South African Journal of Economic and Management Sciences
ISSN: (Online) 2222-3436, (Print) 1015-8812

How does bribery affect the wage performance of formal firms? Instrumental variables and matching evidence from Nigeria

Authors:
Tobechi F. Agbanike[1]
George A. Agwu[1]
Uwazie I. Uwazie[2]
Kevin O. Onwuka[1]
Lasbrey I. Anochiwa[1]
Michael O. Enyoghasim[1]
Anayochukwu Basil Chukwu[1]
Kalu E. Uma[1]

Affiliations:
[1]Department of Economics and Development Studies, Faculty of Management and Social Sciences, Alex Ekwueme Federal University, Ndufu-Alike, Nigeria

[2]Department of Economics, Michael Okpara University of Agriculture, Umudike, Nigeria

Corresponding author:
Tobechi Agbanike,
tobechi_agbanike@yahoo.co.uk

Dates:
Received: 13 Apr. 2018
Accepted: 22 Oct. 2019
Published: 19 Mar. 2020

How to cite this article:
Agbanike, T.F., Agwu, G.A., Uwazie, U.I, Onwuka, K.O., Anochiwa, L.I., Enyoghasim, M.O. et al., 2020, 'How does bribery affect the wage performance of formal firms? Instrumental variables and matching evidence from Nigeria', *South African Journal of Economic and Management Sciences* 23(1), a3123. https://doi.org/10.4102/sajems.v23i1.3123

Background: There is an ongoing debate about the effects of bribery on economic performance, where strong arguments are made on the opposing sides. This article investigates the relationship between bribery and the level of workers' wages. The study is a variant of investigations into firms' compression of wages to pay for staff management mutually beneficial business practices.

Aim: The aim of this study is to estimate the impact of bribery on the wage performance of formal firms.

Setting: The empirical assessment uses a unique firm-level data set comprising 1141 Nigerian manufacturing firms, some of whom paid bribes to corrupt bureaucrats.

Methods: The study utilised a standard ordinary least-squares estimation technique. To address the potential endogeneity and measurement error bias arising from bribery, we used industry-location average bribe rate as instrument.

Results: We find a significant negative effect of bribery on wages to the extent that a one percentage point increase in the rate of bribery reduces the level of wages paid to the workers by about 230 000 naira per worker per annum. A robustness check using the counterfactual evaluation framework of propensity score matching, supports the ordinary least-squares estimation.

Conclusion: This study lends support to the firm level-based hypothesis that bribery has a detrimental long-term effect on firm performance. In particular, that employers using their monopsony power shift the burden of bribery to the workers through compressing wages. In addition, our results justify the enormous attention of the international community in combating bribery and corruption in Nigeria and other developing countries.

Keywords: Bribery; Wage performance; Formal firms; Instrumental variables; Propensity score matching; Nigeria.

Introduction

Bribery is a tax on firms, but the proceeds usually do not go to the government. The literature on bribery has classically focused on the administration of bribes or gaining private advantage by abusing public officials (Achim, Borlea & Anghelina 2018). More recently, however, the debate about the effects of bribery on economic performance has taken the front seat. The two sides of the argument are both convincing.[1] The fact that governments do not receive the proceeds from bribery as tax is already a damage to the economy. The 'efficient grease hypothesis' suggests that bribery facilitates transaction where otherwise bureaucratic holdups could have stalled exchange (see for instance Barasa 2018). The second-best theory of corruption holds that bribery is efficient in allocating licenses and contract through willingness to pay (see Méon & Weill 2010; Xu & Yano 2017). So, is bribery more efficient than formal taxation? Firm-level theories of corruption argue that bribery may cause more damage than taxation because of the associated higher transaction costs, uncertainty and necessary secrecy, which among other things makes corruption contracts not enforceable in courts (see e.g. Rose-Ackerman & Palifka 2016). However, to the extent that there are inefficiencies in the provision of regulations and public goods, firms offering bribes to corrupt bureaucrats may indeed achieve greater productivity and be in a position to better compensate labour than firms that do not offer bribes (Nguyen et al. 2016).

1.See Williams and Shahid (2016) for a summary.

Whereas literature documents that standard firm sponsored practices such as workers training improve productivity, it also finds that the firms often shift the real costs to the employees through wage compression (Neirotti & Paolucci 2013). Similarly, if bribery increases firm productivity, it is imperative to ascertain, as in the case of employer-provided training, how much of the benefits accrue to the workers in the form of wages. The objective of this article is to ascertain if the giving of bribes to bureaucrats by firms results in lower wages for the workers. Whether bribery increases productivity or not, it is unlikely to be neutral to wages because either wages are compressed to recoup bribery expenditures or bribery is undertaken in the first place to reduce regulation costs which may include regulated wage level. Finally, that bribes are often coded as informal gifts in surveys may suggest that they are free-will donations or that they are too insignificant to affect the firm's performance. However, if firms deny their workers necessary compensation as a result of having to meet bribery 'obligations', this means that bribery originates from substantial bureaucratic holdups, and the associated opportunity costs may be detrimental to long-run firm growth.

Nigeria is an appropriate case for this type of study. Transparency International ranked Nigeria 144 out of 180 countries in the 2018 corruption survey (Transparency International 2018) and in the periodic World Bank enterprise surveys, an average of 40% of small and medium firms in Nigeria report giving informal gifts as a condition of accessing public services (Giuseppe, Mousley & Radwan 2009). Nigeria also scores very low in the indices of business freedom and government integrity, both of which suggest a poor business climate that extorts businesses. Thus, using a unique data set containing information on the estimated cost of labour (wages and salaries) and bribe payments of firms operating in Nigeria, this article estimates a naïve and identified relationship between bribery and the compensation of labour. The naïve estimation ignores potential endogeneity of the bribery variable and leads to the conclusion that there is a moderate negative effect of bribes on the amount of labour compensation. The identified model is based on the use of an instrumental variable in a two-stage regression to overcome the potential problems of endogeneity and measurement error. Using the industry-location average bribe as instrument, the negative effect of bribery on wages becomes considerably higher. Further, we support the evidence using a counterfactual evaluation framework of propensity score matching and confirm that workers in bribing firms are significantly less compensated than their peers in non-bribing firms. To the best of our knowledge, this is the first article to relate firm's bribery tendency to workers' welfare even though bribery is fast becoming standard practice among firms especially in developing countries like Nigeria.

The article is organised as follows: section 1 introduces the study, a review of related literature is presented in section 2, empirical strategy is described in section 3, section 4 describes the data and performs basic descriptive analysis, while results and conclusion are presented in sections 5 and 6.

Related literature

The theories of bribery as an economic phenomenon are mainly shaped by moral standpoints which perceive bribery as detrimental to the economy. Country level studies have largely confirmed this standpoint by showing that economic growth and development have inverse relationships with the level of bribery and corruption (see Dimant & Tosato 2018). Evidence at the firm level about the relationship between bribery and firm performance is still emerging. However, one can distinguish two opposing perspectives from the empirical estimates: on one hand, the position of the moral theorisation is confirmed and bribery or corruption is found to harm firm performance (Donadelli, Fasan & Magnanelli 2014; Nguyen et al. 2016). On the other hand, bribery is theorised as greasing the wheels of business and thus enhancing firm performance (Dreher & Gassebner 2013). A number of firm-level studies have confirmed the harmful effects of bribery on firm performance ranging from one to three percentage point difference. In Africa in particular, Fisman and Svensson (2007) find that a one percentage point increase in bribery rate is associated with a reduction of firm growth of three percentage points. A persisting concern, however, is how the bribe variable is treated in the estimations; as Faruq and Webb (2013) show, productivity may be the cause and, at the same time, the effect of bribery. This, in addition to the fact that bribe may be measured with error given its clandestine nature, suggests that the traditional ordinary least-squares (OLS) estimation of the bribe variable may be biased. Athanasouli, Goujard and Sklias (2012) analysed firm-level data from Greece using the instrumental variable method and found that there is a strong negative association between bribery and sales growth. Gaviria (2002) found similar results for the case of Latin American countries, but assumed that the bribe variable is exogenous.

On the other hand, the grease hypothesis emphasises that bribery promotes rather than harms growth by enhancing firms' performance. From this perspective, bribes help circumvent the distortions caused by inefficient bureaucracy in a second-best situation (Dreher & Gassebner 2013). The study shows that even if the firm is new in the market or small, bribes may be used to secure 'good' relationships with bureaucrats to reduce the risk of failure. Another strong argument in line with this perspective is that bribery enhances productivity because it compensates for defective public institutions. However, only few studies have empirically confirmed this perspective; Ayaydin and Hayaloglu (2014) studied manufacturing firms in Turkey and found that bribery helps firms grow faster because bribes enable the firms to bypass bureaucratic holdups. A panel analysis by Vial and Hanoteau (2010) based on manufacturing firms in Indonesia also find a positive relationship between firm bribery, output and labour productivity. Williams and Shahid (2016) found a strong positive impact of bribery in a cross-country study involving 132 developing countries. Nevertheless, none of these opposing perspectives is well established in theory.

In the canonical labour markets, firms are wage takers, whereas, in a regulated system where wages are fixed, bribery may enable firms to circumvent regulations in the labour market and obtain freedom to influence wages (see Smith et al. 2012). Productivity is the main determinant of wages as long as the labour markets operate without friction; otherwise, regulation may supplement productivity in determining the level of worker compensation (De Vaal & Ebben 2011). In line with this, Giuseppe et al. (2009) suggest that for Nigeria, the regulated wage in the formal sector outweighs the average product of labour, which implies that employers have incentive to reduce applicable wages by bribing bureaucrats who enforce the regulations. At the same time, by 'greasing the wheels' of production, bribing bureaucrats could also increase firm productivity per worker through discriminatory access to public goods (Mendoza, Lim & Lopez 2015). In labour markets without friction, the price of labour is determined by productivity, but as we hypothesise that corruption may promote productivity by clearing regulatory burden in a second-best situation, it is not clear who actually pays the bribe nor whether the benefits lead to higher wages for the workers instead of being completely appropriated by the employer. Hence, the issue of whether bribery increases or decreases wages is primarily an empirical question, and one that has not previously been answered.

It is evident from country-level studies that corruption hurts growth; cross-country studies with gross domestic product as outcome of interest usually report negative effects of corruption on growth. However, these cross-country studies have a significant chance of being biased by unobserved heterogeneity across data points. In addition, the use of corruption perception indices by these studies expose the estimated effects to perception bias. Furthermore, the cross-country evidence is not easily generalisable to firm-level situation and may not be used to make inferences concerning workers' welfare. The negative effect of corruption on growth measured at the country level could arise from the inefficient provision of public goods, which could easily yield the prediction that corruption damages growth. Additionally, the cross-country studies and indeed other studies relating bribery to firm performance do not accommodate worker incentives for abating corruption; corrupt transactions are secretly completed between the firm and the bureaucrats, but the average worker is aware of the transactions. If the welfare of the worker is hurt directly or indirectly by bribery, it immediately suggests incentives compatibility between firm workers and anti-graft agencies. Given that grafts may be more visible to firm workers than the graft agencies, anticipated workers-agency cooperation could lead to effective anti-graft policies. Furthermore, the evidence presented here illustrates another aspect of the impact of corruption on long-run economic growth.

In summary, the investigation into the relationship between bribery and firm performance is not yet conclusive. There are two main opposing theories that are equally generating empirical confirmations, although a few studies report findings that are neutral to the debate. For example, Lavallée and Roubaud (2011) find no association between bribery and firm output. Therefore, more empirical evidence is needed to confirm the theories. Moreover, previous studies focus on different dimensions of firm performance and none had studied the wage performance of firms. Our focus on the firm wage performance is informed by the fact that bribery has similar motivation as firms' provision of general worker training, which has been shown to lead to compressed wages. Our basic assumption is that just like firms providing general worker training, graft-paying firms do so in order to increase productivity. The theoretical predictions reveal that in non-competitive labour markets and for the sake of raising productivity, firms provide general worker training and bribe bureaucrats (Acemoglu & Verdier 2000; Acemoglu & Pischke 1998). In that situation, the monopsony power of the employer guarantees recovery of the training and bribery expenditure through the payment of wages below the worker's productivity.

Empirical strategy

Estimating the effects of bribery on the wage performance of firms in this study presents two main estimation challenges: (1) both wages and bribery are likely to be simultaneously determined and (2) bribes may be measured with error. We report on the practical steps taken to resolve these challenges below. Bribery is unlikely to be random; bureaucrats with substantial discretionary powers are likely to assess firms and request bribes according to the firms' ability to pay (see Seker & Yang 2012). Consider that the measure of ability to pay, monitored by the bureaucrats, may have to do with the unobserved firms' efficiency level which in turn determines profit, and we have no way of determining the profits made by the firms on the basis of the current data. Thus, the unobserved profitability associated with the firm's products could be a source of endogeneity. The mechanism for selecting the target firm by the corrupt bureaucrats is illustrated by Fisman and Svensson (2007). The essence is that the optimal incentive of the bureaucrats is to extract as high a bribe as possible, limited only to the willingness of the firms to pay and not exit or snitch on the contract. Logically, the bureaucrats extract larger bribes from firms producing goods with higher profitability because they are most likely to be more willing to pay, and vice versa. Svensson (1999) argues that current and future expected profitability explain a large part of the variations in bribes among graft-paying firms. Hence, if profitability also influences the firm's willingness to offer higher wages, then, with reference to the two firms, a positive relationship between bribe payments and wages should be observed. The second econometric issue that we wish to address is the 'noisy' nature of micro-data; in particular, due to the secretive nature of bribery transactions, the reported bribery level may be subject to measurement error. These estimation difficulties will tend to attenuate any direct negative effect that corruption has on wages. To mitigate these problems, we find suitable instruments for the bribe variable. Our identification strategy can be laid out formally following

Fisman and Svensson (2007): let the relationship between firm wage offering (ω_{ij}) and bribery (b_{ij}) be represented by the equation:

$$\omega_{ij} = \Gamma\left(b_{ij}\left(\theta_{ij}\right), p_{ij}, \theta_{ij}\right) \quad \text{[Eqn 1]}$$

In the Equation 1, the subscripts denote firm i in sector j; θ_{ij} is a firm-specific (unobservable) factor that may impact both bribery rates and wage rates, p_{ij} is a variable capturing the firm's propensity to remunerate workers. This remunerative potential can be decomposed into two parts:

$$p_{ij} = X'_{ij}\delta + \eta_{ij} \quad \text{[Eqn 2]}$$

X'_{ij} is a vector of observable characteristics and η_{ij} is a zero-mean error term.

Linearising the model yields:

$$\omega_i = \beta_0 + \beta_b b_{ij} + X'_{ij}\delta + \beta_\theta \theta_{ij} + \eta_{ij} \quad \text{[Eqn 3]}$$

Going by our previous discussion, the omitted variable θ_{ij} is correlated with both wage rates ($\beta \neq 0$) and bribery ($corr(b, \theta) \neq 0$) In line with the discussion in the introduction, we assume that $\beta_0 > 0$ and ($corr(b, \theta) > 0$). For example, we can think of the shifts in demand described above that are likely to influence both the 'required' bribe and wage rates. Assuming, for simplicity, that θ is essentially uncorrelated with X, this leads to the usual omitted variable bias; given our assumptions, the bias will be towards θ, resulting in an underestimate of the effects of bribery. Based on this, our identification assumption to deal with this problem is that b_{ij} can be decomposed into two terms, one, industry-specific, and the other, particular to the firm:

$$b_{ij} = \beta_{ij} + \beta_j \quad \text{[Eqn 4]}$$

In Equation 4, β_j denotes the (average) amount of bribes common to industry-location j, which in turn is a function of the underlying characteristics inherent in that particular industry-location, determining to what extent bureaucrats can extract bribes, while β_{ij} denotes the idiosyncratic component. Importantly, we assume that the industry-specific part of bribery is determined by the firm's local corruption environment, which depends not only on the location of the firm, but also on the industry in which the firm operates. Thus, we assume that this component is exogenous to the firm, and uncorrelated with θ. For example, such industry-specific factors might include import and export orientation of the product market, and degree of dependence on publicly provided infrastructural services. Likewise, we expect rent extraction through bribery to differ across locations simply because some bureaucrats may be more effective at extracting bribes than others. If this assumption is valid, we may use β_j to instrument for β_{ij}, since $corr(\beta_{ij}, \theta) = 0$. In such a specification, using industry-location averages as an instrument for firm-level bribery gets rid of the bias resulting from unobservables that are correlated with bribery at the firm, but not industry-location level.

Secondly, the risk of measurement error is high in cross-sectional settings. Presently, we are particularly concerned about the bribery variable given the underground environment under which bribery transactions take place and the fact that some managers may feel that reporting high amounts of bribery would paint the firm in a bad light before the public. This sort of endogeneity is usually handled through two-stage estimations where grouped averages are used as instruments for the endogenous variables.[2] Adopting a similar approach in this study and using industry-location average bribery level as the instrument, we assume that the measurement errors are largely idiosyncratic to the firm, and hence uncorrelated with the average bribery values. One of the pieces of support for this assumption is that the coding of the variable as gifts rather than explicitly as bribes in the survey would undermine the underground nature of the transaction and subject the reporting to relatively idiosyncratic perceptions of the managers.

In the meantime, the chosen instrument must fulfil the validity test including a sound theoretical justification. We make the assumption that $corr(\beta_j, \theta) = 0$; the strength of this assumption lies in bribe and wage being randomly determined at the industry-location level. In a similar study, Fisman and Svensson (2007) made two identification points that are equally applicable to the current study: the first relates to the nature of the estimation data, which draws from a pool of small and medium-sized firms across a spectrum of the non-agricultural industrial categories and regions in Nigeria. It is known that these types of firms are not likely to capture the state. Even if they are likely to capture the state, this tendency is not likely to be systematically related at the industry-location level. Secondly, if some processes at the industry-location level drive simultaneous determination of bribe and wages, its effects on the results are most likely idiosyncratic. Suppose that bureaucrats are able to systematically increase both the regulatory burden and demands for bribes for some selected firms at the industry-locations, this could drive the instrumental variable procedure to overestimate the negative effect of bribe payments. On the other hand, if corrupt bureaucrats systematically target particular firms with higher levels of bribery at industry locations with high remunerative potential, this would attenuate the effect of the instrument. In Table 1-A1 (Appendix 1), we report the results of the first stage regressions obtaining support for the relevance of our instruments in predicting the instrumented bribe variable. These in addition to the reported instrument tests in Table 5 provide support that our instruments are valid.

Data and descriptive analyses

For all the empirical analyses in this study, we use the wave of the Nigerian enterprise survey recently published in 2014. The main objective of the enterprise surveys is to monitor developments in the business environments of developing countries. The World Bank and its partners in the countries

2.Justification for the use of this approach can be found in Wald (1940), Angrist and Krueger (2001) and Fisman and Svensson (2007).

conduct the surveys focusing on small and medium enterprises. The surveys achieve representativeness of non-agricultural manufacturing, services firms and excludes firms with major government control. Rich qualitative and quantitative information about the firms are collected through face-to-face interviews with firm managers and owners including various aspects of productivity. The Nigerian sample covers 2676 firms, but we focus only on the 1141 manufacturing firms.

Based on this data, we generated all of the variables that are part of our estimations. Importantly, we make use of labour productivity generated as sales per full-time worker. Although capital productivity would have been an important control in the estimations, we could not generate this variable due to substantial missing values with respect to firm physical assets. The dependent variable is the amount spent per capita on the compensation of labour by the firm per annum. Apart from its natural form, the dependent variable was also operationalised as the natural logarithm of the total costs of labour compensation divided by the number of full-time employees. The variable of interest in the article is bribery that is generated as a dummy variable capturing whether the firm offered any amount in informal gifts to bureaucrats in exchange for access to services such as water or electricity connection. In the main estimations, control variables include characteristics identified in literature as affecting firm wage performance including productivity, size, age and workers' education. Further details about the variables and their construction are presented in Table 1 and the descriptive statistics presented in Table 2. Large firms (number of employees > 99) and firms in which governments have stakes are eliminated from the sample. Theoretically, bribery can have smaller distortionary effects for large and politically powerful firms because such firms can easily capture the regulatory process.

TABLE 1: Variables description.

Variable	Description
Wages	Total labour cost in thousands of naira (including wages, salaries, bonuses etc.)
Bribe	Percentage of annual sales paid as informal gifts to bureaucrats
Labour productivity	Total sales divided by total number of full-time employees
Age	Number of years since the firm started operation in log form
Education	Average number of years of education of a typical production worker
Employee	Number of full-time employees of the firm
Skill ratio	Ratio of skilled production workers to total number of workers of the firm
Export	Firm sells output in the foreign market either directly or indirectly
Training	Firm provides training to employees
Instruments for bribe	
Average bribe	Average bribery rate at industry-location level
Regulation	Average time managers spent dealing with regulation at the industry-location level
Additional variables for propensity scores estimation	
Domestic	Firm is fully owned by domestic private individuals or organisations
Innovation	Firm introduced product or process innovation in the last 3 years
R&D	Firm spent on research and development activities in the last 3 years
Competition	Number of competitors, for the main market in which this establishment sold its main product
Regulation	The average time taken by managers to attend to regulation
Informal competition	Firm competes with informal or unregistered firm
Manager's experience	Number of years the manager has spent working in the industry
Manager's education	= 1 if the manager has a university education, otherwise 0
Foreign technology	Firm operates at present using technology licensed from a foreign-owned company, excluding office software
Shareholding	Firm is shareholding company with shares trading in the stock market
ISO	Firm has at least one internationally recognised quality certification, for example ISO 9000

Comparing wage, productivity and age distributions by bribe status

In order to examine the interrelation of bribery and the wage performance of the firms, we begin our investigation by comparing distributions of main variables using a semi-parametric test for the samples of firms defined by the bribe status. For this purpose, all firms included in the pooled sample are categorised into two broad categories: Bribe and non-bribe firms. We conduct the non-parametric Kolmogorov–Smirnov test (KS test) to determine if there is any significant difference in the wage, labour productivity and age distributions for the two groups. More precisely, the procedure adopted in the study for testing the difference between the distributions functions basically relies on the concept of first-order stochastic dominance and allows us to establish a ranking for the compared distributions. The idea of selecting productivity and age for the test stems from their influence on the propensity of firms to offer higher wages as documented in the literature (Brown & Medoff 2003; Heyman 2005).

We summarise the basic concept of the test as follows: If, for instance, given two random samples assumed to be independently distributed, the one sample $\varphi_1,\ldots\varphi_n$ comes from a distribution function Ω_1 and the second sample $\varphi_{1+1},\ldots\varphi_n$ comes from a distinct distribution function Ω_2. We are interested in testing the hypothesis; $\Omega_1(\varphi) - , \Omega_2(\varphi) \leq 0, \forall \varphi \mathcal{R}$. The stochastic dominance of Ω_1 over Ω_2 is obtained under the conditions that this hypothesis holds and there is strict inequality for at least some $\varphi \in \mathcal{R}$. This is precisely the examination of the cumulative distribution functions of variables in both samples and determining if one lies entirely to the right of the other. This procedure is used to conduct the two-tailed KS test of stochastic dominance, which identifies the independence of the distributions. The stochastic dominance evaluated based on two related null hypotheses as follows: The test is based on the rejection of the null hypothesis of distributions equality:

$$H_0 : ,\Omega_1(\varphi) - ,\Omega_2(\varphi) = 0 \ \forall \ \varphi\mathcal{R} \qquad \text{[Eqn 5]}$$

The two-sided KS test is based on the theory of asymptotic distribution and the test statistics are derived by Kolmogorov (1941) and Smirnov (1939).

A comparison of bribing versus non-bribing firms using the KS test is reported in Table 3. Column 2 of the table tests the hypothesis which suggests that the non-bribing firms'

TABLE 2: Summary statistics.

Variable	Mean	Standard deviation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Bribe	3.41	9.37	1	-	-	-	-	-	-	-	-
2. Lnwage	11.92	3.81	-0.076	1	-	-	-	-	-	-	-
3. lproductivity	12.31	2.17	-0.089	0.198	1	-	-	-	-	-	-
4. lnage	2.62	0.68	-0.048	0.210	0.162	1	-	-	-	-	-
5. lnedu	2.07	0.67	-0.083	0.205	0.075	0.097	1	-	-	-	-
6. employee	2.64	1.18	-0.021	0.249	-0.145	0.154	0.112	1	-	-	-
7. Skill_ratio	0.55	0.33	-0.065	0.058	0.157	0.011	0.176	-0.090	1	-	-
8. Domestic	0.13	0.33	0.102	-0.095	-0.152	-0.227	0.000	0.194	-0.229	1	-
9. Export	0.17	0.37	-0.047	0.193	0.073	0.123	0.128	0.240	-0.079	0.094	1

Source: Authors' computations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.

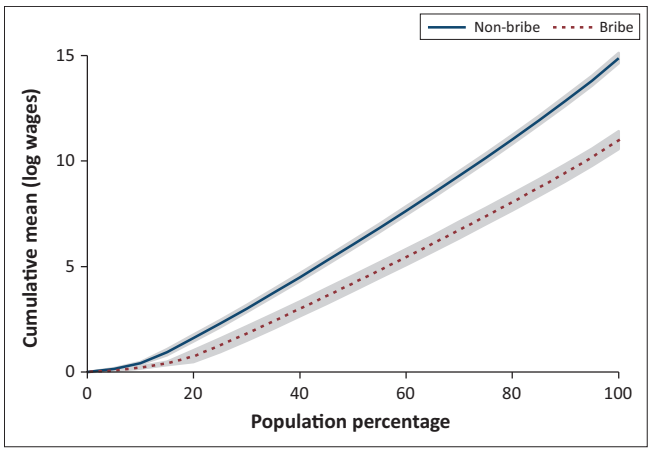
TABLE 3: Kolmogorov–Smirnov tests of stochastic dominance.

Variable	Non-bribe		Bribe		Combined Kolmogorov–Smirnov tests	
	Coefficient of difference	*p*-value	Coefficient of difference	*p*-value	Coefficient of difference	*p*-value
H_0	$\Omega(\varphi_{nb}) -,\Omega(\varphi_b) \leq 0$	-	$\Omega(\varphi_{nb}) -,\Omega(\varphi_b) \leq 0$	-	$\Omega(\varphi_{nb}) -,\Omega(\varphi_b) \leq 0$	-
Wage	0.000	1.000	-0.125***	0.000	0.125***	0.000
Productivity	0.000	1.000	-0.117**	0.027	0.117***	0.054
Age	0.059*	0.097	-0.030	0.551	0.059	0.193

Source: Authors' computations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.
Note: *p*-values are based on the bootstrap approximation.
*, $p < 0.10$; **, $p < 0.05$; ***, $p < 0.01$.

outcome distributions contain smaller values than the distributions for bribe firms, while the hypothesis under test in column 3 suggests the opposite. The results strongly reveal that firms who offer bribes have smaller distributions of wages and productivity than firms that do not offer bribes. The results are statistically significant at 1% and 5% levels. There is no significant difference in age across the group of firms. The combined KS test results (column 4) mirrors the results in columns 2 and 3, as the difference in outcome variables between non-bribing and bribing firms is found to be statistically different from 0, except in the case of age of the firms. To interrogate the data further, the generalised Lorenz curve framework was used to ascertain dominance between the distributions of wages for the two samples.

Figure 1 clearly shows that the wage distribution for non-bribing firms (bribe = 0) dominates the wage distribution for the bribing firms (bribe = 1) under the framework of generalised Lorenz (GL) curve. The wage distribution for the non-bribing firms is less unequal than the wage distribution for the bribing firms, and is quantitatively preferable from a welfare perspective. It can be concluded that the distribution of wages in the sample of non-bribing firms is superior to that of bribing firms. However, productivity distribution in the sample of non-bribing firms also outweighs that of bribing firms (see Table 3). Therefore, to isolate the effect of bribe on wages, the effects of labour productivity and other determinants of wages must be controlled.



Source: Authors' computations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.

FIGURE 1: Stochastic dominance of non-bribing firms' wage distribution over that of bribing firms.

Estimation results

Main estimations

First, we report a set of regressions run with the naïve model where endogeneity of the bribe variable is not controlled. The results in their different specifications are listed in Table 4. In the table, all the specifications show negative effects of bribery on wages. However, the estimated effects are generally moderate. In all the specifications, the standard errors are clustered by the industry location which allows the tendency for the errors across firms in a given industry location to be similar. Without controlling for firm provision of worker training which relates to another form of wage compression, the negative effect of bribery was stronger and characteristics of firm such as age and average education of the workers exert positive influence on wages. However, as soon as the training indicator was introduced, the negative influence of bribery reduced but remained significant, while age and average education became insignificant.

The identified model addresses the possible endogeneity and measurement error problems in this relationship. In view of this, we instrument for bribery in the next estimations relying on the exogeneity of industry-location average bribe and industry-location regulation burden.[3] Clearly, the results reported in columns 1–5 of Table 5 support the hypothesis

3.We use the time firm managers spend in fulfilling and responding to regulations as a proxy for regulation burden.

TABLE 4: Effect of bribery on wage payment, basic estimation.

Variable	Ordinary least squares					
	Log wage	Standard error	Log wage	Standard error	Log wage	Standard error
Bribe	-0.0627***	0.0149	-0.0589***	0.0147	-0.0594***	0.0147
Labour productivity	0.442***	0.0928	0.456***	0.0914	0.436***	0.0926
Age	0.566**	0.253	0.388	0.251	0.417	0.256
Number of employees	0.0382***	0.00907	0.0386***	0.00890	0.0386***	0.00892
Average education	0.520**	0.237	0.311	0.244	0.267	0.248
Training	-	-	-1.124***	0.365	-1.128***	0.372
Trade	-	-	-	-	0.0576	-
Constant	3.501***	1.274	4.544***	1.299	4.753***	1.329
Observations	369	-	364	-	350	-
R-squared	0.180	-	0.209	-	0.210	-

Source: Authors' computations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.
*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

TABLE 5: Effect of bribery on wage payment, instrumental variable estimation.

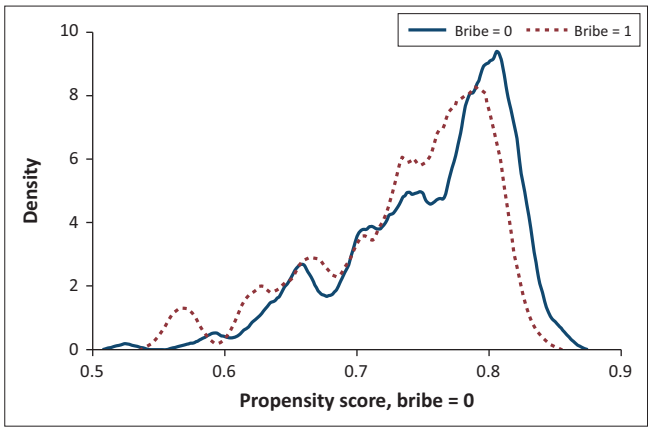
Variables	Instrumental variable							
	Log wage	Standard error	Log wage	Standard error	Log wage	Standard error	Log wage	Standard error
Bribe	-2. 324**	1.233	-2.421**	1.255	-2.515**	1.267	-2.629**	1.341
Labour productivity	0.368***	0.0953	0.392***	0.0938	0.374***	0.0949	0.373***	0.0948
Age	0.419	0.258	0.268	0.256	0.303	0.262	0.303	0.262
Number of employees	0.0475***	0.0118	0.0466***	0.0117	0.0477***	0.0117	0.0475***	0.0117
Average education	0.622**	0.288	0.534*	0.287	0.550*	0.291	0.547*	0.291
Training	-	-	-0.879**	0.396	-0.919**	0.402	-0.907**	0.401
Trade	-	-	-	-	0.124	0.377	0.119	0.376
Constant	5.170***	1.370	5.829***	1.373	5.928***	1.409	5.967***	1.407
F-test of instruments	15.012	0.021	12.003	0.000	17.100	0.000	24.230	0.000
Hansen J-statistics	-	-	-	-	-	-	2.171	0.321
Observations	329	-	324	-	310	-	310	-
R-squared	0.188	-	0.209	-	0.208	-	0.209	-

Source: Authors' computations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.
*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

that wages are compressed in bribing firms. More precisely, the coefficient on bribery takes on values from –2.3 to –2.6. This implies that an increase of one percentage point in the rate of bribery payments will reduce the per capita wage paid to the workers by about 230 000 naira per annum. Thus, results align with evidence of the use of monopsony power by firms to compress wages and the theoretical framework of corruption as an obstacle to growth. This set of results is unaffected even when firm provision of worker training and firm involvement in international trade are controlled. In columns 1–3 of Table 1-A1, we ran the just-identified models where industry-location average bribery is used as instrument whereas in column 5 the model is over-identified using average industry-location regulation burden in addition to the industry-location average bribe rate as instruments. We introduced additional variables of training and trade in columns 2 and 3 to gauge the robustness of the bribe coefficient to the introduction of additional wage enhancing variables. Our choice of variables is informed mainly by the Mincerian specification of the wage function (see Mincer 1974).

Robustness check using propensity score matching

In general, estimations based on cross-sectional data has limitations. A particular concern in this case is that some bribing and non-bribing firms used in the estimation may fall outside the area of common support. There is a non-trivial chance that the 'required' amount of bribery and other firm characteristics, particularly wages, are determined in a system. Moreover, the traditional wage models are based on individual wages as a function of individual characteristics, whereas we model per capita wage as a function of firm characteristics. This means that not all risks of misspecification bias are ruled out in the previous estimations. Furthermore, in studying the elasticity of wages with respect to bribes, it matters how bribery payment is scaled. This is why the bribe variable in this study is measured as percentage of sales; however, this does not guarantee the elimination of all risks of misreporting of either sales or bribe values. Matching estimations overcome these challenges: In the first instance, matching does not assume correct measurement of the bribe variable, but rather whether any amount of bribery was given or not. Secondly, matching does not require specifying the functional form of the outcome equations and therefore is not susceptible to misspecification bias in that respect. The propensity score matching reduces sample selection bias by creating carefully matched treatment and control groups. Mallick and Yang (2013) noted that this property is particularly useful where selection bias arises from endogeneity, which is applicable in this case since bribery and wages are likely codetermined. As Table 1 indicates, we utilised as many covariates as possible in estimating the propensity score in order to ensure that the outcome is indeed conditionally independent of the treatment. This contributed to the common support property of the matched samples as can be seen in Figure 2.



Source: Authors' computations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.

FIGURE 2: Common support between the he bribing and non-bribing samples.

Analysing the data the second time, using the propensity score matching technique, is to serve as a robustness check to the results reported in the previous section. The central feature of the matching analysis is to measure the relationship between a treatment variable and an outcome variable. Presently, the treatment variable is bribe (0 or 1) and the outcome is wages offered by the firm in log and standard forms. Simply comparing a sample of firms offering bribes and another sample of firms not offering bribes would almost certainly produce biased results unless the treated and control groups closely resemble each other in all relevant attributes other than the treatment. The matching approach seeks to replicate the process of experimental random sampling, using non-experimental observed data. Nevertheless, in this study, we restrict the matching procedure to robustness check only because matching can compute the treatment impact, but does not easily lend itself to the computation of marginal impacts of the covariates. So, we prefer the instrumental variable procedure 2SLS over the matching method, mainly because it allows us to compute the marginal impacts and elasticities that are clearly desired from a policy standpoint.

Table 6 reports the average treatment effect on the treated (ATT) generated, using different algorithms of the propensity score matching (PSM). The results support the earlier results generated based on the instrumental variables approach. The PSM ATTs suggest that, on average, the treatment group – that is firms that usually bribe bureaucrats – spend about 180 000 naira less than the control group in wage compensation per worker per annum.

Conclusion

The contribution of this article is in estimating a very significant and robust negative effect of bribery on the wages paid to workers by the Nigerian firms. We used standard OLS, instrumental variables and counter-factual evaluation approaches to arrive at this conclusion. The preferred instrumental variables approach shows that a one percentage point increase in the rate of bribery reduces the amount of wages paid to the workers by 230 000 naira per worker per annum. Our matching estimation shows that the average treatment effect of bribery on the treated ATT is –180 000. This

TABLE 6: Propensity score estimates.

Outcome	ATT	Nearest neighbour			Five-nearest neighbour			Ten-nearest neighbour			Kernel			Radius Caliper 0.05	
		Coefficient	*t*- statistic	ATT	Coefficient	*t*- statistic	ATT	Coefficient	*t*- statistic	ATT	Coefficient	*t*- statistic	ATT	Coefficient	*t*- statistic
Wages	-175 029.3	95 124.6	-1.84*	-179 715.7	98 205.3	-1.83*	-181 715.9	98 224.8	-1.85*	-181 121.0	85 839.3	-2.11**	-178 345.6	82 952.4	-2.15**
Log wages	-0.7928375	0.3292	-2.41**	-0.2705061	0.1161	-2.33**	-0.5265436	0.2426	2.17**	-1.006659	0.4824	2.09**	-1.050272	0.4713	2.23**

Source: Authors' computations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.
Note: Treatment = bribe 0,1.
*, Significant at 10%; **, Significant at 5%.

means that annual per capita wage paid by bribing firms is 180 000 naira less than the amount by non-bribing firms. Based on these, this study lends support to the firm level-based hypothesis that bribery has a detrimental long-term effect on firm performance. In particular, that firm management using their monopsony power shifts the burden of bribery to the workers through compressing wages. We also find a high negative effect of training provision by firms on the workers' wages. The implication of this is that both practices skills training and bribery are results of the same motivation, which is that firms care about productivity, but in the end, instead of benefitting from the improved productivity, workers are indirectly made to pay for it using their wages. In a country like Nigeria, where high unemployment rate puts workers' unions in check, bureaucratic regulation of wages is the only safety net for workers. This result thus emphasises that even this mechanism is compromised through corruption.

However, the scenario creates a significant stake for the ordinary workers in the fight against corruption. Nigeria faces a huge challenge in the fight against corruption, one of which is that the corrupt activities are clandestine. Given this result, incentives are compatible for workers to alleviate the knowledge limitations of the anti-graft agencies who are usually less informed than the workers about the clandestine bribery practices. This means that anti-graft measures such as the whistle-blowers' policy is likely to yield results because the workers are privately motivated to report observed corrupt practices in their enterprises. As the international community continues to provide support in the alleviation of corruption in the developing countries, our results provide empirical justification for this effort. In addition, our article creates room for further research in the direction of linking corruption to workers' welfare. We expect future studies to focus on other work-related welfare measures such as health insurance that are more latent than wages and may be compressed by firms without raising suspicion.

Acknowledgements

The authors would like to thank the anonymous reviewers for their time and suggestions which were most helpful in refining and improving this article.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

T.F.A. was involved in the conceptualisation of the study, data analysis and interpretation of results and drafting of the manuscript. G.A.A. was involved in data cleaning, analysis and interpretation of data and drafting of the manuscript. U.I.U. was involved in the conceptualisation of the study and critically revised the manuscript for important intellectual content. K.O.O. was involved in data cleaning, analysis and interpretation of data. L.I.A. contributed to the design of the study and handled the review of relevant literature. M.O.E. contributed to the design of the study and data cleaning. A.B.C. contributed to interpretation of results and drafting of the manuscript. K.E.U. was involved in the critical revision of the manuscript for important intellectual content. All the authors read and approved the manuscript before its submission.

Funding information

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Ethical considerations

Ethical clearance was not required for the study.

Data availability statement

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

References

Acemoglu, D. & Pischke, J., 1998, 'Why do firms train? Theory and evidence', *The Quarterly Journal of Economics* 113(1), 79–119. https://doi.org/10.1162/003355398555531

Acemoglu, D. & Verdier, T., 2000, 'The choice between market failures and corruption', *American Economic Review* 90(1), 194–211. https://doi.org/10.1257/aer.90.1.194

Achim, M.V., Borlea, S.N. & Anghelina, A.M., 2018, 'The impact of fiscal policies on corruption: A panel analysis', *South African Journal of Economic and Management Sciences* 21(1), 1–9. https://doi.org/10.4102/sajems.v21i1.1970

Angrist, J.D. & Krueger, A.B., 2001, 'Instrumental variables and the search for identification: From supply and demand to natural experiments', *Journal of Economic Perspectives* 15(4), 69–85. https://doi.org/10.1257/jep.15.4.69

Athanasouli, D., Goujard, A. & Sklias, P., 2012, 'Corruption and firm performance: Evidence from Greek firms', *International Journal of Economic Sciences and Applied Research* 5(2), 43–67.

Ayaydın, H. & Hayaloglu, P., 2014, 'The effect of corruption on firm growth: Evidence from firms in Turkey', *Asian Economic and Financial Review* 4(5), 607–624.

Barasa, L., 2018, 'Corruption, transaction costs, and innovation in Africa', *African Journal of Science, Technology, Innovation and Development* 10(7), 811–821. https://doi.org/10.1080/20421338.2018.1519061

Brown, C. & Medoff, J.L., 2003, 'Firm age and wages', *Journal of Labour Economics* 21(3), 677–697. https://doi.org/10.1086/374963

De Vaal, A. & Ebben, W., 2011, 'Institutions and the relation between corruption and economic growth', *Review of Development Economics* 15(1), 108–123. https://doi.org/10.1111/j.1467-9361.2010.00596.x

Dimant, E. & Tosato, G., 2018, 'Causes and effects of corruption: What has past decade's empirical research taught us? A survey', *Journal of Economic Surveys* 32(2), 335–356. http://dx.doi.org/10.1111/joes.12198

Donadelli, M., Fasan, M. & Magnanelli, B.S., 2014, 'The agency problem, financial performance and corruption: Country, industry and firm level perspectives', *European Management Review* 11(3–4), 259–272. https://doi.org/10.1111/emre.12038

Faruq, H. & Webb, M., 2013, 'Corruption, bureaucracy and firm productivity in Africa', *Review of Development Economics* 17(1), 117–129. https://doi.org/10.1111/rode.12019

Fisman, R. & Svensson, J., 2007, 'Are corruption and taxation really harmful to growth? Firm level evidence', *Journal of Development Economics* 83(1), 63–75. https://doi.org/10.1016/j.jdeveco.2005.09.009

Gaviria, A., 2002, 'Assessing the effects of corruption and crime on firm performance: Evidence from Latin America', *Emerging Markets Review* 3(3), 245–268. https://doi.org/10.1016/S1566-0141(02)00024-9

Giuseppe, I., Mousley, P. & Radwan, I., 2009, *An assessment of the investment climate in Nigeria*, The World Bank, Washington, DC.

Heyman, F., 2005, 'Pay inequality and firm performance: Evidence from matched employer–employee data', *Applied Economics* 37(11), 1313–1327. https://doi.org/10.1080/00036840500142101

Kolmogorov, A., 1941, 'Confidence limits for an unknown distribution function', *The Annals of Mathematical Statistics* 12(4), 461–463. https://doi.org/10.1214/aoms/1177731684

Lavallée, E. & Roubaud, F., 2011, 'Corruption and informal enterprise performance: West African evidence', Discussion papers, International Institute of Social Studies, Development, Institutions et Mondialisation DIAL, Paris.

Mallick, S. & Yang, Y., 2013, 'Productivity performance of export market entry and exit: Evidence from Indian firms', *Review of International Economics* 21(4), 809–824. https://doi.org/10.1111/roie.12072

Mendoza, R.U., Lim, R.A. & Lopez, A.O., 2015, 'Grease or sand in the wheels of commerce? Firm level evidence on corruption and SMEs', *Journal of International Development* 27(4), 415–439. https://doi.org/10.1002/jid.3077

Méon, P. & Weill, L., 2010, 'Is corruption an efficient grease?', *World Development* 38(3), 244–259. https://doi.org/10.1016/j.worlddev.2009.06.004

Mincer, J., 1974, *Schooling, experience, and earnings*, Columbia University Press, New York.

Neirotti, P. & Paolucci, E., 2013, 'Why do firms train? Empirical evidence on the relationship between training and technological and organizational change', *International Journal of Training and Development* 17(2), 93–115. https://doi.org/10.1111/ijtd.12003

Nguyen, N.A., Doan, Q.H., Nguyen, N.M. & Tran-Nam, B., 2016, 'The impact of petty corruption on firm innovation in Vietnam', *Crime, Law and Social Change* 65(4–5), 377–394. https://doi.org/10.1007/s10611-016-9610-1

Rose-Ackerman, S. & Palifka, B.J., 2016, *Corruption and government: Causes, consequences, and reform*, Cambridge University Press, Cambridge.

Seker, M. & Yang, J.S., 2012, *How bribery distorts firm growth: Differences by firm attributes*, The World Bank, Washington, DC.

Smirnov, N.V., 1939, 'On the estimation of the discrepancy between empirical curves of distribution for two independent samples', *Bulletin Mathematique de l'Universite de Moscou* 2(2), 3–14.

Smith, J., Obidzinski, K., Subarudi, S. & Suramenggala, I., 2012, 'Illegal logging, collusive corruption and fragmented governments in Kalimantan, Indonesia', in L. Tacconi (ed.), *Illegal logging*, pp. 107–125, Routledge, Abingdon.

Svensson, J., 1999, *Who must pay bribes and how much? Evidence from a cross-section of firms*, The World Bank, Washington, DC.

Transparency International, 2018, *Global corruption report 2018: Corruption and the private sector*, ti@transparency.org, ISSN: 1749–3161, ISBN: 978-0-521-13240-4.

Vial, V. & Hanoteau, J., 2010, 'Corruption, manufacturing plant growth, and the Asian paradox: Indonesian evidence', *World Development* 38(5), 693–705. https://doi.org/10.1016/j.worlddev.2009.11.022

Wald, A., 1940, 'The fitting of straight lines if both variables are subject to error', *The Annals of Mathematical Statistics* 11(3), 284–300. https://doi.org/10.1214/aoms/1177731868

Williams, C.C. & Shahid, M.S., 2016, 'Informal entrepreneurship and institutional theory: Explaining the varying degrees of in formalization of entrepreneurs in Pakistan', *Entrepreneurship & Regional Development* 28(1–2), 1–25. https://doi.org/10.1080/08985626.2014.963889

World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.

Xu, G. & Yano, G., 2017, 'How does anti-corruption affect corporate innovation? Evidence from recent anti-corruption efforts in China', *Journal of Comparative Economics* 45(3), 498–519. https://doi.org/10.1016/j.jce.2016.10.001

Appendix starts on the next page →

Appendix 1

TABLE 1-A1: First stage regressions.

Variable	Just-identified model			Over-identified model		
	Coefficient	Standard error	*t*-statistic	Coefficient	Standard error	*t*-statistic
Productivity	1.374179	0.242763	5.66	1.398033	0.2634501	5.31
Age	3.127523	1.432115	2.18	0.1246374	0.0703682	1.77
Number of employees	-4.28E-06	2.06E-06	-2.08	-0.0000622	0.0000345	-1.8
Average education	-6.036141	2.584733	-2.34	-6.723485	2.661574	-2.53
Training	-6.173525	1.903379	-3.24	-6.16629	1.992131	-3.1
Mean bribe	4.496971	0.696935	6.45	5.546377	2.196012	2.53
Mean-reg	-	-	-	4.454908	0.7376406	6.04
_cons	-232.3541	41.07631	-5.66	-222.99	43.30366	-5.15
R-Squared	0.088	-	-	0.097	-	-

Source: Authors' estimations based on the World Bank, 2014, *Nigeria Enterprise Survey*, 2014, Ref. NGA_2014_ES_v01_M, The World Bank, Washington, DC.