For the rest of the countries, the estimated parameters are marginal. The results corresponding to Panama are the exception, as both investments on capital and on R&D are positively related to unionization.

Table 18. Effect of Unions on Establishment Performance

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
Profitability						
%Workforce unionized	-0.118	0.0826	-0.119+	-0.0191	0.0118	0.0282
	(0.104)	(0.266)	(0.026)	(0.620)	(0.894)	(0.601)
Sales Growth (last 3 years)						
%Workforce unionized	-0.00658	0.023	0.001	-0.0032	-0.0182	0.016
	(0.642)	(0.698)	(0.887)	(0.396)	(0.331)	(0.451)
Introduced new process or product						
%Workforce unionized	0.120+	-0.0108	-0.059	0.136+	0.0206	0.00995
	(0.022)	(0.894)	(0.440)	(0.042)	(0.885)	(0.971)
Investment in capital						
%Workforce Unionized	-0.0286	-0.0423	-0.083	0.0224	0.255	-0.171
	(0.472)	(0.718)	(0.194)	(0.676)	(0.114)	(0.519)
Investment in R&D						
%Workforce Unionized	0.0005	0.0042	-0.068	0.0103	0.0768	-0.0706
	(0.994)	(0.980)	(0.546)	(0.740)	(0.605)	(0.548)
Observations	540	298	564	974	185	251

Note: ^ p<0.1, + p<0.05, * p<0.01. P-values in parentheses. All models are estimated using the full specification model presented in Table 14. For the models with innovation and investment, those variables are excluded from the model.

8. Conclusions

The effect unions have on productivity is one of the most important and controversial debates in the union literature. Despite the large literature on the topic, little consensus has been found with respect to the precise magnitude or even direction of these effects, although those

summarizing the literature have tended to characterize the union productivity effects, on average, as positive, but small, and highly variable across firms and industries. There is even less information available on what unions do in terms of productivity and performance in developing countries.

This essay has aimed to fill gaps in the literature, studying the effects that unions have on productivity and performance at the establishment level in selected countries in Latin America. These Latin American countries have been historically known for the strong role unions have played in their political and economic histories. Following periods of dictatorships, debt crises and economic recovery, however, these countries developed in ways that have produced substantial heterogeneity in their collective bargaining systems and the roles that unions play in their economies.

According to the results presented here, unions appear to have small but positive effects on productivity across all countries in the sample, with the notable exception of Argentina, where a strong negative productivity effect is found, and Bolivia, where no effect is found. Argentina is clearly a special case, having a unique economic structure in which union establishments are the dominant norm. In contrast, Bolivia has the lowest share of unionized establishments among the six Latin American economies in the sample. The weak positive relationships between unions and productivity observed for Mexico, Panama, and Uruguay appear to be sufficient to offset higher labor costs, with there being no significant effect on profitability. The union-productivity estimates, however, also reveal that there is a large heterogeneity within each country, helping explain the low significance levels of the results.

While some of the observed effects can be linked to explanations related to labor regulations, unions and managements conflicts, economic structure, or unionization

organizations, no single narrative can readily explain all results presented here. Even at the establishment level, a precisely estimated union productivity effect of zero is difficult to interpret, being consistent with unions having either no effects or having offsetting positive and negative effects (say, productivity enhancing voice and/or shock effects offset by decreased managerial discretion). The empirical analyses presented here, however, provide an important step toward a better understanding of the role of unions in developing countries in Latin America, an area where there has been little prior evidence. Given the nature of the data and the limitations they place on modeling, the results presented here cannot be strictly represented as causal effects. Instead, they represent the best estimates of partial correlations that capture a portrait of the net outcomes resulting from unions and collective bargaining in these Latin American economies. With the development of new data, similar analysis can be extended to different regions and time frames, and can open the opportunity for future research that provides a more detailed analysis of the effects and channels through which unions affect establishment performance.

APPENDIX A

Table A1. Union Density and Percentage Share by Occupation Industry and Establishment Size

Bolivia	Unionization Rate	%Share	Chile	Unionization Rate	%Share
Occupation			Occupation		
Professionals	19.9%	10.2%	Professionals	12.6%	8.0%
Technicians	14.7%	12.8%	Technicians	14.8%	10.4%
Office workers	8.2%	9.4%	Office workers	14.5%	17.8%
Service and retail	4.8%	12.8%	Service and retail	11.5%	18.6%
Mine and construction	7.2%	31.3%	Mine and construction	13.1%	18.4%
Machinery operators	30.5%	13.8%	Machinery operators	21.7%	12.9%
Unqualified workers	11.8%	9.8%	Unqualified workers	10.0%	13.9%
Industry			Industry		
Mining	29.0%	3.2%	Mining	41.8%	2.4%
Manufacture	11.9%	22.3%	Manufacture	17.8%	17.6%
Electricity, gas and water	36.5%	1.1%	Electricity gas and water	31.7%	1.0%
Construction	7.5%	17.3%	Construction	7.0%	12.9%
Trade and repair	4.9%	14.2%	Retail, food industry, accommodation	12.2%	25.0%
Accommodation and food	2.7%	5.2%	Transport, storage and communication	16.8%	10.5%
Transportation	28.0%	13.3%	Financial services	11.6%	13.1%
Finance and insurance services	14.0%	2.6%	Communitarian services	12.4%	17.6%
Real estate	6.0%	7.1%			
Educational services	20.4%	4.6%			
Health care and social security	16.2%	3.6%			
Communitarian services	13.7%	5.7%			
Establishment size (nr workers)			Establishment size (nr workers)		
1-9	9.2%	50.2%	1-9	2.4%	20.7%
10-19	9.7%	13.7%	10-19	4.3%	9.7%
20-49	15.2%	13.9%	20-49	7.4%	14.2%
50-99	16.1%	7.6%	50-99	12.0%	10.2%
100-more	25.1%	13.8%	100-more	25.3%	40.3%
don’t know	16.9%	0.9%	don’t know	10.4%	5.0%

Note: Estimations corresponds to the weighted pooled average sample used in the analysis.

Table A2. Marginal Effects Logit Model

P(union=1)	Bolivia	Chile
Sex (male=1)	0.034***	0.028***
	(0.011)	(0.010)
Indigenous(=1)	0.0198	
	(0.011)	
Yrs of schooling	0.004***	0.011***
	(0.001)	(0.002)
Exp (=age-yrs school-6)	0.006***	0.003**
	(0.001)	(0.001)
Exp^2/100	-0.008***	-0.003
	(0.003)	(0.003)
Currently married	0.018*	0.013*
	(0.011)	(0.008)
Head of houshold	0.026**	0.014
	(0.010)	(0.009)
# Children 0-6 years Old	0.009*	-0.004
	(0.005)	(0.005)
# Children 7-17 years Old	0.000	0.010**
	(0.003)	(0.005)
N	9614	17182
LL	-1871529.9	-4502758
Pseudo R2	0.1474	0.0568

Note: * p <0.1 ** p<0.05 *** p<0.01. Note included are the coefficients corresponding to occupation, industry, region and year fixed effects.

Table A3. Detailed Decomposition of Union Wage Gaps Using Preferred Model: Bolivia

Bolivia	Mean	Quantiles				
		Q10	Q25	Q50	Q75	Q90
Total change	0.272***	0.202***	0.213***	0.267***	0.355***	0.273***
	(0.032)	(0.034)	(0.037)	(0.042)	(0.034)	(0.080)
Wage structure	0.114***	0.093**	0.122***	0.147***	0.159***	-0.063
	(0.027)	(0.043)	(0.038)	(0.033)	(0.040)	(0.078)
Composition effect	0.158***	0.109***	0.091***	0.120***	0.196***	0.336***
	(0.027)	(0.032)	(0.030)	(0.025)	(0.040)	(0.053)
Wage Structure						
Sex (male=1)	-0.053	-0.217**	-0.196**	-0.047	0.078	-0.063
	(0.065)	(0.098)	(0.088)	(0.103)	(0.107)	(0.185)
Indigenous(=1)	-0.021	-0.014	0.005	-0.017	-0.003	-0.037
	(0.016)	(0.028)	(0.026)	(0.024)	(0.023)	(0.042)
Yrs of schooling	-0.033	0.117	0.043	-0.014	-0.110	-0.112
	(0.087)	(0.170)	(0.139)	(0.134)	(0.162)	(0.219)
Age	0.015	0.090	0.121	0.214	0.080	-0.577**
	(0.109)	(0.145)	(0.168)	(0.150)	(0.185)	(0.274)
Household characteristics	0.008	-0.004	-0.069	-0.100	0.003	0.152
	(0.061)	(0.111)	(0.092)	(0.089)	(0.113)	(0.159)
Year	-0.109	-0.118	-0.097	-0.098	-0.108	-0.137
	(0.070)	(0.119)	(0.111)	(0.080)	(0.099)	(0.166)
Region	-0.034	-0.104	-0.025	0.079	0.009	-0.142
	(0.039)	(0.072)	(0.055)	(0.049)	(0.063)	(0.098)
Occupation	0.161*	0.003	0.050	0.018	0.354*	0.292
	(0.087)	(0.094)	(0.084)	(0.102)	(0.210)	(0.392)
Industry	-0.142	-0.089	-0.140	-0.027	0.247	-0.218
	(0.133)	(0.165)	(0.159)	(0.166)	(0.181)	(0.296)
Constant	0.320	0.430	0.429	0.138	-0.392	0.778
	(0.262)	(0.358)	(0.346)	(0.329)	(0.489)	(0.783)
Composition effect						
Sex (male=1)	0.018***	0.019**	0.015***	0.012***	0.014***	0.016**
	(0.004)	(0.007)	(0.006)	(0.005)	(0.005)	(0.008)
Indigenous(=1)	-0.002	-0.009**	-0.005	-0.003	0.002	0.002
	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
Yrs of schooling	0.013*	0.012*	0.012*	0.011*	0.014*	0.015*
	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.008)
Age	0.031***	0.022***	0.017***	0.021***	0.037***	0.072***
	(0.005)	(0.007)	(0.005)	(0.005)	(0.008)	(0.013)
Household characteristics	0.033***	0.038***	0.034***	0.032***	0.030***	0.032***
	(0.005)	(0.008)	(0.007)	(0.006)	(0.008)	(0.011)
Year	-0.008	-0.004	-0.005	-0.009	-0.012	-0.007
	(0.011)	(0.014)	(0.014)	(0.014)	(0.011)	(0.007)
Region	-0.046***	-0.054***	-0.045***	-0.043***	-0.043***	-0.040***
	(0.008)	(0.011)	(0.008)	(0.008)	(0.010)	(0.013)
Occupation	0.075***	0.063***	0.054***	0.064***	0.066***	0.116***
	(0.015)	(0.017)	(0.012)	(0.014)	(0.021)	(0.036)
Industry	0.021**	-0.012	-0.012	0.011	0.043***	0.083***
	(0.010)	(0.015)	(0.012)	(0.012)	(0.015)	(0.024)
Residual	0.024***	0.035**	0.024*	0.024*	0.045*	0.047
	(0.009)	(0.017)	(0.014)	(0.013)	(0.023)	(0.040)

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors which are in parenthesis. The effects of head of the household, currently married and number of children are aggregated into the Household characteristics. Year, region, occupation and industry also group their respective fixed effects.

Table A4. Detailed Decomposition of Union Wage Gaps Using Preferred Model: Chile

	Mean	Quantiles				
		Q10	Q25	Q50	Q75	Q90
Total change	0.236***	0.210***	0.210***	0.276***	0.309***	0.207***
	(0.018)	(0.021)	(0.018)	(0.028)	(0.036)	(0.042)
Wage structure	0.143***	0.159***	0.168***	0.171***	0.204***	0.052
	(0.014)	(0.023)	(0.017)	(0.022)	(0.028)	(0.044)
Composition effect	0.093***	0.050***	0.041***	0.105***	0.105***	0.155***
	(0.012)	(0.012)	(0.012)	(0.015)	(0.021)	(0.033)
Wage Structure						
Sex (male=1)	-0.018	-0.005	-0.006	0.009	-0.036	-0.115*
	(0.026)	(0.034)	(0.037)	(0.038)	(0.036)	(0.069)
Yrs of schooling	-0.073	-0.025	0.078	-0.024	-0.007	-0.378
	(0.085)	(0.102)	(0.093)	(0.130)	(0.157)	(0.241)
Age	0.114**	0.009	0.112**	0.256***	0.193*	0.030
	(0.054)	(0.068)	(0.053)	(0.073)	(0.114)	(0.166)
Household characteristics	-0.037	-0.010	0.044	-0.020	-0.074	-0.112
	(0.026)	(0.030)	(0.030)	(0.038)	(0.056)	(0.071)
Year	0.002	-0.037	0.009	-0.003	0.011	0.064
	(0.023)	(0.041)	(0.026)	(0.038)	(0.056)	(0.056)
Region	0.025*	0.008	0.006	0.018	0.066**	0.086**
	(0.015)	(0.017)	(0.021)	(0.022)	(0.026)	(0.037)
Occupation	0.128*	-0.079*	-0.007	-0.032	-0.019	1.048***
	(0.067)	(0.041)	(0.071)	(0.094)	(0.135)	(0.277)
Industry	-0.029	-0.024	-0.095	-0.121	-0.260*	0.403*
	(0.066)	(0.050)	(0.061)	(0.099)	(0.154)	(0.243)
Constant	0.031	0.322*	0.028	0.087	0.331	-0.974**
	(0.186)	(0.171)	(0.162)	(0.284)	(0.362)	(0.473)
Composition effect						
Sex (male=1)	-0.018	-0.005	-0.006	0.009	-0.036	-0.115*
	(0.026)	(0.034)	(0.037)	(0.038)	(0.036)	(0.069)
Yrs of schooling	0.024***	0.016***	0.013***	0.022***	0.029***	0.038***
	(0.005)	(0.004)	(0.003)	(0.005)	(0.006)	(0.008)
Age	0.016***	0.003	0.004**	0.011***	0.024***	0.041***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.005)	(0.009)
Household characteristics	0.015***	0.006**	0.005***	0.014***	0.021***	0.030***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.005)	(0.007)
Year	0.007***	0.011***	0.012***	0.005***	0.003	0.001
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.004)
Region	0.004	0.000	0.003	0.007**	0.008**	0.004
	(0.003)	(0.003)	(0.002)	(0.004)	(0.004)	(0.005)
Occupation	0.005	0.008	0.012***	0.014*	0.004	-0.018
	(0.007)	(0.005)	(0.004)	(0.007)	(0.012)	(0.021)
Industry	0.011**	-0.008*	-0.003	0.004	0.024***	0.038**
	(0.005)	(0.004)	(0.003)	(0.005)	(0.008)	(0.015)
Residual	0.000	0.004	-0.016**	0.015	-0.017	0.009
	(0.003)	(0.007)	(0.008)	(0.010)	(0.013)	(0.019)

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors which are in parenthesis. The effects of head of the household, currently married and number of children are aggregated into the Household characteristics. Year, region, occupation and industry also group their respective fixed effects.

Table A5. Detailed Decomposition of Union Wage Gaps Using Preferred Model: Bolivia

	Variance	Inter quantile		
		Q5010	Q9050	Q9010
Total change	0.030	0.065	0.005	0.070
	(0.034)	(0.045)	(0.081)	(0.082)
Wage structure	-0.107***	0.054	-0.210**	-0.156*
	(0.041)	(0.049)	(0.083)	(0.084)
Composition effect	0.137***	0.011	0.216***	0.226***
	(0.029)	(0.023)	(0.046)	(0.054)
Wage Structure				
Sex (male=1)	0.205**	0.170	-0.015	0.154
	(0.087)	(0.115)	(0.195)	(0.220)
Indigenous(=1)	-0.020	-0.003	-0.020	-0.024
	(0.032)	(0.033)	(0.044)	(0.056)
Yrs of schooling	-0.156	-0.130	-0.098	-0.228
	(0.159)	(0.227)	(0.232)	(0.289)
Age	-0.503***	0.124	-0.791***	-0.666**
	(0.177)	(0.204)	(0.293)	(0.311)
Household characteristics	0.171*	-0.096	0.253	0.156
	(0.095)	(0.133)	(0.170)	(0.218)
Year	0.065	0.020	-0.040	-0.019
	(0.137)	(0.139)	(0.178)	(0.200)
Region	-0.001	0.183**	-0.221**	-0.038
	(0.061)	(0.079)	(0.096)	(0.114)
Occupation	0.288*	0.016	0.274	0.289
	(0.165)	(0.132)	(0.392)	(0.413)
Industry	-0.122	0.062	-0.191	-0.129
	(0.315)	(0.219)	(0.332)	(0.334)
Constant	-0.034	-0.291	0.640	0.349
	(0.533)	(0.530)	(0.748)	(0.901)
Composition effect				
Sex (male=1)	0.000	-0.006	0.004	-0.002
	(0.004)	(0.007)	(0.008)	(0.010)
Indigenous(=1)	0.006*	0.006	0.005	0.012*
	(0.003)	(0.004)	(0.004)	(0.006)
Yrs of schooling	0.001	-0.001	0.004	0.003
	(0.002)	(0.003)	(0.003)	(0.003)
Age	0.028***	-0.001	0.050***	0.049***
	(0.007)	(0.007)	(0.011)	(0.013)
Household characteristics	-0.002	-0.006	0.000	-0.006
	(0.006)	(0.009)	(0.011)	(0.014)
Year	-0.003	-0.005	0.002	-0.003
	(0.007)	(0.005)	(0.011)	(0.011)
Region	0.000	0.011	0.003	0.014
	(0.006)	(0.009)	(0.012)	(0.013)
Occupation	0.040*	0.001	0.052	0.053
	(0.020)	(0.020)	(0.032)	(0.041)
Industry	0.058***	0.024	0.072***	0.095***
	(0.015)	(0.016)	(0.024)	(0.026)
Residual	0.008	-0.011	0.023	0.012
	(0.015)	(0.021)	(0.040)	(0.046)

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors which are in parenthesis. The effects of head of the household, currently married and number of children are aggregated into the Household characteristics. Year, region, occupation and industry also group their respective fixed effects.

Table A6. Detailed Decomposition of Union Wage Gaps Using Preferred Model: Chile

	Variance	Inter quantile		
		Q5010	Q9050	Q9010
Total change	-0.048***	0.067**	-0.070*	-0.003
	(0.017)	(0.028)	(0.040)	(0.047)
Wage structure	-0.078***	0.012	-0.119**	-0.107**
	(0.017)	(0.027)	(0.047)	(0.051)
Composition effect	0.030***	0.055***	0.049	0.104***
	(0.011)	(0.015)	(0.030)	(0.034)
Wage Structure				
Sex (male=1)	-0.041	0.015	-0.124*	-0.109
	(0.026)	(0.050)	(0.071)	(0.079)
Yrs of schooling	-0.041	0.000	-0.354	-0.353
	(0.089)	(0.137)	(0.258)	(0.252)
Age	0.034	0.248***	-0.226	0.022
	(0.061)	(0.084)	(0.158)	(0.161)
Household characteristics	-0.036	-0.009	-0.093	-0.102
	(0.029)	(0.043)	(0.076)	(0.079)
Year	0.031	0.034	0.067	0.100
	(0.027)	(0.049)	(0.070)	(0.067)
Region	0.033**	0.010	0.068*	0.078*
	(0.016)	(0.023)	(0.040)	(0.040)
Occupation	0.403***	0.047	1.080***	1.127***
	(0.089)	(0.097)	(0.277)	(0.276)
Industry	0.112	-0.097	0.524**	0.427*
	(0.093)	(0.099)	(0.266)	(0.249)
Constant	-0.572***	-0.235	-1.061**	-1.296***
	(0.205)	(0.299)	(0.482)	(0.488)
Composition effect				
Sex (male=1)	-0.041	0.015	-0.124*	-0.109
	(0.026)	(0.050)	(0.071)	(0.079)
Yrs of schooling	0.006***	0.006***	0.016***	0.022***
	(0.002)	(0.002)	(0.005)	(0.005)
Age	0.015***	0.008***	0.030***	0.038***
	(0.003)	(0.003)	(0.008)	(0.009)
Household characteristics	0.010***	0.008**	0.016***	0.024***
	(0.003)	(0.003)	(0.006)	(0.007)
Year	-0.005*	-0.006**	-0.004	-0.010*
	(0.003)	(0.003)	(0.005)	(0.006)
Region	0.000	0.008***	-0.003	0.004
	(0.002)	(0.003)	(0.005)	(0.005)
Occupation	-0.013	0.006	-0.032*	-0.026
	(0.008)	(0.006)	(0.018)	(0.022)
Industry	0.024***	0.012**	0.034**	0.046***
	(0.006)	(0.005)	(0.014)	(0.015)
Residual	-0.008**	0.011	-0.006	0.005
	(0.003)	(0.013)	(0.020)	(0.021)

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors which are in parenthesis. The effects of head of the household, currently married and number of children are aggregated into the Household characteristics. Year, region, occupation and industry also group their respective fixed effects.

Table A7. Detailed Decomposition of Union Wage and Inequality Gaps Includes Establishment Size Effect: Bolivia

	Mean	Quantiles			Variance	Inter quantile	
		Q10	Q50	Q90		Q5010	Q9050
Total change	0.272***	0.202***	0.267***	0.273***	0.030	0.065	0.005
	(0.032)	(0.034)	(0.042)	(0.080)	(0.034)	(0.045)	(0.081)
Wage structure	0.076***	0.073*	0.103***	-0.111	-0.118***	0.030	-0.214***
	(0.027)	(0.042)	(0.034)	(0.074)	(0.041)	(0.049)	(0.078)
Composition effect	0.196***	0.129***	0.164***	0.384***	0.148***	0.035	0.220***
	(0.027)	(0.032)	(0.028)	(0.044)	(0.028)	(0.026)	(0.041)
Wage Structure							
Sex (male=1)	-0.043	-0.220**	-0.027	0.028	0.204**	0.193	0.055
Indigenous(=1)	-0.019	-0.014	-0.014	-0.021	-0.008	0.001	-0.007
Yrs of schooling	-0.034	0.118	-0.030	-0.053	-0.121	-0.148	-0.022
Age	-0.009	0.069	0.189	-0.649**	-0.433***	0.120	-0.838***
Household characteristics	0.009	-0.009	-0.080	0.195	0.165*	-0.071	0.276
Year	-0.132*	-0.069	-0.153*	-0.130	0.024	-0.084	0.023
Region	-0.029	-0.084	0.070	-0.100	0.012	0.155*	-0.170*
Occupation	0.167**	0.000	0.093	0.172	0.258	0.093	0.079
Industry	-0.096	-0.127	0.079	-0.190	-0.120	0.207	-0.270
Establishment size	-0.023	-0.076	-0.034	-0.020	0.031	0.042	0.015
Constant	0.285	0.486	0.010	0.656	-0.129	-0.476	0.646
Composition effect							
Sex (male=1)	0.017***	0.017**	0.011**	0.014*	0.000	-0.007	0.004
Indigenous(=1)	-0.002	-0.008**	-0.002	0.003	0.006*	0.006	0.005
Yrs of schooling	0.012*	0.012*	0.010*	0.014*	0.001	-0.001	0.003
Age	0.030***	0.021***	0.020***	0.070***	0.028***	-0.001	0.050***
Household characteristics	0.031***	0.036***	0.030***	0.030***	-0.002	-0.006	0.000
Year	-0.008	-0.004	-0.010	-0.008	-0.003	-0.005	0.002
Region	-0.043***	-0.051***	-0.040***	-0.036***	0.001	0.011	0.005
Occupation	0.062***	0.052***	0.051***	0.096***	0.036*	-0.001	0.044
Industry	0.016*	-0.015	0.007	0.073***	0.055***	0.022	0.066***
Establishment size	0.050***	0.038***	0.048***	0.088***	0.024***	0.011	0.040**
Residual	0.032***	0.033*	0.039***	0.040	0.003	0.006	0.001

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors. The effects of head of the household, currently married and number of children are aggregated into the Household characteristics. Year, region, occupation and industry also group their respective fixed effects.

Table A8: Detailed Decomposition of Union Wage And Inequality Gaps Includes Establishment

Size effect: Chile

	Mean	Quantiles			Variance	Inter quantile	
		Q10	Q50	Q90		Q5010	Q9050
Total change	0.236***	0.210***	0.276***	0.207***	-0.048***	0.067**	-0.070*
	(0.018)	(0.021)	(0.028)	(0.042)	(0.017)	(0.028)	(0.040)
Wage structure	0.143***	0.159***	0.171***	0.052	-0.078***	0.012	-0.119**
	(0.014)	(0.023)	(0.022)	(0.044)	(0.017)	(0.027)	(0.047)
Composition effect	0.093***	0.050***	0.105***	0.155***	0.030***	0.055***	0.049
	(0.012)	(0.012)	(0.015)	(0.033)	(0.011)	(0.015)	(0.030)
Wage Structure							
Sex (male=1)	-0.019	-0.032	0.010	-0.097	0.002	0.042	-0.107
Yrs of schooling	-0.094	-0.041	0.005	-0.402*	-0.008	0.046	-0.407
Age	0.088	-0.021	0.224***	-0.011	0.029	0.245***	-0.235
Household characteristics	-0.051*	0.001	-0.037	-0.120*	-0.065**	-0.038	-0.082
Year	0.004	-0.018	-0.019	0.063	0.020	-0.001	0.082
Region	0.023	0.016	0.010	0.097**	0.028	-0.006	0.087**
Occupation	0.119*	-0.059	-0.026	1.078***	0.363***	0.033	1.104***
Industry	-0.086	-0.039	-0.157	0.293	0.032	-0.118	0.450*
Establishment size	-0.074	0.007	-0.048	-0.054	0.026	-0.055	-0.006
Constant	0.168	0.299	0.125	-0.853*	-0.495**	-0.174	-0.978**
Composition effect							
Sex (male=1)	-0.019	-0.032	0.010	-0.097	0.002	0.042	-0.107
Yrs of schooling	0.022***	0.014***	0.020***	0.036***	0.006***	0.006***	0.016***
Age	0.017***	0.004	0.012***	0.042***	0.014***	0.008***	0.030***
Household characteristics	0.014***	0.005**	0.013***	0.029***	0.010***	0.008**	0.016***
Year	0.007***	0.011***	0.005***	0.002	-0.005*	-0.006**	-0.003
Region	0.005*	0.000	0.008**	0.005	0.001	0.008***	-0.003
Occupation	0.005	0.007	0.014**	-0.018	-0.013	0.006	-0.032*
Industry	0.008	-0.010***	0.001	0.034**	0.023***	0.011**	0.033**
Establishment size	0.071***	0.053***	0.074***	0.094***	0.008	0.021**	0.020
Residual	-0.001	0.003	0.032**	-0.021	-0.025***	0.029*	-0.053*

Note: * p <0.1 ** p<0.05 *** p<0.01. Significance levels are estimated using bootstrap standard errors. The effects of head of the household, currently married and number of children are aggregated into the Household characteristics. Year, region, occupation and industry also group their respective fixed effects.

APPENDIX B

Multiple Imputation using Chain Equations

In cases when the missing data structure follows an arbitrary missing pattern and simultaneous imputations of multiple variables are required, two standard imputation approaches can be used: multivariate normal imputation and imputations using chained equations (ICE). While the first approach estimates a model that tries to identify the underlying multivariate distribution, it imposes restrictions on the estimation, assuming the system follows a normal multivariate distribution. The ICE approach, by contrast, lacks a formal theoretical justification, but provides more flexibility in the specification of the imputation models, being consistent with different types of underlying distributional assumptions.

The idea of the ICE approach is to construct univariate imputation models for each variable with missing information, using a fully conditional specification where all variables, other than the one being imputed, are used as independent variables. These conditional models are used to obtain predictions for the missing information, and can be used in subsequent iterations. In cases where the missing data structure follows an arbitrary pattern, an iterative imputation process is needed to account for possible dependence of the estimated parameters to the imputed data. Formally, the procedure can be described as follows.

Let $X_1, X_2, \dots, X_p$ be a set of variables with missing information (imputed variables), and let Z be a set of complete predictors. For each imputed variable, it is possible to construct a univariate imputation models f_i, where each model can be a different distribution function (normal, logistic, etc), that best identifies the specific underlying distribution of the variable X_i:

$$X_1^{t+1} = f_1\left(X_1 | X_2^t, \dots, X_p^t, Z, \theta_1\right)$$

$$X_2^{t+1} = f_2\left(X_1 | X_1^t, \dots, X_p^t, Z, \theta_2\right)$$

$$X_p^{t+1} = f_p\left(X_1 | X_1^t, X_2^t, \dots, X_{p-1}^t, Z, \theta_p\right)$$

Once the imputation models are specified for the first iteration, only complete observations are used for each individual model. Based on the imputation models, random draws using the empirical distribution of the imputed variables are obtained and used in the next iteration of the imputation until convergence is obtained. Although there is no specific rule on the number of imputations needed to obtain convergence of the system, the literature suggests that 10 iterations are typically sufficient to achieve convergence (van Buuren, 2007). However, depending on the complexity of the imputation system, more iterations may be needed. Once convergence is achieved, a random draw of the empirical process is obtained and used to create an imputed sample. This process is repeated for each additional set of imputed samples needed until M different imputed samples are created.

Although the validity of the MI approach relies on the asymptotic properties of the imputation procedure with M approaching infinity, in practice fewer imputations are needed to obtain consistent and stables results. According to Rubin (1987), M=5 imputations should be sufficient to obtain valid inferences for most procedures, but depending on the amount of information missing and the type of analysis required, a larger set of imputed samples could be required.

Once M completed samples are obtained, each of them can be used to obtain M independent estimations for the desired model. Assume the model to be estimated can be written as:

$$y_m = X_m'\beta_m + e_m \text{ for } m = 1, \dots, M$$

such that we have a set of parameters β_m and a variance covariance matrix Σ_m for each imputed sample m. Following Rubin's rule (Rubin, 1987) the results for the parameters and variance covariance matrices can be combined as follows:

$$\tilde{\beta}_M = \frac{1}{M}\sum \tilde{\beta}_m \text{, and}$$

$$\tilde{\Sigma}_M = \frac{1}{M}\sum \tilde{\Sigma}_m + \left(1 + \frac{1}{M}\right) * \sum \frac{(\tilde{\beta}_m - \tilde{\beta}_M)(\tilde{\beta}_m - \tilde{\beta}_M)'}{M - 1}$$

Here, $\tilde{\beta}_M$ and $\tilde{\Sigma}_M$ are the parameters and variance covariance matrix corresponding to the combination of models across the M imputed samples. See Rubin (1987) for more details.

APPENDIX C

Specification Of Imputation Model

Table C1. Variables with Complete Information:

Variable	Definition
Part larger	Indicates if the establishment if part of a larger firm
Public or private shareholding	Indicates if the establishment has stocks in private hands or public stock exchange.
Foreign owned	Indicates if more than 50% of the establishment is owned by foreign capital
% largest shareholder	Indicates if the largest shareholder owns more than 50% of the establishment
Age	Number of years since the establishment began operations
Manager experience	Number of years of experience of top manager
Quality certification	Indicates if establishments have an ISO quality certification
Electric problems	Indicates if establishments have suffered 2 or more outages
Has a generator	Indicates if establishments possess a generator
Electricity request	Indicates if establishments have submitted a request for electricity connection
Water request	Indicates if establishments have submitted a request for water connection
Water obstacle	Indicates if establishments consider access to water as a major obstacle of production
Electricity obstacle	Indicates if establishments consider access to electricity as a major obstacle of production
Mono production	Indicates if all production comes from the main product
Sales export	% of sales that come from export
Inputs from small Firms	%Inputs bought from smaller firms
Foreign input	%Inputs imported
Principal buyer	Indicates if consumers are main buyers from production
Customs and trades	Indicates if Customs and trades regulations are an obstacle for operations
Own transport	Indicates if establishment possess its own transportation system
Transport problem	Indicates if transportation is considered a major obstacle for operation

Subcontract production	%Sales that are subcontracted to other firms
Competition	Indicates the level of competition the establishment faces: None or one competitor (no competition), 2-5 competitors (medium competition), 5 or more competitors (high competition), operates on international market
Sales change	Indicates if sales of main product have gone up or down in the last year
Prices change	Indicates if prices of main product have gone up or down in the last years
Domestic Competition	Pressure from domestic competitors on production costs is important
International Competition	Pressure from international competitors on production costs is important
Foreign Technology	Establishment uses foreign technology for their production
New product or New process	Indicates if the establishment introduced a new or significantly improved product/service or production process
Informality	Indicates if informal markets are a consider a major obstacle for establishment operations
Share of Production Workers	Share of Production workers as % of total permanent workers
Share of skill workers	Share of Skill workers as % of total permanent workers
Share of seasonal workers	Share of seasonal workers as % of total permanent equivalent workers
Share of female workers	Share of Production workers as % of total permanent workers
Level of utilization of capital	%of current output compared to maximum output possible under normal circumstances
Hours of operation per week	Normal weekly hours of operations of the establishment, Includes the variable in levels and logs
New buildings	Indicates if establishment submitted an application to obtain a construction-related permit in last 2 years
Land problem	Indicates if access to land is considered a major obstacle for operation
Government problem	Indicates if government regulations are considered major obstacles for operation
Investment	Indicates if establishment has investment any resources on machinery or vehicles during last fiscal year

Hires seasonal workers	Indicates if establishment hires seasonal workers at all.
Industry fixed effects	Includes industry fixed effects using ISIC Rev.3.1 classification to 2 digits.
Nr of permanent workers	Total number of permanent workers, including its logarithm, logarith squared and interaction with a union Dummy
Nr workers on t-1	Total number of permanent workers 3 years ago
Nr production workers	Total number of workers directly engaged in the production process. Includes its log
Nr non production Workers	Total number of workers not engaged in the production process. Includes its log
Zero production workers	Indicates if there are no production workers in the establishment
Nr of seasonal workers	Nr of workers that are hired for a short-term (i.e. for less than a fiscal year), with no guarantee of renewal of employment contract. Includes its log and interaction with union dummy
Labor regulations	Indicates if establishments consider labor regulations as major obstacles for operations
Inadequate Education	Indicates if establishments consider inadequate education as major obstacles for operations
Manufacture production	% of sales that come from manufacture
Refusal capital	Indicate if the establishment refused to provide information on book or market capital values
Refusal land	Indicate if the establishment refused to provide information on book or market land value
Log sales	Logarithm of total sales in last fiscal year. Includes its square.
Sales in t-1 dummy	Indicates if the establishment didn't provide information on sales 3 years ago.
Union	Variables indicating if the establishment is unionized, the union density within the establishment and a dummy if more than 50% of the establishment is unionized.
Information quality flags	Two dummies indicating if the interviewer perceives the information provided is true, or if the data was taken from administrative records.
Workers avg education	Average education attainment of typical worker. 0-3 yrs of education, 4-6 yrs of education, 7-12 yrs of education and 13+ yrs of education
Training	Indicators of training among permanent workers: No active training program in the establishment, 0-33% of workers trained, 34-66% of workers trained and 67-100% workers trained.
Owner female	Indicates if any of the main owners of the establishment is female.
Region	Fixed effects using region dummies survey in each country. Varies across countries.

Table C2. Imputed Variables:

Variable	Method	Definition
Nr of workers in t-1	PMM	Total number of permanent workers 3 years ago
Cost of labor	PMM	Total annual cost of labor as share of sales
Cost of electricity	PMM	Total annual cost of electricity as share of sales
Cost of communications	PMM	Total annual cost of communications as share of sales
Cost of materials and inputs	PMM	Total annual cost of materials and inputs as share of sales
Cost of fuel	PMM	Total annual cost of fuel as share of sales
Cost of transportation	PMM	Total annual cost of transportation as share of sales
Cost of water	PMM	Total annual cost of water as share of sales
Cost of rentals	PMM	Total annual cost of rent of equipment, building and land as share of sales
Log Nr of workers in t-1	OLS	Log Total number of permanent workers 3 years ago
Log Sales in t-1	OLS	Log Sales 3 years ago
Log wages production workers	OLS	Log average wage of production workers
Log wages non production workers	OLS	Log average wage of non-production workers
Log capital (book value)	OLS	Log of net book value of machinery
Log capital (market value)	OLS	Log of hypothetical cost of purchase of machinery
Log materials and inputs	OLS	Log of total cost of material and inputs
Log salaries	OLS	Log of total cost of salaries

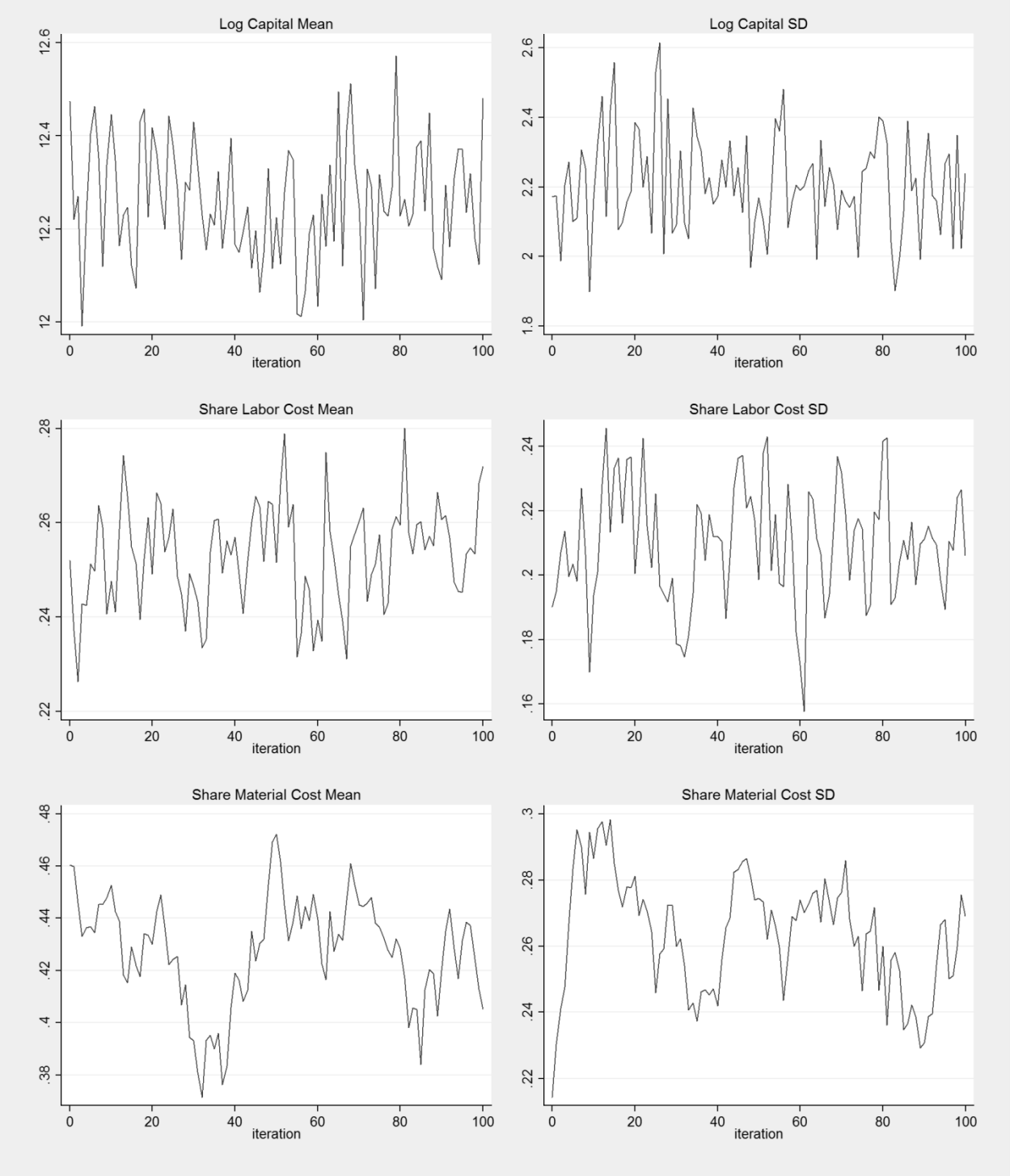
OLS: This method uses linear predictions (plus the empirical standard error) to impute the values of the missing values.
PMM: This method uses linear predictions to match observations with missing values to those with complete information. The observed values are then used for the imputation.

Table C3. Other Measurements:

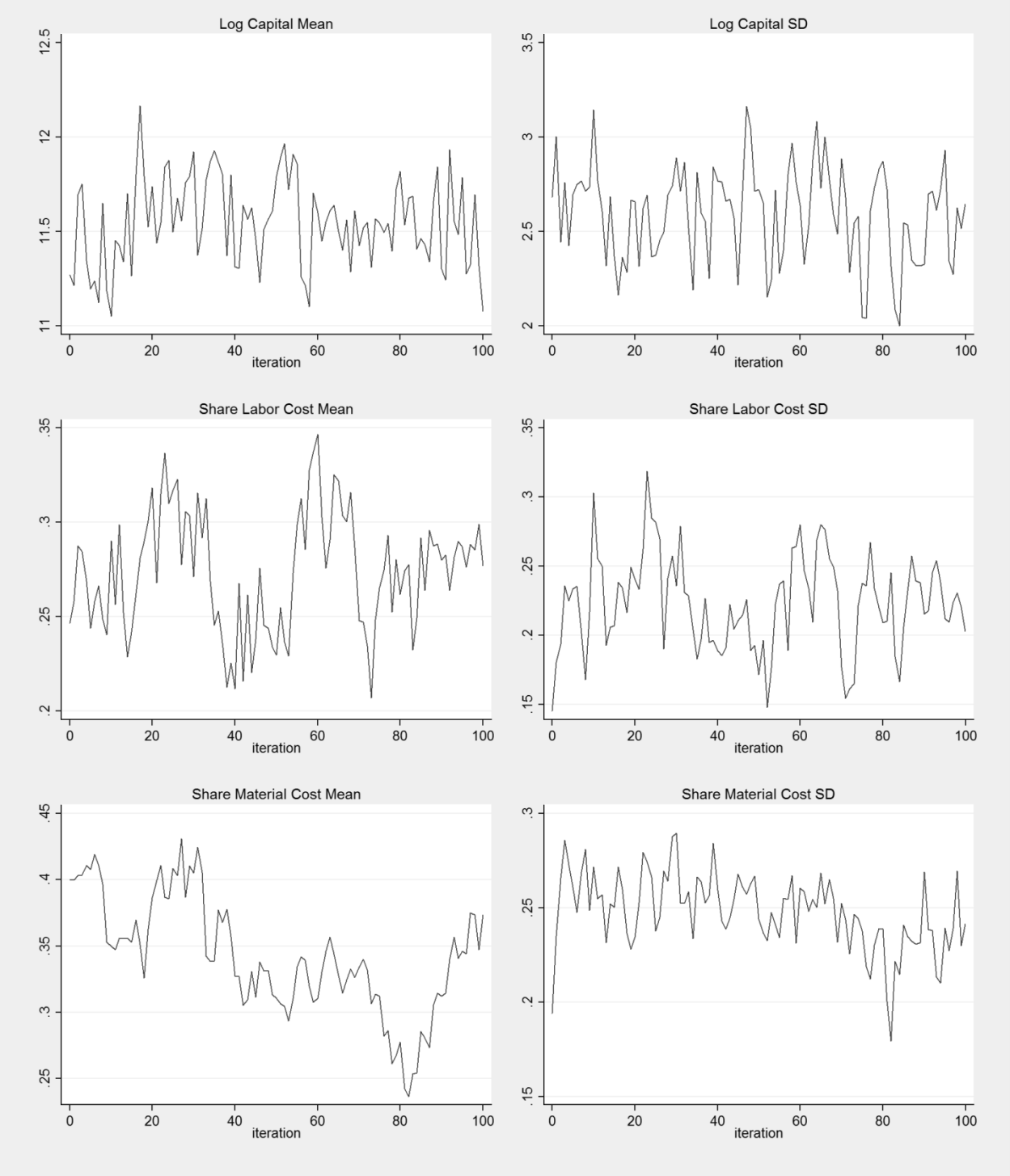
Variable	Definition
Log value added pc	Value added is defined as sales minus costs on materials and inputs, electricity, fuel and water. It is divided by total equivalent permanent workers.
Log total equivalent permanent workers	Total equivalent workers are estimated as total permanent workers plus equivalent seasonal workers. Equivalent seasonal workers are estimated as total number of temporary/seasonal workers multiplied by the average time (in months) a temporal worker participates in the establishment in a year.
Log capital per capita	Log of hypothetical value of capital divided by total number of equivalent workers. Hypothetical value captures the market value of capital, or how much the establishment would pay for it in current state.
Profit	Price cost margin, defined as total sales minus total production costs, divided by total costs.
Sales growth	Defined as the difference between current log sales, and log sales three years ago
Investment in R&D	Indicates if the establishment has spent on research and development
Investment in capital	Indicates if the establishment has bought any fixed assets in the previous period

APPENDIX D

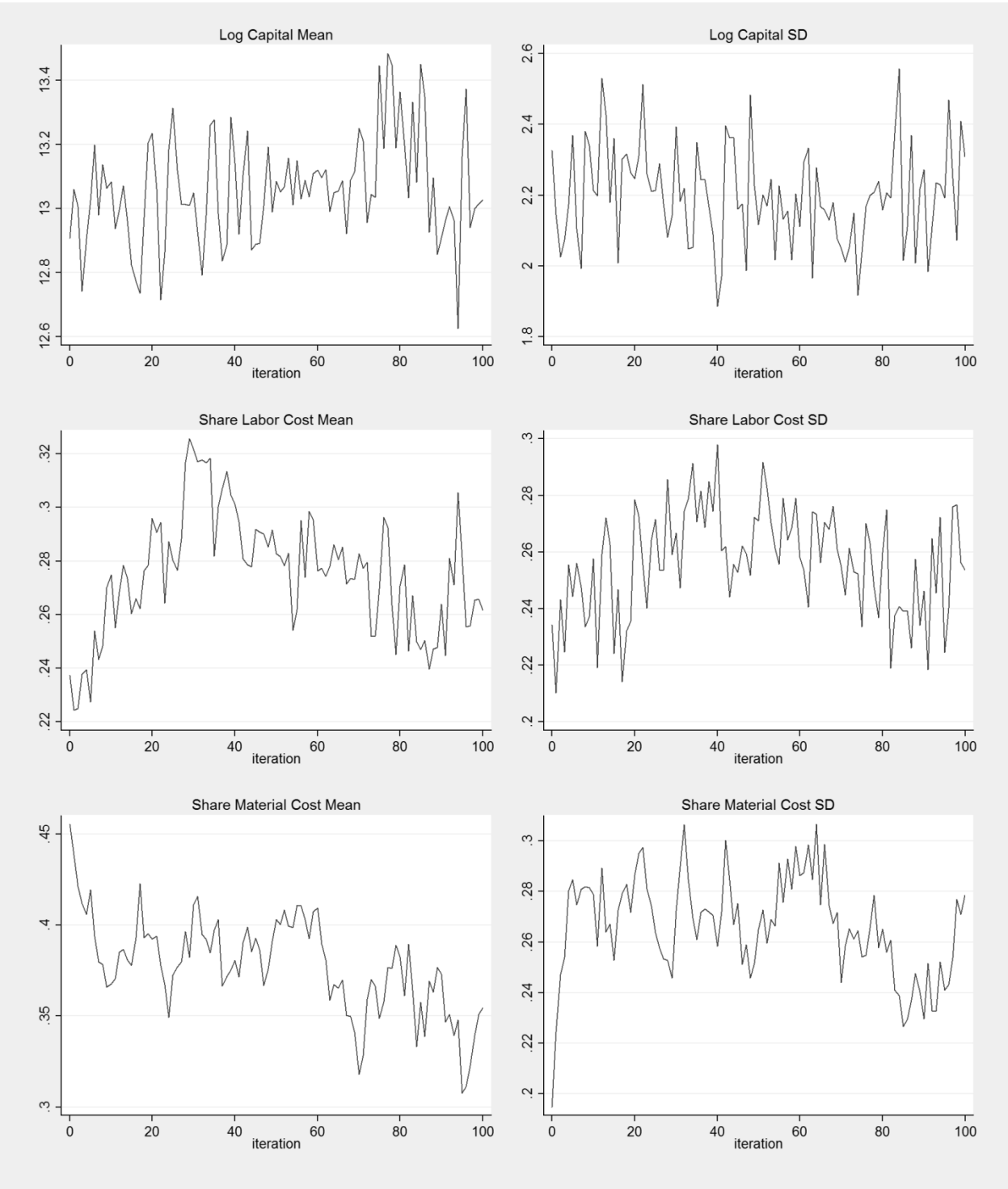
Plot of Mean and Standard Deviation Main Imputed Variables by Country
Argentina



Bolivia


Log Capital Mean
Log Capital SD
Share Labor Cost Mean
Share Labor Cost SD
Share Material Cost Mean
Share Material Cost SD
iteration

Chile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12.8
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13.2
13.4
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20
40
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100
iteration
Log Capital SD
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2.2
2.4
2.6
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40
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80
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iteration
Share Labor Cost Mean
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.28
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.32
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20
40
60
80
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iteration
Share Labor Cost SD
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.28
.3
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20
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iteration
Share Material Cost Mean
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Share Material Cost SD
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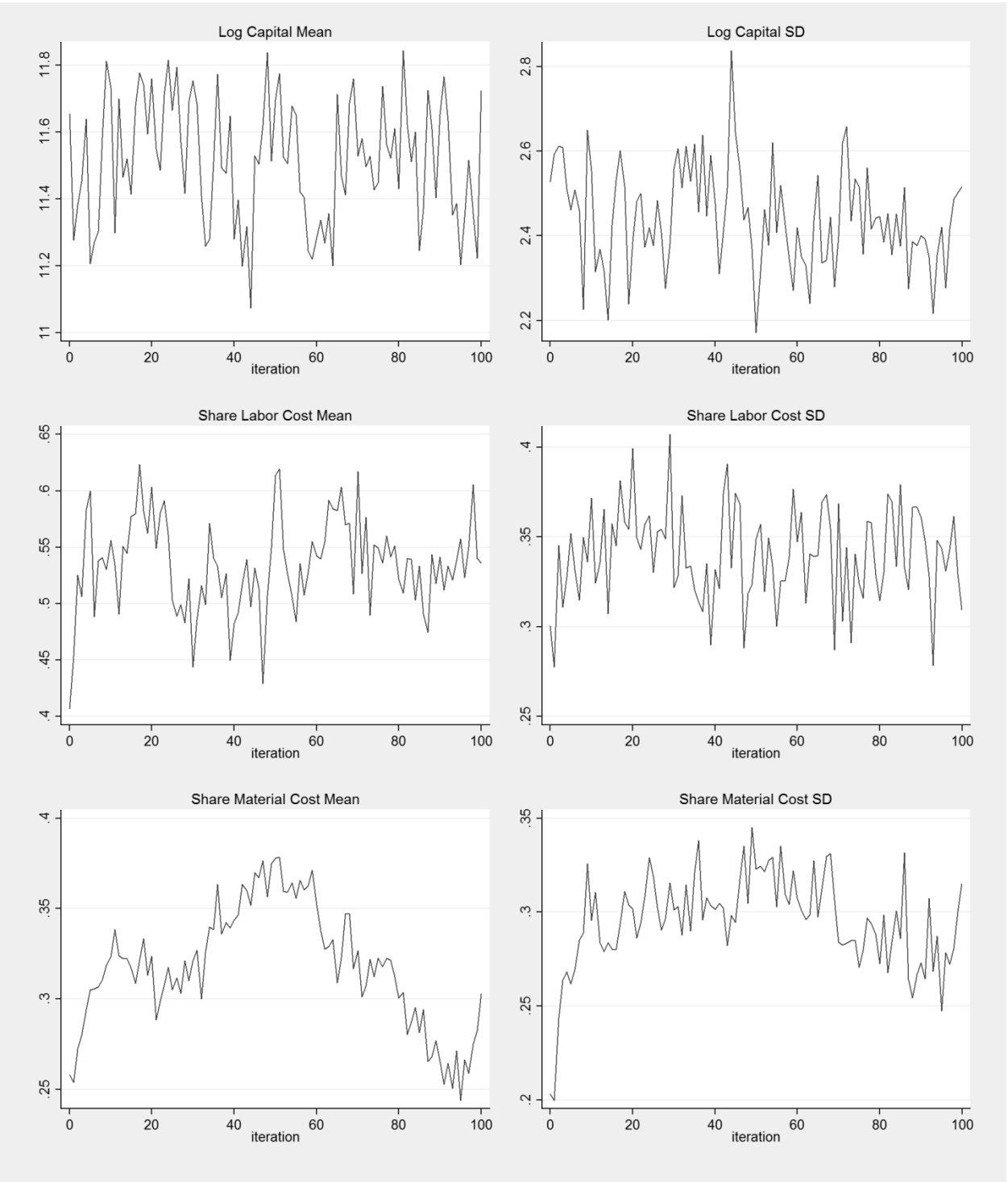
iteration

Mexico


Log Capital Mean
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Log Capital SD
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Share Labor Cost Mean
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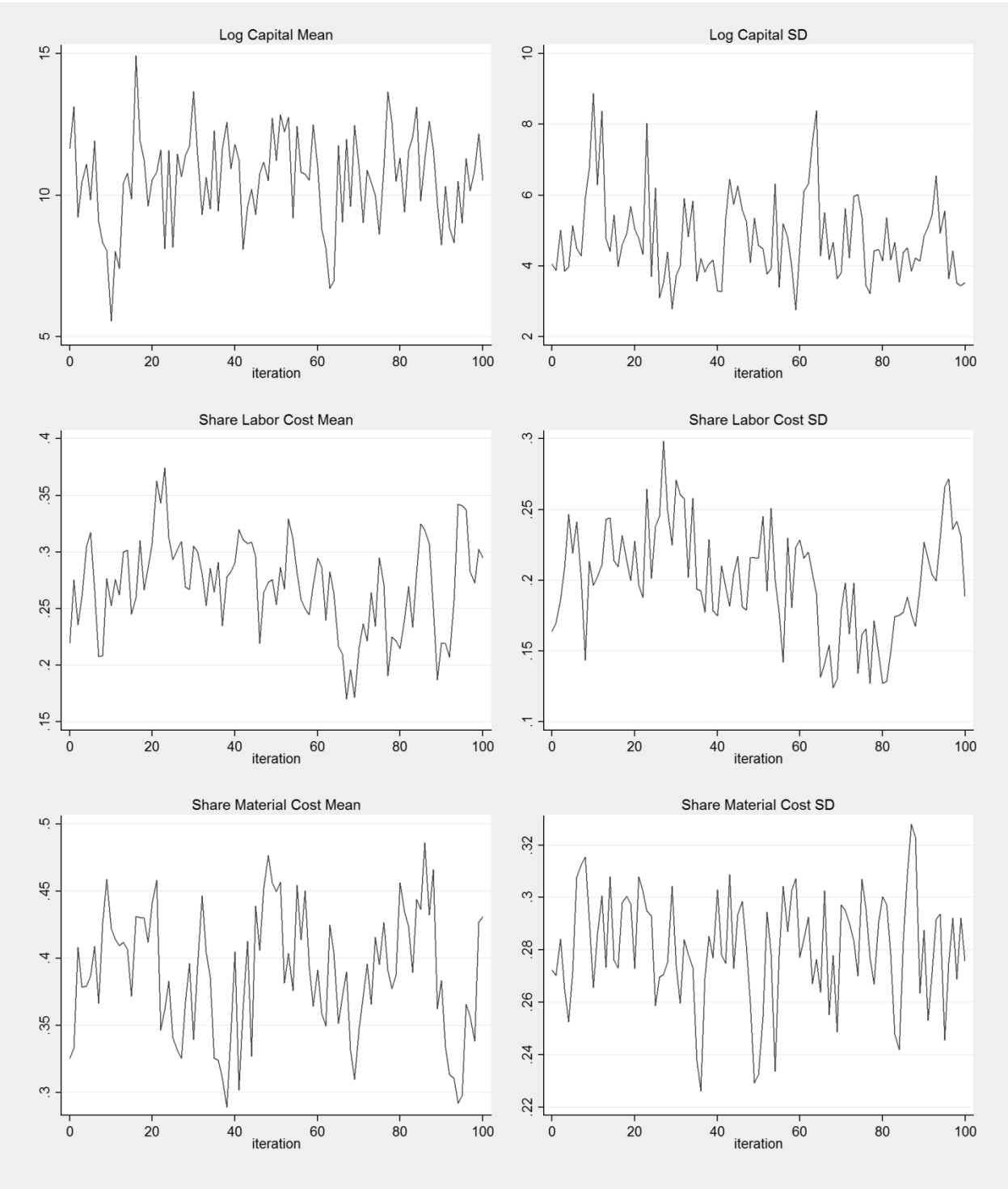
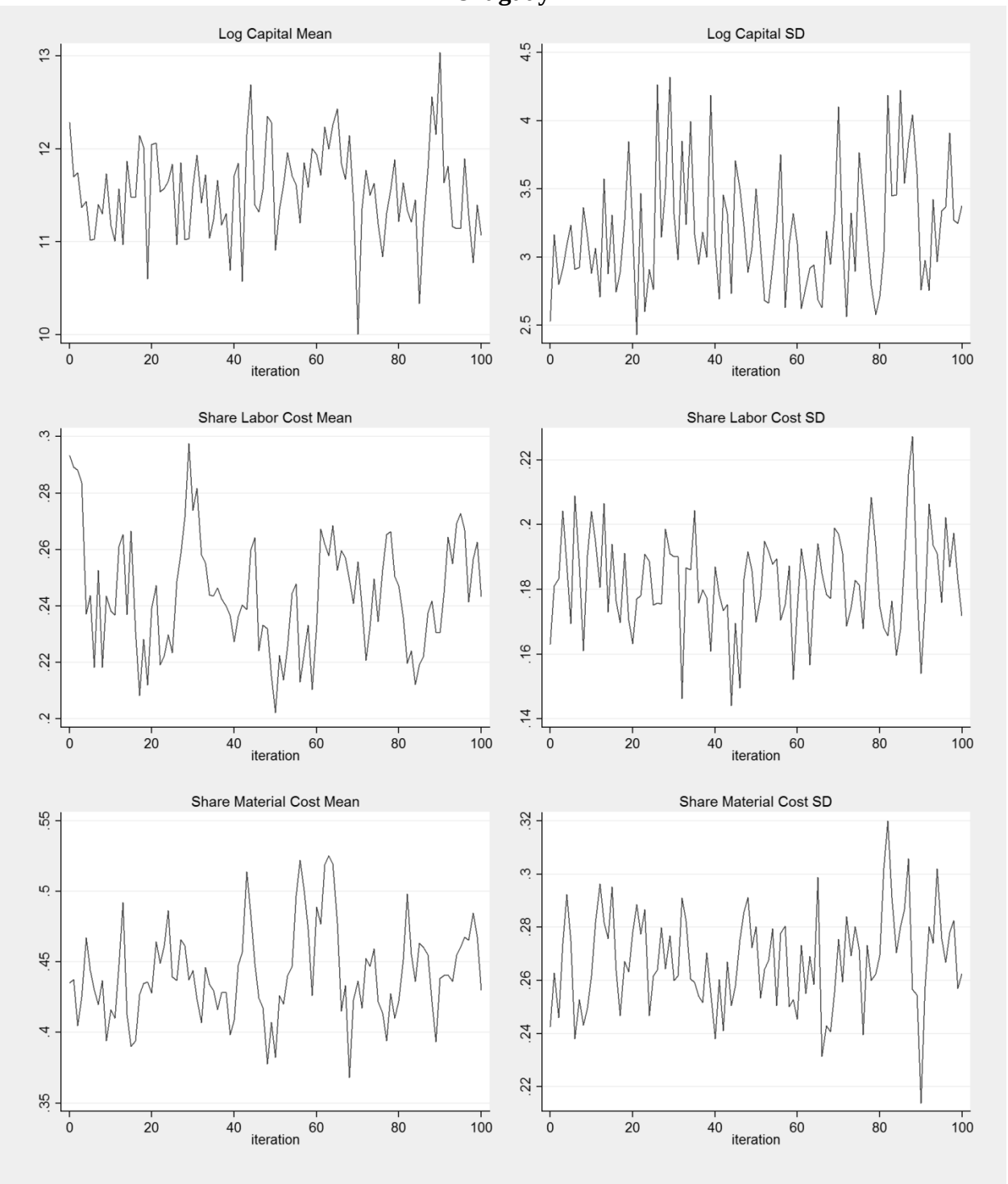
Panama


Log Capital Mean
Log Capital SD
Share Labor Cost Mean
Share Labor Cost SD
Share Material Cost Mean
Share Material Cost SD
iteration

Uruguay


Log Capital Mean
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Log Capital SD
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APPENDIX E

Effect of Unions on Establishment Productivity, by Country. Basic Brown and Medoff Specification

	Argentina	Bolivia	Chile	Mexico	Panama	Uruguay
%Workforce unionized	-0.377^	0.488	0.227	0.061	0.304	0.188
	(0.057)	(0.166)	(0.212)	(0.675)	(0.367)	(0.409)
Log capital pc	-0.009	0.260*	0.232*	0.249*	0.017	-0.03
	(0.914)	(0.000)	(0.000)	(0.000)	(0.814)	(0.678)
Log total labor force	0.201*	0.077	0.172*	0.164*	0.126	0.396*
	(0.000)	(0.426)	(0.001)	(0.000)	(0.101)	(0.000)
Constant	9.308*	5.668*	6.949*	6.680*	9.188*	8.166*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	540	298	564	974	185	251

Notes: ^ p<0.1, + p<0.05, * p<0.01. P-values in parentheses. Models include region and broad industry fixed effects

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VITA

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