

Casting a Shadow

Productivity of Formal Firms and Informality

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Abstract

Using firm-level survey data for a large cross section of countries, the paper assesses the gap in labor productivity between formal and informal firms in developing countries for which comparable data are available. It also investigates the impact of competition from informal firms on the labor productivity of formal firms. The results show that on average, the labor productivity of informal firms is about one-fourth that of formal firms. Moreover, the labor productivity of formal firms that face competition from

informal firms is about 75 percent of the average labor productivity of formal firms that do not experience informal competition. This suggests that competition from the informal sector can erode formal firms' market share and the resources available to boost productivity where formal firms shoulder the additional cost of regulatory compliance. These findings are robust to a range of firm and country characteristics as well as checks for endogeneity concerns.

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Casting a Shadow: Productivity of Formal Firms and Informality

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1. Introduction

Understanding informality—a prominent feature of most developing economies—and its economic implications is of paramount importance for poverty-reducing and welfare-enhancing policies. Indeed, informal businesses absorb a substantial share of the unskilled labor force. Nearly 70 percent of the labor force in emerging markets and developing economies (EMDEs) work informally (International Labour Organization 2018). Moreover, small start-ups often use the informal sector as a stepping stone towards formalization (Nguimkeu 2014). Burdensome regulations (De Soto 1989), exit strategies (Farrell 2004), and survival motives (La Porta and Shleifer 2014) can shape differently the informal or shadow economy through its intensive (workers) and extensive (firms) margins (Ulyssea 2018). Despite the pervasiveness of informality in developing countries, empirical evidence on several key issues pertaining to the informal economy remain to be explored, in part due to data limitations. The paper attempts to fill this gap in the literature by analyzing the labor productivity of informal firms vis-à-vis formal firms and assessing the relationship between competition from informal firms and formal firms' productivity. Our results, based on firm-level survey data from a large cross-section of countries, show that labor productivity is substantially lower for informal firms compared to formal firms, and that the competition from informal firms is negatively related with the labor productivity of formal firms. On average, the labor productivity of informal firms is about one-fourth of that of formal firms. Moreover, the labor productivity of formal firms that face competition from informal firms is about 75 percent of the average labor productivity of formal firms that do not experience informal competition.

The productivity differential between formal and informal firms is a well-established stylized fact (Loayza and Rigolini 2006; Oviedo 2009). Available evidence suggests that compared

to formal firms, labor productivity of informal firms in emerging and developing economies is lower by 30 to 216 percent (Perry et al. 2007; La Porta and Shleifer 2008). This productivity gap is often attributed to modest technological improvements, reliance on unskilled labor, limited economies of scale, and restricted access to services, markets, and funding.¹ Nonetheless, most studies focus on a specific country or a small group of countries. Thus, more work is needed to ascertain (or reject) the cross-country robustness of these findings.

Another strand of the literature investigates how competition from informal firms affects the functioning of firms in the formal sector. The informal sector can have both beneficial and adverse spillovers on the formal sector (Fisman and Svensson 2007). The competition from informal firms can stimulate formal firms to become more productive —innovation, quality upgrading— as a differentiation strategy. Informal competition might also put a limit on rent-seeking bureaucracy and curb inefficient regulations (Sarte 2000). In contrast, aggressive informal competition can reduce the market share and weigh on the productivity of businesses that operate formally (Johnson et al 2000). The adverse impacts of informal competition can occur via different channels such as underinvestment (Gonzalez and Lamanna 2007), reduction of tax base (Schneider and Enste 2000), and social costs (Loayza 1996; Dabla-Norris and Inchauste 2008).

In the same vein, the empirical literature does not provide a clear guidance on how the formal-informal divide affects the performance of formal firms. On the one hand, some studies suggest that the informal and formal sectors operate independently so that there are no productivity spillovers (La Porta and Shleifer 2008, 2014). This is likely to be the case when the informal activity stems from a survival motive. Low-productivity firms may be forced into informal operations or, even if they operate formally, employing informal workers because this reduces

¹ Jovanovic (1982); Amaral and Quintin (2006); Galiani and Weinschelbaum (2012).

their costs (Ulyssea 2018; Boly 2018). These “surviving” informal firms are likely to operate in very different markets and sell different products than formal firms (La Porta and Shleifer 2014). In such circumstances, competition between informal and formal firms and its impact on formal firms may be limited or even non-existent. On the other hand, given the formal-informal nexus, other studies report that competition from the informal sector may hinder the profitability of firms that operate in the formal sector, limiting the resources available to firms to enhance their productivity (Gonzalez and Lamanna 2007; Heredia et al. 2017; Mendi and Costamagna 2017). This is likely to occur when informal firms are sufficiently productive to survive in the formal sector yet choose to remain informal to benefit from the cost advantage of noncompliance with — possibly excessive— taxes and regulations (Maloney 2004; de Mel, McKenzie, and Woodruff 2011).² Even though such informal firms could constitute an untapped potential for a productivity boost (De Soto 1989), they can create aggressive competition with formal firms that bear the additional cost of tax and regulatory compliance. An intense informal competition can reduce the profitability necessary for formal firms to invest in new productivity-enhancing technologies or to innovate, especially in a context of weak property rights enforcement.³ It may also force the lowest-productivity formal firms to exit.⁴

This paper combines the World Bank’s Enterprise Surveys data, which cover formal firms, with surveys on informal businesses conducted by the World Bank in selected countries to document the labor productivity gap and the interactions between formal and informal firms in

² Such circumstances are likely to be associated with an environment of weak regulatory and tax enforcement (Quintin 2008; Dabla-Norris et al. 2008; Ulyssea 2010; Benjamin and Mbaye 2012).

³ This has been documented for some Latin America countries, India, Poland, Portugal, the Russian Federation, and Turkey. For evidence, see Heredia et al. (2017), Perry et al. (2007), Farrell (2004), Capp et al. (2005), Cunha (2006), Gonzalez and Lamanna (2007), Friesen and Wacker (2013), Allen and Schipper (2016), Iriyama, Kishore, and Talukda (2016), and Distinguin, Rugemintwari, and Tacneng (2016).

⁴ This has been documented for the Arab Republic of Egypt, see Ali and Najman (2017), Melitz (2003), and Schipper (2016).

emerging markets and developing economies.⁵ We contribute to the related literature in several ways. First, using a large cross-section of developing countries, we provide new evidence on the labor productivity gap between formal and informal firms and the impact of informal competition on the labor productivity of formal firms. Second, we pay due attention to potential endogeneity concerns in estimating the impact of informal competition on the productivity of the formal firm. To this end, we proxy the informal competition faced by a given formal firm, using the level of informal competition experienced by other formal firms in the same size-industry-location category. As discussed below and argued in the literature, this strategy helps substantially mitigate endogeneity concerns. Third, the World Bank's Enterprise Surveys are conducted using a harmonized sampling methodology and questionnaire that facilitate cross-country comparability, while allowing to control for heterogeneity across data points within a country. Previous studies using micro data are largely restricted to a single country or a narrow set of countries for which comparable data are available. Thus, it is not clear whether the related findings are general enough to be inferred to other countries.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the data and main variables. Section 3 presents the drivers of productivity differential between formal and informal firms. Section 4 assesses the impact of informal competition on the productivity of formal firms. Section 5 concludes.

⁵ Table 1 gives a list of countries selected in the sample, for which data on formal and informal firms are available.

2. Data description and main variables

2.1 Data and empirical strategy

We define informality as the lack of formal registration of firms. Simply put, unregistered firms belong to the informal sector whereas formal firms are those that comply with licensing regulations and register with the relevant authorities. Even though alternative definitions of informality exist, our definition is practically appealing because it can be implemented in various economic contexts. The merits and limitations of various definitions of informality are discussed in Mead and Morrisson (1996) and Benjamin and Mbaye (2012) among others.

We use firm-level data from the World Bank's Enterprise Surveys (ES) on formal or registered firms with 5 or more employees. These surveys are representative of the non-agricultural and non-financial registered private economy –excluding firms with fewer than 5 employees. A common sampling methodology –stratified random sampling– and a harmonized questionnaire are used in all surveyed countries. This data set of formal firms is complemented with data on informal businesses –that are not registered with the relevant authorities. Data on informal businesses come from World Bank surveys carried out –using a random sampling scheme– in a few business centers (cities) in some countries, which may limit their representativeness.⁶ We extend these data with the World Bank's World Development Indicators and other sources discussed below.

The country coverage of the sample used in the empirical analysis varies. The harmonized informality surveys are available for 18 countries and are used for the assessment of formal versus informal productivity gap. The sample includes 3,291 informal firms and 7,326 formal firms. The informal enterprise surveys were carried out between 2009 and 2014, whereas data on formal firms

⁶ Most recent World Bank surveys on informal businesses in Zimbabwe, Mozambique and the Lao People's Democratic Republic are representative. These countries are not included in this study.

were collected between 2007 and 2012. In each country, we use the latest round of ES available. Table 1 provides the list of countries along with the sample size of informal and formal firms.

To analyze the relationship between labor productivity of formal firms and competition they face from informal firms, we use ES data only for formal firms. The sample size here consists of 45,996 firms located in 125 countries. These surveys were conducted between 2008 and 2016. As alluded to above, we use the latest round of ES available in each country (Table 2).

Sampling weights are only available for formal enterprise surveys, because they are representative, and are used throughout the analysis. The weights are normalized so that they add up to 1 for each country. For informal firm surveys, sampling weights are not provided since they are not representative in the selected countries. Therefore, we assign a weight of 1 to each informal firm as commonly done in self-weighted surveys. The weights are normalized so that they add up to 1 for each country. Robust standard errors are reported for all our regressions.

2.2 Dependent variable

The dependent variable in all our regressions is firm-level labor productivity measured by (log of) total sales of the firm in a typical month during the last fiscal year divided by the number of workers at the firm.⁷ Total sales are deflated and expressed in 2009 USD to ensure comparability across countries.⁸ For the sample of 18 countries used to gauge the labor productivity gap between formal and informal firms, the average value of labor productivity (in logs) equals 8.5 and the standard deviation is 1.8. The variable ranges between -0.95 and 20.4. For the sample of 125 countries used

⁷ For the informal surveys, total sales and employment information is available for a typical month in the last year. For the formal surveys, information is available only on total annual sales during the last fiscal year and total number of permanent workers employed by the firm at the end of the last fiscal year. Therefore, we divide the annual sales of formal firms by 12 to obtain average monthly sales.

⁸ Commonly used revenue-based measures of productivity may conflate efficiency and price effects. Disentangling efficiency and price effects, by relying on physical productivity measures, may yield distinct and finer productivity patterns, especially at the firm level (Jones and Nordhaus 2008; Cusolito and Maloney 2018).

for estimating the relationship between labor productivity and competition from informal firms, the mean value of labor productivity (in logs) equals 9.64 and the standard deviation is 1.82. The variable ranges between 0.87 and 20.41.

2.3 Main explanatory variables

To assess the labor productivity gap between formal and informal firms, the main explanatory variable is a dummy that takes 1 if the firm is informal and 0 otherwise. For the relationship between labor productivity and competition from informal firms, the main explanatory variable is a measure of competition. Specifically, the ES ask formal firms if they compete against informal firms or not. Using this variable directly in the regressions is problematic as it is likely to be endogenous to various firm characteristics. Moreover, the labor productivity of a firm may drive whether the firm faces competition from informal firms –henceforth, informal competition– or not – reverse causality problem.

To address the endogeneity problem, one practically appealing solution suggested in the literature is to proxy informal competition faced by a formal firm with the average level of informal competition experienced by all other formal firms –other than the firm in question– in the same location, industry and size group. This group of firms with similar location-industry-size characteristics is often referred to as a cell. The rationale for using a cell-based indicator of informal competition is simple: a reverse causality running from a formal firm’s productivity to the informal competition experienced by other formal firms in the same cell is highly unlikely (see for example, Aterido et al. 2011).⁹ Using the cell average also helps control for potential measurement errors if some firms choose not to respond, misstate the informal competition that

⁹ A cell-based indicator of informal competition minimizes but does not completely rule out the possibility of reverse causality.

they experience, or misreport their regulatory burden (Pounov 2016). Fisman and Svensson (2007) exploit Enterprise Surveys data for Uganda and rely on cell-based instruments to estimate how bribery and taxation affect the growth rate of a firm's sales. Their dependent variable is the annual growth rate of firm's sales over the last three years. Their main explanatory variables are bribery and tax rates measured by the reported amounts of bribes and taxes paid by the firm, expressed as shares of firm's annual sales. To deal with endogeneity concerns, the authors instrument for bribery and tax rates of each firm using averages of these variables over all other firms in each of the 42 industry-location cells. Other studies such as De Rosa et al. (2010) and Dollar et al. (2006) also use cell averages of other firms as instruments.

In constructing the cells, a choice must be made about location, industry and size. Location could either be the country or the city –sub-national sampling region in our case– where the firm is located. Similarly, industry selection could be made at the 2-digit level or at a more disaggregated level. There are both advantages and disadvantages of a narrow grouping. Consider, for example the choice of country vs. city for location. The advantage of using city-industry instead of country-industry cells is that firms in a narrower physical location (city) are more likely to experience similar levels of corruption than firms located further apart from each other. The disadvantage is that there are fewer firms in a city-industry cell than in a country-industry cell, making the average at the city-industry level less reliable than at the country-industry level.

Based on the discussion above, we define the level of informal competition faced by a formal firm as the proportion of all firms in the region-industry-size cell excluding the firm in question that report competing against informal firms. For firm-size, we use the ES classification of small (fewer than 20 employees), medium (20-99 employees) and large (100 or more employees). For region, we use the sub-national regions that match the ES strata. For industry, we

use the 2-digit ISIC Rev. 3.1 groupings. This yields 47 industry groups, 552 location groups and 3 firm-size groups. We exclude all cells with fewer than 3 observations.

To further address endogeneity concerns, we control for several characteristics that could be potentially correlated with both labor productivity –our dependent variable– and our main explanatory variable. Our set of controls is described in the next section.

It worth mentioning that our results are based on cross-sectional data. Hence, despite the endogeneity checks, our findings cannot be treated as truly causal. A richer data set –including time dimension– than the one used in this paper is needed to fully ascertain (or reject) causality.

3. Productivity gap between formal and informal firms

3.1 Preliminary look at the labor productivity gap

Before turning to the regression results, we provide some descriptive evidence on the magnitude and cross-country robustness of the productivity gap. Table 3 shows the median difference in labor productivity between formal and informal firms (column 7). The results show labor productivity is significantly lower for informal than formal firms in all the countries considered individually, except for Cabo Verde and the Democratic Republic of Congo. There is wide variation in the size of the productivity gap across countries. At the lower end, in Côte d’Ivoire, labor productivity of the median informal firm is lower by about 48 percent than for a formal firm. At the higher end is Argentina, where the median labor productivity of informal firms is lower by about 93 percent than for the formal firms. On average across the whole sample, the productivity of informal firms is lower by over 79 percent than for formal firms. Figure 1 offers a graphical illustration of this evidence.

Table 3 also compares the level of labor productivity between informal firms of different types such as firms whose owners have higher education vs. those that do not, male- vs. female-owned firms, et cetera (columns 1-6). The goal is to explore the degree of heterogeneity in the productivity of informal firms. We do find significant productivity differences within the informal sector associated with the education level of the firm owner, firm size, access to finance, to cite a few. We provide additional evidence on how the productivity gap between informal and formal firms may vary with basic firm characteristics such as age, size, et cetera (Figure 1).

3.2 Empirical specification and controls

The empirical estimation of the productivity gap relies on the following equation:

$$Y_i = \alpha + \beta X_i + \sum_{k=1}^K \gamma_k Z_{ik} + \sum_{k=1}^K \delta_k X_i Z_{ik} + CFE_i + \varepsilon_i, \quad (1)$$

where the subscript i denotes the firm, Y is the dependent variable (labor productivity), X is the main explanatory variable (informal firm dummy), $\{Z_k\}_{k=1}^K$ is a set of firm-level controls, XZ_k are interaction terms that aim to capture how the productivity gap may vary depending on basic firm characteristics such as firm's age, firm-size, et cetera (details below), CFE is country fixed effects, and ε is the error term. The equation is estimated using ordinary least squares (OLS) method with Huber-White robust standard errors.

We use a parsimonious structure of controls partly due to data limitations and to limited research on the drivers of productivity in the informal sector.¹⁰ Our choice of controls is guided by existing studies on the determinants of labor productivity, largely focused on formal firms.

¹⁰ The formal and informal surveys that we exploit are based on different questionnaires and, therefore, the overlap in the questions is limited to basic firm characteristics such as age, size, et cetera.

Our first set of controls includes dummy variables that indicate the country where the firm is located (country fixed effects). Thus, differences in overall economic development, financial development, and quality of macro-level institutions are purged from our estimation results.

Next, we control for firm-size (number of workers, logs). A greater allocative efficiency for larger firms and the presence of fixed costs that lead to economies of scale would imply a higher productivity for relatively larger firms (Tybout 2000; Bartelsman et al. 2013). However, the opposite case of diminishing labor productivity with firm-size is also possible due to decreasing returns to scale or diminishing returns to labor. Firm-size is also considered an important proxy measure for several firm attributes that could potentially affect labor productivity such as access to finance, access to raw materials and product markets, tendency to innovate, exporting activity, firm-efficiency and growth (see for example, Acs and Audretsch 1988; Cohen and Klepper 1996; Pagano and Schivardi 2003; Söderbom and Teal 2004; Diaz-Mayans and Sanchez 2008). Specific to the informal sector, Amin and Islam (2015) use Enterprise Surveys data on informal firms and find that labor productivity among informal firms declines sharply with firm-size. Informal firms are typically smaller compared to formal firms. Thus, the possibility of omitted variable bias resulting from the failure to control for firm-size cannot be ruled out.

The link between productivity and age of the firm has been extensively investigated. Age related effects among surviving firms can be explained by a range of factors, including scale economies gained from expansion over time, vintage effects due to younger firms employing new and improved technology or equipment, selection effects which weed out inefficient firms and imply higher productivity for the surviving older firms, and passive learning or learning by doing (see for example, Jovanovic 1982; Zimmerman 1982; Bahk and Gort 1993; Jensen et al. 2001;

Thompson 2005, 2010). If formal and informal firms differ systematically in their age, it could induce an omitted variable bias in our estimates.

Third, productivity differences can also arise across industries. If industries that have high productivity also happen to be the ones that have low or high ratios of informal to formal firms, our main results could suffer from omitted variable bias problems. To guard against this possibility, we control for a dummy variable equal to 1 if the firm is a manufacturing firm and 0 if it belongs to the services sectors.

Next, differences in the quality of management have been found to impact firm productivity (see for example, Bloom and Van Reenen 2007; Syverson 2011; Pfeifer 2015). Differences in education and experience of the top manager could be the possible factors driving differences in management quality. If the overall quality of the firm's top management varies systematically between formal and informal firms, our estimates could be subject to distortions due the omission of key firm characteristics. To address this concern, we control for the (log of) number of years of experience the top manager of the firm has working in the industry (Manager Experience).

Our last control is for the location of the firm within the country. Capital cities are typically among countries' largest economic centers and, therefore, can offer agglomeration benefits: larger markets, better infrastructure to access markets and operate, a larger pool of workers, and greater technology spillovers (Rosenthal and Strange 2004; Duranton and Puga 2004). This is likely to impact labor productivity positively. Thus, if the ratio of formal and informal firms varies systematically across large vs. small cities, our results could be spuriously affected. To guard against this problem, we control for a dummy variable equal to 1 if the firm is in the capital city of the country and 0 otherwise.

3.3 Base regression results

Our base regression results for the productivity gap are given in Table 4. These results show that irrespective of the controls, labor productivity is significantly lower for informal firms than for formal firms. The productivity differential is quantitatively large and roughly same with or without the various controls. Excluding controls, the estimated coefficient value of the informal firm dummy equals -1.43 and is significant at the 1 percent level (column 1). The coefficient value implies that the labor productivity of an informal firm is lower by about 76 percent compared to a formal firm. The coefficient value and, hence, the productivity gap remains almost unchanged when we control for the country fixed effects (column 2). The productivity gap increases when we control for firm-size (column 3) but it declines almost equally when we add the remaining firm-level controls to the specification (column 5). Thus, the estimated productivity gap is roughly the same with or without the various controls. Labor productivity of informal firms is lower by 76 percent than that of formal firms without any controls in place (column 1). The corresponding figure including all the controls in the specification is roughly same at 75 percent (column 5).

As expected, labor productivity is significantly higher for firms with more experienced managers, older firms, firms located in the capital cities vs. other areas, services sector firms vs. manufacturing, and the relatively smaller firms.¹¹

3.4 Interaction term results

Regression results relating the labor productivity gap to various firm characteristics are presented in Table 5. We start with the specification in Equation (1) –as in column 5 of Table 4– and add

¹¹ We also experimented by replacing the capital city dummy with a dummy that equals 1 if the firm is located in the capital city or a city with more than 1 million population and 0 otherwise (large city dummy). However, this did not change any of the results discussed in this section.

one by one the interaction terms between informal firm dummy and each of the following firm characteristics: age of the firm, firm-size, capital city dummy and manager experience. For convenience, the benchmark results without any interaction term –final specification discussed above– are reported in column 1 of Table 5.

Estimation results in Table 5 show sharp heterogeneity in the labor productivity gap depending on firm's age, size, location and manager experience. That is, the interaction term between the informal firm dummy and the firm characteristics is large, negative and statistically significant at the 1 percent level. Recall that firm's age, manager experience and being in capital city tend to boost labor productivity in the base results discussed above. The interaction term results suggest that the benefits of being older, possessing better managerial experience and being in the capital city are much smaller for informal firms than for the formal firms. Thus, the productivity gap between informal and formal firms is much larger for the relatively older firms, firms with more experienced managers and firms located in the capital city. Recall that labor productivity in our sample declines as firm-size increases. Results in Table 5 show that this decline in labor productivity is much bigger for informal firms than for the formal firms. Thus, the labor productivity gap between informal and formal firms becomes larger among the relatively large firms.

To get a sense of the magnitude, labor productivity of an informal firm is lower by 1.56 log points than that of a formal firm in the capital cities vs. 1.2 log points in the rest of the country. In other words, labor productivity of informal firms is lower by about 78.9 percent than that of formal firms in the capital cities of the countries under study; the corresponding figure in the rest of the country is lower at 69.9 percent.

4. Labor productivity of the formal firms that compete against the informal firms

4.1 Empirical specification and control variables

Recall that regression results for the relationship between labor productivity and whether a firm faces competition from informal firms (informal competition) are based on a sample of 45,966 formal (registered) firms. The estimation exercise involves two steps. In the first step, we regress labor productivity on the dummy for informal competition along with basic controls for firm and country characteristics. The equation we estimate is as follows:

$$Y_i = \alpha + \beta X_i + \sum_{k=1}^K \gamma_k Z_{ik} + CFE_i + \varepsilon_i \quad (2)$$

where the subscript i denotes the firm, Y is the dependent variable (labor productivity as defined above), X is the main explanatory variable that equals 1 if the firm reports competing against informal sector firms and 0 otherwise, $\{Z_k\}_{k=1}^K$ is a set of firm-level controls, CFE is country fixed effects, and ε is the error term. The equation is estimated using the ordinary least squares (OLS) method with Huber-White robust standard errors.

Since we now focus only on the formal firms, factors such as exporting activity and foreign ownership of firms may be important. Further, cross-country comparable data are available for these variables. Thus, the control variables included in Equation (2) are dummy variables indicating the country where the firm is located (country fixed effects); size of the firm measured by the (log of) total number of workers employed at the firm at the end of the last fiscal year; (log of) age of the firm; industry fixed effects captured by two dummy variables indicating if the firm belongs to the manufacturing sector or the retail sector (omitted category is other services sector);

dummy variable equal to 1 if the top manager of the firm is a female and 0 otherwise; exports as a proportion of firms' annual sales; and a dummy variable equal to 1 if 10 percent or more of the firm is owned by foreign individuals and companies and 0 otherwise. The motivation for country fixed effects, firm-size, age of the firm and industry has been discussed above. For the remaining variables, several studies have found a link between firm productivity and gender of the manager/owner of the firm for reasons such as difficulty that women face in obtaining finance, public services, etc. (Coleman 2000; Du Rietz and Henrekson 2000; Sabarwal and Terrell 2008). Exporting activity and foreign ownership have also been linked to productivity in several studies, although the direction of causality remains a debatable issue (Melitz 2003; Bernard and Jensen 1999; Wagner 2007). Thus, if the gender of the top manager, exporting activity and the foreign ownership of the firms happen to vary systematically with informal competition, our main results for the relationship between labor productivity and informal competition could suffer from the omitted variable bias problem. To guard against this possibility, we control for a dummy variable equal to 1 if the top manager of the firm is a female and 0 otherwise, proportion of firm's annual sales that is exported, and a dummy variable equal to 1 if foreigners own 10 percent or more of the firm and 0 otherwise.

The second part of the empirical analysis involves exploring the heterogeneity in the labor productivity and informal competition relationship. To this end, we replace country fixed effects in equation (2) with controls for some macro-level variables and their interaction terms with the dummy for informal competition. The choice of the macro-level variables is based on the existing literature on the determinants of productivity and includes the following: (log of) GDP per capita taken from World Development Indicators, World Bank; Control of Corruption measure from Worldwide Governance Indicators, World Bank (Corruption); Distance to the Frontier (DTF)

indicator for the extent of regulatory burden on the private firms obtained from the Doing Business project (World Bank); Business Freedom index obtained from Heritage Foundation's Economic Freedom in the World that aims to capture (lack of) government interference with the private sector. Note that higher values of the Corruption, DTP and Business Freedom index imply a better business environment (less corruption, less burdensome regulations for the private firms, and more freedom from government interference).

4.2 Base regression results

Our baseline regression results are provided in Table 6. These results focus on the linear relationship (without any interaction terms) between labor productivity and informal competition. Results with the interaction terms included are discussed in the next section.

Regression results in Table 6 show a large and statistically significant (at the 1 percent level) negative relationship between labor productivity and informal competition. This holds with or without the various controls and for all the specifications shown in Table 6. Excluding controls, the estimated coefficient value of the informal competition variable equals -0.767 (column 1). The estimated value implies that the labor productivity of firms experiencing the highest level of informal competition (equal to 1) is lower by 54 percent than the labor productivity of firms that face the lowest level of informal competition (equal to 0). Controlling for country fixed effect raises the estimated coefficient value of informal competition variable from -0.767 above to -0.178 (column 2). The sharp drop in absolute terms suggests that a large part of the negative labor productivity and informal competition relationship comes from across country rather than within country effects. Controlling for the various firm characteristics increases the estimated coefficient value of informal competition (in absolute terms) from -0.178 above to -0.268 (column 5). The

latter coefficient value implies that the labor productivity of a typical formal firm that faces the highest level (equal to 1) of informal competition is lower by about 24 percent than a firm that does not face any informal competition.

Regarding the various controls, higher exports and having foreign owners are associated with significantly higher labor productivity. Age of the firm is associated with significantly higher labor productivity while larger firm-size is associated with a significantly lower labor productivity. There are large differences in labor productivity across industries. Retail sector has the highest labor productivity followed by manufacturing and then other services. These differences across industries are all statistically significant.

4.3 Interaction term results

Table 7 contains the results for the interaction terms between informal competition and macro-level variables including (log of) GDP per capita (column 2), regulatory burden on the private firms as measured by the DTF variable (column 3), corruption (column 4) and the Business Freedom index (column 5). As above, we start with the final specification with all the controls discussed above included in the specification (column 1) and add the interaction terms one-by-one in separate regressions.

The results show that all the interaction terms are statistically significant at the 5 percent or 1 percent level. Thus, there is strong evidence of heterogeneity in the labor productivity and informal competition relationship. All the interaction terms are positive implying that greater economic development (higher values of GDP per capita) and better business environment (lower corruption, less burdensome regulations to the firms, and more freedom to businesses) tend to partly offset the otherwise negative relationship between informal competition and labor

productivity. For instance, the labor productivity of a firm that faces the least amount of informal competition (equal to 0) is lower by about 53 percent than for a firm that faces the maximum level of informal competition (equal to 1) in the poorest country in our sample. The corresponding figure for the richest country in our sample is only 17 percent. Note that the former is significant at the 1 percent level while the latter is insignificant at the 10 percent level or less. Figure 2 illustrates additional interaction effects.

5. Conclusion

The productivity gap between informal and formal firms is substantial, averaging 75 percent in a sample of 18 emerging and developing countries. Competition from informal firms also appears to weigh on the productivity of exposed formal firms: the productivity of formal firms that compete with informal firms is only three-quarters that of formal firms that do not compete with informal firms, after controlling for other firm characteristics. Improvements in the business climate, and economic development more broadly, can mitigate some of these negative productivity spillovers from informal to formal firms.

Our analysis offers a rigorous assessment of the impact of informal competition on the activity of exposed formal firms. However, more work remains to be done. First, we did not identify the channels through which competition from informal firms affects the labor productivity of the formal firms. The same holds for the channels through which informality affects the labor productivity gap (between formal and informal firms). Identifying the channels would help to sharpen policy responses to the challenges faced by the firms in the informal sector. It would also refine the interventions to curb the adverse spillovers of informal competition on the activity of formal firms. Second, our results for the impact of informal competition on formal firms can be

extended to other performance measures such as the growth rate of sales and employment, innovation, R&D activity and exporting activity. This is important to properly assess the full impact of the competition from informal firms on the functioning of formal firms. The present paper is a step in that direction and we leave other avenues for future research.

References

- Acs, Z. J., & Audretsch, D. (1988). Innovation in Large and Small Firms: An Empirical Analysis. *American Economic Review*, 78 (4): 678-690.
- Allen, J., & Schipper, T. (2016). Understanding the Informal Sector: Do Formal and Informal Firms Compete? Mimeograph.
- Ali, N., & Najman, B. (2017). Informal Competition, Firms' Productivity and Policy Reforms in Egypt. In Horodnic, I. A., Rodgers, P., Williams, C. C., & Momtazian, L. (Eds) *The Informal Economy: Exploring Drivers and Practices*. Abingdon, UK: Routledge (in press).
- Amaral, P., & Quintin, E. (2006). A Competitive Model of the Informal Sector. *Journal of Monetary Economics*, 53 (7): 1541 – 1553.
- Amin, M., and Islam, A. (2015). “Are Large Informal Firms More Productive than the Small Informal Firms? Evidence from Firm-level Surveys in Africa.” *World Development* 74: 374-385.
- Aterido, R., Hallward-Driemeier, M., & Pages, C. (2011). Big Constraints to Small Firms' Growth? Business Environment and Employment Growth Across Firms. *Economic Development and Cultural Change*, 59 (3): 609 – 647.
- Bahk, B. K., & Gort, M. (1993). Decomposing Learning by Doing in New Plants. *Journal of Political Economy*, 101 (4): 561 – 583.
- Bartelsman, E., Haltiwanger, J., & Scarpetta, S. (2013). Cross-Country Differences in Productivity: The Role of Allocation and Selection. *American Economic Review*, 103 (1): 305 – 334.
- Benjamin, N., & Mbaye, A. (2012). The Informal Sector, Productivity, and Enforcement in West Africa: A Firm-level Analysis. *Review of Development Economics*, 16 (4): 664 – 680.
- Bernard, A. B., & Jensen, J. B. (1999). Exceptional Exporter Performance: Cause, Effect, or Both? *Journal of International Economics*, 47 (1): 1 – 25.
- Bloom, N., & Van Reenen, J. (2007). Measuring and Explaining Management Practices across Firms and Countries. *Quarterly Journal of Economics*, 122 (4): 1351 – 1408.
- Boly, A. (2018). On the Short- and Medium-Term Effects of Formalisation: Panel Evidence from Vietnam. *The Journal of Development Studies*, 54 (4): 641 – 656.
- Capp, J., Elstrodt, H., & Jones Jr., W. (2005). Reining in Brazil's Informal Economy. *McKinsey Quarterly*. Available at <http://www.mckinseyquarterly.com>.
- Cohen, W. M., & Klepper, S. (1996). A Reprise of Size and R&D. *Economic Journal*, 106 (437): 925 – 951.

- Coleman, S. (2000). Access to Capital and Terms of Credit: A Comparison of Men- and Women-owned Small Businesses. *Journal of Small Business Management*, 38 (3): 37 – 52.
- Cunha, B. (2006). Informality, Productivity and Growth. World Bank, Washington, DC.
- Cusolito, A. P., & Maloney, W. F. (2018). Productivity Revisited: Shifting Paradigms in Analysis and Policy. World Bank, Washington, DC.
- Dabla-Norris, E., Gradstein, M., & Inchauste, G. (2008). What Causes Firms to Hide Output? *Journal of Development Economics*, 85 (1-2): 1 – 27.
- Dabla-Norris, E., & Inchauste, G. (2008). Informality and Regulations: What Drives Firm Growth? *IMF Staff Papers*, 55 (1): 50 – 82.
- De Rosa, D., Gooroochurn, N., & Görg, H. (2010). Corruption and Productivity: Firm-level Evidence from the BEEPS Survey. World Bank Policy Research Working Paper 5348, The World Bank, Washington DC.
- De Mel, S., McKenzie, D., & Woodruff, C. (2011). What is the Cost of Formality? Experimentally Estimating the Demand for Formalization. Working Paper, University of Warwick, Coventry.
- De Soto, H. (1989). *The Other Path: The Invisible Revolution in the Third World.* New York, NY: Harper and Row.
- Diaz-Mayans, M. A., & Sánchez, R. (2008). Firm Size and Productivity in Spain: A Stochastic Frontier Analysis. *Small Business Economics*, 30 (3): 315 – 323.
- Distinguin, I., Rugemintwari, C., & Tacneng, R. (2016). Can Informal Firms Hurt Registered SMEs' Access to Credit? *World Development*, 84: 18 – 40.
- Dollar, D., Hallward-Driemeier, M., & Mengistae, T. (2006). Investment Climate and International Integration. *World Development*, 34 (9): 1498 – 1516.
- Du Rietz, A. & Henrekson, M. (2000). Testing the Female Underperformance Hypothesis. *Small Business Economics*, 14 (1): 1 – 10.
- Duranton, G., & Puga, D. (2004). Chapter 48—Micro-Foundations of Urban Agglomeration Economies. *Handbook of Regional and Urban Economics*, 4: 2063 – 2117.
- Farrell, D. (2004). The Hidden Dangers of Informal Economy. *McKinsey Quarterly*, 3: 27 – 37.
- Fisman, R., & Svensson, J. (2007). Are Corruption and Taxation Really Harmful to Growth? Firm Level Evidence. *Journal of Development Economics*, 83 (1): 63 – 75.

Friesen, J., & Wacker, K. (2013). Do Financially Constrained Firms Suffer from More Intense Competition by the Informal Sector? Firm-Level Evidence from the World Bank Enterprise Surveys. Courant Research Centre. Discussion Paper No. 139.

Galiani, S., & Weinschelbaum, F. (2012). Modeling Informality Formally: Households and Firms. *Economic Inquiry*, 50 (3): 821 – 838.

Gonzalez, A., & Lamanna, F. (2007). Who Fears Competition from Informal Firms? Policy Research Working Paper Series 4316, World Bank, Washington DC.

Heredia, J., Flores, A., Geldes, C., & Heredia, W. (2017). Effects of Informal Competition On Innovation Performance: The Case of Pacific Alliance. *Journal of Technology Management and Innovation*, 12 (4): 22 – 28.

International Labour Organization (2018). Women and Men in the Informal Economy: A Statistical Picture. Third edition. Geneva: International Labor Office.

Iriyama, A., Kishore, R., & Talukda, D. (2016). Playing Dirty or Building Capability? Corruption and HR Training As Competitive Actions to Threats from Informal and Foreign Firm Rivals. *Strategic Management Journal*, 51 (2): 315 – 334.

Jensen, J. B., Robert H. M., & Stiroh, K. J. (2001). The Impact of Vintage and Survival on Productivity: Evidence from Cohorts of U.S. Manufacturing Plants. *Review of Economics and Statistics*, 83 (2): 323 – 332.

Johnson, S., Kaufmann, D., McMillan, J., & Woodruff, C. (2000). Why Do Firms Hide? Bribes and Unofficial Activity After Communism. *Journal of Public Economics*, 76 (3): 495 – 520.

Jones, I. C., & Nordhaus, W. (2008). Comment on La Porta and Shleifer “The Unofficial Economy and Economic Development.” *Brookings Papers on Economic Activity*, (2): 353 – 363.

Jovanovic, B. (1982). Selection and Evolution of Industry. *Econometrica*, 50 (3): 649 – 670.

La Porta, R., & Shleifer, A. (2008). The Unofficial Economy and Economic Development. *Brookings Papers on Economic Activity*, Fall: 275 – 352.

La Porta, R., and Shleifer, A. (2014). Informality and Development. *Journal of Economic Perspectives*, 28 (3): 109 – 126.

Loayza, N. (1996). The Economics of the Informal Sector. A Simple Model and Some Empirical Evidence from Latin America. *Carnegie-Rochester Conference Series on Public Policy*, 45: 129-162.

Loayza, N., & Rigolini, J. (2006). Informality Trends and Cycles. Policy Research Working Paper 4078, World Bank, Washington, DC.

- Maloney, W. F. (2004). Informality Revisited. *World Development*, 32 (7): 1159 – 1178.
- Mead, D. C., & Morrisson, C. (1996). “The Informal Sector Elephant.” *World Development*, 24 (10): 1611 – 1619.
- Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica* 71 (6): 1695 – 1725.
- Mendi, P., & Costamagna, R. (2017). Managing Innovation Under Competitive Pressure From Informal Producers. *Technological Forecasting and Social Change*, 114: 192 – 202.
- Nguimkeu, P. E. (2014). A Structural Econometric Analysis of The Informal Sector Heterogeneity.” *Journal of Development Economics*, 107: 175 – 191.
- Oviedo, A. M. (2009). Economic Informality: Causes, Costs, and Policies, A Literature Survey of International Experience. World Bank, Washington, DC.
- Pagano, P., & Schivardi, F. (2003). Firm Size Distribution and Growth. *The Scandinavian Journal of Economics*, 105 (2): 255 – 274.
- Perry, G. E., Maloney, W. F., Arias, O. S., Fajnzylber, P., Mason, A. D., & Saavedra-Chanduvi, J. (2007). Informality: Exit and Exclusion. World Bank, Washington, DC.
- Pfeifer, C. (2015). The Nexus Between Top Managers’ Human Capital and Firm Productivity. *Applied Economics Letters*, 22 (12): 982 – 986.
- Pounov, C. (2016). Corruption’s Asymmetric Impacts on Firm Innovation. *Journal of Development Economics*, 118: 216 – 231.
- Quintin, E. (2008). Contract Enforcement and The Size of The Informal Economy. *Economic Theory*, 37: 395 – 416.
- Rosenthal, S. S., & Strange, W. C. (2004). Chapter 49—Evidence on the Nature and Source of Agglomeration Economies. *Handbook of Regional and Urban Economics*, 4: 2119 – 2171.
- Sabarwal, S., & Terrell, K. (2008). Does Gender Matter for Firm Performance? Evidence from Eastern Europe and Central Asia. IZA Discussion Paper Series No. 3758, IZA.
- Schipper., T. (2016). Informality, Innovation, and Aggregate Productivity Growth. Mimeograph.
- Schneider, F., & Enste, D. H. (2000). Shadow Economies: Size, Causes, and Consequences. *Journal of Economic Literature*, 38: 77 – 114.
- Söderbom, M., & Teal, F. (2004). Size and Efficiency in African Manufacturing Firms: Evidence from Firm-Level Panel Data. *Journal of Development Economics*, 73 (February): 369 – 94.

Syversen, C. (2011). What Determines Productivity? *Journal of Economic Literature*, 49 (2): 326 – 365.

Thompson, P. (2005). Selection and Firm Survival: Evidence from the Shipbuilding Industry, 1825-1914. *The Review of Economics and Statistics*, 87 (1): 26 – 36.

Thompson, P. (2010). Learning by Doing. In Hall, B. H., & Rosenberg, N. (Eds.) *Handbook of the Economics of Innovation*, Volume 1, pp: 429–476.

Tybout, J. R. (2000). Manufacturing Firms in Developing Countries: How Well Do They Do, And Why? *Journal of Economic Literature*, 38 (1): 11 – 44.

Ulyssea, G. (2010). Regulation of Entry, Labor Market Institutions and The Informal Sector. *Journal of Development Economics*, 91: 87 – 99.

Ulyssea, G. (2018). Firms, Informality, and Development: Theory and Evidence from Brazil. *American Economic Review*, 108 (8): 2015 – 2047.

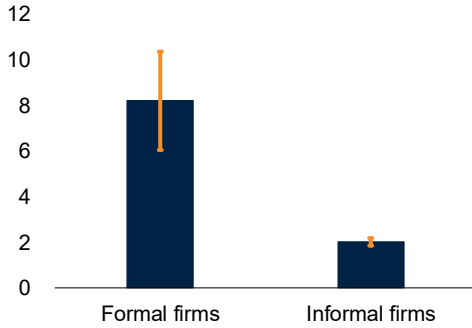
Wagner, J. (2007), Exports and Productivity: A Survey of the Evidence from Firm Level Data. *The World Economy*, 30 (12): 60 – 82.

Zimmerman, M. (1982). Learning Effects and the Commercialization of New Energy Technologies: The Case of Nuclear Power. *Rand Journal of Economics*, 13 (2): 297 – 310.

Figure 1. Productivity gap between formal and informal firms

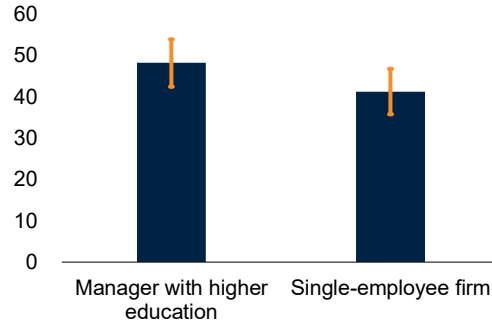
A. Average productivity in formal and informal firms

U.S. dollars per worker, thousands



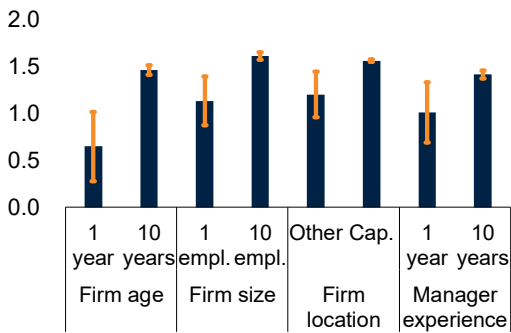
B. Productivity differential between different types of informal firms

Percent



C. Productivity differential between formal and informal firms, by type of informal firm

Log productivity differential



Source: Enterprise Surveys, World Bank.

Notes: Labor productivity is defined as the annual sales in 2009 U.S. dollars per worker.

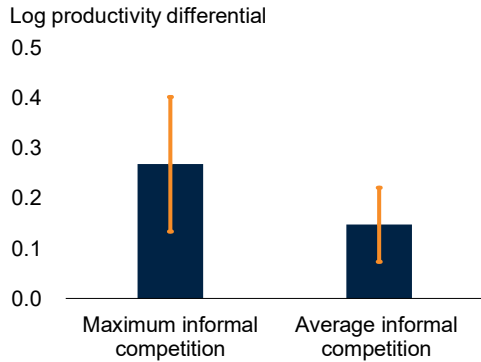
A. Labor productivity in the average formal and average informal firm, controlling for firm characteristics (firm size and age, manufacturing sector activity, location in the capital city and country fixed effects) as shown in column (5) in **Table 4**.

B. Cross-country average of percent difference between labor productivity in the median informal firm with a manager with higher education or without any employees other than the owner, and the median informal firm with a manager without higher education or with more employees than the owner. Estimates from **Table 3**.

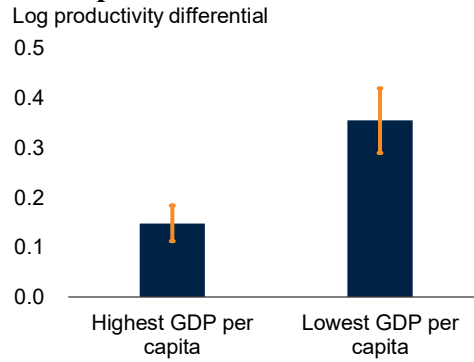
C. Difference in log of labor productivity between the average formal and average informal firm in each group, as estimated in coefficient estimates of **Table 4**. “Other” stands for “not located in capital city”; “Cap.” stands for “located in capital city.”

Figure 2. Productivity of formal firms facing informal competition

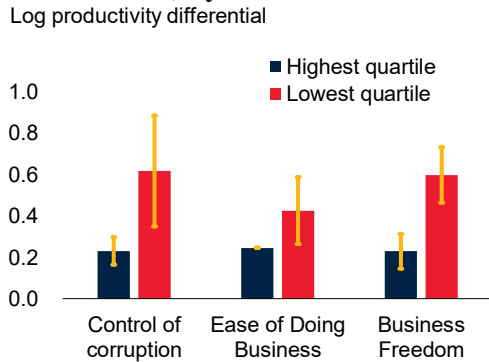
A. Productivity differential of formal firms with and without informal competition, by intensity



B. Productivity differential of formal firms with average informal competition and without, conditional on level of development



C. Productivity differential of formal firms with average informal competition and without, by business climate indicator



Source: World Bank.

Notes: Based on coefficient estimates from **Table 7**.

A. Figure shows log productivity differential between formal firms facing informal competition and formal firms not facing informal competition. Maximum informal competition assumes that all firms in a cell face informal competition; average informal competition assumes that 55 percent of firms in a cell face informal competition.

B.C. Figures shows log productivity differential between formal firms facing informal competition and formal firms not facing informal competition, conditional on development and institutional quality. Assumes that 55 percent of firms in a cell face informal competition. Each bar conditions on the GDP per capita (B), control of corruption (C), ease of doing business (C), or business freedom index (C) of the median country in the top (“highest quartile”) or bottom (“lowest quartile”) quarter of countries in terms of GDP per capita, control of corruption, ease of doing business or business freedom index.

Table 1: Sample of countries for formal vs. informal labor productivity comparison

Country	Number of informal firms	Number of formal firms
Angola	75	159
Argentina	138	909
Botswana	78	225
Burkina Faso	80	325
Cabo Verde	57	121
Cameroon	116	332
Congo, Dem. Rep.	344	438
Côte d'Ivoire	77	425
Ghana	553	504
Guatemala	217	422
Kenya	384	600
Madagascar	125	346
Mali	65	175
Mauritius	80	322
Myanmar	222	521
Nepal	108	343
Peru	232	891
Rwanda	340	178
All countries	3,291	7,296

Table 2: List of countries and sample size use for the relationship between labor productivity and competition from informal firms

Country	Number of firms	Country	Number of firms	Country	Number of firms
Afghanistan	73	Georgia	174	Panama	139
Albania	225	Ghana	443	Papua New Guinea	21
Angola	129	Grenada	115	Paraguay	231
Antigua and Barbuda	104	Guatemala	368	Peru	617
Argentina	453	Guinea	59	Philippines	960
Armenia	165	Guyana	108	Poland	214
Azerbaijan	191	Honduras	190	Romania	246
Bahamas, The	89	Hungary	96	Russian Federation	1,806
Bangladesh	1,231	India	7,931	Rwanda	150
Barbados	80	Indonesia	986	Senegal	337
Belarus	126	Iraq	589	Serbia	219
Belize	116	Israel	315	Sierra Leone	90
Benin	86	Jamaica	227	Slovak Republic	71
Bhutan	148	Jordan	399	Slovenia	170
Bolivia	182	Kazakhstan	290	Solomon Islands	114
Bosnia and	183	Kenya	467	South Sudan	515
Botswana	179	Kosovo	72	Sri Lanka	362
Brazil	882	Kyrgyz	119	St. Kitts and Nevis	97
Burkina Faso	321	Lao PDR	250	St. Lucia	121
Burundi	109	Latvia	119	St. Vincent and the	105
Cabo Verde	128	Lebanon	309	Sudan	207
Cambodia	242	Lesotho	90	Suriname	131
Cameroon	237	Liberia	85	Eswatini	76
Central African	114	Lithuania	105	Sweden	435
Chad	129	Macedonia,	243	Tajikistan	167
Chile	816	Madagascar	60	Tanzania	266
China	1,501	Malawi	228	Thailand	671
Colombia	770	Malaysia	739	Timor-Leste	89
Congo, Dem. Rep.	370	Mali	90	Togo	96
Costa Rica	353	Mauritania	70	Trinidad and Tobago	241
Côte d'Ivoire	207	Mexico	1,069	Tunisia	368
Croatia	227	Moldova	236	Uganda	305
Czech Republic	114	Mongolia	225	Ukraine	137
Djibouti	162	Montenegro	55	Uruguay	163
Dominica	120	Morocco	202	Uzbekistan	279
Dominican Republic	172	Myanmar	461	Venezuela, RB	107
Ecuador	255	Namibia	242	Vietnam	667
Egypt, Arab Rep.	1,334	Nepal	386	West Bank and Gaza	334
El Salvador	497	Nicaragua	239	Yemen, Rep.	219
Eritrea	96	Niger	66	Zambia	494
Estonia	122	Nigeria	978	Zimbabwe	440
Ethiopia	579	Pakistan	407		

Table 3: Labor productivity differential between types of firms (Percent)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Informal firms						Informal versus formal firms
	Manager has higher education	Main owner is male	Services sector	Firm has bank loan	Single-employee firm	Young firm (<=5 years)	
Angola	45.8	70.0	44.9	-60.0	225.0	20.0	-75.5***
Argentina	25.0	200***	0.0	0.0	11.1	-16.7	-92.5***
Burkina Faso	-6.2	-6.2	28.6	6.7	66.7	-10.0	-79.8***
Botswana	89.4*	72.7**	-29.1	100.0	-35.0	-18.2	-89.8***
Côte d'Ivoire	0.0	25.0	66.7**	-40.0	50.0	40.0	-47.5*
Cameroon	-41.7*	36.4	77.8**	-24.0	140.0***	56.2**	-55.8***
Congo, Dem. Rep.	33.3	0.0	36.0**	50.0	50.0***	0.0	10.7
Cabo Verde	133.3	-25.0	185.7	1585**	566.7*	100.0	0.89
Ghana	0.0	12.5	0.0	25.0	66.7***	0.0	-51.8***
Guatemala	25.0	46.7***	33.3**	50.0	57.1***	-20.0	-86.0***
Kenya	50.0***	6.7	-40***	44.0**	12.0	-20.0**	-81.6***
Madagascar	40.0	-33.3	100***	33.3	60.0*	8.3	-88.1***
Mali	13.2	14.3	-19.4	31.4	57.1	-46.2**	-71.3***
Myanmar	80.0*	-11.1	63.6***	11.3	31.2	0.0	-89.1***
Mauritius	66.7*	6.7	114.3***	25.0	6.7	25.0	-82.9***
Nepal	11.1	0.0	0.0	33.3	150.0***	-16.7	-56.5***
Peru	28.6*	12.5	-50***	-11.1	2.9	-7.4	-74.2***
Rwanda	50.0***	28.6**	25.0*	-25.9	50.0***	-11.1	-91.4***
All countries	48.1***	10.2	8.2	20.0**	41.2***	-6.7	-79.4***

Source: World Bank.

Notes: Productivity differential between the median informal and the median formal firm (last column) or between median informal firms among different groups of firms (all other columns). For example, "Manager has higher education" shows the difference in the median productivity among informal firms with managers with higher education and the median productivity among informal firms with managers without higher education. Other firm characteristics are not controlled for. Hence, results are similar but not identical to column (1) in **Table 3**. Productivity is defined as annual sales (in 2009 U.S. dollars) relative to the number of workers. "All countries" is the unweighted average across each column. ***, **, * indicates statistical significance at the 1, 5, and 10 percent level.

Table 4: Base regression results for the Labor Productivity gap

Dependent variable: Labor productivity	(1)	(2)	(3)	(4)	(5)	(6)
Informal firm Y:1 N:0	-1.434*** (0.056)	-1.427*** (0.051)	-1.639*** (0.082)	-1.457*** (0.090)	-1.457*** (0.090)	-1.400*** (0.091)
Firm size (logs, workers)			-0.098*** (0.025)	-0.096*** (0.027)	-0.096*** (0.027)	-0.102*** (0.027)
Firm age (logs)				0.170*** (0.035)	0.170*** (0.035)	0.120*** (0.045)
Manufacturing Y:1 N:0				-0.382*** (0.056)	-0.382*** (0.056)	-0.402*** (0.056)
Manager experience (years, logs)						0.094** (0.040)
Capital city Y:1 N:0						0.201*** (0.061)
Country fixed effects	No	Yes	Yes	Yes	Yes	Yes
Constant	9.229*** (0.041)	9.226*** (0.039)	9.518*** (0.091)	9.237*** (0.118)	9.237*** (0.118)	9.013*** (0.131)
Number of observations	10,527	10,527	10,527	10,527	10,527	10,527
R-squared	0.152	0.270	0.274	0.288	0.288	0.291

Note: Standard errors in brackets. Significance is denoted by *** (1%), ** (5%), * (10%).

Table 5: Interaction term results for the labor productivity gap between formal and informal firms

	(1)	(2)	(3)	(4)	(5)
Informal firm Y:1 N:0	-1.400*** (0.091)	-0.648*** (0.184)	-1.131*** (0.131)	-1.200*** (0.121)	-1.008*** (0.160)
Firm age (logs)	0.120*** (0.045)	0.285*** (0.053)	0.118*** (0.045)	0.116** (0.045)	0.137*** (0.045)
Firm size (logs, workers)	-0.102*** (0.027)	-0.119*** (0.027)	-0.056* (0.032)	-0.104*** (0.028)	-0.108*** (0.028)
Manufacturing Y:1 N:0	-0.402*** (0.056)	-0.407*** (0.056)	-0.401*** (0.056)	-0.401*** (0.056)	-0.399*** (0.056)
Capital city Y:1 N:0	0.201*** (0.061)	0.190*** (0.061)	0.187*** (0.061)	0.394*** (0.087)	0.201*** (0.061)
Manager experience (logs, years)	0.094** (0.040)	0.141*** (0.041)	0.107*** (0.040)	0.091** (0.040)	0.190*** (0.055)
Informal firm * Firm age (logs)		-0.353*** (0.069)			
Informal firm * Firm size (logs, workers)			-0.208*** (0.066)		
Informal firm * Capital city Y:1 N:0				-0.360*** (0.114)	
Informal firm * Manager experience (logs, years)					-0.176*** (0.060)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	9.013*** (0.131)	8.552*** (0.164)	8.859*** (0.149)	8.909*** (0.139)	8.748*** (0.162)
Number of observations	10,527	10,527	10,527	10,527	10,527
R-squared	0.291	0.296	0.293	0.293	0.292

Source: World Bank.

Notes: Standard errors in brackets. Significance is denoted by *** (1 percent), ** (5 percent), * (10 percent). OLS regression with labor productivity as dependent variable, as proxied by annual sales (in 2009 U.S. dollars, logs) per worker, based on a sample using World Bank's Enterprise Survey data collected during 2007-14 for 4,036 informal firms and 7,558 formal firms in 18 countries. "Informal firm" is a dummy variable taking the value of 1 if a firm is unregistered and 0 otherwise.

"Manufacturing" is a dummy variable taking the value of 1 if a firm operates in the manufacturing sector and 0 otherwise.

"Capital city" is a dummy variable taking the value of 1 if a firm is located in the capital city and 0 otherwise.

Table 6: Informal competition and labor productivity

Dependent variable: Labor productivity (logs)	(1)	(2)	(3)	(4)	(5)
Informal Competition (cell-average)	-0.767*** (0.069)	-0.178*** (0.069)	-0.295*** (0.067)	-0.300*** (0.068)	-0.268*** (0.067)
Firm size (number of workers, logs)			-0.146*** (0.015)	-0.170*** (0.016)	-0.197*** (0.016)
Firm belongs to manufacturing sector: Yes 1 No 0			0.150*** (0.044)	0.135*** (0.045)	0.137*** (0.044)
Firm belongs to retail sector: Yes 1 No 0			0.702*** (0.044)	0.699*** (0.045)	0.695*** (0.045)
Firm's age (logs)				0.199*** (0.024)	0.208*** (0.023)
Top manager is female: Yes 1 No 0				-0.042 (0.049)	-0.051 (0.048)
Exports (proportion of sales)					0.268** (0.114)
Foreigners own 10% or more of the firm: Yes 1 No 0					0.638*** (0.063)
Country fixed effects	No	Yes	Yes	Yes	Yes
Constant	10.054*** (0.040)	8.822*** (0.220)	9.079*** (0.176)	7.715*** (0.228)	8.771*** (0.178)
Number of observations	50,289	50,289	49,490	46,900	45,996
R-squared	0.016	0.326	0.378	0.391	0.404

Note: Standard errors in brackets. Significance is denoted by *** (1%), ** (5%), * (10%).

Table 7: Labor productivity of formal firms facing informal competition

	(1)	(2)	(3)	(4)	(5)
Informal Competition	-0.268***	-1.642***	-1.919***	-0.574***	-1.657***
<i>(Proportion of firms in the cell that report competing with informal firms)</i>	(0.067)	(0.602)	(0.618)	(0.059)	(0.307)
Firm size (number of workers, logs)	-0.197***	-0.150***	-0.175***	-0.166***	-0.179***
	(0.016)	(0.017)	(0.019)	(0.019)	(0.020)
Firm's age (logs)	0.208***	0.215***	0.296***	0.286***	0.356***
	(0.023)	(0.026)	(0.032)	(0.029)	(0.032)
Firm belongs to manufacturing sector: Yes 1 No 0	0.137***	0.077*	0.164***	0.157***	0.139***
	(0.044)	(0.046)	(0.052)	(0.048)	(0.053)
Firm belongs to retail sector: Yes 1 No 0	0.695***	0.747***	0.896***	0.862***	0.879***
	(0.045)	(0.047)	(0.053)	(0.049)	(0.054)
Top manager is female: Yes 1 No 0	-0.051	-0.125**	-0.128*	-0.086	-0.063
	(0.048)	(0.058)	(0.073)	(0.067)	(0.070)
Exports (proportion of sales)	0.268**	0.403***	0.431***	0.385***	0.397***
	(0.114)	(0.117)	(0.145)	(0.133)	(0.148)
Foreigners own 10% or more of the firm: Yes 1 No 0	0.638***	0.836***	0.821***	0.658***	0.781***
	(0.063)	(0.062)	(0.070)	(0.066)	(0.074)
Log GDP per capita (PPP, 2009 Int'l Dollars)		0.631***			
		(0.043)			
Informal Competition * Log GDP per capita		0.138**			
		(0.067)			
Distance to Frontier (Doing Business)			0.031***		
<i>(Higher values imply better regulatory practices)</i>			(0.006)		
Informal Competition * DTF			0.022**		
			(0.010)		
Corruption (Governance Indicators)				0.574***	
<i>(Higher values imply less corruption)</i>				(0.048)	
Informal Competition * Corruption				0.177**	
				(0.085)	
Business Freedom index (Economic Freedom of the World)					0.015***
<i>(Higher values imply less regulation and more freedom for businesses)</i>					(0.003)
Informal Competition*Business Freedom index (Economic Freedom of the World)					0.016***
					(0.005)
Constant	8.771***	3.818***	7.469***	9.410***	8.163***
	(0.178)	(0.390)	(0.381)	(0.088)	(0.224)
Country fixed effects	YES	NO	NO	NO	NO
Number of observations	45,996	45,996	44,770	45,996	43,760
R-squared	0.404	0.259	0.184	0.191	0.154

Source: World Bank.

Notes: Standard errors in brackets. Significance is denoted by *** (1 percent), ** (5 percent), * (10 percent). OLS regression with labor productivity as dependent variable, as proxied by annual sales (in 2009 U.S. dollars) per worker, based on a sample of formal firms only using World Bank's Enterprise Survey data collected during 2007-14 for 4,036 informal firms and 7,558 formal firms in 18 countries. "Informal competition" is the share of firms in a cell (a group of firms of similar size in the same region and sector) that report competition from informal firms. It is worth mentioning that one could use a firm-level dummy rather than the proportion of formal firms in a cell to proxy informal competition. However, endogeneity concerns may arise because the informal competition faced by a specific firm may also be driven by its productivity. Therefore, the proportion of formal firms facing informal competition in a cell, which would be uncorrelated with the productivity of a specific firm, should be more robust to endogeneity concerns. "Manufacturing" is a dummy variable taking the value of 1 if a firm operates in the manufacturing sector and 0 otherwise. "Capital city" is a dummy variable taking the value of 1 if a firm is located in the capital city and 0 otherwise.