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How Does the Ecuadorian Labor Market React to A Crisis?

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Abstract: This paper studies the behavior of the Ecuadorian labor market in an economic crisis caused by an exogenous drop in crude oil prices. We consider a two-sector (formal and informal) and apply a difference-in-difference identification strategy. The findings reveal that social security affiliation reduces the probability of remaining employed by 3% during the crises, with disemployment effects disproportionately affecting women (10 times higher than those for men). These results underscore the structural challenges of labor market rigidities in developing economies and highlight the need for policies that mitigate gender-based disparities.

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Introduction

Classical economic theory argues that any regulatory interference increasing labor costs above the market equilibrium will lead to unemployment (Bazen, 1990). This outcome arises because such regulations negatively impact a firm's profitability, leading to fewer jobs. Alternatively, some labor market agents may resort to circumventing these regulations through illegal hiring practices, such as informality (Arrowsmith et al., 2003). Among the various forms of labor market rigidity, the minimum wage has been the most extensively studied in the literature. However, other forms of regulation, such as law enforcement mechanisms, have also been examined (Guzman, 2017). In formal economies, there is a large body of evidence and some agreement on the effects of increasing the minimum wage on different aspects of the labor market (Abowd et al., 1997; Burkhauser, Couch, & Wittenburg, 2000; Deere, Murphy, & Welch, 1995; Fuchs, Krueger, & Poterba, 1998; Neumark, Cunningham, & Siga, 2006; Neumark & Wascher, 1995, 2002, 2004; Zavodny, 2000).

Unlike most formal and developed economies, the imposition of market rigidities and their effect on employment remains a contentious issue in developing countries. The literature on this topic is less extensive and more ambiguous, largely due to the prevalence of informal markets and the highly diverse labor conditions across developing nations (Cahuc & Malherbet, 2004). In Latin American countries, some studies do not find significant effects of minimum wage policies on employment levels. Instead, they report a compression in income distribution, suggesting that in these economies, the minimum wage can function as a tool for wealth redistribution (Alaniz, Gindling, & Terrell, 2011; Baanante, 2004; Broecke, Forti, & Vandeweyer, 2017; Campos, Esquivel, & Santillán, 2017; Khamis, 2013; Montenegro, 2004). Conversely, in countries such as Chile and Colombia, evidence suggests that increases in the minimum wage lead to a slight decline in job creation and a reduction in the likelihood of remaining employed (Arango & Pachón, 2004; Cowan et al., 2005); Diaz & Garcia (2006); (Grau & Landerretche, 2011).

Another important but less explored factor in the literature is the productivity of firms in less developed countries and its role in shaping labor market characteristics. Empirical evidence suggests that firms in developing countries tend to have lower productivity, often due to limited access to finance and inefficient management practices (Bloom et al., 2010; The World Bank, 2005; Tybout, 2000). Furthermore, lower productivity is often linked to the size and life cycle of firms, with small, medium, or younger firms typically being less productive (Taymaz, 2005). In Ecuador, as in other developing countries, the traditional sector is home to many small firms (defined as firms with ten or fewer employees). Employment systems and labor relations in these firms are often informal and casual, due in part to the lack of specialized management and formal hierarchies. Consequently, analyzing the impact of an economic crisis on various labor market sectors requires a consideration of informality as a potential catalyst for both quantitative and qualitative changes in labor market dynamics.

In this case, increasing enforcement could influence the firm's capacity to absorb the costs associated with formalization or, in turn, provide an incentive to evade legislation (Arrowsmith et al., 2003). Considering Ecuador's abundant micro and small firms, higher labor rigidities could imply higher unemployment or increased informal "hires." This phenomenon can be analyzed not only from the point of view of the firm but also from that of the employee. Employees possess a degree of bargaining power, which could be influenced by heightened labor market rigidities. This bargaining power reflects their ability and willingness to participate in either the formal or informal sectors. For example, in 29 European Union countries, labor market regulations positively influence individuals' decision to enter self-employment (entrepreneurship) (Fu, Larsson, & Wennberg, 2018). In this case, individuals will choose self-employment if the expected utility of self-employment exceeds that of other options (Douglas & Shepherd, 2002; Plehn-Dujowich, 2010). Similarly, in more informal economies, workers often decide whether to remain in the formal sector or transition to the informal one.

As with firms, the productivity of individuals plays a fundamental role in determining labor market shock effects. Less skilled and, therefore, less productive employees are less likely to escape the negative consequences of higher labor market rigidities (Sabia, 2006). Consequently, they will prefer to avoid them and remain outside labor legislation through unemployment or informal work. Certain demographic groups, such as younger workers, are more likely to belong to low-skilled, low-productivity segments of the labor force, a factor that will be explored further in this paper. The effects of a shock on the labor market, whether stemming from new legislation or economic cycles, ultimately depend on the interaction between various labor market agents and the underlying forces at play. These effects can manifest in different ways, as highlighted by the literature's "top-down" and "bottom-up" perspectives (Ram et al., 2001):

The "top-down" perspective refers to the fact that a shock could increase or reduce labor costs directly (wage increase) or indirectly (bureaucracy and procedural requirements), which could generate a series of adverse effects such as the reduction of jobs, repositioning of the firm to a less affected region, or in the worst case, the cessation of activities. In contrast, the "bottom-up" perspective focuses on changes in employee bargaining power, which may shift in response to labor market rigidities or other shocks. For this reason, this research analyzes the consequences of compulsory social security affiliation on employment in an economic crisis. We consider a two-sector framework (formal and informal) and apply a difference-in-difference model. The theoretical framework builds on the work by Jales & Yu (2020) which models the decision-making processes of firms and employees through a bargaining framework. In addition, several scenarios could be better adapted to the Ecuadorian economy. The rest of the paper is organized as follows: Section 2 presents a comprehensive literature review, focusing on labor market dynamics during economic crises, particularly informality, gender disparities, and youth unemployment. Section 3 outlines the theoretical framework underpinning the econometric model. Section 4 details the data utilized in the analysis, while Section 5 explains the methodology. Section 6 presents and discusses the results, and Section 7 concludes with key insights and policy implications.

Literature Review

The literature on labor market responses to economic crises has grown significantly, especially in light of recurring global economic shocks. However, informality remains underexplored mainly, particularly in traditionally industrialized countries where it occupies a marginal place in labor market studies (Colombo, Menna, & Tirelli, 2019). Informal workers, who often hold the least skilled jobs and

receive the lowest wages, face heightened vulnerability during crises due to their lack of protections, such as access to social security or health insurance (Kesar et al., 2021; Ulyssea, 2010). Understanding informality as the result of the labor market structure, which naturally produces it (Bosch & Esteban-Pretel, 2015; Meghir, Narita, & Robin, 2015), unemployment in the informal sector necessarily reacts to economic crises. In the face of a shock to the system, economic activity is relocated between the formal and informal sectors (Colombo, Onnis, & Tirelli, 2016). In Latin America, informality is widespread, affecting approximately 158 million workers, or 54% of the workforce (2022). Despite its extraordinary volume, the analyses of informality in the framework of the labor market are still limited in terms of quantity, which would be related to an understanding of economic theory from the Anglo-Saxon model, where informality is recognised as a marginal phenomenon (Olarte, Torrent, & Aguirre, 2024).

Latin America's labor market sees rising unemployment during crises, heavily impacting informal workers (Alaimo et al., 2015; Bosch & Maloney, 2008). Informal workers lost 80% of their income in the region during COVID-19, compared to a 60% global average (ILO, 2020). Studies confirm this trend: informal workers suffer most in Brazil and face slower recovery (Razafindrakoto, Roubaud, & Saludjian, 2023). In Mexico, unemployment among informal workers rises structurally in crises (Moreno & Cuellar, 2021). Women in Colombia's informal sector are hardest hit (García et al., 2024), while in Argentina, young informal workers face the highest unemployment (Albertini, Poirier, & Sopraseuth, 2019). There are many reasons why a crisis particularly hard hits the employment of informal workers. The predisposition to be affected by an economic crisis is, however, high because there is no labor legislation protecting them against dismissal, which makes firing them particularly attractive for the employer, since he does not have to make any disbursement (Phillips, 2011). Informal workers tend to have less access to education and job training, which translates into lower qualifications. The lack of stability and training impedes their professional development, keeping them in low-skilled jobs and reducing their ability to adapt to changes in the labor market (McFarlane, 2012). Many informal workers perform low-skilled jobs, such as in agriculture, street commerce or manufacturing, which are susceptible to replacement by automated technologies. The lack of specialization and access to training limits their ability to adapt to the labor market, which increases their vulnerability, given that such jobs are the first to be replaced by machinery, thus exacerbating their precariousness and economic exclusion (Ulyssea, 2020).

Attending to the reasons linked to labour supply that are not related to human capital, age plays a fundamental role in explaining the number of people affected by unemployment in periods of crisis. When considering different crises, empirical evidence from global studies concludes that youth unemployment rates are more sensitive to the economic cycle than adults (Goldin et al., 2015; ILO, 2024; OECD, 2022). The literature on the youth-adult unemployment gap during crises is extensive in industrialized countries. Notable studies focus on the Great Recession's effects across multiple countries and regions. Arpaia & Curci (2010) find that young people are the most affected in employment, wages, and working conditions. Choudhry, Marelli, & Signorelli (2012) highlight that young people, especially young men, are the most likely to be unemployed during economic downturns. Choudhry et al. (2012) emphasize that the least qualified youth suffer the most. Similarly, Bell & Blanchflower (2009) show that young people, particularly those economically and socially vulnerable, have the lowest chances of employment during and after crises.

The gap between youth and adult unemployment is particularly accentuated in crises in low-income countries. Despite this, the literature on traditionally non-industrialized countries, particularly Latin America, needs to be expanded (Apunyo et al., 2022; Barford, Coutts, & Sahai, 2021; Yeung & Yang, 2020). In Mexico and Central America, Caceres & Salvador (2021) concludes that the youngest, especially the youngest men, are the most affected by the crisis. In Colombia, Ortiz & Cummins (2012) report in their results that not only young people are the most affected, but especially those with less education. The work in Chile by Rodríguez-Puello, Chávez, & Trujillo (2022) concludes that not only during a crisis are young people the most affected, but they are also the most affected when the crisis ends. According to Bendit & Miranda (2015), in Argentina during the crises, the youngest are the most affected and those in economic and social vulnerability. The literature about the crisis effect on Ecuador's labour market is limited. Tulcanaza-Prieto, Báez Salazar, & Aguilar-Rodríguez (2023) study unemployment characteristics in Ecuador and conclude that being young increases the probability of being unemployed.

Youth unemployment is especially impacted by crises due to limited work experience, job search capacity, and financial resources, making young people more vulnerable to labor market marginalization. As a result, they are more likely to face unemployment or insecure contracts during crises (Kalleberg, 2020). In crises, young people are more likely to drop out of school because their families can no longer finance them, and young people must enter the labour market as soon as possible to support the family economy (Calero, Murillo Huertas, & Raymond, 2016). As a result, young people reduce the possibility of finding more qualified employment, and therefore, they can adapt to the different demands in the labour market (Caliendo & Schmidl, 2016). During crises, temporary labor contracts increase, and young people are more likely to secure such contracts, raising the risk of unemployment when they end or being dismissed due to lenient termination conditions for employers (Quintini & Martin, 2006). Labor-intensive jobs, often occupied by younger workers and producing goods less likely to be exported, are particularly affected during national crises. Reduced demand for locally consumed goods and services leads to declining demand for young workers in these sectors (O'higgins, 2012).

The rise in youth unemployment during crises may be linked to a mismatch between the skills gained through formal education and those demanded by the labor market. Crises follow periods of prosperity, during which the need for higher education becomes apparent, based on labor market requirements (Caroleo et al., 2017). During a crisis, a "discouragement effect" arises among younger people, reducing their efforts to seek employment (Van Ham, Mulder, & Hooimeijer, 2001). Witnessing the difficulty of finding work and the increased risk of losing jobs, young workers become discouraged. Skilled young workers, following a period of prosperity, may extend their studies in hopes of securing quality jobs (Perugini & Signorelli, 2007). In contrast, unskilled young workers are more likely to stop studying or work altogether (Bruno, Marelli, & Signorelli, 2014). Finally, the gap between youth and adult unemployment in crisis periods would be related to a lower quality of the related institutionality. The OECD (2021) found that almost two-thirds of non-cyclical unemployment changes over two decades can be explained by changes in policies and institutions. Young people are a group with a limited capacity

to influence the political class, so policies aimed at alleviating the effects of the crisis on young people are minimal (Arnold et al., 2022). Women's labour market participation is lower than men's. The gap is particularly pronounced in low-income countries (Winkler, 2022). The gap between men's and women's labour market participation is accentuated in downturns (Valentina, Umberto, & Emanuela, 2019). In crises, women are the first to lose their jobs (Gezici & Ozay, 2020; Verick, 2009), with young women being the most affected by a fall in economic activity (Arévalo-Sánchez et al., 2024) and those with informal employment (OECD., 2019).

Theoretical Framework

Our theoretical framework is based on a Roy-Rosen bargain model between firms and workers. We use a structure closely following Jales & Yu (2020) research on dual labor markets. In such economies, we have two rational agents: workers (labor supply) and firms (labor demand), each with a utility function to be maximized. The workers' utility function is given by$U(l,s,w) = l \cdot (w - \epsilon + \eta_s)$, where w is the wage, ϵ is the opportunity cost or disutility of work, η_s are the amenities (or convenience) of sector $s \in \{1,0\}$ where 1 represents the formal and 0 the informal sector. In this case, the worker would decide to work ($l = 1$) if the utility he can obtain from work is greater than 0, i.e., $l = 1 if w - \epsilon + \eta_s > 0$. Similarly, firms have an analogous utility function $\Pi(l,s,w) = l \cdot (\alpha - w - \tau_s)$, where α is the worker's productivity, w is the wage, and τ_s are the costs associated with each sector (e.g., taxes or minimum wages for the formal sector, potential fines or bribes for the informal sector). As in the worker's case, firms will only hire if the utility obtained from a contract is greater than 0, i.e., $l = 1 if \alpha - w - \tau_s > 0$.

It is essential to consider that the sector-specific costs (τ_s) can also include risks associated with hiring in specific demographics, each contract can have different costs. For example, in Ecuador, formal employees are entitled to compensation in the event of untimely dismissal; this compensation is based on the worker's seniority; this will imply that younger workers are more accessible to fire if a firm is forced to reduce its personnel. Therefore, we will expect a higher disemployment effect in the youngest portion of the population. Similarly, gender-specific costs in the formal sector could play an essential role in the model's outcome. This may be because legal female workers are granted a more excellent parental leave than their male counterparts, generating the perception that a female hire would imply a more significant cost. This will only be true in the formal sector. Assuming the bargaining power is equally allocated between firms and workers, the contract process can be characterized by a Nash bargaining game where agents can negotiate the employment sector and wage. Formally, the optimization problem can be represented in the following equation:

$$(w,s) = \underset{(w,s)}{argmax}$$

In such scenario, the Nash bargaining solutions are: $s^* = 1\{\eta_1 - \eta_0 > \tau_1 - \tau_0\}$, and $w^* = 0.5(\alpha + \epsilon - \tau_s - \eta_s)$, meaning that a contract, or agreement between worker and firm, would be formal if the differential amenities (or convenience) between sectors are greater than the differential of costs associated with the same sectors. Or seen in another way, the contract will be formal if the firm can obtain a higher relative profit than the one gained in the informal sector, that is if $\tau_1 - \eta_1 < \tau_0 - \eta_0$. Likewise, contracts would prefer employment if the utility generated the contract is greater than 0 for both parties (i.e., $l^* = 1 \Leftrightarrow min\{U(1,s^*,w^*), \Pi(1,s^*,w^*) > 0)$, otherwise workers/firms would prefer unemployment. Once the bargaining process is completed, we can further classify each sector into two categories. Following Jales & Yu (2020) taxonomy, informal contracts can be divided into the Survival and Parasite sub-sectors and formal into types I and II.

Survival is contracts that cannot obtain a positive surplus from the formal sector. Therefore, they only operate in the informal sector. If the cost of running informally is increased, for example, via a greater labor law enforcement (high tau sub-0), these contracts would most likely not survive and, therefore, choose unemployment. Conversely, parasite contracts could absorb the enforcement costs, move to the formal sector, and still have a positive surplus. The term "parasite" refers to the fact that these contracts could be legal. However, the incentives to remain informal are more significant. However, the incentives to stay informal are more meaningful, and consequently, they are willing to operate outside the law for the additional surplus. Equivalently, type I formal contracts are less likely to absorb changes in costs associated with the legal sector and would be unable to operate informally because of the high risk associated with informality. If changes in the costs associated with formality are elevated, for example, a significant increase in minimum wages (high τ_1), type I contracts are more likely to choose unemployment. Type II formal contracts, on the other hand, would still be able to obtain a positive surplus in the informal sector. Thus, these contracts will become informal. To further understand the categorization described above, a simulation can be built using random Gaussian draws for each exogenous parameter ($\alpha, \epsilon, \eta_s, \tau_s$) and applying the bargaining model to each observation. Figure 1 show a baseline simulation with 5000 observations. In this scenario, every exogenous parameter follows the same random distribution $N(1,1)$, the three main groups (formal, informal, unemployed) are balanced, each with approximately 33% of the observations. Furthermore, the formal and informal sectors are divided into equally balanced sub-sectors, each with about 16.5% of the observations.

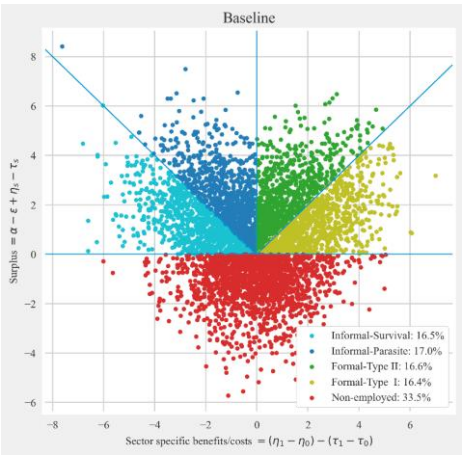

Figure 1: Baseline Simulation.
Source: Authors' own elaboration based on Jales & Yu (2020) methodology. Data contains 5000 simulated contracts using Gaussian draws for each parameter.

Changes in employment.

Further developing the model simulation, we can construct diverse scenarios by changing the exogenous parameters. One especially relevant scenario for this research arises

when the worker's (alpha) productivity changes. We build a low-productivity (high-productivity) scenario by adding (subtracting) a factor of 2 to the meaning of the parameter of interest. In this case α^{LP}~$N(-1,1)$and α^{HP}~$N(3,1)$; all other parameters remain the same as the baseline simulation. Figure 2 (A) shows that in a low-productivity scenario, the probability of unemployment (74.2%) is higher than the baseline scenario. Moreover, relative to each sector, the proportion of informal-parasite and formal-type I contracts increases. This, in turn, implies that increases in labor market rigidities (tau sub s) would have a greater probability of causing unemployment because a more significant proportion of the simulated contracts would not be able to absorb the cost associated with more significant labor market rigidities. The opposite is valid for a high-productivity scenario. As shown in Figure 2 (B), unemployment would be low, and most contracts would survive in the face of higher labor market rigidities (because most are informal-parasite and formal-type II).

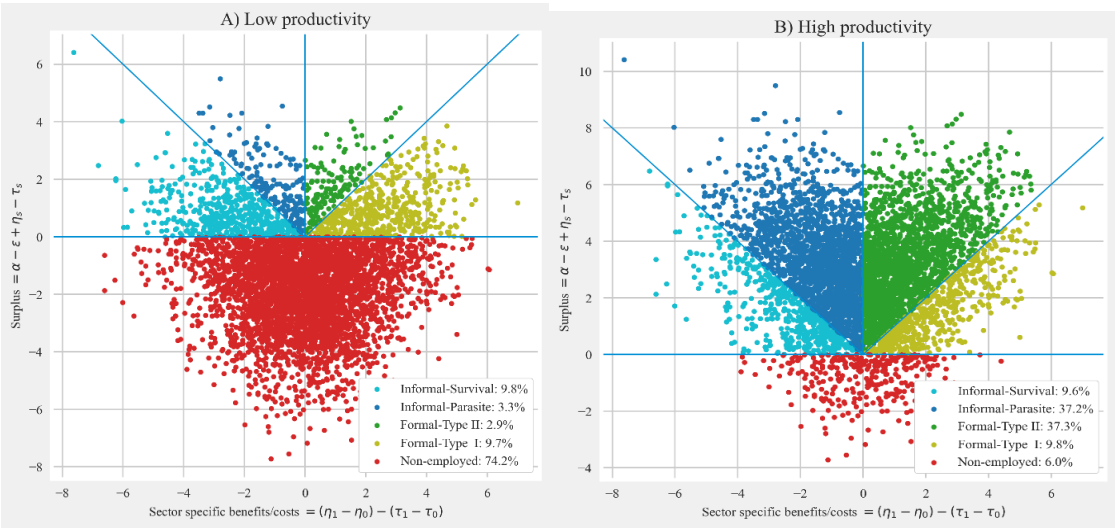

Figure 2: (A) Low-Productivity and (B) High-Productivity Simulation.
Source: Authors' elaboration. Data contains 5000 simulated contracts using Gaussian draws for each parameter.

Finally, two additional relevant scenarios can be simulated from the previously modeled low-productivity economy. Figure 3 (A) shows a low enforcement scenario. For this simulation, a factor of 2 is subtracted from the mean cost associated with the informal sector, i.e., τ_0~$N(-1,1)$. The high enforcement scenario shown in Figure 3 (B) adds the same factor, i.e., τ_0~$N(3,1)$.

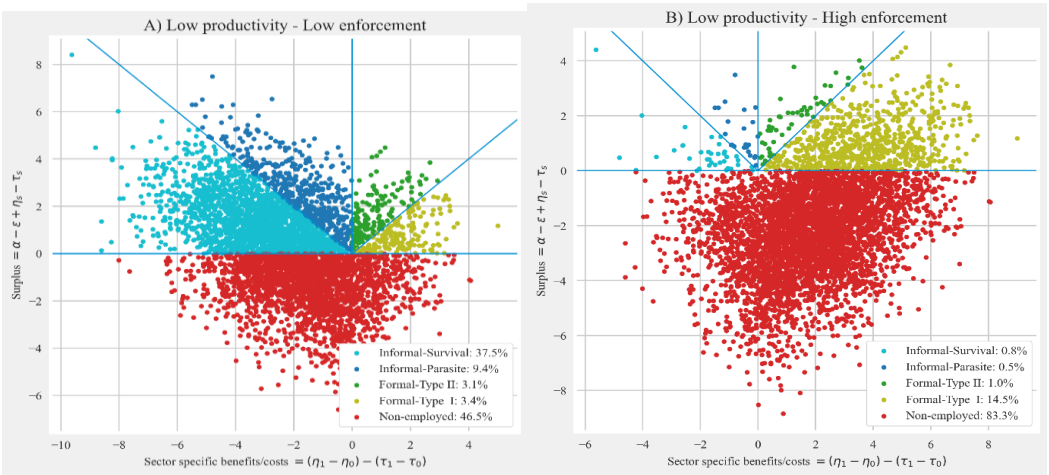

Figure 3: Low Productivity With (A) Low Enforcement and (B) High Enforcement Simulation.
Source: Authors' elaboration. Data contains 5000 simulated contracts using Gaussian draws for each parameter.

As we can see from Figure 3 (B), increasing enforcement in a low-productivity economy would have a positive and highly disproportionate disemployment effect. This happens because, in a low-productivity scenario, most of the informal contracts would be the survival type. Therefore, this increases the probability that firms/workers choose unemployment because they cannot afford the costs associated with the formal sector. Considering that an economic crisis affects the formal and informal labor market in different ways, and based on the theoretical framework, four measurable hypotheses can be obtained: (1) compulsory affiliation generates a disemployment effect since companies, unable to adjust wages, will choose to reduce their labor force. (2) The youngest portion of the workforce will be more affected by the disemployment effect caused by the compulsory affiliation. This is because this specific demographic is likely to be less productive and have lower dismissal costs. (3) Gender-specific costs can be essential in the unemployment decision. Female contracts would be perceived as having a higher cost of formality. Therefore, females will be more impacted by unemployment. Finally, the unemployment effect will be more significant in low-productivity firms because they cannot absorb shocks. This hypothesis reflects that productivity and individual-specific costs are critical factors in determining the outcome of higher labor market rigidities.

Data and Descriptive Statistics of Social Security

Data

We use two panel datasets derived from four rounds of the Ecuadorian National Survey of Employment, Unemployment, and Underemployment (ENEMDU, by its Spanish acronym). The Instituto Nacional de Estadística y Censos (INEC) is responsible for conducting the ENEMDU, which is carried out quarterly in urban areas using a rotating sampling strategy. Under this design, 25% of the surveyed households are interviewed during two consecutive quarters, take a break for the next two quarters, and are interviewed again during the final two quarters (INEC, 2018). The entire sample is refreshed every two years. The first panel covers the commodity price boom period and includes observations from December 2013 and December 2014. The second panel corresponds to the commodity price bust period, comprising data from December 2015 and December 2016. In both datasets, the sample is restricted to the economically active population. To ensure data accuracy, workers with earnings in the bottom 1% and top 1% of the income distribution were excluded, as these values are likely to represent erroneous information and outliers.

Descriptive Statistics of Social Security in Ecuador

Ecuador has two major labor market rigidities: (1) National Minimum Wage (NMW or SBU in Spanish). (2) Compulsory affiliation to social security for all salaried workers. This section describes each rigidity and its implications for the research. First, the NMW, according to the constitution of Ecuador, is a labor guarantee whose objective is to secure a fair remuneration that covers at least the basic needs of the worker and their familyi. The government is responsible for enforcing its general and mandatory application and, annually, reviewing and fixing the value of the NMW. In practice, a tripartite council represented by employers, government officials, and workers from different economic sectors negotiates the increase of the NMW at the end of each year. If no agreement is reached, the Ministry of Labor will be in charge of setting a new wage, which will become effective for the following yearii. After selecting the new NMW, representatives of different industries form sectorial minimum wages (SMW), which may be equal to the NMW. On average, SMW is almost always fixed at less than 3% above the NMW, meaning no significant difference exists among sectors. Thus, the NMW is a better characterization of the labor market. As shown in Table 1, since 2007, the NMW has increased substantially, even surpassing inflation and economic growth, suggesting that the goal of the NMW policy was to promote better wages for the bottom earners and not only to maintain the purchasing power of the lowest wages.

[i] Ecuadorian Constitution, Art. 328

[ii] Labor code, Art. 81

Table 1: Evolution of the National Minimum Wage, 2007-2018.

Year	CPI	NMW		NMW Growth		Inflation	Real GDP Growth
	(2014=100)	(Current USD)	(Constant USD)	(Current USD)	(Constant USD)		
2007	73.40	170.00	231.61	6.25%	2.83%	3.32%	2.20%
2008	79.88	200.00	250.38	17.65%	8.10%	8.83%	6.40%
2009	83.32	218.00	261.64	9.00%	4.50%	4.31%	0.60%
2010	86.09	240.00	278.78	10.09%	6.55%	3.32%	3.50%
2011	90.75	264.00	290.91	10.00%	4.35%	5.41%	7.90%
2012	94.53	292.00	308.90	10.61%	6.18%	4.17%	5.60%
2013	97.08	318.00	327.56	8.90%	6.04%	2.70%	4.90%
2014	100.00	340.00	340.00	6.92%	3.80%	3.01%	3.80%
2015	104.05	354.00	340.22	4.12%	0.07%	4.05%	0.10%
2016	105.21	366.00	347.88	3.39%	2.25%	1.11%	-1.20%
2017	105.00	375.00	357.14	2.46%	2.66%	-0.20%	2.40%
2018	105.28	386.00	366.64	2.93%	2.66%	0.27%	1.30%

Source: Own elaboration using data from Ecuadorian Central Bank.

Although the NMW corresponds to the monthly compensation for full-time employees, the Labor Code allows the hiring of part-time employees as long as their remuneration is not less than the corresponding fraction of the minimum wageiii. To determine the appropriate minimum wage for part-time workers, employers divide the agreed weekly working hours by 40 (legal full-time working hours) multiplied by 4.35 average weeks per month. This scenario implies that, even if a worker's monthly earnings are less than NMW, they could still legally receive the corresponding hourly minimum wage; hence, the rest of this research will use hourly wages. In this sense, the NMW can be used as a reference point depicting the worker's working conditions. To capture structural differences in the labor force concerning their level of income, the sample was divided into five groups according to their location relative to the minimum wage: those earning less than 50% of the MW, those earning between 50% and 90% will be named as "below", between 90% and 110% called "at", between 110% and 200% "above", and more than 200%. Appendix 1 shows the kernel density estimation of hourly earnings and the cutoffs that divide the sample into the five groups mentioned above; two things can be highlighted from the income distribution. First, spikes at the NWM show that this policy is somehow binding, meaning that wages tend to adjust to the annual changes made by the Ministry of Labor. Second, even though the minimum wage is mandatory, there is a high level of non-compliance; in 2013, 42% of the population earned below the NMW, and by 2015, this figure decreased to 35%. This disparity, however, does not affect the whole workforce equally. As shown in Table 2, among the most affected workers are private and day labor workers, who, by law, should be covered by the minimum wage legislation. For this reason, this research will focus specifically on these two groups of workers that will be called private workers from now on.

[iii] Labor code. Article 82

Table 2: Location Relative to the NMW, Percentage, 2013 And 2015.

	Government worker	Private worker	Day laborer	Self-employed	Total
		NWM compliance 2013			
< 0.5*NMW	0.22	5.24	15.09	30.77	16.29
Below	1.54	24.01	43.66	27.66	25.67
At	3.47	19.68	17.31	9.30	13.61
Above	33.65	34.01	18.59	17.18	25.30
>= 2*NMW	61.11	17.07	5.34	15.10	19.13
		NWM compliance 2015			
< 0.5*NMW	0.19	4.77	13.73	27.88	14.49
Below	0.59	16.84	41.83	23.76	20.89
At	2.84	19.47	19.31	8.26	13.31
Above	30.78	39.57	20.72	18.27	27.99
>= 2*NMW	65.61	19.36	4.41	21.83	23.33

Source: Own elaboration using data from ENEMDU.

Much like the NMW, social security affiliation is mandatory for all employees. Every worker who receives income for providing a physical or intellectual service, with or without an employment relationship, is required to be affiliated to the Social Security. From the first day of employment, employers must register new workers with the Ecuadorian Social Security Instituteiv (IESS for the Spanish acronym). In case of non-compliance, employers will be charged with evasion of social security contributions and sanctioned accordingly. Among the private sector, the cost of this compulsory insurance is divided in two parts: first, 9.45% is considered a personal contribution, thus the employee must pay this percentage of his wage. Second, 11.45 % is the employer's contribution. The employer is responsible for collecting, paying and reporting both contributions to IESS and this institution cross-validates the amounts with the salary registered in the Ministry of Labor. Despite the mandatory nature of social security affiliation and the severity of the punishment for failing to comply, there is a significant percentage of non-compliance. As shown in Table 3, the proportion of non-affiliated workers is especially high in those earning below the hourly NWM; as we move upward in wages, the proportion diminishes.

[iv] Labor code, Art. 42

Table 3: Social Security Compliance for Private and Day-Labor Workers by NMW Location, 2013 And 2015.

	2013		2015	
	non-affiliated	affiliated	non-affiliated	affiliated
< 0.5*NMW	93.87	6.13	95.62	4.38
Below	78.65	21.35	80.96	19.04
At	47.44	52.56	48.47	51.53
Above	34.10	65.90	29.17	70.83
>= 2*NMW	22.08	77.92	16.52	83.48

Source: Own elaboration using data from ENEMDU.

Table 4: Sample Summary Statistics.

		Panel 2013-2014			Panel 2015-2016		
		Non-Affiliated	Affiliated	Total	Non-Affiliated	Affiliated	Total
Real hourly earnings	Mean	1.866	1.909	1.888	1.916	1.983	1.950
	(SD)	(0.092)	(0.106)	(0.102)	(0.113)	(0.101)	(0.112)
Remain employed	Mean	0.877	0.923	0.901	0.901	0.917	0.909
	(SD)	(0.328)	(0.267)	(0.299)	(0.298)	(0.276)	(0.287)
Age	Mean	37.678	36.711	37.182	36.020	35.738	35.876
	(SD)	(13.461)	(12.728)	(13.099)	(12.973)	(11.771)	(12.374)
Years of education	Mean	8.156	10.015	9.109	8.077	9.850	8.984
	(SD)	(3.843)	(3.817)	(3.941)	(3.721)	(3.878)	(3.904)
Female	Mean	0.251	0.374	0.314	0.242	0.368	0.307
	(SD)	(0.433)	(0.484)	(0.464)	(0.429)	(0.482)	(0.461)
Rural	Mean	0.324	0.172	0.246	0.387	0.197	0.290
	(SD)	(0.468)	(0.377)	(0.431)	(0.487)	(0.397)	(0.454)
Indigenous-Afro.	Mean	0.172	0.115	0.143	0.190	0.117	0.153
	(SD)	(0.377)	(0.319)	(0.350)	(0.392)	(0.322)	(0.360)
N		633	512	1145	1486	1166	2652

Source: Own calculations from ENEMDU panel data sets.
Note: Statistics calculated using baseline survey and population weights (factor de expansión).

Wages and social security enrollment rates are highly heterogeneous for different employment categories. For instance, government workers are almost fully affiliated with IESS and compliant with the NMW while the opposite is true for own account workers. This occurs because labor law is enforced to different degrees on each of the groups. The same is true for different locations in the income distribution: the higher the income, the more likely it is for a worker to be affiliated with social security. This heterogeneity poses a problem for the estimation because an economic crisis would affect differently each worker depending on the status of his employment and his location in the income distribution. To solve this problem, we restrict our data to the sample of private and day labor workers whose income is at NMW. For this sample, characteristics among the groups are balanced (Table 4), thus eliminating possible confounding sources.

Methodology

Identification Strategy

The identification strategy relies on the exogeneity of the crude oil price shocks, which provides an opportunity to compare labor market outcomes, before and after the commodity bust of 2015-2016, among different types of workers based on their social security affiliation status. Our identification strategy relies on the fact that timing in the variation of crude oil prices is plausibly exogenous and that this external shock affects the working population in different ways. Salaried formal workers who remain affiliated would continue to perceive a similar or higher salary due to the firm's inability to adjust wages downward. However, the impossibility of adjusting wages to a recession may hinder the firm's ability to maintain the same number of employees. Unaffiliated or informal workers may be able to adjust wages and maintain the same level of employment. The external shock we use occurred in January 2015, when crude oil prices plunged by more than 50% compared to the previous year. Since the late 1970s oil export became a major source of income for the Ecuadorian economy. By 2017, the aggregated value of the oil sector averaged at 11.7% of GDP, and the contribution of crude oil exports to the general state budget averaged 19.84% of GDP. Consequently, the slump in crude oil prices triggered an economic crisis, commonly referred to as a commodity bust period (Sinnott, Nash, & De la Torre, 2010). We estimate the possible cost and benefits (in terms of wages and employment) of enrolling in social security, in the face of an economic crisis, using the following difference-in-differences model:

$$Y_{it} = \alpha + \delta_1 Crisis_t + \delta_1 IESS_i + \beta_1 (Crisis_t * IESS_i) + X_{it}\gamma + \varepsilon_{it}$$

where Y_{it} is the outcome of interest for individual i in period t. $Crisis_t$ is a dummy variable equal to 1 for the commodity bust period: 2015-2016. $IESS_i$ = 1 if the worker is affiliated with social security in the baseline survey (treated group) and 0 otherwise. Finally, two specifications of the model are estimated, one with only the treatment and post crisis variables and one with X_{it}, a matrix of control variables reported at the baseline survey; covariates include: age of the worker (in years), years of schooling, gender (1 if female), dummy for self-identified ethnicity (1 if is the respondent is indigenous or Afro-Ecuadorian, 0 otherwise), and industry. The coefficient of interest β_1 could be interpreted as the protection effect of being affiliated to IESS in an economic crisis environment. Because affiliated employees are required to earn at least the NMW, we could expect that the earnings of those affiliated are less vulnerable to macroeconomic shocks such as the commodity crisis of 2015-2016 compared to those who were not covered by social security.

Results

Table 5 shows the main results of our difference-in-differences model. First, we compute manually each individual mean and standard error of the affiliated and non-affiliated in both periods (commodity boom and bust). Then we estimate the difference for each period and then the difference of differences between periods.

Table 5: Manual Difference-In-Differences for Probability of Remaining Employed.

	Total sample		Males		Females		Old (25+)		Young (15-24)		<=10 emp		>10 emp	
	Obs.	Remain employed	Obs.	Remain employed	Obs.	Remain employed	Obs.	Remain employed	Obs.	Remain employed	Obs.	Remain employed	Obs.	Remain employed
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(12)	(14)
Panel 2013-2014 (commodity boom period)														
Affiliated	512	0.923	325	0.952	187	0.874	418	0.937	94	0.863	164	0.893	348	0.935
		(0.267)		(0.214)		(0.332)		(0.242)		(0.344)		(0.310)		(0.246)
Non-Affiliated	633	0.877	490	0.941	143	0.687	496	0.898	137	0.796	506	0.866	127	0.917
		(0.328)		(0.236)		(0.464)		(0.303)		(0.403)		(0.341)		(0.275)
Difference		0.046		0.011		0.187		0.040		0.067		0.027		0.018
		(0.001)		(0.001)		(0.002)		(0.001)		(0.002)		(0.001)		(0.001)
Panel 2015-2016 (commodity bust period)														
Affiliated	1166	0.917	714	0.937	452	0.884	961	0.943	205	0.820	432	0.897	734	0.927
		(0.276)		(0.244)		(0.320)		(0.233)		(0.384)		(0.303)		(0.259)
Non-Affiliated	1486	0.901	1139	0.934	347	0.799	1120	0.908	366	0.881	1237	0.901	249	0.902
		(0.298)		(0.248)		(0.401)		(0.289)		(0.324)		(0.299)		(0.297)
Difference		0.016		0.002		0.085		0.035		-0.061		-0.003		0.025
		(0.001)		(0.001)		(0.002)		(0.001)		(0.002)		(0.001)		(0.001)
Diff. in Diff		-0.030***		-0.009***		-0.102**		-0.005***		-0.128***		-0.030***		0.007***
		(0.001)		(0.001)		(0.003)		(0.001)		(0.003)		(0.002)		(0.002)

Source: Own calculations from ENEMDU panel data sets.
Note: Standard errors are in parentheses. The sample was restricted to private and day-laborer workers.

Column 2 of Table 5 shows the difference-in-differences estimate for all private and day labor workers whose income is at the NMW. The result suggests that being affiliated with the social security decreases the probability of remaining employed by 3%, compared with non-affiliated workers. Compliance with the minimum wage is required to be affiliated; thus, in a crisis, firms are unable to adjust salaries below the minimum wage, and therefore, the only option will be to reduce the workforce. This disemployment effect may not be homogeneous among different demographic groups. While the estimate for males shows a minimal disemployment effect of less than 1%, the effect for females is 10.2% (see Table 5 columns 4 and 6). This enormous difference suggests that, in the formal sector, women are almost ten times more likely to lose their jobs than men. This evidence highlights hidden gender-specific costs perceived by the firm and confirms the second hypothesis.

As predicted by the theoretical framework, young workers have a higher chance of losing their jobs (12.8%) than older workers (0.5%). Two plausible explanations may be responsible for this finding: first, younger workers are seen as less productive, increasing the probability of disemployment for this demographic. Second, the costs associated with letting go of young workers are usually lower because severance payments are based on seniority. Finally, comparing the difference-in-differences estimates by firm's size reveals that the disemployment effect derives exclusively from firms with less than ten employees. Smaller firms tend to have lower productivity, primarily due to a lack of economies of scale, and are more sensitive to macroeconomic shocks. These results align with the simulations from the theoretical framework and the fourth stated hypothesis.

Conclusions

This research investigates how the Ecuadorian labor market responds to economic crises, focusing on the gender gap and the vulnerability of young workers under compulsory social security affiliation. The findings highlight critical structural challenges that require targeted interventions to foster a more equitable labor market. A key result is the pronounced gender disparity in employment outcomes during economic crises. The "hidden costs" of hiring female workers, such as extended parental leave and perceived family care responsibilities, create structural barriers that reduce the likelihood of women retaining their jobs. These disparities reflect the differential costs firms associate with hiring women, which align with the theoretical framework discussed in this study. Specifically, the model's parameters suggest that higher costs for female workers in the formal sector contribute to the gender gap in employment levels. Additionally, measures such as subsidized childcare, parental leave sharing policies, and incentives for firms to hire and retain women could mitigate these disparities. Such reforms, the labor market will continue to reinforce inequalities that exacerbate women's vulnerability during economic crises.

Another significant finding is the increased vulnerability of young workers to unemployment in times of economic crisis. This group is particularly affected due to its lower productivity compared to older, more experienced workers. The theoretical model and supporting simulations show that lower productivity contracts are more likely to become unsustainable during economic downturns, leading to higher job losses among younger employees. While compulsory social security affiliation can improve working conditions and wages for young workers, it may also render formal employment unsustainable for this demographic under the crisis conditions examined. This duality underscores the need for tailored interventions to create pathways to sustainable formal employment for young workers, further enhancing their productivity and making them more resilient to labor market shocks. The study also emphasizes the critical role of productivity in shaping labor market outcomes during crises. Small firms, which dominate Ecuador's traditional sector, often lack the financial and managerial capacity to absorb the costs of macroeconomic shocks. Consequently, these firms are more likely to reduce their workforce or resort to informal employment practices during economic contraction.

These findings align with the theoretical framework developed for this study, suggesting the interplay between labor market rigidities, productivity, and demographic disparities. The gender gap in employment reflects the additional costs associated with hiring women in the formal sector, while the vulnerability of young workers is tied to their lower productivity. The simulations conducted reinforce these conclusions, showing that higher productivity contracts are more likely to survive during crises, while lower productivity firms and workers are disproportionately affected. This research makes several contributions to the understanding of labor market dynamics in developing economies. It provides empirical evidence of how gender and age intersect with formal-informal sector dynamics during economic crises, offering insights for policymakers to design targeted interventions. However, the study also has limitations. The use of survey data may not fully capture the heterogeneity of the informal sector, and the relatively short panel periods restrict the analysis of long-term impacts. Future research could address these gaps by conducting longitudinal studies, exploring sector-specific dynamics, and undertaking comparative analyses across countries with similar economic structures. Finally, this study highlights the importance of addressing structural disparities in labor markets while enhancing overall productivity. Policymakers should prioritize comprehensive labor reforms that promote gender equality, support young workers, and strengthen small enterprises. By doing so, they can mitigate the adverse effects of economic crises, ensuring a more inclusive and resilient labor market in Ecuador and similar developing economies.

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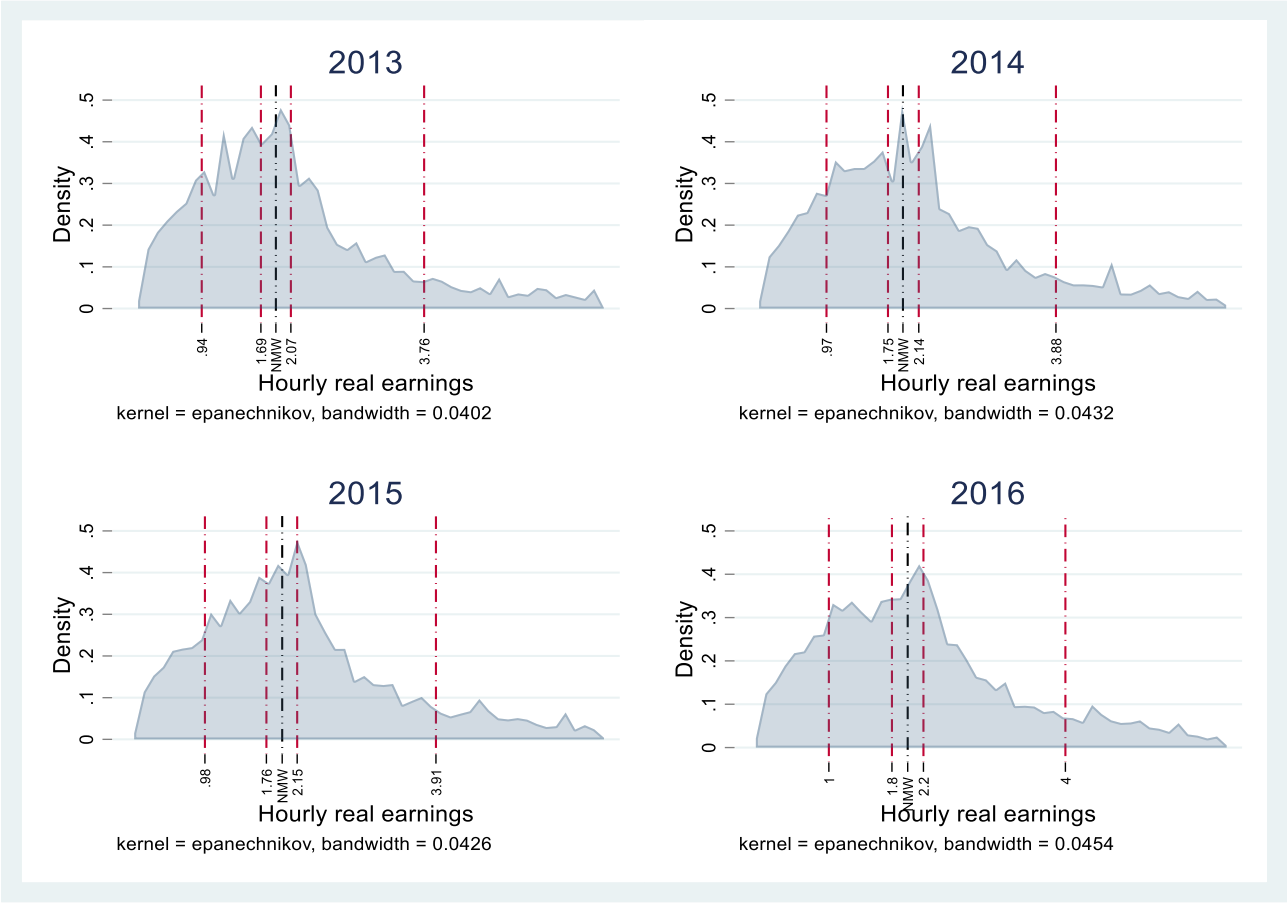
Appendix

Appendix 1

Kernel density estimation of hourly actual earnings and location concerning NMW



Source: Own elaboration using data from ENEMDU, bandwidth according to Silverman rule.
Notes: Red vertical lines correspond to 50%, 90%, 110%, and 200% of the NMW.