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DO MORE PRODUCTIVE FIRMS PAY WORKERS MORE? EVIDENCE FROM EGYPT

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Abstract

Theoretically, in perfectly competitive markets with full information, marginal productivity of labor and workers' wages should be equalized across firms and wages should not be linked to the productivity of a firm. Empirically examining the relationship between wages and productivity across various types of firms can reveal important deviations from perfect competition and full information. This paper investigates the wage-productivity relationship in the case of Egypt. We find that wages are related to firm productivity, even after accounting for worker quality. The relationship between wages, productivity, and firm characteristics suggests that the association is due in part to imperfect competition and in part to the use of efficiency wages by employers.

Keywords: Wages, Productivity, Firms, Egypt
JEL Codes: D22, D24, J31

ملخص

نظريا ، في الأسواق التنافسية التي تتوفر بها معلومات كاملة ، ينبغي أن تكون الإنتاجية الحدية للعمالة وأجور العمال متكافئة بين الشركات كافة ولا ينبغي ربط الأجور بإنتاجية شركة ما. يمكن أن يكشف الفحص التجريبي للعلاقة بين الأجور والإنتاجية عبر أنواع مختلفة من الشركات عن انحرافات مهمة عن المنافسة الكاملة والمعلومات الكاملة. تبحث هذه الورقة في العلاقة بين الأجور والإنتاجية في حالة مصر. ونجد أن الأجور مرتبطة بإنتاجية شركة ، حتى بعد احتساب جودة العامل. تشير العلاقة بين الأجور والإنتاجية وخصائص الشركة إلى أن الارتباط يرجع جزئياً إلى المنافسة غير الكاملة وإلى حد ما إلى استخدام أجور الكفاءة من جانب أصحاب العمل.

1. Introduction

Classical economic theory indicates that in a perfectly competitive economy with full information, real wages for workers will equal the marginal product of labor (Hicks, 1963). In an economy in equilibrium, marginal productivity and wages will be equal across firms, industries, and workers of equivalent quality. The labor market is, of course, not in stasis. Perhaps because of the adoption of new technologies, labor productivity may increase in a particular firm or industry. In the short run, the firm or industry could work to attract additional workers. This will increase the quantity of employment (labor demand in that industry or firm). As the employment in that firm or industry increases, the marginal product of labor will fall due to diminishing marginal productivity until it is equal to the going wage in the labor market for the relevant type of labor. Ultimately, the firm or industry will again be at equilibrium in the long run, paying the same wage rate as other industries and firms for a given type of labor. Essentially, under classical theory, in the long run workers are paid a fixed share of production (Hansen, 1966). The classical theory can even be expanded to allow for different types of workers (perhaps with different human capital) with essentially the same result; equivalent workers being paid equivalent wages, depending on their productivity (Hellerstein, Neumark, & Troske, 1999).

This classical model may not hold for a number of reasons. What alternative theory might pertain depends on the nature of the violations of the assumptions of classical theory. Imperfect information about worker effort is one such problem. Variable effort, and difficulties in monitoring effort, may lead employers to pay efficiency wages, which are wages set at higher than the market clearing level to incentivize greater effort (Lazear & Oyer, 2012). Likewise the costs of labor turnover, which may be industry- and firm-specific, may also motivate efficiency wages (Yellen, 1984).

Firms and industries may be non-competitive, such that either there are higher than average profits to the owners of capital, or, potentially, rent-sharing with workers through higher wages (Blanchflower, Oswald, & Sanfey, 1996). Returns to scale may not be constant; internationally there is low productivity among small firms, particularly in contexts where informality is an option. This may be due to policies that make formality and thus greater scale more costly, or because formality (and access to formal credit) substantially raises productivity (Farrell, 2004; McKenzie & Sakho, 2010; Van Biesebroeck, 2005). Or perhaps there are distortions in productivity linked to non-competitive markets (Parente & Prescott, 1999). The "stickiness" of markets and especially wages may also relate to deviations from the classical theory (Blinder & Choi, 1990; Datt & Ravallion, 1998). Examining the relationship between productivity and wages across firms and industries to investigate these potential departures from perfectly competitive markets with full information can shed light on a number of important aspects of labor and other markets.

In the context of Egypt, a better understanding of labor markets, and especially the demand side of the labor market, is critically important. Labor supply has rapidly increased in Egypt and the workforce has become substantially more educated (Assaad & Krafft, 2015a). Although at the present moment demographic pressures have eased, increases in fertility and the "echo" of the

youth bulge generation mean that renewed pressures on labor supply are imminent (Krafft & Assaad, 2014). Job creation and labor demand were already struggling to keep pace during the global financial crisis and the crisis that followed the January 25th revolution (Assaad & Krafft, 2015b); the subsequent economic difficulties have placed the Egyptian economy in an even weaker position for job creation. Job quality in particular has been a problem for Egypt, with rising informality for new entrants, workers increasingly overqualified for the jobs they can obtain, and falling female labor force participation in the face of weak demand (Assaad & Krafft, 2015b, 2015a; Krafft, 2018). Wages, after falling precipitously in the 1990s with economic restructuring, took until almost 2012 to recover to similar levels as those of the late 1980s (Said, 2015). While public sector wage growth continued after the revolution, wages in the private sector struggled to keep pace with inflation (Assaad & Krafft, 2013).

Although these stylized facts about labor supply and the equilibrium of the labor market can be readily identified, fully understanding their causes, much less their cures, has been precluded by limited information about labor demand. Especially restrictive has been the lack of representative firm-level data on production, purchases of inputs, investments, and sales. The recent release of the microdata from a 50% sample of the 2012/2013 Economic Census carried out by Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS) has opened up a wealth of opportunities for understanding labor demand and especially the relationship between wages and productivity. This is a topic that had not previously been estimable in Egypt and is understudied in developing countries in general. Understanding this relationship can illustrate the functioning of the labor market and the nature of labor demand, and can help inform labor market and broader economic policies in Egypt and around the globe.

Our research investigates whether more productive firms or industries pay their workers higher wages. Whether such a violation of the classical hypothesis of the wage/productivity disconnect occurs, and the nature of any deviations from the classical hypothesis, can shed light on the functioning of the labor market and wage-setting behavior among firms in Egypt. We specifically set forth the following research questions:

(1) Do wages for workers of equivalent quality vary according to the productivity of the firms in which they work?

(2) If there is a relationship between wages and productivity, in which firms (old, high-skilled, highly concentrated, etc.) is the wage/productivity relationship particularly strong? What does this relationship suggest about the relative weight of non-competitive factors versus efficiency wage explanations in understanding the wage-productivity nexus in Egypt?

2. Literature Review

2.1 Economic Theory on Wages and Productivity

Classical economic theory characterizes the functioning of perfectly competitive labor markets. Labor demand at the firm level is determined by the firm profit maximization (or cost minimization) behavior. The firm produces until the output price equals marginal cost. The firm will pick the mix of labor and capital so that the ratio of marginal products equals the ratio of their input prices (wage/cost of capital). Thus, the firm increases labor inputs until the marginal

product of labor equals the wage (Borjas, 2010). Ultimately, across firms and industries workers of equivalent quality are paid the same and thus all firms will be equalizing their marginal product of labor. There should not be variation in marginal productivity nor in wages for equivalent workers across firms or industries. Average productivity across workers, as opposed to marginal productivity, will vary across firms depending on the technology and amount of capital used, but there should be no relationship between this productivity and the wages received by workers of equivalent quality.

Empirically, numerous studies have identified important correlations between wages and productivity. For example, in the U.S. manufacturing industry the correlation between wages and productivity was nearly constant over 1975-1992, at around 0.55 (Dunne, Foster, Haltiwanger, & Troske, 2004). In a meta-analysis across 14 studies, the wage-elasticity of production was found to be 0.325 after accounting for publication bias (Peach & Stanley, 2009). These are substantial deviations from the classical, perfectly competitive markets case.

Reasons for deviations from the classical model, which could lead to correlations between wages and productivity, become evident when we recognize that even workers of equivalent quality differ in their marginal productivity, due to a variety of factors. Workers can be offered a piece-rate equal to the value of their marginal product, and thus a piece rate (or for sales, a commission rate) wage. The problem underlying this issue is an information, incentives, and principal-agent one; the firm may not be able to measure the worker's productivity easily (the ease of measurement will vary by firm and industry characteristics) and also cannot expect the worker to report honestly. Firms may have to undertake costly monitoring or choose to use time rates (hourly wages); their decision will depend on profitability under each option (Borjas, 2010). This incentive or monitoring issue is one route to a link between productivity and wages, as well as variation across firms.

Firms might also be able to increase profits by paying a wage that is above the market-clearing wage. The basic idea of such efficiency wage models is that workers' productivity and work effort depend on the wage. The firm's output may rise rapidly as the wage initially increases, and then at a certain point faces diminishing returns (Borjas, 2010). Efficiency wages in developing countries have historically been linked to nutrition, although the empirical evidence largely does not support this theory. The basic idea is that paying workers a little more allows them to buy more calories and thus be more productive (Swamy, 1997). As an alternative to a nutrition explanation for a wage-productivity nexus, more recent explanations revolve around loyalty, workplace culture, lower turnover, and "creaming" the best workers. These alternative explanations for efficiency wages have obtained more empirical support than nutrition-based explanations (Borjas, 2010; Fafchamps & Soderbom, 2006; Krueger & Summers, 1988; Peach & Stanley, 2009; Raff & Summers, 1987; Yellen, 1984). Because profit-maximizing firms, under efficiency wage theory, set the wage so that the elasticity of output with respect to the wage is exactly one, there is now a link between firm productivity and wages; higher wages are associated with higher productivity (Borjas, 2010).

Other important potential links between wages and productivity are derived from an observation about wages and firm size. Globally, workers are more productive and are paid more in large firms (Idson & Oi, 1999; Schmidt & Zimmermann, 1991). Productivity also grows faster in large firms (Van Biesebroeck, 2005). Economies of scale are one potential reason for the observed patterns (Schmidt & Zimmermann, 1991). However, the prevalence of microenterprises and estimates from developing countries make this a contested interpretation (Tybout, 2000). Another potential explanation of the firm size-wage relationship is the degree of competition. Any of the agents, either workers or firms, could be acting in a non-competitive market for a variety of local reasons (McDonald & Solow, 1981; Parente & Prescott, 1999). When firms are facing an imperfectly competitive market, they can capture rents, and may share these rents with workers (Blanchflower, Oswald, & Sanfey, 1996; Hildreth & Oswald, 1997). Thus high profitability and productivity resulting from rents will, again, be linked with higher wages. Overall, all of these possible relationships between productivity and wages can shed important light on the functioning of labor and product markets.

2.2 Labor Markets in Egypt

In Egypt, a number of features of the labor market are salient to potential wage-productivity relationships. The distribution of firm size and industry has been relatively stagnant over time, suggesting that efficiency-enhancing reallocations are limited. The employment distribution by firm size tends towards a preponderance of microenterprises (Assaad & Krafft, 2015b). Labor is not strongly mobile or dynamic within wage work, with the exception of irregular (daily, casual, or seasonal) work (Assaad & Krafft, 2015b, 2016, Yassine, 2013, 2015). Corruption and non-competitiveness are additional issues in Egypt's labor market. Past studies surveying firms on their challenges have identified corruption as a constraint (Hattab, 2013; World Bank, 2013). Achieving formality in particular has been identified as a challenge linked with corrupt practices (World Bank, 2013). Ultimately corruption and political connections generate protection and favorable deals that erode competition and reduce job creation (Diwan, Keefer, & Schiffbauer, 2014). Thus, the context in Egypt is not conducive to the typical, competitive labor market where marginal products and wages are equalized across firms and industries.

To date, there is very little evidence on wages and productivity in Egypt, due to the aforementioned data shortage. On the wage side, there is quite a lot of literature looking at wage differentials across different worker and firm characteristics. Gender, human capital, socio-economic background, region, and other worker characteristics all play an important role in wage determination (Assaad, Krafft, & Salehi-Isfahani, 2017; Said, 2009, 2015). Reliance on social networks for hiring in particular may contribute to segmentation in the labor market (Assaad, 1993, 1997a; Assaad, Krafft, & Salehi-Isfahani, 2017). Sectoral differences in wages, interpreted as differences in productivity, have been identified in Egypt, although at least in the formal sector, productivity may be converging (Schiffbauer, Sy, Hussain, Sahnoun, & Keefer, 2015). Trade policies as well as other policies that result in excessive "red tape" have been linked to wage disparities (Zaki, 2014). Public versus private differentials in pay have historically distorted the labor market and continue to be important (Assaad, 1997b; Said, 2009, 2015).

Rising wage inequality that is unrelated to individuals' circumstances (Assaad, Krafft, Roemer, & Salehi-Isfahani, 2017) may be due, in part, to increasing distortions in the labor market, which lead to increasing wage dispersion. While these wage patterns suggest potential labor market distortions, without an analysis of the labor demand side, these distortions are only partially understood.

On the productivity side, evidence is more limited due to very limited data. Historically, economic policies created substantial distortions in productivity, particularly in the public sector (Handoussa, Nishimizu, & Page Jr., 1986). Exporters have tended to be more productive (Chaffai & Plane, 2017). For household non-farm enterprises in Egypt in 2012, a number of characteristics of firms, owners, and their locales are associated with productivity, suggesting segmented markets (Abou-Ali & Rizk, 2015). Employment creation is disconnected from typical markers of productivity in these enterprises (Krafft, 2016). Information problems may be a constraint on productivity in Egypt, particularly regarding exporting; for example, when small rug firms are provided assistance to produce for export, productivity improves (Atkin, Khandelwal, & Osman, 2014). Overall, the limited evidence suggests distortions, but there is little work assessing distortions on an economy-wide level.

In terms of the productivity-wage relationship, using national data from 17 years over the period 1914 to 1961, Hansen (1966) estimates the relationship between annual average wages and average prices for maize as a test of whether agricultural labor is being paid the marginal product of labor. On the micro level, Hansen (1966) shows that wages are related to seasonal variation in demand for labor. He also shows that wage differentials by demographics and location align with marginal productivity theory. This historical study is, to the best of the authors' knowledge, the only one directly dealing with wages and productivity in Egypt. Additional research is sorely needed.

3. Data

3.1 Survey and Sample

The analysis in this paper uses the Egypt Economic Census of 2012/2013 (EC 2013). Although officially called a census, the data are in fact a sample. The sampling frame for the survey is all non-government establishments. Businesses that operate outside of establishments (for example, most construction and transportation work is mobile and most agricultural employment is field-based and therefore considered outside of establishments) are not included in the sample. Although government establishments are not included, some public enterprises are included in the sampling frame. We restrict our working sample to only private sector enterprises outside of agriculture. Private non-agricultural employment within establishments makes up 31 percent of total employment in Egypt in 2012.[4]

While larger firms and certain sectors are comprehensively sampled, smaller firms in some sectors have a lower sampling rate. Weights are included to make the data nationally representative of establishments and account for the sampling design. Additionally, researchers

[4] Authors' calculations from Egypt Labor Market Panel Survey 2012.

are given access to only a 50% random sub-sample of the firms in the data; weights are further adjusted to reflect this sub-sampling strategy. The 50% sub-sample results in 62,108 unique firms (establishments).

We exclude firms that did not pay any wages in 2012/13 (N=19,948 establishments)[5] or have negative value added (production) (N=785 establishments) from our analyses, since our focus is on the wage-productivity relationship. We exclude public sector establishments (N=350). We exclude the few (N=475) agricultural establishments included in the sampling frame to concentrate on non-agricultural enterprises. This ultimately results in a working sample of 40,550 firms.

We also draw on the Egypt Labor Market Panel Survey (ELMPS) 2012 data[6] to pull in data on the industry-region level on workers' characteristics, such as whether workers received training or their average educational level in the relevant cell. We merge data for an equivalent sub-sample from the ELMPS: wage workers in private sector establishments. We use four regions: (1) Greater Cairo (2) Alexandria & Suez Canal (3) Lower Egypt and (4) Upper Egypt. We also use the lowest level of industry classification and region combination that has at least 3 observations to merge in characteristics from the ELMPS.[7]

3.2 Key variables: Productivity and wages

The firm-level data allow us to quantify production and thus productivity, both in terms of value added per worker[8] (Y/L) and in terms of total factor productivity (TFP)—the residual after accounting for capital[9] and labor inputs. Examining both is critically important because observed wage-productivity relationships may be due to differences in capital intensity (Schiffbauer, Sy, Hussain, Sahnoun, & Keefer, 2015). TFP is estimated based on each firm's capital stock and number of workers. We estimate both Cobb-Douglas and translog specifications of TFP[10] and

[5] A number of firms are self-employment or have only unpaid workers (such as unpaid family members).

[6] See Assaad & Krafft (2013) for more information on the ELMPS.

[7] Some of the smaller activities were aggregated even at the one-digit level. Real estate was combined with financial and insurance activities, mining with utilities, activities of extraterritorial organizations and domestic services with over services, water supply, sewage, and waste management with other utilities, and public administration/defense with administration and support services. Additionally, for some variables that only were asked of certain sub-groups, the mean in the economic census sample was used if all other levels were missing for an industry-region.

[8] We include in our measure of workers (L) both paid and unpaid workers.

[9] Since we use logs, which would evaluate zero capital as missing, we replace reports of zero capital with one Egyptian pound of capital.

[10] In estimating TFP, in both the translog and Cobb-Douglas specifications, we use log value added as the dependent variable. The explanatory variables in the Cobb-Douglas specification are log labor (number of workers) and log capital (value in Egyptian pounds). The translog specification adds the interaction between log labor and log capital to the Cobb-Douglas specification. The translog also adds the squares of log labor and log capital, for a more flexible functional form. In both estimates of TFP, TFP is then calculated as the residual from the

test the sensitivity of our results to the definition of productivity used. It is important to emphasize that all three of these quantities are measures of firm productivity, or average worker productivity, not the productivity of specific, individual workers.

Wages and social security payments are available in the EC 2013, which is important, as total compensation, including benefits, is what should equal the marginal product of labor. We therefore present results for three measures of compensation: (1) cash wages, (2) total compensation (cash wages + social insurance + in-kind benefits) and (3) "formality adjusted" wages. "Formality adjusted" wages are calculated by doubling wages for formal workers, operationalized here as those who work for firms that pay social insurance, to reflect total compensation. The doubling is based on an estimate (Assaad, 1999) that suggests that total compensation for formally employed workers is about 1.9 times their monetary wages. All measures of compensation were available in thousands of current (2013) Egyptian pounds and are measures of average compensation per wage worker. As with productivity, these measures are not available for individual workers, but rather on the firm level, i.e. the total wage bill for the firm and the total number of wage workers lead to the calculation of average wages.

3.3 Factors that may mediate the wage-productivity relationship

We are interested in understanding which deviations from perfectly competitive markets with full information drive any wage-productivity links. Therefore, we examine a number of different factors that could link wages and productivity based on sharing of rents in noncompetitive markets and efficiency wage hypotheses. To assess potentially non-competitive markets, we calculate concentration ratios (in percentage terms, based on the share of the four largest firms in the total value added of the relevant two-digit industry), along with the Herfindahl-Hirschman Index (scaled from 0, perfect competition, to 10,000, perfect monopoly). Firm size (categorically) and firm age (categorically)[11] are included as controls and may also indicate operation in less competitive markets. Firm formality (commercial registration, accounting books, or paying social insurance) and exporting may also be relevant covariates and are included in our estimation. Capital-intensive industries may be operating in less competitive markets due to high fixed costs creating barriers to entry or because of capital market imperfections. We therefore include capital per worker (in log form) as a measure of non-competitive markets. All of these measures are from the EC 2013 data. On the labor supply side of non-competitive markets, we include a measure from the ELMPS on unionization (percentage of workers in that region-activity cell that are unionized). Generally, we expect firms that operate in non-competitive markets to be more likely to engage in rent-sharing, and therefore expect to see stronger links between wages and productivity for these firms.

Since many of the efficiency wage explanations center around issues of incentives and monitoring or shirking, we merge data on the pay and incentive structure for workers in different

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estimated Cobb-Douglas or translog model. Essentially, the prediction from the model for log value added is subtracted from the observed value to generate the residual.

[11] There were 497 firms with their date of start "not stated" so we could not calculate their ages; we used the mean age of 11 years for these firms.

industries from the ELMPS 2012. The measures include the percentage of workers with piece-rate wages, the percentage of workers with incentive pay or bonuses, and the percentage of workers that have temporary contracts, permanent contracts or no contracts at all. Another aspect of incentives and monitoring is the legal structure of the firm, for which we use the classification provided in EC 2013: sole proprietorship (the reference category), joint stock company, limited liability company, partnership, limited partnership, and de facto company. We expect that legal forms where owners are strongly involved in running their firms to have a weaker relationship between wages and productivity. The nature of supervision, including the percentage of workers who are supervisors and the number of employees they supervise is also an important aspect of examining shirking and is incorporated from the ELMPS 2012 as well at the region/industry level. Generally, we expect that when effort cannot be observed perfectly, that is when supervisors have a large number of subordinates, incentives for greater productivity are necessary and there will be a stronger link between wages and productivity.

Since turnover, and the costs of retraining, are an important potential explanation for efficiency wages, we merge data at the industry/region level on mean tenure, that is length of employment in years (to date), as a measure of turnover. We also merge in data on the percentage of workers who undertake training, the length of training (in weeks), the percentage with training that is employer-provided, and the percentage with training that is paid for by the employer. Since the level of skill is likely to interact with these aspects to affect the costs of turnover, and also directly affect wages, we include several measures of skill. We calculate the percentage of workers in blue collar and white collar occupations (the omitted category being professionals), the percentage of workers reporting their job requires different education levels (basic, secondary, or higher education, with less than basic being omitted). We measure the percentage reporting specific skills required for jobs, such as literacy, math, computer, technical, and physical skills. We also incorporate average test scores of workers in standard preparatory (lower secondary) exams as a measure of worker quality. We expect that in industry/region cells where workers are more skilled, trained, or educated, turnover will be more expensive and therefore higher-productivity firms in these cells can and will pay efficiency wages to retain the best workers. All continuous explanatory variables are standardized (to a mean of zero and standard deviation of one) in order to estimate the main effects of productivity at mean levels and to facilitate comparisons of different factors.

4. Methods

We initially present a descriptive analysis of the patterns of productivity and wages, their dispersion, and their relationship across firms. Further, we examine how the productivity-wage relationship varies with firm characteristics, such as firm size, that have been identified in the literature as important mediators of the wage-productivity relationship.

Our multivariate analyses are based on OLS regressions with various measures of compensation as the dependent variable. The key explanatory variables are productivity, either average labor productivity (Y/L) or the Cobb-Douglas or translog TFP. Since TFP is itself estimated, we bootstrap the standard errors for our regression models (including for Y/L for comparability). We

present our models, below, for compensation as average wages and productivity as, generically, "TFP." The methods are identical for the various measures of compensation and productivity. Initially, we estimate a very simple model:

$$\ln(w_f) = \beta_0 + \beta_1 \text{TFP}_f + u_f \quad (1)$$

where w_f is the average wage per wage worker in firm *f*. Since *TFP* is productivity, β_1 is the relationship between wages and productivity. Specifically, $100*\beta_1$ is the percentage change in wages for a standard deviation increase in productivity. This coefficient answers our first research question: are wages related to productivity?

Our second research question investigates which firms have a particularly strong wage/productivity relationship. To answer this question, we add a series of controls (X_j) to our model and then interact these with productivity:

$$\ln(w_f) = \beta_0 + \beta_1 \text{TFP}_f + \sum_j \beta_j X_{jf} + \sum_j \delta_j X_{jf} * \text{TFP}_f + u_f \quad (2)$$

Now β_1 is the relationship between wages and productivity for the reference firm, β_j are the main effects of firm characteristics on wages, and δ_j are the coefficients on the interactions. These interactions provide critical tests of alternative hypotheses for divergence from classical labor market theory. For instance, if wages are more closely linked to productivity in high-supervision settings, this indicates an effort, shirking, or monitoring issue in the labor market. Alternatively, if there is a significant interaction between the concentration ratio and productivity, this suggests that a lack of competition and rent-sharing are driving wage formation.

It is important to note that all of these estimated relationships are associations. The direction of causality is unclear in our models. For example, it may be that non-competitive, higher productivity firms share their rents with workers. In such a case, causality would flow from productivity to wages. Alternatively, it may be that higher wages attract more skilled workers who are more productive. In such a case, causality would flow from wages to productivity. Or some third, unobserved characteristics of workers, perhaps some unobserved dimension of worker quality, may link the two measures. Although only associations can be observed, *which* associations hold—whether with measures of competitiveness, training, monitoring, or other aspects of workers—can shed light on the potential reasons for the departure from theoretical predictions.

5. Results

5.1 Relationship between compensation and productivity

In exploring the relationship between compensation and productivity, we first assess their relationship across the different compensation and productivity measures in Figure 1. Wages per worker clearly increase with value added per worker (productivity), at least up to a certain point, before leveling off at high levels of productivity, where wages are relatively constant. Essentially

the same pattern holds for all three measures of compensation. There are similar, although not identical, patterns by the different TFP measures. Both, but especially the more flexible translog model, show wages declining a bit at high productivity levels. This decline may be due to the particular combinations of labor and capital used in high-productivity firms. Hereafter, we present figures for our preferred measure of productivity, the translog TFP. The TFP measure of productivity is preferred because it has accounted for capital as well as labor (unlike value added per worker) and the translog specification is preferred for its additional flexibility, which improves model fit.

To assess the strength of the relationship between compensation and productivity, we estimate a model with only compensation and productivity measures (Equation (1)). Figure 2 shows the results of these models, in terms of the coefficients on productivity and their confidence intervals. All are significantly different from zero. Coefficients are largest for adjusted wages, indicating the strongest relationship. The coefficients for standardized log value added per worker all fall in the range of 0.315 to 0.350, meaning that a one standard deviation increase in productivity is associated with a 31.5-35.0% increase in compensation. The coefficients for the TFP measures fall between 0.286 and 0.301, meaning that a standard deviation increase in TFP is associated with a 28.6-30.1% increase in compensation. Overall, the results across measures of compensation are similar enough that, in what follows, we focus on results related to wages.

5.2 Relationship between compensation and productivity by potential mediators

Wages and productivity are clearly related, but why are they related? This section examines, descriptively, how firm and worker characteristics may mediate the link between wages and productivity. There is a varying relationship between firm formality and the link between wages and productivity (Figure 3). Both formal and informal private sector firms show an increase in wages with higher productivity. The slope is a little steeper in the informal sector, indicating a stronger link, for low to moderate productivity firms. It also appears to be particularly the informal sector where the highest productivity firms may pay lower wages.

Wages and productivity are similarly related regardless of firm age through the middle to high range of productivity, but show different relationships on the highest and middle to low ends, depending on firm age (Figure 4). It appears that younger firms have a stronger relationship between wages and productivity, and in particular pay more when they have higher productivity. Owners of newer firms may feel it is more critical to their success to share their profits or rents with their workers than owners of more established firms.

There are slightly different relationships between productivity and wages for larger firms (Figure 5). However, there are definitely different levels of wages related to firm size, with smaller firms paying less. Additionally, there are varying degrees to which the highest productivity firms start to pay lower wages; the dip at the high end increases as firm size decreases. Small, high-productivity firms may wish to retain more of their profits or rents for their owners.

5.3 Multivariate models of the relationship between compensation and productivity

Although we clearly observe a correlation between wages and productivity, this could be due to differential worker quality. To test this possibility, in Table 1 we present regressions for the

relationship between wages and productivity after accounting for worker composition. A number of worker characteristics are significant. However, the coefficient on productivity remains quite similar, in the 0.28-0.35 range, as in the bivariate Figure 2. Thus, the observed relationship is not driven by worker quality. We further add controls for firm characteristics in Table 2 (this now includes all our main effects). While many of the firm characteristics are significant, the coefficient on productivity remains large (0.27-0.29) and significant.

Hereafter, we focus our discussion primarily on the coefficients of the interaction terms between the productivity measure and various firm/industry characteristics to determine how the relationship between wages and productivity varies by firm characteristics. Since the results are generally similar for different measures of productivity (value added per worker, TFP using a Cobb-Douglas production function and TFP using a translog production function) and different measures of compensation (wages per worker, wages and benefits per worker, and formality adjusted wages per worker), we limit ourselves to discussing the results of the relationship between wages per worker and TFP: translog, mentioning when the results differ substantially across different specifications. The full regression results for all nine combinations of the different measures of compensation and productivity are shown in Table 3. We present the interactions of groups of coefficients for our preferred specification in figures. The main effect of productivity is 0.431 in the TFP: translog and wages specification; this means that for the reference firm, wages increase 43.1% when TFP increases by one standard deviation. This estimate is higher than for the simple correlation due the fact that our reference firm type (as defined by the omitted categories for each variable) has a stronger wage-productivity relationship than the average (as we show below).

Figure 6 shows that the link between wages and productivity is strongest for the youngest firms (0-3 years, the reference category). These firms pay lower wages, on average (main effect), but have a stronger link between wages and productivity than older firms (which have a negative interaction). Individuals in new ("start-up") firms may be incentivized or rewarded with higher wages for firm success. Second, we note that there is a significant negative (in some specifications, including our preferred specification) relationship between exporting and the wage-productivity nexus. This relationship may be because exporters are exposed to more competition. As suggested by the bivariate results, the relationship between wages and productivity is significantly weaker in formal firms compared to informal firms. This is somewhat surprising, since we would expect efficiency wages to be more likely within formal firms. However, it could be explained by the closer and more tight-knit social relations between owners and workers in informal firms, which could lead to more profit-sharing behavior on the part of owners.

As shown in Figure 7, the wage-productivity nexus's relationship with the degree of competition in an industry suggests potential rent sharing. For market power as measured by the concentration ratio of the top 4 firms, the interaction is positive but not significant. However, as measured by the Herfindahl-Hirschman index, greater market power is in fact associated with a (usually) significantly stronger relationship between wages and productivity. This suggests that

firms in less competitive industries tend to share their rents with their workers. Contrary to our expectations, more capital-intensive firms appear to find less necessity to link wages to productivity than more labor-intensive firms, although they do pay higher wages than labor-intensive firms at the mean (main effect, not shown). The desire to retain more of the benefits of higher productivity for the owners of the capital appears to trump any effects of reduced competition due to capital market imperfections. Finally, we find that workers in more unionized industries may be able to bargain for a greater degree of rent sharing; the link between wages and productivity is significantly stronger in industries with higher levels of unionization relative to less unionized industries. However, unionization does not appear to affect the levels of wages paid at the mean.

Figure 8 shows the degree to which the relationship between wages and productivity is associated with firm size. The relationship appears to be non-monotonic. The relationship starts by weakening as firm sizes grow from 0-3 to 7-9 employees (this is the only significant coefficient in our preferred specification), and then becoming stronger again with firm sizes beyond 10 employees. The largest firms, those with more than 1000 employees, have the strongest relationship between wages and productivity, but the relationship is measured somewhat imprecisely because of the relatively small number of these firms in the sample. In fact, the relationship for the largest firms becomes statistically indistinguishable from that of the smallest firms in most specifications.

An examination of the main effects of firm size on wages also reveals some non-monotonic patterns and patterns that vary somewhat by the measure of productivity used. Wages generally increase with size as we go from 0-3 employees to 8-10 employees and then start to decline somewhat for firms of 10-99 employees. The pattern for larger firms depends on which measure of productivity is used. When TFP is the productivity measure, the various measures of worker compensation are higher for larger firms, in fact the highest of any firm size category.

We now move to how the relationship between wages and productivity varies by the characteristics of the workforce. As mentioned earlier, these characteristics are measured at the region/industry cell level rather than at the firm level. As shown in Figure 9, wages are more strongly linked to productivity when the industry has a higher percentage of jobs that require a secondary education. Industries where workers have higher test scores have a weaker productivity-wage link. This is in some ways the opposite of an efficiency wage case, in that more skilled workers seem to face less variation in incentives, however, they may do sufficient quality work without financial incentives, after accounting for the education and skill requirements of their jobs. It is also possible that it is differences in ability across workers in the same firm or across workers in the same industry that matter more for efficiency wages rather than the inter-industry differences in education or skills that we measure here.

There is no clear association between the wage-productivity nexus and other skill requirements of various industries, as shown in Figure 10. For instance, although a higher percentage of jobs requiring basic literacy is associated with a weaker relationship, a higher percentage of jobs requiring physical skills or computer skills is associated with a stronger relationship, controlling

for education requirements. Occupations are not associated with differential linkages between wages and productivity.

Figure 11 summarizes the results relating to differences in the wage-productivity nexus by variations across industries in training and experience. Neither affects the wage-productivity relationships. These results do not support a wage-productivity link due to the labor turnover model, where high-productivity employers pay efficiency wages to reduce labor turnover when that turnover is costly to employers. However, the main effects indicate employers pay their employees more when they pay for training and when mean tenure is longer, which suggest that labor turnover may be a factor in wage-setting overall, but not one relating wages and productivity.

Figure 12 presents results relating to performance-linked payment systems, contractual relationships, and supervisory systems, on the one hand, and the wage-productivity nexus on the other. Some of the payment systems (paid by piece and paid incentives) are significantly and negatively related to the wage-productivity nexus in some specifications, suggesting that incentive and monitoring dimensions of the efficiency wage hypothesis may contribute to the relationship in Egypt. When more workers are paid by the piece, there is a negative and significant main effect, while a higher percentage of supervisors and permanent contracts have positive and significant main effects. The main effects of supervisors and contracts are suggestive of efficiency wages across the labor market, but not ones that link productivity and wages.

Figure 13 presents results relating to the association between a firm's legal structure and the wage-productivity nexus. Our expectation was that legal structures where owners have a stronger role in running their firms would have a weaker relationship between wages and productivity. This expectation is borne out by the data only for partnerships, which exhibit a significantly weaker link between wages and productivity than sole proprietorships (in some specifications).

6. Discussion and Conclusions

Our results indicate that there is indeed a strong positive relationship between worker compensation and productivity in the Egyptian private sector. This is a clear deviation from the classical labor market model, which predicts that all firms should equalize compensation for workers of similar quality. At higher levels of productivity, the relationship between compensation and productivity tapers off, and, with some measures of productivity, such as TFP, it actually eventually turns negative. The majority of our analysis was dedicated to examining which firm characteristics are associated with a strong or weak wage-productivity nexus and how consistent these relationships are with either efficiency-wage theory or the theory of non-competitive markets, the two main theoretical approaches that predict a positive wage-productivity nexus.

We find that recently established firms have a stronger wage-productivity nexus. This is consistent with efficiency wage theory that suggest that in situations where worker effort is not easily observed, employers may wish to pay higher than market clearing wage to incentivize effort. Newer firms may neither have well-established supervisory lines of authority nor standard

operating procedures to observe effort and would clearly want to incentivize employees to contribute to the success and growth of the firm by setting up reward systems that tie pay to firm performance. With regard to the main effect of firm age on wages, we find that older firms tend to generally pay higher wages. This pattern suggests that workers in low-productivity newer firms incur some kind of wage penalty.

We also find that mid-sized firms have a weaker wage-productivity relationship. This is also consistent with less developed supervisory structures in small firms and the difficulty of observing effort and thus the need to use efficiency wages to incentivize effort in larger firms. With regard to the main effect of size on wages, we find that wages generally increase with firm size.

Our findings also indicate that firms in less competitive industries, as indicated by the Herfindahl-Hirschman Index, have a stronger wage productivity nexus, as do firms in industries with a higher share of unionized workers. These findings are consistent with rent-sharing theories of wage setting. When market rents exist because of restrictions in competition, owners may share some of these rents with their workers and unions may negotiate for more profits. However, we also find that capital-intensive firms have a weaker wage-productivity nexus, suggesting that when higher productivity is due to capital investments, there is less tendency to share rents.

When it comes to the characteristics of the workforce, there are not clear patterns across measures relating worker quality, training, monitoring, or worker incentives to the wage-productivity relationship. However, some of these factors are directly related to wages possibly capturing heterogeneity in worker quality across industries. For example, we find that the percentages of jobs requiring the use of computers, requiring physical fitness, requiring technical skills, and with higher average worker tenure are positively associated with higher wages. Paradoxically, we find that industries that have higher proportions of white and blue collar workers relative to professional and managerial workers also have higher wages. We also find that industries that make use of more employer-paid training have higher wages, which is consistent with the payment of efficiency wages to reduce worker turnover. Finally, a higher proportion of supervisors is associated with higher wages. This suggests that activities where it is hard to observe worker effort make use of more supervisors as well as efficiency wage to incentivize effort.

Our results are therefore broadly consistent with models that predict the payment of efficiency wages when effort is imperfectly observable or when employers have an incentive to reduce labor turnover. Such factors, however, do not seem closely related to the link between wages and productivity. Our results on mediators for wage-productivity links are consistent with models of imperfect competition, when generated rents (higher "productivity") may be shared with workers. One somewhat unexpected finding is that formal firms are less likely to use efficiency wages than informal firms. In theory, informal firms face greater flexibility in terms of hiring and firing. They should be better able to discipline workers who exert low effort and may therefore not need to link pay and productivity. In contrast, formal firms that are more likely to hire workers

formally have less flexibility in hiring and firing and would therefore have greater incentive to link pay to productivity to reduce shirking. We do not find evidence in favor of these patterns in either the formality status of firms or the prevalence of formal employment contracts in the industry. One reason informal firms may have a stronger link between wages and productivity is the fact that owners and workers in informal firms are more likely to be connected by strong social ties based on kinship and co-residence; ties that may foster greater sharing of risks and rewards.

A potential limitation of our results is our inability to properly correct for worker quality across different kinds of firms due to the limited information we have about workers in this firm-level data. We have attempted to partially address this by correcting for industry-region level worker characteristics, but this is admittedly not enough if there is sorting of higher quality workers to more productive firms within an industry. The main way to properly control for worker quality is to have linked firm-worker data, which is still rather far-off in Egypt.

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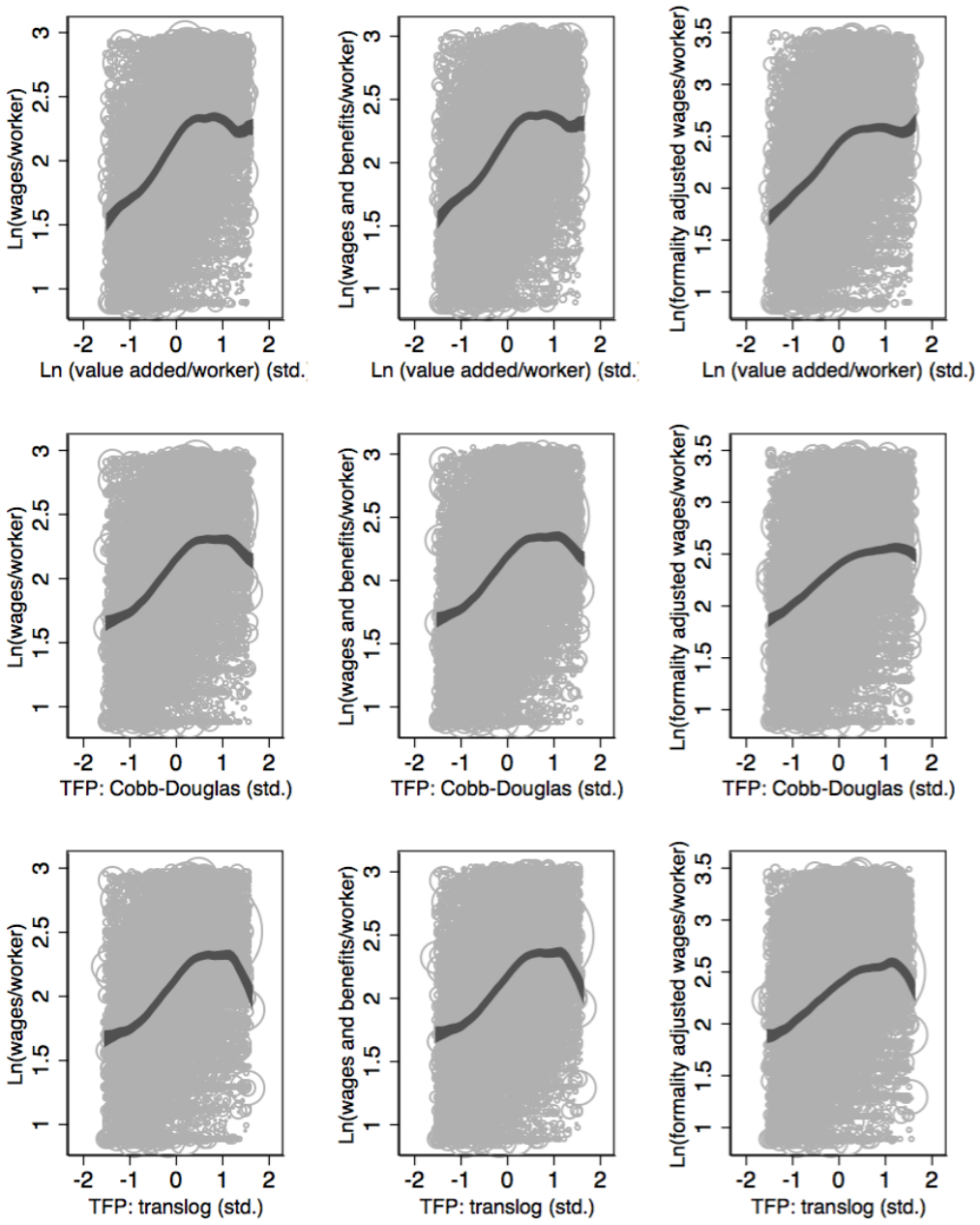
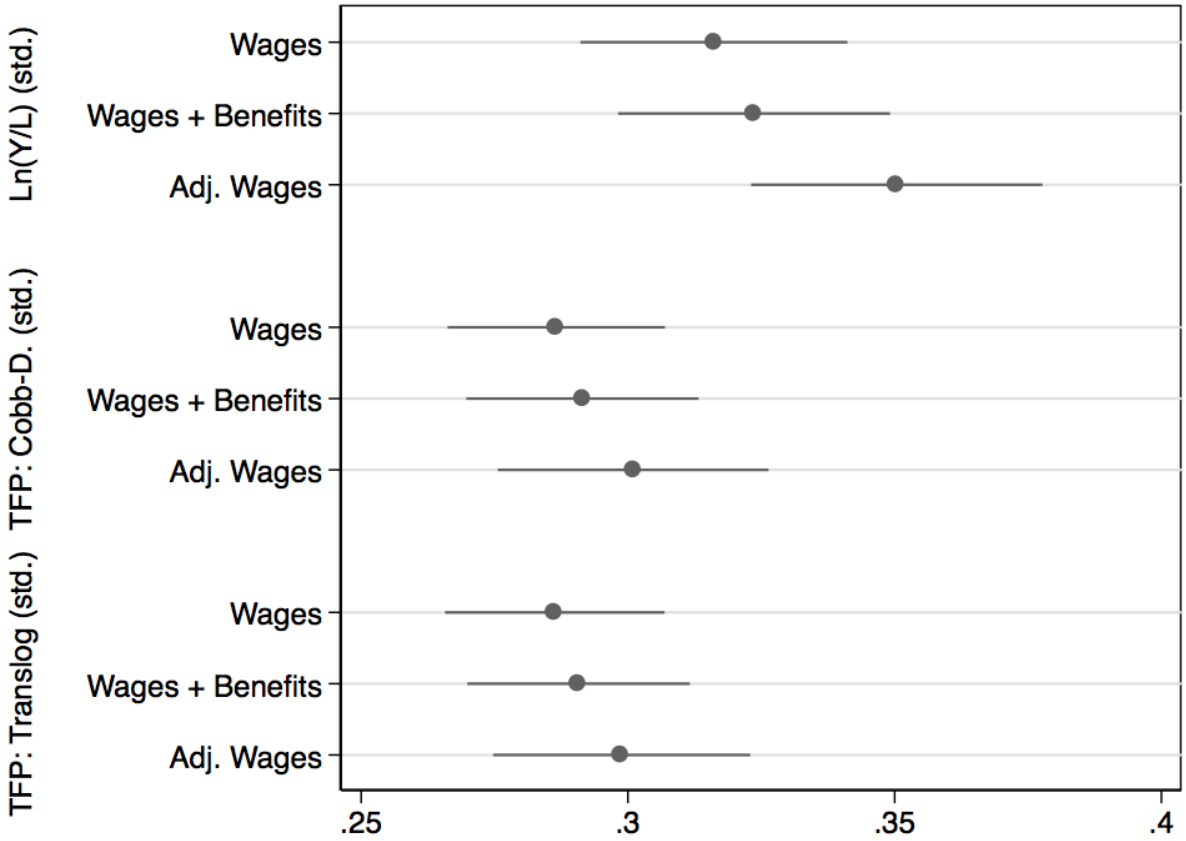
Figure 1. Relationship between compensation and productivity, by measures of compensation and productivity



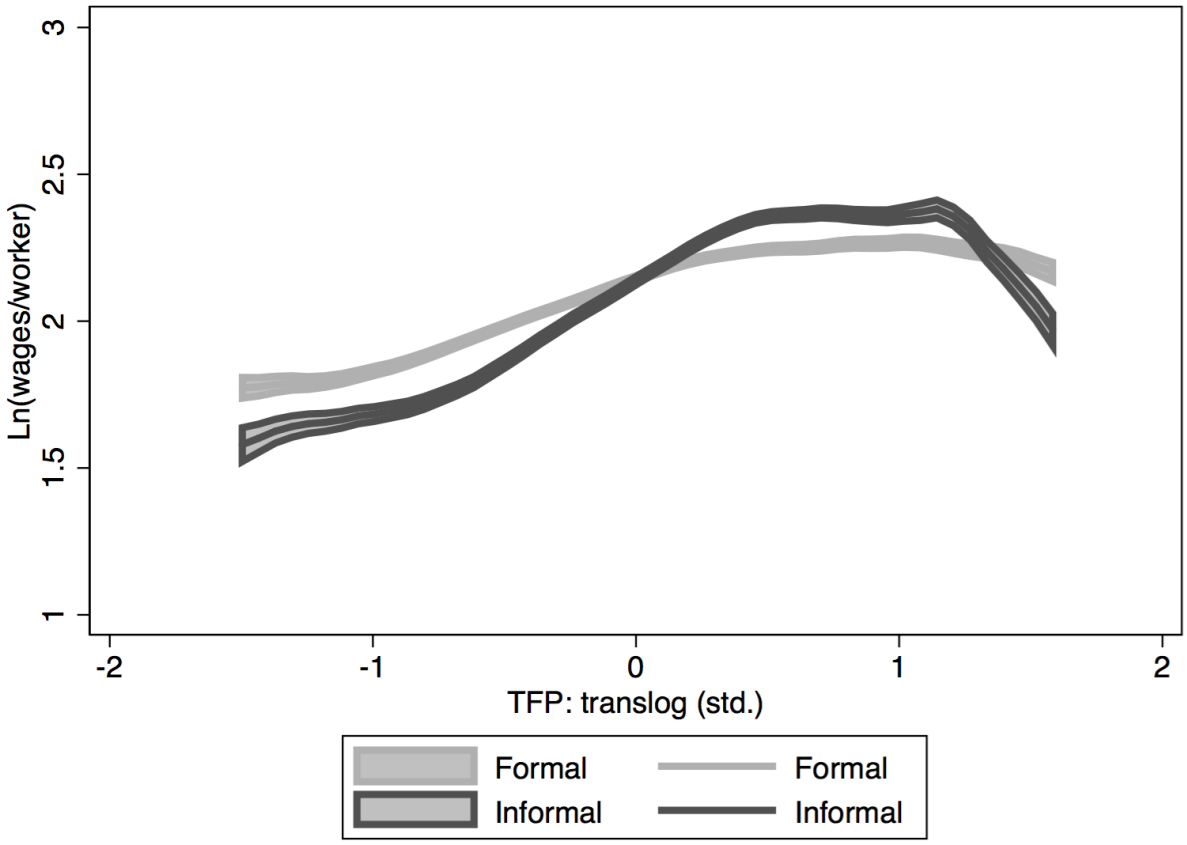
Source: Authors calculations based on EC 2013
Notes: Lines denote local polynomial and 95% confidence interval. Data visualization restricted to 5th-95th percentile of distribution for each variable.

Figure 2. Coefficients and 95% confidence intervals for models containing only measures of compensation and productivity



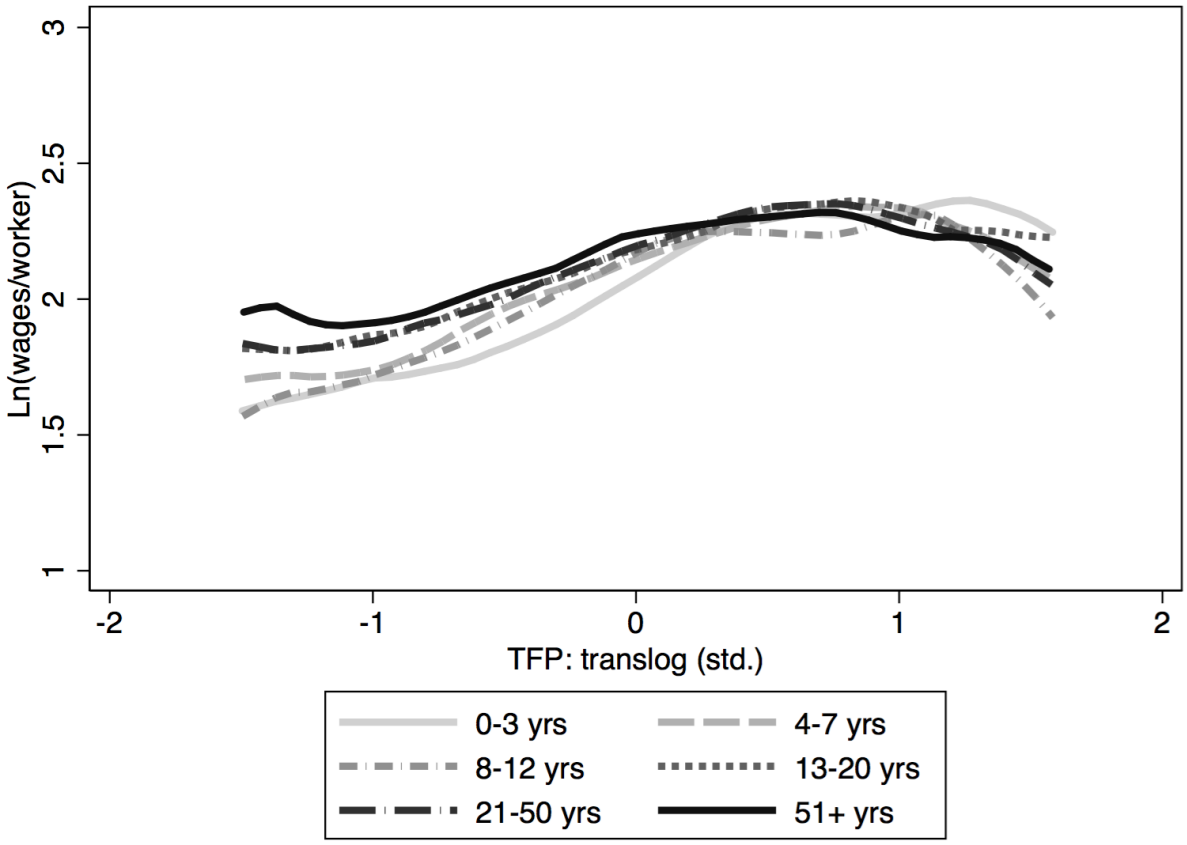
Source: Authors calculations based on EC 2013
Notes: Lines denote 95% confidence intervals from bootstrapped standard errors

Figure 3. Wages and productivity (TFP: translog) by firm formality



Source: Authors calculations based on EC 2013
Notes: Lines denote local polynomial and 95% confidence interval. Data visualization restricted to 5th-95th percentile of distribution.

Figure 4. Wages and productivity (TFP: translog) by firm age



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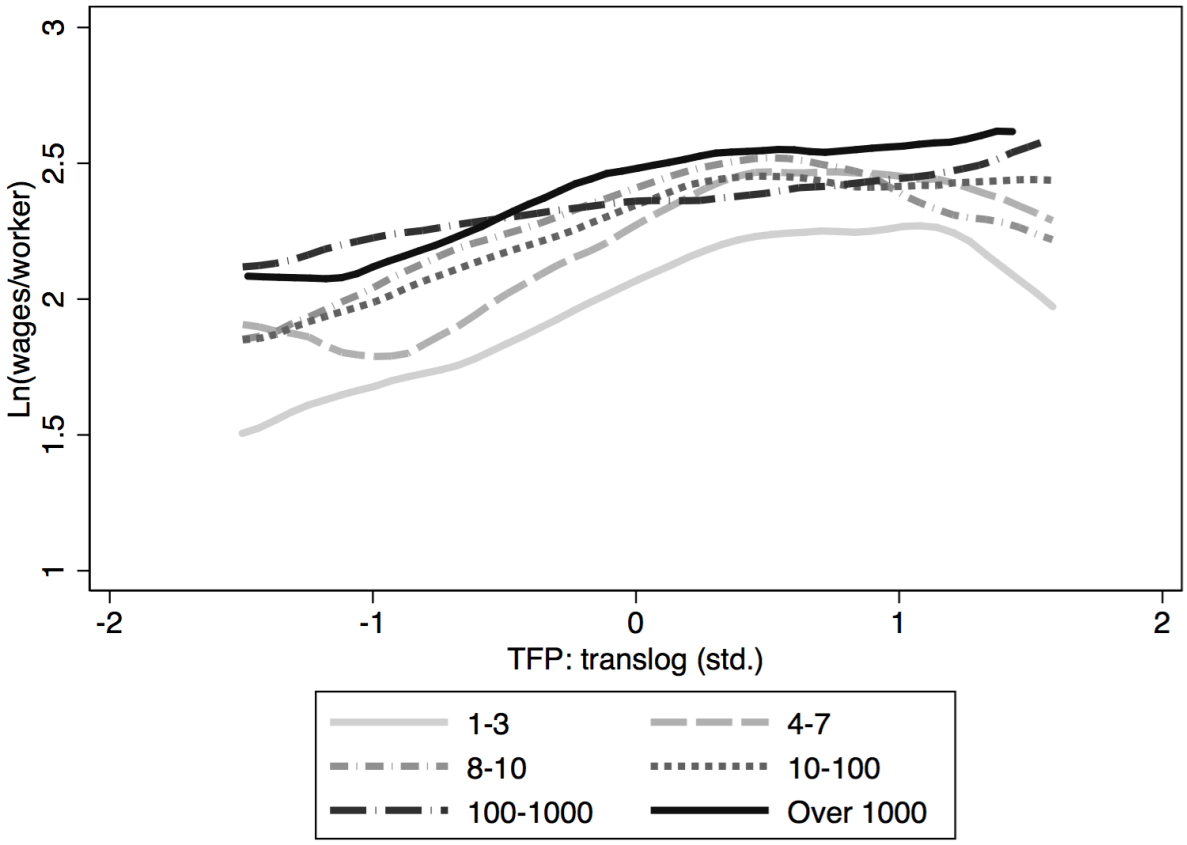
Notes: Lines denote local polynomial. Data visualization restricted to 5th-95th percentile of distribution.

Figure 5. Wages and productivity (TFP: translog) by firm size



Source: Authors calculations based on EC 2013
Notes: Lines denote local polynomial. Data visualization restricted to 5th-95th percentile of distribution.

Figure 6. Firm age, exporting, sector, and formality: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.

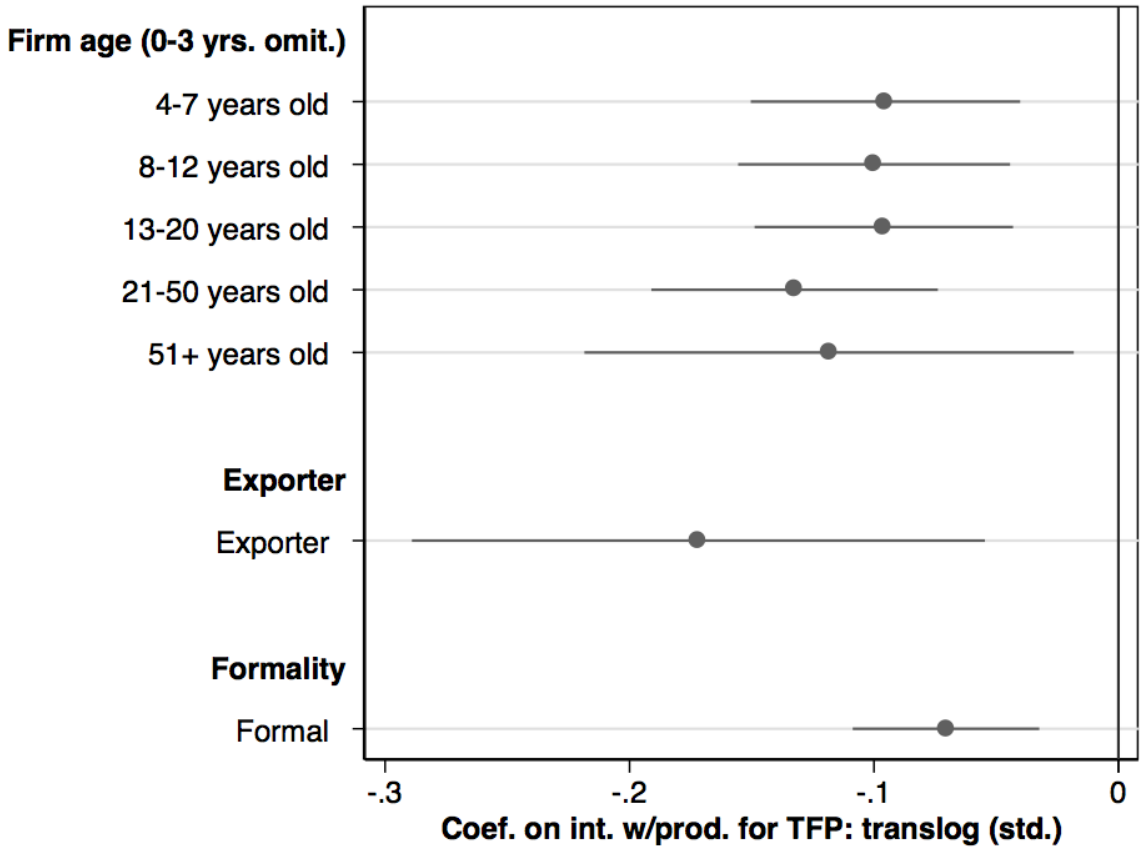


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Figure 7. Competition and capital intensity: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.

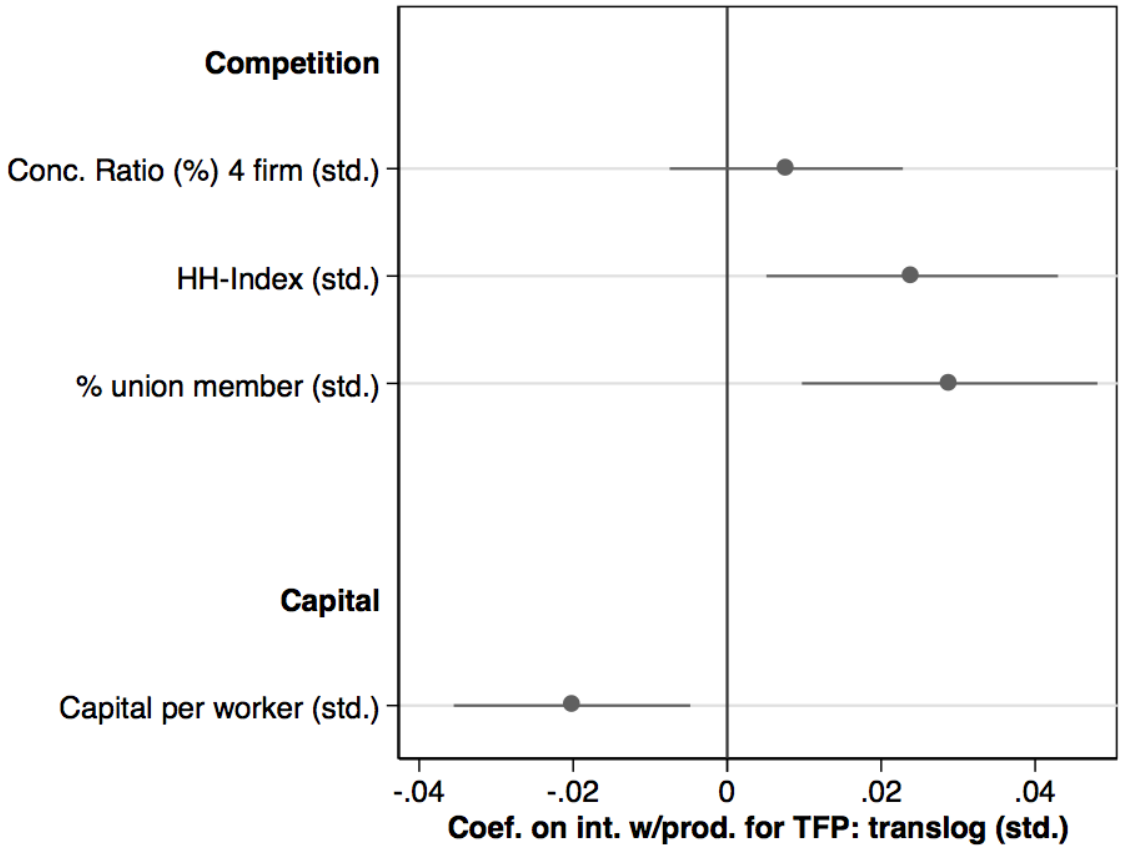

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Figure 8. Firm size: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.

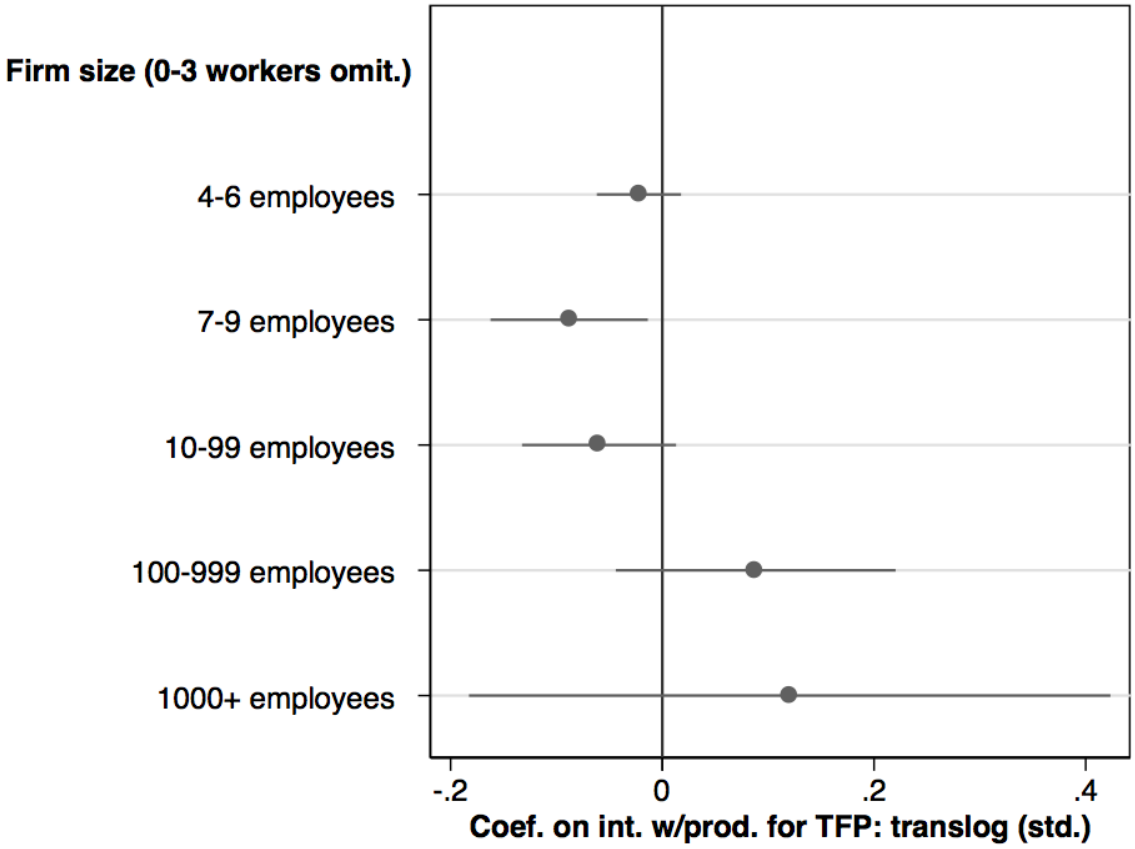

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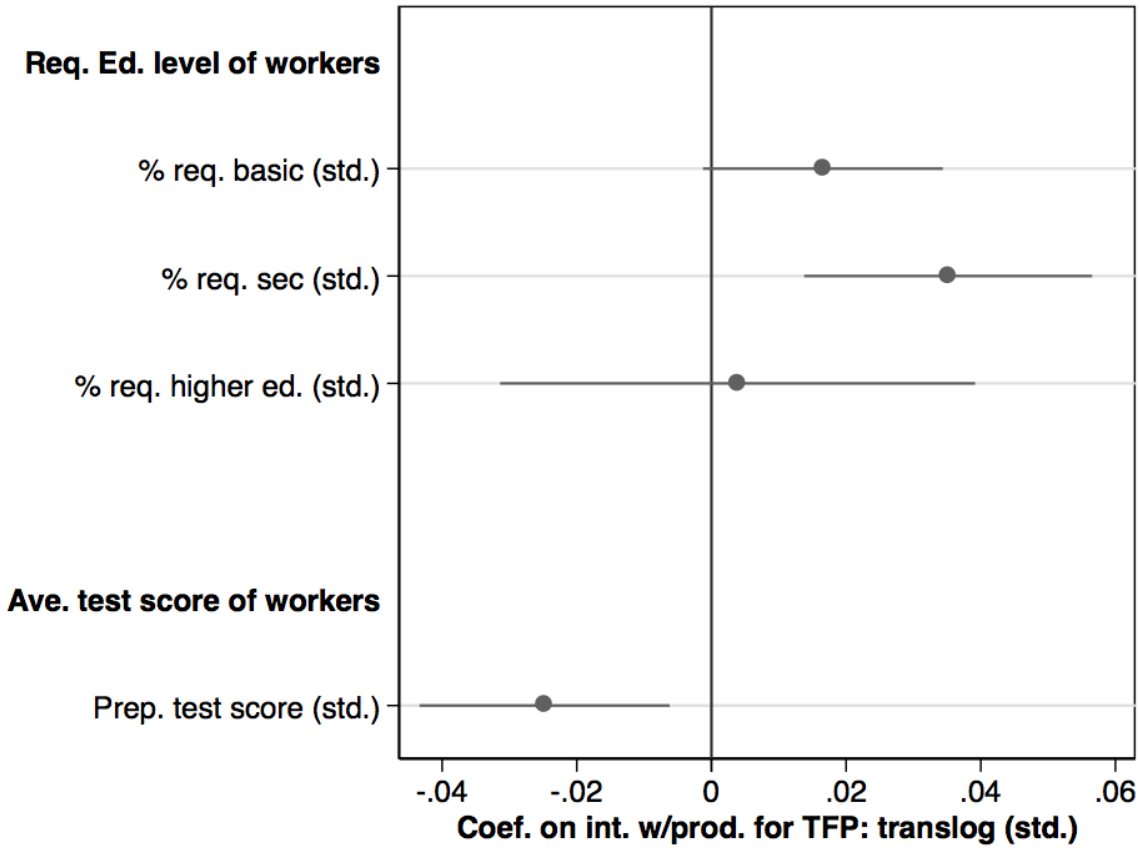
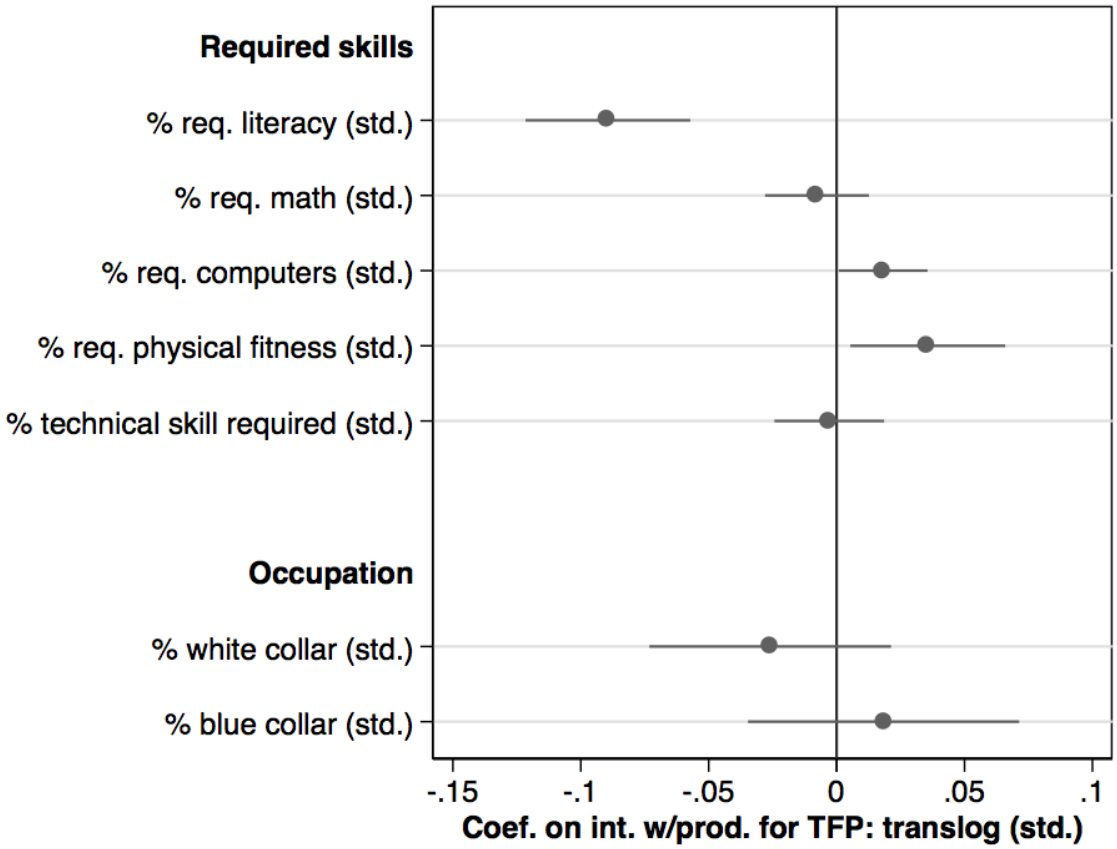
Figure 9. Worker education requirements and test scores: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.



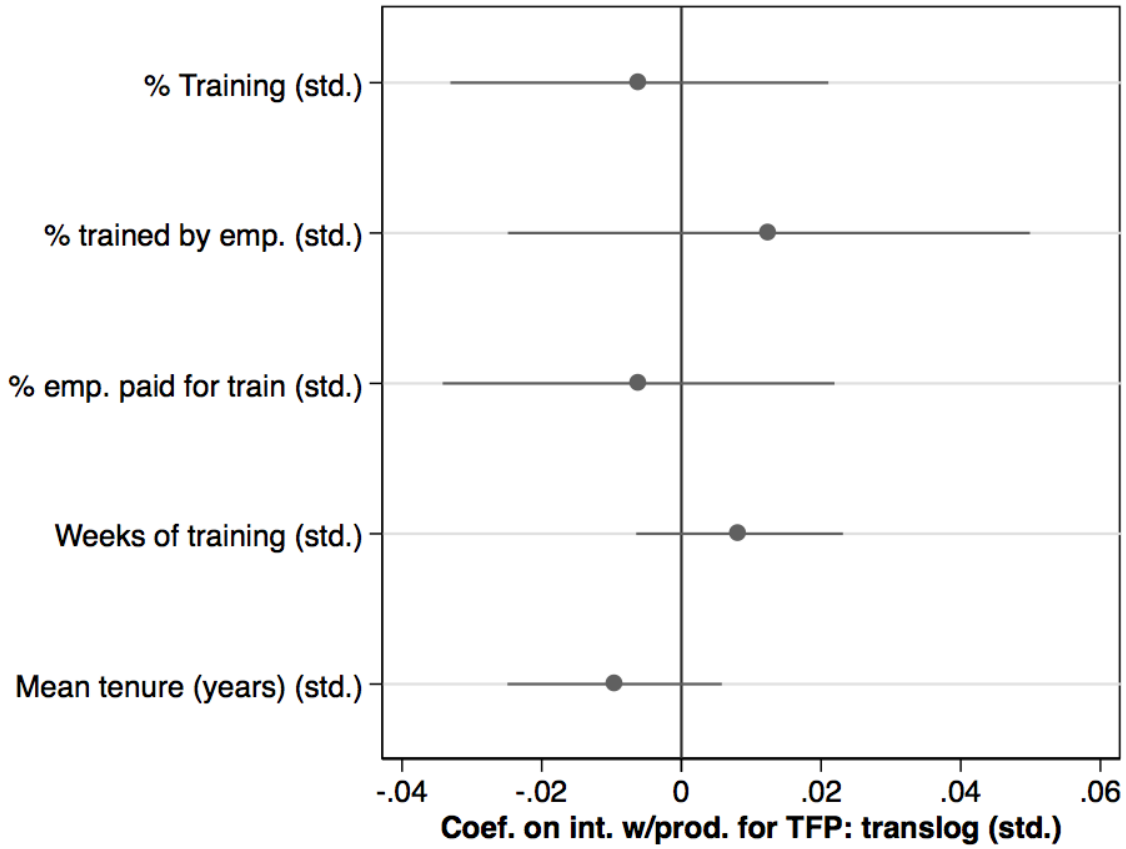
Source: Authors calculations based on EC 2013
Notes: Lines denote 95% confidence intervals

Figure 10. Worker skills and occupation: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.



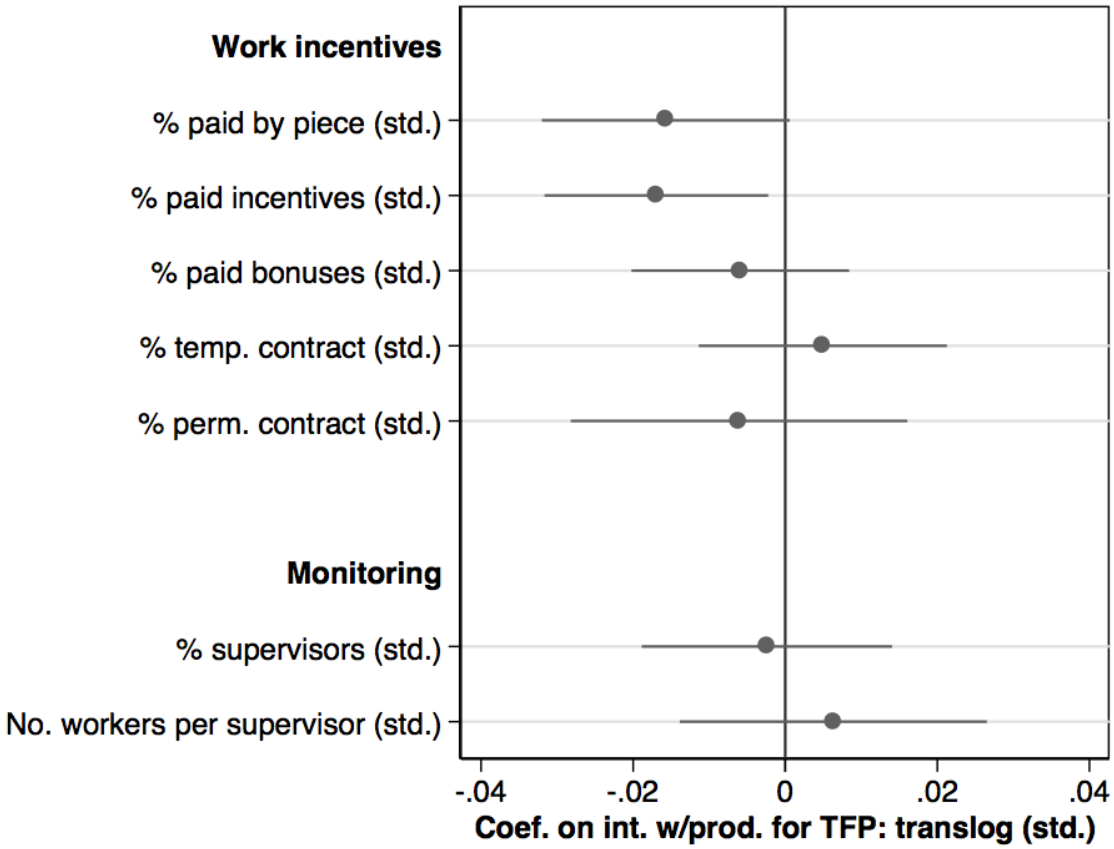
Source: Authors calculations based on EC 2013
Notes: Lines denote 95% confidence intervals

Figure 11. Worker training and experience: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.



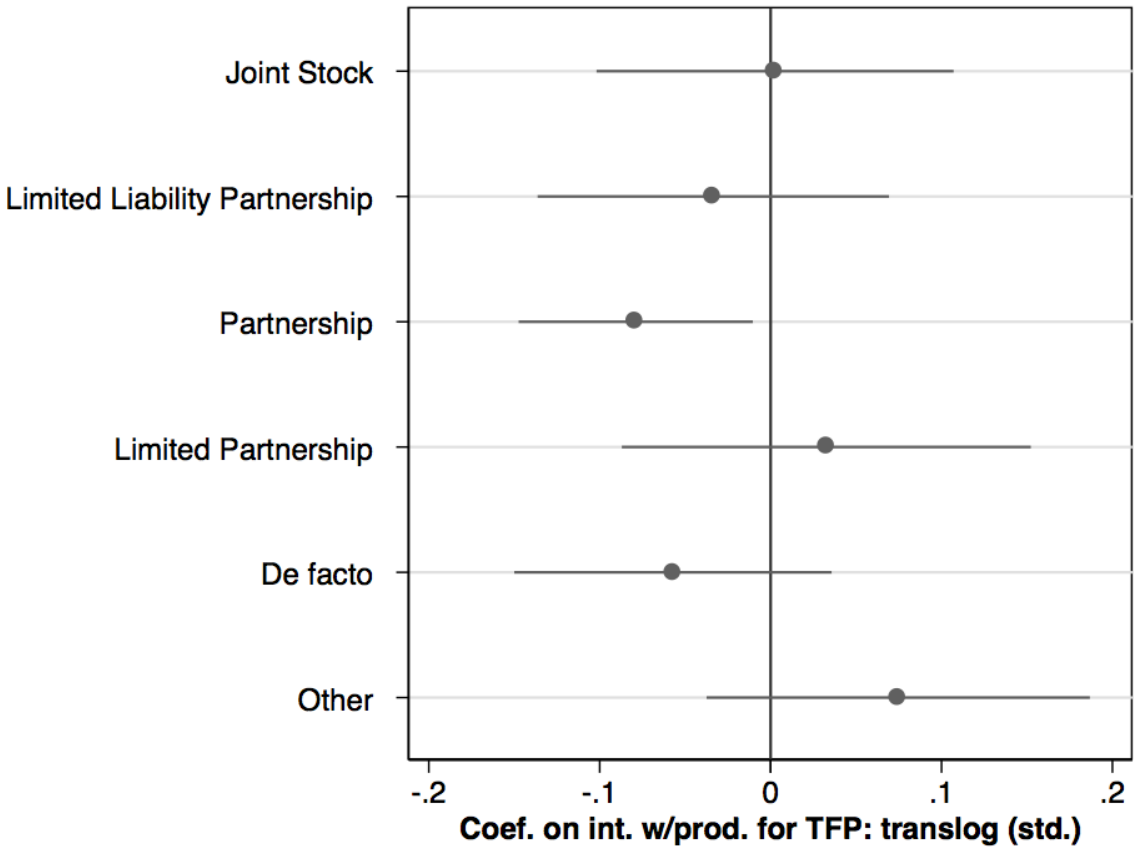
Source: Authors calculations based on EC 2013
Notes: Lines denote 95% confidence intervals

Figure 12. Worker incentives and supervision: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.



Source: Authors calculations based on EC 2013
Notes: Lines denote 95% confidence intervals

Figure 13. Firm legal structure: Coefficients of interaction terms with productivity and 95% confidence intervals for model using TFP: translog as a measure of productivity.



Source: Authors calculations based on EC 2013
Notes: Lines denote 95% confidence intervals

Appendix; Regression models

Table 1. Regressions with worker quality main effects only

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L) (std.)	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**
Productivity	0.314***	0.285***	0.284***	0.321***	0.289***	0.288***	0.347***	0.298***	0.296***
	(0.012)	(0.011)	(0.010)	(0.012)	(0.010)	(0.010)	(0.014)	(0.013)	(0.012)
% req. literacy (std.)	0.020	0.025	0.024	0.020	0.025	0.024	0.014	0.022	0.021
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.019)	(0.019)	(0.019)
% req. math (std.)	-0.063***	-0.069***	-0.069***	-0.059***	-0.065***	-0.064***	-0.037***	-0.043***	-0.042***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.011)	(0.012)	(0.011)
% req. computers (std.)	0.019*	0.019*	0.020*	0.019*	0.020*	0.020*	0.024**	0.025**	0.025**
	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
% req. physical fitness (std.)	0.051***	0.056***	0.057***	0.053***	0.058***	0.059***	0.067***	0.074***	0.075***
	(0.011)	(0.011)	(0.013)	(0.011)	(0.012)	(0.013)	(0.014)	(0.015)	(0.016)
% technical skill required (std.)	0.079***	0.080***	0.078***	0.074***	0.074***	0.073***	0.047***	0.048***	0.046***
	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)
Job ed. req. (% less than basic omit.)									
% req. basic (std.)	0.021*	0.021*	0.021*	0.022*	0.021*	0.021*	0.009	0.008	0.008
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.011)	(0.010)	(0.010)
% req. sec (std.)	-0.002	0.002	0.002	0.000	0.004	0.004	-0.007	-0.003	-0.003
	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)	(0.013)	(0.013)	(0.013)
% req. higher ed. (std.)	-0.035*	-0.032*	-0.033*	-0.034*	-0.031	-0.031	-0.044*	-0.042*	-0.043*
	(0.016)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.019)	(0.020)	(0.020)
Prep. test score (std.)	-0.035***	-0.036***	-0.035***	-0.035***	-0.036***	-0.035***	-0.043***	-0.044***	-0.043***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)
% Training (std.)	0.004	0.010	0.011	0.006	0.012	0.013	0.023*	0.030*	0.030*
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.012)	(0.012)
Weeks of training (std.)	-0.009	-0.013	-0.013	-0.009	-0.014*	-0.014*	-0.016*	-0.022**	-0.022**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Mean tenure (years) (std.)	0.049***	0.054***	0.055***	0.052***	0.057***	0.058***	0.069***	0.075***	0.076***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)	(0.009)

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L) (std.)	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**
Constant	2.074***	2.074***	2.074***	2.117***	2.117***	2.117***	2.344***	2.344***	2.344***
	(0.008)	(0.010)	(0.010)	(0.008)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)
N (observations)	40550	40550	40550	40550	40550	40550	40550	40550	40550
R-squared	0.273	0.234	0.233	0.282	0.239	0.238	0.241	0.187	0.185

Notes: *p<0.05; **p<0.01; ***p<0.001

Bootstrapped standard errors (500 repetitions) in parentheses

Table 2. Regressions with worker quality and firm characteristics main effects only

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L) (std.)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L) (std.)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L) (std.)	TFP: Cobb-Douglas	TFP: Translog
Productivity	0.285***	0.272***	0.271***	0.288***	0.275***	0.274***	0.285***	0.272***	0.270***
	(0.012)	(0.010)	(0.010)	(0.012)	(0.010)	(0.010)	(0.013)	(0.012)	(0.011)
Firm size (1-3 omit.)									
4-6 employees	0.161***	0.195***	0.188***	0.155***	0.189***	0.181***	0.157***	0.192***	0.184***
	(0.021)	(0.020)	(0.021)	(0.020)	(0.020)	(0.020)	(0.022)	(0.022)	(0.023)
7-9 employees	0.254***	0.314***	0.304***	0.241***	0.302***	0.291***	0.228***	0.289***	0.278***
	(0.035)	(0.035)	(0.034)	(0.035)	(0.033)	(0.032)	(0.037)	(0.038)	(0.037)
10-99 employees	0.117**	0.217***	0.209***	0.120**	0.221***	0.213***	0.136**	0.236***	0.228***
	(0.039)	(0.041)	(0.038)	(0.039)	(0.041)	(0.038)	(0.044)	(0.046)	(0.045)
100-999 employees	0.307***	0.529***	0.543***	0.360***	0.585***	0.598***	0.420***	0.641***	0.655***
	(0.090)	(0.096)	(0.112)	(0.087)	(0.094)	(0.104)	(0.096)	(0.097)	(0.111)
1000+ employees	0.646***	0.976***	0.984***	0.706***	1.040***	1.047***	0.755***	1.085***	1.092***
	(0.134)	(0.135)	(0.163)	(0.126)	(0.135)	(0.151)	(0.130)	(0.137)	(0.158)
Firm age (0-3 years omit.)									
4-7 years old	0.102***	0.103***	0.104***	0.102***	0.103***	0.103***	0.103***	0.104***	0.104***
	(0.021)	(0.020)	(0.023)	(0.021)	(0.022)	(0.022)	(0.024)	(0.022)	(0.022)
8-12 years old	0.055*	0.055*	0.057*	0.057*	0.057*	0.060*	0.069*	0.069*	0.072**
	(0.025)	(0.025)	(0.026)	(0.025)	(0.026)	(0.024)	(0.028)	(0.028)	(0.026)
13-20 years old	0.093***	0.093***	0.097***	0.092***	0.093***	0.097***	0.090***	0.091***	0.094***
	(0.026)	(0.023)	(0.025)	(0.025)	(0.025)	(0.023)	(0.026)	(0.026)	(0.025)
21-50 years old	0.101***	0.102***	0.105***	0.105***	0.106***	0.109***	0.114***	0.115***	0.118***
	(0.027)	(0.027)	(0.026)	(0.027)	(0.026)	(0.025)	(0.029)	(0.027)	(0.028)
51+ years old	0.126**	0.128**	0.133***	0.126**	0.127**	0.132**	0.147**	0.148**	0.153**
	(0.041)	(0.040)	(0.040)	(0.043)	(0.044)	(0.040)	(0.048)	(0.048)	(0.049)
Exporter	-0.013	0.015	0.064	-0.015	0.013	0.063	-0.040	-0.012	0.036
	(0.080)	(0.082)	(0.094)	(0.070)	(0.070)	(0.085)	(0.071)	(0.073)	(0.074)
Formal	-0.029	-0.027	-0.025	0.029	0.031	0.032*	0.539***	0.541***	0.543***
	(0.016)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)
Conc. Ratio (%) 4 firm (std.)	-0.040***	-0.040***	-0.039***	-0.040***	-0.040***	-0.039***	-0.040***	-0.040***	-0.039***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
HH-Index (std.)	-0.004	-0.004	-0.004	-0.002	-0.002	-0.002	-0.003	-0.003	-0.003
	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L) (std.)	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**
Capital per worker (std.)	0.017	0.079***	0.078***	0.018	0.081***	0.080***	0.022*	0.084***	0.083***
	(0.009)	(0.011)	(0.011)	(0.009)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)
% union member (std.)	-0.003	-0.002	-0.002	0.000	0.001	0.001	-0.000	0.000	0.000
	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.009)
% req. literacy (std.)	0.011	0.012	0.011	0.009	0.010	0.010	0.003	0.004	0.003
	(0.016)	(0.014)	(0.016)	(0.015)	(0.015)	(0.015)	(0.017)	(0.018)	(0.017)
% req. math (std.)	-0.050***	-0.050***	-0.050***	-0.047***	-0.047***	-0.047***	-0.036***	-0.037***	-0.036***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
% req. computers (std.)	0.027**	0.028**	0.028***	0.028***	0.028**	0.029***	0.028**	0.029**	0.029**
	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
% req. physical fitness (std.)	0.030**	0.031**	0.030*	0.031*	0.031**	0.031**	0.026*	0.026*	0.026*
	(0.011)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.013)
% technical skill required (std.)	0.070***	0.071***	0.069***	0.069***	0.070***	0.068***	0.072***	0.072***	0.071***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Job ed. req. (% less than basic omit.)									
% req. basic (std.)	0.012	0.012	0.011	0.013	0.013	0.012	0.007	0.007	0.006
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
% req. sec (std.)	-0.007	-0.007	-0.008	-0.005	-0.006	-0.006	-0.015	-0.015	-0.016
	(0.011)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.012)	(0.012)	(0.012)
% req. higher ed. (std.)	-0.005	-0.006	-0.005	-0.005	-0.005	-0.005	-0.018	-0.019	-0.019
	(0.017)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
Prep. test score (std.)	-0.027**	-0.028**	-0.027**	-0.026**	-0.026**	-0.026**	-0.027**	-0.028**	-0.027**
	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
Occup.: % prof./man. omit.									
% white collar (std.)	0.104***	0.103***	0.105***	0.109***	0.109***	0.111***	0.108***	0.108***	0.110***
	(0.022)	(0.023)	(0.023)	(0.024)	(0.023)	(0.023)	(0.024)	(0.023)	(0.023)
% blue collar (std.)	0.119***	0.120***	0.122***	0.122***	0.122***	0.124***	0.124***	0.125***	0.127***
	(0.022)	(0.023)	(0.023)	(0.023)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
% Training (std.)	-0.001	-0.001	-0.001	-0.001	-0.000	-0.001	0.003	0.004	0.003
	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
% trained by emp. (std.)	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.006	-0.007	-0.007
	(0.015)	(0.014)	(0.013)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
% emp. paid for train (std.)	0.020	0.020	0.021	0.021	0.021	0.021	0.016	0.016	0.017

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L) (std.)	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**
	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)	(0.013)
Weeks of training (std.)	0.005	0.005	0.005	0.005	0.005	0.005	0.008	0.008	0.008
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Mean tenure (years) (std.)	0.033***	0.033***	0.034***	0.035***	0.035***	0.036***	0.035***	0.035***	0.036***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)
% paid by piece (std.)	-0.016*	-0.016*	-0.015*	-0.018**	-0.018**	-0.017**	-0.019**	-0.019**	-0.018**
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
% paid incentives (std.)	-0.014*	-0.014*	-0.015*	-0.013	-0.013*	-0.013*	-0.008	-0.008	-0.009
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
% paid bonuses (std.)	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
% temp. contract (std.)	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	-0.000
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
% perm. contract (std.)	0.040***	0.041***	0.043***	0.037***	0.037***	0.039***	0.040***	0.040***	0.042***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
Legal status (sole prop. omit)									
Joint Stock	0.247***	0.263***	0.308***	0.262***	0.278***	0.323***	0.220**	0.236**	0.281***
	(0.071)	(0.069)	(0.067)	(0.068)	(0.070)	(0.069)	(0.071)	(0.075)	(0.079)
Limited Liability Partnership	0.025	0.032	0.041	0.044	0.052	0.061	-0.048	-0.040	-0.031
	(0.081)	(0.077)	(0.076)	(0.077)	(0.081)	(0.081)	(0.086)	(0.086)	(0.086)
Partnership	0.061*	0.065*	0.064*	0.066*	0.071*	0.070*	0.059	0.064	0.063*
	(0.031)	(0.031)	(0.030)	(0.031)	(0.029)	(0.030)	(0.034)	(0.033)	(0.031)
Limited Partnership	-0.052	-0.043	-0.042	-0.028	-0.018	-0.018	-0.063	-0.054	-0.053
	(0.070)	(0.067)	(0.071)	(0.066)	(0.065)	(0.065)	(0.070)	(0.074)	(0.072)
De facto	0.053	0.053	0.050	0.049	0.049	0.046	0.044	0.045	0.042
	(0.038)	(0.039)	(0.036)	(0.040)	(0.037)	(0.039)	(0.043)	(0.043)	(0.037)
Other	-0.117	-0.113	-0.110	-0.108	-0.105	-0.102	-0.223**	-0.220**	-0.217**
	(0.069)	(0.066)	(0.076)	(0.069)	(0.069)	(0.075)	(0.074)	(0.080)	(0.084)
% supervisors (std.)	0.034***	0.034***	0.033***	0.034***	0.034***	0.034***	0.029***	0.029***	0.028***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
No. workers per supervisor (std.)	0.008	0.008	0.009	0.010	0.011	0.011	0.014	0.014	0.015
	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Constant	1.953***	1.932***	1.932***	1.969***	1.947***	1.947***	1.953***	1.932***	1.931***

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L) (std.)	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**	**ln (Y/L) (std.)**	**TFP: Cobb-Douglas**	**TFP: Translog**
	(0.018)	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.020)	(0.019)	(0.020)
N	40550	40550	40550	40550	40550	40550	40550	40550	40550
R-squared	0.313	0.310	0.309	0.326	0.323	0.322	0.423	0.420	0.419

Notes: *p<0.05; **p<0.01; ***p<0.001
Bootstrapped standard errors (500 repetitions) in parentheses

Table 3. Full regression models (main effects and interactions)

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog
Productivity main effect	0.450***	0.433***	0.431***	0.455***	0.438***	0.436***	0.442***	0.427***	0.426***
	(0.021)	(0.023)	(0.023)	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)	(0.023)
Interactions with productivity									
Firm size (1-3 omit.)									
4-6 employees	-0.024	-0.025	-0.022	-0.028	-0.028	-0.025	-0.031	-0.032	-0.030
	(0.021)	(0.022)	(0.020)	(0.022)	(0.021)	(0.021)	(0.023)	(0.024)	(0.024)
7-9 employees	-0.098*	-0.096*	-0.088*	-0.096*	-0.093*	-0.085*	-0.099*	-0.097*	-0.088*
	(0.040)	(0.037)	(0.038)	(0.039)	(0.038)	(0.040)	(0.042)	(0.040)	(0.043)
10-99 employees	-0.068	-0.070	-0.060	-0.068	-0.070	-0.060	-0.070	-0.075	-0.064
	(0.037)	(0.037)	(0.037)	(0.038)	(0.037)	(0.037)	(0.044)	(0.044)	(0.041)
100-1000 employees	0.073	0.053	0.088	0.088	0.071	0.106	0.085	0.066	0.106
	(0.060)	(0.061)	(0.067)	(0.060)	(0.057)	(0.061)	(0.066)	(0.063)	(0.071)
1000+ employees	0.247*	0.212	0.120	0.250*	0.217	0.126	0.255*	0.221	0.123
	(0.114)	(0.120)	(0.155)	(0.110)	(0.116)	(0.152)	(0.117)	(0.116)	(0.150)
Firm age (0-3 years omit.)									
4-7 years old	-0.088***	-0.092***	-0.095***	-0.088**	-0.093***	-0.096***	-0.089**	-0.094***	-0.097***
	(0.026)	(0.027)	(0.028)	(0.029)	(0.026)	(0.026)	(0.030)	(0.028)	(0.028)
8-12 years old	-0.094**	-0.099**	-0.100***	-0.092**	-0.098***	-0.099**	-0.078*	-0.085*	-0.087**
	(0.030)	(0.031)	(0.028)	(0.030)	(0.030)	(0.031)	(0.032)	(0.034)	(0.032)
12-20 years old	-0.095***	-0.091**	-0.096***	-0.097***	-0.094***	-0.098***	-0.082**	-0.081**	-0.086**
	(0.027)	(0.029)	(0.027)	(0.028)	(0.026)	(0.025)	(0.029)	(0.030)	(0.028)
21-50 years old	-0.143***	-0.132***	-0.132***	-0.144***	-0.135***	-0.136***	-0.129***	-0.122***	-0.124***
	(0.030)	(0.030)	(0.030)	(0.031)	(0.030)	(0.029)	(0.034)	(0.033)	(0.032)
51+ years old	-0.126*	-0.118*	-0.118*	-0.124*	-0.120*	-0.122*	-0.121*	-0.111*	-0.112*
	(0.050)	(0.051)	(0.051)	(0.050)	(0.049)	(0.052)	(0.052)	(0.052)	(0.055)
Exporter	-0.038	-0.081	-0.172**	-0.042	-0.073	-0.152**	-0.099	-0.120*	-0.170**
	(0.080)	(0.070)	(0.060)	(0.071)	(0.062)	(0.058)	(0.060)	(0.058)	(0.059)
Formal	-0.075***	-0.068***	-0.071***	-0.077***	-0.070***	-0.072***	-0.076***	-0.070***	-0.072***
	(0.019)	(0.020)	(0.019)	(0.021)	(0.019)	(0.021)	(0.022)	(0.021)	(0.021)

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog
Conc. Ratio (%) 4 firm (std.)	0.006	0.010	0.008	0.008	0.011	0.009	0.009	0.012	0.010
	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)
HH-Index (std.)	0.021*	0.022*	0.024*	0.022*	0.023*	0.025*	0.020*	0.019	0.022*
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)	(0.010)
Ln(K/L) (std.)	-0.027***	-0.025***	-0.020*	-0.027***	-0.026***	-0.021**	-0.033***	-0.031***	-0.027**
	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
% union member (std.)	0.032**	0.031**	0.029**	0.033***	0.033***	0.031**	0.029**	0.028**	0.026*
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
% req. literacy (std.)	-0.097***	-0.093***	-0.089***	-0.101***	-0.097***	-0.093***	-0.103***	-0.098***	-0.093***
	(0.018)	(0.018)	(0.016)	(0.019)	(0.018)	(0.017)	(0.022)	(0.021)	(0.021)
% req. math (std.)	-0.001	-0.008	-0.008	0.000	-0.005	-0.005	-0.008	-0.015	-0.015
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
% req. computers (std.)	0.019*	0.018*	0.018*	0.020*	0.018*	0.019*	0.024*	0.022*	0.024*
	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
% req. physical fitness (std.)	0.033*	0.033*	0.036*	0.031*	0.031*	0.034*	0.037*	0.035*	0.039*
	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.016)	(0.015)	(0.015)	(0.017)
% technical skill required (std.)	0.001	0.000	-0.003	-0.001	-0.001	-0.004	-0.004	-0.005	-0.009
	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)
Job ed. req. (% less than basic omit.)									
% req. basic (std.)	0.014	0.017	0.017	0.017	0.020*	0.019*	0.017	0.020	0.019
	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)	(0.012)	(0.011)	(0.011)
% req. sec (std.)	0.035**	0.036**	0.035**	0.039**	0.039**	0.039***	0.041**	0.043**	0.042**
	(0.012)	(0.012)	(0.011)	(0.013)	(0.012)	(0.012)	(0.015)	(0.014)	(0.015)
% req. higher ed. (std.)	0.021	0.009	0.004	0.025	0.013	0.008	0.026	0.016	0.010
	(0.018)	(0.020)	(0.018)	(0.019)	(0.017)	(0.018)	(0.021)	(0.020)	(0.020)
Prep. test score (std.)	-0.024**	-0.027**	-0.025**	-0.023**	-0.028**	-0.025**	-0.021*	-0.025**	-0.022*
	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
Occup.: % prof./man. omit.									
% white collar (std.)	-0.021	-0.024	-0.026	-0.022	-0.024	-0.025	-0.022	-0.027	-0.027

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog
	(0.024)	(0.024)	(0.024)	(0.024)	(0.022)	(0.024)	(0.026)	(0.025)	(0.025)
% blue collar (std.)	0.016	0.019	0.018	0.012	0.017	0.017	0.012	0.014	0.015
	(0.028)	(0.026)	(0.027)	(0.027)	(0.024)	(0.027)	(0.029)	(0.027)	(0.029)
% training (std.)	-0.013	-0.005	-0.006	-0.009	-0.002	-0.003	-0.013	-0.006	-0.007
	(0.013)	(0.013)	(0.014)	(0.013)	(0.012)	(0.012)	(0.014)	(0.015)	(0.015)
% trained by emp. (std.)	0.018	0.013	0.013	0.017	0.013	0.012	0.019	0.013	0.012
	(0.017)	(0.017)	(0.019)	(0.018)	(0.018)	(0.017)	(0.020)	(0.019)	(0.021)
% emp. paid for train (std.)	-0.006	-0.008	-0.006	-0.006	-0.007	-0.005	0.004	0.004	0.005
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.017)	(0.016)	(0.017)
Weeks of training (std.)	0.005	0.007	0.008	0.004	0.006	0.007	0.003	0.006	0.007
	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Mean tenure (years) (std.)	-0.011	-0.012	-0.010	-0.009	-0.011	-0.009	-0.009	-0.009	-0.007
	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
% paid by piece (std.)	-0.019*	-0.017*	-0.016	-0.018*	-0.016*	-0.015	-0.023**	-0.022**	-0.021*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
% paid incentives (std.)	-0.019**	-0.018*	-0.017*	-0.019**	-0.017*	-0.016*	-0.015	-0.014	-0.014
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)
% paid bonuses (std.)	-0.004	-0.005	-0.006	-0.002	-0.004	-0.004	0.001	-0.001	-0.001
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)
Contract: % no contract omit.									
% temp. contract (std.)	0.002	0.006	0.005	0.001	0.005	0.004	0.000	0.005	0.004
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
% perm. contract (std.)	-0.005	-0.005	-0.006	-0.008	-0.008	-0.010	-0.009	-0.009	-0.010
	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)
% supervisors (std.)	-0.008	-0.002	-0.002	-0.008	-0.002	-0.002	-0.010	-0.005	-0.005
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
No. workers supervised (std.)	0.003	0.006	0.006	0.004	0.008	0.008	0.005	0.008	0.009
	(0.010)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)
Legal status (sole prop.									

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog
omit)									
Joint Stock	0.024	0.014	0.003	0.017	0.005	-0.009	0.028	0.011	-0.007
	(0.062)	(0.051)	(0.053)	(0.062)	(0.054)	(0.050)	(0.069)	(0.064)	(0.059)
Limited Liability	-0.006	-0.028	-0.034	0.002	-0.021	-0.027	0.055	0.029	0.024
	(0.050)	(0.050)	(0.052)	(0.050)	(0.051)	(0.051)	(0.057)	(0.059)	(0.058)
Partnership	-0.071	-0.077*	-0.079*	-0.072*	-0.079*	-0.081*	-0.065	-0.072	-0.074*
	(0.037)	(0.035)	(0.035)	(0.035)	(0.035)	(0.036)	(0.039)	(0.039)	(0.036)
Limited Partnership	0.052	0.031	0.033	0.070	0.047	0.047	0.079	0.054	0.052
	(0.067)	(0.066)	(0.061)	(0.068)	(0.061)	(0.063)	(0.071)	(0.061)	(0.062)
De facto	-0.059	-0.059	-0.057	-0.064	-0.064	-0.063	-0.044	-0.040	-0.040
	(0.047)	(0.050)	(0.047)	(0.048)	(0.047)	(0.043)	(0.052)	(0.050)	(0.049)
Other	0.073	0.067	0.075	0.071	0.065	0.073	0.091	0.086	0.096
	(0.049)	(0.052)	(0.057)	(0.051)	(0.054)	(0.059)	(0.058)	(0.058)	(0.061)
Main effects									
Firm size (1-3 omit.)									
4-7 employees	0.160***	0.198***	0.188***	0.154***	0.192***	0.182***	0.157***	0.194***	0.184***
	(0.020)	(0.019)	(0.020)	(0.019)	(0.018)	(0.020)	(0.020)	(0.021)	(0.022)
8-10 employees	0.252***	0.300***	0.289***	0.238***	0.287***	0.276***	0.228***	0.275***	0.264***
	(0.030)	(0.029)	(0.028)	(0.029)	(0.026)	(0.028)	(0.033)	(0.032)	(0.030)
10-99 employees	0.153***	0.224***	0.212***	0.156***	0.229***	0.216***	0.175***	0.247***	0.234***
	(0.030)	(0.034)	(0.033)	(0.029)	(0.033)	(0.033)	(0.032)	(0.035)	(0.036)
100-999 employees	0.161	0.471***	0.479***	0.193*	0.520***	0.530***	0.262**	0.589***	0.591***
	(0.083)	(0.089)	(0.101)	(0.089)	(0.089)	(0.097)	(0.090)	(0.093)	(0.100)
1000+ employees	0.232	0.924***	0.934***	0.288	0.984***	0.994***	0.330	1.024***	1.032***
	(0.173)	(0.145)	(0.181)	(0.183)	(0.144)	(0.168)	(0.188)	(0.152)	(0.175)
Firm age (0-3 years omit.)									
4-7 years old	0.064**	0.069***	0.073***	0.064***	0.069***	0.072***	0.066**	0.070**	0.074***
	(0.020)	(0.021)	(0.020)	(0.019)	(0.020)	(0.020)	(0.021)	(0.022)	(0.020)
8-12 years old	0.029	0.032	0.038	0.031	0.034	0.040	0.043	0.046	0.051*
	(0.023)	(0.025)	(0.023)	(0.023)	(0.024)	(0.024)	(0.024)	(0.027)	(0.025)
13-20 years old	0.070**	0.073**	0.080***	0.070**	0.073**	0.079***	0.066**	0.068**	0.075**
	(0.024)	(0.024)	(0.023)	(0.024)	(0.023)	(0.024)	(0.026)	(0.025)	(0.025)
21-50 years old	0.082***	0.083***	0.089***	0.085***	0.085***	0.091***	0.094***	0.094***	0.100***

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog
	(0.022)	(0.024)	(0.023)	(0.023)	(0.023)	(0.022)	(0.023)	(0.024)	(0.025)
51+ years old	0.100*	0.100*	0.107*	0.099*	0.100*	0.106*	0.120*	0.118**	0.125*
	(0.042)	(0.042)	(0.043)	(0.042)	(0.040)	(0.042)	(0.049)	(0.045)	(0.050)
Exporter	0.031	0.009	0.037	0.039	0.008	0.039	0.069	-0.016	0.008
	(0.073)	(0.070)	(0.090)	(0.073)	(0.070)	(0.077)	(0.077)	(0.066)	(0.077)
Formal	-0.036*	-0.032*	-0.028	0.021	0.025	0.029	0.531***	0.535***	0.539***
	(0.016)	(0.015)	(0.016)	(0.016)	(0.014)	(0.016)	(0.016)	(0.017)	(0.016)
Conc. Ratio (%) 4 firm (std.)	-0.035***	-0.035***	-0.033***	-0.035***	-0.034***	-0.033***	-0.035***	-0.035***	-0.033***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
HH-Index (std.)	-0.003	-0.002	-0.002	-0.001	0.000	-0.001	-0.003	-0.001	-0.002
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Ln(K/L) (std.)	0.019*	0.090***	0.078***	0.021**	0.092***	0.079***	0.026**	0.097***	0.083***
	(0.008)	(0.009)	(0.010)	(0.008)	(0.010)	(0.010)	(0.008)	(0.010)	(0.011)
% union member (std.)	-0.006	-0.005	-0.005	-0.003	-0.002	-0.002	-0.005	-0.004	-0.004
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
% req. literacy (std.)	-0.001	0.002	0.001	-0.002	0.000	-0.000	-0.008	-0.006	-0.007
	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.016)	(0.015)	(0.016)
% req. math (std.)	-0.050***	-0.050***	-0.049***	-0.047***	-0.047***	-0.046***	-0.037***	-0.037***	-0.036***
	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
% req. computers (std.)	0.025***	0.025***	0.025**	0.025***	0.025***	0.025***	0.025**	0.025**	0.025**
	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
% req. physical fitness (std.)	0.026*	0.027*	0.028*	0.026*	0.027*	0.028*	0.023	0.024*	0.025*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)
% technical skill required (std.)	0.068***	0.067***	0.065***	0.067***	0.067***	0.064***	0.068***	0.067***	0.065***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Job ed. req. (% less than basic omit.)									
% req. basic (std.)	0.017*	0.016*	0.015*	0.018*	0.017*	0.017*	0.011	0.010	0.009
	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
% req. sec (std.)	0.003	0.002	0.001	0.005	0.003	0.003	-0.006	-0.007	-0.008
	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.010)	(0.011)	(0.011)
% req. higher ed. (std.)	0.003	-0.003	-0.004	0.003	-0.003	-0.003	-0.011	-0.016	-0.016

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog
	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)	(0.014)	(0.015)	(0.016)	(0.015)
Prep. test score (std.)	-0.027***	-0.028***	-0.028***	-0.025***	-0.026**	-0.027**	-0.027**	-0.028***	-0.028***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Occup.: % prof./man. omit.									
% white collar (std.)	0.081***	0.079***	0.084***	0.085***	0.083***	0.088***	0.085***	0.083***	0.088***
	(0.021)	(0.021)	(0.023)	(0.023)	(0.022)	(0.023)	(0.022)	(0.023)	(0.022)
% blue collar (std.)	0.093***	0.094***	0.100***	0.094***	0.096***	0.102***	0.099***	0.099***	0.106***
	(0.022)	(0.021)	(0.023)	(0.022)	(0.023)	(0.023)	(0.023)	(0.024)	(0.023)
% Training (std.)	-0.001	0.001	0.001	-0.000	0.001	0.001	0.003	0.005	0.006
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
% trained by emp. (std.)	-0.020	-0.023	-0.022	-0.020	-0.023	-0.022	-0.016	-0.018	-0.018
	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
% emp. paid for train (std.)	0.025*	0.026*	0.026*	0.025*	0.026*	0.027*	0.020	0.021	0.022
	(0.013)	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.014)	(0.013)	(0.014)
Weeks of training (std.)	0.004	0.006	0.006	0.004	0.006	0.006	0.008	0.009	0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Mean tenure (years) (std.)	0.034***	0.036***	0.036***	0.036***	0.037***	0.037***	0.037***	0.038***	0.039***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)
% paid by piece (std.)	-0.020**	-0.022***	-0.021***	-0.022***	-0.024***	-0.023***	-0.024***	-0.026***	-0.025***
	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)
% paid incentives (std.)	-0.009	-0.011	-0.011	-0.008	-0.010	-0.010	-0.002	-0.004	-0.004
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)
% paid bonuses (std.)	0.004	0.003	0.003	0.004	0.003	0.004	0.004	0.004	0.004
	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Contract: % no contract omit.									
% temp. contract (std.)	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006
	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
% perm. contract (std.)	0.028**	0.029***	0.031***	0.025**	0.026**	0.027**	0.025**	0.026**	0.028**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)

	Ln(wages/worker)			Ln(wages and benefits/worker)			Ln(formality adjusted wages/worker)		
	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog	ln (Y/L)	TFP: Cobb-Douglas	TFP: Translog
Legal status (sole prop. omit)									
Joint Stock	0.281**	0.287***	0.334***	0.303***	0.308***	0.358***	0.258*	0.271***	0.324***
	(0.093)	(0.069)	(0.068)	(0.091)	(0.061)	(0.068)	(0.106)	(0.076)	(0.072)
Limited Liability	0.133	0.140*	0.151*	0.143*	0.153*	0.164*	-0.001	0.027	0.038
	(0.072)	(0.062)	(0.066)	(0.069)	(0.069)	(0.074)	(0.097)	(0.092)	(0.090)
Partnership	0.064*	0.064*	0.065*	0.069**	0.070*	0.070**	0.062*	0.062*	0.063*
	(0.027)	(0.027)	(0.026)	(0.027)	(0.028)	(0.026)	(0.027)	(0.028)	(0.028)
Limited Partnership	-0.026	-0.014	-0.011	-0.010	0.008	0.012	-0.048	-0.028	-0.023
	(0.075)	(0.063)	(0.060)	(0.071)	(0.057)	(0.056)	(0.081)	(0.065)	(0.063)
De facto	0.028	0.032	0.029	0.026	0.029	0.026	0.019	0.023	0.020
	(0.038)	(0.040)	(0.038)	(0.038)	(0.040)	(0.035)	(0.039)	(0.039)	(0.039)
Other	-0.120	-0.089	-0.070	-0.112	-0.082	-0.064	-0.207*	-0.175	-0.154
	(0.080)	(0.092)	(0.104)	(0.086)	(0.097)	(0.103)	(0.095)	(0.104)	(0.116)
% supervisors (std.)	0.034***	0.036***	0.035***	0.035***	0.036***	0.036***	0.029***	0.031***	0.030***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
No. workers supervised (std.)	0.005	0.006	0.007	0.007	0.009	0.009	0.011	0.013	0.014
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Constant	2.001***	1.966***	1.964***	2.017***	1.982***	1.980***	2.001***	1.967***	1.964***
	(0.016)	(0.017)	(0.018)	(0.017)	(0.019)	(0.017)	(0.017)	(0.018)	(0.018)
N	40550	40550	40550	40550	40550	40550	40550	40550	40550
R-squared	0.352	0.349	0.346	0.366	0.362	0.359	0.453	0.451	0.448

Notes: *p<0.05; **p<0.01; ***p<0.001
Bootstrapped standard errors (500 repetitions) in parentheses