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An Obstacle For Creative Destruction

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BUSINESS INFORMALITY IN COLOMBIA: AN OBSTACLE FOR CREATIVE DESTRUCTION¹

Carolina Ydrovo Echeverry²

This version: January 18, 2010

Abstract

This document studies the effects of business informality in terms of distortions in resource absorption, particularly labor, by informal companies. It also assesses the consequences of lower demand for labor of informal firms over aggregate productivity. With firm level data from the DANE Micro-establishments Survey, a matching exercise between formal and informal firms is conducted. It was found that the latter hire fewer employees than formal firms with the same characteristics, including Total Factor Productivity. The matching results allow using counterfactual demands of labor of informal firms to calculate and compare the real and counterfactual aggregate productivity levels. The results indicate that if informal firms would demand the amount of employment demanded by similar formal firms, market share distribution of firms would improve and this would positively affect aggregate productivity.

Key Words: Informal sector, Labor demand, Factor demand, Aggregate productivity, Colombia.

JEL Classification: J23, O17, O47, D24.

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INFORMALIDAD EMPRESARIAL EN COLOMBIA: UN OBSTÁCULO A LA DESTRUCCIÓN CREATIVA

Carolina Ydrovo Echeverry

Resumen

Este documento estudia los efectos de la informalidad empresarial en términos de distorsiones en la absorción de recursos, en particular de trabajo, por parte de las firmas informales. También evalúa las consecuencias de la menor demanda de trabajo de las firmas informales sobre la productividad agregada. A partir de datos a nivel de la firma de la Encuesta de Microestablecimientos del DANE, se realiza un ejercicio de emparejamiento entre firmas formales e informales. Se encuentra que estas últimas contratan menos empleados que firmas formales con iguales características, entre éstas productividad total de los factores. Los resultados del emparejamiento permiten usar las demandas de trabajo contrafactuales de las firmas informales para calcular y comparar los niveles de productividad agregada real y contrafactual. Los resultados indican que si las firmas informales demandaran la cantidad de empleo que demandan las firmas formales similares, mejoraría la distribución de participación de mercado a través de las firmas, y esto impulsaría la productividad agregada positivamente.

Palabras clave: Sector informal, Demanda de trabajo, Demanda de factores, Productividad agregada, Colombia.

Clasificación JEL: J23, O17, O47, D24.

1. Introduction

The costs of informality for the economy in terms of lower tax collection for governments and failures in social wellbeing coverage for workers are well known. In fact the definition of informality approved by the International Labor Conference of 2002 includes labor relations that are not subject to standards established by labor laws, tax laws, social protection and other labor benefits (Tokman, 2007). Mejia and Posada (2007) and Rozo (2008) are some authors that propose coexistence models between the formal and informal sectors, in which the latter is comprised by firms that do not pay taxes on income and this way harm government revenue. On the other hand, Cardenas and Mejia (2007) show the high probability of an informal firm (that does not register its activities and revenue before the authorities) having labor contracts that are not governed by the law, making illegal discounts in payment of workers and in many cases, leaving them without pension or health coverage.

There are additional channels, not studied very often, through which informality could produce important costs for the economy. Particularly, this article will propose and study the possibility of informality putting the brakes on the process of creative destruction that drives aggregate productivity growth, harming the economic growth of Colombia³.

Part of the existing literature seems to suggest the presence of this potential channel. On the one hand, Arias, Fajnzylber, Maloney and Saavedra (2007a) state that there are incentives for a company to remain in informality, such as not having to renew licenses every year, not paying taxes, not being subject to regular inspections and not having to comply with labor laws. On the other hand, Loayza and Serven (2006) describe some channels through which incentives may stop growth dynamics and investment in technology by informal companies. An example is that these companies abstain from investing and growing in order to continue evading payment of taxes and reducing the probability of being detected. These effects could in turn imply putting

³ “More than half a century ago, Joseph Schumpeter, well-known economist of the time, popularized the term *creative destruction* to illustrate the process through which “incessantly” the old economic structures are absorbed and substituted by new, more productive and efficient economic structures. In this process emerging technologies push the old ones” (Ramirez-F., 2006).

the brakes on aggregate productivity growth, not only because the lack of investment in technology directly affects productivity, but also because some firms whom given their profitability could have incentives to grow and absorb greater resources do not develop such dynamics for reasons related to regulation.

In this sense, it is important to also look at informality as a problem that affects a country's economic performance. For this reason, to the extent that the additional cost produced by informality and that represents an obstacle for economic growth by putting the brakes on the creative destruction process may be documented and quantified, in terms of productivity, this may contribute to decreasing the lack of attention to the problem.

The existence of firm level data for Colombian micro-companies allows measuring if the size of some informal firms does not correspond to what their performance would suggest. Particularly, economic theory suggests that, given the heterogeneity between firms, those with greater productivity must own a greater portion of the market, while those with a lower productivity may keep the lower portions or even exit the market. However, informality offers firms certain conditions under which firms do not necessarily determine their size according to their productivity. Thus, the hypothesis to be proven is that informal firms absorb on average less labor than they could, given their productivity, and that this harms the creative destruction process in Colombia, also affecting the country's aggregate productivity.

The strategy to prove the hypothesis consists of two econometric exercises and one numerical exercise. The definition of informality used for their development is the lack of a mercantile registration in force⁴. First, a linear regression is estimated in which the number of employees hired by a firm depends on some variables that characterize it and a formality dummy, which is what allows assessing the existence of the abovementioned gap. Second, a matching method is used to estimate the effect of informality on labor demand by firms. This exercise allows mitigating the endogeneity problem between the variable to assess and the observable characteristics of firms. Finally, and based on the matching results, aggregate productivity is calculated in the counterfactual scenario in which informal firms demand the

⁴ Section five of this document provides details on why this definition was chosen.

level of employees that would correspond if they were formal. This calculation is divided into average productivity and efficiency in allocation following the methodology proposed by Olley and Pakes (1996), to later compare both terms with that which the observed data are generated with.

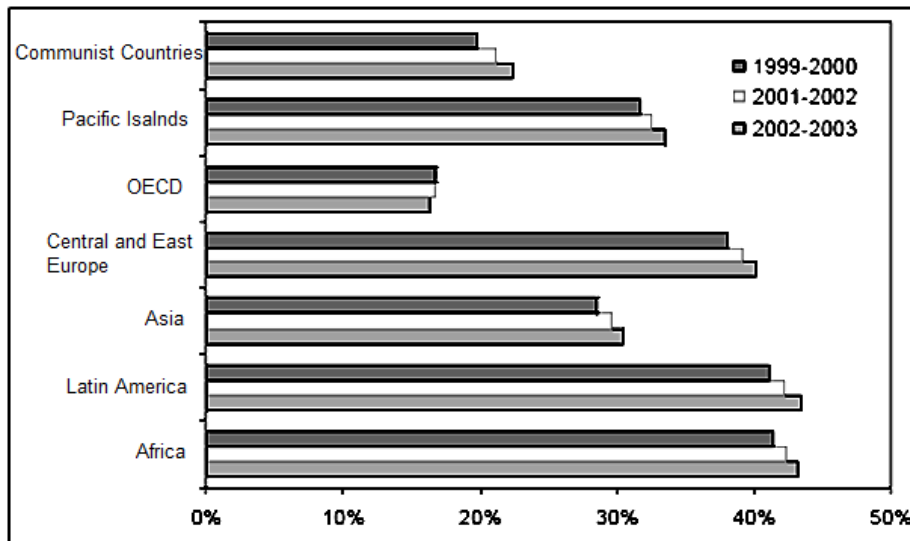
The results of the matching exercise show that informal firms in fact do hire on average less workers than formal firms with similar characteristics. Likewise, the comparison between observed aggregate productivity and aggregate productivity in the counterfactual scenario shows that efficiency in the allocation of resources improves if informal firms demand what would correspond if they were formal. The above constitutes a test that informality acts as a brake on creative destruction and thus imposes a cost, in terms of productivity, for the economy.

The document has eight sections including this introduction. The second section makes a brief literature review in order to document, for the specific case of Colombia, the incentives that exist to remain in informality and the possible consequences on some performance variables of firms. The third section presents the theoretical model that guides the empirical strategy. It takes as basis the determinants of informality to assess their implications in terms of demand for factors. The description of the two econometric exercises conducted is found in section four, while the data used to conduct said exercises is described in the fifth section. The results obtained from the two approximations are presented in the sixth section. The seventh section presents an additional numerical exercise to assess the consequences of the previous results on aggregate productivity, and finally, some relevant conclusions are presented in section eight.

2. Literature Review

The informality problem is present both in the developed world and in developing countries. However, in the latter informality represents a greater problem (in terms of the relative size of the formal sector), which additionally has been increasing (graph 1).

Graph 1. Size of the informal economy 1999-2003 in the regions of the world⁵



Source: Schneider (2005)

Colombia is no exception: Cardenas and Rozo (2007) estimate the size of informality based on the survey 123 of DANE conducted in 2001 and find that 46.2% of micro-companies are informal in the sense of not having a mercantile registration⁶. This figure is more dramatic in the ANDI report (2006), which finds in the Survey of Micro-establishments of 2004 that from close to 650,000 micro-establishments, only one third has a valid mercantile registration. Keeping in mind that in Colombia around 96% of companies is included in the category of micro-companies (DNP, 2007), it may be said that informality represents a very large problem

⁵ Schneider obtains the size of informality estimating a DIMIMIC (Dynamic Multiple Indicators Multiple Causes) model using as determinants of informality direct or indirect taxation as a percentage of GDP, the participation of public employment in total employment, unemployment rates and per capita income.

⁶ The survey 123 of DANE of 2001 uses the Continuous Household Survey to identify head of households of certain productive units, that later make part of the sample in case of fulfilling at least 3 requirements: having a maximum of 10 employees, not keeping accounting and being single person companies or de facto companies.

for the country⁷. However, informality does not occur exclusively in small businesses. According to a document of the National Planning Department, in which business informality is measured according to accounting records and mercantile registrations, in 2006 35% of medium-sized companies (with more than 50 and up to 200 workers) were informal, while 9% of large companies (more than 200 workers) were informal⁸.

Given that the informality problem is not negligible, different authors around the world have asked what are the incentives that lead a company to operate in informality. Arias, Fajnzylber, Maloney, Mason, Perry and Saavedra (2007b) show that there is a possibility that the decision to be informal is related to the unfavorable employment situation or to certain restrictions of the labor market, or in other words, that the decision is made for reasons of exclusion or involuntarily. However, the same study shows that in Latin America “63.7% of informal businesses develop this activity as an escape”, meaning, as a result of a voluntary decision after conducting a cost-benefit analysis, with which they conclude that informality provides more independence and flexibility. Mejia and Posada (2007) present a model that is consistent with these findings. These authors show that an increase in informality may be the result of optimal individual decisions in response to a change in the system of incentives, in which the net advantage of being informal increases due to the ease of evading provisions associated with a small size, while the net advantage of formality, derived from the technological development of economies of scale, decreases.

Cardenas and Rozo (2007) find that the companies make a cost-benefit analysis to make the decision to be formal or informal. Included in the benefits they not only mention the evasion of regulations provisions and payments, but also lower costs of inputs in comparison with those faced when operating in the formal market. In terms of costs, the same authors together with Cardenas and Mejia (2007) mention the restrictions of access to financial system resources, limited access to subsidies programs, technical assistance or training by the government and the

⁷ It is important to clarify that although micro-companies represent the largest part of businesses in number, the same does not occur for its representation in terms of assets.

⁸ DNP in association with the World Bank. “Informality, exit and exclusion”. May 2007.

impossibility of entering into agreements with the State and using traditional mechanisms for the protection of property rights.

Additionally, belonging to formality also represents important costs such as high tax rates, tax payments that companies must make, the time spent in doing so and non-wage labor costs. Concerning tax rates, Loayza (1996) estimates for a group of Latin-American countries that an increase of one standard deviation in the tax rate leads to an increase of 0.33 standard deviations in the size of the informal economy. De Soto (1989), Pozo (1996), Giles (1999) and Schneider (1999) find evidence in the same sense. Furthermore, the World Bank's Doing Business report (2006) shows that Colombia, together with Venezuela, is the Latin-American country with the largest number of tax payments (68) that additionally take between 19 and 20 days, compared to Paraguay for example, where only 33 payments are required, taking 13 days. Finally, the report finds that in Colombia a small or medium-sized company contributes approximately 82% of its profits to the treasury, a quite higher figure than the regional average (49.4%).

The above, together with the perception of the small companies of being at a disadvantage compared to large companies, who may hire advisors to reduce taxation levels (Cardenas and Mercer-Blackman, 2006), would confirm that it is a rational decision of agents not to enter the formal economy in order not to make efforts towards the payment of taxes (while the companies that can, hire advisors), or incurring in cumbersome proceedings imposed by law.

On the other hand, Santamaria and Rozo (2008) conclude, from the surveys conducted to businessmen, that the main causes for business informality are (i) unemployment and the need for survival; (ii) the high tax burden; (iii) low governmental controls; (iv) the existence of numerous proceedings to develop activities formally; (v) the lack of information regarding the formalization process of companies; (vi) high payroll costs and (vii) low confidence in the state due to inefficiencies and corruption in public spending. In this same sense, De Soto (1989) states that informality is a coherent alternative for a segment of the population that looks to survive and not break the law deliberately, and that this occurs "when the Law imposes rules that exceed the

socially accepted legal framework, does not cover expectations, elections and preferences of those who may not follow said rules and the State does not have sufficient coercive capacity”.

In the Colombian case, Mejia and Posada (2007) relate the increase in informality of the last 15 years to the changes in economic policy parameters, such as the increase in VAT and contributions to the health and pensions systems, and greater coverage of the subsidized health programs for those who are not employed in the formal sector.

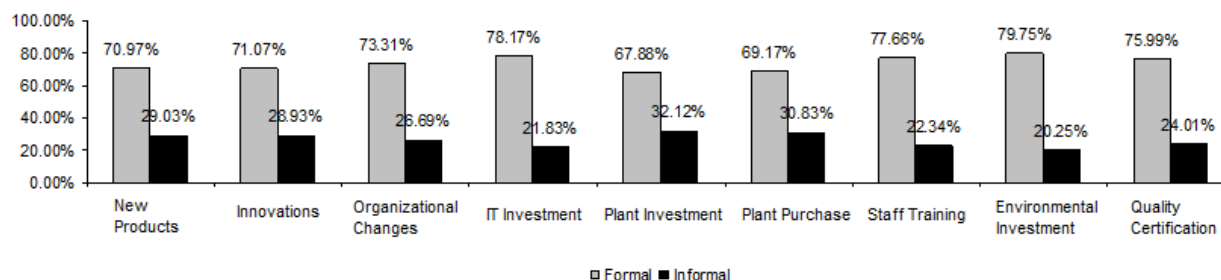
All the incentives mentioned not only harm the size and evolution of informality but also the breach of some provisions and payments by informal firms puts those that do comply at a disadvantage. This is a form of unfair competition that distorts market conditions and becomes a source of transfer of resources (VAT, income tax, industry and trade taxes, parafiscals, etc.) of the formal sector towards those who work in illegality (ANDI, 2006), not only affecting the growth of informal companies but also productivity of formal companies (Santamaria and Rozo, 2008)⁹.

Concerning growth and productivity of informal firms, De Paula and Scheinkman (2007) propose a model of partial equilibrium and use microdata obtained from surveys conducted in Brazil to show that formalization is associated with an increase of 0.33 standard deviations in investment per worker and 0.51 in facilities per worker. They also find that informal firms are smaller, less productive and use less capital per worker. Cardenas and Mejia (2007) carry out exercises for comparing averages and matching using data from the Micro-establishments Survey of DANE for the years 2002-2003. These authors find that informal firms are less efficient (lower sales, income or production as a percentage of fixed assets) and are restricted in terms of expansion or investment in technology, probably due to their lower access to credit, their lack of access to legal protection from the State and/or their need of remaining at a small scale. Fajnzylber, Maloney and Rojas (2007) also find that in Brazil informality is associated with lower capital stock, while Tokman (1992) mentions that in Latin America the informal sector is not only characterized by low productivity levels, but also by the incapacity of

⁹ The Investment Climate Survey analyzed by these authors, reveals that the effects of “unfair” competition on formal companies are more serious for young, small companies with little experience in the foodstuffs, textiles, manufactures and retail sectors. This reduces productivity of said companies.

accumulating physical and human capital at a large scale. Graph 2 complements these findings showing that informal firms contribute the least to the total of new products, innovations, organizational changes and investment in technology, among others (Santamaria and Rozo, 2008).

Graph 2. Distribution of innovations and investment per type of company



Source: Santamaria and Rozo (2008). Data: Cali and Yumbo Census of 2005

Finally Santamaria and Rozo (2008) present descriptive statistics based on a census in Cali and Yumbo, with which they confirm the lower productivity levels of informal companies, and argue that they generally maintain a production scale inferior to the optimum, generating less and lower quality employment, which leads to the limitation of economic development, which includes growth and reduction of poverty.

This literature suggests on several occasions that variables such as efficiency, productivity and size are harmed when referring to informal companies. However, the authors mentioned in this section are limited to comparing variables that result from firms that differ in the dimension of formality and in some cases that are similar to each other in other observable characteristics available in the data. What they have not asked yet is if a smaller size and absorption of resources by informal companies correspond to their lower productivity, or if on the contrary, even with the productivity they have, they are below the potential scale with which they could operate. If the latter is true, it is likely that the consequences of the gap in size of each informal firm may be taken to a macroeconomic level. The economy as a whole may be harmed in terms of aggregate productivity, not only due to lower efficiency of the informal sector, but also due to the lack of an adequate allocation of productive resources amongst firms, corresponding to the distribution of productivities given in the groups of formal and informal firms.

An adequate allocation of resources finally leads the most productive firms in the market to grow and be more successful, while less productive firms lose market power and eventually exit the same. The process of entry and exit of firms that are displaced due to their differences in productivity is known as creative destruction. Part of this process is the movement of firms within the market, which grow or become smaller and in the same way gain or lose market share, until finally some firms end up definitely exiting the same. This movement within the market through changes in the allocation of productive resources is the part of creative destruction that will be analyzed in this paper.

3. Theoretical Framework

The model presented below uses the same functions and assumptions as the work of De Paula and Scheinkman (2007), unless otherwise indicated. Said model incorporates the existence of the formal and informal sectors in the same market, in order to find results on demands for capital and labor by firms in both sectors.¹⁰ The implications on demand for labor constitute the basis of the estimations made in the following section.

The most notable difference with the model of De Paula and Scheinkman is that their model includes three types of agents: those who chose to be workers, those who chose to operate as an informal firm and those who chose to operate as a formal firm. The model in this document only analyzes the choice between being a formal or an informal firm, ignoring what happens with workers.

The model assumes the existence of two representative firms, one formal and one informal, who use capital (k) and labor (l) to operate with the following production function:

$$y = Ak^\alpha l^\beta \text{ where } \alpha \text{ and } \beta \in (0,1)^{11} \quad (3.1)$$

¹⁰ This model is a variation of the model of Rausch (1991), which in turn is based on the strategy of Lucas (1978). Both quoted by De Paula and Scheinkman (2007).

¹¹ De Paula and Scheinkman additionally assume decreasing returns to scale, but in the model of this document, in order to have consistency with the estimations and given that the main result related to demand for labor does not

The above assumes that all firms in all sectors possess the same technology. The formal firm must pay an *ad-valorem* tax (τ) and its unit cost of capital is $r_f > 0$. The informal firm does not pay taxes and has a unit cost of capital of $r_i \geq r_f$. This captures the greater risk that possibly exists when granting a loan to a firm that is not legally incorporated and consequently, the restriction of liquidity the same faces¹². Both firms pay the workers a wage w .

On the other hand, the informal firm has a probability of being detected for operating illegally. If the firm is detected it loses all its benefits (meaning, its benefits fall to zero). The probability of detection depends monotonically and increasingly on the firm's size, which in this case shall be measured with its stock of fixed capital, and is defined as:

$$p(k) = \begin{cases} 0 & \xrightarrow{si} k \leq \bar{k} \\ 1 & \xrightarrow{si} k > \bar{k} \end{cases} \quad (3.2)$$

The first order conditions of a standard process of benefit maximization imply that the ratio (k/l) will proportionately depend on relative prices of both factors for a firm without size restrictions. In this sense, given that $r_i \geq r_f$, an informal firm will have a (k/l) less than that of a formal firm.

The authors assume that the condition to be a formal or informal firm directly depends on the productivity of firms¹³ given by:

$$\begin{aligned} \text{If } A \leq \bar{A} &\Rightarrow \text{informal firm} \\ \text{If } A > \bar{A} &\Rightarrow \text{formal firm} \end{aligned} \quad (3.3)$$

Given this, the condition of no-arbitrage for firms between the two sectors implies:

$$\pi_f(\bar{A}) = \pi_i(\bar{A}) \quad (3.4)$$

The implication of the above assumptions is that around \bar{A} there is a discontinuity in the levels of capital and labor used by the firms. The reason is that the company, whose productivity approaches \bar{A} from the bottom, given that it is informal, must choose \bar{k} even though its

change if this assumption is removed (D.R.S), it is only assumed that both parameters are greater than zero and less than one.

¹² Section 4 of De Paula and Scheinkman's article presents evidence in favor of this assumption and of the difference that this generates on the ratio capital-labor between formal and informal firms.

¹³ De Paula and Scheinkman (2007) relate the parameter of productivity with the managerial ability of the person running the company, whether formal or informal, and with this, the start from the assumption that to be formal a certain level of \bar{A} is required as a minimum managerial ability.

marginal productivity of capital surpasses its marginal cost. On the other hand, when approaching \bar{A} from the top, given that the company is already formal, the same may chose a $k^* > \bar{k}$.

Now, assuming a specific relation between unit costs of use of capital by formal and informal firms, such that $r_i(1-\tau)^{1/\alpha} \leq r_f$ ¹⁴, the condition of no-arbitrage including this assumption implies:

$$\pi_i(\bar{A}) \leq \bar{A} [l_f(\bar{A})]^\beta [k_f(\bar{A})]^\alpha (1-\tau) - w [l_f(\bar{A})] - r_i [k_f(\bar{A})] (1-\tau)^{1/\alpha} \quad (3.5)$$

This means that an informal firm would reach greater benefits (than the optimal benefit for an informal firm with productivity \bar{A}) if it were free to use $l = l_f(\bar{A})$ and $k = k_f(\bar{A})^\alpha (1-\tau)$. Thus, it must be true that the informal firm must be restricted and may not use this level of capital. More specifically $[k_f(\bar{A})]^\alpha (1-\tau) > \bar{k}^\alpha$, meaning that the use of capital by a firm with \bar{A} that is not restricted is greater than the effective use if the firm is restricted.

As a consequence and given the first order maximization conditions regarding labor, it may be concluded that:

$$\left[\frac{\bar{A} \beta (1-\tau) [k_f(\bar{A})]^\alpha}{w} \right]^{1/(1-\beta)} > \left[\frac{\bar{A} \beta \bar{k}^\alpha}{w} \right]^{1/(1-\beta)} \quad (3.6)$$

The left side of equation (3.6) corresponds to demand for labor of a formal firm with $A = \bar{A}$ (approaching \bar{A} from above). On the other hand, the right side corresponds to demand for labor of an informal firm with $A = \bar{A}$. In conclusion, a discontinuity is observed in the levels of capital and labor around productivity of the marginal firm, mainly by the size restriction of informal firms.

¹⁴ Although De Paula and Scheinkman do not derive this assumption from any particular process, condition $r_i(1-\tau) = r_f$ may be obtained by equaling the first order conditions regarding the capital of both firms, and knowing that $(1-\tau) < 1$ and that $\alpha < 1$, the assumption that $r_i(1-\tau)^{1/\alpha} \leq r_f$ is fulfilled.

Taking into account the previous model, we wish to assess if in a world of firms with a given distribution of productivities, two firms with the same productivity (or very close) differ in size – regardless of the measures used. In this sense it is important to clarify that firms with $A = \bar{A}$ may only be compared (in terms of the theoretical model), but that in reality this corresponds to firms that are similar in several dimensions, one of them being productivity, to determine if they differ in terms of workers hired. Given that we would be comparing firms with the same fundamentals, obtaining positive results in terms of the difference in size between firms would be a direct result of informality.

4. Empirical Model

Equation (3.6) allows generalizing demand for labor of any firm as a variable that depends on the productivity of the firms, of the use of capital, of the parameters of the production function, of the market wages and of something that differentiates formal firms from informal firms (in the model, taxes, the differences in interest rates and the size limitation to avoid being detected). The model implies that the effects of informality are observed when comparing formal and informal firms at the productivity level \bar{A} . In general, if we take two identical firms in terms of their productivity and the prices of factors faced, but that differ in terms of whether or not to be formal, we should observe differences in the absorption of productive resources.

The first econometric exercise is derived from this generalization, which consists of the following lineal regression:

$$\ln(l_{it}) = \alpha + \beta w_{st} + \gamma \ln(tfp_{it}) + \sigma \ln(k_{it}) + \rho(formal_i) + \vec{\psi}(\vec{E}) + \vec{\phi}(\vec{A}) + \varepsilon_{it} \quad (4.1)$$

where l is labor, w is wages, tfp corresponds to productivity, k is capital and $formal$ is a dummy that takes the value 1 if the firm is formal and 0 if the firm is informal, according to the mercantile registration. In the previous model, this dummy would be capturing the payment or non-payment of taxes by the firms, the liquidity restriction faced by informal firms and the size restriction. Finally, \vec{E} is a vector of dummies that categorizes the age of a firm, and \vec{A} is a vector of dummies for the years of the observations, that additionally captures variations on the time of the interest rate, given the impossibility of obtaining disaggregated data over interest rate.

The subscript i corresponds to firms, t to years. The subscript s refers to the sector to which the firm i belongs.

This regression intends to analyze the relation between the use of labor of firms and the dimension of formality of the same, leaving everything else constant. In this sense, it is expected to find that the coefficient of *formal* be positive and significant, proving that a formal firm employs more labor than an informal firm, which would mean that the informal firm absorbs less resources than it would if it were formalized.

However, this specification has endogeneity problems, given that an informal firm may chose to be small given its size restriction, but it could also happen that a small firm chooses to be informal because, for example, it is not worth formalizing it at that scale of production¹⁵. Furthermore and as is assumed by the model, the decision to be formal or informal is endogenous to the productivity level of each firm, which would imply an additional problem of multicollinearity in the regression. For this reason the results of regression (4.1) will be taken as merely descriptive and a new specification that overcomes the endogeneity problems will be pursued.

It is interesting to note that the difference in labor demands between formal and informal firms may be interpreted as the result of the existence of factorial adjustment costs associated with being in the informal sector. Eslava, Haltiwanger, Kugler. A. and Kugler. M. (2008a) present a model of adjustment costs for capital and labor, in which effective demand of said factors is not equal to the desired levels, when there are adjustment costs that may be related to the regulation or with technological frictions. In this case the desired levels of capital and labor correspond to what would be demanded if adjustment costs were temporarily removed. The above discussion suggests that the adjustment costs could differ between formal and informal firms; particularly, adjusting factorial demand above the limit of detection would generate costs for the informal firms. In the conceptual framework of Eslava et al. the implication is that two firms that differ on whether or not they are formal, but are identical in all other dimensions, have

¹⁵ McKenzie and Woodruff's (2006) use a survey of informal micro-companies in Mexico to show the main reason for which they do not register is not that it is very expensive or it takes a long time to do so (2% and 8% of surveyed companies respectively), or that the operation costs as a registered firm are very high (4% of firms), but that firms are too small to make it worth registering (75%).

the same desired demands of factors but differ in terms of their effective levels. Both firms would be outside the levels they would have in absence of adjustment costs, with a greater difference for the informal firm.

Given the above discussion, an adequate comparison of the levels of employment between formal and informal firms requires assessing the impact of informality with a method that compares two firms alike in all dimensions, except belonging to formality. The matching method does not only allow making this type of comparison based on observable characteristics of the companies, but also, as was said before, helps mitigate the endogeneity problem between formality and some of the observable variables, as it compares firms that are alike in said variables.

This method gathers all characteristics of the firms in a single dimension, the propensity score, which in this case corresponds to the predicted probability of being formal. The estimation of the probability is done through a probit model, with the following specification:

$$\Pr(\text{formal} = 1)_i = f(c + \beta'X_i) + \varepsilon_i \quad (4.2)$$

where $\Pr(\text{formal} = 1)_i$ is the probability that a firm i is formal, c is a constant, X_i is a variable vector that gathers the characteristics of the firm i that are relevant to explain the probability that said firm is formal, β' is the vector of coefficients corresponding to each of the variables within X_i , and ε_i is the error.

As you are aware, the central hypothesis of this paper includes the fact that an informal firm, with the same productivity as a formal firm, employs less labor than the formal firm. Additionally and as was said before, it is likely that formality or informality of a company is directly related to its productivity. For these reasons, it is indispensable to include productivity, measured as the residue of a production function that uses capital and labor as factors¹⁶, as an explanatory variable in the estimation of the probability of being formal, also in order to match the firms in this dimension. It is important to clarify that one of the basic assumptions to use the matching model is conditional independence, which implies that the independent variables are

¹⁶ The data section shows more details on the calculation of productivity.

not affected by the variable treatment (in this case, the formality variable). In this sense, there is no certainty that company productivity is not affected by informality or vice versa, and in the literature there is no consensus on the causality between both variables. Coherently with the theoretical model presented in the previous section, the estimation made in this work assumes that productivity is a determinant of formality or informality of firms.

The other observable characteristics used as determinants of the probability of being formal are chosen based on the work of Cardenas and Mejia (2007) and are the following: type of location (categorizes the place where the economic activity is developed), legal organization (commercial company or another type of organization), main economic activity and time of operation of the firm¹⁷. The categories contained in each of the variables are described later in the data section.

After estimating the probit model, the matching method uses the *pscore* to match formal firms with informal firms. There are several methodologies to make said matching and estimate the impact of the treatment (in this case being formal). Choosing between the different methodologies generally implies a tradeoff between quality and precision of matching and quantity of observations that may be matched¹⁸.

One of the most widely used methods, also used in this paper, is the Kernel method. This method matches each observation of the treatment group (formal) with all observations of the control group (informal) and compares the variable of interest, in this case the number of employees hired, by each formal firm with a weighed average of the same variable in the control group. The weighing depends monotonically of the closeness between each observation of the control group and the observation of the treatment group, in *pscore* terms.

The Kernel method estimator, which measures the average difference in the variable of interest between the matched firms of the treatment and control group, is given by:

¹⁷ Although Cardenas and Mejia include within these variables the size of the firm, measured as the number of persons that work in the establishment, in the present case this variable is not included, given that it is a resulting variable over which impact of informality is to be assessed.

¹⁸ For a more detailed analysis of the main methodologies used and their differences, see Becker and Ichino (2002).

$$\tau^K = \frac{1}{N^T} \sum_{i \in T} \left\{ Y_i^T - \frac{\sum_{j \in C} Y_j^C G\left(\frac{p_j - p_i}{h_n}\right)}{\sum_{k \in C} G\left(\frac{p_k - p_i}{h_n}\right)} \right\} \quad (4.3)$$

where T is the group of observations in the treatment and C in the control, Y_i^T and Y_j^C are the variables of interest of the observations of treatment and control, respectively, N^T is the number of observations in the treatment group, h_n is a parameter of bandwidth or range and p_j , p_i and p_k are the propensity scores of the corresponding units. $G(\cdot)$ is a Kernel function that may be the Normal or the Epanechnikov. Under standard conditions of h_n and kernel,

$$\frac{\sum_{j \in C} Y_j^C G\left(\frac{p_j - p_i}{h_n}\right)}{\sum_{k \in C} G\left(\frac{p_k - p_i}{h_n}\right)} \quad (4.4)$$

is a consistent estimator of the counterfactual of the variable of interest for the observation i of the treatment group (Becker and Ichino, 2002).

This matching allows finding the average gap between demand for labor of an informal firm and a formal firm, having these firms be the same in their other observable characteristics.

5. Data

Data of the Micro-establishments Survey of DANE for the years 2000 to 2007 are used to conduct the different estimation exercises. This survey is representative for the micro-establishments at a national level and gathers annual data of establishments in the industry, trade and services sectors, with 10 or less employees, located in the municipal capitals of all municipalities in the country. The sample design to carry out the survey is done separately every year, for which it is not possible to track the different establishments through time.

The survey data allow classifying the establishments as formal or informal depending on whether or not they have a mercantile registration¹⁹. Informality in this sense is derived not only from evading the cost of the procedure to obtain the registration, but also from the fact that it is possible that the company that is not registered does not fulfill the requirements to do so (including, having a RUT or Single Tax Registration, issued by the National Department of Taxes and Customs – DIAN). This definition of informality is used by Schneider and Enste (2000) and Cardenas and Rozo (2007) in their papers. Additionally, Cardenas and Mejia (2007) find that it is consistent with alternative definitions of informality and that additionally the different definitions are considered dependent amongst each other²⁰. To definitely choose the definition for mercantile registration, they are based on the fact that it is the one that best includes all other definitions, meaning that the probability of an establishment being informal (under any definition) is particularly high when the establishment does not have a mercantile registration.

Despite the mentioned advantages of this definition, it is important to mention that it also has limitations. An implication of restricting the present work to this definition is that some companies that do have a mercantile registration but that for example do not pay annual taxes or their contracts do not fulfill labor laws, among others, could be left outside of the group of informal companies. The contrary is also possible: companies without a mercantile registration, but that fulfill certain norms and regulations, would be classified as informal firms. On the other hand, the fact that the definition classifies firms in binary form eliminates the possibility of separately analyzing firms that are partially informal because they fulfill some requirements, but not others, and of assessing if their performance is affected by the breach of certain specific requirements.

The Micro-establishments Survey also has data on the type of establishment: single, main, branch or auxiliary unit. This allows exclusively choosing single establishments, in order

¹⁹ The mercantile registration is a document issued by the different chambers of commerce of the country, to make the existence of a producer or merchant public and legal.

²⁰ The authors calculate cross correlations between having a mercantile registration, keeping some sort of accounting, paying taxes and paying labor benefits. They also apply the Pearson Chi Squared test, with which the null hypothesis that the measurements are independent among themselves is always rejected.

to include in the sample complete firms and not establishments that may be part of a company, without including the totality of the company in the survey. Additionally, there is no identifier at the firm level, for which there would be the possibility of having two establishments of the same firm, but without being identified as such. Although the fact of only leaving single establishments in the sample may entail a selection bias in favor of formal firms, this also eliminates the problems described before and allows that the analysis made throughout the work be done at a firm level and not at an establishment level. This is the strategy followed in the analysis reported below.

A detailed description of the variables included in the different specifications of the empirical model previously discussed is made below. Regression (4.1) includes labor (l_{it}), wages (w_{st}), productivity (tfp_{it}), capital (k_{it}), the dummy $formal_i$ and the vectors (E) and (A) , which are dichotomous variables of the age of the firm and the year of observation in the sample.

For the variable l_{it} the total number of remunerated employees in firm i in the year t is taken. w_{st} is the real wages index for large sectors (trade and manufacturing industry), taken as the annual average of the monthly index²¹. Total Factor Productivity, $\log(tfp_{it})$, is calculated as the residue of the aggregate value of the firm in the year t , net of total labor (remunerated and non-remunerated) and capital by their corresponding shares. The latter are calculated using the share in costs of both factors²². k_{it} is the real value of fixed assets of the firm i at the end of the year t . Real variables take January 2003 as base period²³.

The model also includes dichotomous variables that characterize the age of the firm and year effects. For the age the following variables are included: from 0 to less than 1 year, from 1 to less than 3 years, from 3 to less than 5 years, from 5 to less than 10 years and 10 or more

²¹ The data were taken from the Central Bank, which makes its own calculations and uses the Monthly Manufacturing Sample. There are no data on differential wages between the formal and informal sector.

²² The fraction of the aggregate value of all firms in each year, represented by the corresponding payment of wages, was calculated. Then we took an average of this fraction between all years of the sample to obtain the participation of employment. This participation was estimated at 0.78. Assuming that the sum of the two participations (labor and capital) is equal to 1, participation of capital was estimated at 0.22.

²³ The Consumer Price Index (CPI) in the service and retail sectors, and the Producer Price Index (PPI) in the manufacturing and wholesale sectors are used to deflate. Both are reviewed in the webpage of DANE.

years. This last category and the dummy of the year 2000 are excluded variables in the estimation of equation (4.1).

Table 1 shows descriptive statistics of the mentioned variables, for formal and informal firms. The average of the number of remunerated employees for both types of firms is a first approach to the expected results in subsequent exercises. It should be noted that these figures already suggest that informal firms employ less workers on average than formal firms. If fixed assets are taken as another measurement of the size and absorption of capital, it may also be said that informal firms absorb on average less resources than formal firms. Also, average productivity of informal firms is less than that of formal firms. Finally, informal firms are on average younger than formal firms.

Table 1. Descriptive statistics for formal and informal firms (2000-2007)

	Mean		Median		Min		Max		Standard Deviation	
	Formals	Informals	Formals	Informals	Formals	Informals	Formals	Informals	Formals	Informals
Paid Employees*	1.2925	0.3263	1	0	0	0	22	14	1.7920	0.8730
Productivity: log(TFP)	3.3085	2.9965	3.3611	3.0644	-11.1916	-7.3892	16.3503	15.0751	1.6619	1.8518
Wages: Real Index (jan2003=100)	1.0859	1.0860	1.0876	1.0876	0.9886	0.9886	1.1669	1.1669	0.0674	0.0674
Fixed Assets (COL\$) (jan2003=100)	16,806,196	6,749,148	3,837,328	1,422,205	0	0	6,789,726,050	6,835,643,016	68,013,882	43,068,516
Age**	3.2132	2.9526	3	3	1	1	5	5	1.2628	1.3933
Number of Observations	Formals	81,609								
	Informals	60,939								

*This variable contains values that are greater than the limit established for establishments to classify in the survey. This is because at the time of sample design, those establishments fulfilled the requirement of number of employees, but in the next months they grew in size and at the time of the survey they got out of the 10 employees limit.

**This variable is in its 5 original categories (previously described), which assign numbers from 1 to 5, respectively.

Source: Own calculations. Data: Micro-establishments Survey (DANE).

The matching method uses the same variables described above to calculate the estimated probability that a firm is formal. Additionally, it includes dichotomous variables of the type of location, legal organization and main activity of the company. The location of the establishment has three categories: commercial establishment, fixed place of business or household with an

economic activity. The type of legal organization covers commercial companies (limited liability, joint stock, corporation, etc.), cooperative, de facto company and individual or single owner company. Concerning the company's main activity, the survey includes the following activities: manufacturing industry; construction, trade, hotels and restaurants; transportation, storage and communications; financial intermediation; real estate activities; and community, social and personal services. The probit estimation does not include the dummies of commercial establishment, commercial company and transportation, storage and communications.

6. Results

The results of the estimation by ordinary least squares of demand for employees (equation (4.1)) are shown in table 2. As was indicated above, this regression is only descriptive given its endogeneity problems.

Table 2. Demand for remunerated labor, ordinary least squares

Dependent Variable: Logarithm of Number of Paid Employees	
	Coefficient
Formal	0.1642*** (0.0067)
logK	0.2146*** (0.0026)
logW	2.7904*** (0.1470)
TFP	0.1813*** (0.0029)
Age:	
1 to 3 years	0.0107 (0.0117)
3 to 5 years	0.0373*** (0.0124)
5 to 10 years	0.0599*** (0.0126)
More than 10 years	0.0885*** (0.0123)
Constant	-3.5802*** (0.0483)
R ²	0.2079
N	42,875
Prob > F	0.0000

Note: This table contains estimations after year effects controls. Standard errors are in parentheses. *10% significant. **5% significant. ***1% significant.
Source: Own calculations. Data: Microestablishments Survey (DANE).

The coefficient of *formal* has the expected sign, which under the standard conditions of a linear regression, would mean that the formalization of a firm would imply an increase in its demand for labor of approximately 16%. However, given the endogeneity of this variable it is very likely that this coefficient is upward biased. As would be expected under the first order conditions of the benefit maximization problem, productivity has a positive effect on the hiring of employees. An increase of one standard deviation in productivity (close to 1.74) is related to an increase of close to 31 percentage points in demand for labor. Capital – represented by fixed assets – behaves as a complementary factor of labor (an increase in assets of 1%, increases demand for labor by 0.21%).

The variables that characterize the age of the firm show that increases in the same are related to increases in the amount of employees hired. This is to be expected under the assumption that firms that operate in the market grow in time and gain market share (at least it is what a firm in principle would want).

The sign of the coefficient of wages is contrary to what is expected. If we were clearly capturing the side of labor demand, the latter would depend negatively on market wages. Furthermore the magnitude of the coefficient is not negligible. These results may be a consequence of the endogeneity problems of this specification²⁴.

In order to overcome the endogeneity problem of the previous regression, the matching method described above was used. The results of the probit model are shown in table 3²⁵.

²⁴ An attempt was made to correct the sign of the coefficient of wages incorporating an element of the supply of labor as an instrument of wages (a calculation of the Economically Active Population in the corresponding sector was used), including an interaction between belonging to the formal sector and wages, and replacing the wage index by the mean of wages paid by the firm (total payment of wages over number of employees). Only the replacement of the index gave the expected results. However, given the denominator of the new variable of wages, it is of great concern that the result is only obtained by construction. In any case, it is encouraging to note that the estimated effect of the formality dummy is robust to these specification changes.

²⁵ The coefficients of this table do not measure the marginal effects, but are useful to analyze the direction and magnitude of the impact of each variable over the probability of being formal.

Table 3. Estimation of the probability of being formal, probit model

Dependent Variable: Formal=1 if the firm is formal, 0 otherwise

	Coefficient
TFP (log)	0.0333*** (0.0025)
Location:	
Fixed place	-1.6513*** (0.0196)
Household	-0.7241*** (0.0094)
Legal Organization:	
Cooperative	-0.9722*** (0.0926)
De Facto Company	-1.3049*** (0.0467)
Single owner Company	-1.2665*** (0.0315)
Age:	
1 to 3 years	0.5917*** (0.0159)
3 to 5 years	0.8566*** (0.0175)
5 to 10 years	0.9096*** (0.0178)
More than 10 years	0.7812*** (0.0170)
Economic Activity:	
Manufacturing	-0.4094*** (0.0255)
Trade, hotels and restaurants	-0.2289*** (0.0241)
Financial Intermediation	0.6741*** (0.1645)
Real Estate Activities	-0.9918*** (0.0287)
Social and personal Services	-0.6073*** (0.0268)
Constant	1.3199*** (0.0413)
Pseudo R ²	0.1410
N	108,598
Prob > chi ²	0.0000

Note: the dummy of construction (as economic activity) was also excluded because the dependent variable was the same in all cases (3 observations). Standard errors are in parentheses.
*10% significant. **5% significant. ***1% significant.

Source: Own calculations. Data: Microestablishments Survey (DANE).

As was expected, increases in productivity are directly related to increases in the probability of being formal. Particularly the marginal effect of this variable shows that an increase of 1 logarithmic point in the firm's productivity increases its probability of being formal by 0.013 percentage points²⁶. This is one of the reasons why the matching exercise, carried out to compare the labor used between formal and informal firms, must include the productivity between variables used for the matching, given that in another case firms could be compared that are the same in all their observable characteristics, except for formality and productivity, and gaps in employment would be attributed to informality, when in reality they could be an effect of differences in productivity.

Although the objective of this investigation is not finding the determinants of informality, it is interesting to find that the businesses that develop their activities in a fixed place of business or in a household are businesses less likely to be formal, compared to those developed in a commercial establishment. Likewise, operating under the figure of a cooperative, de facto company or as an individual, is associated with a lower probability of being formal, with the de facto company being the characteristic that mostly negatively affects said probability. All categories of age of the firm are positively related to the probability of formalization compared to firms with less than one year of existence. Particularly, it may be seen that the older the firm, the positive relation with the probability of being formalized becomes larger, except when the firm has more than 10 years of existence (the magnitude is reduced a bit, although it continues to be positive).

The economic activities in which a firm has a lower probability of being formal are manufacturing, trade, hotels and restaurants, real estate activities and social and personal services; while the activity that shows the highest probability of being formalized (for a firm that exercises that activity) is financial intermediation. Firms in real estate activities are the least likely to be formal.

Once the probit model has been estimated, the Kernel method may be used to match formal firms with informal firms using the *p*score, in order to assess the impact of informality on

²⁶ See table 1 in the annex to see all marginal effects.

demand for labor. The variable of interest is the number of remunerated employees. However, as evidence of robustness and to expand the impact analysis, the effect on the number of remunerated employees as a proportion of the total employees and the ratio of total employees over total assets are also estimated. In particular it could be expected that the proportion of remunerated employees be less in informal firms, given that by not following labor laws it may be easier for them to have non-remunerated workers. However, a positive proportion of non-remunerated employees in formal firms is also expected because given that all firms come from the micro-establishments sample, it is likely that they are, for example, small family businesses where family members or persons close to the family are willing to work without getting paid²⁷. On the other hand, we wish to see if, consistently with the model of De Paula and Scheinkman, the ratio capital-labor is greater in formal firms than in informal firms.

The results of estimating the impact of informality using the matching method using a common support are found in table 4. Given that statistical programs do not include uncertainty of the estimation and therefore do not take into account the additional variance to calculate the standard error, the bootstrapping method is used to generate an average of prediction errors and recalculate the standard error of the specific estimator. This is achieved taking several samples replacing the original sample, from where the estimator of interest and the corresponding prediction errors are obtained.

Table 4. Effect of informality on demand for workers

	Number of Observations	Formal	Informal	Difference (Informal - Formal)
Logarithm of number of paid employees	42,827	0.6915	0.4436	-0.2479***
Paid employees / Total labor	108,570	39.25%	19.24%	-20.01%***
Total labor / Fixed Assets	108,570	0.0146%	0.0096%	-0.005%

Note: The number of remunerated employees is in logarithm and the difference in the number of observations is due to missing values generated with the logarithm on observations with zero remunerated employees. *10% significant. **5% significant. ***1% significant.

Source: Own calculations. Data: Microestablishments Survey (DANE).

²⁷ The definition of formality according to the mercantile registration also affects this result, given that there may be firms defined as formal in this work that in reality do not fulfill certain labor obligations and have non-remunerated workers in their companies.

As is shown in table 4, an informal firm hires on average less remunerated employees than a formal firm with similar characteristics. The difference is close to 24 percentage points (given that we measure demand for labor in logarithms)²⁸. This difference reflects the smaller size of informal firms compared to formal firms, and this is evidence of the hypothesis of this investigation: informal firms, given their productivity, absorb fewer resources (factors) than those they would absorb if they were formalized. Additionally, informal firms have a smaller proportion of remunerated employees as part of total employees. This is a 20-percentage point difference. The data of 39% and 19% deviate slightly from those found by Cardenas and Mejia (2007), however, you should recall that the specification of both works are different. Particularly the specification in this work includes productivity, which is consistent with the theoretical model proposed. Surprisingly but interestingly, formal firms have less remunerated employees than non-remunerated employees. This evidences that the use of non-remunerated employment is a fundamental characteristic of micro-companies, who have the support of family members or whose partners are willing to work temporarily without remuneration. Furthermore, firms may take advantage of the legal figures that do not require remuneration (such as interns or apprentices) to avoid some costs. From a micro-business point of view, this category of employment may mean a high percentage of employees.

Although this last result is only a proportion within each firm and does not allow drawing conclusions on the size and share of firms in the market, the gap that exists in the proportion of remunerated employees between formal and informal firms does have implications on employment and labor conditions. In this sense, the fact that an informal firm has a proportion 20 percentage points below what it could, means that informality is leaving outside of the formally remunerated labor market (for example, earning a legal minimum wage) a group of employees that would be included if these firms were formalized.

The matching results also show that the ratio of employees over assets (that may also be interpreted as the number of workers per each peso in assets) is less in informal firms than in formal firms, although this difference is not significant. The interpretation of the difference is not

²⁸ When applying the exponential function to logarithmic values the average of the number of remunerated employees per type of firm is seen. Formal firms hire on average 2 remunerated employees, while informal firms hire 1.56 employees.

very clear from a point of view of resource absorption, given that the denominator of the ratio is not the same (the value of assets is on average less in informal firms than in formal firms). However, with simple mathematic reasoning that compares both fractions, it may be deduced that the decrease in hiring of employees due to the firm's informality is more than proportional than the decrease in possession of fixed assets for the same reason. This may be the result of the fact that informality exists mainly due to high labor costs, as is mentioned by Rozo (2008), for which a firm, when being informal, looks to reduce its costs from the labor side, which is what represents the largest decrease.

Although the model of De Paula and Scheinkman concludes that the ratio capital-labor is greater in formal firms than in informal firms, and this would imply a larger ratio labor-capital in informal firms, this finding is due to the restriction in the use of capital faced by informal firms in the model (a larger cost of use of capital). The information necessary to empirically prove the effect of said restriction is not available in this case and given that the above results contradict those of the theoretical model it is possible that other variables such as the size restriction, in terms of employees present in reality, or the intention of reducing costs from the labor side by the informal firms, are the reason that the hiring of employees decreases more than proportionately than the possession of assets in informal firms and in this way, the empirical net result is that the ratio labor-capital is less in informal firms than in formal firms. However, it is important to note that if wages of both sectors differ, for example $w_f > w_i$ (which is less restrictive than what the model assumes and corresponds better to Colombian data), it is not clear that the inequality in the equation (3.6) is maintained and the results proposed by the model concerning the ratio capital-labor in each sector would also be affected.

During the carrying out of the matching exercise alternative exercises were made to prove the robustness of the results. A radius method was used instead of the Kernel estimator to make the matching and the differences are very similar. The difference in the ratio labor-capital becomes significant at 10%.

7. Effects on Aggregate Productivity

After finding that in fact there is a gap in the demand for workers between formal and informal firms, it should be considered if the existence of said gap, at least in the universe of micro-establishments, has consequences at a macroeconomic level, especially when said universe represents close to 96% of all companies in Colombia. In particular it must be seen if the fact that informal firms are absorbing less resources than what they could if they were formal, harms aggregate productivity of the universe of firms (formal and informal) and if this negative impact on productivity is due to the incorrect allocation of resources between firms in the market.

To find an answer it is necessary to use a static decomposition of Olley and Pakes (1996). In this decomposition aggregate productivity is obtained first as a weighted average of intra-firm productivities, where the weightings are calculated from the market shares of each firm. However, this result may be decomposed as the sum of two terms: the first is the simple average of the productivities of all firms, and the second is the sample covariance between productivity and market share of firms. Thus the decomposition has the following form:

$$P_t = \sum_{i=1}^{N_t} s_{it} P_{it} = \bar{P}_t + \sum_{i=1}^{N_t} (s_{it} - \bar{s}_t)(P_{it} - \bar{P}_t) \quad (7.1)$$

where P_t is the aggregate productivity of the market in time t , \bar{P}_t is the simple average of productivities of all firms in time t , s_{it} and P_{it} are respectively the market share and productivity of the firm i in time t , and \bar{s}_t is the simple average of market shares of all firms. The last term of equation (7.1) is the covariance mentioned above. The greater and larger the covariance means that the most productive firms get the largest portions of the market and consequently, aggregate productivity will be greater.

With this in mind and using the result that informal firms would have a sub-optimal market share (measured by the number of employees), it may be expected that aggregate productivity be below the case in which all firms were formal. To analyze this possibility we compare the observed aggregate productivity with a counterfactual that precisely captures what aggregate productivity would be if informal firms demanded factors in the same way as formal

firms do. Additionally, comparing the terms that make up said productivity, it is possible to look whether the difference in aggregate productivity comes from an improvement in the allocation of resources in the market.

To achieve the calculation of counterfactual aggregate productivity, we repeat the matching exercise using as match of each informal firm an average of all formal firms, whose distances from the informal firm (in *p*score terms) is no greater than 0.01 percentage points. In this sense it may be seen for each informal firm, the counterfactual of the number of employees, which is the average of this variable for all formal firms that were matched with the informal firm in question. On the other hand, the formal firms remain with the original number of employees. With these new demands for labor (counterfactual for informal firms and real for formal firms) a new market size and the shares corresponding to each firm (measured in terms of employment) may be calculated, to finally calculate counterfactual aggregate productivity and the different terms of the decomposition (7.1).

From the comparison of both aggregate productivities (real and counterfactual) it may be assessed if total productivity, as a weighed average of the firms' productivities would grow if the informal firms were formalized and could hire more workers. Better yet, the decomposition of aggregate productivities in their two terms allows assessing if the covariance between productivity and market share would be greater in the counterfactual case, which would drive aggregate productivity upward thanks to a better adjustment of the size of firms according to intra-firm productivity. This improvement in the term of covariance would be none other than an improvement in the process of creative destruction in the market. The results of the decomposition are found in table 5.

Table 5. Static decomposition of aggregate productivity – Olley and Pakes

	Left Side	Right Side	
	$\sum_{i=1}^{N_t} s_{it} P_{it}$	\bar{P}_t	$\sum_{i=1}^{N_t} (s_{it} - \bar{s}_t)(P_{it} - \bar{P}_t)$
Observed Aggregate Productivity	3.2255 (100.00%)	3.1802 (98.60%)	0.0453 (1.40%)
Counterfactual Aggregate Productivity	3.2747 (100.00%)	3.1802 (97.11%)	0.0945 (2.89%)

Note: The percentages of each term as a proportion of aggregate productivity are in parentheses, under the respective term. Fuente: Cálculos propios.
Source: Own calculations. Data: Microestablishments Survey (DANE).

The results of the exercise of decomposition of Olley and Pakes are as expected. Given the observed distribution of productivities of firms, a reallocation of market shares in which formal firms keep their level of observed employment, but informal firms hire the number of employees of the counterfactual scenario, would improve the adjustment between the size and productivity of the total sample of firms. In particular, the covariance in the real scenario between market share and productivity is 0.0453, which represents 1.4% of real aggregate productivity, while the covariance that would exist between counterfactual participations and given productivities would be 0.0945 and would represent 2.89% of counterfactual aggregate productivity.

The above means that if informal firms increased the hiring of employees corresponding to the gap that exists between its hiring and that of formal firms with the same characteristics, aggregate productivity of the market would increase thanks to a distribution of market shares between all firms that would be better correlated with the distribution of productivities of the same firms. This means in other words that the formalization of informal firms facilitates the process of creative destruction, and ultimately favors growth of aggregate productivity. In this particular case, aggregate productivity would have an increase of approximately 5 percentage points (given that we measure productivity in logarithms).

Given that the exercise proposes changes in market shares of firms originated in changes in labor demand proposed for informal firms, and taking intra-firm productivities as given for formal and informal firms, the aggregate term of decomposition (the first term on the right-hand side) remains the same in both decompositions. This implies that the estimated increase in aggregate demand of the market may be entirely attributed to the improvement in the covariance between market share and productivity.

It is important to note that the counterfactual calculation of aggregate productivity done in this exercise omits effects of general equilibrium and could be upward bias: if labor demand of informal firms increases, then wages also increase and this would negatively affect demand for labor in the two sectors.

8. Conclusions

Some of the most acknowledged problems as a consequence of business informality are flaws in the coverage of social wellbeing of employees and a reduction in collection of taxes by the government. However, beyond them, there are also potential negative effects on the growth of the economy. In particular, the existence of informal firms (under the definition used in this paper) causes a gap in demand for labor by the same, regarding what could be the potential demand.

Using a matching method to compare the hiring of employees by formal and informal firms with similar characteristics, we found that informal firms have less remunerated employees on average, compared to remunerated employees of similar formal firms. Likewise, an informal firm has on average a lower proportion of remunerated employees (as part of total employees) than a formal firm. These results show that informal firms, by being under said condition of illegality, absorb less market resources than what they could if they were not informal, given that their productivity would allow so. In the conditions proposed in the model of this paper, the above occurs because informal firms face size restrictions to remain in illegality, and this may be construed as an adjustment cost in which informal firms have to incur (which in this case is a

non-monetary cost). This adjustment cost does not allow said firms to demand the desired level of labor, but rather demand below said level.

One of the limitations of the previous results makes reference to a criticism of the non-observable variables. When using the matching method it is assumed that the probit includes all variables that affect the difference between two firms, one formal and one informal; however, it is likely that there are other variables that differentiate these firms and that are not observed in the data, for which the model would be omitting said variables.

On the other hand, the consequences of the gap of employment between the desired and the effective, or between the real and the potential level, not only fall on each informal firm separately and over its employees, but also over the entire market as a whole. In this sense, the implications at a macroeconomic level are found in terms of aggregate productivity. Specifically, if informal firms demanded the levels of employment demanded on average by formal firms with the same characteristics, aggregate productivity of the market would increase by 1.53%. This is due to the fact that the calculation of aggregate productivity (as was done in this paper) has a covariance component between productivity and market share (measured with the total number of employees) of the firms, that when replaced by the counterfactual covariance that would exist if informal firms demanded the labor of formal firms, this would increase and positively drive aggregate productivity. The best adjustment between intra-firm productivity and the corresponding market share is in other words perfecting, or at least moving forward, in the process of creative destruction of the Colombian market.

During the development of this investigation and as part of the matching exercise, it was also found that the probability that a firm is informal is associated with the fact that it develops its activity in a household or fixed place of business (not in a commercial establishment), that is incorporated as a cooperative, de facto company or individual (not as a commercial company), and that it develops its activity in the manufacturing, trade, restaurants, social services, among other sectors. On the other hand, productivity is a factor that positively affects the probability that a firm becomes formal.

It should be mentioned that the scope of this work only covers the universe of the micro-establishments in Colombia, thanks to the representation at a national level of the Micro-establishments Survey. However, given that the micro-companies represent close to 96% of the Colombian business world, it is a good start to analyze the implications of informality throughout the country.

Although some authors, such as Mejia and Posada (2007), show that there is an optimal level or a natural rate of informality, different than zero, they also mention that this rate may be reduced for example, with a technical change in the formal sector, given that economic development facilitates the solution of the problem of excessive informality. Rozo (2008), on the other hand, contributes in this field proposing a reduction in taxes on wages, compensating with an increase in income taxes. After this investigation and taking into account the implications of informality, economic researchers shall continue proposing and assessing mechanisms that help to reduce business informality, not only to reduce the size of something that is illegal that harms the government's revenue, but also because it is a way to drive productivity and economic growth.

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Annex

Table 1. Marginal effects of the probit model

Dependent Variable: Formal=1 if the firm is formal, 0 otherwise

	dy/dx
TFP (log)	0.0128*** (0.0010)
Location:	
Fixed Place	-0.5418*** (0.0038)
Household	-0.2812*** (0.0035)
Legal Organization:	
Cooperative	-0.3645*** (0.0299)
De facto Company	-0.4570*** (0.0117)
Single owner Company	-0.3524*** (0.0051)
Age:	
1 to 3 years	0.2194*** (0.0056)
3 to 5 years	0.2898*** (0.0049)
5 to 10 years	0.3024*** (0.0047)
More than 10 years	0.2731*** (0.0052)
Economic Activity:	
Manufacturing	-0.1610*** (0.0100)
Trade, hotels and restaurants	-0.0873*** (0.0091)
Financial Intermediation	0.2225*** (0.0439)
Real Estate Activities	-0.3747*** (0.0094)
Social and personal Services	-0.2386*** (0.0103)

Note: dy/dx shows the marginal effect evaluated at the mean. The dummy of construction (as economic activity) was also excluded because the dependent variable was the same in all cases (3 observations). Standard errors are in parentheses. **5% significant. ***1% significant.

