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Determinants of Informality in the Dominican Republic.

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Approval

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Abstract

Informality is one of the most critical problems facing the Dominican Republic and the countries in the way of development; therefore, its study and monitoring is one of the essential objectives that the economics sciences must have to be able to find solutions to this problem that is becoming more and more urgent.

A solid identification of the factors that affect the determination of informality in the Dominican Republic was conducted in this investigation, as well as its main implications. Based on past research on the topic, factors were identified, such as gender, age, educational level, geographic region, and activity sector, among others, which were essential for estimating the marginal effects of each one over the probability of working in the informal sector.

With these estimations, it was determined that factors like age and education have a quadratic effect on this probability; in other words, the additional years of age first progressively diminish this propensity significantly before reaching a maximum point and reverting this trend and then increasing the likelihood; with the years of education, the first additional years of education have an impact of rising the propensity of informality, reaching its maximum point and after that, the highest additional years, especially for who has zero years of education initially, reduce the probability of being employed in this sector in more than 80

This analysis is done for the other explicative elements identified. Likewise, this is performed in a dynamic context to analyze the change from 2016 to 2019, a period of substantial economic growth, and from 2019 to the third quarter of 2022, in which the labor market is finishing the recovery of the significant employment loss caused by the COVID-19 pandemic.

Finally, public policy recommendations are made that could be implemented to find a solution to this problem and all the positive effects that could bring this solution.

Table of Contents

Introduction

1.1 Problem Statement

Informality and the scarce human capital that characterizes the Dominican and Latin American labor market are the main factors that prevent the region from being driven to development.

Arthur Lewis described the dual economies phenomenon present in Latin America, in which he established the existence of an industrial modern sector with high salaries intensive in capital and established in the urban centers and, at the same time, an agricultural or raw goods sector with subsistence salaries, a labor force excess, and impoverished work environment. The author suggests that these two sectors coexisting in Latin American economies are the determinants of the tremendous inequality and a great unemployed labor mass (Todaro & Smith, 2015) .

Furthermore, informality has adverse effects at the microeconomic level, such as the incapacity of bancarization of the employees that are part of this sector, the impediment of the informal employers of getting funding for the improvements of their business, the employees of this sector are unprotected because they are not contributing to the Social Security and are not getting other labor law benefits.

On the other hand, informality has detrimental macroeconomic effects, such as weaker economic growth and lower tax revenues, because the people working in this sector generally do not report the income tax; these factors slow the development process.

1.2 Purpose of the Investigation

Informality is a problem that systematically affects the Dominican Republic, Latin America, and most developing countries; therefore, it is crucial to identify the principal factors influencing the high informality present in the Dominican labor market.

After this identification, it is necessary to estimate the marginal effects of each one on the likelihood of being employed in the informal sector to know which has the most influence on this probability. Given that the government has an important budget constraint, It cannot solve every societal problem; therefore, the identification of the pertinent areas with the design and implementation of public policies that attack those problems in an effective and opportune way has positive effects not only on the informality but on many areas that contribute on the development of the nation.

In essence, a solid identification of the factors that impact the labor informality in the Dominican Republic, based on past investigations about the topic, with which can be done the pertinent estimations and subsequently determine which are the most critical factors to find a solution to this problem, helps to propose which areas should be focused to treat and according to the international experience, implement proved public policies to solve this situation.

1.3 Research Questions

What are the theoretical models that suggest the existence of the informality?
What are the demographic, social, and economic factors impacting the likelihood of a person being employed in the informal sector in the Dominican Republic?
What is the marginal propensity of each one of these factors to the labor informality?
How does the marginal propensity of these factors evolve before and after the COVID-19 pandemic?

Context and Diagnostic

2.1 Theoretical Framework

Informality is a concept that has been widely discussed due to its high incidence in developing countries and its micro and macroeconomic implications. However, it does not have a single definition. It is important to highlight the following definitions, which, from different perspectives, address the problem stated vastly.

One of the informality definitions is the one that considers all private salaried employees who have not signed a contract in the organization where they are working(considering that the labor code contemplates that it is not mandatory that the contract needs to be written); also, the workers who do not enjoy of the benefits established in the Social Security and the labor code such as paid vacations, Christmas salary, early warning, severance in case of being fired, among others. In addition, self-employed people whose businesses do not have a license to operate, domestic workers, and people who do unpaid work are considered informal employees (Guzmán, 2007)

"The formality or informality of the occupation is defined by the access or not to the social security(health insurance and/or pension plan) product of the working relationship" (BCRD, 2023) . Therefore, all private salaried workers and self-employed people who are not contributing to a pension fund and/or are registered in the family health insurance are considered informal.

Within the framework of all these definitions, the methodology used to count the number of people employed in the informal sector by the (BCRD, 2023) is the following: It accounts for the informal salaried employees that are working either in the informal or the formal sector, the domestic workers who are not contributing to social security and, as well, the employees in the formal sector who are doing activities without getting paid.

Some of the precursor theories of the concept of informality are the development models that highlight the existence of a dual economy in sub-developed countries, which was introduced by (Lewis, 1954), who states that the sub-developed economies are composed of two opposed sectors but interdependent. A modern sector made up mainly of industries with high utilization of capital and the traditional subsistence sector, which has an excess of labor mass so significant that for this reason, Lewis titles his paper 'Economic Development with Unlimited Labor Supply '; this model implies that the workers of the sector in which are included subsistence farmers, informal workers, little merchants, and domestic services employees, have marginal productivity very close to zero or even negative(in the cases in which there is a relative overpopulation to the natural resources), in consequence, they gain a minimum salary that only covers for their survival.

Another focus suggests that informality results from institutional limitations and governmental relationships. Thus, informality is a decision taken by the agents who prefer to break the law while running a business because there is no serious risk of negative consequences for operating in the informal sector. Among the benefits of having an informal enterprise is that it gives them an advantageous position compared to their pairs in the formal sector. Besides, its position at the law margin helps them grow more to some extent because they do not need to comply with regulations like paying taxes, minimum salary, and adequate labor

conditions. However, this limits them to loan access and property rights that are fundamental for the full development of a firm. The defendants of this focus advocate for eliminating the obstacles to the firms formalization (Guzmán, 2007).

(Maloney, 2004) have a particular and contributive approach since he exposes that informality is a voluntary result. Also, it results from a benefit-cost analysis; firms and employees choose the informal sector over the formal one because it maximizes their utilities given their preferences.

Thus, many MSMEs that do not have big aspirations or long-term potential choose informality since being a formal enterprise represents more costs than benefits from having this status. Likewise, many workers could prefer informality due to the schedule flexibility that informality brings because, given their preferences, this could grant more utility than a higher salary. Additionally, they could prefer saving independently, investing, and proportioning themselves to health insurance over receiving social security benefits such as health insurance and contributing to a pension fund (Guzmán, 2007).

Also, (Acuña et al., 2021) compile the points of view of various authors that despite these approaches being opposite, they are not necessarily excluding. Their idea is that there are people who choose the informal sector over the formal by their own decision and voluntarily, while there are people in this sector who do not have more transition options.

A regional approach is a fundamental aspect of the informality analysis, given that a comparison analysis between countries brings an insufficient image of this phenomenon because there is a spatial heterogeneity in the economic performance at the regional level within each country, which is a common factor in every country. At the regional level, there are huge differences in economic activity, educational level, productivity, and life quality, among other factors that promote the existence of differentiated labor markets that could explain the differences in economic growth results to a certain extent (Acuña et al., 2021).

In short, although informality was identified as a problem many decades ago, the cause of it and its conceptualization have had diverse approaches and explanations since its roots are not only economic but also social, demographic, and historical, which makes it a complex situation.

2.2 Empirical Background

Many studies have been done in the Dominican Republic and Latin America to find the causes of informality and its implications on people's living standards and macroeconomic aspects, such as fiscal revenue and long-term economic growth.

(Guzmán, 2007) was one of the precursors of the informality study in the Dominican Republic, making the most complete and comprehensive diagnostic of the leading causes, explaining that one person belongs to the formal sector and the economic, demographic, and historical characteristics of these employees.

Either for legal, social security, or International Labor Organization(ILO) criteria, (Guzmán, 2007) found that at least 50% of the urban workers belonged to the informal sector, this figure being 65.3% when considered under the social security criteria, which evidence the high incidence of this phenomenon in the Dominican labor market. Among the people who are in this situation are the self-employees with a low level of schooling, the people who are working in enterprises of 5 employees or less, the workers who do not have a contract or who work in an enterprise that does not have a license for operating; furthermore, the self-employees with a low level of schooling, the patrons of their own business and the self-employed professionals are the ones who have less tendency of being contributing to a pension fund. Additionally, these three criteria mentioned before show a high degree of correlation, indicating the multifactoriality of this problem.

In the demographic and socioeconomic analysis of the factors that impact urban informality in the Do-

minican Republic (Guzmán, 2007) highlights that men, employees with low levels of education, and families with a lower income level are more likely to be informal workers. Likewise, construction, commerce, tourism, and transport jobs have a higher probability of being informal. The East and South regions have more incidence of informality than the North and Metropolitan. Also, informality increases at extreme ages when a person must be entering or exiting the labor market.

Not earning enough money and the preference for being paid more are the main justifications for those who do not contribute to a pension fund. Furthermore, a common reason for self-employees who are in this situation is that they win more than as employees, are more accustomed to that, have more flexibility, and do not want to have a boss (Guzmán, 2007).

When talking about companies, the principal reasons that people argue for not registering their business are: because the business is small and for this cause, it is not worth it, any venture like this does not register formally, it is too challenging to get certifications and permits, it is not considered necessary to get a license, or it is too expensive, among others. The owners of businesses mention the benefits of not being registered formally, including not needing to pay taxes, avoiding government regulations, not having to pay bribes to officials, reducing salary expenses, not having to pay severances, and allowing expanding the business without permits. However, they cite that being in this situation harms their business in the following ways: it makes it difficult to negotiate with big enterprises, to defend themselves legally in case of having issues, to do business with the government, to access loans in the formal financial sector, and in many cases, they are obligated to pay bribes to government inspectors (Guzmán, 2007).

Two predominant factors that aggravate the problem of informality are its intergenerational dimension and the persistence of the labor condition and unemployment. For the heads of households employed informally, 76% of their working sons and daughters are informal workers, while just 24% are formal workers. Likewise, it is found that most people, especially the old ones, have spent all their lives in a labor condition of formality or informality and, to a lesser extent, on the same activity type. Also, the author estimated that for every 100 unemployed at a temporal point, approximately 40 would not have found a job after five months of searching, 20 after a year, and 10 after 20 months of searching. This data evidences the insertion difficulty of the formal labor market and, to a certain point, demonstrates one reason that the informal sector employees cite, which is that this is the only type of job they can find (Guzmán, 2007).

(World Bank, 2017) had a result that, to a certain extent, contradicted (Guzmán, 2007) because they evidenced that controlling for economic activities with a higher incidence of informality in which men have a larger preponderance, such as agriculture and construction, women have a probability between 1.3 and 1.6 bigger of being working in informality than men with the same educational level, residing both in urban zones, without receiving remittances, and both working in the retail sales sector.

(Gómez, 2013) found by estimations that young people between 15 and 29 years who are married or in a free union have a higher propensity to work in the informal sector. In addition, concerning the educational level, young with high school or technic education have more probability of having a job in the formal sector; on the other hand, young with a college education have less probability of working in the formal sector, which the author associates with the business preferences of hiring people with labor experience.

(World Bank, 2017) confirms what (Guzmán, 2007) suggests regarding education since its results show a strong correlation between educational level, the probability of contributing to a pension fund, health insurance coverage, and labor formality. The workers who are registered in the Social Security system either in the formal or informal sector (considering that in that study, the database used was the ENFT, which does not use the current definition of informality extracted from the ILO; afterward, it is substituted for the ENCFT which includes social security within the aspects considered for determining if it is an informal or formal worker) have a mean schooling level higher than the ones who are not registered and similarly high for formal and informal workers.

Therefore, (World Bank, 2017) infers from the past idea that employers would have more willingness

to deal with the administrative and financial burden inherent to the Social Security system for the greater productivity that offers employees with higher education. Furthermore, despite needing more data to confirm it, this could indicate that if the costs of the contributions to social security are not offset by higher productivity of the workers, the probability of informality increases.

Empirical evidence shows that countries with an economy where activities of the primary sector, like agriculture and mining, have a greater weight in their GDP tend to have more informal workers because aspects such as legal protection and contract fulfillment have less value. In addition, the data shows that commerce and construction are sectors where informality prevails. Likewise, in areas where there is a production of goods or a service provision with greater seasonal intensity, the creation of jobs tends to be for informal employees to perform temporal activities (Acuña et al., 2021).

Visualizing the relationship between immigration and informality in the Dominican Republic there are some important results. 45% of employed immigrants were in the informal sector in 20212, but by making a comparison for gender, there were obtained results opposed; men, who represent the majority of immigrants, only 33.7% were in the informal sector, while 70% of immigrant employed woman were in informality. This situation is aggravated when only taking into account the immigrants from Haiti since 60% of men and 78% of women are dedicated to informal jobs. However, when looking into data on immigrants from other countries, more than 80% of them are employed in formal jobs (Lozano, 2013).

A relevant finding for the Dominican labor market is the relationship between informality and Haitian circular migration: "It is shown that the informality character is important for the migrant to develop a cyclic pattern. They have a higher frequency of committing the event the temporal workers in reference to the permanent employees." (A. Fernández, 2019) . This fact implies that the informal temporal jobs influence Haitian immigrants; instead of staying in the country, they return to Haiti more often.

From a macroeconomic point of view (Roldós et al., 2019) found that informality is well-related to the business cycle in Latin America and the Caribbean. Informality is counter-cyclical, and the fluctuations of the GDP have a higher impact on this than unemployment. Additionally, informality slows the speed of adjustments in the labor market, negatively affecting productivity growth. These authors also evidenced that more rigid laws for protecting employment in certain aspects contribute to increased informality, specifically, the high costs and barriers to termination, like the requirement of approval from third-party people for the dismissal of a worker. On the other hand, the authors indicate that high minimum salaries, in comparison to the productivity of the workers, increase informality and diminish the rapidity of shock adjustment.

By relating informality and economic growth, it is shown that informality has a negative effect on this, given that (Quispe et al., 2021) , evaluating this relationship in the period of 2015-2020, found that labor informality reduces economic growth in Peru in 38%; also, a reduction in 1% in the rate of informality boosts growth in 5%, and a decrease of 3% will increase growth in 10.3%.

(Rodríguez & Guerra, 2019) Confirmed the existence of a salary gap between formal and informal workers, with the salary of the formal higher; in addition, considering the salary distribution in the informal sector, there exists a significant heterogeneity. The authors show results that support the idea that a part of the population works in the informal sector for subsistence.

In a more rigorous estimation, the results of (World Bank, 2017) contradict the last idea. The authors found that using a propensity score matching analysis, which eliminates the endogeneity bias, the informal sector employees generate incomes 5.2% higher than the formal sector ones, keeping all the other factors constant. These authors associate this result with the fact that the unobserved factors in the informal labor market make it possible for employees to obtain higher salaries than they could gain in the formal sector.

(Rodríguez & Guerra, 2019) found that the people with the lowest probability of working in the informal sector have a college education, contradicting the estimations of (Gómez, 2013). They found that: "These negative coefficients of the educational level intensify between women, to a greater extent than in the model

between men, in both educational levels achieved, which could be a reflection that schooling has increased at a higher pace among women and they tend to be less prone to participate in the informal sector in the extent that its schooling increases. It is worth highlighting that primary education is significant among women but not in men, which implies fewer exigences for women to access the formal sector than men by educational level achieved." (Rodríguez & Guerra, 2019).

There is an effect of poverty on informality; only if there is an effect of informality on poverty, in other words, a poor person has more probability of being employed in the informal sector and, as well, a person working in the informal sector has more probability of being in a poverty situation. Therefore, it is confirmed that factors such as residing in urban zones, a higher educational level, working in the financial industry, and living in the Cibao region diminish the probability of being in informality. In contrast, aspects such as being the head of household and working in the agriculture and livestock sector increase this probability (Rodríguez, 2022).

Remittances have a negative effect on the employment level, especially in the informal sector, where the employment rate is reduced by 15% for the informal workers receiving remittances. These positively impact the decision to acquire a higher level of schooling and bring out economically active people from the labor market, primarily informal workers, since the decision to study has a more significant impact than the working one under these circumstances. On the other hand, for informal employees, the monthly reserve salary increases up to RD$ 3,430, which is coherent with the reduction of the employment rate in this sector and could lead to infer that people who work in the informal sector have a larger dependency on remittances for determining their level of consumption in comparison to the formal sector ones (Díaz & Olivo, 2015).

Microenterprise informality is one of the factors that limit their access to financing. Hence, they need to go to usurers or lenders who offer informal credits, which have very high rates ranging between 3% daily and 20% monthly and have variable amounts and immediate disbursement. This sector has higher risks because of the missing concrete guarantees, additional costs for the low volumes, and regulations restricting the capacity to attend the sector (Ortiz & Garcia, 2012).

"In total, the formalization costs- including the contributions to social security, protections, and benefits for the workers- increase the labor costs by 41% over the mean salary. Employers probably resist paying these costs unless the workers demonstrate productivity that justifies the expense. This can partially explain why formal workers present higher educational levels than informal ones." (World Bank, 2017)

(Ortiz, 2019)obtained results of the overindebtedness risk of microenterprises, in which the author determines that the two categories that have the lowest risk of overindebtedness- defined as the occurrence of payment delays of 90 days or more - are the ones that have a revenue of RD$ 15,000 or less and between RD$ 15,000 and RD$ 45,000; which can be explained because people with low incomes have the goal of making in due time their payments because if they lose the access of these microcredits, that are credit programs for microenterprises, they will only have the chance to obtain informal loans under the circumstances mentioned before; while the ones who present a high risk are who have an estimated income higher than RD$ 75,000.

In the Dominican Republic, informality has a larger effect on sectors in which economic growth has a significant impact on employment, such as retail sales, construction, and transport; nevertheless, sectors like finance, mining, and electricity that have a low incidence of informality, generated an inconsiderable amount of new jobs during the substantial growth of the GDP registered during 2004-2015 (World Bank, 2017).

One of the most relevant consequences of a high informality rate is its negative effect on tax revenue, (Dirección General de Impuestos Internos (DGII), 2013) underlines that: "It is estimated that the non-compliance of informal employees on the Income Tax amounts to 0.5% of the GDP of 2011, with revenue potential in the Income Tax of RD$ 10,469.9 million. "

Another recent study obtained results similar to those just mentioned. (World Bank, 2017) found that the formalization of approximately 106,000 workers with income surpassing the Tax on Personal Income

threshold would increase the tax revenue of RD$ 10,000 million per year or 0.33% of GDP. In addition, considering that in this formalization process, the educational level of informal workers would adjust upward before this mobility occurs, which would boost the income of workers according to the schooling returns of the mincer equation for the country, that will almost duplicate the rise of the government revenue up to RD$ 18,800 million per year or 0.61% of GDP.

(Prazmowski, 2020) suggests that the evasion, avoidance, and informality that characterize the production of goods and the provision of services are the principal aspects that have caused the failure of tax reforms implemented in the Dominican Republic, and that is why the country is one with the lowest tax burden in Latin American and the Caribbean. The author shows that these three combined problems represent approximately 60% of the economic activity that authorities currently are not supervising or cannot do. Thus, it is estimated that evasion, avoidance, and informality constitute a mean of 15% of GDP, which implies that without these fiscal distortions, the fiscal authorities could duplicate their revenues or have the same tax revenue, reducing the tax rates in half and staying all the other factors constant.

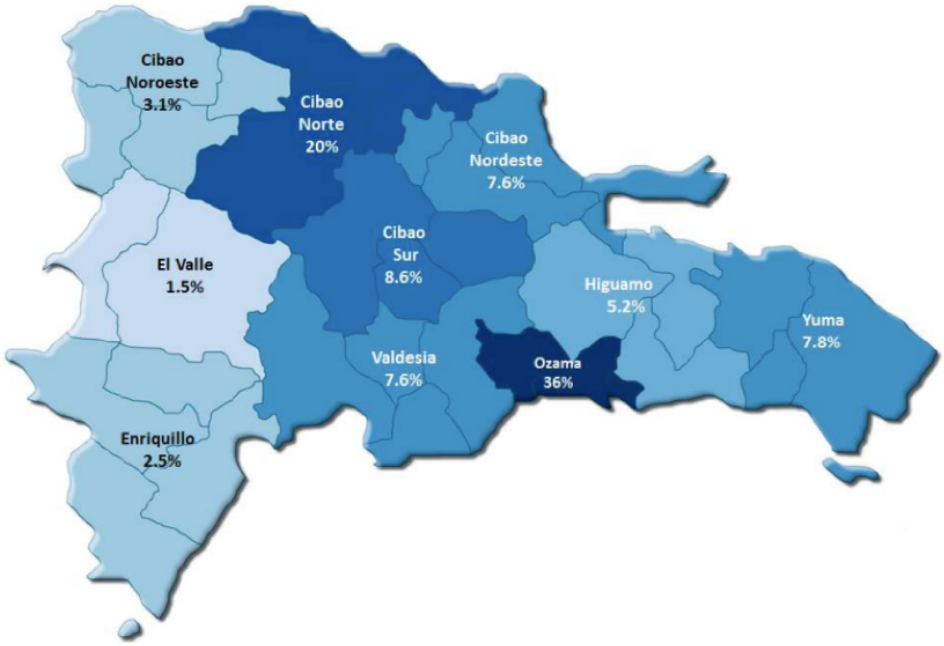
(Torres et al., 2020) show how countries with a higher percentage of GDP in the informal economy tend to have lesser use of electronic means of payment, so they recommend the implementation of public policies for reducing informality in Mexico, among them: fiscal incentives to consumers and enterprises, mandatory acceptance of electronic means of payment, exigence that salary pay must be done electronically, and limit the cash purchases; these measures could increase the tax revenue by 0.58% of Mexican GDP and reduce the informal economy up to 1.5% of GDP.

The financial and actuarial effects of informality on a social security system depend on the type of system according to its financing. Informality will not impact the system if it is an individual capitalization system, like in the Dominican Republic. However, it would be on the worker not contributing to his capitalization account. Moreover, if there is a pay-as-you-go pension system, informality risks its sustainability since there is a lower revenue that must be covered by the state, putting government finances under pressure (Fernández, 2016). Despite not having a direct impact on the system in the Dominican case, it hurts public finances because these people who work in the informal sector do not have enough savings to live in their old age; they will have to continue working, and when they cannot work more, or when they do not find a job, a significant part of this people are going to depend directly of government subsidies for covering their basic needs; evidencing that this problem could demand much state funds if it is not solved in the proper time.

2.3 Context

Evidencing a distribution made by (Dirección General de Impuestos Internos (DGII), 2013) with data from 2011, it is found that regions Ozama, North Cibao, and South Cibao represent 64.6% of the total informal employees subject to Income Tax, providing a crucial indication for the adoption of measures according to every region, given the economic activity, cultural and demographic factors of each one that let address the problem of informality in a more transversal way.

Illustration 1. Distribution of informal employees subject to Income Tax. 2011



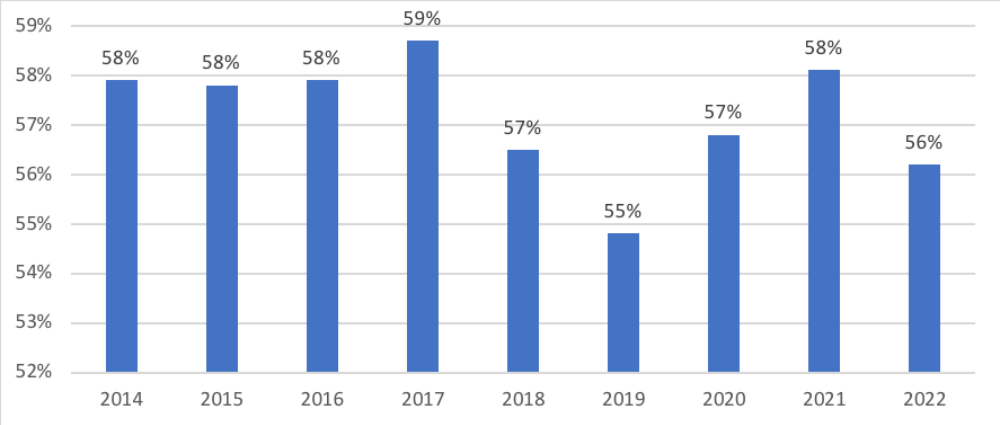
Source: Extracted from (Dirección General de Impuestos Internos (DGII), 2013)

Visualizing the trend of the main parameters of the Latin American labor market from 2006 to 2018, (Acevedo et al., 2021) highlight that most countries of the region presented significant advances in diminishing the number of informal workers and inactive people, pointing out the case of the Dominican Republic which reduced the informality rate by five percental points in the period considered.

In contrast, (World Bank, 2017) found that the proportion of informal workers from the total workers in the Dominican labor market has oscillated around 55% when taking into account the period between 2001 and 2015, so the author indicates that this is evidence of a possible existence of structural fundamentals that not allow the informality to be reduced. This divergence between these last two papers is explained in the period they take, from 2006 to 2018, when the economy was in constant and accelerated economic growth after the recovery of the Baninter crisis. Therefore, that is the reason for a reduction of 5% in the informality rate. However, considering the period between 2001 and 2015, this includes the effect of the crisis that significantly impacted unemployment, inflation, and poverty, which could have affected the analysis.

In 2013, a diagnostic of the situation of MSMEs threw results that evidence the prevalence of informality in this type of enterprise. For micro-enterprises, it was obtained that 89.8% of this type of business were not registered; the fulfillment of the compliment stipulated in law is more common among enterprises that have more than ten years registered, and it is more informality in the manufacture and commerce sectors than in the services one. In contrast, this situation is contrary to the small and medium enterprises, in which only 2.8% were not formally registered; this is associated with the higher number of employees these enterprises have, who put more pressure to access social security and the employers prefer to comply with regulations for avoid being sued for labor accidents. MSMEs with a female owner had almost triple the incidence of informality compared to those with male owners. Likewise, the formality of an MSME presented a positive correlation with the age and educational level of the owner. Nevertheless, this high percentage of formalization in small and medium enterprises did not correspond with the universe of MSMEs since, for that year, the micro-enterprises represented 98% of MSMEs, generating 76% of the jobs. Micro, small, and medium enterprises employed 54.4% of the total workers of the economy; therefore, herein lies a significant part of the high incidence of informality in the Dominican economy (Ortiz et al., 2013).

Graphic 1. Informality rate in the Dominican labor market, 2016-2022

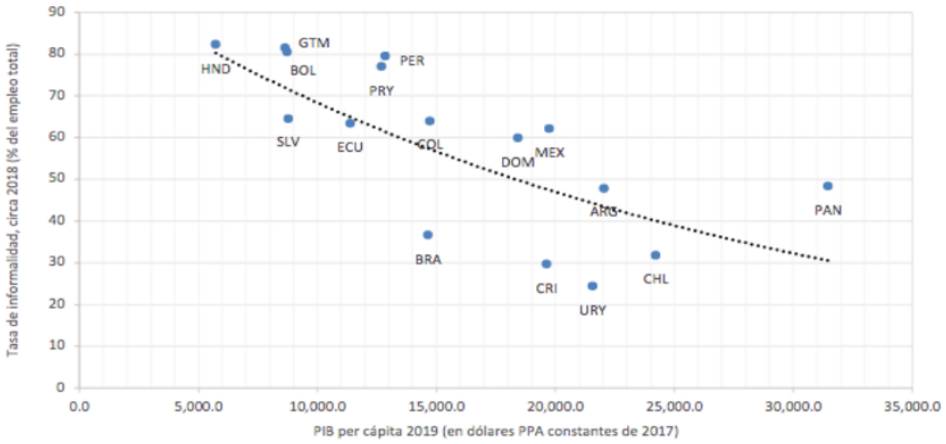


Source: own elaboration with data from Central Bank of the Dominican Republic(BCRD for its Spanish abbreviation)

Visualizing the trend of the proportion of informal employees from the total number of workers considering the fourth quarter of each year can show that this variable has a volatile behavior; however, it does not have a constant trajectory. Nevertheless, this rate has a mean of 57.2% in the considered period in Graphic 1, which confirms, to a certain point, the approach of (World Bank, 2017); the authors associate this persistence of informality through time with structural factors of the Dominican economy that preclude the formalization of workers at the necessary rhythm. It should be noted that this result is being affected by the effects of the COVID-19 pandemic in 2020, as displayed in the graphic, starting in 2017, which is the year with the highest informality rate of the period, this started a downward trajectory that despite not being substantial but it is obtained the minimum value of the period in 2019 with 55% of total workers in the informal sector. Afterward, the significant employment loss provoked by the measures to stop the spreading of the virus in 2020 and the extension of them to a great part of 2021 caused a jump in informality in 2020 to 57%, a peak in 2021 of 58%, then decreasing to 56% in the fourth quarter of 2022. Therefore, it is necessary to continue monitoring this tendency to verify whether it is a downward trend of this variable or whether these decreases are just volatility that presents this variable, confirming the existence of structural factors that perpetuate the informality in the Dominican labor market.

Observing Graphic 2, (Acevedo et al., 2021) show that in 2019, the Dominican Republic had a considerably high level of informality regarding its development level measured by GDP per capita, given that while GDP is increasing, the labor market must absorb a higher number of workers to the formal sector and thus, reduce the proportion of informal employees progressively rise the GDP; However, because of different hypotheses stated before like the existence of structural factors that perpetuate informality in the long term and the low level of education in the Dominican population which encourage the informal employment, these could explain a big part of the reason that the country given its level of GDP per capita present a higher informality level to the expected in this regression with data of Latin American countries.

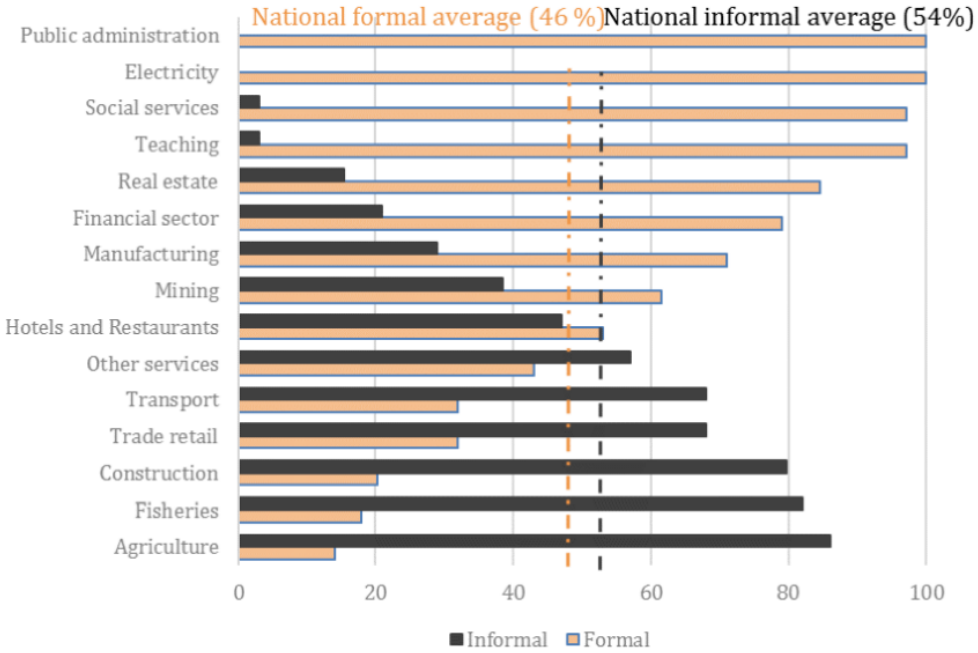
Graphic 2. The informality rate of people 15 years or more of age and GDP per capita of Latin American countries



Source: Extracted from (Acevedo et al., 2021).

In Graphic 3, it can be observed that for 2015, the sectors with the highest level of informality were agriculture, fishing, and construction, having a rate of informal workers of around 80%; subsequently, the sectors of retail commerce, transport, and other services are above the mean that is 54%. Furthermore, despite being below the mean, the hotel and restaurant sector has a significant percentage of 45%. On the other hand, the situation is totally different in the other sectors of the Dominican economy, given that the others have a percentage of formality of at least 60%, highlighting public administration and the electric sector with 100% of formality; social services and education with percentages very close to 100 and then, real state and the financial sector with a percentage of around 80%.

Graphic 3. Informal and formal employment rate by sector, 2015



Source: Extracted from (World Bank, 2017).

Metodology

3.1 Econometric model

This investigation uses a quantitative method based on the deductive and inductive methods; since investigation questions are made from the theory, econometric models are applied to the data compiled by official organisms to answer the questions initially raised, and finally, the results are presented as new empirical evidence (Monje, 2011).

This study will estimate the probability of being employed in the informal sector in the Dominican Republic; the model is one of discrete choice with a dichotomic variable. In that case, using a linear regression model will not be efficient since the results have continuous interpretations and, at the same time, the dependent variable is discrete (Albarrán, 2020).

It would be possible to estimate this probability with the more common methodology, the Ordinary Least Squares(OLS); however, this presents some restrictions for the discrete choice models; among them are: the forecasts of the model are not limited to adopting only values between 0 and 1, so results with the absence of rational interpretation are obtained. By construction, the regression errors are heteroscedastic; in other words, the variance depends on the explicative variable, and therefore, the errors are not constant. Likewise, the errors breach the assumption of normality; for any given value of the explicative variable, the errors only have the possibility of taking the values of 0 and 1; for that reason, the errors have a binomial distribution, not a normal one (Lema, 2017).

Although these problems have remedies such as adjustment measures, robust standard errors to heteroscedasticity, and big samples because of the asymptotic properties, the OLS estimators continue to present important constraints in comparison to other estimators, especially to the marginal effect since the linearity of the Linear Probability Model(LPM), limit that the incidence of each explicative variable on the probability of occurrence of the phenomenon be constant, which contradict reality where many opportunities this interactions are not linear.

Consequently, there are two models for capturing this kind of link, restraining the predictions to values between 0 and 1. On the one hand, it is the model that is based on the cumulative distribution function of the standard logistic distribution(Logit). Conversely, it is the cumulative standard normal distribution function(Probit). Both models will be estimated and use McFadden's pseudo-R2 measure, which can observe which model has more capacity for predicting reality and, accordingly, that will be chosen to apply in this investigation (Lema, 2017).

It will be used the model of (World Bank, 2017) with some modifications to verify some hypotheses formulated before; therefore, it will be estimated by the following equation:

$$\text{Probability}(\text{informal} = 1, \text{formal} = 0) =$$

$$\beta_0 + \beta_1 Educ + \beta_2 Educ^2 + \beta_3 Age + \beta_4 Age^2 + \beta_5 Urb + \beta_6 Rem + \beta_7 Lit$$

$$+\beta_8 Men + \beta_9 Agri + \beta_1 0 Constr + \beta_1 1 Com + \beta_1 2 Head + \beta_1 3 Marr + \beta_1 4 South + \beta_1 5 Ozama + \beta_1 6 East + \epsilon$$

The dependent variable is a binary variable that equals one when it is an informal worker and zero when it is a formal one.

The independent variables are the following:
Educ: Are the educational years attended and completed for the person calculated, taking the last year approved for the person, starting from preschool, the first grade required for the Dominican educational system, and calculating the grades that have been completed for the person.

Age: is the age of the individual.

Urb: A binary variable that takes the value of 1 when it is a person residing in an urban zone and 0 when residing in a rural zone.

Rem: A dichotomic variable that takes the value of 1 when it is an individual who has received remittances in the considered period and 0 in a contrary case.

Lit: A binary variable that takes the value of 1 when the person knows how to read and write and 0 when not.

Men: A dichotomic variable that takes the value of 1 when it is a man and 0 when it is a woman.

Agri: A binary variable that takes the value of 1 when the person is working in the agriculture sector and 0 when not.

Constr: A dichotomic variable that takes the value of 1 when the person is working in the construction sector and 0 when not.

Com: A binary variable that takes the value of 1 when the person is working in the commerce sector and 0 when not.

Head: A dichotomic variable that takes the value of 1 when the person is head of household and 0 when not.

Marr: A binary variable that takes the value of 1 when the person is married or in a free union and 0 when not.

South: A dichotomic variable that takes the value of 1 when the person resides in the Southwest region and 0 when not.

Ozama: A binary variable that takes the value of 1 when the person resides in the Ozama region and 0 when not.

East: A dichotomic variable that takes the value of 1 when the person resides in the Southeast region and 0 when not.

ϵ = The error term or not observable perturbations.

It would be realized a Breusch-Pagan test to check that the model has a constant variance of the errors, that is, that the model is homoscedastic; in case of rejecting this null hypothesis and having a heteroscedastic model, it will be estimated robust standard errors. In addition, a Variance Inflation Factor(VIF) test will be made to check the existence of multicollinearity (Gujarati & Porter, 2010).

3.2 Data

The data that will be used for the estimations are from the Continuous National Survey of the Workforce(ENCFT for its Spanish abbreviation), elaborated by the Central Bank. The marginal propensity to the informality of the factors mentioned before will be determined in the fourth quarter of 2016 and 2019 and the third quarter of 2022, which is the last available currently. There are the following sample sizes: 20,293 observations in 2016, 19,941 in 2019, and 17,820 in 2022; though the databases are filtered because only the employed people are relevant for this study, therefore, these are reduced to 9,152, 9,545, 8,194 observations in 2016,2019, and 2022, respectively. These three years were chosen with the purpose of visualizing whether it occurs a significant change between the 2016 and 2019 period when the Dominican economy presented important economic growth in which there was a greater creation of formal jobs and how can be observed in graphic 1, the diminishing of the percentage of informal jobs with respect of the total jobs. In addition, making estimations with the most recent data can be evidenced whether, in this post-pandemic period, the coefficients are consistent with the past trend or whether the pandemic affected them.

Table 1. Statistic summary of variables education and age in the database of 2016

Indicator	Education	Age
Minimum	0	8
First Quintile	7	25
Median	11	38
Mean	10.13	39.11
Third Quintile	13	49
Maximum	22	98

Source: Own elaboration with data of the ENCFT

Table 2. Statistic summary of variables education and age in the database of 2019

Indicator	Education	Age
Minimum	0	9
First Quintile	8	28
Median	11	38
Mean	10.46	39.91
Third Quintile	13	50
Maximum	23	99

Source: Own elaboration with data of the ENCFT

Table 3. Statistic summary of variables education and age in the database of 2022

Indicator	Education	Age
Minimum	0	6
First Quintile	8	28
Median	12	38
Mean	10.45	40.12
Third Quintile	13	51
Maximum	24	96

Source: Own elaboration with data of the ENCFT

In the data of 2016, there are 5,539 informal and 3,613 formal employees, 6,674 reside in urban zones and 2,478 in rural zones, 345 received remittances, 8,605 know how to read and write, and 547 do not know, there are 5688 men and 3,464 women, 1,003 belong to the agriculture and livestock sector, 654 to the construction sector, 1834 to the commerce sector, and 5,661 to the other sectors; 4,777 are head of household and, 4375 are other members of the house, 5,048 are married or in free union, and 4,093 are single, 3,048 live in the Ozama region, 3,033 in the North region, 1,747 in the South and, 1,324 in the East.

In the data of 2019, there are 5,470 informal and 4,075 formal employees, 7,028 reside in urban zones and 2,517 in rural zones, 315 received remittances, 8,974 know how to read and write, and 571 do not know, there are 5,758 men and 3,787 women, 1,082 belong to the agriculture and livestock sector, 694 to the construction sector, 1,920 to the commerce sector, and 5,849 to the other sectors; 5,106 are head of household and, 4439 are other members of the house, 5,221 are married or in free union, and 4,319 are single, 3,239 live in the Ozama region, 3,165 in the North region, 1,727 in the South and, 1,414 in the East.

In the 2022 data, there are 4,992 informal and 3,202 formal employees, 5,880 reside in urban zones and 2,314 in rural zones, 278 received remittances, 7,665 know how to read and write, and 529 do not know, there are 4,988 men and 3,206 women, 959 belong to the agriculture and livestock sector, 731 to the construction sector, 1,674 to the commerce sector, and 4,830 to the other sectors; 4,348 are head of household and, 3,846 are other members of the house, 4,463 are married or in free union, and 3,725 are single, 2,524 live in the Ozama region, 2,725 in the North region, 1,782 in the South, and 1,163 in the East.

Results

A probit and a logit model of the main factors determined before that affect the probability of a worker being employed in the informal sector was estimated in 2016, 2019, and 2022. Mostly, the coefficients of the explicative variables were of the expected sign, and, likewise, the vast majority were statistically significant.

However, when performing the Breusch-Pagan test to verify the homoscedasticity of the model, the null hypothesis was rejected that the model has an error variance constant and, therefore, there is a heteroscedastic model. For this reason, there were estimated standard errors robust to heteroscedasticity, which are valid for making inferences about the population parameters and forecasting the variables (Gujarati & Porter, 2010).

Furthermore, after making the Variance Inflation Factor (VIF) test, the null hypothesis that it does not exist a significant correlation between the independent variables is not rejected; thus, the model does not present multicollinearity given that all the values are lower than 3, 10 is the value of this test from which there is a multicollinearity problem that needs attention, the test was only performed with the lineal variables because clearly if the quadratic variables are added, it will be obtained that the lineal and quadratic ones are correlated each other (Gujarati & Porter, 2010).

When visualizing the significance of the variables for the year 2016, the literacy variable is significative if it is taken at a 10% level of confidence; nonetheless, at 5%, it is not possible to reject the null hypothesis that expresses that this does not have a significant effect on the dependent variable. On the other hand, the variables head of household and Ozama are statistically significant at a confidence degree of 1%; married and urban variables are not statistically significant, while the remaining variables are significant at levels very close to 0.

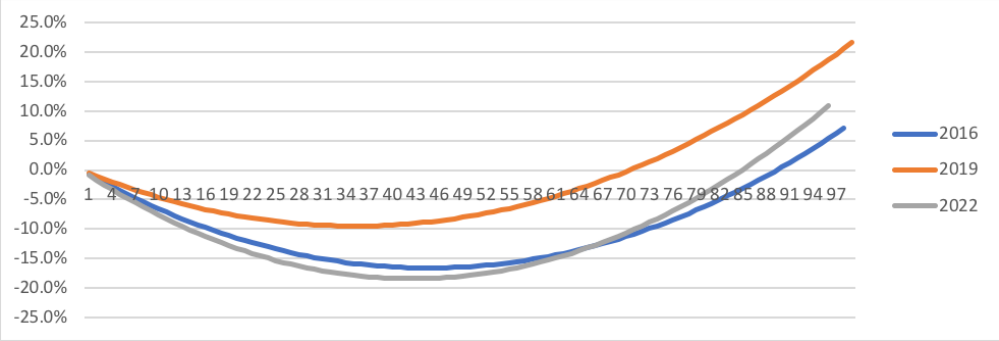
In 2019, the urban variable again is not statistically significant; the coefficient of literacy is significant at 10%, head of household at 5%, and age at 1%; the coefficients of the remaining variables are significant at levels very close to 0. In 2022, head of household, married, and East do not have statistical significance; urban is significant at 10%, remittances at 5%, and literacy at 1%; at the same time, the remaining are at levels very close to 0.

Calculating the McFadden pseudo-R2 for the three periods of the study, it is obtained that for 2016 and 2022, the probit model and 2019, the logit model are the ones that have a higher McFadden R2 and, therefore, a larger explicative capacity, for this reason, this models are chosen for presenting the results and making conclusions of them.

It is followed the suggested by (Gujarati & Porter, 2010) , who express that the coefficient derived from these models, both the probit and logit, are not interpretable in the way that is needed; it is required to estimate the mean marginal effects which do present the incidence of the explicative variables on the probability of occurrence of the phenomenon of study conveniently .

After estimating the mean marginal effects and visualizing graphics 4 and 5, it can be made the following interpretations, for years 2016,2019 and 2022, keeping all the other factors constant, to acquire an additional year of education and to have one more year of age have a quadratic relationship over the probability of being employed in the informal sector.

Graphic 4. Mean marginal returns of each additional year of age, years 2016,2019 and 2022



Source: Own elaboration with data of the ENCFT

In 2016, an additional year of age had the effect of reducing the probability of being employed in the informal sector by 0.7%, while each supplementary year had a higher reduction in the probability of being employed in the informal sector; this reduction reached a maximum point at 44.64 years with a value of 16.59%, in other words, this quantity of additional years make that an individual has a marginal propensity 16.59% lower of working in the informal sector. Afterward, with each additional year, there is a diminishing of the reduction until progressively, when reaching 89.4 additional years, this effect turns null. After that level, each extra year increases the probability of working in the informal sector, and as more years are added, this increase in the probability becomes higher. Subsequently, in 2019, the additional year of the maximum diminish of probability is 35.23, with a reduction of 9.47%; in 2022, these values are 42.47 years and 18.4%, respectively. Likewise, in 2019 and 2022, the intercept is found at 70.42 and 84.93 years, respectively.

This finding confirms what (Guzmán, 2007) stated when this author exposed that informality was an entrance and an exit door of the Dominican labor market, given that despite this model not estimating the probability of being employed in this sector for each year, this trajectory confirms this hypothesis because when you compare two employees with the same socioeconomic characteristics proposed for this model but one with greater age, initially this person has a decreasing probability of being employed in the informal sector, after reaching a maximum point this reduction in the probability of being employed in that sector start diminishing before reaching a point where this difference converts to null and then positive, in essence, this person now has a greater probability in comparison with the other.

This evolution through the years, which for 2019, the diminishing of the maximum probability and the additional years, could be explained by the substantial economic growth and employment creation registered between 2016 and 2019 when in the economy were created an important quantity of formal jobs and, especially for the young people as can be evidenced in the labor market data published by the Central Bank of Dominican Republic (BCRD for its Spanish abbreviation); thus the entrance of a considerable quantity of young people to the formal labor market makes this projection to move up and to the left as can be visualized in the graphic 4. However, for the third quarter of 2022, the estimations have a maximum point much higher, but from an age lower than 2016; therefore, it could be evidenced that young formal employment has recovered slower after the pandemic.

In addition, when analyzing the trend of the acquisition of each additional year of education, it matches the findings of (World Bank, 2017), given that the acquisition of the first additional years has an effect of increasing the probability of being in a situation of labor informality, although, after reaching a maximum these effects start a decreasing trend and after a certain point, the additional years of education reduce the probability of being employed in the informal sector and while higher additional years are acquired after the

point that they reduce the probability, this reduction of probability get accelerated to the point of becoming substantial in years of education that are equivalent of college and post-college level.

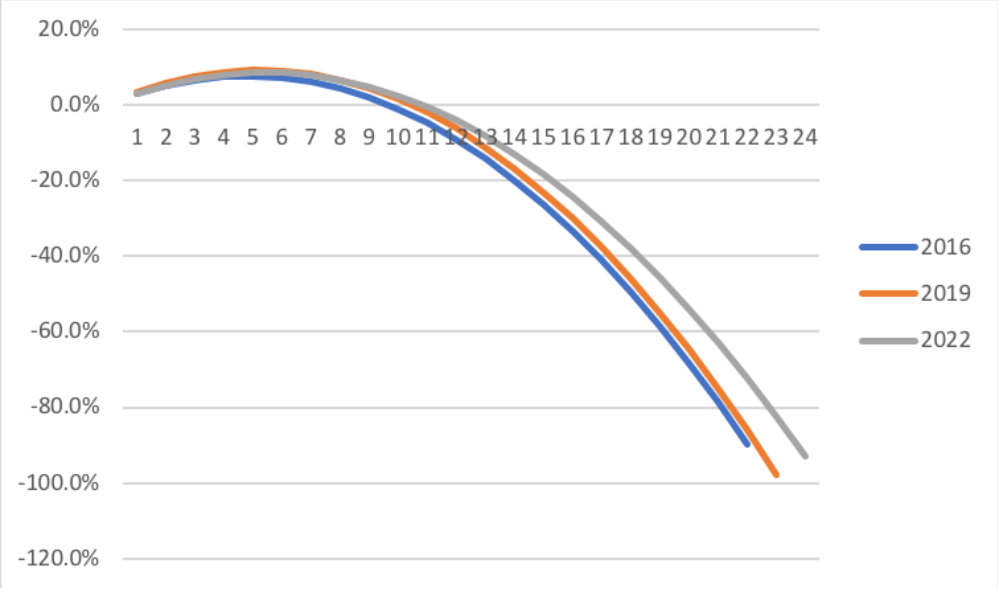
In 2016, the acquisition of an additional year of education increased the probability of being employed in the informal sector by 2.9%; this effect continued increasing before reaching a maximum in 4.84 additional years with a higher probability of 7.7%; afterward, for values higher than 9.66 additional years of education there is a lower probability of being employed in the informal sector; considering two people that do not have any schooling level, acquiring 13 years of education which are equivalent of a complete high school reduce the probability by 14.3%, 17 years which represent a complete college degree of 4 years reduce it by 41.2% and 22 years which implies finalizing a master's degree and a PhD reduce it by 89.6%, in comparison with one that does not have any year of education.

For 2019 and 2022, more additional educational years are needed to reach the maximum increase of informality propensity and reduce it. Likewise, when considering two people without any year of education, the additional schooling levels mentioned before have a lower effect on reducing the probability of labor informality.

These results could be evidencing the low quality of the Dominican educational system, which does not bring the necessary knowledge and abilities for the people to enter the labor market; for this reason, the employers need to find over-qualified workers given that it can be observed an important quantity of people with colleges degrees in jobs that internationally do not require them and also, a significant percentage of enterprises that require a college level for jobs that do not need the abilities nor the knowledge that are linked with this academic level ((ANJE), Asociación Nacional de Jóvenes Empresarios, 2022).

It can be highlighted that the marginal effects of the additional years of education might be overestimated because an important proportion of the sample does not have any schooling level. However, this overestimation only moves the curve to the right since this type of relationship is found in (World Bank, 2017) , who use a similar model to the one used in this investigation.

Graphic 5. Marginal returns of each additional year of education acquired, years 2016, 2019, and 2022



Source: Own elaboration with data of the ENCFT

In 2016, a person who received remittances had a 12.8% higher probability of working in the informal sector than one who did not receive them. Men had an 8.4% lower probability of being an informal employee than women. A person with a job that belongs to the farming, construction, or commerce sector has a

higher probability that his job is informal by 24.4%, 42.9%, and 17%, respectively, compared with the other economic sectors.

An individual who is the head of his household had a 3.2% lower probability of working in the informal sector than the other house members. Somebody who lives in the Southwest region had a 10.8% greater probability of being an informal worker than someone living in the North, while a resident of the Ozama or Metropolitan had a 3% higher and a resident of the Southeast region had a 6% lower when comparing all these regions with the North or Cibao Region.

Table 4. Mean Marginal effects of the probit model. 2016

Education	Education^2	Age	Age^2
0.03189	-0.003301	-0.007425	0.0000831
Urban	Remittances	Men	Agriculture
-0.01635	0.1282	-0.08423	0.2438
Construction	Commerce	Head of Household	Married
0.4285	0.1697	-0.03245	-0.01547
South	Ozama	East	Literacy
0.1081	0.03039	-0.06062	-0.06213

Source: Own elaboration with data from the ENCFT

With the purpose of evaluating the change of the marginal effects of the explicative variables on time, three years that represented different circumstances were chosen, given that 2019 marks the last year of the substantial uninterrupted economic growth registered since the Baninter crisis in the Dominican Republic which was halted by the recession generated by the measures to contain the COVID-19 pandemic in 2020. Afterward, in the third quarter of 2022, it already had a full recovery of economic activity and almost completed for the labor market. Therefore, it was chosen besides 2016, the year 2019, to visualize the change of the effects in a period of important economic growth, and 2022 to evidence the lagged effects that the pandemic could have over the estimated effects and their implications.

Table 5. Mean marginal effects of the logit model. 2019

Education	Education^2	Age	Age^2
0.03544	-0.003389	-0.005375	0.00007627
Urban	Remittances	Men	Agriculture
-0.002948	0.1079	-0.06461	0.2811
Construction	Commerce	Head of Household	Married
0.409	0.1633	-0.02583	-0.03688
South	Ozama	East	Literacy
0.1046	0.0443	-0.06354	-0.06469

Source: Own elaboration with data from the ENCFT

When visualizing the variable of urban zone, neither is it statistically significant in 2019; in 2022, it is only significant at a 10% degree of confidence, so it is not relevant to analyze its evolution. The variable remittances have a descendent trajectory; first, it diminishes from 12.8% to 10.8%, then, this diminishing deepens because, for 2022, the marginal effect of it reduces by almost half to reach 6.2%. This trend could be explained by the notable increase in the country's remittances, considering that since 2021, the amount of remittances received by the country has trended higher than the pre-pandemic period.

Highlighting the tendency of the gender variable, the marginal effect of it diminished significantly, going from 8.4% in 2016 to 6.5% in 2019; therefore, this shows that the higher propensity of women in comparison to men of being employed in the informal sector had reduced itself, on the other hand, in 2022 this propensity rose to 7.3%, from where it can be inferred that in the third quarter of 2022 the recovery of the female employment had been slower and tending to informality as can be evidenced in the Central Bank data.

The effects of the variables of the three sectors considered have different trends; the agriculture one increases in a relevant magnitude in all the transitions considered, going from 24.4% in 2016 to 28.1 in 2019 to 28.3% in 2022, while the probability of the commerce first diminished and then increased, being 17% in 2016, 16.3 in 2019 and 20.1% in 2022; moreover, the construction sector had a diminishing trend in all the periods considered, going from 42.3%, then 40.9% to 38.9% in 2022. These results show that a person working in the agriculture or the commerce sector has an increasingly higher probability of being employed in the informal sector than in the other sectors. In contrast, the people employed in the construction sector have a higher but decreasing probability of being an informal worker than the other sectors, but continue to be the one with the highest coefficient by more than 10% from the agriculture sector.

(World Bank, 2017) emphasize that these three sectors are the main ones in which the immigrant labor force entering the country illegally is employed; therefore, the formalization process would be facilitated if greater effort is made in these three sectors.

The head of household factor presents a descendent tendency both in magnitude and significance, given that this goes from 3.2% in a degree of confidence of 1% in 2016 to 2.6% in a degree of 5% in 2019 to not be statistically significant in 2022. This trend is evidence that this factor has become irrelevant to the point that in the third quarter of 2022, it is a factor that is not significant in this model of informality in the Dominican Republic.

The evolution of the married variable is not pertinent to analyze given that it is only statistically significant in 2019, so comparing it with the other years would not be of any utility.

The three chosen regions have different trends; the Southwest has a descendent evolution, passing from 10.8% in 2016, 10.5% in 2019 to 9.5% in 2022, while the Ozama or Metropolitan region goes from 3% in 2016, 4.4% in 2019 to 4.3% in 2022; the Southeast have a negative marginal effect that goes from 6% in 2016, 6.4% in 2019 and in 2022 it is not statistically significant; all this in comparison with North or Cibao region. These results of the Southeast region are contradictory with the ones found by (Guzmán, 2007), in which the residents of this region have a greater incidence of informality than the residents of the Cibao region; this could be happening because that study only focused on urban zone.

For the people who know how to read and write, the probability is negative and rising in magnitude given that this is 6.2%,6.5%, and 12.6% in 2016,2019 and 2022, respectively. These results indicate that a literate person increasingly reduces his probability of working in the informal sector, evidencing the importance of education in this problem.

It is worth highlighting that all these marginal effects are obtained by keeping all the other factors constant; in other words, when taking into account the marginal effect of the age variable, it is controlled by schooling level, residence zone, if the person receives remittances or not, gender, economic sector, member of the household, marital status, residence region and literacy; and the same for the other variables.

Table 6. Mean marginal effects of the probit model. 2022

Education	$Education^2$	Age	Age^2
0.03185	-0.002941	-0.008668	0.0001021
Urban	Remittances	Men	Agriculture
-0.02006	0.06214	-0.07319	0.2825
Construction	Commerce	Head of Household	Married
0.3884	0.2005	0.0152	-0.01475
South	Ozama	East	Literacy
0.09527	0.04348	-0.01208	-0.1261

Source: Own elaboration with data from the ENCFT

Conclusion and Recommendations

5.1 Conclusion

Informality is a multifactorial problem in which elements of different kinds intervene: socioeconomic, demographic, historical, and cultural, among other factors.

After realizing a document review, the first and principal theoretical model that addresses informality is the development model of Lewis that states a dual economy, which expresses that sub-developed economies are composed of two totally opposed sectors but interdependent between them: a modern sector made up of industries and with high utilization of capital and the traditional subsistence sector that has a surplus of labor so big that for this reason, Lewis names his paper: 'Economic development with unlimited labor supply.'

Likewise, another focus suggests that informality is a consequence of institutional restraints and governmental relationships. Another approach states that informality is a voluntary result of a cost-benefit analysis that maximizes enterprises' and employees' utility. In combination with the last approach, another suggests that a group of people choose informality by the criteria mentioned, and other people are employed in the informal sector because they do not have the option to transition to the formal one.

Last but not least, there is the regional approach of informality that proposes that it is not enough to make a comparison between countries of their informality level; instead, it is needed to make a regional study of this phenomenon since between the regions of each country, especially among the ones that are developing, there are abysmal differences in schooling levels, productivity, life quality, among other fundamental elements that define the characteristics of each labor market.

It was possible to identify the factors that are the main drivers of labor informality in the Dominican Republic, such as gender, economic activity sector, residence region, urban or rural zone, age, member of the house, previous generations, lack of employment opportunities, immigration, poverty, remittances, among others.

Likewise, the size of the enterprise is one of the main determinants of whether it is formal or informal, given that in 2013, 89% of microenterprises were not formally registered, while only 2.8% of small and medium-sized enterprises were in this situation. Among the principal reasons for being informal, these enterprises state that they are small businesses and that no enterprise of this type registers formally; getting certificates and permits is too difficult, they do not consider it necessary to get licenses, or these are too expensive and the high labor cost of formalizing.

The principal consequences of informality are the lack of people's access to social security, the perpetuation of poverty among informal workers, and a considerable salary gap between informal and formal sectors. At the macroeconomic level, informality reduces long-term economic growth, and fiscal revenue increases the demand for government subsidies and puts the sustainability of social security systems that are pay-as-you-go pension systems at risk.

After this literature revision and contextualization of the problem, it was estimated a logit and probit model for the years 2016, 2019, and 2022 of the effect of the principal determinants at a microeconomic level over the probability of a worker being in a labor condition of informality in the Dominican Republic.

It was found that age has a quadratic effect on the probability of informality, in which having an additional year of age diminishes the probability, and this diminishing continues increasing until reaching a maximum reduction. Afterward, this tendency reverts and reaches a point where the additional age increases this propensity. When comparing 2016, 2019, and 2022, it is evidenced that until 2019, there has been an important expansion of formal jobs, especially for young people, pushing the projection to the left and up; in other words, having a lower maximum reduction and age for increasing the probability. However, in the third quarter of 2022, with the obtained projection, it could be seen that formal employment is recovering at a slower pace after the pandemic. These results prove that informality is the Dominican labor market's entry and exit door.

When visualizing the trend of the effects of each additional of education, it is obtained that the acquisition of the first complementary years of education has an effect of increasing the probability of being in a situation of labor informality; nevertheless, after reaching a maximum, these effects start a decreasing tendency and after a certain point, reduce the probability of being employed in the informal sector. While more additional years are acquired after they reduce the probability, this reduction accelerates until substantial in the years of education that are equivalent to college and post-college levels. When comparing the three study periods, it is proven that each time higher additional years of education are needed to reach the maximum increase of informality propensity, so this could be evidence of the low quality of the Dominican educational system.

Evidencing the other control variables, a person receiving remittances has a higher probability of being an informal worker. However, when evaluating the evolution in the years of study, this variable has a decreasing incidence, especially in 2022, which could be explained by the significant flow of remittances the country has been receiving since the pandemic.

The gender variable shows that women have a higher probability of being in an informal job, which in 2019 diminished but in 2022 increased with respect from 2019, which evidence that in the third quarter of 2022, the recovery of female employment had been slower and trending to informality.

The agriculture, commerce, and construction sectors have a higher propensity to informality in comparison with the other sectors; nonetheless, they do not have a uniform trend because the first two have major increases in the considered periods, while the construction sector, although having a decrescent trajectory, continues to be the one with the highest probability of informal employment in comparison with the others.

The head of household factor is becoming not pertinent, so in the third quarter of 2022, it is a factor that is not significant in this model of labor informality in the Dominican Republic. Likewise, it is not relevant to analyze the evolution of the married variable since it is only statistically significant in 2019.

It is confirmed that in comparison with the Cibao region, the Southwest and Ozama regions have a higher probability of informality, which is decrescent for the first and rising for the second; it is obtained a result contrary to the empirical evidence reviewed that the Southeast region has a lower and crescent in magnitude than the Cibao one. In addition, when evaluating when a person is literate, this reduces the probability of informality in comparison with a person who is not literate and has a crescent trajectory evidencing the importance of education in informality.

5.2 Recommendations

After the identification and estimation of the marginal propensity of the main factors determinants of informality, it is necessary to address the ones that have higher incidence and importance. It is necessary to design and implement public policies that are effective for the elimination of this problem that negatively affects the individuals and the aggregate economy of the country.

Given the results obtained in this investigation, public policies that improve the quality of education are fundamental to diminishing the high levels of informality that the country has since this would bring people the necessary abilities that the enterprises of the formal sector demand, without the necessity of them requiring personal with higher schooling level than the needed for each position and in comparison with the schooling level demanded in these positions in other countries.

Moreover, the promotion of continued training for workers and the creation of jobs for the youngest population are two of the pillars for reverting this structural tendency of the Dominican labor market in which people use the informal sector as an entry and exit door of the labor market.

(World Bank, 2017) propose that the implementation of education programs contribute to expanding the tax base; these programs, combined with interventions to reduce the administrative costs of the formal operativity of enterprises and promoting the quality of the commercial activities environment, would increase its effectivity. Furthermore, focusing on the sectors that have a higher incidence of informality, such as agriculture, commerce, and construction, could give faster results.

The designing and implementation of specific public policies for each region could have a bigger effect on the combat of informality; given the knowledge of the most affected sectors and the regions with more propensity to this type of activity, there could be executed focused measures for each region.

(Acuña et al., 2021) proposed a combination of vertical and horizontal coordination mechanisms to address informality based on the elaborated by the OECD; among the vertical ones are the conformation of mechanisms and work teams for sharing information and discussing the common objectives of the policies as well as making agreements of cofinancing in public programs; among the horizontal ones are the elaboration of an integrated perspective of labor markets at a regional or municipal level that optimize all the efforts of policies and regulations in the labor scope, the identification of complementary policies that reinforce the various actions over a collective purpose of the policy and the utilization of instruments, such as fiscal incentives or legal requirements.

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Appendixes

Appendix A. Probability of Informal Employment Model with standard errors robust to heteroscedasticity, year 2016

	Dependent variable:	
	Probability informal worker	
	(1)	(2)
Years of education	0.181^{***}	0.105^{***}
	(0.032)	(0.019)
Years of education2	-0.018^{***}	-0.011^{***}
	(0.002)	(0.001)
Age	-0.041^{***}	-0.024^{***}
	(0.010)	(0.006)
Age2	0.0005^{***}	0.0003^{***}
	(0.0001)	(0.0001)
Urban	-0.093	-0.054
	(0.061)	(0.036)
Remittances	0.737^{***}	0.423^{***}
	(0.143)	(0.085)
Men	-0.465^{***}	-0.278^{***}
	(0.056)	(0.033)
Agriculture	1.362^{***}	0.805^{***}
	(0.106)	(0.059)
Construction	2.481^{***}	1.414^{***}
	(0.153)	(0.080)
Commerce	0.923^{***}	0.560^{***}
	(0.063)	(0.037)
Head of Household	-0.182^{***}	-0.107^{***}
	(0.057)	(0.034)
Married	-0.087	-0.051
	(0.053)	(0.031)
South	0.612^{***}	0.357^{***}
	(0.074)	(0.043)
Ozama	0.180^{***}	0.100^{***}
	(0.062)	(0.037)
East	-0.313^{***}	-0.200^{***}
	(0.080)	(0.047)
Literacy	-0.385^{**}	-0.205^{*}
	(0.193)	(0.110)
Constant	2.013^{***}	1.201^{***}
	(0.245)	(0.143)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Source: Own elaboration with data of the ENCFT

Appendix B. Probability of Informal Employment Model with standard errors robust to heteroscedasticity, year 2019

	Dependent variable:	
	Probability informal worker	
	(1)	(2)
Years of education	0.191^{***}	0.112^{***}
	(0.032)	(0.019)
Years of education2	-0.018^{***}	-0.011^{***}
	(0.001)	(0.001)
Age	-0.029^{***}	-0.016^{***}
	(0.010)	(0.006)
Age2	0.0004^{***}	0.0002^{***}
	(0.0001)	(0.0001)
Urban	-0.016	-0.003
	(0.059)	(0.035)
Remittances	0.582^{***}	0.338^{***}
	(0.146)	(0.086)
Men	-0.348^{***}	-0.201^{***}
	(0.054)	(0.033)
Agriculture	1.516^{***}	0.893^{***}
	(0.103)	(0.058)
Construction	2.206^{***}	1.270^{***}
	(0.131)	(0.072)
Comemerce	0.881^{***}	0.535^{***}
	(0.060)	(0.036)
Head of Household	-0.139^{**}	-0.079^{**}
	(0.055)	(0.033)
Married	-0.199^{***}	-0.119^{***}
	(0.050)	(0.030)
South	0.564^{***}	0.325^{***}
	(0.072)	(0.043)
Ozama	0.239^{***}	0.139^{***}
	(0.060)	(0.036)
East	-0.343^{***}	-0.215^{***}
	(0.075)	(0.045)
Literacy	-0.349^{*}	-0.196^{*}
	(0.189)	(0.108)
Constant	1.273^{***}	0.739^{***}
	(0.240)	(0.144)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Source: Own elaboration with data of the ENCFT

Appendix C. Probability of Informal Employment Model with standard errors robust to heteroscedasticity, year 2022

	Dependent variable:	
	Probability informal worker	
	(1)	(2)
Education	0.171^{***}	0.102^{***}
	(0.035)	(0.021)
Education2	-0.016^{***}	-0.009^{***}
	(0.002)	(0.001)
Age	-0.046^{***}	-0.028^{***}
	(0.011)	(0.006)
Age2	0.001^{***}	0.0003^{***}
	(0.0001)	(0.0001)
Urban	-0.102^{*}	-0.064^{*}
	(0.061)	(0.037)
Remittances	0.332^{**}	0.199^{**}
	(0.142)	(0.084)
Men	-0.394^{***}	-0.234^{***}
	(0.058)	(0.035)
Agriculture	1.564^{***}	0.905^{***}
	(0.115)	(0.064)
Construction	2.126^{***}	1.244^{***}
	(0.127)	(0.069)
Comemerce	1.054^{***}	0.642^{***}
	(0.065)	(0.039)
Head of Household	0.087	0.049
	(0.059)	(0.035)
Married	-0.079	-0.047
	(0.055)	(0.032)
South	0.524^{***}	0.305^{***}
	(0.074)	(0.044)
Ozama	0.245^{***}	0.139^{***}
	(0.066)	(0.039)
East	-0.042	-0.039
	(0.083)	(0.050)
Literacy	-0.691^{***}	-0.404^{***}
	(0.220)	(0.124)
Constant	1.873^{***}	1.137^{***}
	(0.255)	(0.147)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Source: Own elaboration with data of the ENCFT

Appendix D. Breusch-Pagan heteroscedasticity test, year 2016

Logit and Probit
BP = 779.69; df = 16; p-value = 2.2e-16

Source: Own elaboration with data of the ENCFT

Appendix E. Breusch-Pagan heteroscedasticity test, year 2019

Logit and Probit
BP = 642.1; df = 16; p-value = 2.2e-16

Source: Own elaboration with data of the ENCFT

Appendix F. Breusch-Pagan heteroscedasticity test, year 2022

Logit and Probit
BP = 815.98; df = 16; p-value = 2.2e-16

Source: Own elaboration with data of the ENCFT

Appendix G . Variance Inflation Factor (VIF) of logit model, year 2016

Education	Age	Urban	Remittances	Men	Agriculture	Construction
1.558545	1.381025	1.162642	1.026545	1.217074	1.191436	1.036985
Commerce	Head of Household	Married	South	Ozama	East	Literacy
1.036178	1.338976	1.085829	1.245753	1.454114	1.25535	1.368072

Source: Own elaboration with data from the ENCFT

Appendix H . Variance Inflation Factor (VIF) of probit model, year 2016

Education	Age	Urban	Remittances	Men	Agriculture	Construction
1.571044	1.378987	1.176461	1.025759	1.227617	1.23918	1.051356
Commerce	Head of Household	Married	South	Ozama	East	Literacy
1.0429	1.336063	1.085666	1.25387	1.456742	1.254679	1.378472

Source: Own elaboration with data from the ENCFT

Appendix I . Variance Inflation Factor (VIF) of logit model, year 2019

Education	Age	Urban	Remittances	Men	Agriculture	Construction
1.594864	1.300013	1.167867	1.022444	1.228595	1.219604	1.055462
Commerce	Head of Household	Married	South	Ozama	East	Literacy
1.046113	1.276402	1.058238	1.260127	1.460743	1.249756 1.450421	

Source: Own elaboration with data from the ENCFT

Appendix J . Variance Inflation Factor (VIF) of probit model, year 2019

Education	Age	Urban	Remittances	Men	Agriculture	Construction
1.6096	1.303839	1.182712	1.022634	1.243158	1.272377	1.071362
Commerce	Head of Household	Married	South	Ozama	East	Literacy
1.051563	1.278237	1.057327	1.26249	1.461143	1.247691 1.453304	

Source: Own elaboration with data from the ENCFT

Appendix K . Variance Inflation Factor (VIF) of logit model, year 2022

Education	Age	Urban	Remittances	Men	Agriculture	Construction
1.528535	1.295075	1.13165	1.032731	1.220463	1.172287	1.059976
Commerce	Head of Household	Married	South	Ozama	East	Literacy
1.045172	1.279149	1.055659	1.286232	1.434218	1.247178	1.381609

Source: Own elaboration with data from the ENCFT

Appendix L . Variance Inflation Factor (VIF) of probit model, year 2022

Education	Age	Urban	Remittances	Men	Agriculture	Construction
1.583479	1.301887	1.14137	1.03197	1.234489	1.229138	1.081971
Commerce	Head of Household	Married	South	Ozama	East	Literacy
1.053608	1.284826	1.054498	1.295896	1.433856	1.246662	1.420432

Source: Own elaboration with data from the ENCFT

Appendix M. McFadden R^2 for the logit and probit models of each year

Year	Model	McFadden R^2
2016	Logit	0.2008841
2016	Probit	0.2012354
2019	Logit	0.1958701
2019	Probit	0.1956898
2022	Logit	0.1760413
2022	Probit	0.1764473

Source: Own elaboration with data of the ENCFT