The Impact of the Immigration Shock caused by the 2010 Haiti Earthquake on the Labour Market of Dominican Republic

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This paper uses data from the 2008-2014 National Labour Force Survey of the Dominican Republics (ENFT) to study the effect of the immigration shock caused by the 2010 Haiti earthquake on the Dominican Labour Market, paying especial attention to informal labour. A difference-in-difference estimation suggests that wages of national workers were reduced by 3 percent as a result of the immigration shock. The likelihood of full-time unskilled workers to be employed in the informal sector seems to be 1 percentage points lower, while unskilled workers in general (regardless of full-time status) are 4 percentage points more likely to be informal. Lastly, the coefficient estimate of the probability of being employed suggest an adverse impact of 1 percentage point.

I. Introduction

It is widely believed that immigration impacts the economy of the destination country, and these effects have long been studied in the economic literature, with the vast majority focusing on the labour market outcomes (See Chapter 5 of Bodvarsson & Van den Berg, 2009). Card (1990), for example, found that the Cuban immigration shock in Miami in the 1980s, known as the Mariel Boatlift, had no effect on wages and unemployment rates of unskilled workers. Conversely, Bodvarsson, Van den Berg, & Lewer (2008) found evidence that the Mariel Boatlift augmented labour demand in US, which might explain Card's findings.

Pischke & Velling (1997) found that immigration to Germany in the 1980s had no detrimental impact on the labour market. Also for Germany, D'Amuri, Ottaviano, & Peri (2010) found that the increase in immigration of the 1990s had a very small effect on native wages but substantial effect on previous immigrants employment. Card (2001) studied the effect of immigration on "occupation-specific labour markets" in the 1990s, which he found to be negative for 'getaway' cities like Miami and Los Angeles. Friedberg (2001) concludes that the sudden increase of immigration to Israel in the first half of the 1990s reduced the growth of native wage and employment when estimated using Ordinary Least Squares (OLS) but had no impact when using Instrumental Variable (IV) estimations. The acceleration in immigration to Spain in the second half of the 1990s was studied by Carrasco, Jimeno, & Ortega (2008) and found to have no negative effect on employment or wages.

A common challenge for labour economists is to correctly specify the causal relationship between two variables, in our case, immigration and labour market outcomes. Finding a way to address the self-selection and endogeneity biases is crucial for any study to be relevant. The 2010 earthquake in Haiti provides a unique opportunity to study the effect of Haitian immigration on the Dominican labour market without it being correlated with a demand shock. In addition, this paper enriches the literature by paying special attention to the impact of immigration on the informal status of the worker.[1]

[1] This is of interest in Dominican Republic due to a substantial increase of the country's informal sector in the last fifteen years. Informal workers are at high risk of social vulnerability as they are often excluded from the social

To this effect, using data from the National Labour Force Survey of the Dominican Republic (ENFT), I estimate a difference-in-difference model. This approach is similar in fashion to that used by Card (1990) to estimate the effect of the Mariel Boatlift in the 1980s, which provoked a sudden increase in Cuban immigrants to the United States due to political reasons and not induced by changes in labour demand. Morin (2015) also took advantage of an educational reform to estimate the effect of a double-cohort, due to a somewhat arbitrary elimination of Grade 13 in Ontario, Canada, on the labour market outcomes of the youth.

I find that the immigration shock caused by the earthquake seems to have increase the skilled-unskilled wage gap by 3 percent for full-time national workers. Moreover, the gap in the probability of being informal between the two groups dropped by 1 percentage points as a consequence of the immigration shock. My results also suggest that unskilled workers in general (regardless of full-time status) are 4 percentage points more likely to be informal than skilled workers. Furthermore, the immigration shock seems to have had an adverse impact of 1 percentage point in the probability of a worker to be employed.

The rest of the paper is organized as follows: The next section describes the evolution of informality in the Dominican Republic and presents measurements of the size of the informal sector. Section III briefly describes the Haitian immigration to the Dominican Republic and the consequences of the 2010 earthquake. The data used in this paper is explained in section IV, followed by the methodology and results in section V. Finally, I conclude in section VI.

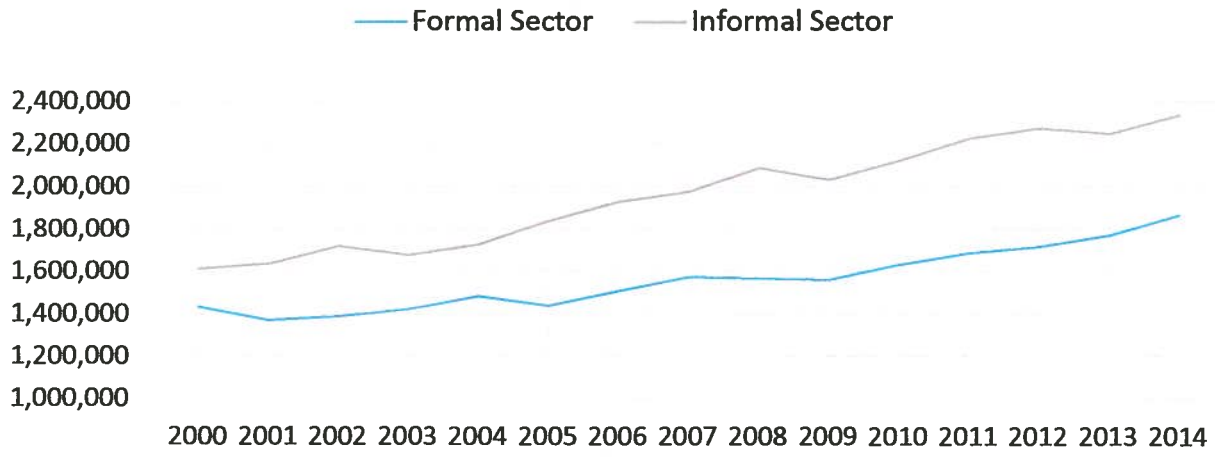
II. The Informal Sector in the Dominican Republic

In the Dominican Republic the informal economy has been playing an important role in the media during the last few years due to a palpable increase of the informal sector. According to the data from the Central Bank of the Dominican Republic (BCRD) informal employment grew at an annual rate of 2.5 percent over 2000-2014 while the average growth rate of the formal

security system, pension system, and legal protection. A formal definition of Informal workers is presented in section II and revisited in section IV. For more detailed information about the views of informality, see table A.1 in appendix A.

counterpart for the same period was only 1.5 percent. Furthermore, the proportion of workers in the informal sector has move from approximately 53 percent in 2000 to 56 percent in 2014. Figure 1 shows informal worker as defined by the Central Bank of the Dominican Republic (following the International Labour Organization (ILO) definition), and includes all workers in firms with less than five employees, domestic workers, unskilled workers, workers without remuneration as well as self-employed and managers in the following sectors: farmers, operators and drivers, artisans and merchants.[2] As shown in figure 1, employment in both the formal and informal sectors follow an upward trend.

Figure 1: Evolution in the number of workers in the formal and informal sector in the Dominican Republic, 2000-2014



Data retrieved on October 22, 2015
Central Bank of the Dominican Republic
Department of National Accounts and Economic Statistics

Informality is a highly heterogeneous sector of the economy and refers in broad terms to all economic activity that takes place outside the regulatory system (i.e., without complying with the government fiscal and market regulations, and that is hidden from the authorities).[3] The size and the approach to measure the informal economy vary according to the institution conducting the estimation. However, it is fair to say that approximately half of the Dominican Economy is

[2] Unless otherwise noted, the definition of informality used in this paper is that of the Central Bank of Dominican Republic (which follows the ILO definition). See Appendix A for a summary of definitions, effects and determinants of Informality in the Labour Market.

[3] See Quejada Pérez, Yánez Contreras, & Cano Hernández (2014); Loayza (1997); Giles & Tedds (2002)

informal. Table 1 summarizes a few measurements of the informal sector for the Dominican Republic.

Table 1: Informal sector in the Dominican Republic

Source	Size	
Directorate of Information and Defence of the Social Security Affiliates (DIDA)[1]	78,000 workers not registered in the National Council of Social Security	
Directorate General of Internal Tax (DGII)[2]	About 50% of the economy is informal	
Central Bank of the Dominican Republic (BCRD)[3]	55.6% of workers have informal jobs	
Ministry of Labour[4]	52% of the economy is informal	
Ministry of Industry and Commerce (MIC)[5]	Approximately 800,000 businesses are not registered SMEs represent 96% of the Dominican labour market, of which 98.4% have less than 15 employees	
Regional Center of Sustainable Economic Strategies (CREES)[6]	64.4% of workers are not covered by the Social Security System	
Central Bank of the Dominican Republic, the Ministry of Economy, planning and development, and the World Bank (2007)[7]	Legal Perspective	54%
	Social Security Perspective	65%
	International Labour Organization Perspective	50%
Estimations using the National Labour Force Survey of 2014	Legal Perspective	49%
	Social Security Perspective[a]	28%
	International Labour Organization Perspective	56%
	Informal by any definition[b]	71%

Note: [a]This estimation is limited by the data available in the ENFT. The question regarding social security coverage (used to construct this variable) is missing for self-employed individuals, domestic workers and workers without salary (informal by definition). [b]This includes all individuals defined as informal by any definition.

Source: [1]Clemente (2015), [2]Reyes Rodríguez (2015a), [3]Reyes Rodríguez (2015a), [4]Sierra (2015), [5]Reyes Rodríguez (2015b), [6]Collado Di Franco & Rojas Rodríguez (2015), [7]Secretaria de Estado de Economía, Planificación y Desarrollo, Banco Central de la República Dominicana, & World Bank (2007). See table A.4 and A.5 in appendix A for a detail explanation of these definitions.

As can be seen in table 1, the Ministry of Labour, the Directorate General of Internal Tax (DGII) and the Central Bank of the Dominican Republic (BCRD) estimations suggest that at least 50 percent of the employment in 2015 took place in the informal sector. According to the Ministry

of Industry and Commerce (MIC), in 2015 more than 94 percent of firms had less than 15 employees. Although the Ministry does not provide statistics on firms with less than five employees (which would classify them as informal), a proportion this high imply that a large informal sector exists.

The Regional Center of Sustainable Economic Strategies (CREES) used an alternative approach to measure informality and found that 6 out of 10 employees were not contributing to the social security system (and thus, not covered by it), this methodology suggests that more than 60 percent of the workers are informal. Alternatively, the Directorate of Information and Defence of the Social Security Affiliates (DIDA) stated that about 78,000 employees were not registered in the Social Security System. While this number might seem irrelevant when compared with the almost three million registered workers, it is a sign that the authorities are aware of unregistered employment.

Lastly, table 1 presents estimations from Ministry of Economy, Planning and Development, Central Bank of the Dominican Republic, & World Bank (2007) according to three definitions of informality: the International Labour Organization (50 percent), Social Security perspective (65 percent) and Legal perspective (54 percent). Estimations using data from the 2014 ENFT for these three definitions, and an additional classification that includes all informal workers according to any of the definitions, are also included in the table.

Table 1 includes measures of informal employment and the informal sector, and a distinction should be made between the two. For informal employment the unit of study is the worker and the definition relies on the conditions of employment (i.e., compliance with labour legislation, access to social security and whether or not they have contracts), this is the focus of the DIDA, the Ministry of Labour, CREES, and BCRD in the table. On the other hand, the DGII and MIC concentrate on the informal sector, in this case the unit of study is the firm and the definitions depends on characteristics such as firm's size, ownership and productivity.[4]

[4] For a more detailed definition of these classification, see Collado Di Franco & Rojas Rodríguez (2015); Adams, Johansson de Silva, & Razmara (2013); and Khamis (2009).

Informality is believed to have an important effect on the economy and society trough at least four main channels:

Efficiency loss:[5] Because of their nature, informal firms cannot write enforceable contracts or use market-supporting institutions and find it hard to access the credit market. As a result they invest too little in both capital and research and development, preventing them from reaching their potential growth and operating more efficiently. There is plenty of empirical work supporting the view that huge productivity gaps exists between the formal and informal sector and that the latter is in itself inefficient.

Provision of public goods:[6] The existence of the informal sector also implies a loss in tax revenues from individuals and firms. This reduction in public funds causes the provision of public goods to be suboptimal, and reduces the availability of public services, which in turn hurts growth. This also translates to less trust in institutions (and the government) and foster a culture of informality.

Growth of informal firms:[7] With firms that, facing efficiency and productivity restrictions, operate in a suboptimal scale of production, growth is limited. In addition, by congesting the public goods available to formal firms and unfairly competing with them, the informal sector poses a challenge to the growth of formal firms. Nonetheless, some authors have found that in Latin America informality does not withhold firm's growth.

Social protection:[8] Last, but not least, the absence of social protection due to the exclusion from the formal sector (government, institutions and otherwise) puts firms and workers at high risk of social vulnerability as they are excluded from social security, pension system, and legal protection.

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[5] See Johnson et al. (2000), Charlot, Malherbet, & Terra (2012), La Porta & Shleifer (2014), Quejada Pérez et al. (2014), and Loayza et al. (2005).
[6] See Loayza (1997), De Andrade, Bruhn, & McKenzi (2013), Johnson et al. (2000), and Oviedo et al. (2009).
[7] See Oviedo et al. (2009), Dabla-Norris & Inchauste (2008), Loayza (1997), and Charlot et al. (2012).
[8] See Loayza (1997), Quejada Pérez et al. (2014), and Secretaria de Estado de Economía, Planificación y Desarrollo et al. (2007).

The topic of informality has been studied from many lenses and the literature has yet to come to an agreement on its characteristics, causes and implications. The enormous size of the informal sector in the Dominican Republic and the effects it may have on the competitiveness, efficiency and growth of the economy are reason to worry.

III. The 2010 Haiti Earthquake and Immigration in the Dominican Republic

To better understand the immigration trends in the Dominican Republic, figure 2 presents the evolution of new immigrants using data from the first National Immigration Survey (ENI).[9] I focus on the 2008-2012 period to appreciate any tendency changes around the 2010 cut-off. Haitians account for more than 90 percent of the new immigrants in this period. Additionally, data from the National Labour Force Survey (ENFT) finds that the Haitian proportion of the total immigrants moved from 77.98 percent in 2008 to 81.52 percent in 2014.[10] According to the ENFT, 2.39 percent of the working-age population of the Dominican Republic in 2008 was of Haitian citizenship, reaching a high of 2.83 percent in 2011 and moving to 2.52 percent by 2014. With such large figures it is evident that Haitian workers play an important role in the Dominican Labour Market.[11]

On January 12, 2010 an earthquake of magnitude 7.0 struck Haiti, becoming the seism with the most casualties of 2010.[12] While the quake completely destroyed the Haitian capital and most of the West and South Departments (according to the World Bank (2012), 8 percent of the capital stock of Haiti was destroyed), it had little to no impact on infrastructure in the Dominican side. As part of the immediate response to this natural disaster, the Dominican Republic opened its border to provide emergency assistance to survivors and offered temporary housings and accommodations in hospitals and schools. It is assumed by Dominican authorities (and the general population) that most Haitians stayed in the Dominican territory. The World Bank (2012) estimated a 6 percent increase in Haitian emigration in 2010, and expects migration flows to stay

[9] Data in figure 2 correspond to the number of immigrants that reported arriving (for the last time) to the Dominican Republic on each year.

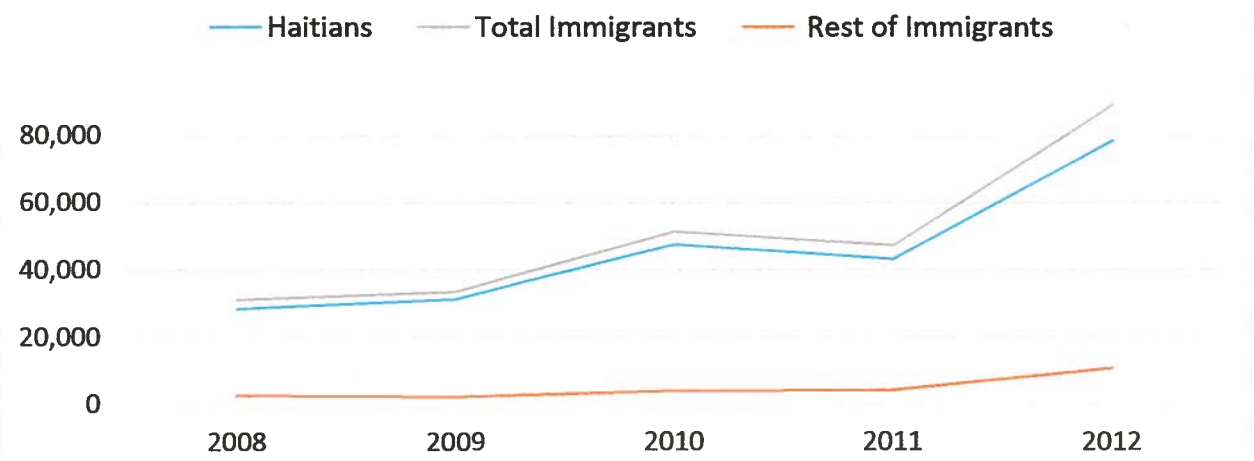
[10] The National Immigration Survey of the Dominican Republic (ENI) conducted in 2012 reported that for the 2010-2012 period 88.70 percent of the immigrants residing in the country were Haitians. See Tables C.3, C.4 and C.5 in Appendix C for detail statistics on immigration.

[11] See Appendix B for a detailed historic context of the migration flows from Haiti to the Dominican Republic.

[12] The M7.0 on the Richter scale measure is according to the United States Geological Survey (USGS).

at 3 percentage points above their level should the earthquake hadn't take place. This leads to an increase of one percentage point of the migrant workers (from Haiti) in the Dominican Republic. This unfortunate event provides a unique opportunity to evaluate the impact of immigration on the labour market of the Dominican Republic, as the supply shock is exogenous and presumably unrelated to any changes in the demand for immigrants, particularly Haitians workers.

Figure 2: Immigration Flow (10 years or older)
Dominican Republic, 2008-2014



Data retrieved on April 04, 2016
National Office of Statistics (ONE)
National Immigration Survey (2012)

IV. Data

The main results of this paper rely on the National Labour Force Survey (ENFT) dataset for the 2008-2014 period. The survey is conducted semi-annually in the Dominican Republic since 1991 in April and October.[13]

The sample of the ENFT is nationally representative and follows a two-stage design based in the political division of the 2002 National Census and the 2006 cartography actualization of the National Office of Statistics (ONE). In the first stage, the primary sampling unit are randomly selected with a probability proportional to their size (number of houses in each area). Households

[13] There are two exceptions for this periodicity: The survey was conducted quarterly in 1991-92 and monthly in 1998-99.

are then selected in the second stage with equal probability using a systematic random sampling design. Every year, eight independent sub-samples are chosen as described above, the four sub-samples with odd numbers are used for the April survey while the October survey uses the four sub-samples with even numbers. The sample is renewed by approximately 25 percent each year, and there are no common households on the April and October samples. This allows me to combine these two samples and perform a yearly analysis.

The ENFT contains information regarding individuals' labour market activities and personal characteristics that makes it possible to estimate the impact of the immigration shock caused by the 2010 Haiti earthquake on the labour market outcomes in the Dominican Republic. In particular, it includes personal characteristics and information on the individual labour force status, wages, hours of work and type of occupation. It also has information about their employment conditions (i.e., whether they signed a contract or enjoy paid vacations) and the firms where they are employed (i.e., size of the firm and whether the firm is registered/licensed to operate), allowing to identify informal workers.

The main analysis of the paper concentrate on full-time national workers aged 16 to 65 with wages of at least DOP$20 an hour. Immigrants are dropped from the sample to ensure that personal characteristics do not bias the estimation of the effect of the immigration shock on native workers. This is consistent with Ottaviano & Peri (2012)'s argument that immigrants and national workers are not perfect substitutes, even if they have identical experience, education and occupation, as their cultural background matters for their labour market outcomes.

As is done in many studies of this type, following Katz & Murphy (1992), my sample is also restricted to full-time workers (i.e., 40 hours a week or more) between the age of 16 and 65.[14] Another common restriction is to only include individuals earning at least half the minimum wage. In this respect, the hourly wage of the workers in our sample is DOP$20 or higher.[15]

[14] In addition, part-time workers are not commonly found in the Dominican Republic. More than 35 percent of the individuals in the ENFT sample are full-time and work 40 or 45 hours a week.

[15] The National Council of Social Security (2010) on its resolution 231 set the (monthly) minimum wage for social security purposes at DOP$6,481.00, equivalent to DOP$40/h for individuals working 40 hours a week.

With the intention of eliminating any biases caused by unobserved trend, I focus the analysis on 2008 to 2014, a small enough period near 2010 when the earthquake triggered the immigration shock. In doing so, the model will compare outcomes of individuals in a labour market that would have been similar on average but suffered an exogenous shock, making it easier to estimate the real impact of the earthquake.

There are three variables of interest, the (log of) real hourly wages and two dummies for informality and employment status respectively. The (log of) hourly wages is expressed on 2010 DOP$ pesos, and is adjusted using the national consumer price index. The construction of the dummies for informality and employment relies on the Central Bank of Dominican Republic definition and is as follows:

The dummy for informality is equal to one (worker is informal) when the individual works in a firm with less than five employees, in a family-owned business, is a domestic worker, works without salary or is a farmer, artisan, self-employed (non-professional) or manager in an unregistered firm. It was constructed from the answer to the following questions:

Did you perform any of the following activities last week?
- *Farming, harvesting or ranching?*
- *Worked on a product (craft or otherwise) to sell it?*
- *Helped a relative with their business or farm?*
- *Perform domestic work for someone else?*

What is your primary occupation?
How many people work in your place of work?

The dummy for employment is equal to one when the individual worked at least one hour during the reference week, or had a job but did not worked for circumstantial reasons (i.e., vacations, illness or strike). It was constructed from the answer to the following questions:

Did you worked at least one hour last week?
Even if you did not worked last week, did you had a job, business or economic activity?
Did you perform any of the following activities last week?
- *Farming, harvesting or ranching?*
- *Worked on a product (craft or otherwise) to sell it?*
- *Helped a relative with their business or farm?*
- *Perform domestic work for someone else?*

The descriptive statistics of the variables used for the estimations are summarized in Table 2 below:

Table 2: Descriptive statistics

		Variable	Min	Max	Mean	Std. Dev.
Personal Characteristics	Labour Market Outcome	Hours (principal occupation)	40	95	47.56	7.55
		Hours (principal + secondary occupation)	40	115	48.37	8.45
		Wage	20	2067.18	76.55	74.97
		Real Wage (Dec 2010 $$)	16.79	1750.51	73.16	71.78
		Informal Status	0	1	0.42	0.49
		Gender (male)	0	1	0.71	0.46
		Age	16	65	37.41	11.77
	Level of Education	No School	0	1	0.04	0.19
		Pre-School	0	1	0.00	0.02
		Elementary School	0	1	0.35	0.48
		Secondary School	0	1	0.34	0.47
		Vocational School	0	1	0.00	0.06
		Undergraduate Studies	0	1	0.26	0.44
		Graduate Studies	0	1	0.01	0.11
	Civil Status	Married or Common-Law	0	1	0.60	0.49
		Divorced or Separated	0	1	0.15	0.36
		Widow(er)	0	1	0.01	0.11
		Single	0	1	0.24	0.42
	Time of Residence in Current Area	Rural zone indicator	0	1	0.27	0.44
		Since Birth	0	1	0.62	0.44
		6 months or less	0	1	0.01	0.09
		7 months - 1 year	0	1	0.01	0.09
		1 to 5 years	0	1	0.03	0.18
		6 years or more	0	1	0.32	0.47
	Sector	Public Sector	0	1	0.15	0.36
		Private Sector	0	1	0.81	0.40
		Free Zone	0	1	0.04	0.19
		Size of household	1	23	4.20	1.87
		Head of household	0	1	0.55	0.50
		Has secondary occupation	0	1	0.57	0.23
		N			81,329	

Note: Data are from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to full-time national workers aged 16-65, perceiving a salary of at least DOP$20/h.

As shown in Table 2, 42 percent of the individuals in our sample operate in the informal sector. Workers have a 47.5 hours work-week on average and earn an average wage of DOP$73/h (in 2010 DOP$). It is interesting to mention (although not shown in the table) that seven out of ten native workers in the sample earn less than the average wage. Likewise, five out of ten workers in the survey earn less than the minimum wage (DOP$40/h).

The average individual in the sample is 37 years old, 71 percent are men and 60 percent are married or in a common-law relationship. Six out of ten workers in the sample have lived in the area they currently live since they were born, and only 27 percent live in a rural zone. About 73 percent have only high school education or less, with a 4 percent of them having no formal education at all, which implies that the native labour force is mostly unskilled.

The level of education is of particular interest as it is used in the next section to identify the treatment and control groups. More than 90 percent of the immigrants from Haiti have no more than a high school education (about 35 percent have no schooling at all). Thus, what the 2010 earthquake causes is primarily a positive supply shock of unskilled labour. As mentioned before, the proportion of unskilled workers is also high among Dominicans (about 70 percent) for whom the average level of education is also high school.[16]

V. Methodology

From the laws of supply and demand we know that a positive (negative) supply shock should have a negative (positive) impact on price. Consequently, we expect that the 2010 earthquake, through an increase in immigration, should reduce wages. In this study I attempt to separate the effect of the increase in immigration from possible demand shocks and unobserved trends in the labour market (although no known demand shocks occurred close to the earthquake, it is important to consider the possibility of one).

A difference-in-difference model can address this problem by comparing average wages between a control group (individuals not affected by the supply shock, but that would be affected by

[16] See Table C.1 in Appendix C for level of education statistics.

potential demand shocks) and a treatment group (in our case, workers whose labour is substitutive with that of the Haitian immigrants) before and after the earthquake. Knowing that the educational attainment is at most high school for 90 percent of the Haiti immigrants, the immigration shock should affect the native unskilled workers.[17] Skilled workers, on the other hand, should not be affected by this sudden increase in immigration. By looking at the evolution of average wage of the skilled and unskilled workers, I find no evidence that a skill-level-specific demand shock took place in the years close to the earthquake.

Such a model is estimated using the following regression equation:

$$\log(w_{igt}) = \alpha + \beta\left(EQK_t \, x \, USK_g\right) + \delta \, EQK_t + \sigma \, USK_g + X_{igt}\gamma + \varepsilon_{igt} \qquad (1)$$

where i represents an individual, g a group of workers (skilled vs unskilled) and t time. $\log(w_{igt})$ is the logarithm of the real hourly wages. EQK is a dummy equal to 1 if observed after the earthquake and 0 otherwise, and USK is a dummy equal to 1 for unskilled individuals, defined as those with high school education or less. Lastly, X_{igt} is a vector of personal characteristics, including age, gender, marital status, time of residence and working sector.

$\left(EQK_t \, x \, USK_g\right)$ will thus represent the treatment group, unskilled workers observed after the earthquake. Its coefficient will capture the change in the difference between the wage of the unskilled workers relative to that of the skilled worker before and after the earthquake. If the regression equation is correctly specified, $\hat{\beta}$ captures the effect of the immigration shock due to the 2010 earthquake on the wages of Dominican workers.[18]

Table 3 summarizes the impact of the immigration shock on the wages of Dominican workers. Specification (1) includes only our dummies of interest. Specification (2) adds personal

[17] This is in line with the results of Aristy Escuder (2011) who found that Dominican and Haitian are substitute workers in the construction sector (66.7 percent of the surveyed employers agreed with this fact), which employs a large number of unskilled workers and is also the main occupational destination of Haitian immigrants.

[18] Although a difference-in-difference estimation significantly reduces the biases that would be present should a simple difference or a pre-post approach is used, the estimation may still be affected by the fact that unskilled labour may complement skilled labour increasing the productivity of skilled workers and their salaries. Such increase will enlarge the wage gap and can lead to an overestimation of the real effect of the immigration shock.

characteristics and province fixed effects.[19] Specification (3) adds dummies for the time the worker has been living in their current area and sector dummies (for private and public sector as well as free zones). The regression results are not statistically significant at conventional confidence levels, but seem to suggest that the immigration shock increased the skilled-unskilled wage gap by approximately 3 percent. This would be in line with basic economic theory, as the over-supply of unskilled substitutive labour pushes down its equilibrium price.[20]

Table 3: Effect of the supply shock on wages (full sample)

	(1)	(2)	(3)
EQK x USK	-0.0232	-0.0300	-0.0295
	(0.0197)	(0.0129)	(0.0141)
EQK	-0.0419	-0.0358*	-0.0355*
	(0.0185)	(0.0129)	(0.0122)
USK	-0.5979***	-0.6034***	-0.5847***
	(0.0814)	(0.0491)	(0.0539)
Controls for personal characteristics	No	Yes	Yes
Province fixed effects	No	Yes	Yes
Time of residence	No	No	Yes
Sector	No	No	Yes
R^2	0.167	0.2727	0.2801
N	81,329	81,329	81,329

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to full-time national workers aged 16-65, perceiving a salary of at least DOP$20/h. Dependent variable is the log of real (hourly) wages. Standard errors clustered at the province level (31 provinces) are shown in parentheses.
*Significant at 10%, **Significant at 5%, ***Significant at 1%

In order to estimate the implied wage elasticity I use data from the Central Bank's department of national accounts and economic statistics to calculate the average annual increase of labour supply. The broad measure of the labour force suggest that the supply of labour increased by 2.07 percent over the 2008-2014 period.[21] The elasticities implied by my results are between -1.15 and -1.45, indicating that the wages are responsive to changes in the labour supply. These

[19] Personal characteristics include gender, age and marital status.
[20] In fact, estimations for a sample of individuals above the minimum wage line suggest that the skilled-unskilled wage gap increased by 7 percent following the immigration shock.
[21] The broad measure of the labour force includes all individual that reported their willingness and availability to accept a job even if they did not actively look for one, as well as the employed population.

elasticities, however, are not statistically significant at conventional confidence levels, since they are computed using results that are not statistically significant.

To better understand the effect on employment, I relax the sample restriction to include the full labour force (regardless of employment status), and find that the immigration shock reduced the probability of being employed by 1 percentage point for the unskilled worker relative to the skilled one. The results are summarized in table 4.[22]

Table 4: Effect of the supply shock on employment

	(1)	(2)	(3)
EQK x USK	-0.0088	-0.0113*	-0.0114*
	(0.0054)	(0.0040)	(0.0040)
EQK	0.0026	0.0021	0.0020
	(0.0057)	(0.0049)	(0.0051)
USK	-0.0189	-0.0482***	-0.0491***
	(0.0103)	(0.0065)	(0.0066)
Controls for personal characteristics	No	Yes	Yes
Province fixed effects	No	Yes	Yes
Time of residence	No	No	Yes
Sector	No	No	No
R^2	0.0009	0.0918	0.0919
N	167,411	167,411	167,411

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to national labour force (aged 10-65) regardless of their employment status. Dependent variable is a dummy for employment (equal to 1 when individual is employed). Standard errors clustered at the province level (31 provinces) are shown in parentheses.

*Significant at 10%, **Significant at 5%, ***Significant at 1%

Regressions for (weekly) hours of employment have coefficient estimates much larger, going from a decrease of 13.7 percent (in specification 1) to one of 17.1 percent (in specification 3).[23] Like before, these effects are not statistically significant at conventional confidence levels. One

[22] My results are close to those of D'Amuri, Ottaviano, & Peri (2010), recall that no impact of immigration on native wages was found, but employment of previous immigrants was negatively affected. Note that my results for employment are for native workers.

[23] Results are for full-time national workers aged 16 to 65 with wages of at least DOP$20 an hour (all sample restrictions hold).

possible reason is the low degree of flexibility of the Dominican Labour Market, where it is common practice to employ a worker under contract (with clearly defined hours of work) that is not easily adjusted if the situation for the employer or the employee changes. This becomes evident by looking at disaggregated statistics for this variable.[24] The majority of workers in the survey (23.3 percent) have a work-week of 44 or 45 hours (typically 8 hours/day Monday-Friday and 4 or 5 hours on Saturdays). 11.6 percent work 40 hours, a normal work-week in the public sector (no Saturdays).

I further explore the impact of the immigration shock on informal labour. First, I estimate equation (2), where the dependant variable is a dummy for informal status according to the ILO definition (as defined in the data section). One would expect the earthquake to increase the probability of being informal.[25] The rapid increase of workers would likely inundate the market, increasing unemployment, reducing wages and making it impossible for the formal sector to absorb the excess of supply. Workers will either be facing no choice but to join the informal sector or will choose to do so given the reduced opportunity cost (lower wages reduce the benefits of the formal sector).

$$iilo_{igt} = \alpha + \beta\left(EQK_t \, x \, USK_g\right) + \delta \, EQK_t + \sigma \, USK_g + X_{igt}\gamma + \varepsilon_{igt} \qquad (2)$$

However, the results in table 5 suggests that the immigration shock reduced the probability of an unskilled worker to operate in the informal sector by at least one percentage points. This is not what the theory would predict, nor what the official statistics present. Recall the positive slope of the informal workers evolution in figure 1. Also, using data from the Central Bank of the Dominican Republic I find that informal employment grew 1.9 percent on average after the earthquake (as opposed to the 1.1 percent or 1.3 percent average annual growth rate for the 2000-2010 and 2008-2010 period respectively).

[24] See Table C.2 in Appendix C.

[25] Bohn & Owens (2012) found immigration to be associated with informal employment, especially in the construction industry.

Table 5: Effect of the supply shock on informal status

	(1)	(2)	(3)
EQK x USK	-0.0109	-0.0139	-0.0145
	(0.0109)	(0.0113)	(0.0078)
EQK	-0.0030	-0.0020	0.0014
	(0.0066)	(0.0074)	(0.0053)
USK	0.3684***	0.3001***	0.2265***
	(0.0236)	(0.0168)	(0.0081)
Controls for personal characteristics	No	Yes	Yes
Province fixed effects	No	Yes	Yes
Time of residence	No	No	Yes
Sector	No	No	Yes
R^2	0.1055	0.1644	0.2867
N	81,329	81,329	81,329

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to full-time national workers aged 16-65, perceiving a salary of at least DOP$20/h. Dependent variable is a dummy for informality (following ILO definition). Standard errors clustered at the province level (31 provinces) are shown in parentheses.

*Significant at 10%, **Significant at 5%, ***Significant at 1%

The discrepancy between the expected and actual results may be due, in part, to the sample restrictions of this study, which does not account for the self-employed, domestic workers and workers without salary (a great proportion of informal workers as defined by ILO). What these results might be suggesting is that unskilled workers were less likely to have paid employment after the shock (relative to skilled workers). It will be interesting to explore to what degree this results imply that the conditions of informal employment deteriorated following the earthquake.

From the data in the survey it is also possible to estimate equation (2) defining informality from the Legal Perspective.[26] I relax the sample restrictions to include national workers aged 16-65, regardless of their full-time status or wages and find a positive and statistically significant (at a

[26] The individual is considered informal if he/she works in a firm without license or if the firm has license but the worker does not have a contract. Domestic workers and workers without salary are always considered informal while workers in the public sector are always considered formal regardless of the existence of contract or firm's license. See Table A.4 for the specific questions used to create the variable.

99 percent confidence level) impact of 3.7 percentage points (on average), adding controls does not change these results significantly.[27]

Furthermore, to have a better idea of the effect of the immigration shock on informal labour, I estimate equation (1) including only informal employees.[28] The results are again not statistically significant at conventional confidence levels. In this case, results suggest a decline in the skilled-unskilled wage gap of about 7.6 percent on average. Two forces might explain this result, an increase in the wages of the unskilled workers or a decrease of the skilled workers wages. Because economic theory predicts that the over-supply of labour should decrease its price, one may argue that unskilled workers are unlikely to get higher wages as a result of the immigration shock. Nonetheless, the model fails to identify the reason for the apparent smaller wage-gap.

VI. Conclusion

Economists have long studied the impact of immigration on the destination economy. And, finding ways to address the identification bias and to disentangle the supply shock from unobserved changes in labour demand has been the main focus of recent studies. The 2010 Haiti earthquake allows for a prime example of a natural experiment, in the sense that the increase in immigration it caused is clearly exogenous to labour market conditions.

The results of a difference-in-difference provides no evidence that the immigration shock following the 2010 Haiti earthquake affected the wages for native unskilled workers. Moreover, estimates of the effect on the probability of being is informal (that suggest a one percent decrease) are neither economically nor statistically significant.

However, one should be very careful in interpreting these results. When sample restrictions are relaxed, I find that the immigration shock increases the gap in labour market outcomes between skilled and unskilled workers in two ways. First, it reduced the probability of being employed for native unskilled workers (relative to the skilled ones) by one percentage point. And second, it

[27] Results are summarized in table C.8 in appendix C.

[28] All other sample restrictions still hold. Results are summarized in table C.6 in appendix C.

increases the probability of being informal from the legal perspective (for those that are employed) by almost four percentage points.

Two interesting questions remain unanswered, what is the effect of the immigration shock on wage distribution? And, how the shock affected employment conditions within the informal sector. This leaves room for further studies on this particular topic.

References

ABC. (2015, December 1). Cinco años después del terremoto casi 80.000 Haitianos siguen sin hogar. *abc*. Retrieved from http://www.abc.es/internacional/20150112/abci-haiti-aniversario-cinco-201501121025.html (accessed December 1, 2015)

Adams, A. V., Johansson de Silva, S., & Razmara, S. (2013). *Improving skills development in the informal sector*. The World Bank.

Aristy Escuder, J. (Ed.). (2011). Impacto de la migración Haitiana sobre el mercado laboral y las finanzas públicas de la República Dominicana. In *Movimientos migratorios desde y hacia la República Dominicana. T. 1* (Vol. I). Santo Domingo, República Dominicana: Ministerio de Economía, Planificación y Desarrollo, Fondo para el Fomento de la Investigación Económica y Social.

Auriol, E., & Warlters, M. (2005). Taxation base in developing countries. *Journal of Public Economics*, *89*(4), 625–646.

Báez Evertsz, F., Lozano López, W., Díaz Segura, J., & Durán Rodríguez, R. (2011). *Inmigrantes Haitianos y mercado laboral: Estudio sobre los trabajadores de la construcción y de la producción del guineo en la República Dominicana*.

Bodvarsson, O. B., & Van den Berg, H. (2009). *The economics of immigration: Theory and policy*. New York and Heidelberg: Springer.

Bodvarsson, Ö. B., Van den Berg, H. F., & Lewer, J. J. (2008). Measuring immigration's effects on labor demand: A reexamination of the Mariel Boatlift. *Labour Economics*, *15*(4), 560–574.

Bohn, S., & Owens, E. G. (2012). Immigration and informal labor. *Industrial Relations: A Journal of Economy and Society*, *51*(4), 845–873.

Card, D. (1990). The impact of the Mariel Boatlift on the Miami labor market. *Industrial & Labor Relations Review*, *43*(2), 245–257.

Card, D. (2001). Immigrant inflows, native outflows, and the local labor market: Impacts of higher immigration. *Journal of Labor Economics*, *19*(1), 22–64.

Carrasco, R., Jimeno, J. F., & Ortega, A. C. (2008). The effect of immigration on the labor market performance of native-born workers: Some evidence for Spain. *Journal of Population Economics*, *21*(3), 627–648.

Charlot, O., Malherbet, F., & Terra, C. (2012). Informality in developing economies: Regulation and fiscal policies. *Journal of Economic Dynamics and Control,* 51, 1-27

Clemente, C. (2015, September 4). Unos 78,000 Trabajadores no Están Registrados en SS. *Listin Diario*.

Collado Di Franco, M., & Rojas Rodríguez, J. R. (2015, October). Medición alternativa de la informalidad laboral en República Dominicana. Centro Regional de Estrategias Sostenibles.

Consejo Nacional de Seguridad Social. (2010, February 11). Resolución No. 231.

Dabla-Norris, E., Gradstein, M., & Inchauste, G. (2008). What causes firms to hide output? The determinants of informality. *Journal of Development Economics*, *85*(1), 1–27.

Dabla-Norris, E., & Inchauste, G. (2008). Informality and Regulations: What drives the growth of firms? *IMF Staff Papers*, 55(1), 50–82.

D'Amuri, F., Ottaviano, G. I. P., & Peri, G. (2010). The labor market impact of immigration in Western Germany in the 1990s. *European Economic Review*, *54*(4), 550–570.

De Andrade, G. H., Bruhn, M., & McKenzi, D. (2013). A helping hand or the long arm of the law? Experimental evidence on what governments can do to formalize firms. *World Bank, Policy Research Working Paper* No. 6435

Disasters Emergency Committee, (DEC). (2012). *Haiti Earthquake Facts and Figures*. Disaster Emergency Committee. Retrieved http://www.dec.org.uk/articles/haiti-earthquake-facts-and-figures (accessed on December 1, 2015)

Djankov, S., La Porta, R., Lopez-De-Silanes, F., & Shleifer, A. (2002). The regulation of entry. *Quarterly Journal Of Economics*, *117*(1), 1–37.

Duarte, I. (2011). La mano de obra Haitiana en la construcción: Características, valoraciones y prácticas. In *Movimientos migratorios desde y hacia la República Dominicana. T. 1:*

Santo Domingo, República Dominicana: Ministerio de Economía, Planificación y Desarrollo, Fondo para el Fomento de la Investigación Económica y Social.

Friedberg, R. M. (2001). The impact of mass migration on the Israeli labor market. *Quarterly Journal of Economics*, *116*(4), 1373–1408.

Giles, D. E. A., & Tedds, L. M. (2002). *Taxes and the Canadian underground economy*. Toronto: Canadian Tax Foundation.

Johnson, S., Kaufmann, D., McMillan, J., & Woodruff, C. (2000). Why do firms hide? Bribes and unofficial activity after communism. *Journal of Public Economics*, *76*(3), 495–520.

Khamis, M. (2009). A note on informality in the labor market. *IZA Discusion Paper* No. 4676

Katz, L. F., & Murphy, K. M. (1992a). Changes in relative wages, 1963-1987: Supply and demand factors. *The Quarterly Journal of Economics*, *107*(1), 35–78.

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

Loayza, N. (1997). The economics of the informal sector: A simple model and some empirical evidence from Latin America. *World Bank, Policy Research Working Papers* No. 1727

Loayza, N., Oviedo, A. M., & Servén, L. (2005). The impact of regulation on growth and informality: Cross-country evidence. *World Bank, Policy Research Working Paper* No. 3623

Lozano, W. (1992). Agricultura e inmigración: La mano de obra Haitiana en el mercado de trabajo rural Dominicano. In *La cuestion Haitiana en Santo Domingo: Migración internacional, desarrollo y relaciones inter-estatales entre Haiti y República Dominicana*. Dominican Republic: Facultad Latinoamericana de Ciencias Sociales (FLACSO).

Maloney, W. F. (1999). Does informality imply segmentation in urban labor markets? Evidence from sectoral transitions in Mexico. *World Bank Economic Review*, *13*(2), 275–302.

Morin, L.-P. (2015). Cohort size and youth earnings: Evidence from a quasi-experiment. *Labour Economics*, *32*, 99–111.

Moya Pons, F. (1992). Las tres fronteras: Introduccion a la frontera Dominico-Haitiana. In *La cuestion Haitiana en Santo Domingo: Migración internacional, desarrollo y relaciones inter-estatales entre Haiti y República Dominicana*. Dominican Republic: Facultad Latinoamericana de Ciencias Sociales (FLACSO).

Ottaviano, G. I. P., & Peri, G. (2012). Rethinking the effect of immigration on wages. *Journal of the European Economic Association*, *10*(1), 152–197.

Oviedo, A. M., Thomas, M. R., & Karakurum-Özdemir, K. (2009). Economic informality causes, cost, and policies: A literature survey. *World Bank Working Paper* No. 167

Oxfam International. (2015). Haiti Earthquake - our response. OXFAM. Retrieved from https://www.oxfam.org/en/haiti-earthquake-our-response (accessed on December 1, 2015)

Page, K. (2010, July 9). On the ground in Haiti, after the quake: Q&A with UNICEF Senior Communication Advisor Kent Page. Retrieved from http://www.unicef.org/infobycountry/haiti_54237.html (accessed on December 1, 2015)

Pischke, J.-S., & Velling, J. (1997). Employment effects of immigration to Germany: An analysis based on local labor markets. *Review of Economics & Statistics*, *79*(4), 594–604.

Quejada Pérez, R., Yánez Contreras, M., & Cano Hernández, K. (2014). Determinants of labor informality: An analysis for Colombia. *Investigación & Desarrollo*, *22*(1), 2–21.

Reyes Rodríguez, P. (2015a, January 29). Piden a DGA persistir contra informalidad. *Listin Diario*. Retrieved from http://www.listindiario.com/economia/2015/02/11/355795/buscan-exonerar-de-impuestos-a-las-micro (accessed October 28, 2015)

Reyes Rodríguez, P. (2015b, February 11). Buscan Exonerar de Impuestos a las Micro. *Listin Diario*. Retrieved from http://www.listindiario.com/economia/2015/01/29/354240/piden-a-dga-persistirnbspcontra-informalidad (accessed October 28, 2015)

Secretaria de Estado de Economía, Planificación y Desarrollo, S., Banco Central de la República Dominicana, B., & World Bank. (2007). La Informalidad en el mercado laboral urbano de la República Dominicana. Santo Domingo: Banco Central de la República Dominicana.

Sierra, L. (2015, April 22). Sectores Discuten Sobre Informalidad. *Listin Diario*. Retrieved from http://www.listindiario.com/economia/2015/04/22/364358/sectores-discuten-sobre-informalidad (accessed October 28, 2015)

Straub, S. (2005). Informal sector: The credit market channel. *Journal of Development Economics*, *78*(2), 299–321.

The World Bank. (2012). *Haití, República Dominicana : Más que la suma de las partes.* Santo Domingo: The World Bank.

Appendix A: Informality

Appendix A presents a summary of the literature around the informal economy. Tables A.1 trough A.3 cover the definition and views of informality, the effects it has on the economy and the variables that determine this sector. Table A.4 details the characteristics taken into account for the three definitions used in the Secretaria de Estado de Economía, Planificación y Desarrollo, Banco Central de la República Dominicana, & World Bank (2007) study (and followed in this paper) as well as the input-variables used for the construction of the dummies.

Table A.1: Views of Informality

Voluntary[1]	Pro-Cyclical	Under good economic performance the risks of undertaking entrepreneur projects are lower and the relative benefits of the more flexible and deregulated informal increase. The costs imposed by labour and fiscal rigidities outweigh the benefits of the formal sector	The informal sector is the desired destination. Individuals perform cost benefit analysis and choose to work in the informal sector.
	Integrated Labour Market	Highly productive and trained workers that have no constraint to enter the formal market choose to benefit from avoiding taxes and regulations. The Informal sector represents an unfair competition.	
Involuntary[2]	Anti-Cyclical	During recession and times of high unemployment the excess of labour is absorbed by the informal sector (can be interpreted as masked unemployment).	The formal sector cannot absorb the labour force or is design to prevent the insertion of the less privileged population. Workers only option is to perform their economic activities outside the legal system (the informal sector)
	Segmented Labour Market	Fiscal and market regulations constitute a barrier for the segment of the population with lower endowments. These barriers prevent workers and firms from becoming formal.	

Source: Khamis (2009); Edwards, Ram, & Black (2004); La Porta & Shleifer (2014); [1]Maloney (1999); Oviedo, Thomas, & Karakurum-Özdemir (2009); Khamis (2009); Quejada Pérez et al. (2014); [2]de Soto (1989); Auriol & Warlters (2005)

Table A.2: Effects of Informality

Through Efficiency Loss[1]	Because of their nature, informal firms cannot write enforceable contracts or use other market supporting institutions, and find it hard to access the credit market. As a result they invest too little in both capital and research and development, preventing them from reaching their potential growth and operating more efficiently. There is plenty of empirical work supporting the view that huge productivity gaps exists between the formal and informal sector and that the latter is in itself inefficient.
Through the Provision of Public Goods[2]	The informal sector also implies a loss in tax revenues. This reduction in public funds causes the provision of public goods to be suboptimal and the worse public infrastructure negatively affects economic growth. The presence of the informal sector reduces the availability of public services which in turn hurts growth. This also translate to less trust in institutions and the government and foster a culture of informality.
Through Informal Firm's Growth[3]	With firms that, facing efficiency and productivity restrictions, operate in a suboptimal scale of production, growth is limited. In addition, there's an indirect effect to formal growth due to the congestion of public goods available to formal firms and unfair competition. Nonetheless, some authors have found that in Latin America informality does not withhold firm's growth.
Through Social Protection[4]	Last, but not least, the absence of social protection due to the exclusion from the formal sector (government, institutions and otherwise) puts firms and workers at high risk of social vulnerability as they are excluded from social security, pension system, and legal protection.

Source: [1]Johnson et al. (2000), Charlot, Malherbet, & Terra (2012),La Porta & Shleifer (2014), Quejada Pérez et al. (2014), Loayza et al. (2005), [2]Loayza (1997), De Andrade, Bruhn, & McKenzi (2013), Johnson et al. (2000), Oviedo et al. (2009), [3]Oviedo et al. (2009), Dabla-Norris & Inchauste (2008), Loayza (1997), Charlot et al. (2012), [4]Loayza (1997), Quejada Pérez et al. (2014), Secretaria de Estado de Economía, Planificación y Desarrollo et al. (2007)

Table A.3: Determinants of Informality

Tax Burden[1]	[tax rates, structure of the tax system and tax administration] Higher taxes increase the cost of staying formal. The higher they are the higher the probability that workers and firms will choose to avoid them, including the cases where it will simply be impossible to bear this cost. Friedman et al (2000), however, found a negative relation between tax rates and the informal sector and argued that the reason to being informal is to avoid bureaucracy and corruption rather than taxes.
Regulatory Burden[2]	[entry costs, registration procedures, and labour regulations] The stricter the regulations the higher the costs for the firm to become formal. This will increase the informal sector by increasing both the number of firms for which registration is simply beyond reach and those that willingly decide to benefit from not complying with the regulations. Another argument is that higher regulations reduce labour demand on the formal sector, and sometimes impose an implicit tax on the worker. This results in an increases of informal employment.
Institutional Quality[3]	[tax-money allocation, provision of public goods, enforcement and legal system] A better institutional quality increases the benefits from being formal. Thus reducing the share of firms that voluntarily choose to operate informally as the advantages of the formal sector outweigh the its costs (or alternatively, outweigh the benefits of the informal sector)
Economic and Financial Development[4]	Economic development is associated with better institutional quality, better market conditions and higher rule of law. The incentive to operate informally is reduced. Furthermore, access to the financial system allows firms to comply with regulations, increase their investment to become more productive and take advantage of the benefits from the formal sector.
Age and Experience[5]	Younger individuals without a lot of experience find it hard to find a job in the formal market and are more prone to join the informal sector.
Education and Productivity[6]	Higher productivity is associated with higher incomes (and higher benefits from operating in the formal sector). The opportunity cost of being informal increases for highly educated people reducing their propensity to be being informal.
Sex[7]	Females are more likely to work informally to benefit from the flexibilities of this sector. Arguably because they have to look after family obligations and housework in a greater extent than do men.

Note: other variables that have been proved to be associated with informality are: inflation, quantity of jobs/occupations a worker has, household composition, civil status, type of occupation, worker's safety nets, real disposable income, poverty levels, tax morality and whether someone in the household already has a formal job.

Source: [1]Quejada Pérez et al. (2014), Straub (2005), Giles & Tedds (2002), Loayza (1997), Loayza, Oviedo, & Servén (2005), Dabla-Norris, Gradstein, & Inchauste (2008), Johnson, Kaufmann, McMillan, & Woodruff (2000), [2]Maloney (1999), Straub (2005), Giles & Tedds (2002), Auriol & Warlters (2005), Loayza (1997), Loayza et al. (2005), Djankov, La Porta, Lopez-De-Silanes, & Shleifer (2002), Dabla-Norris et al. (2008), Botero, Djankov, La Porta, Lopez-De-Silanes, & Shleifer (2004), [3]Oviedo et al. (2009), Giles & Tedds (2002), Dabla-Norris et al. (2008), Johnson et al. (2000), [4]Giles & Tedds (2002), Loayza et al. (2005), [5]Maloney (1999), Giles & Tedds (2002), Secretaria de Estado de Economía, Planificación y Desarrollo, Banco Central de la República Dominicana, & World Bank (2007), [6]Maloney (1999), Dabla-Norris et al. (2008), Secretaria de Estado de Economía, Planificación y Desarrollo et al. (2007), [7]Secretaria de Estado de Economía, Planificación y Desarrollo et al. (2007), Adams et al. (2013).

Table A.4: Definitions of Informality

	Definition	Questions used to create variable
International Labour Organization Perspective	["iilo"] The individual is consider informal when he/she works in a firm with less than 5 employees, in a family-owned business, is domestic worker, works without salary, or is a farmer, artisan, self-employed (non-professional), manager in an unregistered firm.	*How many people work in your place of work?* *What is your primary occupation?* *Did you perform any of the following activities last week?* *Farming, harvesting or ranching?* *Worked on a product (craft or otherwise) to sell it?* *Helped a relative with their business or farm?* *Perform domestic work for someone else?*
Legal Perspective	["il"] The individual is consider informal if he/she works in a firm without license or if the firm has license but the worker does not have a contract. Domestic workers and workers without salary are always consider informal while workers in the public sector are always consider formal regardless of the existence of contract or firm's license.	*What is your primary occupation?* *Did you signed a contract in your current job?* *Does the business you work at has a license for operating?*
Social Security Perspective	[iss] The individual is consider informal if he/she is not registered in the social security or pension system. Domestic workers and workers without salary are always consider informal while workers in the public sector are always consider formal regardless of their social security coverage.	*What is your primary occupation?* *In your current job, do you contribute to the Pension Plan System?* *In your current job, do you contribute to the Social Security System?*

Note: The ENFT survey only has data on social security coverage for employees on the public and private sector. Data on individuals with a different occupation (including self-employed, domestic workers and workers without salary) is missing. This is important to account for when interpreting this variable.

Appendix B: Historic Context of the Haitian-Dominican Republic Immigration Flows

The Dominican Republic and Haiti are one of the few two nations to share an insular territory. To understand their relations it is necessary to go back to the XV century. The *Island of Santo Domingo* was a Spanish colony and its west side was eventually occupied by buccaneers and filibusters and later colonized by France. The presence of the two colonies led many conflicts regarding their border. According to Moya Pons (1992), it was in 1631 when the limits were set for the first time, and in 1777 the Treaty of Aranjuez fixed the definitive intercolonial border. With the independence of the two countries –Haiti from France and the Dominican Republic from Haiti– the troubles started again. The first agreement between the two independent republics of Haiti and the Dominican Republic was signed in 1929 and ultimately lead to massacre of Haitians ordered by the dictator Rafael Leonidas Trujillo in 1937. Trujillo, who spread a sentiment of anti-Hatianism, also promulgated a law in 1941 that established that 70 percent of the employed labor force had to be Dominican.

First half of the XX Century

The international migration flows date back to the late XIX century with the development of the sugar industry and the agro-export economy in the Dominican Republic. The Haitian immigration in particular, took place in the context of the United States military occupation that caused a destabilization of the agriculture and repressed the peasants in Haiti while promoting the expansion of the sugar industry in the Dominican Republic.[29] This two forces lead thousands of Haitians to offer their labour in the Dominican Republic during the cane cutting periods. (Báez Evertsz, Lozano López, Díaz Segura, & Durán Rodríguez, 2011). The dictatorial government of Trujillo was a period of regulations –by any means– of the border and the labor market, and in 1952 (even with the anti-Haitianism of the regimen) both States reached an agreement that allowed Dominican farmers to employ Haitians workers in a temporary basis.

[29] The military occupation of Haiti took place from 1915 to 1934, while the occupation of the Dominican Republic was from 1916 until 1924.

Second half of the XX Century

In the decade of 1960, the per-capita GDP of the Dominican Republic and Haiti (which was similar at the time) started to diverge, creating a huge gap between the countries.[30] In the 1980s and 1990s the Dominican Republic transitioned from an agro-export economy to one based on Free Zones and Tourism, at the same time in Haiti the Duvalier dictatorship reached an end and was followed by political instability and, once again, an US military occupation in 1995. In this decade there was an increase in immigration and Haitians started to expand the sector in which they work to include non-sugar farming activities (especially rice and coffee), urban activities (including those in the informal sector) and construction. During these years the temporary nature of the migration started to lose ground and migrants stayed in the country much more frequently than before (Báez et al., 2011; Lozano,1992).

The XXI Century

With the new century a new structure of immigration emerged. There was a diversification of the farming production that used Haitian workforce and it also extended to the urban economy in the Construction, Tourism, Service and Trade Sectors. The construction sector became the most important labour destination for new immigrants and caused an internal movement of old migrant towards the sector.

Several authors have studied the current migration flows and its integration in the Dominican labour market. Using studies from Aristy Escuder (2011), Duarte (2011), Lozano (1992) and Báez Evertsz et al. (2011) 6 stylized facts are presented:

1. The newer inflow of migrants is not temporary.
2. The majority of Haitian migrants work in the Construction Sector.[31]
3. The Haitian workforce concentrates on the low-skilled occupations and substitutes the low-skilled national workforce.
4. There is a wage-gap between immigrants and nationals.[32]

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[30]According to the World Bank (2012) the GDP of the Dominican Republic have been growing at 5 percent annually since 1960 (the highest rate of the region) while that of Haiti has grew at the lowest rate of Latin America, 1 percent.

[31] According to the survey conducted by Duarte (2011) the Construction Sector is dependent on the Haitian workforce.

[32] According to the survey conducted by Aristy Escuder (2011) monthly income of a Dominican national working in construction is almost 2 times that of their Haitians counterpart.

5. An increase in the Haitian workforce has a negative impact on overall wages.[33]
6. The Haitian workforce is complementary of the investment in capital and skilled workforce.[34]

The 2010 earthquake

On January 12, 2010 an earthquake of magnitude 7.0 struck Haiti, causing over 316,000 deaths and leaving more than 350,000 critically injured and over 1.5 million people homeless, it was the seism with more casualties of the year.[35] The already fragile economy of Haiti –one of the poorest countries before the earthquake– faced the destruction of its capital city, where most of the governmental and administrative buildings along with roads, hospitals and schools were demolished. According to the Disasters Emergency Committee (2012) more than 19 million cubic metres of rubble and building remains were in the capital city, 60 percent of the government buildings 80 percent of the schools in Port au Prince and 60 percent of the schools in the South and West Departments were damaged or completely destroyed. The World Bank (2012) estimates that 8 percent of the capital stock was destroyed by the quake causing losses of over 120 percentage points of the Haitian GDP at the time. The model also predicts an increase of 6 percentage points in migrant outflows and are expected to be 3 percent higher than their "no-earthquake" level until 2020.

Part of the immediate response of the Dominican Republic to this natural disaster was to open its frontiers to provide emergency assistance to survivors and offered temporary housings and accommodations in hospitals and schools. International organizations agree that it was one of the worst situations they have had to face. Kent Page, a Senior Communication Advisor at the United Nations International Children's Emergency Fund (UNICEF), said: *"I've worked in various complex emergencies, in Afghanistan, Rwanda, Angola, Liberia and other places in West Africa, but this was truly a unique emergency for a number of reasons. It was happening in the poorest country in the western hemisphere, in an urban setting. Because of the destruction of so many*

[33] Aristy Escuder (2011) estimates that a 10 percent increase in the Haitian workforce reduces the wage of a Dominican worker by 1 percent.
[34] Aristy Escuder (2011) found the Hicksian elasticity of work-capital to be positive. The elasticity was negative for the Haitian-Dominican worker.
[35] M7.0 on the Richter Scale according to the United States Geological Survey (USGS).

government ministry buildings and the impact on government workers, it was really epic in nature"(Page, 2010). Oxfam International also identified *"The level of destruction and logistical challenges"* as one of the worst they had ever faced (ABC, 2015).

The situation in Haiti is still worrying. Even with the exceptional response from the International Community –providing over USD$10 billion in humanitarian aid, and thousands of workers– an article published in the Spanish newspaper ABC estimates that more than 80,000 were still living in 'temporary' camps on January 2015. It also echoes a denunciation by Amnesty International concerning 'forced expulsion' from the camps of over 60,000 people which are left without home and without means to survive. The United Nations World Food Programme estimates that more than 3 million of Haitians don't know when they will get their next meal (ABC, 2015).

Effect on the migration patterns

The World Bank (2012) estimated that the earthquake increased the emigration by 6 percent in 2010 and that the migration flows will stay 3 percent above their level (without earthquake) until 2020. This will lead to an increase of one percentage point of the migrant workers in the Dominican Republic by 2020.

Appendix C: Additional Regressions and Descriptive Statistics

The first part of this section contains tables with descriptive statistics of immigration, employment and level of education variables for the full sample of the National Labour Force Survey in the 2008-2014 period. After, results of additional regressions (changing sample restrictions and specifications) are presented.

Table C.1: Highest level of education achieved

		2008	2009	2010	2011	2012	2013	2014
(A) Dominicans	No School	7.59%	7.30%	6.96%	6.71%	6.41%	6.07%	5.90%
		(0.2648)	(0.2602)	(0.2546)	(0.2503)	(0.2450)	(0.2388)	(0.2356)
	Elementary School	50.23%	49.74%	48.95%	48.05%	47.71%	47.63%	46.52%
		(0.4999)	(0.4949)	(0.4998)	(0.4996)	(0.4994)	(0.4994)	(0.4986)
	Secondary School	27.97%	28.29%	28.92%	30.42%	30.48%	30.46%	32.07%
		(0.4488)	(0.4504)	(0.4534)	(0.4600)	(0.4603)	(0.4602)	(0.4667)
	Undergraduate Studies	13.37%	13.80%	14.34%	14.23%	14.68%	15.03%	14.80%
		(0.3404)	(0.3449)	(0.3505)	(0.3493)	(0.3539)	(0.3573)	(0.3551)
(B) Haitians	No School	40.08%	36.27%	38.03%	35.34%	35.56%	29.83%	34.97%
		(0.4900)	(0.4807)	(0.4854)	(0.4780)	(0.4787)	(0.4575)	(0.4768)
	Elementary School	45.71%	42.05%	39.96%	41.26%	44.26%	49.74%	42.62%
		(0.4981)	(0.4936)	(0.4898)	(0.4923)	(0.4967)	(0.4999)	(0.4945)
	Secondary School	11.16%	16.73%	18.13%	19.68%	15.33%	16.09%	17.85%
		(0.3149)	(0.3732)	(0.3852)	(0.3975)	(0.3602)	(0.3674)	(0.3829)
	Undergraduate Studies	2.44%	4.63%	3.66%	3.42%	4.82%	4.24%	4.11%
		(0.1543)	(0.2102)	(0.1879)	(0.1817)	(0.2142)	(0.2015)	(0.1987)
(C) Full Sample	No School	8.32%	7.96%	7.79%	7.49%	7.14%	6.70%	6.60%
		(0.2761)	(0.2708)	(0.2680)	(0.2633)	(0.2576)	(0.2500)	(0.2483)
	Elementary School	49.92%	49.41%	48.59%	47.72%	47.54%	47.54%	46.01%
		(0.4999)	(0.4999)	(0.4998)	(0.4994)	(0.4993)	(0.4993)	(0.4984)
	Secondary School	27.63%	28.02%	28.62%	30.14%	30.08%	30.05%	31.65%
		(0.4471)	(0.4491)	(0.4520)	(0.4588)	(0.4586)	(0.4585)	(0.4651)
	Undergraduate Studies	13.24%	13.72%	15.17%	14.06%	14.53%	14.87%	14.76%
		(0.3389)	(0.3441)	(0.3488)	(0.3476)	(0.3524)	(0.3558)	(0.3547)

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to working-age population (aged 10 or older). Standard Deviation is shown in parentheses. A group includes all individuals enrolled or that completed any grade within that level and not necessarily those who graduated (i.e., an individual who studied up to grade 10 and then drop-out is included in the "Secondary School" group).

Table C.2: Employment hours per week

hours	Full Sample	Dominicans	Haitians
1-19	6.46%	6.55%	4.56%
20	5.24%	5.33%	2.94%
21-29	5.74%	5.76%	4.92%
30	6.25%	6.27%	5.98%
31-34	0.95%	0.94%	1.35%
35	2.79%	2.79%	3.08%
36-39	2.34%	2.32%	2.96%
40	11.63%	11.79%	7.94%
40-43	1.37%	1.37%	1.55%
44	19.48%	19.49%	17.03%
45	3.78%	3.81%	3.22%
46	1.81%	1.79%	2.40%
47	0.27%	0.26%	0.29%
48	11.89%	11.77%	15.46%
49	0.86%	0.85%	1.16%
50	5.95%	5.85%	8.30%
51-59	4.75%	4.72%	5.67%
60	4.49%	4.40%	6.59%
61-95	3.95%	3.92%	4.61%
Mean	40.9	40.8	43.2
Median	44	44	44
N	156,252	148,566	7,292

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using the survey weights. Sample is restricted to employed individuals.

Table C.3: Haitian Immigration (ENFT)

	Haitians	Rest of Immigrants
2008	77.98%	22.02%
2009	82.63%	17.37%
2010	86.45%	13.55%
2011	85.08%	14.92%
2012	88.28%	11.72%
2013	85.97%	14.03%
2014	81.55%	18.45%

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using the survey weights. Sample is restricted to working-age population (aged 10 or older). Table shows percentage of the total immigrants in the sample.

Table C.4: Haitian Immigration (ENI)

	Haitians	Rest of Immigrants
2008	91.58%	8.42%
2009	93.35%	6.65%
2010	92.49%	7.51%
2011	91.26%	8.74%
2012	88.16%	11.84%

Note: Data is from the National Immigration Survey of the Dominican Republic (ENI). Weighted using the survey weights. Sample is restricted to working-age population (aged 10 or older). Table shows percentage of the total immigrants in the sample.

Table C.5: Immigrant Population (ENI)

	Haitians	Rest of Immigrants	Total Immigrants
2008	28,401	2,611	31,012
2009	31,169	2,220	33,389
2010	47,552	3,862	51,414
2011	43,058	4,126	47,184
2012	78,543	10,551	89,094

Note: Data is from the National Immigration Survey of the Dominican Republic (ENI). Weighted using the survey weights. Sample is restricted to working-age population (aged 10 or older). Table shows total immigrants in the sample.

Table C.6: Effect of the supply shock on wages (informal workers)

	(1)	(2)	(3)
EQK x USK	0.0921	0.0716	0.0665
	(0.0363)	(0.0317)	(0.0286)
EQK	-0.1835***	-0.1587***	-0.1548***
	(0.0276)	(0.0243)	(0.0217)
USK	-0.4225***	-0.4127***	-0.3876***
	(0.0582)	(0.0456)	(0.0493)
Controls for personal characteristics	No	Yes	Yes
Province fixed effects	No	Yes	Yes
Time of residence	No	No	Yes
Sector	No	No	Yes
R^2	0.0338	0.1274	0.1391
N	38,878	38,878	38,878

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to full-time national workers aged 16-65, perceiving a salary of at least DOP$20/h. Dependent variable is a dummy for informality (following ILO definition). Standard errors clustered at the province level (31 provinces) are shown in parentheses.

*Significant at 10%, **Significant at 5%, ***Significant at 1%

Table C.7: Effect of the supply shock on informal status

	iilo	ii	iss	il
EQK x USK	-0.0145	-0.0019	-0.0215	0.0277*
	(0.0078)	(0.0075)	(0.0109)	(0.0093)
EQK	0.0014	-0.0372***	-0.0312**	-0.0209***
	(0.0053)	(0.0055)	(0.0101)	(0.00324)
USK	0.2265***	0.2306***	0.1743***	0.1464***
	(0.0081)	(0.0161)	(0.0155)	(0.0093)
Controls for personal characteristics	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes
Time of residence	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
R^2	0.2867	0.3879	0.2119	0.2108
N	81,329	81,329	45,558	81,329

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to full-time national workers aged 16-65, perceiving a salary of at least DOP$20/h. Dependent variable is a dummy for informality (according to each definition as explain in table A.3, where "ii" is an individual clasified as informal by any definition). Standard errors clustered at the province level (31 provinces) are shown in parentheses.

*Significant at 10%, **Significant at 5%, ***Significant at 1%

Table C.8: Effect of the supply shock on informal status (legal perspective)

	(1)	(2)	(3)	(4)
EQK x USK	0.0372***	0.0400***	0.0409***	0.0337***
	(0.0095)	(0.0099)	(0.0097)	(0.0078)
EQK	-0.0288*	-0.0325**	-0.0337**	-0.0240**
	(0.0104)	(0.0103)	(0.0101)	(0.0070)
USK	0.2969***	0.2657***	0.2553***	0.1687***
	(0.0149)	(0.0143)	(0.0120)	(0.0111)
Controls for personal characteristics	No	Yes	Yes	Yes
Province fixed effects	No	Yes	Yes	Yes
Time of residence	No	No	Yes	Yes
Sector	No	No	No	Yes
R^2	0.077	0.1116	0.1152	0.2527
N	131,413	131,413	131,413	131,413

Note: Data is from the National Labour Force Survey of the Dominican Republic (ENFT). Weighted using survey weights. Sample is restricted to national workers aged 16-65, regardless of wages and their full-time status. Dependent variable is a dummy for informality (following the legal definition). Standard errors clustered at the province level (31 provinces) are shown in parentheses.

*Significant at 10%, **Significant at 5%, ***Significant at 1%