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Are Skills Rewarded in Sub-Saharan Africa?

Determinants of Wages and Productivity in the Manufacturing Sector

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Abstract

Using recent matched employer-employee data from the manufacturing sector in 20 Sub-Saharan African countries, the authors analyze how the supply of skills and legal origin of the country affect the wage setting process. The wage analysis yields three main findings. First, increasing returns to education, especially for older workers, suggest that the expansion of education in Africa has reduced returns to education for entrants in the labor market. Second, age effects matter not just for returns to education, but also for the wage setting process more generally. In particular, in civil-law countries, returns to seniority are rewarded only after a certain age. Third, workers exercise some power in the wage setting process but their influence varies by linguistic group. In common-law countries, union presence benefits all workers equally, not just members, whereas in civil-law countries, only older members enjoy higher wages. The authors also contrast wage premia with relative marginal productivities for different age, occupation, and education categories. The findings show that in general, older, highly educated, and highly ranked workers receive wage premia that do not reflect a higher relative marginal productivity.

This paper—a product of the Poverty Reduction and Economic Management Department, Africa Region—is part of a larger effort in the department to analyze the relationships between labor market policy, economic growth, and poverty reduction in Sub-Saharan Africa. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at lfox@worldbank.org, and aoviedo@worldbank.org.

Are Skills Rewarded in Sub-Saharan Africa? Determinants of Wages and Productivity in the Manufacturing Sector*

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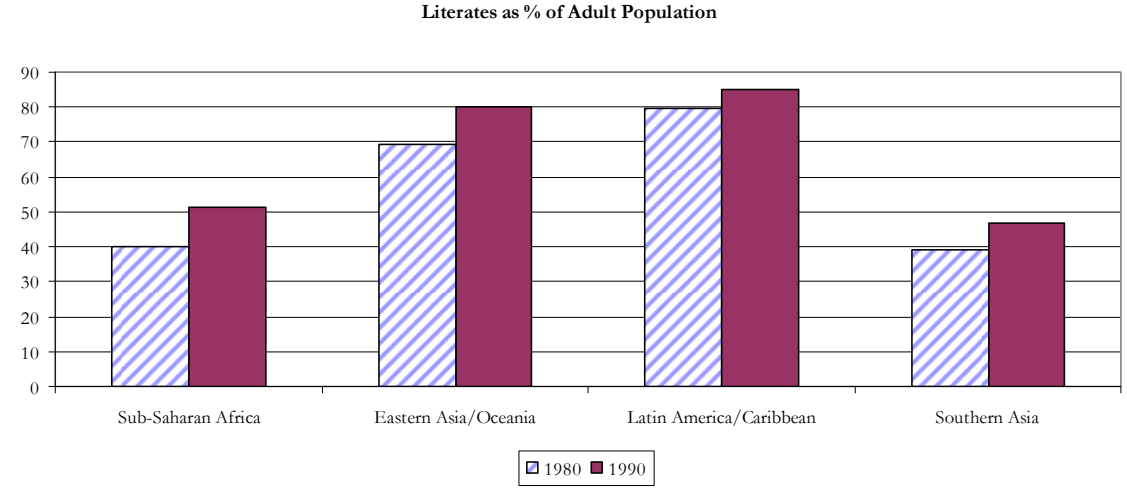
I. Introduction

The goal of this paper is to provide an update on the state of skills, wages, and productivity in the manufacturing sector in Sub-Saharan Africa (SSA). Although employment in the manufacturing sector has been growing at a steady pace in the last years, manufacturing still accounts for less than 10 percent of overall value added in SSA.[1] As Table 1 shows, the share of manufacturing in GDP between 2002 and 2006 in 17 countries does not exceed 14 percent. (An exception is Swaziland, where it reaches 37 percent.) The contribution of manufacturing to total employment is also very small, accounting for less than 10 percent on average.[2]

INSERT TABLE 1

One reason cited for the slow development of the manufacturing sector is the low education level of the African workforce. A number of studies have highlighted the importance of education to economic growth, and the dampening effect on growth of the failure to expand education in the colonial period.[3] African countries attained independence with a huge education deficit relative to the rest of the world. This massive skill shortage hurt African economies in every sector, public and private (see Figure 1).

Figure 1



Source: SPESSA (1999)

Since the 1960s, African countries, jointly with donors and other partners, have made a huge effort to expand access to education, with astonishing levels of success. While the workforce in SSA

[1] We exclude South Africa from our analysis.
[2] For example, the share of industry employment in total employment is about 7 percent in Madagascar and Uganda (World Bank, 2007a).
[3] See Bosworth and Collins (2003), and Ndulu *et al.* (2007).

countries still lags behind the rest of the world in average levels of education, we find that in some countries the average education level of manufacturing workers is as good as it was in Asian countries 20 years ago.

Not all countries have followed the same patterns in expanding access. In a number of countries - primarily former British colonies- the "universal primary education" (UPE) model was adopted beginning in the mid-1990s. In this model, a large push was made towards access for all, but often with a quality decline in the initial period, at least in terms of inputs per student.[4] Other countries have focused on expanding both primary and secondary school while trying to maintain quality.

In this paper we focus attention on how the expansion of education has affected the relation between skills and labor market outcomes, specifically wages in the manufacturing sector. We are also interested in how skills with positive returns for wages relate to productivity at the firm level.

There is an ample literature on returns to education in Africa, especially using household survey data from the 1980s and early 1990s. Appleton *et al* (1996) review some of them, citing 14 studies that analyze the returns to education for wage workers. Most used basic "Mincerian" specifications, although a few had additional information measuring other, usually unobservable, characteristics. All found positive and significant returns to education, but in contrast to what is observed in OECD countries, most researchers find that rates of return curves are still convex in Africa, especially for higher education, implying that skill shortages persist at this level. The cost of expanding higher education, combined with the brain drain (which has, in effect, made the market for skilled professions in some areas global) imply that this skill shortage is likely to persist for some time. Most authors have also found that returns to education are lower for women (see Table 2), and a few studies also find evidence of age effects (see Söderbom *et al.,* 2006).

INSERT TABLE 2

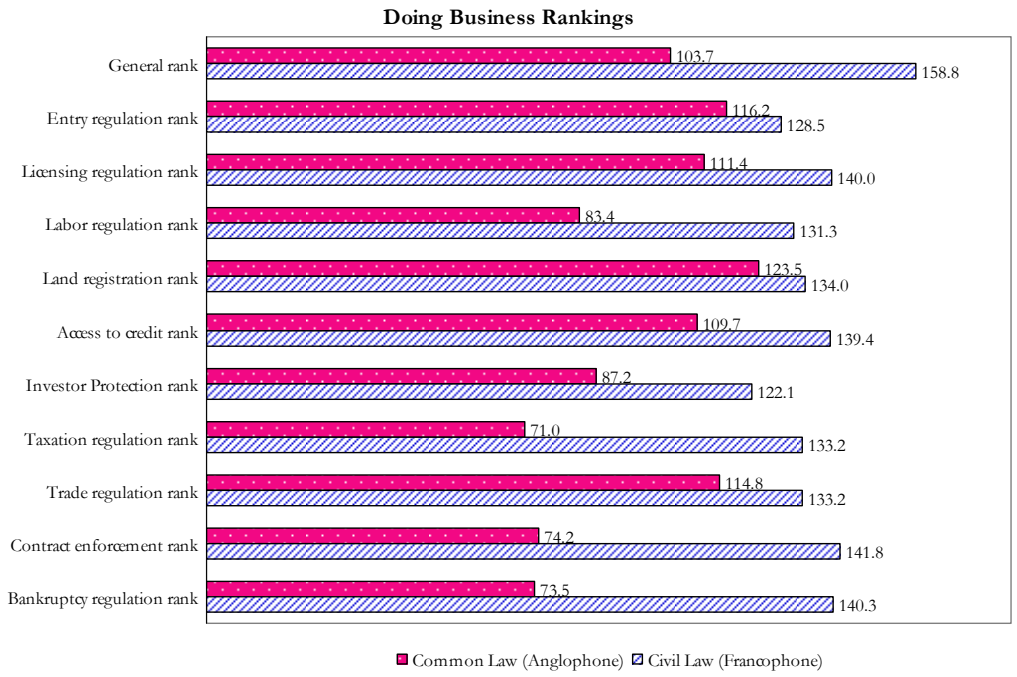
Recent analyses of the determinants of wages using repeated cross section data also suggest that returns to education are declining for new generations, especially for primary education (see Fox and Gaal, 2008). This is not surprising given how fast the labor force has been growing compared with the growth of physical capital. In addition, as education systems move from elite systems to broad ones, the selectivity factor associated with education (especially post-primary education) decreases.[5] Finally, there is no doubt that in some countries, enrollment expanded faster than the supply of trained teachers and other inputs, lowering quality.

[4] See Avenstrup (2006)

[5] In other words, returns to education were over-estimated for older cohorts as education was correlated with other, unobservable, individual characteristics.

But wage setting might not solely depend on worker's ability. Indeed, the empirical literature has found ample evidence of a strong link between firm characteristics and worker wages (e.g., Krueger and Summers, 1988; Blanchflower *et al.*, 1996, Abowd *et al.*, 1999, Söderbom et al., 2004), suggesting that observable proxies of worker ability do not explain the entire wage setting process. Several recent studies use 1990s manufacturing data from the Regional Program for Enterprise Development (RPED) to analyze wages in African manufacturing, finding evidence of rent-sharing (e.g., Teal, 1996; Azam and Ris, 2001; Alby, 2003, 2007; Söderbom and Teal, 2001; Söderbom et al., 2004), efficiency wages (Azam and Lesueur, 1997; Söderbom et al., 2004; Mazumdar and Mazaheri, 2002), inefficient labor management (Fafchamps and Söderbom, 2006), job sorting (Benhassine *et al*, 2006), as well as a role of unions in wage setting (Manda, *et al.,* 2001; Alby, 2007), which is another form of rent-sharing.[6] Interestingly, the evidence also suggests that the unexplained gap between earnings and productivity tends to narrow in relatively more advanced countries (Van Biesebroeck, 2007).

Figure 2



Source: Doing Business. Higher ranks denote more stringent regulations. The worst score is 178.

Labor regulations, in particular hiring and firing costs might also play a role in the process of upgrading the labor force to add more skilled labor. Increasing evidence in the literature suggests that the legal origin of a country has a significant impact on several measures of institutional quality,

[6] For a complete review of papers that use this data, see Bigsten and Söderbom (2006).

including regulation, which ultimately have an effect on development.[7] In Africa, labor and other regulations vary substantially according to the legal origin of the country; particularly between common-law and civil-law systems (see Figure 2).

Our paper adds to the literature on skills and labor market outcomes in SSA in several ways: first, we use recent matched employer-employee data covering 20 countries in Sub-Saharan Africa. To our knowledge, this is the first study to include such a large number of countries and to use the new Enterprise Surveys collected between 2003 and 2007.[8] Our sample enables us to analyze common patterns in wage-setting mechanisms in manufacturing across much of the continent, with enough confidence that our findings are relevant at the aggregate level. Indeed, the combined manufacturing output in our sample countries equals 44 percent of the total manufacturing output in Sub-Saharan Africa.[9]

Second, we split countries according to their legal origin (and thus the source of their Western language use) to analyze wage determination, and in particular how the expansion of the educated labor force has affected returns to education. To this end, we analyze separately across age groups (and legal origins) how skills, captured in different ways, affect wages. In this sense, our paper complements a recent study by Alby (2007), who also looks at differences in wage setting according to legal origin, using Enterprise Survey data for 9 countries. Consistent with the literature, he finds evidence of rent-sharing, and he also finds that unionization has varying affects across both country groups (a result we find as well). However, Alby's study does not look at how returns to education vary with a worker's age, something for which we do find strong evidence.

Finally, we investigate how differences in skills (associated with differences in wages) translate into differences in productivity. Following Hellerstein *et al.* (1999) and Van Biesebroeck (2007) we jointly estimate wage and productivity premia for the pooled sample and for each legal origin group. Our results suggest that productivity premia are much lower than their corresponding wage premia, which is consistent with previous findings by Bigsten *et al.* (2000).

The rest of the paper is organized as follows. Section II describes the data. Section III describes institutional differences across countries, as well as differences in firm and worker characteristics in our sample. In particular, we look at differences in skills across common law (Anglophone) and civil law (Francophone) countries. In Section IV we present results of our wage regressions, in Section V we present results of our wage and productivity premia estimations, and we conclude in Section VI.

[7] See La Porta et al. (1998), Heckman and Pagés (2000), Beck and Levine (2004), and Loayza *et al.* (2005).
[8] The data collected under the RPED project covered the early to mid- 1990s. Thereafter, all firm surveys are done under the global Enterprise Surveys project. See www.enterprisesurveys.org.
[9] Excluding South Africa.

II. Data

We use surveys of manufacturing firms carried out by the world-wide Enterprise Survey project of the World Bank group between 2003 and 2007.[10] The firms surveyed are for the most part registered for tax purposes; they employ at least 5 employees.[11] The manager/owner of the firm is interviewed in detail about basic firm characteristics (age, legal status, etc.), as well as specific investment climate questions, for instance whether the firm has experienced power outages, what the delays have been when it requested a public service, how difficult it is to deal with public officers, etc. In addition, the manager is asked to rank the investment climate obstacles according to his/her opinion (infrastructure, access to finance, labor regulations, crime, corruption, etc., a total of 15 investment climate aspects). In short, the surveys contain a rich set of questions that can be used to relate firm performance to the investment climate of the country.

Our sample covers 12 civil law countries (Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Democratic Rep. Congo, Guinea, Madagascar, Mali, Mauritania, Rwanda, and Senegal), all of them Francophone, except Cape Verde; and 8 common law countries (all Anglophone): Botswana, Gambia, Ghana, Kenya, Namibia, Swaziland, Tanzania, and Uganda. Within manufacturing, our sample has firms in the following sectors: food & beverages; chemicals, paints & pharmaceuticals; construction materials; metals; paper & printing; plastics; textiles, garments & leather; wood; and other manufacturing.[12]

A number of surveys in Africa include a worker module for a sub-sample of randomly selected firms in manufacturing. A maximum of 10 workers were interviewed in each firm.[13] They were asked about their current and starting occupation, wages, tenure, experience, gender, and other relevant questions for Africa (health, transportation, etc.). In most cases, the sample is not random, since the goal was to interview at least one worker in each job category (manager, professional, skilled production, unskilled production, non-production).[14]

We use this information, plus the data in the firm surveys, to analyze employment growth and the determinants of wages in African manufacturing firms. Our total number of observations is roughly

[10] Comprehensive information about these surveys is available at www.enterprisesurveys.org.
[11] In some countries, separate surveys have been implemented for micro- and informal firms, but we are not using these data at present.
[12] Hereafter, we refer to common law countries as "Anglophone" and civil law countries as "Francophone".
[13] Most firms have at least 6 workers in their sample.
[14] In the surveys conducted in the last 3 years, worker sampling is done as follows. In a random sample of manufacturing firms, only after the manager agrees, (a) if a list of workers exists, the interviewer(s) obtains the list of workers and randomly selects the predetermined number of employees; (b) if the list does not exists - that is, in most of the cases- the interviewer(s) walks in the factory and randomly selects workers in all categories (professional, skilled, unskilled, manager, etc.) ensuring that all categories are represented. (Personal communication with Giuseppe Iarossi, who oversees data collection in Africa.)

17,000 workers in 3,800 firms.[15] We exclude foreign workers (a very small fraction of the total sample) as their wage patterns are markedly different from national workers.

III. Institutional differences and manufacturing characteristics across Sub-Saharan Africa

Institutions

The fast recent growth in manufacturing employment observed in our sample is remarkable achievement, especially given the constraints faced by firms.[16] For instance, when firms are asked to express the degree of obstacle to their business posed by the lack of infrastructure (electricity, water, telecommunications), between 80 and 95 percent of firms qualify it as a major or severe obstacle.[17] Comparing more "objective" data on business regulations, such as the Doing Business indicators, also places SSA at the bottom the ranking (see Table 3). These rankings alone have led many observers to predict a dim future for the sub-continent.

INSERT TABLE 3

But as Figure 2 above shows, within SSA there are important differences, particularly between Anglophone (common law) and Francophone (civil law) countries. Notably, in virtually all categories of the Doing Business indicators (entry, licensing, registration, labor, contracts, trade, taxation, access to finance, investor protection, bankruptcy), the Anglophone group's ranking stands ahead of the Francophone group's. For instance, in the labor regulation category, the Anglophone group has better scores in hiring, rigidity of hours, and has lower non-wage labor costs. Furthermore, even though the actual firing costs (in terms of weeks of wages) are higher in Anglophone countries, the overall firing index is lower (that is, firing is less difficult legally).

Firms

Tables 4 and 5 provide information about the firms in our sample. Despite the similar industry composition of our sample across both legal groups, we do find a few differences in other firm characteristics: 21 percent of firms in the Francophone area are partly (or entirely) foreign owned, which is the case only for 13 percent in the Anglophone area. Thus, despite an apparently weaker investment climate, Francophone countries attract more foreign investment.

INSERT TABLE 4

[15] The number of observations on the wage regressions fall to approximately 10,000 due to missing values. See Table A15.
[16] For a detailed discussion of employment growth in manufacturing and the role of regulations, see Fox and Oviedo (2008).
[17] See Fox and Oviedo (2008).

Table 5: Selected firm characteristics

	Exporter (percent)	Privatized (percent)	Foreign owned (percent)	Part. foreign owned (percent)	Provides training (percent)	Workers reported for taxes (percent)
Anglophone	25	9	11	13	33	49.2
Francophone	25	3	19	24	29	66.9

Source: Enterprise Surveys

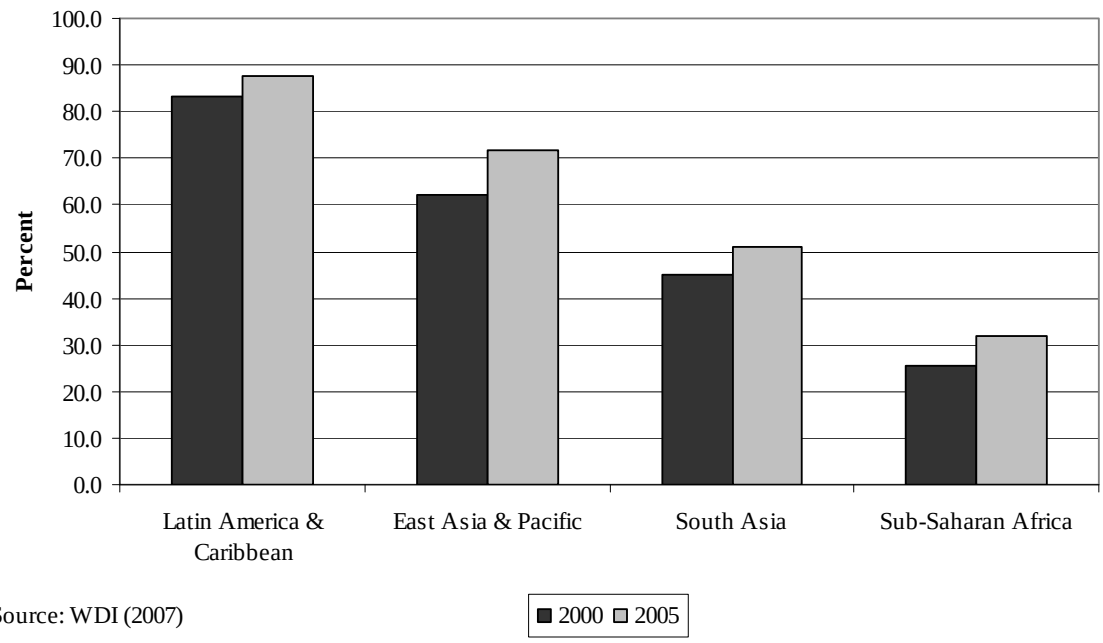
But overall, the within group differences are much greater than those between groups: the share of exporting firms varies from 4 percent in Cape Verde to 59 percent in Kenya. Likewise, the share of firms that have at least some foreign ownership ranges from 7 percent in Ghana to 50 percent in Botswana. If we look at the size distribution of firms, we find similar patterns to other countries. On average over 50 percent of firms are small (less than 20 employees), but there is a large variance in size across countries.[18]

[18] This is a much smaller share than would be found in most business registers or censuses in African countries. Here the composition of the sample matters particularly: since it is restricted to formal firms, large firms tend to be overrepresented.

Workers

African countries have made major strides in increasing educational attainment. Since 1990, the annual change in primary enrollment has been well above the rate of population growth – nearly 5 percent between 1998 and 2002. Secondary enrollment has increased even faster but from a lower base (see Figure 3).

Figure 3



Source: WDI (2007)

As a result, the supply of graduates with completed primary and some secondary education is increasing every year. Table 6 reports that countries such as Cameroon and Namibia have been able to shift their education distribution so that about 40 percent of their labor force has 10-12 years of education. Countries such as Uganda, who started later owning to a long civil war, were still able by 2002 to provide 70 percent of the labor force with at least 6-9 years of education, and another 8 percent with 10 and above. Unfortunately, rivals in South and East Asia have been able to increase education levels faster, in part because they have lower population growth. The educational distribution of the entire labor force (at the turn of the century) in Africa is quite similar to that of Asian countries 20 or 30 years earlier.[19]

INSERT TABLE 6

[19] See Psacharopoulos and Arriagada (1992).

Nonetheless, manufacturing firms in Africa have been able to attract a well educated labor force, allowing upgrade in skill levels since the 1990s. Table 7 shows that on average, workers in our sample had 11 years of education; 12 years in firms with over 100 employees. This compares favorably with China, where workers in manufacturing have on average 9.8 years of education, and Morocco, where only 27 percent have more than 12 years of education.[20] Even unskilled workers have on average over 8 years of education, which roughly corresponds to having completed a junior secondary education.[21] Similarly, average education (years) for professional workers corresponds nearly to a university degree, and there is relatively little variation across countries within this category. Firms in both country groups have older workers with slightly less education. Larger firms and exporters tend to have slightly more educated workers.

INSERT TABLE 7

We tried to compare the levels of education from the previous wave of enterprise surveys but the sample of countries differs, and there were also changes in the sampling methodology. For the countries where we do have data in both waves, the numbers are shown in Table 8. In Ghana and Kenya the share of workers with post-secondary education seems to have increased significantly.[22] Likewise, the average number of years of education increased in both countries.

INSERT TABLE 8

A word of caution is in order here: although the worker sampling has been made as randomly as possible, it is still likely that some worker categories are being overrepresented in this sample, particularly high-skilled workers, because of the stratification technique. While there is no precise way to establish this (nor to construct appropriate weights), we can still roughly compare our sample averages with a few responses from the firm's survey, which give us an indication of the "true" averages at the firm level. We can do this in particular for the distribution of education (albeit only for those firms interviewed before 2006) and for the distribution of occupations (only for the categories of skilled and unskilled production workers).

INSERT TABLES 9 AND 10

[20] The source of education in China is the National Bureau of Statistics, One Percent Population Sample (2005). We're grateful to John Giles for providing us with this number.
[21] Readers should exercise caution in interpreting cross country comparisons of education years, because they do not necessarily reflect similar levels of skills due to the variation of education quality within and across countries. In this paper we do not correct for education quality, although in our regional regressions we argue that one potential reason for differences in returns to education is quality.
[22] However, numbers for Kenya must be interpreted with caution as differences might be largely due to sample composition (oversampling of large establishments).

Table 9 shows the distribution of the workforce at the firm level according to years of education, and the distribution implied by the worker sample. We observe a systematic shift of the distribution in the workers' sample, with far higher shares of workers that have ore than 12 years of education than what the firm reports as the average. This is particularly the case for Kenya and Uganda. In Table 10 the bias towards skilled workers seems less evident, although more comprehensive distributions (only available in Kenya, Mali, and Senegal) suggest that managers and professionals are somewhat overrepresented in the workers' sample. However this bias is not as marked as the one for education.

Tables 11 and 12 show union membership rates across countries and for different age brackets. The rates of unionization are not very high, which seems at odds with the picture of labor market rigidity from Doing Business discussed above. However, several studies of the African labor market point out that unions have by-and-large lost ground since the 1980s.[23]

INSERT TABLES 11 AND 12

Figure 4

Source: Enterprise Surveys

There is substantial variation across countries, however, with very high rates in East and Southern Africa, and lower rates in Francophone countries (with the highest rate observed in Cape Verde). Unionization increases with worker age and tenure, which may be one of the reasons for the high severance pay costs in Anglophone countries (see Figure 4). Older firms have a more unionized labor

[23] See Mazumdar and Mazaheri (2002), Fox and Gaal (2008). However, this does not imply that union members receive equal treatment as compared to non-members. See Section VI.

force, and they are also more likely to have been privatized. We will return to this issue in the analysis below, on the role of unions in wage setting processes.

IV. Determinants of wages

We now turn to the analysis of the determinants of wages. In particular, we are interested in testing several hypotheses of labor market frictions that potentially affect the wage determination process. In a perfectly competitive labor market, workers' wages equal their marginal productivity, and provided that there are sufficient outside options and that labor supply is unlimited at any productivity level, wages should strictly reflect a worker's ability, that is, firm characteristics or worker characteristics unrelated to ability should not be significantly associated to wages. In practice, the labor market is highly imperfect, since the supply of qualified workers is limited, and there are relatively few job opportunities for unskilled workers. More able managers might also want to attract more able workers, hence offering them a premium above their productivity.[24] In addition, legal restrictions on hiring and firing, minimum wages, unions, and other societal arrangements might interfere with the wage-setting process.

In our estimations we concentrate on measuring how wages are affected by workers' age, education, experience, occupation in the firm, bargaining power, and whether the firm is likely to pay efficiency wages to attract more able workers. We use in turn a pooled sample of all workers across countries, and segmented samples for common-law (Anglophone) and civil-law (Franco- and Lusophone) countries. First, we construct a worker's monthly wages using the worker questionnaire, which contains two questions regarding current wages and allowances, namely the unit of payment (hourly, weekly, monthly, etc.) and the amount in current local currency units. We compute the monthly wage by multiplying the hourly rate obtained from the questionnaire, by the number of hours worked per week (where available) times four.[25]

In order to compare wages across workers and countries, we converted the nominal wages to PPP-US dollars by using the exchange rate corresponding to the year prior to the survey and the 2005 PPPs from the International Comparison Group (2008).[26] Table 13 shows annual wages by country,

[24] See Abowd *et al.* (1999) a detailed study of this phenomenon in France.

[25] If the hours worked were not available we assumed the employee works 40 hours on average. In many cases there were inconsistencies in the answers of workers. In particular, many workers reported a payment unit different than monthly (say, hourly), but reported the amount corresponding to the payment frequency (usually monthly). This created an unusual number of outliers, so nominal wages were subsequently corrected by taking into account education, occupation, and payment frequency. This reduced the number of outliers considerably, however, it is still possible that some measurement error remains. If this error is randomly distributed, it should not affect our results.

[26] Using the official exchange rate only is misleading as it does not take into account difference in the cost of living across countries. In order to reduce measurement errors, we also tried normalizing the nominal monthly wage by taking the ratio of the monthly wage to the median wage of the unskilled production worker category

and Table 14 shows monthly wages by country and occupation. Table 13 displays the mean, median, and number of observations for both workers' annual wages as well as average annual wages calculated at the firm level.[27] The systematic discrepancies between the workers' and the firms' averages confirm the fact that our worker sample is likely to over-represent highly-skilled workers and those that have highly-paid occupations.

INSERT TABLES 13-14

Except for the wages of managers, median wages in Francophone countries are higher than in Anglophone countries. There are several possible explanations for this observation: *(i)* living costs may be higher in Francophone cities (even after the PPP correction). However, in this case, we would expect even the managers' median wages to be higher. *(ii)* It is possible that the market for professionals is an international one, while the other markets are local, although the variation of the median wage across countries goes against this hypothesis. Rather, because the category "managers" includes both employed managers as well as owners, it is likely that owners are actually paid less on average than some of their more qualified employees, which can drive the average manager wage down if the sample has relatively more small firms. *(iii)* There may be a better supply of educated workers in Anglophone countries. This explanation, (and to some extent, the cost of living), are both plausible, given that Rwanda and Madagascar have both much higher median wages than the others for all occupations.[28] *(iv)* It is possible that unions push up the salaries of the lowest paid workers in Francophone countries (although the unionization rate is lower in Francophone countries).

We test the hypotheses regarding workers' education, occupation, and the union wage effect in our regression model, including also a few firm attributes that we believe may capture efficiency wages. First, we estimate a basic Mincerian earnings model, which we then expand to try to account for unobserved ability and other individual characteristics which, if excluded, are believed to bias the OLS regression (see Appleton *et al.*, 1996). Thus, we estimate the following model:

$$\ln W_{ij} = \alpha + \beta_1(E_i) + \beta_2(\mathbf{I}_i) + \beta_3(O_i) + \beta_4(\mathbf{F}_j) + \beta_5(U_i) + \varepsilon_{ij} \qquad (1)$$

where $\ln W_{ij}$ is the log of the monthly wage or employee i in firm j, E_i is education in years of employee i, $\mathbf{I}_i$ is a vector of other characteristics of employee i used in the standard Mincerian

(within country). This specification worked well and the regression results are qualitatively similar, but we lost some of variation at the lower end, so we decided to use the PPP-exchange rate.

[27] In the firm questionnaire the manager reports the annual cost of labor. This number is divided by the number of employees (permanent and temporary, correcting for the average duration of a temporary contract). It is then also corrected using PPP exchange rates.

[28] We tried removing Rwanda from the Francophone sample given that it seems to be an outlier, but the median wages were basically unaffected – they were still significantly higher in the Francophone area.

formulation, (age, tenure, experience, gender, whether the worker is full-time), O_i is occupation of employee *i*, where *O* is a dummy for the following categories: manager, professional, skilled production, unskilled production, and non-production. This variable potentially captures unobservable characteristics of the worker which allow them to perform a particular occupation.[29] $\mathbf{F}_j$ is a vector of firm characteristics, namely size and exporter status. There is evidence in the literature that large firms pay higher wages, which is typically attributed to efficiency wages paid to more able and dedicated workers (Söderbom *et al.*, 2004). The same is true for exporters, for whom the quality of the product is more important than for non-exporters. U_i is a dummy that indicates whether the worker belongs to a union, while U_f indicates whether there are any unionized workers in the firm.[30] As Alby (2007) finds in his analysis, rent-sharing can take different forms and benefit workers differently, hence, we might find union effects on wages related to a worker belonging to a union, or a general wage effect related to the presence of a union at the firm. Finally, ε_{ij} is an error term that is assumed to be uncorrelated across firms, but not necessarily within firms. This means that in our estimations we cluster the errors at the firm level, which typically yields larger standard errors for the estimates.

This model assumes that the effects of the independent variables on wages are consistent across cohorts. However, as suggested above, given the rapid expansion in both the size of the labor force and in access to education, this may not be true. In addition, there might be other reasons for wages to differ with age, for instance if unions lobby on behalf of older workers, or if workers' promotions are correlated with age.[31] To test these hypotheses, we introduce a dummy variable for workers above the median age (32 years old). All our regressions also control for worker effort (proxied by hours worked), as well as other unobserved effects at the country and industry level.

[29] Benhassine *et al.*, (2006) argue that African firms are able to detect these characteristics and sort workers into occupations accordingly.
[30] As Table 16 shows, around 43 percent of firms have at least one unionized worker in Anglophone countries, versus 25 percent in Francophone.
[31] In fact, unionization is positively correlated with age (0.15). Having received at least one promotion at the firm is also positively correlated with age (0.08).

Results

Table 15 reports the results of the regressions with the pooled sample. Following Murphy and Welch (1990) we add quartic terms for tenure and previous experience in order to capture more accurately the age-earnings profiles.[32]

INSERT TABLE 15

Column (1) reports the results from the basic specification. In terms of individual variables, we have a few deviations from the standard Mincerian. We are able to subdivide experience into that acquired at the firm, and that acquired before the employee joined the firm (but in the same industry). The former is expected to be worth more than the latter, as during tenure at the firm, firm-specific as well as general human capital can be built up. In contrast to evidence from the US and other developed economies, returns to age, experience, and tenure seem to be linear in our case, since the quartic terms are insignificant (with the exception of age, which is negative but very close to zero). The linear returns to tenure and experience are equal to 0.014 and 0.016 respectively, well below the ones reported for the US, of around 0.03 (see, for instance Topel, 1991; and Altonji and Williams, 2005). The age dummy is positive and highly significant, indicating that older workers receive about 14 percent higher wages, for equal levels of education and experience.

In the basic specification we include the number of years of education as a linear term and squared, and we find that both terms are positive and significant at the 1 percent level, suggesting increasing returns to education. In fact, everything else equal, for a worker with six years of education each extra year of education is associated with a wage increase of 4.4 percent; for a worker who is at the mean of education years (10.8) the increase is 5.4 percent, and for a worker with 16 years (the equivalent of a university degree) the increase of an additional year is 6.4 percent.

In column (2), we add dummy variables indicating the level of educational achievement of the worker (i.e., the highest degree obtained).[33] These dummies are expected to pick up the marginal effect of obtaining a certificate of completion for full secondary, vocational training, or university, and they also capture increasing returns to education.[34] As expected, education still has a positive coefficient, however, it is much lower than in the previous regression, and not statistically significant. The squared term is still significantly different from zero, but it only represents a semi-elasticity of 0.1 percent. On the other hand, the coefficients for each degree obtained are large and significant,

[32] As we see in the results, these turn out to have insignificant coefficients. The same is true for quadratic terms.
[33] The categories are: Primary degree or no education, Junior secondary or secondary degree, Vocational training degree, and Tertiary or university degree.
[34] Additionally, they might also capture signaling effects.

suggesting that employers place a much higher value on having completed an education.[35] In fact, compared to those with only primary or no education, having completed a secondary education raises the wage by 16 percent, while workers with vocational training receive on average 35 percent higher wages. Workers with a tertiary or university degree have an 81 percent higher wage. We take this a strong evidence of increasing returns to education, which is consistent, for instance, with findings for Kenya and Tanzania by Söderbom *et al.* (2006).

Experience appears to be worth more than years of education (not counting the degree obtained), with an additional year of previous experience or tenure adding a two percent increase in wages. Surprisingly, years of prior experience are worth the same as tenure years in this specification, but this shifts slightly after we add other variables (although statistically they are not different). With respect to other characteristics, female workers earn about 5 percent less, and this characteristic stays negative at this level through the analysis. Temporary workers earn between 25 and 24 percent less than permanent workers, which is as expected.

In our first two specifications, we only augment the Mincerian model with firm size and whether the firm is an exporter. As expected, we find that exporter firms pay higher wages, about 14 percent higher. On the other hand, we only find weak evidence of a firm size effect, since the coefficient for medium firms is not significant. Large firms appear to pay between 9 and 12 percent more than small firms.

It could be argued that our results are sensitive to sample composition, in the sense that some countries will carry a disproportionately large weight in the regression when in fact the size of their economy is small in comparison to the rest. We test this by performing the same regression analysis as previously, but we weigh each observation by the GDP of the corresponding country. Results are reported in column (3) of Table 15. The coefficients related to education and age are maintained, whereas those of gender, tenure, and experience fall somewhat and lose their significance, as does the firm size effect. The exporter effect is maintained. Although results are not radically different whether or not we weigh the observations, in all following exercises we choose to weigh the observations by GDP.

In column (4) of Table 15, we add the variables for occupation, which appear to pick up a significant fraction of unobserved ability, as the net returns to educational achievement decline. Linear returns to education are about the same, but returns to all degrees fall, especially vocational and secondary, which fall by nearly 50 percent. Returns to prior experience also fall below the returns to years of tenure. The skills and characteristics found in managers and professional workers seem to be

[35] It is also likely that more able workers usually have completed their education.

especially valuable to the firm, which pays a premium of 85 percent to managers and 56 percent to professionals (relative to unskilled workers), even after controlling for education and experience.

In this same regression we introduce the two variables aimed at capturing rent-sharing from the workers' side. We include a dummy for workers who belong to a trade union, and a dummy for workers who a relatives to the owner or manager of the firm. We find no significant wage premium for union members, and surprisingly, relatives of the owner or manager seem to earn about 12 percent less. Finally, in column (5) we add a firm-level variable aimed at capturing rent-sharing at the firm level.[36] Specifically, we include a dummy for firms in which at least one worker belongs to a union, to indicate union presence at the firm. This could have an effect not just on members' wages, but on the entire wage bill. We find a positive but insignificant union-firm effect of about 7 percent.

Institutional effects

Broadly speaking, the regression models estimated so far with the pooled sample show a well behaved wage function – the signs of the coefficients were as expected, and consistent. Now we analyze the wage function separately for the two legal systems in our sample: common- and civil-law (i.e., corresponding to Anglophone and Franco/Lusophone countries). Recall that the overall regulatory environment is much less friendly in Francophone countries, but the hiring and firing costs are actually higher in some Anglophone countries than in the mean of Francophone countries. What do these institutional differences mean for returns to education, occupational premia, and rent-sharing?

INSERT TABLE 16

Table 16 reports the results obtained for the specifications in columns (1), (3), and (4) of Table 15, estimated separately for Francophone and Anglophone countries. The differences are striking. Returns to years of education appear to be higher in Anglophone than in Francophone countries, however in both regressions the coefficient is insignificant. Returns to educational achievement on the other hand, are large and significant in both groups, and slightly larger in Anglophone countries, especially at the secondary and tertiary levels. (Vocational degree-holders earn roughly the same premium of 31-37 percent in both.) University or tertiary degree holders earn 93 percent more than uneducated workers in Anglophone countries, whereas they get about 72 percent more in Francophone countries. Secondary degree holders earn about 24 percent more than uneducated workers, but the premium for a secondary degree in Francophone countries is only 11 percent.

[36] We also omit the quartic terms from previous specifications, as they were all insignificant. This does not alter our results.

In terms of experience, we find that after controlling for education only previous experience has an effect on wages in Anglophone countries, but not tenure; while an additional year of tenure increases wages by 2.1 percent, and an additional year of previous experience increases wages by 1.2 percent in Francophone countries. We also find that there is no significant wage penalty for being a woman in Anglophone Africa, whereas females in Francophone countries earn about 8 percent less.

As for firm effects, the exporter premium is still high and significant in both groups. On the other hand, the firm size effect is only present in Francophone countries, and its significance is stronger for medium-sized firms, which suggests the presence of efficiency wages in these countries.

In columns (2) and (3) we augment the specification by adding worker occupation, union membership (again at the worker and firm level), and relation to the owner or manager. As in the pooled results, the coefficients for educational achievement fall considerably after these additions, especially in the Anglophone group. They remain high and significant, however. Results on experience change somewhat, with tenure becoming positive and significant for Anglophone countries, and higher than previous experience. In the Francophone both tenure and previous experience coefficients fall slightly, but remain significant at the 1 percent level.

Occupation categories have positive and significant coefficients in both groups, but the magnitudes of the coefficients are much larger in the Anglophone group. Indeed, a manager in an Anglophone country earns over 100 percent more than an unskilled worker, whereas in a Francophone country a manager earns about 53 percent more. Differences in other categories are not as large, but still significant, for instance, the semi-elasticity for professional workers is almost twice as large in Anglophone than in Francophone countries (0.73 vs. 0.41). If promotions at the firm were mostly determined by seniority, then presumably experience would not affect wages. However, the fact that tenure and experience still matter, especially in Francophone countries, suggests that there is job sorting, that is, workers are not randomly assigned to occupations and then rewarded only according to their observable skills (education, experience, etc.), but instead they are assigned to occupations that match their abilities independently of observable skills.

Turning to rent-sharing evidence, we find that union membership brings about a 15 percent higher wage in Francophone countries, but has no effect in Anglophone. This is a somewhat unexpected result, because union density is lower in Francophone countries than in Anglophone. Does this mean unions are ineffective in Anglophone countries? On the contrary, we find that the presence of a union does benefit *all* workers regardless of membership in Anglophone countries, since these workers earn roughly 16 percent more than workers of firms where there is no union presence. It is important to keep in mind that there could be an endogeneity problem with this result, if unionized

workers are more productive, or if firms that have union presence have in general a more productive workforce. We will explore productivity issues in the next section. As for relatives of the owner/manager working at the firm, we find that they earn about 15 percent less than non-related workers, but only in Francophone countries. [37]

Firm effects are maintained similar to those of the baseline specification, that is, firm size matters in Francophone countries, but not in Anglophone countries, while exporters pay higher wages in both groups.

Age effects

So far, results for all regressions, pooled and segmented, show a positive and significant effect of worker's age, even after controlling for education, experience, and occupation. We now explore whether returns to education, experience, occupation, and other characteristics differ according to age groups. Our motivation for this exercise is to find out whether the rapid expansion in education has changed returns to education (i.e., lowered them), so that firms would be essentially overpaying older workers. In addition, we want to know whether age plays a role in any other effects that we have already observed at the mean sample level.

To investigate age effects, we divide workers into "young" and "old" according to the median age of 32 years.[38] Then, we run the same specification as in column (5) of Table 15, but separately for each age group. That is, we allow all coefficients to vary with respect to the age group. Even if we might lose accuracy in the estimation du to the reduction in sample size, we still have enough observations in each case to have reasonably precise estimates.

INSERT TABLE 17

Table 17 reports the results from this exercise. The first thing to notice is that even if the sample size is considerably reduced in each case, the R squared remains high, revealing that our specification explains between 30 and 60 percent of the overall variation in wages, which is similar to the values reported in Tables 15-16. Interestingly, our specification seems to be able to explain much more of the variation in the Francophone sample.

This new set of results confirms by and large that age effects matter, and that they have different effects in each of our groups. We find that returns to educational attainment are significant only for

[37] Alby (2007) finds a similar difference in the union effect between civil law and common law countries. He hypothesizes that this result is *a response* to lower regulation in the Anglophone countries.

[38] This is the overall median, but the median age is about the same for both linguistic groups. In previously reported exercises, we also divided workers into several cohorts, however results suggested that there was a single cutoff, corresponding to "young" workers and the rest. In addition, we did a piece-wise linear spline on age to see if there were level and slope differences. Results are similar to those from Tables 15-16.

older workers in Anglophone countries, whereas in Francophone countries they are significant (except for secondary education) and have similar magnitudes for both age groups. As before, returns to years of education are only positive and significant at the 10 percent level for older workers in Francophone countries.

Also similar to the last exercise, returns to experience and tenure do not seem to affect wages in Anglophone countries, while in Francophone countries they do increase wages, and these returns seem to be slightly higher for younger workers. Returns to occupation in Anglophone countries do not vary across age groups, but they do in Francophone countries. In the latter group, the magnitudes of the coefficients are much higher and significant for the older group.[39]

Finally, our results regarding bargaining power seem to confirm the initial results of Tables 15-16 that union membership matters in Francophone countries, and union presence matters in Anglophone countries. However, in this case we also find that union membership, and also being related to the owner, matter more for older workers in the Francophone group. This is more in line with our hypothesis stated earlier, that unions tend to protect older workers more. In contrast, union presence seems to benefit all workers equally in Anglophone countries (and being related to the owner makes no difference).

In summary, our wage analysis reveals *(i)* increasing returns to education in all countries, but for older workers only in Anglophone countries, suggesting that the expansion of education in Anglophone Africa has reduced returns to education for entrants in the labor market; *(ii)* age effects matter not just for returns to education, but they affect the wage setting process more generally. In particular, in Francophone countries returns to occupation are rewarded only after a certain age; *(iii)* workers exercise some power in the wage setting process, but this influence varies by linguistic group: in Anglophone countries union presence benefit all workers equally, not just members, whereas in Francophone countries only older members enjoy higher wages.

V. Are wage and productivity premia equal in African manufacturing?

The evidence that certain categories of workers systematically get higher wages suggest underlying differences in worker ability, due to education, experience, as well as unobserved characteristics. While certain categories, such as education, are very likely to reflect productivity differences among workers, in other categories it is less certain that better paid workers are indeed more productive. This is a relevant question if, for example, we conclude that union members enjoy a greater

[39] There is some potential for small sample bias given that relatively fewer young workers hold high occupations. However, over 65 percent of the Francophone sample is less than 32 years old, and their levels of education are higher, so we believe the potential for this bias is small.

bargaining position in wage determination, so that they get paid more regardless of their productivity. But it could also be the case that union members are more productive, and therefore they are simply getting rewarded according to their productivity and not their union status.

In this section we take advantage of our data to analyze productivity differences across worker categories, and to link these differences to differences in wages. Our methodology draws largely from Hellerstein *et al.* (1999), and Van Biesebroeck (2007), who use employer-employee data to analyze wage and productivity premia respectively in the United States, and in three African countries (Kenya, Tanzania, and Zimbabwe). In this respect, our analysis in closer to Van Biesebroeck's, with two major differences: first, we use more recent and comprehensive data. Second, we pool the countries' data together in order to increase our sample size and hence the precision of our estimations. We perform two exercises: one with the pooled data, and another where we split the sample according to the linguistic group (English or French), as we did in previous analyses.

In essence, this exercise consists of estimating a production function at the firm level, but allowing the labor input to vary according to several "quality" characteristics of the worker. In parallel, a wage equation is estimated that includes the same quality characteristics. The coefficients from the production function and wage regressions are then compared in order to determine whether wage premia actually reflect higher productivity for a particular quality attribute.

To illustrate this, consider the following example. Suppose that workers correspond to one of two categories, that we call "0" and "1", and let the production function take the form

$$\ln Y = \ln A + \alpha_K \ln K + \alpha_L \ln \tilde{L} + \varepsilon \quad (2)$$

where $\tilde{L}$ is quality-adjusted total labor, which equals $\tilde{L} = L + (\phi_1 - 1)L_1$; L_1 is the total number of employees of category "1", ϕ_1 is the relative marginal productivity of workers of category "1", and L is the total number of employees. That is, workers who belong to category "1" are more productive than category "0" workers by a fraction $(\phi_1 - 1)$.[40] Then we can express (2) as:

$$\begin{aligned} \ln Y &= \ln A + \alpha_K \ln K + \alpha_L \ln\left[L\left(1 + (\phi_1 - 1)\frac{L_1}{L} \right) \right] + \varepsilon \\ &= \ln A + \alpha_K \ln K + \alpha_L \ln L + \alpha_L \ln\left(1 + (\phi_1 - 1)\tilde{L}_1\right) + \varepsilon \end{aligned} \quad (3)$$

[40] Expressing marginal productivities in this form facilitates the convergence of the estimation algorithm.

where L=L0+L1 and $\tilde{L}_1 = \frac{L_1}{L}$.

Likewise, for the worker, wages are determined by the augmented "Mincerian" specification:

$$\ln W = w_0 + \sum_{k=1}^{K} \beta_k X_k + w_1 I + \eta \qquad (4)$$

where I=1 if the worker belongs to category "1", and zero otherwise, and X_k is a worker characteristic independent of the worker category.

From equations (3) and (4) it is readily seen that the productivity premium of workers that belong to category "1" is equal to $(\phi_1 - 1)$, while their wage premium corresponds to the semi-elasticity w_1.

The goal of the exercise is then to test whether the productivity premium is equal to the wage premium, that is, whether workers who get paid more are really more productive. This amounts to testing whether $w_1 = (\phi_1 - 1)$.

This exercise is straightforward if we consider only two categories (e.g. male vs. female). However, considering more categories (for example, gender and race) implies that the new number of total worker categories needs to include combinations of both main categories (black females, black males, etc.).

In our exercise we restrict the analysis to age, occupation (as before, divided into managers, professionals, skilled production, unskilled production, and non-production), educational attainment (none or primary, junior or senior secondary, vocational, and upper education), and union membership. Because of data limitations, we cannot obtain accurate estimates the proportion of workers of all characteristic combinations at the firm level. We can, however, use only the estimated proportions of each broad category, provided we make the following two assumptions.[41] First, we restrict the relative marginal productivities of two worker occupations (managers and professionals, for instance) within one age group (e.g., 32 years old and younger) to be equal to the relative marginal productivities of the same two worker occupations within the other age group. The second assumption is that the ratio of two worker categories within a group (for instance, the ratio of managers and professionals within the young age group) is the same for the same categories in another group (managers and professionals in the old age group). These two assumptions allow us to simplify our expression of quality adjusted labor as follows:

[41] This follows Hellerstein *et al.* (1999)

$$\widetilde{L} = \left[L + (\phi_O - 1)O\right] \times \left[(\phi_M - 1)\frac{M}{L} + (\phi_P - 1)\frac{P}{L} + (\phi_S - 1)\frac{S}{L}\right] \times \left[(\phi_E - 1)\frac{E}{L} + (\phi_V - 1)\frac{V}{L} + (\phi_T - 1)\frac{T}{L}\right] \times \left[(\phi_U - 1)\frac{U}{L}\right] \quad (5)$$

where O is the number of workers older than 32 years old; M, P, and S are respectively the numbers of managers, professionals, and skilled-production workers; E, V, and T are respectively the numbers of workers with secondary, vocational, or upper education (tertiary and university) degrees; and U is the number of union members.

In principle, we do have a sub-sample of workers for each of these categories at the firm level. Indeed, in both Hellerstein *et al.* and Van Biesebroeck's studies the shares of workers for each category are calculated at the firm level. However, because in our sample certain categories of workers are overrepresented, particularly those with high rank and education, our results could be sensitive to this sample bias. We therefore perform two sets of exercises, the first with proportions of each category calculated at the firm level, and the second with proportions at the country, industry, size, and firm age level.[42]

The dependent variable in the production function estimation is the log of value added (sales minus materials) converted to US PPP dollars. To measure the capital stock, we use the log of replacement value of machinery and equipment stocks, also converted to US PPP dollars. In the wage estimation, the dependent variable is the monthly wage converted to US PPP dollars (also used in the previous section). The estimation of equation (2) and the wage specification presented in equation (1) (and corresponding to column (4) of Table 15) is done jointly, with productivity estimated at the firm level, and wages at the worker level. All errors are clustered at the firm level. Because equation (2) is not linear in its parameters, the joint estimation is done by non-linear maximum likelihood. All estimations control for country, industry, and size effects, they also include a dummy for exporters, a dummy for union presence at the firm, and the average hours worked per week.[43] In addition, to mimic our preferred specification in the wage determination analysis, in the wage equation we control for gender, permanent status, years of education, years of education squared, tenure, previous experience, worker age, and whether the worker is related to the owner or manager.

[42] Within each country, there are 10 industries (Food & beverages, Chemicals, paints & pharmaceuticals, Construction materials, Metals, Paper & printing, Plastics, Textiles, Garments & leather, Wood, Other manufacturing), three size classes (less than employees, 20 to 99 employees, and 100 more), and 5 firm age categories (less than 5 years old, 5 to 9 years old, 10 to 19 years old, 20 to 39 years old, and 40 years old and older).

[43] In the first exercise (Table 19) hours worked per week is the average of the workers' sample at the firm level. In the second exercise (Tables 29 and 30) we use the mean for the corresponding country, industry, size, and age class.

Table 19 presents the results for the first exercise, for the pooled sample as well as the Anglophone and Francophone groups. To lighten the presentation of the table, we only report the coefficients pertaining to occupation, educational attainment, age, and union membership. Before we move on to the results' discussion, it is worth pointing out that in all our specifications returns to scale appear to be decreasing.[44] This stands in contrast to Van Biesebroeck's results, who finds that in Kenya, Tanzania, and Zimbabwe returns are slightly increasing. However, it is not clear what measure of capital is used in his analysis.

INSERT TABLE 19

The first three columns of the Table present the results of the pooled estimation. Recall that the productivity premium is equal to one minus the reported coefficient. The occupation coefficients are all greater than one in the pooled estimation, however, only the professionals' coefficient is significantly higher than one (but barely, as the p-value equals 0.08), as the tests at the bottom of the Table show. This suggests that for an average firm, having a larger share of professionals is associated with a significant increase in output, but this is not the case for having more managers or more skilled production workers. Moreover, the joint test of all occupation coefficients equal to one cannot be rejected. Because in the wage equation managers, professionals, and skilled production workers all receive higher wages, we could conclude that all three categories are overpaid with respect to their productivity. However, the hypothesis of equality of wage and productivity premia cannot be rejected for any occupation, which indicates that in fact workers are not paid above their relative marginal productivity.

The same is true for educational attainment. Although all coefficients are higher than one, none of them is significantly so, as the Wald tests confirm, including the joint test, and the hypothesis of equal premia cannot be rejected at any education level (jointly as well as individually).

Having older workers seems to hurt production, however the coefficient for the share of workers above 32 is not significantly less than one. For union membership, we obtain similar results, that is, the productivity coefficient is not significantly different from one, and the equality of premia cannot be ruled out. In summary, for the pooled sample our results suggest that the range of wage premia that workers in a given category receive is not statistically different from the range of marginal productivities of workers in the same category.

[44] The coefficient for capital varies between 0.03 and 0.05, and the coefficient for labor is between 0.76 and 0.79. We also attempted at conducting this exercise separately for each industry, however the coefficients were too imprecisely estimated due to lack of a sufficiently large sample in most industries. However, if we only estimate equation (3) by non-linear least squares, we notice that most industries exhibit close to constant returns, with the exception of Food & beverages, Furniture, and Paper & printing, for which returns were slightly increasing.

Results are slightly different when we split the sample into Anglophone and Francophone. In particular, vocational degree holders appear to be more productive relative to those with no education, whereas those with upper level education appear as less productive. Both coefficients are significantly different from one. In both cases, the hypothesis of equality of premia is rejected, which indicates that vocational degree holders are paid below their marginal productivity, while more educated workers are paid above. The same is true for managers, who get a sizeable wage premium, but whose productivity is not above the average. In Francophone countries there are no significant differences with respect to the pooled sample.

To mitigate the potential problems caused by sample selection bias, we perform two additional exercises, but this time, instead of using the worker shares calculated at the firm level, we use shares calculated for the corresponding country, industry, size, and firm age level. First, we include all worker categories as was done in Table 19. In the second exercise, we take into account only two groups at a time, so that our first estimation includes age and occupation, the second has age and educational attainment, and the third has age and union membership. Results are presented in Tables 20 and 21.

INSERT TABLES 20-21

Broadly, our results from the previous table are confirmed. In most categories productivity premia are barely higher than one, although not statistically different from one, with a few exceptions. Having older workers does seem to affect production in this specification, since the coefficient for the share of workers above 32 is significantly less than one. Another category that appears to have lower productivity is upper-education degree holders, in particular for the Anglophone group. On the other hand, vocational degree holders are more productive in Anglophone countries. These results were also apparent in Table 19.

Further, in the pooled sample the hypothesis of equality of wage and productivity premia is rejected only for managers and older workers, which indicates that only in these two categories workers are paid above their relative marginal productivity. In the Anglophone group we find that managers, skilled production workers, and upper-education degree holders have wage premia that are significantly higher than their relative marginal productivities, whereas vocational degree holders' wage premium appears to be below their relative marginal productivity. Finally in the Francophone group we find that older workers, union members, and vocational degree holders appear to have wage premia above their relative marginal productivity. These results are largely confirmed when we estimate the equations separately for two groups at a time, as shown in Table 21. In summary, our results suggest that in general, highly educated and highly ranked workers receive wage premia that

do not reflect a higher relative marginal productivity.[45] These results are consistent with previous findings by Bigsten *et al.* (2000), and by Van Biesebroeck (2007) for the least developed countries in his sample. However they contradict evidence for Ghana provided by Verner (1999), who estimates wage and production function equations and finds positive productivity premia for education. In contrast to our specification, Verner estimates linear equations for production function and wages. This amounts, if our specification from equation (3) is the correct one, to an identification problem for the productivity premium, which is indistinguishable from the marginal product of labor.

VI. Concluding remarks

Enhancing competitiveness in value-added sectors is a high priority for policy agendas in many African countries. Although our knowledge about the functioning of the non-agricultural private sector is expanding fast, we still know little about how institutions are affecting the efficiency of this sector. In this paper we investigate labor market outcomes, in particular wages, in the manufacturing sector in 20 SSA countries, specifically looking at (a) skill shortage and cohort effects, and (b) effects of regulatory environment and unions. We looked for them in countries which have less regulation but more unionization, and have expanded education faster (Anglophone countries with a common law system) and in countries which have more regulation but less unionization and have expanded education more slowly (Franco- and Lusophone countries with a civil law system).

In both countries, we find evidence of skill shortages, especially with respect to higher education. We also find cohort effects on returns to educational attainment in Anglophone countries, with older cohorts getting higher returns. In Francophone countries we find that there are strong occupation premia, but only for older workers, whereas they are uniform across age groups in Anglophone countries (but still very significant in size). Interestingly, our productivity estimation results suggest that neither older workers, nor those with higher qualifications (by degree or occupation) are significantly more productive than younger ones, which points to wage premia above the relative marginal productivity of these groups.

There are different reasons why older workers could be getting higher wages. One possible reason is high severance payments. The only way firms can afford to keep older workers is to depress the earnings of younger workers.[46] In this case, the premium is of concern, as it could decrease the private returns to education such that parents would no longer be willing to pay the cost of secondary school.

[45] In a separate set of (unreported) exercises, we relaxed our assumptions of equal relative productivities and equal shares for two categories in two different groups. Unfortunately, our estimates turned out to be too imprecise, perhaps due to the sample bias issue.

[46] Depending on the company and the decade, both effects could be found in the airline industry in the U.S. once the product market became more competitive.

The social effects of the premium are unclear. Low returns to secondary education could create cobweb cycles, where periods of an expansion of enrollment are followed by shortage of graduates as parents respond with a lag to fluctuating returns. In order to realize the social returns and support increased investment in manufacturing, governments would then have to subsidize the expansion of secondary more than otherwise. At the same time, many workers in these firms are supporting a number of dependents – in their immediate family and outside of it. If firms were able to lay off older workers cheaply, in a situation of few if any mechanisms for income smoothing, the poverty effect could be substantial. Thus, the overall economic and social impact of the cohort premium is difficult to estimate, and will vary country by country. In OECD countries, firms have tried to shift the costs of older workers to the public purse through early retirement on public pensions. African governments cannot afford this solution.

As for the union effect, we find important differences between Anglophone and Francophone countries: in Anglophone countries all workers benefit significantly from union presence at the firm, regardless of their membership. In Francophone countries only older union members get a higher wage than non-members. In summary, our results indicate that institutional aspects play an important role in wage determination, by giving certain groups of workers more bargaining power. But this effect differs according to the legal origin of the country.

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Appendix: Tables

Table 1: Manufacturing, value added (% of GDP)

		Year				
		2002	2003	2004	2005	2006
Anglophone	Botswana	4.2	4.3	4.1	3.7	3.7
	Gambia	5.7	5.3	5.3	5.2	
	Ghana	9.0	9.0	8.8	8.3	7.6
	Kenya	11.3	11.2	11.2	11.5	12.1
	Namibia	11.1	12.4	13.5	13.1	12.9
	Swaziland	37.9	38.4	37.9	37.2	36.8
	Tanzania	7.3	7.2	7.0	6.8	6.9
	Uganda	10.0	9.3	9.2	9.2	8.6
Francophone	Benin	8.6	8.5	7.6	7.5	
	Burkina Faso	12.3	12.9			
	Burundi	8.4	8.5	8.5	8.8	
	Cameroon	20.6	20.2	19.2	18.7	18.5
	Cape Verde	6.1	8.0			4.8
	Congo, DR	5.4	5.4	6.3	6.6	6.5
	Guinea	4.1	3.9	3.7	3.7	3.7
	Madagascar	12.5	13.7	14.2	14.0	13.4
	Mali	3.2	2.8	3.4	3.2	3.1
	Mauritania	6.2	6.0	5.9	5.0	
	Rwanda	11.2	8.9	8.0	8.2	8.5
	Senegal	12.5	11.7	11.5	10.9	10.2

Source: ADI (2007)

Table 2: Estimates of returns to education using firm survey data

Authors	Countries	Years	Returns	Increasing	Comments
Mazumdar and Mazaheri (2002)	Cameroon, Cote d'Ivoire, Ghana, Kenya, Tanzania, Zambia, Zimbabwe	early 1990s	positive, significant	yes	
Bigsten *et al.* (2000)	Cameroon, Ghana, Kenya, Zambia, Zimbabwe	early 1990s	positive, significant	yes	Returns to human capital are much lower if measured at the firm level via the production function.
Teal (in progress)	Ghana	1993-95	positive, significant	yes	cited in Appleton *et al.* (1996)
Söderbom *et al.* (2006)	Kenya, Tanzania	1993-2001	positive, significant	yes	Find also cohort effects (young vs. old). Returns are higher for older workers.

The studies use manufacturing firm and worker data from the RPED dataset. Their dependent variable is worker wages.

Table 3: Doing Business Rankings for Sub-Saharan Africa			
	Mean*	**Minimum**	**Maximum**
General rank	135.4	27	178
Trade regulation rank	129.9	16	178
Entry regulation rank	125.3	8	178
Land registration rank	123.2	26	173
Bankruptcy regulation rank	121.3	26	178
Labor regulation rank	116.4	10	176
Contract enforcement rank	115	33	176
Access to credit rank	112.8	13	176
Licensing regulation rank	112.5	9	178
Investor Protection rank	111	9	175
Taxation regulation rank	104.6	11	176
*Mean over 46 SSA countries. Source: Doing Business			

Table 4: Industry distribution by country (number of firms)

		Agro industry	Chemicals and related products	Materials for construction	Furniture	Metallic products	Industry of paper and paper products	Plastics products	Textiles and leather	Wood	Other	Total
Anglophone	Botswana (2006)	12	10	19	19	8	8	0	28	0	10	114
	Gambia (2006)	5	0	2	8	11	1	1	4	0	1	33
	Ghana2007	80	7	0	0	21	0	6	128	0	71	313
	Kenya (2003)	69	25	17	8	42	18	23	68	12	0	282
	Namibia (2006)	18	4	9	22	16	10	2	7	0	18	106
	Swaziland (2006)	15	5	8	4	2	10	2	21	0	3	70
	Tanzania (2003)	81	27	11	65	29	25	7	31	0	0	276
	Tanzania (2006)	70	15	9	60	27	16	6	56	0	14	273
	Uganda (2003)	122	18	40	47	21	23	7	15	7	0	300
	Uganda (2006)	92	8	10	93	53	22	0	17	0	12	307
	Total	564	119	125	326	230	133	54	375	19	129	2,074
Francophone	Benin (2004)	50	9	10	61	27	45	3	7	25	10	247
	Burkina Faso (2006)	14	1	1	0	3	12	2	4	7	7	51
	Burundi (2006)	23	14	2	22	6	8	1	26	0	0	102
	Cameroon (2006)	31	11	6	0	8	19	6	7	18	13	119
	Cape Verde (2006)	12	1	2	0	0	0	1	5	16	10	47
	DR Congo (2006)	59	16	3	24	10	4	2	22	0	9	149
	Guinea (2006)	27	3	0	29	18	0	0	41	0	17	135
	Madagascar (2005)	45	17	0	64	20	6	13	89	0	38	292
	Mali (2003)	51	16	19	13	22	11	7	10	5	0	154
	Mauritania (2006)	29	5	4	13	12	8	0	5	0	4	80
	Rwanda (2006)	21	7	2	7	4	9	1	7	0	1	59
	Senegal (2003)	93	34	19	6	25	36	15	23	10	1	262
	Total	455	134	68	239	155	158	51	246	81	110	1,697
	Total	1,019	253	193	565	385	291	105	621	100	239	3,771

Table 6: Education of the labor force and manufacturing workers (percent)

	Coverage	Country	Year	< 6 yrs	6-9 yrs	10-12 yrs	12 + yrs
Africa	Labor force	Botswana	1996	22.1	63.4		13.8
	Manufacturing[a]	Botswana	2006	18.4	13.5	64.6	3.0
	Labor force[§]	Burkina Faso	2003	72.9	17.6	6.0	3.5
	Manufacturing[a]	Burkina Faso	2006	32.1	34.9	11.6	20.8
	Labor force[§]	Cameroon	2001	74.1	16.5	6.9	2.5
	Manufacturing[a]	Cameroon	2006	11.2	39.4	16.6	32.8
	Labor force[§]	Ghana	1998	65.0	25.1	8.6	1.2
	Manufacturing[a]	Ghana	2007	25.9	16.6	50.0	5.1
	Labor force	Guinea	1998	61.3	27.5	8.0	3.2
	Manufacturing[a]	Guinea	2006	52.2	31.5	8.4	7.6
	Labor force[‡]	Kenya	2005	63.5	34.9		1.6
	Manufacturing[a]	Kenya	2003	20.6	47.7	3.0	28.7
	Labor force[b]	Madagascar	2005	54.0	39.5	3.9	2.6
	Manufacturing[a]	Madagascar	2005	19.4	14.7	48.0	17.9
	Labor force	Namibia	1997	15.6	37.2	42.1	4.7
	Manufacturing[a]	Namibia	2006	15.2	14.6	68.3	1.5
	Labor force	Rwanda	1996	41.7	53.8	3.4	0.3
	Manufacturing[a]	Rwanda	2006	27.7	31.6	16.9	23.7
	Labor force[§]	Senegal	2001	86.4		10.7	1.0
	Manufacturing	Senegal	2003	40.6	22.0	18.3	16.5
	Labor force	Tanzania	1991	53.5	43.2		
	Manufacturing	Tanzania	2003	49.6		37.0	13.4
	Labor force[c]	Uganda	2005	17.4	47.8	31.1	3.7
	Manufacturing	Uganda	2003	24.2		40.5	34.0
East Asia	Labor force	Indonesia	1996	28.2	52.6	16.3	3.0
	Manufacturing	Indonesia	2003	12.2			35.9
	Labor force	South Korea	2003		26.1	43.6	30.3
	Manufacturing	South Korea	2005	1.2	1.4	53.6	43.9
Middle East & North Africa	Labor force	Morocco	2003	36.7	40.2	10.2	7.6
	Manufacturing	Morocco	2004	39.2	33.3	19.1	8.4
	Labor force	Oman	2000	26.3	34.9	25.0	13.8
	Manufacturing	Oman	2003	14.8	21.8	29.7	33.7
South Asia	Labor force	Pakistan	2002	47.4	18.4	11.2	22.2
	Manufacturing	Pakistan	2002	59.3	18.7	12.5	9.5
	Labor force	Sri Lanka	2003		68.7	16.8	14.6
	Manufacturing	SriLanka	2004	24.7	33.2	36.8	5.3

Sources: Labor force - ILO; Manufacturing - Enterprise Surveys

(a): Data comes from workers' module of Enterprise Surveys

(b): Individuals employed in primary, industry, and services sectors. Source: Stifel et al. (2007)

(c): Employed population, 15-64 years of age. Source: Household Surveys.

(§) Individuals older than 10. Less than 6 years includes completed primary. Source: Household Surveys

(‡): Individuals older than 15 years old. Source: Household Surveys.

Table 7: Average years of education of employees

	Anglophone	Francophone
By firm size		
Small (<20)	10.7	9.1
Medium (20-99)	10.8	11.3
Large (100+)	12.3	12.7
Total	11.1	10.6
By worker occupation		
Management	13.7	12.7
Professional	14.4	15.5
Skilled production	11.2	11.2
Unskilled production	10.0	8.3
Non-production	10.5	10.4
Total	11.1	10.6
By worker age		
<20 years old	9.2	7.2
20 to 29 years old	11.0	9.5
30 to 39 years old	11.5	11.2
40 to 49 years old	11.0	11.6
50 to 59 years old	10.8	10.7
60 years old and older	9.9	10.8
Total	11.1	10.6

Source: Enterprise Surveys

Table 8: Average years of education of employees, 1990s and 2000s

Burundi (1992-1995)*	4.9
Burundi (2006)	8.72
Ghana (1992-1995)*	9.5
Ghana (2007)	10.47
Kenya (1992-1999)*	8.6
Kenya (2003)	11.52
Tanzania (1992-1995)*	8.2
Tanzania (2006)	10.55

Source: Enterprise Surveys (workers' module).
(*) Source: Benhassine *et al.* (2006) from RPED

Table 9: Distribution of years of education firms and workers

	< 6 yrs	6-9 yrs	10-12 yrs	12 + yrs
Kenya (2003)	3.3	23.4	71.5	0.9
Kenya (2003)	4.8	22.3	36.5	36.4
Uganda (2003)	24.7	40.8	31.4	3
Uganda (2003)	7.1	17.7	26.5	48.7
Benin (2004)	30.5	34.9	18.7	15
Benin (2004)	17.5	35.1	18.8	28.6
Madagascar (2005)	21.7	28.2	15.6	9.5
Madagascar (2005)	7.2	22.9	26.7	43.2
Mali (2003)	34.2	26.2	27.2	11
Mali (2003)	15.4	24.9	13.8	46
Senegal (2003)	40.6	22	18.3	16.5
Senegal (2003)	7.1	27.7	20.2	45

Note:
The first row corresponds to the distribution of workers by education years at the firm level (comes from the firm survey). Shaded rows denote averages from the worker's surveys.
Source: Authors' calculations from Enterprise Surveys

Table 10: Occupation distribution (percent)

		WORKERS		
		Skilled production	Unskilled production	Non-production
Anglophone	Botswana (2006)	34.3	41.9	18.4
	Gambia (2006)	42.6	19.7	18.9
	Ghana (2007)	44.9	31.4	12.2
	Kenya (2003)	36.2	21.9	24.7
	Namibia (2006)	40.2	37.7	17.5
	Swaziland (2006)	20.2	51.2	19.0
	Tanzania (2003)	26.1	11.1	38.3
	Tanzania (2006)	36.1	38.8	16.0
	Uganda (2003)	21.5	10.3	35.5
	Uganda (2006)	23.8	56.8	12.8
	Male	31.0	25.0	24.0
	Female	31.0	26.0	31.0
	Total	30.9	25.6	25.5
Francophone	Benin (2004)	25.1	19.8	31.2
	Burkina Faso (2006)	18.2	35.1	28.2
	Burundi (2006)	36.3	41.1	12.0
	Cameroon (2006)	28.7	25.9	26.2
	Cape Verde (2006)	17.0	50.0	27.0
	DR Congo (2006)	39.3	33.2	16.2
	Guinea (2006)	25.0	57.4	10.2
	Madagascar (2005)	18.8	43.9	26.2
	Mali (2003)	33.1	24.2	16.3
	Mauritania (2006)	21.2	55.2	10.9
	Rwanda (2006)	18.6	35.6	24.3
	Senegal (2003)	26.5	30.7	23.3
	Male	29.0	35.0	19.0
	Female	14.0	29.0	41.0
	Total	26.0	33.0	24.0
		FIRMS		
		Skilled production	Unskilled production	Non-production
Anglophone	Botswana (2006)	43.9	30.2	22.6
	Gambia (2006)	59.8	15.5	17.0
	Ghana (2007)	56.0	25.0	15.3
	Kenya (2003)	20.8	21.9	10.0
	Namibia (2006)	41.6	33.4	20.1
	Swaziland (2006)	35.1	34.7	26.7
	Tanzania (2003)	32.2	26.5	14.7
	Tanzania (2006)	54.1	21.5	15.3
	Uganda (2003)	19.5	20.4	6.1
	Uganda (2006)	40.4	33.0	19.9
	Total	50.4	25.4	15.8
Francophone	Benin (2004)	40.7	24.3	19.2
	Burkina Faso (2006)	35.1	38.4	23.7
	Burundi (2006)	24.6	50.4	22.5
	Cameroon (2006)	38.1	39.2	20.7
	Cape Verde (2006)	30.0	42.0	25.2
	DR Congo (2006)	36.8	36.1	23.0
	Guinea (2006)	51.1	32.9	12.4
	Madagascar (2005)	21.9	49.0	8.1
	Mali (2003)			
	Mauritania (2006)	36.5	34.1	25.4
	Rwanda (2006)	25.2	26.5	27.4
	Senegal (2003)			
	Total	34.2	36.4	19.4

* In most countries, the categories provided in the firm-level questionnaire were limited to: skilled production, unskilled production, and non-production.
Source: Enterprise Surveys

Table 11: Unionized workforce

		Unionized firms (percentage)*	Workforce unionized at the firm level (percentage)	Unionized workers (percentage)§
Anglophone	Botswana (2006)	18.1	11.7	5.0
	Gambia (2006)	17.6	9.1	17.0
	Ghana2007	50.4	24.4	42.0
	Kenya (2003)	63.6	44.1	25.0
	Namibia (2006)	50.5	36.2	29.0
	Swaziland (2006)	37.2	21.8	33.0
	Tanzania (2003)	51.6	40.1	38.0
	Tanzania (2006)	46.7	34.8	34.0
	Uganda (2003)	10.1	6.5	5.0
	Uganda (2006)	8.3	2.6	4.0
	Male			22.0
	Female			27.0
	Total	42.8	24.1	23.0
Francophone	Benin (2004)	6.5	3.6	4.0
	Burkina Faso (2006)	35.3	27.2	16.0
	Burundi (2006)	1.3	1.3	3.0
	Cameroon (2006)	31.1	17.9	34.0
	Cape Verde (2006)	46.8	31.2	30.0
	DR Congo (2006)	23.9	15.1	30.0
	Guinea (2006)	8.8	3.8	15.0
	Madagascar (2005)	27.5	10.0	11.0
	Mali (2003)	43.7	29.6	29.0
	Mauritania (2006)	42.8	27.8	24.0
	Rwanda (2006)	12.0	8.8	10.0
	Senegal (2003)	46.5	30.3	27.0
	Male			19.0
	Female			15.0
	Total	24.5	14.8	18.0

*: A firm is unionized if it has any number of unionized workers. Over half of the firms have no unionized workers at all.

§: In the workers' sample.

Source: Enterprise Surveys

Table 12: Unionization rate by firm age (percentage)

	Anglophone	Francophone
Less than 5 years old	10.5	6.7
5 to 9 years old	22.3	8.5
10 to 19 years old	21.6	17.1
20 to 39 years old	31.6	25.2
40 years old and older	44.4	36.2
Total	24.0	14.8

Source: Enterprise Surveys

Table 13: Annual wage statistics by country

		WORKERS*		
		Mean	Median	Observations
Anglophone	Botswana (2006)	10,059	5,950	352
	Gambia (2006)	5,449	4,762	111
	Ghana (2007)	4,497	3,062	658
	Kenya (2003)	8,061	3,531	1,881
	Namibia (2006)	8,835	5,134	321
	Swaziland (2006)			
	Tanzania (2003)	6,714	2,964	1,529
	Tanzania (2006)	5,825	3,636	579
	Uganda (2003)	4,286	2,013	1,239
	Uganda (2006)	5,424	4,355	660
	Total	6,498	3,444	7,330
Francophone	Benin (2004)	3,739	2,224	1,668
	Burkina Faso (2006)	9,324	4,500	250
	Burundi (2006)	3,182	2,309	365
	Cameroon (2006)	8,043	5,259	617
	Cape Verde (2006)	4,759	3,426	284
	DR Congo (2006)	3,501	2,467	392
	Guinea (2006)	3,912	2,791	316
	Madagascar (2005)	12,013	8,348	1,723
	Mali (2003)	4,341	2,270	686
	Mauritania (2006)	8,503	6,364	212
	Rwanda (2006)	11,965	5,419	171
	Senegal (2003)	5,911	3,604	1,483
	Total	6,728	3,987	8,167

(Table 13, continued)

		FIRMS		
		Mean	Median	Observations
Anglophone	Botswana (2006)	8,124	5,165	113
	Gambia (2006)	2,817	2,405	33
	Ghana (2007)	2,115	1,417	313
	Kenya (2003)	10,161	2,583	231
	Namibia (2006)	8,565	5,679	104
	Swaziland (2006)	6,520	4,159	69
	Tanzania (2003)	3,328	1,262	215
	Tanzania (2006)	4,373	2,727	272
	Uganda (2003)	2,114	1,487	276
	Uganda (2006)	4,017	2,540	307
	Total	3,269	1,913	1,933
Francophone	Benin (2004)	2,994	1,662	244
	Burkina Faso (2006)	5,078	3,522	50
	Burundi (2006)	3,131	1,924	102
	Cameroon (2006)	8,691	5,390	118
	Cape Verde (2006)	6,424	3,403	47
	DR Congo (2006)	2,615	1,888	149
	Guinea (2006)	3,790	1,406	135
	Madagascar (2005)	10,991	7,845	217
	Mali (2003)	2,899	1,616	135
	Mauritania (2006)	5,469	4,606	80
	Rwanda (2006)	4,793	2,867	59
	Senegal (2003)	4,598	2,295	205
	Total	4,853	2,472	1,541

*: Annual wage for a worker is computed as follows. The worker is asked the unit of payment (hourly, daily, etc.), the amount paid by unit (in current LCU), and the number of hours worked per week. First, we compute the monthly wage on the basis of the payment unit, the amount, and the number of hours worked per week (where relevant). Then, we multiply this number by the implied months worked per year, on the basis of the hours worked per week (assuming workers work on average 48 weeks per year). For firms, we take the total annual labor cost (in current LCU) and divide it by the number of employees (permanent and temporary). All wages are then transformed into USD-PPP (PPPs are from 2005).
Source: Authors' calculations from Enterprise Surveys

Table 14: Monthly wages by country and occupation

		Median wage in USD-PPP				
		Managers	Professionals	Skilled production	Unskilled production	Non-production
Anglophone	Botswana (2006)	486	2,149	496	331	453
	Gambia (2006)	761	198	331	228	397
	Ghana (2007)	492	507	213	160	213
	Kenya (2003)	1,119	832	256	166	236
	Namibia (2006)	2,552	939	470	282	494
	Swaziland (2006)	237	395	593	289	441
	Tanzania (2003)	549	442	177	221	148
	Tanzania (2006)	530	606	253	189	202
	Uganda (2003)	288	320	128	112	80
	Uganda (2006)	726	492	258	194	194
	Total	531	485	242	197	167
Francophone	Benin (2004)	289	491	186	124	144
	Burkina Faso (2006)	900	750	490	175	325
	Burundi (2006)	564	146	175	117	146
	Cameroon (2006)	1,215	996	438	319	319
	Cape Verde (2006)	721	1,189	324	231	216
	DR Congo (2006)	317	251	152	164	175
	Guinea (2006)	205	410	164	148	246
	Madagascar (2005)	1,649	1,539	742	536	660
	Mali (2003)	394	315	189	110	132
	Mauritania (2006)	455	909	505	404	313
	Rwanda (2006)	2,151	1,340	645	229	376
	Senegal (2003)	820	601	330	207	270
	Total	505	681	300	239	258

Source: Authors' calculations from Enterprise Surveys (for calculation details, see Table 19)

Table 15: Wage determination regressions - pooled sample

	Pooled sample				
Dependent variable:	Non-GDP-weighted		GDP-weighted		
log of monthly wage (PPP)	[1]	[2]	[3]	[4]	[5]
Hrs. per week worked	0.004**	0.005**	0.007***	0.001	0.001
	[2.22]	[2.39]	[3.19]	[0.76]	[0.67]
Female worker	-0.045**	-0.065***	-0.044	-0.059**	-0.053*
	[2.00]	[2.93]	[1.61]	[2.12]	[1.85]
Education (years)	0.032***	0.012	0.011	0.002	0.005
	[2.67]	[0.99]	[0.84]	[0.19]	[0.39]
Education years squared	0.002***	0.001**	0.001**	0.001**	0.001*
	[3.96]	[2.42]	[2.45]	[2.14]	[1.80]
Junior/senior secondary degree		0.162***	0.189***	0.103**	0.112***
		[4.76]	[4.38]	[2.42]	[2.59]
Vocational degree		0.346***	0.328***	0.146**	0.151**
		[7.25]	[5.46]	[2.45]	[2.50]
Tertiary/university degree		0.807***	0.843***	0.534***	0.544***
		[16.62]	[14.18]	[9.68]	[9.91]
Age > 32 (dummy)	0.143***	0.133***	0.157***	0.114***	0.118***
	[5.48]	[5.23]	[4.83]	[3.88]	[4.05]
Tenure (years)	0.014***	0.016***	0.012***	0.014***	0.011***
	[4.54]	[5.14]	[3.47]	[4.25]	[4.02]
Tenure^4	0.000	0.000	0.000	0.000	
	[1.02]	[0.89]	[0.65]	[1.63]	
Previous experience (years)	0.016***	0.016***	0.013***	0.009***	0.009***
	[6.13]	[6.31]	[3.85]	[2.83]	[3.89]
Experience^4	0.000	0.000	0.000	0.000	
	[1.57]	[1.61]	[1.50]	[0.36]	
Permanent, full-time worker	0.337***	0.287***	0.269***	0.266***	0.249***
	[7.48]	[6.53]	[5.21]	[5.24]	[5.33]
Manager				0.849***	0.863***
				[8.74]	[8.70]
Professional				0.559***	0.583***
				[10.09]	[11.13]
Skilled production worker				0.205***	0.207***
				[5.62]	[5.66]
Non-production worker				0.122***	0.119***
				[3.97]	[3.70]
Belongs to union				0.049	0.031
				[1.34]	[0.79]
Related to owner/manager				-0.124***	-0.126***
				[2.69]	[2.69]
Medium firm (20-99 empl.)	0.06	0.043	0.035	0.035	0.021
	[1.57]	[1.17]	[0.67]	[0.58]	[0.33]
Large firm (100+ empl.)	0.122***	0.085**	0.058	0.096	0.077
	[2.72]	[2.01]	[1.09]	[1.60]	[1.25]
Exporter	0.146***	0.137***	0.148***	0.138***	0.124***
	[4.49]	[4.39]	[3.93]	[3.61]	[3.27]
Unionized firm					0.067
					[1.62]
Constant	3.624***	3.757***	3.618***	4.089***	4.114***
	[20.89]	[21.80]	[17.68]	[25.81]	[25.75]
Observations	11580	11559	11559	9697	9435
R-squared	0.39	0.42	0.36	0.41	0.42

Notes: Column (2) reports the coefficients for the basic specification, weighted by the GDP of the country. Robust t-statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Wages are converted to PPP US dollars (see Table 19). All regressions include country and industry dummies, and hours worked per week.

Countries: Benin, Botswana, Burkina Faso, Burundi (excluded), Cameroon, Cape Verde, DR Congo, Gambia, Ghana, Guinea, Kenya, Madagascar, Mali, Mauritania, Namibia,Rwanda, Senegal, Swaziland, Tanzania, Uganda.

Industries: Food & beverages (excluded), Chemicals, paints & pharmaceuticals, Construction materials, Metals, Paper & printing, Plastics, Textiles, garments & leather, Wood, Other manufacturing.

Other excluded categories: <20 empl (firms), unskilled workers, no education/primary degree.

Table 16: Wage determination regressions - by legal origin

	Anglophone			Francophone		
Dependent variable:	Basic	Augmented		Basic	Augmented	
log of monthly wage (PPP)	(1)	(2)	(3)	(1)	(2)	(3)
Hrs. per week worked	0.010***	0.003	0.003	-0.001	-0.002	-0.001
	[3.43]	[1.41]	[1.13]	[0.52]	[0.70]	[0.44]
Female worker	-0.034	-0.067*	-0.054	-0.076***	-0.055*	-0.052*
	[0.88]	[1.74]	[1.38]	[2.78]	[1.79]	[1.66]
Education (years)	0.013	-0.008	-0.006	0.002	0.008	0.01
	[0.78]	[0.52]	[0.39]	[0.13]	[0.45]	[0.54]
Education years squared	0.001*	0.001*	0.001*	0.001**	0.001	0.001
	[1.86]	[1.79]	[1.67]	[2.40]	[1.35]	[1.08]
Junior/senior secondary degree	0.239***	0.141**	0.156**	0.107**	0.089*	0.098**
	[3.88]	[2.10]	[2.29]	[2.27]	[1.88]	[2.06]
Vocational degree	0.304***	0.059	0.072	0.374***	0.321***	0.325***
	[3.85]	[0.74]	[0.89]	[5.50]	[4.90]	[4.88]
Tertiary/university degree	0.928***	0.497***	0.496***	0.717***	0.597***	0.613***
	[11.30]	[5.89]	[6.10]	[9.86]	[8.95]	[9.05]
Age > 32 (dummy)	0.187***	0.133***	0.152***	0.113***	0.075*	0.062*
	[3.89]	[2.94]	[3.33]	[3.17]	[1.91]	[1.65]
Tenure (years)	0.005	0.011**	0.007*	0.021***	0.017***	0.017***
	[0.92]	[2.35]	[1.79]	[3.84]	[2.98]	[4.76]
Tenure^4	0.000	0.000		0.000	0.000	
	[0.15]	[1.59]		[0.00]	[0.20]	
Previous experience (years)	0.015***	0.009*	0.009**	0.012***	0.010***	0.012***
	[2.79]	[1.71]	[2.22]	[3.61]	[2.93]	[4.40]
Experience^4	-0.000*	0.000		0.000	0.000	
	[1.80]	[0.86]		[0.94]	[1.11]	
Permanent, full-time worker	0.268***	0.276***	0.252***	0.286***	0.261***	0.252***
	[3.92]	[4.01]	[4.18]	[4.42]	[3.73]	[3.62]
Manager		1.048***	1.072***		0.525***	0.540***
		[7.58]	[7.55]		[6.12]	[6.19]
Professional		0.728***	0.741***		0.413***	0.454***
		[7.75]	[7.63]		[6.00]	[7.33]
Skilled production worker		0.239***	0.246***		0.170***	0.170***
		[4.88]	[5.04]		[3.82]	[3.73]
Non-production worker		0.139***	0.134***		0.100***	0.104**
		[2.81]	[2.62]		[2.60]	[2.58]
Belongs to union		-0.023	-0.073		0.141***	0.153***
		[0.43]	[1.34]		[3.31]	[3.20]
Related to owner/manager		-0.092	-0.102		-0.152**	-0.156***
		[1.32]	[1.43]		[2.52]	[2.62]
Medium firm (20-99 empl.)	0.016	0.018	-0.021	0.073**	0.068*	0.085**
	[0.20]	[0.17]	[0.19]	[2.10]	[1.87]	[2.31]
Large firm (100+ empl.)	0.012	0.086	0.036	0.105*	0.087	0.117*
	[0.16]	[0.88]	[0.35]	[1.68]	[1.30]	[1.96]
Exporter	0.143***	0.134**	0.108**	0.147***	0.130***	0.129***
	[2.65]	[2.41]	[1.97]	[3.64]	[2.92]	[2.88]
Unionized firm			0.160***			-0.047
			[2.78]			[0.96]
Constant	4.292***	4.720***	5.160***	4.193***	4.214***	4.179***
	[14.99]	[17.90]	[29.67]	[21.26]	[20.40]	[20.19]
Observations	5041	3785	3710	6518	5912	5725
R-squared	0.27	0.32	0.32	0.52	0.54	0.54

Notes: Robust t-statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Wages are converted to PPP US dollars (see Table 19). All regressions include country and industry dummies, and hours worked per week. All observations are weighted by the country's GDP.

Francophone: Benin (excluded), Burkina Faso, Cape Verde, Cameroon, DRCongo, Burundi, Guinea, Madagascar, Mauritania, Rwanda, Senegal.

Anglophone: Botswana (excluded), Ghana, Gambia, Kenya, Namibia, Swaziland, Tanzania, Uganda.
Industries: Food & beverages (excluded), Chemicals, paints & pharmaceuticals, Construction materials, Metals, Paper & printing, Plastics, Textiles, garments & leather, Wood, Other manufacturing.

Other excluded categories: <20 empl (firms), unskilled workers, no education/primary degree.

Table 17: Wage determination by age groups

	All		Anglophone		Francophone	
	≤32	32+	≤32	32+	≤32	32+
Education (years)	-0.011	0.007	-0.003	-0.026	-0.036*	0.043*
	[0.58]	[0.50]	[0.08]	[1.59]	[1.68]	[1.70]
Education years squared	0.002***	0.001	0.002	0.002**	0.003***	-0.001
	[2.61]	[1.06]	[1.36]	[2.17]	[3.18]	[0.71]
Vocational degree	0.004	0.320***	-0.111	0.309***	0.349***	0.303***
	[0.06]	[4.56]	[1.20]	[3.13]	[4.46]	[3.32]
Junior/senior secondary degree	0.006	0.210***	-0.009	0.316***	0.120**	0.079
	[0.12]	[4.02]	[0.12]	[3.86]	[2.41]	[1.24]
Tertiary/university degree	0.407***	0.660***	0.246**	0.708***	0.704***	0.539***
	[5.58]	[9.49]	[2.31]	[6.73]	[9.06]	[5.81]
Tenure	0.016***	0.010***	0.012	0.005	0.023***	0.016***
	[2.67]	[3.24]	[1.41]	[1.11]	[3.02]	[4.35]
Previous experience in industry	0.015***	0.009***	0.013	0.007*	0.020***	0.011***
	[2.59]	[3.46]	[1.40]	[1.74]	[3.62]	[3.90]
Permanent, full-time worker	0.249***	0.218***	0.227***	0.276***	0.320***	0.116
	[4.84]	[3.06]	[3.57]	[2.84]	[3.77]	[1.39]
Manager	0.731***	0.928***	1.022***	1.090***	0.177	0.744***
	[5.57]	[9.12]	[5.71]	[7.22]	[1.36]	[7.33]
Professional	0.537***	0.631***	0.737***	0.747***	0.270***	0.566***
	[7.94]	[9.20]	[7.42]	[4.64]	[3.28]	[7.35]
Skilled production worker	0.150***	0.264***	0.191***	0.306***	0.089*	0.240***
	[3.40]	[5.42]	[3.09]	[4.78]	[1.83]	[3.62]
Non-production worker	0.063	0.192***	0.08	0.229***	0.046	0.164***
	[1.24]	[4.17]	[0.95]	[3.52]	[1.03]	[2.64]
Belongs to union	0.048	0.027	0.015	-0.136**	0.094*	0.192***
	[1.00]	[0.54]	[0.24]	[2.10]	[1.85]	[2.76]
Related to owner/manager	-0.096*	-0.171***	-0.088	-0.129	-0.092	-0.227***
	[1.80]	[2.71]	[1.07]	[1.37]	[1.48]	[2.62]
Unionized firm	0.081*	0.05	0.140**	0.172**	-0.023	-0.084
	[1.75]	[0.91]	[2.19]	[2.15]	[0.45]	[1.23]
Constant	4.189***	4.232***	4.804***	5.401***	4.340***	4.185***
	[21.46]	[21.85]	[16.37]	[23.90]	[18.37]	[15.99]
Observations	4760	4684	1983	1731	2777	2953
R-squared	0.4	0.4	0.28	0.34	0.59	0.51

Notes: Robust t-statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Wages are converted to PPP US dollars (see Table 19). All regressions include country, size, industry, and exporter dummies, hours worked per week, and dummies for female, and permanent full time workers. All observations are weighted by the country's GDP.

Countries: Benin, Botswana, Burkina Faso, Burundi (excluded), Cameroon, Cape Verde, DR Congo, Gambia, Ghana, Guinea, Kenya, Madagascar, Mali, Mauritania, Namibia,Rwanda, Senegal, Swaziland, Tanzania, Uganda.

Industries: Food & beverages (excluded), Chemicals, paints & pharmaceuticals, Construction materials, Metals, Paper & printing, Plastics, Textiles, garments & leather, Wood, Other manufacturing.

Other excluded categories: <20 empl (firms), <32 years old (workers), unskilled workers, no education/primary degree.

Table 18: Average regressor values for basic regression sample

	All		Anglophone		Francophone	
	Obs = 9435		Obs =3785		Obs = 5912	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Female worker	0.25	0.43	0.26	0.44	0.23	0.42
Years of education completed	10.73	4.34	11.00	3.73	10.56	4.68
No education/primary degree	0.24	0.43	0.22	0.41	0.26	0.44
Junior/senior secondary degree	0.43	0.50	0.43	0.50	0.43	0.50
Vocational training	0.15	0.35	0.21	0.40	0.11	0.31
Tertiary/university degree	0.17	0.38	0.13	0.34	0.20	0.40
Age	34.09	8.97	33.54	8.78	34.45	9.07
Tenure	6.58	5.83	7.04	5.96	6.29	5.72
Years of prior experience	3.60	5.10	3.21	4.87	3.85	5.23
Permanent, full-time worker	0.91	0.29	0.90	0.30	0.92	0.28
Manager	0.05	0.23	0.06	0.24	0.05	0.22
Professional	0.08	0.27	0.05	0.21	0.09	0.29
Skilled production worker	0.30	0.46	0.36	0.48	0.26	0.44
Unskilled production worker	0.35	0.48	0.34	0.47	0.36	0.48
Non-production worker	0.22	0.42	0.19	0.39	0.24	0.43
Belongs to union	0.20	0.40	0.25	0.43	0.17	0.38
Related to owner	0.10	0.30	0.07	0.25	0.12	0.33
Small firm (< 20 empl.)	0.42	0.49	0.38	0.49	0.45	0.50
Medium firm (20-99 empl.)	0.36	0.48	0.38	0.49	0.35	0.48
Large firm (100+ empl.)	0.22	0.41	0.24	0.43	0.20	0.40
Exporter	0.34	0.47	0.36	0.48	0.32	0.47
Unionized firm						
Benin	0.12	0.33			0.20	0.40
Botswana	0.03	0.17	0.08	0.26		
Burkina Faso	0.01	0.11			0.02	0.14
Burundi	0.04	0.19			0.06	0.24
Cameroon	0.06	0.23			0.10	0.29
Cape Verde	0.03	0.16			0.04	0.21
DR Congo	0.04	0.20			0.07	0.25
Gambia	0.01	0.10	0.02	0.15		
Ghana	0.06	0.23	0.14	0.35		
Guinea	0.02	0.15			0.04	0.19
Kenya	0.16	0.36	0.40	0.49		
Madagascar	0.14	0.35			0.24	0.42
Mali	0.00	0.00				
Mauritania	0.02	0.14			0.03	0.18
Namibia	0.03	0.17	0.08	0.27		
Rwanda	0.02	0.13			0.03	0.16
Senegal	0.11	0.31			0.18	0.39
Swaziland	0.00	0.00				
Tanzania	0.05	0.21	0.12	0.33		
Uganda	0.06	0.24	0.16	0.36		
Food & beverages	0.23	0.42	0.22	0.41	0.24	0.42
Chemicals & paints	0.07	0.26	0.06	0.24	0.08	0.27
Construction materials	0.04	0.19	0.04	0.20	0.04	0.18
Furniture	0.15	0.35	0.16	0.37	0.14	0.34
Metals	0.09	0.29	0.11	0.32	0.08	0.27
Paper & printing	0.09	0.28	0.06	0.24	0.10	0.30
Plastics	0.04	0.19	0.04	0.20	0.04	0.18
Textiles & garments	0.18	0.38	0.22	0.42	0.15	0.36
Wood	0.04	0.21	0.02	0.12	0.06	0.24
Other manufacturing	0.08	0.26	0.06	0.24	0.08	0.28

Table 19: Wage and productivity premiums combining age, occupation, education, and union status

	Pooled sample			Anglophone			Francophone		
	Production function	Wage equation	Equal premia P-value	Production function	Wage equation	Equal premia P-value	Production function	Wage equation	Equal premia P-value
	N=1438	N=7726		N=583	N=3210		N=855	N=4516	
Unionized firm	-0.013	0.01		0.048	**0.11**		0.158	-0.049	
	(0.107)	(0.038)		(0.158)	(0.062)		(0.139)	(0.046)	
Union member	**1.023**	-0.008	0.839	**1.375**	-0.085	0.137	**0.771**	0.057	0.074
	(0.156)	(0.038)		(0.316)	(0.059)		(0.164)	(0.045)	
Age (32+)	**0.83**	0.02	0.155	**0.729**	0.049	0.076	**0.892**	-0.011	0.615
	(0.133)	(0.026)		(0.176)	(0.044)		(0.192)	(0.031)	
Manager	**1.229**	**0.713**	0.169	**1.02**	**1.052**	0.050	**1.476**	**0.518**	0.938
	(0.327)	(0.077)		(0.453)	(0.143)		(0.526)	(0.078)	
Professional	**2.502**	**0.48**	0.229	**2.344**	**0.643**	0.533	**2.102**	**0.394**	0.488
	(0.851)	(0.059)		(1.120)	(0.130)		(1.018)	(0.063)	
Skilled production	**1.052**	**0.198**	0.385	**1.002**	**0.268**	0.217	**1.481**	**0.16**	0.310
	(0.166)	(0.036)		(0.217)	(0.055)		(0.311)	(0.044)	
Vocational degree	**1.496**	**0.173**	0.353	**3.000**	**0.18**	0.058	0.540	**0.219**	0.037
	(0.347)	(0.058)		(0.966)	(0.086)		(0.319)	(0.068)	
Junior/senior sec.	**1.25**	**0.134**	0.627	**1.762**	**0.233**	0.294	**1.234**	0.068	0.572
	(0.240)	(0.040)		(0.511)	(0.067)		(0.295)	(0.051)	
University	**1.286**	**0.531**	0.534	0.436	**0.474**	0.000	**1.426**	**0.515**	0.857
	(0.401)	(0.057)		(0.278)	(0.094)		(0.498)	(0.069)	
H0: Age +32 coefficient =1			0.199			0.125			0.575
H0: Vocational coefficient =1			0.153			0.038			0.149
H0: Secondary coefficient =1			0.298			0.136			0.427
H0: University coefficient =1			0.475			0.042			0.392
H0: Manager coefficient =1			0.484			0.965			0.365
H0: Professional coefficient =1			0.078			0.230			0.279
H0: Skilled production coefficient =1			0.755			0.993			0.123
H0: Unionized worker coefficient =1			0.884			0.235			0.161
Joint test: occupation coefficients =1			0.306			0.688			0.377
Joint test: occupation premia are equal			0.197			0.125			0.756
Joint test: education coefficients =1			0.554			0.011			0.235
Joint test: education premia are equal			0.569			0.000			0.114

Notes: Shares of uinon members, older workers, managers, professionals, skilled production workers, holders of vocational, secondary, and upper-level degrees are calculated as the mean values at the firm level. The estimation of the production function and the wage equation is done jointly, clustering the errors at the firm level. Standard errors in parentheses below coefficients. **Bold** coefficients indicate significance at the 10% level or better. The production function coefficients represent one plus the productivity premium; the wage regression coefficients are semi-elasticities. The equality of premia test is a Wald test of the null hypothesis that the wage regression coefficient is equal to the production function coefficient minus one for the corresponding category.

Table 20: Wage and productivity premiums combining age, occupation, education, and union status

	All countries			Anglophone			Francophone		
	Production function	Wage equation	Equal premia P-value	Production function	Wage equation	Equal premia P-value	Production function	Wage equation	Equal premia P-value
	N=1438	N=7726		N=583	N=3210		N=855	N=4516	
Unionized firm	0.011	0.011		0.057	**0.109**		0.197	-0.047	
	(0.105)	(0.038)		(0.154)	(0.062)		0.137	0.046	
Union member	**0.892**	-0.011	0.504	**1.423**	-0.088	0.091	**0.595**	0.054	0.006
	(0.144)	(0.038)		(0.304)	(0.059)		0.167	0.045	
Age (32+)	**0.641**	0.02	0.007	**0.802**	0.051	0.278	**0.552**	-0.013	0.017
	(0.137)	(0.026)		(0.229)	(0.044)		0.18	0.031	
Manager	**0.944**	**0.708**	0.031	**0.545**	**1.047**	0.000	**1.409**	**0.514**	0.893
	(0.330)	(0.078)		(0.301)	(0.146)		0.775	0.079	
Professional	**2.072**	**0.468**	0.439	**1.541**	**0.626**	0.920	**1.555**	**0.383**	0.881
	(0.777)	(0.059)		(0.824)	(0.129)		1.137	0.064	
Skilled production	**0.902**	**0.196**	0.117	**0.855**	**0.266**	0.051	**1.768**	**0.158**	0.237
	(0.185)	(0.036)		(0.207)	(0.054)		0.513	0.044	
Vocational degree	**1.332**	**0.167**	0.620	**3.37**	**0.171**	0.045	0.311	**0.216**	0.066
	(0.330)	(0.058)		(1.106)	(0.085)		0.487	0.067	
Junior/senior sec.	**0.841**	**0.126**	0.133	**1.613**	**0.221**	0.426	**0.872**	0.062	0.479
	(0.190)	(0.040)		(0.498)	(0.066)		0.269	0.05	
University	**0.631**	**0.519**	0.000	-0.382	**0.468**	0.000	**0.994**	**0.505**	0.155
	(0.224)	(0.056)		(0.249)	(0.094)		0.359	0.068	
H0: Vocational coeff=1			0.314			0.032			0.157
H0: Secondary coeff =1			0.402			0.219			0.635
H0: University coeff =1			0.099			0.000			0.986
H0: Manager coeff=1			0.866			0.131			0.598
H0: Professional coeff =1			0.168			0.512			0.625
H0: Skilled production coeff =1			0.594			0.482			0.135
H0: Unionized worker coeff=1			0.452			0.164			0.015
Joint test: occupation coefficients =1			0.402			0.387			0.480
Joint test: occupation premia are equal			0.065			0.000			0.648
Joint test: education coefficients =1			0.118			0.000			0.524
Joint test: education premia are equal			0.000			0.000			0.159

Notes: Shares of uinon members, older workers, managers, professionals, skilled production workers, holders of vocational, secondary, and upper-level degrees are calculated as the mean values at the country, industry, size class, and firm age class levels. The estimation of the production function and the wage equation is done jointly, clustering the errors at the firm level. Standard errors in parentheses below coefficients. **Bold** coefficients indicate significance at the 10% level or better. The production function coefficients represent one plus the productivity premium; the wage regression coefficients are semi-elasticities. The equality of premia test is a Wald test of the null hypothesis that the wage regression coefficient is equal to the production function coefficient minus one for the corresponding category.

Table 21: Wage and productivity premiums by occupation, education, union status, and age

	All countries			Anglophone			Francophone		
	Production function	Wage equation	Equal premia P-values	Production function	Wage equation	Equal premia P-values	Production function	Wage equation	Equal premia P-values
	N=1438	N=7726		N=583	N=3210		N=855	N=4516	
Unionized firm	-0.003	0.01		0.041	**0.112**		0.149	-0.05	
	(0.104)	(0.038)		(0.162)	(0.063)		(0.136)	(0.046)	
Unionized worker	**0.978**	-0.012	0.947	**1.755**	-0.089	0.020	**0.56**	0.054	0.003
	(0.153)	(0.038)		(0.364)	(0.059)		(0.163)	(0.045)	
Age (32+)	**0.575**	0.019	0.00	**0.474**	0.050	0.000	**0.499**	-0.014	0.002
	(0.121)	(0.026)		(0.147)	(0.044)		(0.152)	(0.031)	
Manager	**1.018**	**0.708**	0.06	**0.864**	**1.046**	0.010	**1.758**	**0.515**	0.762
	(0.348)	(0.078)		(0.402)	(0.146)		(0.799)	(0.079)	
Professional	**1.909**	**0.467**	0.54	**1.336**	**0.625**	0.695	1.211	**0.381**	0.840
	(0.725)	(0.059)		(0.694)	(0.129)		(0.831)	(0.064)	
Skilled production	**1.006**	**0.197**	0.34	**1.19**	**0.271**	0.786	**1.368**	**0.155**	0.623
	(0.198)	(0.036)		(0.293)	(0.054)		(0.430)	(0.044)	
Vocational degree	**1.299**	**0.167**	0.678	**3.303**	**0.171**	0.048	0.419	**0.218**	0.118
	(0.316)	(0.058)		(1.085)	(0.085)		(0.507)	(0.068)	
Junior/senior sec.	**0.863**	**0.126**	0.180	**1.532**	**0.221**	0.519	**0.837**	0.062	0.399
	(0.196)	(0.040)		(0.488)	(0.066)		(0.267)	(0.050)	
University	**0.807**	**0.521**	0.004	-0.36	**0.466**	0.000	**1.041**	**0.507**	0.157
	(0.251)	(0.056)		(0.240)	(0.094)		(0.329)	(0.068)	
H0: Manager coeff=1			0.96			0.735			0.343
H0: Professional coeff =1			0.21			0.628			0.800
H0: Skilled production coeff =1			0.98			0.516			0.393
Joint test: occupation coefficients =1			0.64			0.85			0.72
Joint test: occupation premia are equal			0.22			0.07			0.94
H0: Vocational coeff=1			0.344			0.034			0.252
H0: Secondary coeff =1			0.486			0.276			0.542
H0: University coeff =1			0.442			0.000			0.902
Joint test: education coefficients =1			0.344			0.000			0.627
Joint test: education premia are equal			0.016			0.000			0.190
H0: Unionized worker coeff=1			0.886			0.038			0.007

Notes: Shares of uinon members, older workers, managers, professionals, skilled production workers, holders of vocational, secondary, and upper-level degrees are calculated as the mean values at the country, industry, size class, and firm age class levels. The estimation of the production function and the wage equation is done jointly, clustering the errors at the firm level. Standard errors in parentheses below coefficients. **Bold** coefficients indicate significance at the 10% level or better. The production function coefficients represent one plus the productivity premium; the wage regression coefficients are semi-elasticities. The equality of premia test is a Wald test of the null hypothesis that the wage regression coefficient is equal to the production function coefficient minus one for the corresponding category.