Risk Sharing in Labor Markets[1]

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Abstract

Empirical work in labor economics has focused on rent sharing as an explanation for the observed correlation between wages and profitability. The alternative explanation of risk sharing between workers and employers has not been tested. Using a unique panel data set for four African countries, we find strong evidence of risk sharing. Workers in effect offer insurance to employers: when firms are hit by temporary shocks, the effect on profits is cushioned by risk sharing with workers. Rent sharing is a symptom of an inefficient labor market. Risk sharing, by contrast, can be seen as an efficient response to missing markets. Our evidence suggests that risk sharing accounts for a substantial part of the observed effect of shocks on wages.

1 Introduction

If labor markets were perfectly competitive, all firms would pay the same wages for the same type of work. But the empirical evidence is very different, showing large wage differentials across firms. Do such differentials indicate the need for policies promoting competition? In many situations yes may well be the appropriate answer. But in this article we argue that policymakers may have to look elsewhere: rather than a labor market imperfection, the problem may be the limited ability of firms to deal with risk. If this is what explains wage differentials, policymakers should aim to improve the functioning of credit and insurance markets.

Evidence for developed countries typically shows strong correlations across firms of profits and wages per worker. Labor economics has suggested various explanations for this. Theoretical papers have focused on two such explanations: rent sharing and risk sharing between employers and workers (see, for example, Oswald 1995 and Malcomson 1999). Under rent sharing workers demand higher wages from employers in more profitable firms, and thanks to wage bargaining workers in those firms receive higher wages. In risk sharing models, changes in value added are shared between the firm and the workers when the firm is exposed to shocks, so that profits and wages change in the same direction.[1] In effect workers provide insurance to their employers, and they are compensated for the resulting volatility of their incomes by a wage premium. Most risk sharing models assume that there are no financial markets, so employers cannot respond to risk by using credit or by buying insurance: there are no alternatives to risk sharing with employees.

Both the rent and the risk sharing literature are concerned with profit-wage correlations (which may occur in both the short run and the long run equilibriums), but the focus of the rent sharing literature is primarily on long run or steady state correlations. The reason is that rent sharing is inherently long run but that a long run correlation is difficult to reconcile with nonrent sharing explanations (Blanchflower, Oswald, and Sanfey 1996). Conversely, risk sharing is, by definition, primarily concerned with short run wage-profit correlations.

Empirical work on labor markets in developed countries has usually tested the first of these models, rent sharing. Evidence of rent sharing between workers and employers has also been found for labor markets in developing countries, as by Teal (1996) for Ghana and Velenchik (1997) for Zimbabwe. Mazumdar and Mazaheri (1998) investigate rent sharing and efficiency wage explanations for interfirm wage differences for Ghana, Kenya, Zambia, and Zimbabwe. To the best of our knowledge there has been no empirical work on risk sharing.

The aim of this article is to test for risk sharing, using panel data for manufacturing firms in Africa. That the data are for African firms is fortunate. Industrial firms in Africa are exposed to very high risks, reflecting demand shocks, price volatility, unreliable infrastructure and poor contract enforcement (Fafchamps 1996, Collier and Gunning 1999, and Bigsten and others 2000b). And in most African economies the financial markets, particularly those for insurance, are poorly developed. This conjunction of high risk and weak financial markets suggests that if risk sharing through implicit labor contracts is to be found anywhere, it is in African manufacturing.

There is a growing literature on the responses that African manufacturing firms have adopted to the risks they face. These include holding inventories and liquid assets (studied for Zimbabwe by Fafchamps, Gunning, and Oostendorp 2000) and risk sharing between firms in networks (Bigsten and others 1999). Within networks delays in payments or delivery are usually accepted from partners, since network members can observe whether the delays reflect bad luck (making contract flexibility possibly efficient) or bad faith (opportunism). While evidence of such risk sharing *between* firms is accumulating, there has been no applied work on risk sharing between workers and employers *within* firms. There is, however, interesting anecdotal evidence of risk sharing. For example, in Zimbabwe a Christmas bonus is common (in the form of a "13th month"payment), but it is not paid if the firm has fared poorly during the year.

It is important to be able to distinguish between these two explanations for a correlation between wages and profits since they have different policy implications. Rent sharing clearly is a symptom of an inefficient labor market. But risk sharing also implies labor market imperfections—for if workers could costlessly move from one firm to another, it would be impossible to enforce the risk sharing contract. If a firm experienced a negative shock, its workers would leave the firm rather than accept the wage cut implied by risk sharing. However, given the transaction costs that make the risk sharing contract enforceable, risk sharing may well be second best in the sense that it makes efficient use of the labor market to compensate for a missing insurance market. In this case policymakers should aim to improve the functioning of financial markets (credit and insurance) rather than labor markets.

In this article we investigate whether risk sharing occurs in African manufacturing firms, using a unique multicountry panel data set. We use the data to construct measures of sustained and temporary changes in firms' value added, so that we can test for both rent sharing and risk sharing: permanent changes will raise wages through rent sharing, temporary changes through risk sharing. The demarcation between permanent and temporary shocks (and thus between rent sharing and risk sharing) is, of course, debatable. Rather than use a single operational classification of shocks as temporary or permanent, we use several.

The data set is unique in containing data both on firms and on a sample of workers in these firms. This makes it possible to estimate earnings functions while controlling for characteristics of the workers and for characteristics of the firm employing them. Here we use data for four countries: Cameroon, Ghana, Kenya, and Zimbabwe. We find evidence of risk sharing under each of the several concepts of permanent shocks.

We set out the model in section 2 and discuss the survey data in section 3. The econometric results are in section 4. In section 5 we consider whether the effect of risk sharing on wages is quantitatively important. Section 6 discusses the policy implications of our findings.

2 Modeling Rent Sharing and Risk Sharing

We use a hybrid model that encompasses the two canonical models for rent and risk sharing (Blanchflower, Oswald, and Sanfey 1996).[2] Consider a bargaining problem involving two agents: workers and an employer. Both agents are risk averse. The employer maximizes the expected value of $v(\pi)$ where v is a strictly concave function of profits π. Workers have an outside wage of $\overline{w}$ when bargaining breaks down or when they are unemployed—and w if they are employed by the firm. With n workers employed and the labor force equal to 1 (by choice of units) the average utility of workers (in the absence of a breakdown of bargaining) is $nu(w)+(1-n)u(\overline{w})$ where $u(y)$ is a strictly concave function of income y (w or $\overline{w}$). Production is subject to short run or temporary (s^s) and long run or permanent (s^l) shocks, with both types multiplicative. The firm's value added f depends only on employment, n. So profits are given by

$$\pi = s^s.s^l.f(n) - wn.$$

The probability density function (pdf) of s^s is $g(s^s)$. The bargaining problem can now be written as a Nash problem:

$$\max \phi \log W + (1-\phi) \log E$$

where ϕ measures the relative bargaining power of workers and

$$W = \int [nu(w) + (1-n)u(\overline{w})]g(s^s)ds^s - u(\overline{w}) = \int n[u(w) - u(\overline{w})]g(s^s)ds^s$$

$$E = \int v(\pi) g(s^s) ds^s.$$

Risk is shared between the two agents if the wage rate, employment, or both are state-contingent, depending on the realization of s^s: $n = n(s^s)$ or $w = w(s^s)$.[3] If w is state contingent, the first-order condition for w is:

$$\frac{\phi}{W} u'(w) - \frac{1-\phi}{E} v'(\pi) = 0 \qquad \text{for all } s^s, s^l$$

hence

$$\frac{\phi}{1-\phi} \frac{E}{W} = \frac{v'(\pi)}{u'(w)}. \tag{1}$$

Shocks will affect both profits and wage rates so that (1) traces out the relationship that will be observed between w and π over time as the firm is exposed to a series of s^s shocks. Alternatively it is the relationship that will be found between wages and profits in a cross-section of firms.

We consider the two types of shocks in turn. In the case of a s^s shock we assume that agents will recognize it as a draw from the given pdf $g(s^s)$ so that in (1) neither E nor W is affected. The first-order condition can thus be written as $u'(w) = \lambda v'(\pi)$, with λ a constant. It follows that

$$\frac{dw}{d\pi} = \lambda \frac{v''}{u''} = (\frac{w}{\pi}) \frac{-\pi v''/v'}{-wu''/u'}$$

so that

$$\frac{\pi}{w} \frac{dw}{d\pi} = \frac{\Omega}{r} \tag{2}$$

where Ω and r denote the relative risk aversion of the employer and the workers respectively. Equation (2) is a well-known result in the literature (for example, equation (25) in Blanchflower, Oswald, and Sanfey 1996). It indicates that the elasticity of wages to profits depends only on the risk aversion of the two agents. Clearly, if the employer is risk-neutral so that $\Omega = 0$, wages will be unaffected by shocks (as in Baily 1974 or Azariadis 1975). Since the result is derived from the first-order condition for the wage rate, it holds irrespective of whether only w or both w and n are adjusted in response to shocks.

Now consider s^l shocks. In this case the model reduces to[4]

$$\max \phi \log n[u(w) - u(\overline{w})] + (1-\phi) \log v(\pi)$$

with first-order conditions for the wage rate:

$$\phi \frac{u'(w)}{nu(w) - nu(\overline{w})} - (1-\phi)\frac{v'(\pi)}{v(\pi)} = 0$$

and for employment:

$$\phi \frac{u(w) - u(\overline{w})}{nu(w) - nu(\overline{w})} + (1-\phi)\frac{v'(\pi)(f'(n) - w)}{v(\pi)} = 0.$$

From the first of these:

$$\frac{u(w) - u(\overline{w})}{u'(w)} = \frac{\phi}{1-\phi}\frac{v(\pi)}{nv'(\pi)}.$$

Assuming constant relative risk aversion, we can substitute $v/v' = \pi/(1-\Omega)$. Taking a first-order approximation to $u(\overline{w})$, this gives

$$w = \overline{w} + \frac{\phi}{1-\phi}\frac{1}{1-\Omega}\frac{\pi}{n}.$$

Note that this implies (for a constant degree of relative risk aversion and constant ϕ) that the elasticity of wages to profits per head is equal to $(w - \overline{w})/w$. If the outside wage ($\overline{w}$) is low relative to the wage paid by the firm (w), this elasticity is likely to be larger than Ω/r, the elasticity for risk sharing.[5] To this extent we expect permanent shocks to have a stronger effect on wages than temporary shocks.

The theoretical model treats labor as homogeneous and firms as identical. Our empirical strategy is to estimate earnings functions in which wages are determined by characteristics of the firm and the workers. We include among the regressors two measures of shocks: permanent and temporary. If risk sharing occurs, temporary shocks should be a significant determinant of wage levels. We will investigate whether this is so and whether the evidence is sensitive to the way the demarcation line between permanent and temporary shocks is drawn. We cannot observe when implicit contracts are drawn up or renegotiated. So we implicitly assume that the same contract remains in force during the period covered by our data (three rounds of panel data, collected at one-year intervals).

3 Data

Our data are from the Regional Programme on Enterprise Development surveys in Cameroon, Ghana, Kenya, and Zimbabwe. In each country three rounds of interviews were held during 1992-95. For Ghana we also have data for 1996, from a survey Oxford University organized using a similar survey instrument. The samples were chosen from four manufacturing subsectors: food, textile and clothing, wood and furniture, and metal working and machinery. Firm size ranged from fewer than five employees to well over a thousand. The average size of firms was smallest in Ghana (36 employees), largest in Zimbabwe (303). The questionnaire covered the firm's finance, technology, contractual relations with suppliers and clients, labor force, marketing, capital, investment, and exports.[6]

Many of the firms did not have audited accounts. So data on such concepts as value added or profits were not collected directly but constructed on the basis of questions about sales and direct and indirect cost items. The labor market module of the questionnaire included questions about total wage costs, the composition of the labor force, and workers' educational attainments. A separate questionnaire was administered to a small sample of (at most) 10 workers in each firm. These individual data concerned wages, education, work experience, and job description. Workers were interviewed only once so that, while we have panel data for firms, we have only cross-section data for workers. In the analysis we use the linked firm-worker data to test for risk and rent sharing. We focus on total earnings and thus do not distinguish between basic earnings and allowances (including bonuses) because the information on bonuses does not always seem reliable.

All available observations were used, except suspicious data excluded using the following rules: (1) value added was negative, (2) sales, wages, or employment increased or fell by more than a factor 5 between one year and the next, and (3) mean wages in the firm were less than 5 percent or more than 500 percent of the mean wage in the sample.

4 Results

Risk Sharing: Prima Facie Evidence

If the risk sharing model is correct, firms facing the most volatility in performance should exhibit the greatest volatility in average wages per worker or in employment. As a first step we calculated the volatility of profits, value added, and sales, checking whether they are systematically related to the observed volatility in employment or average wages per worker. Volatility is measured as the standard deviation of the log of annual observations for profits, value added, sales, employment, and average wages per worker for firms with at least three annual observations. For Ghana we have observations on four rounds for some of the firms, but for the other countries, at most three. Average wages per worker are calculated by the total wage bill (including allowances) divided by the total number of workers as reported in the firms' questionnaires. Because volatility is measured as the standard deviation of logarithms, the volatility of profits is calculated only for firms with profits. This may bias the result, but the standard deviation of profits *per worker* is not a suitable alternative since it is directly affected by the volatility in employment.

Table 1 reports the findings, with firms ordered by quartiles of profits, value added, and sales volatility. If the risk sharing hypothesis is correct, the standard deviation (measured by the median across firms in a given quartile) of the log of employment and of average wages per worker should increase going down the columns.

This is indeed the case: both employment and wages are more volatile in firms with more volatile profits. The effect is remarkably strong: for both variables the standard deviation roughly doubles from the bottom profits quartile to the top.[7] This is a necessary condition for risk sharing: under risk sharing (temporary) shocks should affect both profits and wages or employment.

Changes in profits are, of course, endogenous to shocks. We therefore present the same information for the standard deviation of sales and value added, more direct measures of exogenous shocks. The evidence for these two variables is very similar to that for profits: greater volatility is associated with higher volatility of both wages and employment. Our focus here is on risk sharing in the form of workers accepting wage volatility, but note that there is also *prima facie* evidence of substantial employment volatility.

Clearly the evidence is only suggestive: the standard deviation records all changes and thus does not distinguish between permanent and temporary shocks. In addition table 1 does not control for firm characteristics that may also affect wages (other than the shocks the firm is exposed to).

Our next step is to construct measures of temporary and permanent shocks and to include these as regressors in an earnings function regression. Bigsten and others (2000a, table 7) estimated a Mincerian earnings function using the Regional Programme on Enterprise Development data for Cameroon, Ghana, Kenya, Zimbabwe, and Zambia. The dependent variable is the log of earnings (in PPP dollars) and the regressors are human capital measures (dummy variables indicating whether a worker had completed primary, secondary, or university education), the worker's age and age squared, his tenure with the firm (also squared), and firm dummies to control for observable and unobservable firm differences. Bigsten and others also include the logarithm of firm size (number of employees) and capital intensity because workers in larger and more capital-intensive firms tend to receive higher wages. This is commonly interpreted as some type of rent sharing between the larger and more capital-intensive firms and the workers. Here we adopt the same specification but replace firm size and capital intensity with explicit measures for temporary and permanent shocks to test for risk and rent sharing directly.

But first we need to address reverse causality or endogeneity. In the risk and rent sharing literature, better firm performance leads to higher wages. By contrast, the efficiency wage literature emphasizes the opposite direction of causality: higher wages lead to better firm performance through less shirking, lower labor turnover, or higher morale (Shapiro and Stiglitz 1984, Dasgupta and Ray 1986). Such an efficiency wage mechanism introduces an endogeneity bias. Blanchflower, Oswald, and Sanfey (1996) suggest two possible remedies. First, if it takes time for wages to adjust to shocks the equation is recursive and wages become a function of past shocks. With this remedy, past movements in value added can be viewed as predetermined, and wages can be estimated as a function of lagged values of shocks. The second remedy is to find valid instruments to correct for potential endogeneity bias.

We adopt the first approach—for three reasons. First, there is evidence that the impact of shocks on wages is indeed recursive. Blanchflower, Oswald, and Sanfey (1996, table 2) show that the effect of profit shocks on wages increases over time. Second, the lag structure test for risk versus rent sharing: the effect of permanent shocks on wages should persist while the effect of temporary shocks should taper off quickly. This implies that longer lags for permanent shocks should still be significant, while becoming insignificant for temporary shocks. Third, there are no obvious valid instruments.

Blanchflower, Oswald, and Sanfey (1996) suggest cost measures, such as the cost of energy, as instruments. Teal (1996) uses the amount of foreign borrowing per employee and the share of intermediate imported input costs in total output for a study on Ghana, where the exchange rate fell far faster than domestic prices rose during the study period. But even these cost measures are problematic if better firm performance comes with the capability of workers to adapt to international best practice and thus the greater use of energy-intensive foreign inputs. The basic problem is that clearly exogenous instruments, such as firm-specific input or output prices, are simply difficult to measure and therefore not available.

For all these reasons we use lagged values of permanent and temporary shocks to test for risk and rent sharing. Endogeneity is also mitigated because we use shocks in value added rather than profits to test for risk and rent sharing. The use of value added data allows two period lags for each of the countries because of the availability of retrospective data.[8]

Risk sharing using a production function specification

We estimate a Cobb-Douglas production function regressing the log of value added on the log of the firm's physical capital and the log of the number of employees. We allow the coefficients for physical capital and employment to vary across countries and also include country and year-specific sector dummies.[9] We also include random or fixed effects to control for unobserved firm heterogeneity.

The coefficients for physical capital and employment are mostly significant but typically lower in the fixed effects specification (table 2). The Hausman test of random versus fixed effects is rejected in favor of fixed effects. But the coefficients for physical capital are implausibly low in the fixed effects regression, suggesting serious measurement errors. Fortunately none of the following results is affected in any serious way if we use the random effects specification rather than the fixed effects, which we do.[10]

We use the production function results to construct the long run shock s^l as the value predicted by the regressors and the controls not reported in table 2, except for employment. We do not include the part predicted by employment in the construction of the long run shock because employment may vary in the short run because of risk sharing. This implies that an increase in value added as a result of an increase in the firm's capital stock is treated as a permanent shock, possibly giving rise to rent sharing. Similarly, if there are productivity changes at the sectoral level, we treat them as permanent. We consider all other changes in value added—movements along the production function as a result of changes in employment or deviations from the regression line—as our measure of short-run shocks (s^s). In effect we treat changes in value added not due to changes in the firm's physical capital or firm sector as temporary shocks. Of course we can interpret the impact of short run shocks on wages as risk sharing only if these shocks have low persistence. This turns out to be the case: the first-order autocorrelation (allowing for firm fixed effects) is 0.19, suggesting that persistence is a small proportion of our short run shock variable.[11]

We scale the long run shock by the number of employees because the model suggests a stable relationship between wages and profits per worker for rent sharing (but between wages and total profits for risk sharing).[12]

The question we address is whether these two measures of shocks affect wages paid by the firm, controlling for the human capital variables and the other determinants of wages identified by Bigsten and others (2000a). We therefore introduce the shock variables as regressors in the earnings function (table 2). Firm fixed effects and country-specific year dummies are included to control for firm heterogeneity and macroeconomic variations. We find a strong pattern across length of lag and type of shock. The short run shock is positive and significant only for the one period lag, while the long run shock is positive and significant for the two period lag. That the coefficient for long run shocks increases with the length of the lag has also been reported by Blanchflower, Oswald, and Sanfey (1996, table 2).

The risk and rent sharing coefficients pool across countries at the 10% significance level. Virtually the same estimates are found if the fixed effects Cobb-Douglas production function is used to construct short and long run shock variables.

Worker heterogeneity

We controlled for such observed worker characteristics as age, tenure, and education. But we cannot control for worker heterogeneity in terms of unobservables, because in our panel data firms were followed over time but workers were interviewed only once. So we can introduce fixed effects for firms but not for workers to control for unobserved heterogeneity.[13] This is a serious limitation. For example, Abowd, Kramarz, and Margolis (1999) show (using French data) that unobserved worker heterogeneity (which we do not control for) is large relative to unobserved firm heterogeneity (which we do control for).

Workers may differ in how they are affected by shocks.[14] For example, risk sharing could take the form of reducing the number of hours worked but only for junior workers. Or risk sharing could impose wage volatility on junior workers but not the senior. In either case the effect of short run shocks on our wage variable (monthly earnings) would differ by worker category. We investigate this by including an interaction term (s^s x age) in the table 3 regression. This interaction term is insignificant (t-values of 0.95 and 1.20 for the one and two lag specifications respectively) so this form of heterogeneity does not appear to pose a problem.

Is it really risk sharing?

The evidence in table 3 clearly suggests that workers in Sub-Saharan manufacturing share risks (and rents) with their firms. But is the relationship between the short run shocks in value added and wages really a consequence of risk sharing and not something else? We investigate this by looking at three elements of risk sharing: labor market imperfections, credit market imperfections, and compensating differentials.

Risk sharing and labor market imperfections.

Risk sharing implies some kind of labor market imperfection or friction. If workers could move costlessly to another firm when the firm experienced a negative shock, a risk sharing arrangement clearly could not be enforced. Risk sharing contracts can be enforced only when firms and workers are somehow locked in. We expect production workers to be more mobile than other workers who typically have more firm-specific skills and experience. The reason: the label "production workers" covers people with few skills (unlike accountants, supervisors, managers, and technicians). This leaves "production workers" as a relatively unskilled and presumably more mobile group, an interpretation supported by data on tenure. For example, in a regression of tenure on a dummy for production workers (controlling for age, quadratically, and including firm fixed effects) the dummy is negative and significant. So production workers in our sample are indeed more mobile between firms than other workers. This makes a risk sharing contract more difficult to implement for this category.

To test for this we estimated the wage regression for production and other workers separately (the first two regressions of table 4). We include only one period lags because there is no evidence of risk sharing for two period lags. The result confirms the risk sharing interpretation: risk sharing is observed only for nonproduction workers, with a positive and highly significant coefficient for the short run shock variable.

Risk sharing and credit market imperfections.

Risk sharing is a form of informal credit for the firm, unnecessary if credit markets function perfectly. But there is ample evidence that credit markets function less than perfectly, especially in developing countries, and risk sharing may be an efficient response to such imperfections. We would expect firms that are more credit constrained to be more likely to use risk sharing as a credit tool. So, in principle, we could test whether more credit constrained firms exhibit more risk sharing using some proxy for how credit constrained they are.

Causality can, however, also run from risk sharing to credit rationing. Presumably firms that are highly effective in sharing risks with workers will be less credit constrained than firms that have to rely entirely on outside finance. But if we assume that all firms are credit constrained to some extent, the ones exposed to the greatest outside shocks (such as those in demand and input supply) will be most likely to use some form of risk sharing to cope with liquidity crises. Outside shocks are exogenous and therefore a valid test for the risk sharing interpretation of our result.

We tested whether firms that face greater demand shocks also share more risks. We calculated demand volatility as the standard deviation of annual log of sales for each firm and divided the firms into low and high demand volatility depending on whether the standard deviation was below or above the median. Next we tested whether wages react differently to short run value added shocks for low and high demand volatility firms.

The third regression in table 4 presents the results for the nonproduction Workers, for whom we found evidence of risk sharing. The results confirm that these workers share risk but only in firms with high demand volatility: there is no evidence that nonproduction workers share risks in low demand volatility firms.

Risk sharing and wage compensation.

The results may be viewed as strong evidence of risk sharing in African manufacturing. The efficiency wage explanation for the correlation between wages and value added was excluded through the use of lagged values of the shock variables. There is also evidence of rent sharing, but this cannot explain the variation of wages with short run variations in value added. But Blanchflower, Oswald, and Sanfey (1996) discuss an alternative hypothesis that could explain why wages are affected by short run shocks in value added. If wages are set competitively but there is slow adjustment, positive value added shocks may lead to increases in wages if firms temporarily move up the labor supply curve in booming industries. The rent sharing hypothesis can withstand this criticism because it has been shown that firm and industry differentials in wages tend to persist over very long periods. The competitive-slow-adjustment model cannot explain such long term variations from the competitive model. But it can explain the short run variations in wages following short run shocks in value added. Risk sharing also implies that workers are compensated if they enter the implicit contract *ex ante* or punished if they are forced to accept the contract *ex post*. If they enter the contract voluntarily, they will demand

(and receive) a risk premium for incurring some of the risks the firm is facing. If they are forced to accept risk sharing because of unexpected volatility occurring during the contract period and because of the costs of job mobility, they will pay a risk premium. Either way, risk sharing implies a correlation between wages and short run firm-specific wage volatility that cannot be explained by the competitive-slow-adjustment model.

We measure the short run firm-specific wage volatility as the standard deviation of the log average wage across time within a firm. The average wage is measured as the ratio of the total wage bill (including allowances) and the total number of employees. To create a firm-specific measure of compensation that also varies by type of worker, the standard deviation of the log wage (within a firm) is calculated for two groups: production and nonproduction workers. We need intrafirm variation in the wage volatility measure to include a volatility measure in a wage regression together with firm fixed effects.

Firms with greater intrafirm wage volatility pay higher wages to the workers, even after controlling for firm and worker characteristics (table 5). This confirms the risk sharing hypothesis as opposed to the competitive-slow-adjustment hypothesis. With intrafirm wage volatility increasing from 0.06 to 0.63 between the 10th and 90th percentile, workers receive an additional 7% wage as compensation if they were to move from the low wage volatility firm to the high.

5 How important is risk sharing?

How important are the risk sharing effects identified in the article? And how important are they relative to the other determinants of wages? To capture the importance of each of these determinants, we consider how much wages change if we move from the 10th to the 90th percentile of the distribution for each of these determinants. Table 6 shows how much of the rise in earnings between the 10th and 90th percentile of the distribution can be attributed to each of the explanatory variables. Average wages increase 392 percent between the 10th and 90th percentile. Wages would increase by 15 percent if the short run shock increases from the 10th to the 90th percentile of its distribution. The wage increase for a similar move for the long run value added shock is 28 percent. This suggests that one third of the combined impact of risk and rent sharing can be traced to risk rather than rent sharing. This is important, because it qualifies the common perception that African labor markets are inefficient in light of widespread rent sharing. In fact, African labor markets appear to be highly efficient. They compensate for poorly developed financial markets by allowing firms to share negative shocks with their workers. These risk and rent sharing effects are comparable to the effect of education (20 percent).

6 Conclusion

The developed country literature has focused on rent sharing as an explanation for the correlation across firms between wages and profits typically observed in cross-section data. The alternative explanation of risk sharing has been explored in theoretical work but not tested empirically. Under risk sharing, only part of the effect of shocks is on profits. Workers provide insurance to employers by accepting changes in employment or wages.

We investigated this hypothesis using a four-country panel data set for African manufacturing firms. The descriptive analysis suggests a *prima facie* case for risk sharing: the more volatile a firm's value added, the greater the volatility of the average wages it pays—and of the size of its labor force. Risk sharing in our sample thus involves changes both in employment and in average wages.

In the econometric analysis we focused on changes in wages. We estimated an individual earnings function including a firm specific measure of shocks among the regressors and controlling for worker and firm characteristics. We separated measures of permanent and temporary shocks by estimating a production function (with time-variant stocks of physical capital and employment). Value added changes resulting from investment or time trends (sector and country specific) time trends are treated as long run shocks. Deviations from this permanent component are treated as temporary shocks. We found evidence of risk sharing, with temporary shocks having a positive and significant effect on wages.

Because we used lagged values for the shock variables, this effect cannot be easily explained by an efficiency wage hypothesis. The observed lag structure for short run versus long run shocks also suggests that it is risk sharing rather than rent sharing. Short run shocks affect wages but only temporarily, while long run shocks have a longer effect on wages. We also find that nonproduction workers are more likely to share risks than production workers. This is consistent with the risk sharing hypothesis since the skills of nonproduction workers are more firm specific than those of production workers. So a risk sharing contract can be enforced more easily for nonproduction workers. Finally, the positive effect of short run shocks on wages cannot be explained by a short run, upward sloping, labor supply curve since we also find that workers in firms with high intrafirm wage volatility receive a risk premium. The risk sharing hypothesis can explain this premium but the competitive-slow-adjustment model cannot.

When the correlation between wages and profits reflects risk sharing rather than rent sharing, it need not be interpreted as a symptom of a labor market inefficiency. Instead, risk sharing can be seen as an efficient (second-best) use of the labor market to substitute for a missing insurance market. Our evidence suggests that risk sharing is quantitatively important: one third of the combined impact of risk and rent sharing can be traced to risk sharing rather than to rent sharing, the literature's focus.

What does risk sharing mean for policy? Consider insurance for firms. Because firms would substitute formal insurance for risk sharing, wage volatility would be reduced. But to the extent that workers are compensated for the wage volatility they experience under risk sharing, they will not benefit from the insurance. Firms, however, would clearly be better off since the possibilities for risk sharing with workers are obviously rather limited. Formal insurance would give the firm access to a bigger risk pool. If wages are rigid, there would be even less scope for risk sharing. Wage rigidity is therefore damaging not just by distorting the labor market but by blocking the possibility of risk sharing as a substitute for insurance.

Notes

[1]Risk sharing models apply the optimal contract framework of Baily (1974) and Azariadis (1975). In those early papers workers are risk averse but the firm is risk neutral. In this framework employers insulate workers from shocks: risks faced by the firm are not shared with workers. In the optimal contract the wage is independent of the state of nature. In later models, however, both agents are risk averse and this leads to risk sharing.

[2]Our hybrid model is based on models 1 and 3 in their theoretical appendix.

[3]In Oswald (1995) and Blanchflower, Oswald, and Sanfey (1996) both n and w are state contingent.

[4]To achieve comparability with the s^s shock model, we changed the risk sharing model of Blanchflower, Oswald, and Sanfey (1996) by replacing π in the maximand by $v(\pi)$. Note that the difference between average utility $nu(w) + (1-n)u(\overline{w})$ and the utility of the outside wage $\overline{w}$ reduces to $n[u(w) - u(\overline{w})]$.

[5]For example, if the degree of relative risk aversion is 1 for the employer and 2 for workers, the statement is true if and only if $\overline{w} < 2w$.

[6]A very detailed description of the data, sampling and questionnaire can be found at http://www.worldbank.org/research/projects/facs/facs_countries.htm.

[7]Interestingly, this is not true for wages as reported in the workers' survey. Using those data we find very little change across quartiles, the median standard deviation of wages taking the values 0.32, 0.28, 0.28, and 0.33 (top quartile). This strongly suggests that risk sharing in the form of wage volatility is dominated by bonuses.

[8]Retrospective data are available for sales, employment, and investment but not for the use of intermediate inputs. We therefore calculate value added for the presurvey years from the retrospective sales data by applying the ratio of value added to sales observed in the survey years for each firm. The results are virtually the same if we use the estimated value added

series also for the survey years, suggesting that this procedure does not create any serious bias.

[9]This is tantamount to estimating the production function country by country. We do this because pooling is rejected.

[10]In fact, the results are also almost unaffected if we use a pooled (random or fixed effects) production function for all countries.

[11]The 0.19 estimate is subject to the Nickell bias because of the short length of our panel. But in our estimates (table 3) we observe that the short run shocks are significant for a one period lag but not for a two period lag. This also suggests low persistence in the short run shock variable.

[12]This point is also noted by Blanchflower, Oswald, and Sanfey (1996, p. 239) who therefore view the wage correlation with profit-per-employee as evidence for rent sharing rather than risk sharing (which implies a wage correlation with total profits). If we also scale the short run shock by the number of employees, the results remain generally the same. To be more specific, the effect is to leave the coefficients of the short run shock variable exactly as reported in table 3 and to change their t-scores marginally. For the long run coefficients, as before, the coefficient is larger and more significant for the two-period lag.

[13]One could argue that worker characteristics such as tenure are endogenous because they may be correlated with omitted worker characteristics. But even if we exclude tenure from the specification, the size, and significance of the coefficients of the shock variables are unaffected.

[14]We are grateful to one of the referees for this point.

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Table 1. Volatility of Employment and Average Wages by Volatility of Sales, Value Added, and Profits

	Median of firm-specific standard deviations of	
	annual employment	average wages per worker
quartiles of $\sigma_{profits}$		
25	0.12	0.23
50	0.16	0.28
75	0.18	0.36
100	0.23	0.45
quartiles of $\sigma_{value\ added}$		
25	0.12	0.22
50	0.14	0.27
75	0.24	0.39
100	0.22	0.44
quartiles of σ_{sales}		
25	0.10	0.25
50	0.18	0.34
75	0.19	0.40
100	0.28	0.53

Note: standard deviations are calculated in terms of logs. Values are in PPP US$. Only firms with at least three observations are included.

Table 2. Cobb-Douglas Production Function for Log Value Added

	(1) random effects		(2) fixed effects	
	coefficient	t-score	coefficient	t-score
Log capital				
Cameroon	0.21	6.38	0.05	1.09
Ghana	0.21	7.50	0.01	0.34
Kenya	0.19	6.62	0.07	1.78
Zimbabwe	0.25	7.13	0.01	0.31
Log employment				
Cameroon	1.09	18.54	0.58	6.15
Ghana	0.79	11.85	0.28	2.57
Kenya	0.93	17.64	0.44	5.21
Zimbabwe	0.88	14.14	0.34	2.81
N	2,788		2,788	
R^2	0.81		0.52	

Note: Also included in the regression are country and year-specific sector dummies.

Table 3. Effects of Value Added Shocks on Monthly Wages

	One period lag		Two two period lag	
	coefficient	t-score	coefficient	t-score
Short run shock s^s	0.03	2.13	-0.01	0.59
Long run shock s^l	0.01	0.49	0.07	1.77
Primary education	0.04	1.79	0.03	1.12
Secondary education	0.20	8.58	0.18	6.88
University education	0.80	17.33	0.79	14.33
Age	0.08	17.11	0.09	15.75
Age^2	-0.001	14.22	-0.001	13.16
Tenure	0.01	2.70	0.01	1.82
Tenure^2	-0.00001	0.13	-0.0001	0.63
Firm dummies	yes		yes	
N	6,789		5,248	
R^2	0.52		0.47	

Note: Also included in the regression are country-specific year dummies and dummies for sex and occupation of worker. The number of observations is lower in the 2-period case since lags are not available for all firms. Limiting the regression to the same observations does not affect the results.

Table 4. Effects of Value Added Shocks on Monthly Wages:

Production versus Other Workers and Demand Volatility

	Production workers		Other Workers		Demand Volatility	
	coefficient	t-score	coefficient	t-score	coefficient	t-score
Short run shocks s^s	0.02	1.31	0.06	2.71		
Low demand volatility					0.02	0.54
High demand volatility					0.07	2.69
Long run Shocks s^l	-0.03	0.94	0.06	1.42	0.05	1.32
Primary education	0.03	1.35	0.05	1.26	0.05	1.26
Secondary education	0.16	5.23	0.27	6.48	0.27	6.47
University education	1.05	13.02	0.70	11.25	0.70	11.19
Age	0.09	14.85	0.05	6.06	0.05	6.03
Age^2	-0.001	12.67	-0.0005	4.30	-0.0005	4.27
Tenure	0.01	2.97	0.005	1.12	0.01	1.14
Tenure^2	-0.0001	0.91	-0.0001	0.46	-0.0001	0.51
Firm dummies	yes		yes		yes	
N	4,292		2,497		2,478	
R^2	0.36		0.38		0.23	

Note: Also included in the regression are country-specific year dummies and dummies for sex and occupation of worker. The number of observations in columns 1 and 2 sums to 6,789, as in column 1 of table 3. The number of observations in column 3 is lower than in column 2 because demand volatility has been calculated only for firms reporting at least 3 years of data.

Table 5. Testing for Wage Compensation:

Effects of Intrafirm Wage Volatility

	coefficient	t-score
Short run shock s^s	0.03	2.50
Long run shock s^l	0.00	0.09
Primary education	0.03	1.35
Secondary education	0.18	6.94
University education	0.77	15.14
Age	0.08	15.89
Age^2	-0.001	13.14
Tenure	0.01	3.06
Tenure^2	-0.0001	0.85
Intrafirm wage volatility	0.12	2.18
Firm dummies	yes	
N	5,748	
R^2	0.50	

Note: Also included in the regression are country-specific dummies for year, and for the sex amd occupation of the worker. The number of observations is lower than in table 3 (6,789) since intrafirm wage volatility is not available for all firms.

Table 6. The Importance of Risk Sharing in Determining Wage Differentials

	90th percentile	median	10th percentile	percentage increase
Log monthly wages	4.46	5.26	6.05	392
Transient shock	1.74	3.68	5.49	15
Permanent shock	3.81	5.27	6.82	28
Education (dummy)	secondary completed	primary completed	primary not completed	20

Note: The percentage increase in the rows for transient shocks, permanent shocks, and education indicate how much wages would rise in response to a change in those variables from the 10th to the 90th percentile.