

ESSAYS ON INFORMAL LABOR MARKETS IN DEVELOPING COUNTRIES

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Economics - Doctor of Philosophy

2018

ABSTRACT

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This paper studies the informal labor markets of Colombia and Paraguay. Colombia has been found to show a significant reduction in informal employment due to the reduction in payroll taxes. Conversely, Paraguay shows highly isolated informal/formal labor markets with few factors improving movements between these.

Chapter 1 evaluates how the drastic reduction in payroll taxes in 2012 reduced informality in Colombia. By the end of 2012 the Colombian government implemented a tax reform that, among other things, substantially reduced payroll taxes. I evaluate the effect of this reform on informality both theoretically and empirically.

Theoretically, I develop a labor market model incorporating the changes introduced by the reform. As the reduction in payroll taxes was accompanied by a change in social transfers' funding, which led to uncertain changes in profits and social benefits, straightforward predictions on informality are not possible.

Empirically, I obtain difference-in-difference (DID) estimates from two household surveys—one composed by many repeated cross sections across many years and the other a much shorter panel dataset. Estimates from the repeated cross sections data indicate small, short-term effects and large long-term effects. Industry was the first sector to enjoy a reduction in informality, followed by services and agriculture. For workers earning around one minimum wage, I find large point estimates. Estimates from the household survey panel data are in line with these results.

Chapter 2 characterizes informal-formal employment transitions in Paraguay. Results indicate that some factors, such as education and firms size, improve workers' movement between informal and formal employment, and wage gains from moving into formality are modest. Workers who tend to stay indefinitely informal are more likely to become unemployed or inactive.

Estimates, based on a survival model, indicate that education and firm size highly increase informal-to-formal transitions, especially if workers have stayed informal for a long time. Older women have lower formal-to-informal transitions and, surprisingly, education plays no significant role. Mincer estimates point to high wages for formal workers, compared with informal, but that individual workers' wage gains from moving into formality are small.

ACKNOWLEDGMENTS

I would like to thank Todd Elder for his continuous guidance and help with this study. To Steven Haider, Scott Imberman, and Eduardo Nakasone for serving in my dissertation committee and their invaluable advice. I also want to thank Matias Busso, Andrés Escobar, Mónica Uribe, and Paula Herrera-Idárraga for their helpful comments on the different chapters of this dissertation. To Gabriel Piraquive for his assistance in obtaining access to the data used at the preliminary stages.

This work also benefitted from the helpful comments and valuable discussion with the participants of the APPAM DC student conference, participants of the Pontifical Xavierian University seminars, and participants of the Southern Economic Association conference.

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KEY TO ABBREVIATIONS

ECE *Encuesta Continua de Empleo*

ELCA *Encuesta Longitudinal de Colombiana de la Universidad de Los Andes*

GEIH *Gran Encuesta Integrada de Hogares*

pps percent points

AMEs Average Marginal Effects

OLS Ordinary Least Squares

Chapter 1: Payroll Taxes, Social Security and Informality. The 2012 Tax Reform in Colombia

1 Introduction

Informality is the collection of firms, workers, and activities that operate outside the legal and regulatory framework (De Soto, 1989). Informal workers are unable to obtain formal employment, which offers higher wages and social security. But informality can be attractive if social security is undervalued and the government provides different subsidies to workers and their families who are below the poverty line. Firms can also be informal to avoid burdensome regulations and excessive taxes by choosing a smaller scale of production with restricted access to credit (Perry et al., 2007). Because of these two perspectives, informality has been a persistent problem in Latin America. Around the year 2000, an average of 48% of wage workers held informal jobs, and 56% of all workers were employed in informal firms. By 2015, the corresponding figures were 40% and 51%—just an 8 and 5 percent point (pps) decrease in 15 years, respectively.¹

One of the main causes of informality is high taxes (Hirschman, 1970; De Soto, 1989; Lora & Fajardo-González, 2016). In Colombia, high payroll taxes, specifically, lead to informality (Clavijo et al., 2015; Merchán Álvarez, 2015; Fedesarrollo, 2014; Kugler & Kugler, 2009; Sánchez et al., 2009; Santa María, et al., 2009). In this context, would a reduction in payroll taxes lead to lesser informal employment? The Colombian tax reform of 2012 (from now on just *reform*) substantially

¹ Own calculations based on the Socio-Economic Database for Latin America and the Caribbean (CEDLAS and The World Bank). Updated July 2017. In informal firm, if (s)he is a worker in a small firm, a non-professional self-employed, or a zero-income worker. In informal job, if (s)he is a salaried worker without the right to a pension when retired.

reduced payroll taxes and provided an opportunity to answer this. I evaluate this reform's impact on informal employees both theoretically and empirically.

I develop a labor market model that incorporates the main elements of the reform. The model provides a framework in which to incorporate informality—defined as lack of social security—and evaluate how it is affected by taxes. The reform reduced payroll taxes, thereby decreasing the employers' relative cost of hiring formal workers. But the reform also partially replaced the funding of social transfers with taxes on profits, leading to uncertain changes in profits and social benefits. All these changes caused by the reform, taken in conjunction, lead to uncertain predictions of its effect on informal employment.

Empirically, I obtain difference-in-difference (DID) estimates from two household surveys with different data structures. The first one is composed by many repeated cross sections covering years 2008 to 2016. The second is a panel dataset that covers years 2010, 2013, and 2016 which, till now, has not been used to study the reform's effects.

Estimates from the repeated cross sections data indicate small, short-term effects and large long-term effects. Before-after DID point estimates are -1.1 pps for the period January to April 2013, -2.1 pps for the period May-December 2013, and -5.4 pps for the period January 2014 and after. Monthly DID point estimates rise from -5.6 in August 2013 to -9.4 pps in December 2016. When estimating the change in informality trend, total policy estimates are lower: from zero in May 2013 to -4.6 pps in December 2016. Industry sector enjoyed the reduction in informality first and was later followed by services and agriculture. I find larger point estimates for workers earning around one minimum wage (MW) than for all workers. Estimates from the household survey panel data are in line with these results.

This document is structured in seven parts, including this introduction. The following section includes a literature review divided into two parts—one on informality in labor market models and another on empirical studies on taxes and informality. The third section describes the social security system in Colombia. The fourth describes the reform. Sections five and six form the core of the study presenting the proposed labor market model and the econometric estimate results respectively. The last section concludes.

2 Literature review

Social protection and productivity are two concepts related to informality. Social protection refers to workers whose jobs do not comply with a part or all the legal requirements, tax obligations, labor contract and/or are deprived of certain labor rights like pensions or health insurance. Conversely, productivity focuses on workers in low-productivity, small-scale firms or family-based activities (Tornarolli et al., 2014). Economic models and empirical studies have been designed with these definitions in mind.

2.1 Modeling informality

Informal labor markets have traditionally been modeled as dualistic models since Lewis (1954). In these models, workers and firms pay taxes, contribute to social security, and/or comply with the MW only in the formal market. They are characterized by higher wages in the formal market and just some workers getting access to it. The classic model by Harris & Todaro (1970) includes urban and rural sectors, where the urban sector specializes in manufactures and the rural in agriculture; wages in the urban sector are fixed at the MW while wages in the rural are free. Rauch (1991) explicitly modeled the formal-informal size dualism, where exogenous MWs are only enforced in large firms and obtains formal and informal sectors endogenously. Workers are all

equal, and firms have different levels of managerial talent, which determines firm size as stated by Lucas (1978)—greater talent generating larger firm size.

More recent dualistic models have introduced taxes and other improvements. Fortin et al. (1997) incorporated both the corporate profit and payroll taxes in a model with heterogeneous firms resulting in an endogenous informal sector. If the marginal cost of tax and regulation evasion increases with firm size, their model can explain discontinuities in the firms' sizes. They obtained three forms of dualism consistent with market segmentation: scale, wage, and evasion. Galiani & Weinschelbaum (2012) also introduced payroll taxes in a model with heterogeneous firms and, as innovation, workers with preferences over the formal/informal sector. They incorporated three stylized facts: (1) small firms tend to operate informally while large firms tend to operate formally; (2) unskilled workers tend to be informal while skilled have formal jobs; and (3) workers other than the household head are less likely to operate formally than primary workers. Antón (2014) develop a dynamic, general equilibrium model with occupational choice and informality including value added, payroll and corporate income taxes.

In an innovative approach, Amaral & Quintin (2006) introduced informality in a competitive market. They retained heterogeneous workers and entrepreneurs. Firms face a choice between taxes and credit: formal (informal) firms (do not) pay taxes but (do not) have access to credit. In equilibrium, there is a demand for formal and informal workers, but labor supply is the same, i.e., there is only one labor market. Contrary to other models, similar workers earn the same amount in the formal and informal sectors.

Models' predictions on how taxes affect informality are generally uncertain, so simulations are used. With informality defined as a low productivity sector and taxes not translated in higher

benefits for workers or firms, the models proposed by Fortin et al. (1997) and Galiani & Weinschelbaum (2012) implied that lower payroll taxes lead to lower informality. But, if a lack of social protection defines informality, informal workers receive public subsidies, and payroll taxes fund formal social benefits results are ambiguous (Antón, 2014). Lower payroll taxes make formal employees cheaper to employers, thus, decreasing informality. But if only informal employees qualify for subsidies, incentives to take formal jobs are weakened. Also, if the lower payroll taxes undermine the funding for formal social benefits or if these benefits are undervalued, formal jobs are even less attractive. For this reason, simulations are used to predict the effect tax changes has on informality. Steiner (2014) and Antón (2014) used this approach to study the Colombian reform. Steiner (2014) found that the reform should increase formal employment by 1.4% and Antón (2014) suggested that the reform would decrease informal rates by 1.4 to 1.5 pps.

2.2 Empirical background

Lora & Fajardo-González (2016) studied the effects of taxes on labor markets in Latin-America. Carried out for 15 Latin American countries, they found that payroll taxes reduce employment when workers do not value their benefits; otherwise, they increase labor participation. Vuletin (2008) used the data from 32 Latin American and Caribbean countries in the early 2000s and found high taxes to be a key factor determining the size of the informal economy. Loayza (1996) used the data from Latin American countries in the early 1990s and found that the size of the informal sector depends positively on proxies for tax burden and labor-market restrictions.

Many studies provide support to the positive relationship between payroll taxes and informality in Colombia. Merchán Álvarez (2015) used the increase in payroll taxes between 1992 and 2006 and found a significant positive effect of payroll taxes on informality. Clavijo et al. (2015)

estimated the payroll taxes that firms in Colombia faced from 1980 to 2015 and concluded that increments of 1% on payroll taxes reduced formalization by 0.4%. Mondragón-Vélez et al. (2010) showed that a 10% increase in payroll taxes increases informality by 8%. Santa María et al. (2009) analyzed the effect of the 1993 social security reform, which increased payroll taxes by 14 pps, and found a significant effect on the increase of informal employment. Sánchez et al. (2009) found that the increase in payroll taxes since the 1990s augmented informality by 5.3 pps.

Recent empirical studies have explored the effect of the reform on informality. Kugler et al. (2017) estimated a positive effect on formality of 1 to 11.1 pps depending on the data source used and treated group considered. Bernal et al. (2017) found a significant short-term increase on firms' formal employment of about 4.3%. Fernández and Villar (2016) estimated a short-term reduction in informality of 4.1 to 6.7 pps on the treated workers depending on the specification and methodology used.

3 Labor market regulations

The main Colombian labor market regulations are the MW and the social security system. All workers earning at least an MW must make contributions to social security while those earning below an MW are exempt from this obligation and are provided with subsidized social benefits.

3.1 Minimum Wage

The MW is the same for all workers in Colombia since 1983 and it is updated every year. A permanent commission is responsible for proposing the MW of the following year no later than December 15. If the commission does not reach a consensus the president decrees the new MW. The MW has also been used as an index base for many economic variables (taxes, fines, fees for

services and pensions). More critically, payroll taxes regulations indicate the amount of payroll taxes to be paid by employers according to the number of MWs an employee earns.

The Ministry of Social Protection oversees the enforcement of the MW. However, there are no statistics available on the number of complaints and sanctions (or the amount of these) corresponding to non-compliance with the MW regulation (Arango et al., 2007).

The proper use of MW in empirical estimations required some additional calculations. The main frequency of the legal MW is monthly and assumes a maximum of 48 weekly hours worked. Any worker working less than 48 weekly hours can legally earn less than the monthly MW. To incorporate this, I obtain an hourly MW by dividing the monthly MW² by 4 (weeks) and then by 48 (hours). I calculate the hourly gross wage as monthly gross wage / 4 / regular weekly hours worked in the main occupation. Finally, I define the number of hourly MWs by dividing the hourly gross wage in the hourly MW.

3.2 Social security

The social security system is composed of four parts: pensions, health, labor risks, and social services. All workers earning at least one hourly MW must contribute to social security. Employers must make health contributions for his/her employees. If the employer does not make the proper contributions, he/she faces high default interests and payment for immediate health care costs required by his/her employees.

² Monthly MWs obtained from the Central Bank of Colombia.

Self-employed workers must make their own contributions, based on their actual income, to health, pensions, and occupational hazards—the latter when it applies. The same default interests to employers apply to self-employed workers who are not up-to-date with their obligations.

3.2.1 Pension system³

For workers earning at least one hourly MWs, the pension system is based mainly on a mandatory contributory pillar under two schemes: one public pay-as-you-go and one private with capitalization. In any scheme, funds must guarantee a minimum pension equal to the current monthly MW. Multiple parallel alternative schemes have been designed for workers earning less than an hourly MW and/or in poverty.

The pension system has problems that undermine its value to workers in Colombia. By 2013, only 37% of the elderly received a pension, which is low compared to the OECD average (around 90%), and 80–90% in Argentina, Brazil, Chile, and Uruguay. Coverage is also low among women, workers with low and medium incomes, workers in small businesses, or self-employed workers (Bosch et al., 2015). In rural areas, only 10% are covered, which is a product of avoided contributions or insufficient earnings to contribute. People contribute, on average, only 15 years (instead of the 25 required), as rural workers often spend their entire life not making contributions and urban workers face periods without contributions.

The requirement that pensions cannot be lower than a monthly MW is costly. Minimum pension represents around 60% of the average wage while it represents less than 20% on average in OECD countries. Many people reach retirement age without having contributed enough to

³ Based on Bosch, et al. (2015).

qualify for benefits at all, as only around half of the working population earns more than the monthly MW (2012 figures).

The public pay-as-you-go scheme mainly benefits high-income formal workers. More than 80% of pensions go to the highest income quintile while the two poorest quintiles receive less than 2% (Santa María et al., 2010), they are often the best educated and high-income individuals (OECD, 2013), contributions are deductible from the income tax base, the returns on pension investment are not taxable, and the benefits are largely tax exempt.

3.2.2 Health care

There are two forms of affiliation to the health care system: contributory and subsidized. All workers earning at least a monthly MW must be in the contributory scheme and contribute to the health system by paying their corresponding amount to their health promotion entity.⁴ All employees, self-employed and retired workers, must be affiliated to the contributory scheme. The responsibility of the employee's affiliation is of the employer. The contribution is 12.5% of the salary—a percentage fully assumed by independent workers; employees assume 4% and the employer 8.5% (zero for employees earning less than 10 monthly MWs after the reform).

With the subsidized scheme, the government subsidizes the population without employment, work contract, or income. Members of this scheme receive full or partial subsidies, which are financed with funds from the contributory scheme and additional public funds. Municipalities or

⁴ Health promotion entities organize and ensure the provision of health services.

districts manage membership using targeting mechanisms.⁵ Users of this scheme have the right to receive the same benefits as in the contributory scheme.

Workers undervalue the health care system because of its inherent issues. Despite the high coverage, 94.6% by 2015, the system suffers from quality issues with 18.3% of affiliates considering their health coverage to be bad or extremely bad by 2015.⁶ Also, certain health care services tend to be denied by insurers or providers, resulting in long wait times to obtain medical appointments and/or medical care (exams and treatment) or unexpected direct costs for affiliates when in need of health care. This has led to large legal conflicts between insurers and their affiliates, insurers and providers being under corruption charges (Vélez, 2016), and insurers going bankrupt.⁷

4 Payroll taxes and the 2012 tax reform

Payroll taxes have increased systematically in recent decades in Colombia. Since the 1980s, payroll taxes were about 42–46% for 1–2 monthly MWs and 38% for those with more than 2 monthly MWs. At the end of the 1980s, payroll taxes increased even more due to higher pension contributions⁸ and parafiscals.⁹ In 1994, payroll taxes increased 8–9 pps as a product of larger contributions to health and pensions and the creation of the general system of professional risks. In 2003 and 2007, new increases were imposed on the employer’s contributions to health and pensions. In May of 2013, payroll taxes reached peak levels of 59–66% for 1–2 monthly MWs and 52% for wages

⁵ They use Identification the Classification System of Potential Beneficiaries (*Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales*, SISBEN), census listings of indigenous communities, identification of abandoned child and indigent population.

⁶ Source: DANE, Encuesta de Calidad de Vida 2015.

⁷ <http://www.elpais.com.co/elpais/economia/noticias/asi-fue-como-quebraron-saludcoop>

⁸ Formal workers get a mandatory discount, determined by law, from their gross wage towards their pension fund. These are administered by a single public entity, Colpensiones, or private administrators, Administradoras de Fondos de Pensiones (Pension Fund Managers, AFPs). Workers choose to which of these entities to which send their discounted amount should be sent.

⁹ Parafiscals are all contributions (not taxes) to fund a public social service.

above 2 monthly MWs. The 2012 tax reform drastically reduced these payroll taxes for the first time (Clavijo et al., 2015).

The 1607/2012 Act, passed on December 2012, aimed to promote formal employment. It lowered the hiring costs for firms, thus, reducing the employer’s contributions by 13.5 pps for workers earning less than 10 monthly MWs: 5 pps destined to public institutes¹⁰ and 8.5 pps to the health care system. Public institutes’ contributions took effect on May 1st, 2013 and health on January 1st, 2014. With this, the total tax on labor in Colombia was reduced from 59% to 45.5%—a 23% reduction (Fedesarrollo, 2014).

Taxes on firms’ profits were modified to make up for the lost fiscal revenue. The statutory rate was reduced from 33% to 25% and a new surtax introduced.¹¹

Revenues from this profit surtax were directed to the concerned public institutes and health care system. These funds were not part of the general public budget, and the government provided additional funding if revenues fell short of budget needs. The statutory rate of the profit surtax was established at 9% for the period 2013–2015 (OECD, 2015), which was later increased for years 2015–2018 for large firms. The tax reform of 2016 finally eliminated the profit surtax starting in 2017.

¹⁰ The *Servicio Nacional de Aprendizaje* (National Service of Learning, SENA), a public institution focused in the development of professional education programs, and the *Instituto Colombiano de Bienestar Familiar* (Colombian Institute of Family Welfare, ICBF), a public institution in charge of the development and protection of children and families.

¹¹ The *Impuesto sobre la renta para la equidad* (Corporate Income Contributions to Equity, CREE)

4.1 Other regulatory changes

In the period of analysis, 2008–2016, other regulatory changes might have had an impact on informality along the reform: law 1429 of 2010 (First Job Act), decree 2616 of 2013, and an increased enforcement were included in the reform.

The First Job Act, introduced in 2010, reduced taxes for certain firms. Beneficiary firms had to have less than 50 workers, or assets of less than 5,000 MWs, and opening between December 2010 and December 2014. Under this law, firms enjoyed no income tax or payroll taxes for the first two years of operation. Benefits were conditional on new hires of certain types of workers: (i) less than 28 years of age, (ii) heads of households in poverty, (iii) victims of the armed conflict, (iv) disabled, (v) women older than 40 years of age, and (vi) workers earning less than 1.5 monthly MWs. Given the limited scope of beneficiary firms, it is likely that this policy had a small effect on the overall informality of the economy, but any significant estimate before the reform could be the product of this regulation.

The decree 2616 of 2013 allowed, since January 2014, weekly contributions to social security. Previously, the system only allowed monthly contributions. For example, for an employee working for a single week earning less than a monthly MW, the employer had to pay the contributions corresponding to a monthly MW. Weekly contributions apply to all workers with labor contracts working less than 30 days—independent of the hours worked.¹² If the worker works between 1 and 7 days in a month, the minimum contribution is one week (1/4 of a monthly MW). For 8–14 days, 2 weeks (1/2 monthly MW), for 15–21 days, 3 weeks (3/4 monthly MW), and for more than 21 days, an entire monthly MW. This additional flexibility might have allowed these workers to

¹² These workers still qualify for the subsidized health scheme.

become formal. But it is not possible to control for this regulatory change as the data limitations do not allow to identify how many weeks an employee has worked in a month.

Finally, the reform also improved the enforcement capabilities of the public entity that supervises workers' contributions to social security. This increased enforcement might explain part of the reduction in informality. Unfortunately, there is no way to disentangle this from the effect of the lower payroll taxes.

5 Labor market model

The reform introduced not only a reduction in payroll taxes but also a change in the funding of social benefits using a new tax on profits. I develop a labor market model that incorporates these changes and investigate the final effect of these on informality. The following is a modified version of the model proposed by Antón (2014). The main characteristics of the model are: a) static, b) single good sold in a perfectly competitive market, c) individuals characterized by different managerial ability (Lucas, 1978), d) taxes on payroll and profits, e) imperfect enforcement of payroll tax, f) employees' formal/informal status defined by employers' compliance with payroll tax, g) informal employees, self-employed, and employers receive Non-Contributory Social Benefits (NCSB), h) formal employees receive Contributory Social Benefits (CSB), i) Social Benefits are not fully valued (Levy, 2008), and j) Government collects taxes and makes social benefits transfers keeping a balanced budget.

The model has one period with a single representative household composed by a continuum of individuals of mass one. Each individual is endowed with a managerial ability z that has a probability density function $g(z)$ with support $[\underline{z}, \bar{z}]$; $G(\cdot)$ denotes the cumulative distribution function.

Individuals can choose to be employees, self-employed, or employers according to their managerial ability.

5.1 Profits

Employers produce a single product y using labor l and managerial ability z . The product is sold in a perfectly competitive market at price p , which is used as numeraire. Technology is characterized by a Cobb-Douglas production function $y = z^{1-\gamma}(l_I + l_F)^\gamma$. Employers are required to pay τ_l for each unit of labor hired but imperfect enforcement of payroll tax allows hiring formal employees, paying τ_l and a wage w_F , or informal employees, paying only wage w_I . Employers face a probability of audit θ_l and, if audited, they pay a fine $\sigma_l \tau_l w_I l_I$ where $\sigma_l \in [0,1]$ measures the severity of the fine, and l_I is the level of informal employment used by the firm. The government also raises a fraction τ_π of the firms' profits.¹³ The employer's problem is

$$\pi(w_I, w_F, z, \tau_l, \tau_\pi) = \max_{l_I, l_F} (1 - \tau_\pi) \{ z^{1-\gamma} (1 - \tau_\pi)^\gamma - (1 + \tau_l) w_F l_F - (1 + \theta_l \sigma_l \tau_l) w_I l_I \} \quad (1)$$

There will be labor tax evasion as long as $(1 + \theta_l \sigma_l \tau_l) w_I l_I \leq (1 + \tau_l) w_F$. To obtain a non-degenerated distribution of informal labor across firms in equilibrium, it is assumed that θ_l is not constant but an increasing function of l_I and z , this is, $\theta_l(l_I, z)$ with $\partial \theta_l / \partial l_I > 0$ and $\partial \theta_l / \partial z > 0$. From $\pi(w_I, w_F, z, \tau_l, \tau_\pi)$, we obtain factor demands $l_I(w_I, w_F, z, \tau_l)$ and $l_F(w_I, w_F, z, \tau_l)$. τ_π plays no direct role in the firms' labor demands. For any level of τ_π , the level of labor employment chosen by the firms does not change. Also, formal and informal workers have equal productivity making firms hire informal workers as long as they are cheaper than formal ones.

¹³ I assume perfect enforcement of this tax.

Self-employed, on the other hand, are informal employees and part-time entrepreneurs whose profits are given by

$$\pi^{SE}(w_I, z) = \max_{l_o} \{z^{1-\nu} l_o^\nu + w_I(\kappa - l_o)\} \quad (1)$$

Where $(1 - \kappa)$ is the fraction of labor the self-employed lose as a consequence of a commitment to managerial activities (Gollin, 2008). With $0 \leq l_o \leq \kappa \leq 1$, $(\kappa - l_o)$ is the fraction of time offered to the market. Self-employed have labor demands $l_o(w_I, z)$.

5.2 Households

The representative household has a concave utility function $u(C)$, where C is the total consumption of goods. For the employee, household income comes from labor, and for the employer, income is generated from the profits from self-employment and profits from firms. The non-decreasing nature of the distribution $g(z)$ guarantees two critical levels of managerial ability, z_1 and z_2 , such that for $z < z_1$, the individual chooses to be an employee, for $z_1 < z < z_2$, the individual chooses to be self-employed, and for $z_2 \geq z$, the individual chooses to be an employer. This means that a mass $[z, z_1)$ will be employees, a mass $[z_1, z_2)$ will be self-employed and a mass $[z_2, \bar{z}]$ will be employers. The household also must choose the fraction η of formal employees. Informal employees, self-employed, and employers receive an NCSB transfer T_I and formal employees receive a CSB transfer T_F . The household problem is given by

$$\max_C u(C) = \max_{\eta, z_1, z_2} u \left(\int_{\underline{z}}^{z_1} WN g(z) dz + \int_{z_1}^{z_2} [\pi^{SE}(\cdot, z) + T_I] g(z) dz + \int_{z_2}^{\bar{z}} [\pi(\cdot, z) + T_I] g(z) dz \right)$$

Where $WN = \eta(w_F + T_F) + (1 - \eta)(w_I + T_I)$. The household's first order condition for η is given by

$$w_F + T_F = w_I + T_I \quad (3)$$

(3) can be interpreted as the indifference between formal and informal employment. At z_1 , the individual has to be indifferent between being employee or self-employed, then

$$\eta(w_F + T_F) + (1 - \eta)(w_I + T_I) = \pi^{SE}(\cdot, z_1) + T_I$$

And given (3), we have the final condition for z_1

$$w_I = \pi^{SE}(\cdot, z_1) \quad (4)$$

which, as π^{SE} is strictly increasing in z , uniquely determines z_1 .

Individuals at z_2 will also be indifferent between self-employment and being an employer, then

$$\pi^{SE}(\cdot, z_2) = \pi(\cdot, z_2) \quad (5)$$

In addition, the government must keep a balanced budget, i.e., total revenues must equal total expenses. Before the reform, total revenues from payroll tax equal CSB expenses

$$\tau_l w_F \eta \int_{\underline{z}}^{z_1} g(z) dz = \tau_{CSB} \eta \int_{\underline{z}}^{z_1} g(z) dz \quad (6)$$

After the reform, revenues from the new tax on profits, τ_π^{TR} , are added to the left-hand side of the equation

$$\tau_l w_F \eta \int_{\underline{z}}^{z_1} g(z) dz + \tau_\pi^{TR} \int_{z_2}^{\bar{z}} \pi(\cdot, z) g(z) dz = \tau_{CSB} \eta \int_{\underline{z}}^{z_1} g(z) dz \quad (7)$$

Before and after the reform, total revenues from the profit tax equal NCSB expenses

$$\tau_\pi \int_{z_2}^{\bar{z}} \pi(\cdot, z) g(z) dz = \tau_{NCSB} \left[(1 - \eta) \int_{\underline{z}}^{z_1} g(z) dz + \kappa \int_{z_1}^{z_2} g(z) dz + \int_{z_2}^{\bar{z}} g(z) dz \right] \quad (8)$$

where $\tau_\pi = \tau_\pi^0$ before the reform and $\tau_\pi = \tau_\pi^0 + \tau_\pi^{TR}$ after the reform, where τ_π^{TR} is the part of the tax on profit used to fund CSB. On the other hand, every formal employee receives w_F and CSB

transfers T_F . From (6), we have before the reform $\tau_{CSB} = \tau_l w_F$, while after $\tau_{CSB} = \tau_l w_F +$

$\tau_\pi^{TR} \frac{\int_{z_2}^{\bar{z}} \pi(\cdot, z) g(z) dz}{\eta \int_{\underline{z}}^{z_1} g(z) dz}$. Following Levy (2008), formal workers value these benefits by a fraction $\beta_F \in$

$[0,1]$, then $T_F = \beta_F \tau_l w_F$ before the reform and $T_F = \beta_F \tau_l w_F + \tau_\pi^{TR} \frac{\int_{z_2}^{\bar{z}} \pi(\cdot, z) g(z) dz}{\eta \int_{\underline{z}}^{z_1} g(z) dz}$ after the reform.

Likewise, informal employees receive w_F and NCSB transfers¹⁴ by τ_{NCSB} but value these benefits by $\beta_I \in [0,1]$. These assumptions mean that the first order condition for η before the reform can be written as

$$w_F + \beta_F \tau_l w_F = w_I + \beta_I \tau_{NCSB} \quad (9)$$

and after the reform as

$$w_F + \beta_F \left(\tau_l w_F + \tau_\pi^{TR} \frac{\int_{z_2}^{\bar{z}} \pi(\cdot, z) g(z) dz}{\eta \int_{\underline{z}}^{z_1} g(z) dz} \right) = w_I + \beta_I \tau_{NCSB} \quad (10)$$

(9) mean that for any given β_F , β_I , τ_l , and τ_{NCSB} , w_I is determined by w_F before the reform and also τ_π after (10).

Eqs. (9) and (10) represents the fact that the reform changed the funding of CSB transfers using the new tax on profits. This means that even if τ_π does not affect the firms' labor demand directly, the new amount of CSB transfers could be different from before the reform, and household chooses a different level of η . This is a departure from Antón (2014), who only considered the change in the level of payroll taxes and not the change in funding of CSB.

¹⁴ For simplicity, I assume these benefits do not change after the Tax reform.

5.3 Equilibrium

All individuals such that $z \in [\underline{z}, z_1)$ are employees and $z \in [z_1, z_2)$ are self-employed, then the supply of labor in the economy is

$$N \equiv G(z_1) + \kappa \int_{z_1}^{z_2} g(z) dz \quad (11)$$

On the other hand, individuals with $z \in [z_1, z_2)$ are self-employed with equilibrium labor demands given by $l_o(w_F^*, z)$ and those with $z \in [z_2, \bar{z}]$ are employers with equilibrium labor demands $l(w_F^*, z, \tau_l) = l_I(w_F^*, z, \tau_l) + l_F(w_F^*, z, \tau_l)$. The equilibrium in the labor market is given by

$$N = \kappa \int_{z_1}^{z_2} l_o(w_F^*, z) g(z) dz + \int_{z_2}^{\bar{z}} l(w_F^*, z, \tau_l) g(z) dz \quad (12)$$

Finally, the resource constraint yields the equilibrium in the goods market

$$C = Y(\tau_l, \tau_\pi) = \int_{z_1}^{z_2} y_o(\cdot, z) g(z) dz + \int_{z_2}^{\bar{z}} y(\cdot, z) g(z) dz \quad (13)$$

In equilibrium, we obtain (w_F^*) given $(\tau_l, \tau_\pi, T_F, T_I)$. Equilibrium informal wage w_I^* is obtained from (9) before the reform and (10) after.

5.4 Reform and informality

The multiplicity of changes introduced by the reform makes straightforward comparative statics not possible. First and foremost, the reform changed the funding of CSB, which is represented by (9) and (10). Before the reform, CSB depended only on payroll taxes; after the reform, resources also come from the new tax on profits. This changes the government budgetary constraints and makes uncertain if the new level of contributory social benefits will be higher or lower than before the reform.

Second, lower payroll taxes not only increase labor demand from the employers and pushes z_1 up (12) but also increased the firms' profits, thus, attracting more self-employed to become employers, i.e., a decrease in z_2 . Therefore, the final directions of z_1 and z_2 are uncertain.

Third, the increased labor demand and lower labor supply will lead to an increase in w_F , alongside w_I as indicated by (9).

Finally, comparing (9) and (10), CSB transfers can go up or down after the reform leading to an uncertain new level of η chosen by households. These effects in conjunction lead to an uncertain final effect on the informality rate in the economy.

6 Econometric estimates

Econometric estimations are based on two types of household microdata. The first is composed of repeated cross sections coming from the *Gran Encuesta Integrada de Hogares* (Major Integrated Household Survey, GEIH) while the second is the panel data *Encuesta Longitudinal Colombiana* (Longitudinal Colombian Survey, ELCA).

The GEIH is carried out by the National Statistics Department of Colombia and has been in place since 2006, including a section on informality since 2007. The survey currently specializes in the measurement of the labor market structure and households' incomes. It has an annual size of approximately 240,000 households (800,000 observations) making it the major one at the national level. It covers 24 capital cities and their metropolitan areas (DANE, 2013). For my analysis, I use all microdata from 2008 to 2016.¹⁵

¹⁵ The survey questionnaires for 2006 and 2007 suffered many changes rendering the data for these years not comparable with 2008 to 2015.

The ELCA is carried out by the University of Los Andes. It was designed from 2007 to 2010 to follow about 10,000 households for 12 years, ending with about 21,000 individuals per year. It covers a multiplicity of topics ranging from childhood growth dynamics to social capital. The sample is probabilistic, stratified, multistage, and on conglomerates with municipalities selection based on demographic and socioeconomic variables. Questionnaires differ for urban and rural areas and, due to consistency problems across time, I use only data for households in urban areas.¹⁶ This urban sample is representative of the five geographic regions (Bogota, Central, Oriental, Atlántica, and Pacífica). For my analysis, I use all the microdata for 2010, 2013, and 2016.

Each data source provides different benefits and problems. GEIH is highly frequent (monthly) and spans over several years (before and after the reform) with high sample size and very similar questionnaires across the period. ELCA covers only three years with much smaller sample sizes. ELCA provides the critical benefit of observing the same individuals across time which, as explained below, might address bias concerns on econometric estimations based solely on GEIH.

As the reform reduced the payroll taxes attached to social services, I use a social security definition of informality. I classify informal as (i) an employee not making health or pension contributions to subsidized health schemes or earning under 1 hourly MW¹⁷ or (ii) self-employed not contributing to a pension fund without health coverage or to subsidized health schemes. I

¹⁶ For example, firm size is unavailable for rural areas.

¹⁷ Two adjustments were needed when using MWs. First, when using the MW of each year from January to December, a high peak of informality was present in January. This is the product of slow adjustment of labor contracts to the new monthly MW. To avoid this, the monthly MW of each year is used from February to January of the next year. For example, the monthly MW of 2013 is valid from February 2013 until January 2014, the monthly MW of 2014 is valid from February 2014 until January 2015 and so on. Second, measurement error was detected on hourly wages close to the minimum in year 2016 resulting in a sudden peak in informality rates. To adjust for this, a 99% of the MW was used as cutoff. This has almost no effect in informality rates for other years.

consider formal as (i) an employee making pension contributions to contributory health schemes and earning above 1 hourly MW or (ii) self-employed making pension contributions to contributory health schemes.

The reform excluded specific groups from the reduction in payroll taxes: (i) all workers earning 10 monthly MW or more, (ii) all non-profit firms, (iii) any natural person employer of one employee, and (iv) government workers. Employers could not deduct the payroll taxes derived from employees earning more than 10 monthly MWs for the new profit surtax, implying a different tax burden for employers. For this reason, employees earning more than 10 monthly MWs are discarded from the analysis. Employers and government workers are also excluded. Employers act more as firms, and government workers belong to a non-optimizing employer.

The remaining workers that are part of the analysis are private employees, domestic, laborer or farmhand,¹⁸ and self-employed. I classify private, domestic and laborer or farmhand as treated and self-employed as control. Self-employed have a different tax legal framework than employees and are not subject to payroll taxes. But, as characterized by the model above, self-employed might still be indirectly affected by the reform due to the change in the funding of social benefits and the new labor demand from employers.

An additional concern regards workers' control-treated transitions. Workers might move from self-employment to salaried work after the reform, thereby contaminating the estimates of its impact on informality. ELCA data allows to control for this with fixed effects estimates on the

¹⁸ As any natural person, employer with one employee was excluded from the reform, and survey data does not allow to observe if the employer is a natural person; only domestic and laborer in firms with more than one employee are included in the analysis.

treated dummy, which captures control-treated transitions within individuals. In addition, fixed effects estimate control for individuals' unobserved heterogeneity. This type of estimate has not been used before to study the reform.

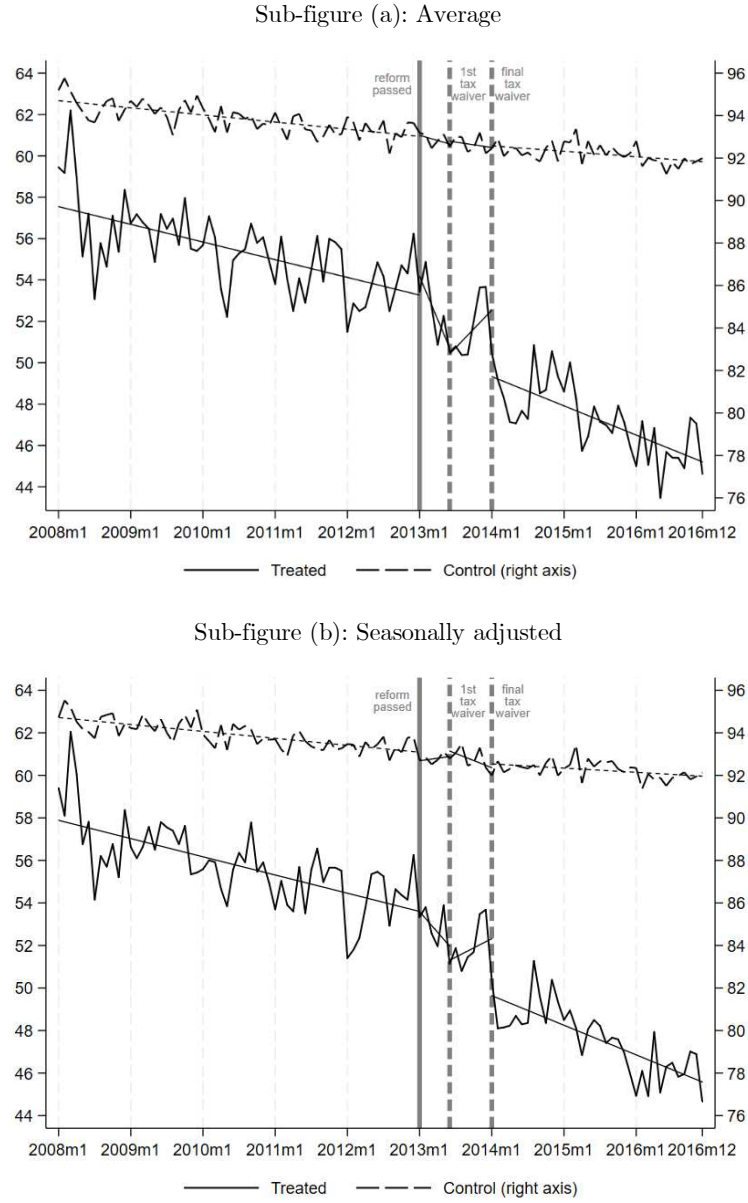
6.1 Results based on repeated cross sections

6.1.1 Informality before and after the reform

Figure 1 presents monthly informality rates from 2008 to 2016. We can observe how 2013 is a transition year where just part of the reform was implemented. On figure 1-a, we see how the informality rate for the treated group had a sudden decrease in January 2014, when all parts of the reform were in place. At the same time, we observe almost no change for the control group. But a seasonal component is clear on the informality rate for the treated group, with a permanent decrease at mid and peaks at the end of each year. To control for this, figure 1-b presents seasonally adjusted averages making the change in informality after the reform clearer. Small decreases are present after the law and the first tax waiver were passed, but the largest drop is still present since January 2014. Again, we see almost no change for the control group.

Informality trends require some care. On figure 1-b, we see that trends of treated and control groups are not parallel, thus, violating a critical assumption for the DID approach. In addition, the decreasing trend for the treated group is more pronounced after the final tax waiver. This could be indicating that there was a change in both the level and trends of informality. I implement multiple econometric strategies to evaluate this series' behavior.

Figure 1. Monthly informality rate, % of workage workers



Source: Author calculations based on GEIH household survey data. Notes: Private employees as treated, self-employed as control. Informality definition in main text. Straight lines indicate linear OLS fits. Seasonally adjusted product of regressing informality dummy in month dummies and adding average informality to residuals. Workage if age 12 or more in urban areas, age 10 or more for rural areas.

6.1.2 Regression models and estimates

I estimate different DID specifications to capture changes in informality levels and trends. The simplest one is

$$P(I_{it}) = \alpha_0 + \alpha_1 \textit{treated} + \alpha_2 \textit{treated} * \textit{Jan13} + \alpha_3 \textit{treated} * \textit{May13} + \alpha_4 \textit{treated} * \textit{Jan14} + \alpha \mathbf{X}_{it} + \varepsilon_{it} \quad (14)$$

where $P(I_{it})$ indicates the probability that a worker i has an informal job at time t , $\textit{treated}$ a dummy of treatment group, $\textit{Jan13}$ a dummy equal to one if January to April 2013, $\textit{May13}$ a dummy equal to one if May to December 2013, $\textit{Jan14}$ a dummy equal to one if January 2014 or later, $\mathbf{X}_{it}$ includes all controls and ε_{it} is the random error term. In this specification α_2 measures the effect of the reform passing, α_3 the effect of the first tax waiver and α_4 the effect of the last tax waiver.

The second specification uses year-month interactions

$$P(I_{it}) = \beta_0 + \beta_1 \textit{treated} + \beta_2 \textit{treated} * \mathbf{ym}_{08-12} + \beta_3 \textit{treated} * \mathbf{ym}_{13-16} + \beta_4 \mathbf{ym}_{08-16} + \beta \mathbf{X}_{it} + \varepsilon_{it} \quad (15)$$

Where $\mathbf{ym}_{08-16}$ is a vector of year-month dummies for 2008 to 2016, $\mathbf{ym}_{08-12}$ is a vector of year-month dummies for 2008 to 2012, and $\mathbf{ym}_{13-16}$ is a vector of year-month dummies for 2013 to 2016. Here, β_3 is the vector of treatment effects of interest while β_2 acts as a parallel trend test. In this specification, I use December 2012 as the baseline.

Specifications (14) and (15) impose no time structure. Parameter estimates on $\textit{treated} * \textit{time}$ measure the change in the time series, including the part due to a change in trend. To restrict to a linear trend and separate changes in levels and trend I use an additional specification

$$\begin{aligned}
P(I_{it}) = & \gamma_0 + \gamma_1(t - c) + \gamma_2 after + \gamma_3 treated + \\
& \gamma_4(t - c) * treated + \gamma_5 after * treated + \\
& \gamma_6(t - c) * after * treated + \boldsymbol{\gamma}_7 \mathbf{X}_{it} + \boldsymbol{\gamma}_8 \mathbf{X}_{it} * treated + \varepsilon_{it}
\end{aligned} \tag{17}$$

where t is the year-month time variable, c the time baseline (December 2012), and *after* a dummy equal to one if January 2013 or after. Here, γ_5 captures the change in informality level while γ_6 the change in trend. The total estimated effect of the reform equals $\gamma_5 + \gamma_6 t$, with t for January 2013 or after.

For all specifications, I take the same estimation approach. I use seasonality adjusted residuals, as shown in figure 1-b, as the dependent variable. To avoid the problems of using non-linear estimators in a DID context (Greene, 2010; Blundell & Dias, 2009; Ai & Norton, 2003), I assume a Linear Probability Model (LPM) with estimates obtained using Ordinary Least Squares (OLS) with robust standard errors clustered by the industry. LPM allows DID estimates to be readily interpretable and is much faster, given the large sample size of 2,302,575 observations in the GEIH data.¹⁹ Controls by age, gender, education, and department are included in all regressions.²⁰ I use main sectors and workers above 1 hourly MW for differential impact analysis.

In Table 1, we can see that treated and control are different in terms of the control variables used in the regression specifications. In terms of the sample size per year, the control group is larger the treated one—by about 28% before the reform and 16% after. Differences in workers’

¹⁹ LPM limitations like predicted probabilities outside the (0,1) interval or heteroskedasticity are not of much concern in a DID context. I am not interested in the predicted probabilities, and heteroskedasticity is easily adjusted for.

²⁰ Sector and firm size are highly correlated with informality but using them as controls raises concerns of endogeneity. For example, a firm could change their size and its composition of informal workers after the decrease in payroll taxes.

characteristics remain relatively the same before and after the reform. Control workers remain more female, older, less educated, less urban, earning lower wages, more concentrated in agriculture and services, and in small firm sizes than treated workers.

Table 2. Workers characteristics

		Control		Treated	
		[2008-2012]	[2013-2016]	[2008-2012]	[2013-2016]
Freq. workage workers		741,369	577,816	577,280	496,325
Male (%)		60.8	59.8	64.2	61.4
Age (avg. years)		41.6	42.5	34.2	34.7
Years of education (avg.)		7.2	7.6	9.4	10.1
Urban (%)		73.5	72.6	80.7	82.9
Wages (avg. # hourly MWs)		1.05	1.06	1.32	1.37
Sector (%)	Agriculture	20.6	20.6	17.0	13.1
	Industry	17.6	16.5	27.0	26.3
	Services	61.8	62.9	56.0	60.5
Firm size (%)	Alone	75.3	76.3	0.7	1.5
	[2-5]	17.8	16.9	34.4	29.7
	[6-10]	1.5	1.4	11.1	10.6
	[11-19]	0.8	0.8	6.6	6.5
	[20-49]	1.0	1.0	10.7	10.4
	[50+)	3.6	3.6	36.6	41.3

Author calculations based on GEIH microdata. Notes: Employees as treated, self-employed as control.

Simple DID estimates show an increasing reduction in informality after the reform (Table 2). The DID estimate for the approval of the reform (DID1) is -1.5, which indicates a larger reduction of 1.5 pps for treated workers than controls between January and April 2013. The estimated reduction for the first tax waiver (DID2) is bigger at 2.5 pps; after the second tax waiver, we obtain an even larger reduction of 6.5 pps.

Table 5. Simple DID estimates

Group	[2008-2012]	Jan-Apr 2013	May-Dec 2013	[2014-2015]	DID1	DID2	DID3
Control	93.8	92.9	92.7	92.2	-0.9	-1.1	-1.6
Treated	55.4	53.0	51.7	47.3	-2.4	-3.7	-8.1
Difference	-38.4	-39.9	-41.0	-44.9	-1.5	-2.5	-6.5

Author calculations based on GEIH microdata. Notes: Employees as treated, self-employed as control. Informality definition in main text.

Before-after DID estimates go in line with the simple estimates (Table 3). In column (1), I obtain similar point estimates to those obtained in the simple calculation. Using controls, column (2), the point estimate for January to April 2013 becomes marginally significant at -1.1 pps, for May to December 2013, highly significant at -2.1 pps as well as for January 2014 and after where the point estimate is -5.4 pps.

The reform impact was unequally distributed among sectors in the short term and almost evenly in the long term. For January to April 2013, only industry had a significant estimate of -1.7 pps; for May to December 2013, both industry and services have significant estimates of -2.6 and -1.7 respectively. For Jan 2014 and later, point estimates are significant for all three sectors at about -5 pps.

Employers' compliance with MW is critical for formality; for employees around 1 hourly MW, the DID estimate was larger than for all workers for Jan 2014 and after. For workers with wages equal to half to one and a half hourly MW, [0.5-1.5] MW, DID estimate is not significant for January to April 2013. For May to December 2013, the point estimate is significant at -1.7 pps, lower than for all workers at -2.1 pps. But for January 2014 and later, the point estimate is larger at 6.6 pps compared with 5.4 for all workers. This could be indicating that the reform had a larger impact for workers around MW than for all workers.

Table 7. Before-after DID estimates

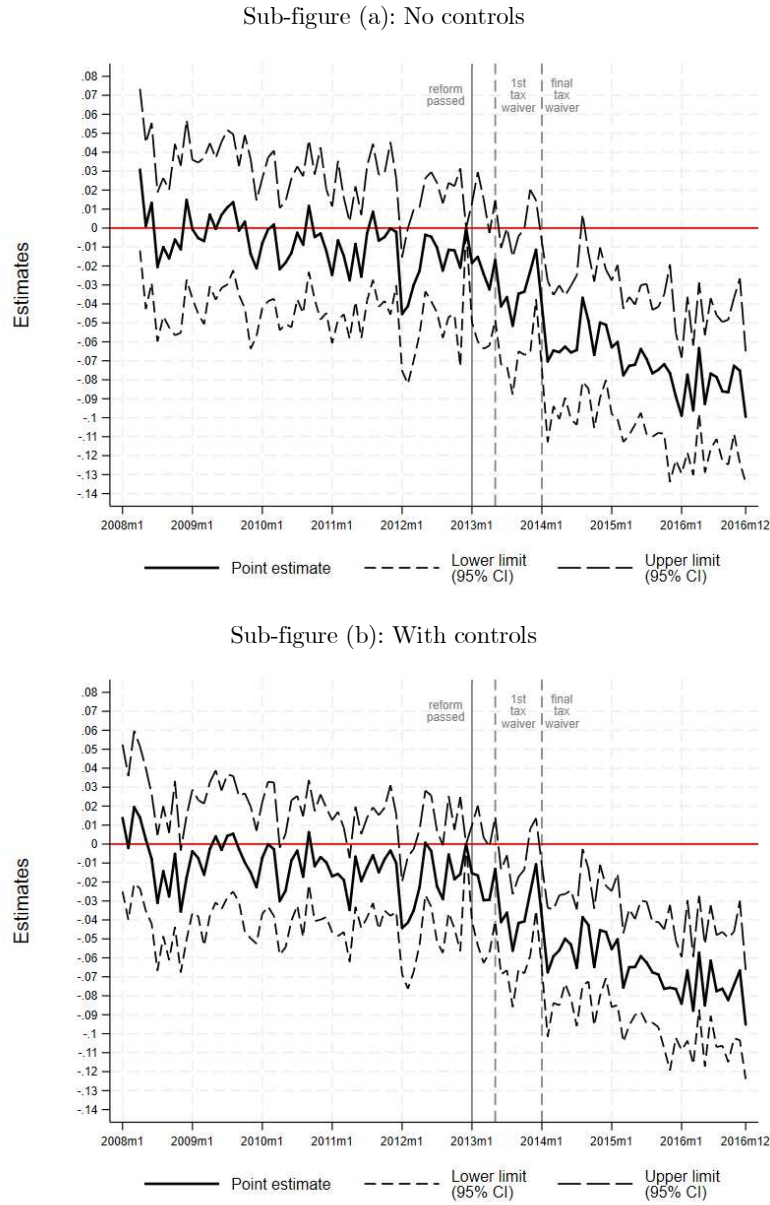
Variable	All employees		Sector			[0.5-1.5]
	(1)	(2)	Agriculture	Industry	Services	MW
			(3)	(4)	(5)	(6)
treated*Jan-Apr13	-0.016** (0.007)	-0.011* (0.006)	-0.019 (0.021)	-0.017** (0.008)	-0.003 (0.008)	-0.009 (0.007)
treated*May-Dec13	-0.025*** (0.008)	-0.021*** (0.006)	-0.011 (0.016)	-0.026*** (0.009)	-0.017** (0.007)	-0.017** (0.007)
treated*2014-2016	-0.065*** (0.011)	-0.054*** (0.008)	-0.053** (0.018)	-0.047*** (0.006)	-0.048*** (0.011)	-0.066*** (0.010)
Controls	No	Yes	Yes	Yes	Yes	Yes
Observations	2302498	2302118	200489	503430	1597352	1416825

Source: Author calculations based on GEIH microdata. Notes: Results from OLS regressions with robust standard errors clustered by industry. Residuals of OLS regression of informality on month dummies as dependent variable. Standard errors in parentheses. Number of observations in brackets. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Employees as treated, self-employed as control. Informality definition in main text. Controls include age, gender, education and department.

The increasing size of point estimates after the reform is even more pronounced on treated*year-month interactions (Figure 2).

We see that, with or without controls, confidence intervals for point estimates before January 2013 include zero in almost all months. In addition, the Wald test of statistical significance of treated*months point estimates for months before January 2013 cannot reject the hypotheses of all equal to zero for 40 out of 48 months without controls, 38 months with controls, at 10% or less. Thus, although parallel trends are slightly not parallel, the difference is not statistically significant.

Figure 4. Diff-in-diff treated*year-month estimates



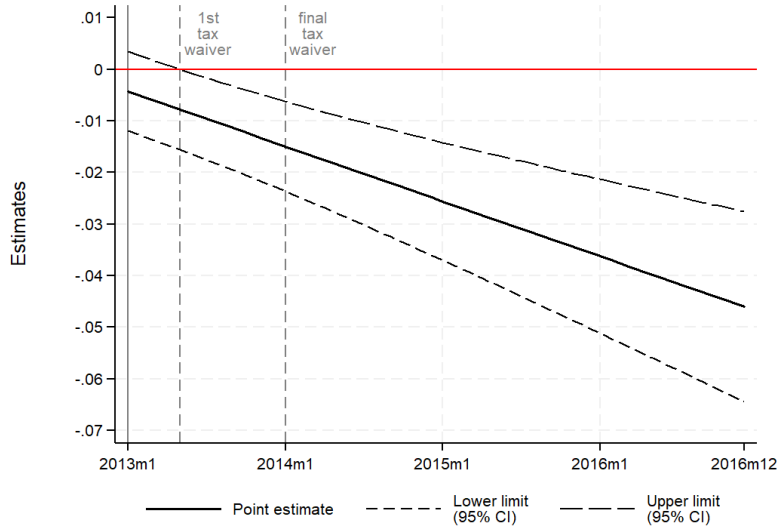
Source: Author calculations based on GEIH microdata. Notes: Results from OLS regressions with robust standard errors clustered by industry. Residuals of OLS regression of informality on month dummies as dependent variable. Employees as treated, self-employed as control. Informality definition in main text. Controls include age, gender, education and department.

With controls, from January to May 2013, we see that confidence intervals also include zero. From June to October 2013, all point estimates do not include zero and go up to -5.6 pps for August. Starting January 2014, all point estimates become significant with confidence intervals

not including zero. Point estimates indicate larger reductions in informality starting in January 2014 at -3.8 and getting largest by December 2016 with -9.4.

Estimation of the change in level and trend in informality also indicates significant but smaller impact (Figure 3). Using the estimates from specification (17), figure 3 presents the total estimated effect $\hat{\gamma}_5 + \hat{\gamma}_6 t$. We see that, as before, for January to April 2013, estimates are not significant. From May to December 2013, the total effect estimate goes from almost zero to -1.4 pps. By December 2014, the estimated total effect goes up to -2.5 pps, -3.5 for December 2015, and a maximum of -4.6 pps by December 2016.

Figure 6. Treated*after + treated*after*year-month estimates



Source: Author calculations based on GEIH microdata. Notes: Results from OLS regressions with robust standard errors clustered by industry. Residuals of OLS regression of informality on month dummies as dependent variable. Employees as treated, self-employed as control. Informality definition in main text. Controls include age, gender, education and department.

Finally, results are robust to the use of alternative definitions of informality (Table 4). No pension or no health, columns (1) and (2), are both significantly reduced by the reform passing, January–April 2013, and its first tax waiver, May–December 2013. Reduction in the share of

workers earning under 1 MW takes until after the second tax waiver with a significant point estimate for [2014–2016] and for January 2015 and January 2016.

Table 11. DID estimates by different informality definitions

Specification		No pension	No health	Under 1 MW
		(1)	(2)	(3)
before-after	treated*Jan-Apr13	-0.020*** (0.007)	-0.023*** (0.007)	-0.018 (0.026)
	treated*May-Dec13	-0.023*** (0.006)	-0.026*** (0.006)	-0.018 (0.017)
	treated*[2014-2016]	-0.047*** (0.008)	-0.052*** (0.009)	-0.067*** (0.010)
year-month	treated*2013m1	-0.004 (0.014)	0.017 (0.012)	-0.019 (0.013)
	treated*2014m1	-0.039*** (0.014)	-0.022* (0.012)	-0.013 (0.015)
	treated*2015m1	-0.041** (0.017)	-0.029* (0.017)	-0.074*** (0.015)
	treated*2016m1	-0.063*** (0.014)	-0.045*** (0.014)	-0.077*** (0.016)

Source: Author calculations based on GEIH microdata. Notes: Results from OLS regressions with robust standard errors clustered by industry. Residuals of OLS regression of informality on month dummies as dependent variable. Standard errors in parentheses. Number of observations in brackets. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Employees as treated, self-employed as control. Informality definition in main text. Controls include age, gender, education and department.

6.2 Results based on panel data

6.2.1 Informality before and after the reform

The results in this section are based on a balanced panel subset from the ELCA panel data, which is not significantly different from the total panel data (see Tables 17 and 18 on Appendix). In Table 5, we can see that simple DID calculations are negative for years 2013 and 2016 compared with 2010. As expected, the control group has a high informality starting at 93% in 2010 and ending in 92% in 2016, but the treated group has a much lower level of informality at 63% in 2010 and ending in 52% in 2016. This implies DID simple calculations of -9% for 2013 and -9.7% for 2016.

Table 14. Simple DID estimates, balanced panel

<i>Group</i>	<i>Informality rate (%)</i>			<i>Diff-in-diff</i>	
	2010	2013	2016	2013	2016
<i>Control</i>	93.2	93.8	92.0	0.6	-1.2
<i>Treated</i>	62.7	54.3	51.8	-8.4	-10.9
<i>Difference</i>				-9.0	-9.7

Source: Author calculations based on ELCA microdata. Notes: Informal if: (i) Employee not making health or pension contributions, in subsidized health scheme or earning under 1 hourly MW, (ii) Self-employed not contributing to a pension fund, without health coverage or in subsidized health scheme. Workage if age 12 or more in urban areas, age 10 or more for rural areas.

The before-after DID estimates indicate significant reductions in informality except for workers in agriculture (Table 6). For all workers including control-treated transitions, we have a DID estimate of -9.6 pps, similar figures for workers in industry and services, and higher estimates for workers around 1 MW, in line with the results from GEIH data.

Table 17. Before-after fixed effects estimates, balanced panel

	All employees		Sector			[0.5-1.5]
	(1)	(2)	Agriculture	Industry	Services	MW
<i>After</i>	-0.019**	0.006	0.112*	-0.028	0.018	0.014
	(0.008)	(0.013)	(0.058)	(0.036)	(0.016)	(0.025)
<i>Treated</i>	-0.089***	-0.091***	0.048	-0.124***	-0.080***	-0.013
	(0.017)	(0.017)	(0.056)	(0.048)	(0.022)	(0.027)
<i>Treated*After</i>	-0.099***	-0.096***	-0.054	-0.095***	-0.094***	-0.123***
	(0.015)	(0.015)	(0.053)	(0.035)	(0.020)	(0.025)
<i>Controls</i>	No	Yes	Yes	Yes	Yes	Yes
<i>N</i>	10716	10679	799	2482	7379	6024

Source: Author calculations based on ELCA microdata. Notes: Controls include age, gender, education and department. Informal if: (i) employee not making health or pension contributions, in subsidized health scheme or earning under 1 hourly MW, (ii) self-employed not making health or pension contributions, in subsidized health scheme. * p<0.1 ** p<0.05 *** p<0.01

Per-year DID estimates are in line with results from before-after DID (Table 7). We obtain significant point estimates of -9.2 pps for 2013 and -10 pps for 2016 for all workers, point estimates slightly higher in workers at services and lower for workers at industry. Interestingly we obtain a marginally significant point estimate for 2016 in agriculture. We obtain larger estimates for workers around 1 MW.

Table 19. Treated*year fixed effects regressions, balanced panel

	All employees		Sector			[0.5-1.5]
	(1)	(2)	Agriculture	Industry	Services	MW
<i>Treated*2013</i>	-0.094*** (0.016)	-0.090*** (0.017)	0.027 (0.052)	-0.094*** (0.036)	-0.101*** (0.021)	-0.109*** (0.028)
<i>Treated*2016</i>	-0.106*** (0.018)	-0.101*** (0.018)	-0.100* (0.059)	-0.081** (0.040)	-0.113*** (0.023)	-0.133*** (0.029)
<i>Controls</i>	No	Yes	Yes	Yes	Yes	Yes
<i>N</i>	10716	10679	989	3202	9393	6024

Source: Author calculations based on ELCA microdata. Notes: Controls include age, gen-der, education and department. In-formal if: (i) employee not making health or pension contributions, in subsidized health scheme or earning under 1 hourly MW, (ii) self-employed not making health or pension contributions, in subsidized health scheme. * p<0.1 ** p<0.05 *** p<0.01

7 Conclusions

Current studies provide mixed guidance to policymakers on the effects of payroll taxes on informality. Predictions from economic theory depend on how informality is defined, workers' preferences for informal employment, and the specific economic model chosen (Antón, 2014; Galiani & Weinschelbaum, 2012). Empirical evidence points to a positive relationship between payroll taxes and informality (Merchán Álvarez, 2015; Clavijo et al., 2015; Mondragón-Vélez et al., 2010; Santa María et al., 2009; Sánchez et al., 2009). The large reduction of payroll taxes in Colombia in 2012 provides a great opportunity to evaluate this both theoretical and empirically.

My labor market model incorporates the reduction in payroll taxes and the structural change in the funding of social benefits introduced by the reform. Due to the structural change in the funding of social benefits and multiple general equilibrium changes, the model is unable to provide clear comparative statics resulting from the reform. The result depends on how employees, self-employed, and employers react to the new economic conditions.

Econometric estimates indicate significant reductions in informality derived from the reform. From repeated cross-section household survey, DID estimates are marginally significant after the

first tax waiver in May 2013 and increasingly larger after the second one in January 2014. The industry sector was the first one to enjoy a reduction in informality after the reform was passed, then services joined the list after the first tax waiver, and also agriculture after the second. For workers with wages around 1 MW, estimates are also significant after the first tax waiver; after the second tax waiver, point estimates are even larger than for all workers.

The informality rate in December 2012 for the treated group was 56.2%. Then, simple DID before-after indicates that the reform passing had a small effect of 2% ($1.1/56.2$); the first tax waiver a slightly bigger one of 3.7%, and the largest effect of 9.6% came after the second tax waiver. Monthly DID estimates also reflect this same pattern; for example, I estimate reductions of 10% for August 2013 and up to 16.7% for December 2016. When restricting informality to have a linear trend, I obtain smaller but more stable point estimates from almost zero in May 2013 to 8.2% in December 2016.

The informality rate on the panel sample for 2010 for the treated group was 62.7%, and the DID point estimates indicate a treatment effect of 14.7% ($9.2/62.7$) for 2013 and 15.9% ($10/62.7$) for 2016. These are in line with the results obtained from the repeated cross-sections. DID estimates also indicate significant reductions for those in industry or services (marginally significant for those in agriculture in 2016). We still obtain no significant point estimates for workers earning 1 hourly MW or more. Also, the difference in point estimates including control-treated transitions or not indicate a mild bias introduced by this. It is still pending estimations based on repeated cross sections that replicate, as close as possible, the characteristics of the panel sample.

These results are consistent with those in Fernández & Villar (2016) but very different from Kugler et al. (2017). I successfully replicate Fernández & Villar (2016), with similar point estimates, sample sizes, controls, and econometric methodology. Treated and control groups are similar, with 80% of workers identified on the same groups in this study and in Fernández & Villar (2016). Differences in estimations are due to the longer period and estimation methodology in this study. In the case of Kugler et al. (2017), despite attempts to emulate same formality measures and treated and control groups, the large differences in sample sizes between the original study and those in the replication render the comparison of point estimates not appropriate.²¹

This study contributes to the literature on the effects of the reform (Kugler et al., 2017; Bernal et al., 2017; Fernández & Villar, 2016) by expanding the period of analysis while exploring the results obtained for alternative sources of data. Expansion of the period of analysis to 2008–2016 allows the inspection of the very short-term effect (2013), short term (2014), and medium to long term (2015–16). In addition, it also allows the visual inspection of the validation of the self-employed as the control group by looking at DID estimates before the reform [2008–2012]. I also use an alternative source of data: the panel ELCA household survey. With this, I double check for consistency across data sources and run estimates, which is not possible with repeated cross sections, like fixed effects.

An important limitation of this study is the use of self-employed as the control group as they might still be indirectly affected by a decrease in payroll taxes. In the context of the Colombian reform, firms could increase their labor demand and hire from the pool of self-employed workers

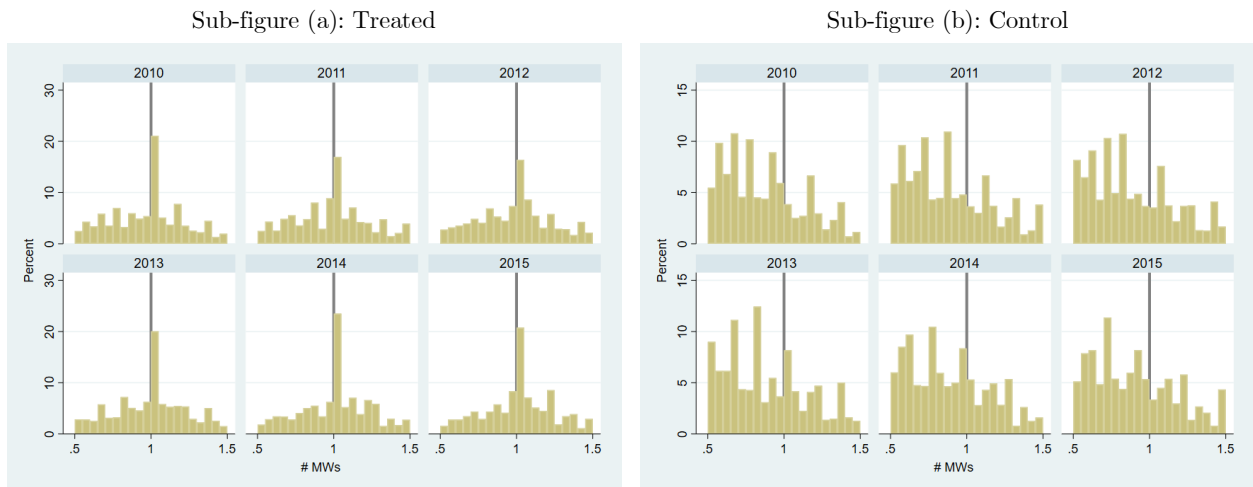
²¹ Further details on the replication exercise can be seen in annex table 21.

and self-employed could decide to formalize if the contributory social benefits are improved or if their wages are increased. This could lead to biased estimates of the reform effect on informality.

For policy implications, it is important to highlight that the estimates' connection with payroll taxes is indirect and replications might not lead to the same results. Multiple regulatory changes—increased flexibility to make contributions to social security, a change in social benefits funding, and increased enforcement—took place at the same time as the reduction in payroll taxes. The reform also implemented new taxes on firms' profits to fund social benefits as well as changes in value-added taxes. It is possible that some or all these factors explain part of the reduction in informality. Also, this study is limited to employees, those most directly affected by changes in payroll taxes but also a small fraction of workers in developing countries. If the reduction in payroll taxes reduces informality only among these types of workers, informality reduction in the country could be small. Accordingly, replications in other contexts should be done with care.

Future research agenda could aim to unveil the effects of the reform on the distribution of wages. As observed above, one of the reform effects was the lower share of treated workers earning under 1 MW. Looking more closely to the distribution of wages around 1 MW (Figure 4), we see a sudden jump since 2013 on the share of workers at exactly 1 MW without any significant change in the control group. Further exploration of the phenomena could look across all the income distribution of treated (employees) workers compared with controls (self-employed). One possible unintended consequence of the reform could be the reduction of wages for employees above 1 MW with excluded workers getting increasingly self-employed. A likely instrument to explore this could be the discontinuous tax rates present in the Colombian tax code according to the different number of minimum wages a worker earns.

Figure 9. Histograms of hourly wages



Source: Author calculations based on GEIH microdata. Notes: Employees as treated, self-employed as control. Informality definition in main text.

Chapter 2: Informal Employment Dynamics in Paraguay

1 Introduction

Low-income countries are characterized by the large participation of small, informal, household level, low-productivity firms that employ a large share of the poorer workforce (McCaig & Pavcnik, 2015). It is very unlikely that these firms will move to the formal sector (La Porta & Shleifer, 2014; Mel et al., 2013; Mel et al., 2010), but it is possible that workers will transition to formal employment as the economy grows (Gollin, 2008; Lucas, 1978). Then, analyzing workers' movements out of informality becomes critical, and results based on cross sectional data say little about workers' informal-formal transitions, how and when they leave informality, and what facilitates this transition. As household panel datasets become available in developing countries, there is the potential to increase the understanding on how their labor markets work compared with developed countries (Bosch & Maloney, 2010). In this study, I characterize the informal labor market dynamics in Paraguay using a 2010–2014 panel household survey data. This exercise provides a baseline for questions like the following: How many workers make informal-formal transitions? How transitions change according to gender, age, firm size, or sector? How persistent is informal employment? Which factors explain the probability of being informal, staying informal, or moving into informality? How big is the wage gap between workers staying formal vs. staying informal? Which are the returns of moving into formality?

Current results present the Paraguayan labor market as dynamic, but informal and formal employment are highly isolated. Workers tend to stay informal or formal indefinitely, especially on informality. Just a small share of workers leave informality in the period of analysis. This is worrisome as informal workers are more likely to become unemployed or inactive.

Workers staying informal have lower wages than workers staying formal with significant differences based on gender. While women have lower monthly wages systematically, they only have lower hourly wages if they stay informal. On the other hand, quarterly wage gains in monthly and hourly wages are similar between workers staying informal and workers staying formal. This could partially explain why workers rarely leave informality.

I use a survival model that allows to control for the history of workers' informal/formal employment to estimate the Average Marginal Effects (AMEs) of each demographic and labor variable on the informal-formal transitions. AMEs' estimates for education and firm size are highly significant at informal-to-formal transitions. Point estimates are also increasing with time, i.e., as workers stay informal for longer, education and firm size have a more significant role in moving into formality. With the formal-to-informal transition, estimates indicate that older women have a lower probability of becoming informal, larger firm size is significant only among male workers, and, surprisingly, education plays no significant role.

Mincer specifications indicate that individual workers gain little from moving into formality. Estimates show that monthly and hourly wages are significantly higher for workers staying formal, moving into formality or moving into formality as compared to those staying informal. But within workers gains on monthly wages are much smaller and we obtain no significant estimates for hourly wages.

I find a much more segmented informal/formal employment than Ruppert Bulmer et al. (2017). Running separate survival model specifications for men and women, I find that education increases transitions into formality but not on informality. On wages I obtain significant gains in monthly and hourly wages between informal-formal workers, although small within gains, while

Ruppert Bulmer et al. (2017) are unable to identify any gains in monthly wages. In addition, this study contributes to the increasing studies on informal labor market dynamics in developing countries (McCaig & Pavcnik, 2015; Slonimczyk & Gimpelson, 2015; Bosch & Maloney, 2010; Lehmann & Pignatti, 2007; Gong et al., 2004; Maloney, 1999).

This study is structured in seven parts, including this introduction. The second makes a brief literature review of the theory and empirical studies on informal markets. The third section is devoted to the Paraguay labor market regulatory framework, which is critical to understand informal employment. The fourth describes the data used. The fifth carries out a descriptive analysis of Paraguay's informal labor market. The sixth includes the regressions. The final section concludes.

2 Literature review

Economic theory has provided different explanations for informality. The traditional dualistic or exclusion point of view (De Soto, 1989; Harris & Todaro, 1970; Lewis, 1954) sees labor markets divided in two: one where regulations are enforced (formal) and another where they are not (informal). Regulations in the formal market can be interpreted as a minimum wage above the market clearing level, taxes, social security benefits, union collective bargaining, or efficiency wages. The key of this exclusion framework is that informality is involuntary: workers want a formal job, but, as there are insufficient positions open, they are forced to be employed in the informal market or be unemployed. The exclusion is also translated into employers' firms' sizes, where small firms are considered informal and large formal. The intuition for this is that large firms are easier to monitor by the government, while small ones stay under-the-radar avoiding

public regulations. Rauch (1991) explicitly modeled this formal-informal size dualism, where exogenous minimum wages are only enforced in large firms and obtain formal and informal sectors endogenously.

In contrast, the exit or voluntary explanation sees the formal and informal labor markets as integrated, where some workers voluntarily choose one type of employment (Maloney, 2004; Maloney, 1999). According to this point of view, economic agents decide their degree of compliance with state regulations depending on the net benefits associated with formality. In developing countries, where formal state benefits are deficient and/or law enforcement is weak, many agents might rationally choose informality. Incentives for this are even stronger when the state provides universal or non-contributory benefits to informal workers. In addition, larger firms might underreport their activities or incomes if detection risks are low (Perry et al., 2007).

Studies provide mixed evidence on which story better fits the data. McCaig & Pavcnik (2015), for Vietnam, found that younger, skilled, male, and urban workers are more likely to switch to the formal sector, especially among migrants. Slonimczyk & Gimpelson (2015), for Russia, found evidence in favor of integrated labor markets as “the choice of whether and in what sector to work has more to do with fundamentals (preferences, endowments, and technology) and less to do with history.” Bosch & Maloney (2010) found, for Argentina, Brazil, and Mexico, evidence of voluntary informality among self-employed but involuntary in wage employment, especially among young workers. Lehmann & Pignatti (2007) pointed to the existence of a segmented labor market in Ukraine, as workers try to enter formal employment and use informality or unemployment as waiting stages, but they found voluntary informal self-employment in urban areas. Gong et al. (2004) provided mixed evidence for the Mexican labor market, while age has no effect on the

formal/informal transitions and married women with children seem to choose informality voluntarily; they also found that workers formal/informal in one period are strongly likely to remain in the same state the next period. Gong et al. (2004) contrasted with Maloney (1999) who instead found a strongly integrated labor market in Mexico.

3 Labor market regulations

Paraguay's social security system is composed of two major entities: The Institute of Social Welfare (*Instituto de Previsión Social*, IPS) and The Fiscal Fund (*Caja Fiscal*). The IPS directs and administers social security in Paraguay. Enrollment to the IPS is mandatory for all private workers, day laborers, municipal employees, officials from decentralized entities, public and mixed companies, and private school teachers. These workers receive health coverage and make pension contributions. The Fiscal Fund concentrates on the largest number of public employees. The IPS and Fiscal Fund cover 97% of salaried employees listed in the social security system. There are also private insurers who offer medical and retirement services, although membership is voluntary (OISS, 2014).

3.1 Pensions²²

Paraguay's pension system has no supervisor entity, with all public and private pension funds created by different laws, without coordination or connection. The public pension system is highly decentralized and composed of eight institutions, the IPS and Fiscal Fund being the main ones. The public system of pensions is mandatory for all wage workers—public and private. Independent workers, employers, self-employed, and domestic workers are not obliged to contribute but, since 2013, can make voluntary contributions to the IPS. Workers excluded from the mandatory public

²² Based on Navarro & Ortiz (2014)

pension system contribute to a series of private voluntary pension funds. The government of Paraguay also provides some non-contributory pensions for specific groups.²³

The system has contributory and non-contributory pillars. The contributory has all wage workers as the target population with entirely defined benefits. The non-contributory pillar is aimed at the poor population. The private pension system is disconnected from the public one and is unregulated. All public institutes work under a pay-as-you-go funding system with contribution rates from 12.5 % on the IPS to 28% on *Caja Bancaria*. Most pension funds have other financial sources (public funds, additional contributions, donations).

The pension system introduces several distortions in the labor market. It incentivizes early retirement as many pension funds allow retirement at 35 or 40 years of age. It discourages savings as it is a defined benefits system, i.e., benefits do not depend on the savings effort but only on the contributor's tenure. Other problems include high replacement rates (80 to 90% compared with an average of 58% in OECD countries), high contributory rates, highly bureaucratic pension administration funds, and badly designed benefits.²⁴ In conjunction, these problems might explain part of the high informality present in Paraguay's labor market.

3.2 Health care²⁵

The health care system is composed of public and private sectors and regulated by the Superintendence of Health. The public sector is represented by the Ministry of Public Health and Social

²³ These cover (i) veterans of the Chaco War and its survivors, (ii) ex gratia pensions granted by the National Congress; (iii) maintenance pension for senior citizens, and (iv) the survivor's pension for heirs of the police and military personnel killed in service.

²⁴ For example, pension benefits are based on the last wage or the average of the last 60 months (in 26 OECD countries, the entire labor history is used). These benefits are, in all cases, greater than what they could obtain in the financial market with their accumulated capital.

²⁵ Based on Mancuella Alum & Cabral de Bejarano (2011)

Welfare (*Ministerio de Salud Pública y Bienestar Social*, MSPyBS), the IPS, the Military Health, the Police Health, the National University of Asunción, and assistance services of decentralized companies Itaipú and Yacyretá. The private sector includes private insurers, for-profit, non-profit, and mixed providers.

The MSPyBS is financed with public resources and exercises the roles of rectorship, financing, and service provision. The latter is carried out through an integrated network of services, distributed in 18 Health Regions corresponding to each of the departments and the capital, Asuncion. It serves the population that lacks public or private insurance. The IPS serves enrolled wage workers with its own network of service providers and is financed with contributions from workers, employers, and the public sector.

The Army and Police Health cover, respectively, active and retired military and police officers, their families, as well as the civilian population in places without other providers. Their funds come from the public budget, and they have their own services network. The National University of Asuncion has a hospital/school affiliated with the Faculty of Medicine; it is financed mainly with public resources and covers mainly the poor, uninsured population.

Decentralized hydroelectric companies Itaipú and Yacyretá are also financed with public resources. They offer ambulatory care in their own facilities and medical insurance to their officials, former officials, and family members. They also offer services such as preventive medicine and medical assistance to the population residing within the area where they operate.

Institutions providing lucrative private health services are financed through private insurance premiums and out-of-pocket payments, while non-profit health service providers are financed

through donations and own resources. Mixed institutions are financed by a combination of these two types of resources.

3.3 Minimum wage²⁶

The minimum wage (MW) was established in Paraguay in 1943. Since then, the president periodically updates it. Every new MW is valid for two years although it can be updated if accumulated inflation reaches 10%, or above, since the last MW level.²⁷ In practice, the level of MW is the accumulation of adjustment decisions, sparingly supported by specific studies, and motivated by different circumstances at different times.

The “minimum wage for unspecified activities” is general along with many minimums determined for specific occupations. The general MW does not apply to public wage employees, self-employed, family workers, or employers. Exemptions are also present for workers under the age of 18 in apprenticeships contracts and persons with deficient physical or mental capacity. In other cases, like for domestic workers, remuneration in money may be less than MW.²⁸

The MW is established in monthly terms, and the regulation (Law #213) dictates that payment per day cannot be lower than the monthly MW. On the other hand, regulations establish a maximum of 8 hours per day or 48 hours per week.²⁹ Based on this, in this study, the hourly MW is calculated as $\text{monthly MW} / 4.33 / 48$ (4.33 being the average number of weeks in a month in a year).

²⁶ Based on Damill & Frenkel (2003)

²⁷ Law No. 213/93, “Labor Code,” and complementary laws.

²⁸ But not the total remuneration, including that received in benefits or in kind.

²⁹ Although these maximums vary by occupation, the worker’s age or if the job is done at night.

4 Data

The panel data used is the Continuous Employment Survey (*Encuesta Continua de Empleo*, ECE) carried out by the National Statistics Department of Paraguay (DGEEC). The total dataset includes 64,056 observations covering 20 quarters from 2010q1 to 2014q4. The geographic coverage includes Asunción as well as the urban areas in the Central department, representing about 40% of the national workforce and a little more than 60% of the urban workforce (2011 figures). The panel is unbalanced, i.e., data is not available for all quarters for all individuals.

The panel rotation scheme considers the quarterly periodicity. A sample-selected household is interviewed in a certain month 1; it is not interviewed during the next two (2) months and interviewed again at the third month of its first interview, i.e., in month 4. This sequence of visits is repeated 5 times, whereby the household remains in the sample for 15 months and are interviewed 5 times in these months. A household stays in the panel for a maximum of 5 consecutive quarters. A partial sample replacement is done every sixth quarter and the sample is completely changed at the end of 5 years (20 quarters). I use the 2010–2014 data for which partial sample changes are present in 2011q2, 2012q3, and 2013q4.³⁰

5 Descriptive statistics

I define informal workers as those not making pension contributions and formal workers as those making pension contributions. Even if not mandatory for all workers, pension contributions have been one of the main informality definitions used for Paraguay (Ruppert Bulmer et al., 2017; Ayala, 2016; González, 2010). On the household survey data, information on pensions is available

³⁰ Further details on the number of observations in the panel data can be observed in annex table 21.

for all years³¹ and is highly correlated with larger firms and job quality indicators (Table 8). Just 31% of all workers contribute to pensions. Contributors are concentrated in large firms and have labor contracts and higher wages. Interestingly, even at large firms, 49% of workers do not contribute to pensions, and non-contributing workers can also have high wages with about 54% of those working above 1 monthly, or hourly MW, not contributing to pensions.

Table 23. Pension contributions and labor market variables, age 15+, row shares (%), 2010-2014

		<i>Contrib. to pension</i>	
		<i>No</i>	<i>Yes</i>
<i>All workers</i>		68.6	31.4
<i>Firm size</i>	5 or less emps.	99.3	0.7
	more than 5 emps.	49.2	50.8
<i>Has contract</i>	No	95.2	4.8
	Yes	26.1	73.9
<i>Wage above 1 monthly MW</i>	No	84.7	15.3
	Yes	52.8	47.2
<i>Wage above 1 hourly MW</i>	No	85.3	14.7
	Yes	53.9	46.1

Source: Own estimates based on ECE microdata. Note: Hourly MW = monthly MW / 4.33 / 48. Based on un-weighted frequencies.

As is usual in developing countries (Cunningham, 2001), labor status differs substantially on gender (Table 9). More than 68% of male workers are wage employees compared to just 49% female. Private wage employment is predominant among male workers, with 54% of them in this category, while just about 32% of women have this type of job. Additionally, wage public employment is slightly more prevalent among men than among women: 17% compared to 14% respectively. More women are self-employed, with 26% of them in this type of employment and just 19% of men. A large share of women are domestic workers: 16% compared to less than 1% men. About

³¹ Another option would be the use of Tax Registry (*Registro Único del Contribuyente*, RUC), mandatory for tax purposes. Unfortunately, this data is unavailable in the household panel survey for years 2010 and 2011.

10% of male workers are employers, about 5 pps higher than the share of female employers. Finally, more women are unpaid family workers, with 4% of women in this type of job and just 2% men. In line with this, the rest of the analysis below is carried out depicting results for men and women separately.

Table 26. Labor status shares of workers by gender, % workers, 2010-2014

	<i>Male</i>	<i>Female</i>
Unpaid family worker	1.6	4.2
Employer	10.0	4.5
Self-employed	19.1	25.9
Domestic worker	1.0	16.2
Wage private	54.2	32.5
Wage public	14.2	16.7

Source: Own estimates based on household panel survey data. Note: Hourly MW = monthly MW / 4.33 / 48. Based on un-weighted frequencies.

Informal employment is used as an option to fight unemployment, given the limited movement into formality (Table 10). Most individuals stay inactive, 76% (82%) of men (women), and those leaving inactivity move majorly into informality, 16% (13%) of men (women), or unemployment, 7% (5%) of men (women), and less than 1% into formality. Unemployed individuals shift significantly different based on gender. Both unemployed men and women obtain informal jobs; however, while 46% of male workers do this transition, only 31% of women do the same. This is explained by the larger unemployed-to-inactive movement among women, which is 32% compared with 19% among men.

Informal workers are far more prone to become unemployed or inactive, and few move into formality. Among male workers who start informal, 7% of them move into inactive, and 4% become unemployed, compared with 0.6% and 1.5% among formal workers. This is even more pronounced among female workers: 13% move into inactive, 4% become unemployed, compared with 1.4% and 1% among formal workers. Just 6% of male and 4% of female workers become

formal workers. On the other hand, formal workers seem to use informal employment as an option against unemployment or inactivity: 11% of formal male workers move into informality compared to 9% of women.

Table 29. Inactive, unemployed, informal and formal transitions, age 15+

		Male					Female				
		<i>Quarter t</i>					<i>Quarter t</i>				
		Inactive	Unemployed	Informal	Formal	Total	Inactive	Unemployed	Informal	Formal	Total
<i>Frequencies</i>											
Quarter t-1	Inactive	2,335	210	496	18	3,059	5,405	330	863	24	6,622
	Unemployed	162	259	388	30	839	288	315	281	21	905
	Informal	511	324	6,458	462	7,755	833	241	5,120	273	6,467
	Formal	24	57	412	3,397	3,890	35	26	235	2,290	2,586
<i>Total</i>		3,032	850	7,754	3,907	15,543	6,561	912	6,499	2,608	16,580
<i>Row shares</i>											
Quarter t-1	Inactive	76.3	6.9	16.2	0.6	100	81.6	5.0	13.0	0.4	100
	Unemployed	19.3	30.9	46.2	3.6	100	31.8	34.8	31.0	2.3	100
	Informal	6.6	4.2	83.3	6.0	100	12.9	3.7	79.2	4.2	100
	Formal	0.6	1.5	10.6	87.3	100	1.4	1.0	9.1	88.6	100
<i>Total</i>		19.5	5.5	49.9	25.1	100	39.6	5.5	39.2	15.7	100

Source: Own estimates based on ECE household panel survey data. Notes: Informal if making pension contributions, formal if making pension contributions.

Most workers stay formal or informal, with those staying informal having lower wages than if staying formal, especially among women (Table 11). More than 90% of workers stay formal; 89% of male and 95% for female workers stay informal, clearly indicating that the transition between informal and formal employment are limited. For all four transition groups, female workers have lower monthly wages than their male counterparts, especially if staying informal: average monthly wage among female workers is 73% of male workers' monthly wages. On the other hand, men have higher hourly wages only if staying informal.³²

³² The main reason the wage gender gap in favor of women when using hourly wages is related with the lower number of hours among female workers in formal positions. Formal female workers have an average of 42 weekly hours in their main occupation, compared with 49.6 among formal male workers. In addition, 50% (30%) of formal men (women) work 48 hours or more.

All four transition groups have larger wages with higher increases present among workers moving into formality. The lowest, but still positive, increase in wages is present among workers moving into informality. Percent increase in both monthly and hourly wages is similar among workers staying informal or formal. The largest increase of 23% is at monthly wages among female workers moving into formality, also large among men at 14%. The increase is also sizable at hourly wages: 17% (14%) among male (female) workers moving into formality.

Table 32. Informal-formal transitions, 2010-2014

		<i>Male</i>		<i>Female</i>	
		<i>Quarter t</i>		<i>Quarter t</i>	
	<i>Quarter t-1</i>	Informal	Formal	Informal	Formal
<i>Frequency</i>	Informal	6,458	462	5,120	273
<i>(unweighted)</i>	Formal	412	3,397	235	2,290
<i>Row share</i>	Informal	93.3	6.7	90.7	9.3
<i>(%)</i>	Formal	10.8	89.2	5.1	94.9
<i>Monthly wage</i>	Informal	569.0	739.6	416.4	662.9
<i>(2005 USD PPP)</i>	Formal	707.1	876.8	671.8	826.4
<i>Hourly wage</i>	Informal	3.1	3.8	2.7	3.9
<i>(2005 USD PPP)</i>	Formal	3.8	4.5	4.2	5.0
<i>Change monthly</i>	Informal	9.3	14.3	9.7	23.0
<i>wage (%)</i>	Formal	3.7	8.7	2.9	9.6
<i>Change hourly</i>	Informal	11.8	17.2	12.1	14.0
<i>wage (%)</i>	Formal	10.2	11.1	6.3	11.7

Source: Own estimates based on ECE data. Notes: Informal if making pension contributions, formal if making pension contributions.

Informal employment state dependence is stronger than the formal state dependence (Table 12). Of all workers who start informal in round 1, about 92% stayed informal on the fifth round with little difference between male and female. Instead, of all workers starting formal at round 1, 87% of male and 89% of female workers remain formal by the fifth round. This indicates that formal workers are more prone to leave formality than informal workers to leave informality.

Table 35. Informal/formal rates, 2010-2014

Round	<i>Informality rate if informal at round 1</i>		<i>Formal rate if formal at round 1</i>	
	Male	Female	Male	Female
1	100.0	100.0	100.0	100.0
2	93.8	94.5	89.4	90.1
3	93.2	93.7	87.1	88.4
4	92.8	92.7	86.4	89.8
5	92.4	92.5	87.2	89.1

Source: Own estimates based on ECE data. Notes: Informal if making pension contributions, formal if making pension contributions.

Workers making informal-formal transitions are mostly young, single, without children, and more educated—characteristics that are more accentuated among women (Table 13). Among both men and women, workers staying formal have a higher share of workers between 30 and 49 years of age compared to workers staying informal. Workers moving into formal or informal employment are largely young, aged 15–29. Interestingly, the presence of youth is even larger among workers moving into informality, but the presence of workers aged 30–39 is larger among workers moving into informality. This could be indicating that movements into formality are possible but short-lived among young workers, who are being forced to move into informality as they age.

Single workers or workers with no children are more likely to move into formality or informality. This is especially evident among women: 43% of single women move into formality and 41% without children, compared with 41% and 37% among men respectively, and 43% of single women move into informality and 38% without children, compared with 37% and 36% among men respectively.

The more educated are widely more present in workers staying formal and also among those making transitions, especially among women. While 46% of male workers staying formal have secondary incomplete or complete, 76% of female workers staying formal have tertiary incomplete

or complete. At the same time, while male workers who move into formality or informality are about evenly spread from secondary incomplete to tertiary complete, female workers making the same transitions have mainly tertiary incomplete or complete: about 67% of those moving into formality or of those moving into informality. In few words, education makes a significant difference in staying formal as well as allowing informal-formal transitions among women.

Workers staying formal or moving into formality are highly concentrated in large firms while those staying informal are concentrated in smaller size firms (Table 14). Workers staying formal are located mostly in large firms—68% (61%) of men (women) in firms with 50 employees or more. The same is true for workers moving into formality—51% (50%) of men (women) in firms with 50 employees or more. Workers staying informal, on the other hand, are mostly present in smaller firms—41% (29%) of men (women) on firms with 2–5 employees followed by 26% (28%) in alone. Interestingly, a sizeable share of workers staying informal is in large firms, 11% (31%) of men (women), indicating some poor law enforcement on these firms.

With a very small share of workers in agriculture, workers staying formal are concentrated in services, especially among women. Among male (female) workers staying formal, 76% (90%) of them are in services. A higher share of workers is in the industry or agriculture sector among those staying informal—33% of men and 11% of women. There is not much difference in the share of workers across sectors among those moving into formality or informality.

Table 38. Workers demographic characteristics, age 15+, 2010-2014

Variable		Male				Female			
		Stay formal	Stay informal	Informal-to-formal	Formal-to-informal	Stay formal	Stay informal	Informal-to-formal	Formal-to-informal
<i>Frequencies</i>									
All		3,397	6,458	462	412	2,290	5,120	273	235
<i>Age</i>	[15-29]	1,064	2,190	208	151	663	1,555	133	98
	[30-39]	966	1,265	93	99	684	1,093	60	62
	[40-49]	749	1,221	71	81	512	1,048	37	35
	[50-59]	516	1,057	67	54	365	854	30	28
	60+	102	725	23	27	66	570	13	12
<i>Marital status</i>	Single	1,035	2,224	189	152	836	1,763	117	102
	Ever married	2,362	4,234	273	260	1,454	3,357	156	133
<i># age [0-14] in household</i>	None	1,198	2,418	173	148	887	1,826	111	89
	At least one	2,199	4,040	289	264	1,403	3,294	162	146
<i>Education</i>	Less than primary	77	652	8	13	22	560	1	2
	Primary complete	122	664	25	33	46	663	14	11
	Secondary incomplete	506	1,836	90	76	112	1,111	21	15
	Secondary complete	969	1,224	127	112	343	887	49	45
	Tertiary incomplete	706	767	89	67	669	719	75	66
	Tertiary complete	812	623	99	87	972	625	98	80
<i>Shares (%)</i>									
All		100	100	100	100	100	100	100	100
<i>Age</i>	[15-29]	31.3	33.9	45.0	36.7	29.0	30.4	48.7	41.7
	[30-39]	28.4	19.6	20.1	24.0	29.9	21.3	22.0	26.4
	[40-49]	22.0	18.9	15.4	19.7	22.4	20.5	13.6	14.9
	[50-59]	15.2	16.4	14.5	13.1	15.9	16.7	11.0	11.9
	60+	3.0	11.2	5.0	6.6	2.9	11.1	4.8	5.1
<i>Marital status</i>	Single	30.5	34.4	40.9	36.9	36.5	34.4	42.9	43.4
	Ever married	69.5	65.6	59.1	63.1	63.5	65.6	57.1	56.6
<i># age [0-14] in household</i>	None	35.3	37.4	37.4	35.9	38.7	35.7	40.7	37.9
	At least one	64.7	62.6	62.6	64.1	61.3	64.3	59.3	62.1
<i>Education</i>	Less than primary	2.4	11.3	1.8	3.4	1.0	12.3	0.4	0.9
	Primary complete	3.8	11.5	5.7	8.5	2.1	14.5	5.4	5.0
	Secondary incomplete	15.9	31.8	20.5	19.6	5.2	24.3	8.1	6.8
	Secondary complete	30.4	21.2	29.0	28.9	15.9	19.4	19.0	20.5
	Tertiary incomplete	22.1	13.3	20.3	17.3	30.9	15.8	29.1	30.1
	Tertiary complete	25.4	10.8	22.6	22.4	44.9	13.7	38.0	36.5

Source: Own estimates based on ECE data. Notes: Informal if making pension contributions, formal if making pension contributions. Ever married includes married, united, separated, widow and divorced.

Table 41. Workers labor characteristics by informality transitions, age 15+

Variable	<i>Male</i>				<i>Female</i>			
	Stay formal	Stay informal	Informal-to-formal	Formal-to-informal	Stay formal	Stay informal	Informal-to-formal	Formal-to-informal
<i>Frequencies</i>								
<i>Firm size</i>								
Alone	5	1,603	5	48	4	1,399	9	26
[2-5]	92	2,543	53	77	113	1,458	23	40
[6-10]	145	633	35	35	137	255	31	21
[11-20]	269	364	42	27	184	149	24	24
[21-50]	409	297	59	56	368	155	28	19
[50+]	1,981	679	201	93	1,249	1,551	117	82
<i>Sector</i>								
Agriculture	11	174	4	11	1	55	3	3
Industry	799	1,980	123	106	219	518	33	25
Services	2,587	4,304	335	295	2,070	4,547	237	207
<i>Shares (%)</i>								
<i>Firm size</i>								
Alone	0.2	26.2	1.3	14.3	0.2	28.2	3.9	12.3
[2-5]	3.2	41.6	13.4	22.9	5.5	29.4	9.9	18.9
[6-10]	5.0	10.3	8.9	10.4	6.7	5.1	13.4	9.9
[11-20]	9.3	5.9	10.6	8.0	9.0	3.0	10.3	11.3
[21-50]	14.1	4.9	14.9	16.7	17.9	3.1	12.1	9.0
[50+]	68.3	11.1	50.9	27.7	60.8	31.2	50.4	38.7
<i>Sector</i>								
Agriculture	0.3	2.7	0.9	2.7	0.0	1.1	1.1	1.3
Industry	23.5	30.7	26.6	25.7	9.6	10.1	12.1	10.6
Services	76.2	66.6	72.5	71.6	90.4	88.8	86.8	88.1

Source: Own estimates based on ECE data. Notes: Informal if making pension contributions, formal if making pension contributions.

6 Regressions

With regressions, I evaluate the correlation of individual demographic and economic variables in informality while controlling for other factors. Using informality dummy as the dependent variable, point estimates on education, sector, or firm size for all informal-formal workers indicate how workers' characteristics correlate with the probability of moving into formality or informality. Given the state's dependence relevance of informal/formal employment, I use survival models. These models exploit the total history of workers' informal or formal employment to obtain estimates of the probability of moving into formality or informality. I present the estimates of the AMEs from the second to the fifth round in the panel for all demographic and labor variables

presented above.³³ AMEs show how each covariate's estimated effect on the hazard³⁴ changes with each successive panel round with respect to the baseline hazard.³⁵ In addition, I obtain additional OLS and Fixed Effects estimates using the logarithm of hourly wages as the dependent variable to also evaluate the wage gaps across informal-formal transition groups while controlling for other factors.

AMEs estimates on the probability of moving into formality can be seen in Table 15. The results indicate that education and firm size play the most significant role in increasing the probability of moving into formality. Point estimates are positive and highly significant at almost all education levels. Values indicate increasingly higher probabilities of moving with higher education and panel round. This is even more pronounced among female workers, for whom we obtain significant point estimates even at primary complete (relative to less than primary), and while point estimates are lower among male workers at secondary incomplete and complete, they are higher at tertiary incomplete and complete. The larger point estimates at each panel round indicate how higher education becomes more critical to move into formality as the worker spends more time in informality.

As with education, AMEs are positive and highly significant at larger firm sizes and panel round. Point estimates start negative and significant at 5% among male workers and going from -1.4 pps in round 1 to -5.1 pps in round 5. These estimates get increasingly higher at larger firm

³³ All survival estimates use a Weibull model. Hazard ratio estimates can be seen in Table 22.

³⁴ In this case, the hazard is the probability that an individual will move into formality/informality.

³⁵ Baseline hazard is the hazard corresponding to a reference individual with all covariate values equal to zero.

sizes getting to 10.8 (3.7) pps in round 1 to 40.4 (16.3) pps in round 5 among male (female) workers at firms with 50 or more employees.

Estimates indicate that age plays a significant role among female workers. AMEs point estimates are marginally significant at 10% only for workers in the age range 30–39 among male workers. Among women, point estimates for older age groups get increasingly higher getting to -3.3 pps at age 60 or more in round 1 to -14.7 pps in round 5. This indicates that older women are less likely to move into informality increasingly, so more time is spent in informality.

The factors marital status and children only have an effect among women. AMEs point estimates on ever married are positive and highly significant, indicating that married women have a higher probability of moving into formality. On the other hand, point estimates on children are negative and marginally significant but get larger at higher rounds, i.e., the presence of children in the household reduces the probability of moving into formality.

AMEs estimates for moving into informality are considerably different based on gender (Table 16). Point estimates are negative and significant for ages 30 to 59 among women with almost no difference by panel round, i.e., workers on these age groups have a lower probability of moving into informality—independent of the time spent being formal.

Surprisingly, estimates indicate that education plays no significant role in movements into informality. The only significant estimates at 5% are positive for primary complete among men, i.e., having primary complete increases the probability of moving into informality. For all other education levels, point estimates are statistically non-significant. This could be indicating that, for workers who start formal, education is not correlated with moving into informality.

Table 44. Average marginal effects (AMEs) on moving into formality if starting informal, age 15+ workers by gender and panel round

	<i>Male</i>				<i>Female</i>			
	<i>Round</i>				<i>Round</i>			
	2	3	4	5	2	3	4	5
<i>Age</i>								
<i>(relative to [15-29])</i>								
[30-39]	-0.019*	-0.033*	-0.049*	-0.063*	-0.011	-0.020	-0.032	-0.047
	(0.011)	(0.018)	(0.026)	(0.034)	(0.009)	(0.017)	(0.028)	(0.042)
[40-49]	-0.011	-0.020	-0.029	-0.037	-0.016*	-0.030*	-0.048*	-0.073*
	(0.012)	(0.021)	(0.031)	(0.040)	(0.009)	(0.017)	(0.028)	(0.042)
[50-59]	0.002	0.004	0.006	0.008	-0.026***	-0.049***	-0.078***	-0.117***
	(0.016)	(0.029)	(0.043)	(0.055)	(0.010)	(0.018)	(0.029)	(0.043)
[60+]	-0.016	-0.028	-0.042	-0.054	-0.033***	-0.062***	-0.098***	-0.147***
	(0.018)	(0.033)	(0.048)	(0.061)	(0.011)	(0.020)	(0.031)	(0.046)
<i>Education level</i>								
<i>(relative to less than primary)</i>								
Primary complete	0.014	0.025	0.038	0.051	0.014***	0.027***	0.042***	0.062***
	(0.011)	(0.020)	(0.029)	(0.039)	(0.005)	(0.009)	(0.014)	(0.021)
Secondary incomplete	0.026***	0.047***	0.069***	0.094***	0.013***	0.024***	0.038***	0.056***
	(0.009)	(0.015)	(0.022)	(0.030)	(0.005)	(0.008)	(0.012)	(0.018)
Secondary complete	0.059***	0.106***	0.158***	0.214***	0.039***	0.075***	0.117***	0.172***
	(0.013)	(0.022)	(0.031)	(0.043)	(0.010)	(0.018)	(0.028)	(0.041)
Tertiary incomplete	0.042***	0.075***	0.112***	0.152***	0.062***	0.120***	0.187***	0.275***
	(0.012)	(0.021)	(0.030)	(0.042)	(0.017)	(0.029)	(0.042)	(0.061)
Tertiary complete	0.077***	0.137***	0.204***	0.277***	0.070***	0.137***	0.212***	0.313***
	(0.019)	(0.031)	(0.044)	(0.059)	(0.016)	(0.026)	(0.038)	(0.056)
Ever married	0.011	0.019	0.029	0.037	0.022***	0.040***	0.063***	0.093***
<i>(relative to single)</i>	(0.009)	(0.016)	(0.024)	(0.030)	(0.008)	(0.014)	(0.021)	(0.032)
At least one children [0-14] in	-0.008	-0.014	-0.020	-0.026	-0.016*	-0.030*	-0.048**	-0.071**
household (relative to none)	(0.008)	(0.015)	(0.022)	(0.028)	(0.008)	(0.015)	(0.024)	(0.036)
<i>Firm size at start</i>								
<i>(relative to [2-5])</i>								
Alone	-0.014**	-0.025**	-0.037**	-0.051**	-0.003	-0.006	-0.010	-0.014
	(0.006)	(0.012)	(0.018)	(0.024)	(0.005)	(0.010)	(0.016)	(0.024)
[6-10]	0.020*	0.037*	0.056*	0.077*	0.038**	0.072**	0.114***	0.165***
	(0.012)	(0.021)	(0.032)	(0.044)	(0.016)	(0.028)	(0.043)	(0.062)
[11-20]	0.045***	0.082***	0.124***	0.170***	0.042**	0.081**	0.129**	0.187**
	(0.018)	(0.031)	(0.047)	(0.065)	(0.020)	(0.038)	(0.059)	(0.086)
[21-50]	0.057***	0.104***	0.157***	0.215***	0.058***	0.110***	0.175***	0.254***
	(0.022)	(0.038)	(0.057)	(0.078)	(0.022)	(0.040)	(0.061)	(0.087)
[50+]	0.108***	0.196***	0.296***	0.404***	0.037***	0.071***	0.113***	0.163***
	(0.021)	(0.033)	(0.048)	(0.066)	(0.012)	(0.020)	(0.031)	(0.044)
<i>Sector at start</i>								
<i>(relative to industry)</i>								
Agriculture	-0.016	-0.027	-0.040	-0.052	0.012	0.021	0.034	0.050
	(0.025)	(0.043)	(0.064)	(0.082)	(0.065)	(0.118)	(0.189)	(0.278)
Services	-0.003	-0.005	-0.007	-0.009	-0.018	-0.033	-0.053	-0.079
	(0.009)	(0.016)	(0.024)	(0.031)	(0.016)	(0.028)	(0.046)	(0.068)
Observations	1684	1204	994	830	1338	932	760	603

Source: Own estimates based on ECE data. Notes: Informal if making pension contributions, formal if making pension contributions. Estimates obtained from survival-time regressions using a Weibull survival function. * p<0.1 ** p<0.05 *** p<0.01

AME estimates are significant at different firm sizes but only among male workers and slightly decreasing with panel round. For alone, AME estimates are significant at 10% indicating 29 pps in round 1 to 27 pps in round 5. AME estimates increase with larger firm sizes to up to -17 pps in round 1 to -16 in round 5 for firms with 50 or more employees.

By sector, we only obtain an AME significant estimate in agriculture among females, but with just 3 female workers moving from formal-to-informal (Table 14), this estimate becomes irrelevant. We obtain no significant AMEs estimate for marital status or children for both male and female workers.

Mincer regressions presented in Table 17 show that while workers in other transition groups gain significantly more than workers staying informal, individual workers gain little from moving into formality. Male (female) workers staying informal gain the most with monthly wages 23% (24%) higher than those staying informal, and even those moving into informality gain 7.2% (17%) more. Fixed effects estimates, which capture within individuals' wage variations, indicate that these gains are only 5.8% for men (7.7% for women). Gains in hourly wages are lower, with male (female) workers staying formal gaining 19.7% (11%), moving into formality 17.3% (11.7%) and moving into informality 8.2% (16.7%) more than those staying informal. And Fixed Effects estimates on hourly wages are non-significant, i.e., individual workers do not have significant gains in hourly wages from moving into formality.

Table 47. Average marginal effects (AME) on moving into informality if starting formal, age 15+ workers by gender and panel round

	<i>Male</i>				<i>Female</i>			
	<i>Round</i>				<i>Round</i>			
	2	3	4	5	2	3	4	5
<i>Age</i>								
<i>(relative to [15-29])</i>								
[30-39]	-0.008 (0.016)	-0.007 (0.015)	-0.007 (0.015)	-0.007 (0.014)	-0.040* (0.021)	-0.038* (0.020)	-0.037* (0.019)	-0.039* (0.020)
[40-49]	-0.007 (0.018)	-0.006 (0.017)	-0.006 (0.016)	-0.006 (0.016)	-0.059*** (0.022)	-0.056*** (0.021)	-0.054*** (0.020)	-0.057*** (0.021)
[50-59]	-0.033* (0.019)	-0.031* (0.019)	-0.030* (0.018)	-0.029* (0.017)	-0.055** (0.024)	-0.052** (0.023)	-0.051** (0.022)	-0.053** (0.023)
[60+]	0.053 (0.048)	0.050 (0.046)	0.048 (0.044)	0.047 (0.042)	-0.050 (0.039)	-0.047 (0.037)	-0.046 (0.036)	-0.048 (0.037)
<i>Education level</i>								
<i>(relative to less than primary)</i>								
Primary complete	0.125** (0.058)	0.117** (0.054)	0.114** (0.053)	0.114** (0.053)	0.059 (0.128)	0.055 (0.118)	0.054 (0.117)	0.056 (0.120)
Secondary incomplete	0.023 (0.042)	0.022 (0.040)	0.021 (0.039)	0.021 (0.039)	-0.034 (0.104)	-0.032 (0.096)	-0.031 (0.095)	-0.032 (0.097)
Secondary complete	-0.002 (0.041)	-0.002 (0.039)	-0.002 (0.038)	-0.002 (0.038)	-0.052 (0.099)	-0.048 (0.091)	-0.047 (0.090)	-0.049 (0.093)
Tertiary incomplete	-0.015 (0.042)	-0.014 (0.039)	-0.014 (0.038)	-0.014 (0.038)	-0.085 (0.098)	-0.078 (0.090)	-0.077 (0.089)	-0.080 (0.092)
Tertiary complete	-0.009 (0.041)	-0.009 (0.038)	-0.008 (0.037)	-0.008 (0.037)	-0.083 (0.097)	-0.076 (0.090)	-0.075 (0.089)	-0.078 (0.091)
Ever married (relative to single)	-0.024 (0.016)	-0.023 (0.016)	-0.022 (0.015)	-0.021 (0.015)	-0.006 (0.015)	-0.005 (0.013)	-0.005 (0.013)	-0.005 (0.013)
At least one children [0-14] in household (relative to none)	-0.008 (0.013)	-0.007 (0.013)	-0.007 (0.012)	-0.007 (0.012)	0.010 (0.014)	0.009 (0.013)	0.009 (0.012)	0.009 (0.013)
<i>Firm size at start</i>								
<i>(relative to [2-5])</i>								
Alone	0.290* (0.160)	0.286* (0.158)	0.281* (0.156)	0.273* (0.151)	0.798 (0.620)	0.764 (0.593)	0.745 (0.578)	0.723 (0.561)
[6-10]	-0.077 (0.054)	-0.076 (0.054)	-0.075 (0.053)	-0.073 (0.051)	0.018 (0.044)	0.017 (0.042)	0.017 (0.041)	0.016 (0.040)
[11-20]	-0.153*** (0.051)	-0.151*** (0.051)	-0.148*** (0.050)	-0.144*** (0.049)	-0.045 (0.038)	-0.043 (0.037)	-0.042 (0.036)	-0.041 (0.035)
[21-50]	-0.115** (0.051)	-0.113** (0.050)	-0.111** (0.050)	-0.108** (0.048)	-0.043 (0.036)	-0.041 (0.035)	-0.040 (0.034)	-0.039 (0.033)
[50+]	-0.170*** (0.049)	-0.168*** (0.048)	-0.165*** (0.047)	-0.160*** (0.046)	-0.046 (0.034)	-0.044 (0.033)	-0.043 (0.032)	-0.041 (0.031)
<i>Sector at start</i>								
<i>(relative to industry)</i>								
Agriculture	0.062 (0.083)	0.058 (0.079)	0.056 (0.075)	0.054 (0.074)	0.932** (0.415)	0.891** (0.394)	0.854** (0.386)	0.866** (0.391)
Services	-0.005 (0.013)	-0.005 (0.012)	-0.004 (0.012)	-0.004 (0.011)	-0.034 (0.026)	-0.033 (0.025)	-0.031 (0.024)	-0.032 (0.025)
Observations	933	663	502	385	621	435	345	284

Source: Own estimates based on ECE data. Notes: Informal if making pension contributions, formal if making pension contributions. Estimates obtained from survival-time regressions using a Weibull survival function. * p<0.1 ** p<0.05 *** p<0.01

Table 49. Mincer regressions, log(wage 2005 USD PPP), age 15+ workers by gender

	<i>OLS</i>				<i>Fixed effects</i>	
	<i>Male</i>	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>	<i>Female</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Monthly</i>						
Formal-informal transition (relative to staying informal)						
Stay formal	0.534*** (0.021)	0.815*** (0.027)	0.233*** (0.022)	0.242*** (0.031)		
Informal-to-formal	0.356*** (0.032)	0.605*** (0.040)	0.211*** (0.027)	0.203*** (0.040)		
Formal-to-informal	0.305*** (0.040)	0.639*** (0.053)	0.073** (0.034)	0.167*** (0.049)		
Formal					0.058** (0.026)	0.077** (0.039)
<i>Hourly</i>						
Formal-informal transition (relative to staying informal)						
Stay formal	0.489*** (0.023)	0.772*** (0.029)	0.197*** (0.024)	0.134*** (0.031)		
Informal-to-formal	0.300*** (0.038)	0.532*** (0.047)	0.173*** (0.032)	0.117*** (0.042)		
Formal-to-informal	0.303*** (0.043)	0.631*** (0.058)	0.082** (0.035)	0.167*** (0.051)		
Formal					0.043 (0.030)	0.017 (0.039)
<i>Controls</i>	No	No	Yes	Yes	Yes	Yes
Observations	8296	6247	8296	6247	8296	6249

Source: Own estimates based on ECE data. Notes: Informal if making pension contributions, formal if making pension contributions. OLS regressions using robust standard errors. Controls include age, education, marital status, number of children in household, firm size and sector. Dummies per year-quarter and constant included. * p<0.1 ** p<0.05 *** p<0.01

7 Conclusions

This study analyzes the dynamics of Paraguayan informal labor markets using a quarterly household survey panel data for years 2010 to 2014. Until recently, these types of studies were scarce due to the lack of panel data in developing countries. As these new sources of data become available, they can provide more insights on how labor markets work in low-income settings.

Descriptive analysis indicates that movements between informal and formal employment are rare, but the Paraguayan labor market is dynamic. Most workers stay formal or informal, but

informal employment is used as an option against unemployment by both unemployed individuals as well as formal workers, given the limited movement into formality. This is clearly a second-best chosen by individuals as informal workers are far more prone to become unemployed or inactive, which is something more pronounced among women.

Workers staying informal have lower wages than if staying formal or moving into formality or informality. Among these transition groups, female workers have lower monthly wages than their male counterparts, especially if staying informal. On the other hand, men have higher hourly wages only if staying informal. While women have lower monthly wages systematically, they only have lower hourly wages if they stay informal.

All four transition groups have quarterly wage gains with larger increases present among workers moving into formality. The lowest, but still positive, increase in wages is present among workers moving into informality. Percent increase in both monthly and hourly wages is similar among workers staying informal or formal. The largest increase of 23% is at monthly wages among female workers moving into formality and also large among men at 14%. The increase is also sizable at hourly wages: 17% (14%) among male (female) workers moving into formality. The similar wage gains, if staying informal or formal, could partially explain the limited movement into formality.

Almost all workers remain informal for the entire panel while formal workers are more likely to move into informality. The few workers making informal-formal transitions are mostly young, single, without children, and more educated. Workers staying formal or moving into formality are highly concentrated in large firm while those staying informal are concentrated in smaller size firms.

AMEs estimates, obtained from survival models for informal-formal transitions, show that education and firm size play the most significant role in increasing the probability of moving into formality. Education and firm size are highly correlated with higher probabilities of becoming formal, with increasingly larger estimates at higher education levels and firm sizes. The survival model also indicates that these effects are increasing with panel round: as workers stay longer in informality, education and firm size have a more significant role in moving into formality.

Factors correlated with transitions into informality differ significantly based on gender. AMEs indicate that older women have a lower probability of becoming informal. Estimates for firm size are significant only among male workers and slightly decreasing with panel round. Surprisingly, estimates indicate that education plays no significant role in movements into informality. Estimates are also not significant for marital status, number of children, or sector.

On wages, Mincer regressions indicate that workers who do not stay informal gain significantly more, but individual workers gain little from moving into formality. OLS estimates are positive on monthly and hourly wages for workers staying formal, moving into formality and relative to workers staying informal. Those staying formal are the ones gaining the most with estimates of 23% (24%) for men (women) on monthly wages and 20% (11%) on hourly wages. But Fixed Effects estimates, which capture within workers gains, are only 5.8% (7.7%) on monthly wages and show no significant estimates for hourly wages.

My results contrast with Ruppert Bulmer et al. (2017) who found dynamic formal-informal transitions but segmented the labor markets with men having lower probabilities of moving to formal jobs and education having no effect. I find much more segmented informal-formal labor markets with education having an impact on transitions into formality and no effect on transitions

into informality, with separate estimates for men and women. On wages, while Ruppert Bulmer et al. (2017) found no specific direction of monthly wages from informal-to-formal transitions, I identify informal-formal monthly and hourly wage gains both between and within workers.³⁶

The current data put limits on the extrapolation of these results and calls for further research. The data used covers only the urban areas of Asunción and Central, which might not represent the labor market conditions in the rest of the country. Also, the unavailability of data of Tax Registry for all quarters impedes the exploration of other definitions of informality. It only covers 20-year-quarters from 2010 to 2014 with the National Statistics Department of Paraguay currently carrying out a continuation of this survey for 20-year-quarters from 2015 to 2019. As this new data becomes available, it could provide more evidence on the dynamics of the informal labor market in Paraguay.

³⁶ Ruppert et al. (2017) reached their conclusions through different regression specifications (i) including all workers, men, and women using a dummy for male, and (ii) focusing only on informal-to-formal transition, if started informal, using AMEs estimates from a Logit model. Finally, for wages, they present a scatter plot of wages at quarter t-1 vs wages at quarter t of workers moving from informal-to-formal.

APPENDIX

Table 51. ELCA urban population characteristics, all panel vs. balancedAPPENDIX

Table 53. ELCA urban population characteristics, all panel vs. balanced

		<i>All panel</i>			<i>Balanced panel</i>		
		2010	2013	2016	2010	2013	2016
<i>Frequencies</i>		22,179	20,574	19,298	12,506	12,506	12,506
<i>Male (%)</i>		47.1	46.9	46.8	45.7	45.7	45.7
<i>Age (Ave. years)</i>		28.6	30.0	31.7	28.8	31.8	34.8
<i>Education</i>	No study	3.4	3.2	2.9	4.0	2.9	2.8
	Prim. inc.	29.8	21.2	19.0	30.8	22.4	18.4
	Prim. comp.	13.3	11.1	10.9	13.2	11.2	10.7
	Sec. inc.	16.4	24.1	25.1	16.4	24.1	24.8
	Sec. comp.	19.1	18.7	17.5	18.9	18.1	17.7
	Ter. inc.	6.1	10.0	11.9	5.5	9.4	12.2
	Ter. inc.	11.9	11.7	12.7	11.1	11.9	13.5
<i>Region</i>	Orinoquia-Amazonia		0.0			0.0	
	Atlantica	24.0	24.6	25.1	26.7	26.7	26.8
	Oriental	20.0	18.6	18.1	20.4	20.3	20.5
	Central	19.9	18.3	16.5	18.6	18.6	18.7
	Pacifica	19.9	19.2	17.4	20.0	20.0	19.9
	Bogota	16.3	13.8	12.1	14.3	14.4	14.1
	Atlantica media		0.7	2.6			
	Cundi-Boyacense		1.7	2.4			
	Eje Cafetero		2.8	3.7			
	Centro-Oriente		0.3	2.1			

Source: Author calculations based on ELCA household survey microdata.

Table 56. ELCA main labor statistics, all panel vs. balanced panel

		<i>All panel</i>			<i>Balanced panel</i>		
		2010	2013	2016	2010	2013	2016
<i># employed workage</i>		6,107	9,021	8,665	4,000	5,732	6,063
<i>Sector</i>	Agriculture, cattle and fishing	6.5	7.2	7.0	6.8	6.5	5.6
	Manufacture and mining	17.4	15.7	10.7	17.4	16.0	11.0
	Electricity, gas and water	0.6	1.1	0.8	0.6	1.2	0.7
	Construction	5.3	5.9	6.9	5.3	5.3	6.3
	Retail, restaurant and hotels	29.0	29.8	29.5	29.0	30.4	30.0
	Transport and communication	9.4	8.0	8.3	8.8	7.4	8.4
	Finance and real state	2.5	1.2	1.4	2.4	1.2	1.4
	Govt/public administration	3.1	2.6	2.0	2.8	2.4	2.0
	Other services	26.2	28.4	33.6	26.8	29.7	34.6
<i>Firm size</i>	Alone	34.1	35.3	37.9	36.2	36.5	38.4
	[2-5]	24.7	23.6	22.5	24.2	23.2	21.8
	[6-10]	6.4	6.5	6.4	6.5	6.1	6.0
	[11-19]	3.8	4.3	4.1	3.8	4.4	3.9
	[20-49]	5.7	6.9	6.2	5.6	6.6	6.2
	[50+)	25.3	23.4	22.8	23.8	23.1	23.6

Source: Author calculations based on ELCA household survey microdata.

Table 59. Replication exercise

Dependent variable		Before-after diff-in-diff			Kugler et al. (2017)		Fernandez and Villar (2016)			
					diff-in-diff		diff-in-diff		matching diff-in-diff	
		Original	Replication	Original	Replication	Original	Replication			
variable	Estimate	(1)			(2)	(3)	(4)	(5)	(6)	(7)
		[2008-2012] vs Jan-Apr13	[2008-2012] vs May-Dec13	[2008-2012] vs [2014-2016]	[2010-2012] vs 2013		2012 vs 2014		2012 vs 2014	
=1 if no pension or health	Treated * after	-0.011* (0.006)	-0.021*** (0.006)	-0.054*** (0.008)			-0.047*** [-23.7]	-0.055*** (0.002)	-0.041***	-0.052*** (0.002)
=1 if pension and health	Less than 10 MWs * after				0.124*** (0.030)	-0.008 (0.012)				
	Self-employed with more than 3 workers * after				0.008** (0.003)	0.030*** (0.006)				
Observations		2,302,195			377,669	1,242,677	590,286	597,605	590,286	597,613
Standard errors		Clustered by industry			Clustered by department		No information		No information	
Weighted		Yes			No information		No		No	
Controls	Age	x			x		x		x	
	Age squared				x					
	Gender	x			x		x		x	
	Marital status				x		x		x	
	Years of education	x			x		x		x	
	Years of education squared				x					
	Education level						x		x	
	# monthly MWs				x					
	Labor state				x					
	Firm size				x					
	Firm size * Labor state				x					
	Sector				x					
	Urban dummy						x		x	
	City group						x		x	
	Department dummy	x								
	Year dummy				x					
Weight						x		x		
January, February and December dummies							x		x	

Source: Author calculations based on GEIH microdata. Notes: Standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01

Table 62. Panel observations structure, unweighted frequencies

Year- Quarter	All panel					Total	Age 15+ and employed					Total
	Panel round						Panel round					
	1	2	3	4	5		1	2	3	4	5	
2010q1	3,146					3,146	1,474					1,474
2010q2	654	2,614				3,268	328	1,248				1,576
2010q3	165	523	2,523			3,211	62	255	1,189			1,506
2010q4	164	157	426	2,370		3,117	77	67	195	1,141		1,480
2011q1	116	160	168	410	2,396	3,250	65	76	79	196	1,103	1,519
2011q2	2,629	114	154	166	205	3,268	1,249	61	81	69	103	1,563
2011q3	400	2,417	89	141	167	3,214	179	1,148	51	68	75	1,521
2011q4	309	403	2,225	119	133	3,189	149	192	1,092	62	71	1,566
2012q1	403	285	385	1,958	108	3,139	181	124	184	911	57	1,457
2012q2	219	385	274	407	1,861	3,146	112	174	123	190	909	1,508
2012q3	1,886	215	388	283	392	3,164	910	109	175	130	187	1,511
2012q4	527	1,804	210	377	296	3,214	272	865	110	170	137	1,554
2013q1	525	523	1,558	222	400	3,228	279	279	724	110	182	1,574
2013q2	540	504	547	1,501	230	3,322	276	269	276	714	115	1,650
2013q3	486	539	516	539	1,260	3,340	246	275	279	266	602	1,668
2013q4	1,272	458	520	514	546	3,310	634	223	263	269	268	1,657
2014q1	666	1,099	486	494	520	3,265	342	539	239	240	257	1,617
2014q2	652	644	931	452	486	3,165	312	328	430	231	240	1,541
2014q3	611	664	663	726	446	3,110	305	320	317	365	208	1,515
2014q4	524	635	613	622	597	2,991	264	322	303	310	291	1,490
Total	15,894	14,143	12,676	11,301	10,043	64,057	7,716	6,874	6,110	5,442	4,805	30,947

Source: Author calculations based on ECE household survey microdata.

Table 64. Survival model hazard ratios, age 15+ workers by gender

	<i>Moving into formality if informal in round 1</i>		<i>Moving into informality if formal in round 1</i>	
	<i>Male</i>	<i>Female</i>	<i>Male</i>	<i>Female</i>
	(1)	(2)	(3)	(4)
<i>Age</i>				
<i>(relative to [15-29])</i>				
[30-39]	-0.294 (0.190)	-0.208 (0.216)	-0.093 (0.198)	-0.470** (0.239)
[40-49]	-0.142 (0.206)	-0.338 (0.246)	-0.081 (0.218)	-0.802*** (0.296)
[50-59]	0.219 (0.237)	-0.916** (0.385)	-0.485 (0.319)	-0.724** (0.356)
[60+]	-0.370 (0.363)	-0.652 (0.440)	0.478 (0.368)	-0.630 (0.629)
<i>Education level</i>				
<i>(relative to less than primary)</i>				
Primary complete	0.775 (0.512)	1.696 (1.068)	0.965* (0.553)	0.343 (0.782)
Secondary incomplete	1.063** (0.438)	1.650 (1.054)	0.263 (0.536)	-0.272 (0.747)
Secondary complete	1.649*** (0.445)	2.745*** (1.047)	-0.027 (0.540)	-0.440 (0.702)
Tertiary incomplete	1.348*** (0.452)	3.215*** (1.041)	-0.218 (0.553)	-0.878 (0.699)
Tertiary complete	1.933*** (0.447)	3.484*** (1.039)	-0.126 (0.535)	-0.844 (0.682)
Ever married (relative to single)	0.208 (0.161)	0.439** (0.183)	-0.285 (0.182)	-0.078 (0.197)
At least one children [0-14] in household (relative to none)	-0.175 (0.137)	-0.338** (0.171)	-0.096 (0.162)	0.136 (0.198)
<i>Firm size at start</i>				
<i>(relative to [2-5])</i>				
Alone	-0.551** (0.272)	-0.387 (0.339)	0.827** (0.366)	2.123*** (0.749)
[6-10]	0.565** (0.227)	1.079*** (0.293)	-0.420 (0.284)	0.155 (0.380)
[11-20]	0.931*** (0.238)	1.289*** (0.322)	-1.132*** (0.319)	-0.540 (0.434)
[21-50]	1.193*** (0.233)	1.527*** (0.303)	-0.713*** (0.263)	-0.504 (0.384)
[50+]	1.545*** (0.177)	1.073*** (0.243)	-1.407*** (0.238)	-0.546 (0.336)
<i>Sector at start</i>				
<i>(relative to industry)</i>				
Agriculture	-0.350 (0.464)	0.284 (0.792)	0.554 (0.585)	2.319*** (0.475)
Services	-0.055 (0.155)	-0.417 (0.263)	-0.060 (0.158)	-0.411 (0.271)
Constant (alpha)	-5.976*** (0.491)	-7.675*** (1.074)	-1.172* (0.602)	-0.857 (0.801)
Observations	5516	4491	2483	1685

Source: Author calculations based on ECE household survey microdata. Notes: Estimates based on Weibull survival function. Constant estimates baseline hazard. Standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01

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