Payroll Taxes and Informality: Evidence from Argentina*

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Abstract

This paper studies how changes in payroll tax rates affect labor markets with widespread informality. For identification, I leverage time-varying sector-by-area and across-areas changes in payroll tax rates in Argentina with difference-in-differences analyses. Four main findings emerge. First, changes in the payroll tax rate affect informality in the expected directions: tax cuts reduce the share of informal workers while tax hikes increase it, although effect sizes are modest. Second, the effects on informality vary significantly by firm size: payroll tax cuts reduce informality among wage earners only in large firms, which account for a small proportion of overall informality, while tax hikes shift employment toward small firms and increase their already higher share of informal workers. Third, the effects on informality are mainly driven by recently hired workers: tax cuts reduce reliance on newly hired workers, who are more likely to be informal, while tax hikes increase it, and informality is most affected among newly hired workers. Fourth, wages show little response to changes in payroll tax rates, both for formal and informal workers. Overall, these results provide new insights into the effects of payroll tax rate changes on labor markets with an informal sector, and highlight the importance of firm size and worker tenure in mediating the effects on informality.

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1. Introduction

Informal employment accounts for a large share of total employment in low- and middle-income countries. Informality poses important challenges, since it complicates tax collection and the allocation of welfare expenditure, in addition to informal jobs being typically associated with lower wages, benefits, and job security for workers (Camacho et al., 2014; Gerard and Gonzaga, 2016). Informality could also imply a degree of misallocation of resources, since lower productivity informal firms face lower *de facto* costs, which allows them to compete with higher productivity formal firms within the same industries (Ulyssea, 2018; Meghir et al., 2015).

Employer-borne payroll taxes have frequently been referred to as a contributing factor to informality by affecting the costs firms face for operating formally.[1] The argument is that high payroll taxes imply a high cost of hiring formal workers, leading firms to substitute towards informal workers or to operate informally altogether, thus contributing to high levels of informality. This basic intuition can be extended to various models of informality where payroll taxes constitute a cost of operating formally (e.g. Ulyssea, 2018; Haanwinckel and Soares, 2020), and it has led to policy recommendations of reducing payroll taxes to reduce labor market informality (Pagés et al., 2017). In addition, the existence of widespread informality also bears implications for the effects of payroll tax rate changes on wages, since payroll taxes are levied only on formal workers and informal jobs are typically associated with lower wages. However, empirical evidence on the effects of payroll tax rates on labor markets with widespread informality is scarce.

In this paper, I study how labor markets with widespread informality respond to employer-borne payroll tax rate cuts and hikes. I exploit a series of payroll tax changes implemented in Argentina in the 1990s. These changes varied by geographic area and economic sector, and ended with the adoption of a uniform tax rate across areas in 2001. Starting from an almost uniform tax rate across areas, the federal government began a process of payroll tax cuts in 1993, where the basic premise was to give larger cuts to areas farther away from the City of Buenos Aires. The first tax cut reduced the national rate of 33% to values ranging between 6.6% and 23.1%, and applied only to some sectors until mid-1995, when it was extended to all sectors.[2] A new process of additional minor tax cuts started in 1998, but it was halted in 1999 due to concerns regarding the government budget deficit, leaving different tax rates by

[1] Throughout the paper, when I refer to "payroll taxes" I am referring to employer-borne payroll taxes unless otherwise noted.

[2] The sectors for which the initial tax cut applied were Primary Production, Manufacturing, Construction, Tourism, and R&D, leaving sectors like Commerce, Transportation, Financial Services, Real Estate, and several others unaffected. Taxes were temporarily increased in mid-1995 due to fiscal concerns during the Mexican currency crisis. I describe the process of cuts in more detail in Section 2.

area. Finally, all payroll tax cuts were repealed with the adoption of a 23% rate across areas in mid-2001.

I combine detailed data on all of these payroll tax rate changes with large-scale labor-force survey data that, importantly, contains information for both formal and informal workers.[3] The availability of information for both formal and informal workers allows me to explicitly analyze the effects of payroll taxes on the share of informally-employed workers and on salaries for both formal and informal workers, as opposed to analyzing administrative data –that only covers formal workers by definition– and attempting to infer what happens to informal employment and salaries.

I begin by analyzing the labor-market responses to a payroll tax cut. I leverage the fact that, starting from an almost uniform tax rate of 33% across areas, the initial tax cut in 1993 reduced this rate to values ranging between 6.6% and 23.1% depending on the area, and it applied only to some economic sectors until mid-1995. I use a difference-in-differences approach comparing the evolution of workers in sectors affected by the tax cut to that of workers in unaffected sectors. The identification assumption is that, in the absence of the tax cut, outcomes of workers in affected sectors would have followed the same trend as those in unaffected sectors, which is supported by the similar evolution of both groups across various outcomes prior to the reform.

Results show that the payroll tax cut induced a modest reduction of informality, with little-to-no effect on wages. Regarding informality, workers in affected sectors are significantly less likely to be informal after the tax cut: a 10 percentage point reduction in the payroll tax rate reduces the probability of a worker being informal by about 1.5 percentage points on average. Although consistent with intuition and simple models, this estimate indicates a modest effect: taken at face value, reducing informality by 3 percentage points would require a payroll tax cut of over 20 percentage points, which is higher than the actual payroll tax rate in many countries. This mirrors findings from other recent research that has found limited effects of policies that attempt to encourage reductions in informality (see Ulyssea, 2020).

Firm size plays a key role in the effect on informality: the tax cut reduced informality only in larger firms, which account for little informality to begin with, without shifting workers away from smaller firms, which account for most informality. In addition, the tax cut reduced the reliance on recently hired workers, who are more likely to be informal, and the overall reduction in informality is driven primarily by lower informality among these recently hired workers. These factors explain the limited effect of the payroll tax cut on reducing informality: the tax cut was not effective for reducing informality in firms that

[3] I define informality as an indicator of the worker reporting not having access to work-related social security benefits mandated by law (pension contributions, paid medical leave, etc).

account for most informality (small firms) and its effect on overall informality is through the flow of employment rather than the stock.

Regarding salaries, I find no significant effect of the payroll tax cut on hourly earnings. This contradicts predictions from standard models with only a formal labor market, since these would predict that a tax cut should increase (post-tax) wages as a response to an outward shift in the labor demand. Interestingly, I find no substantial effect on wages for either formal or informal workers after the tax cut, save for a minor and imprecisely estimated reduction for informal workers.[4]

I then turn to the labor-market responses to a payroll tax hike. I leverage the fact that, starting from different tax rates across areas ranging from 9.2% to 19.7% in 1999, a uniform tax rate of 23% was adopted for all areas in mid-2001. I use this convergence of different tax rates into a uniform level with a difference-in-differences approach, comparing the evolution of workers in areas with large tax increases relative to workers in areas with smaller tax increases. An important caveat for this analysis, though, is that this was a time of severe economic instability and recession, which involves an overall increase in unemployment and a substantial exchange rate depreciation.[5] The difference-in-differences approach allows to control for aggregate shocks that affect all areas in the same way at each point in time but, as discussed below, the recessionary context plays a role in explaining the findings.

Results show that workers in areas with larger payroll tax increases are significantly more likely to be informal in the medium term, with little effect on overall employment and wages. Specifically, a 10 percentage point increase in the payroll tax rate increases the rate of informality by about 3 percentage points. Importantly, the response does not kick in immediately, but rather differences in informality arise over a year after the reform. Further evidence indicates that the increase in informality is mirrored by a reduction in formal jobs, with no effect on overall employment, indicating that the payroll tax increase induced a crowd-out of formality in favor of informality. As discussed before, the context at the time probably plays a role for explaining this finding: this was a time of severe economic recession with unemployment increasing uniformly across the country. The difference in informality rates arises once the economy starts to recover in late 2002, which suggests that higher payroll taxes are crowding out formal jobs in favor of informal jobs during the recovery.

Once again, firm size plays a key role for the effects on informality: the increase in the

[4] Interpretation of the evolution of salaries for formal and informal workers should be cautious, however, since informality falls after the tax cut. Comparing wage changes for formal and informal workers separately implies a sample split based on post-treatment behavior and differences could arise due to composition effects after the treatment.

[5] Although not entirely obvious how an exchange rate depreciation should differentially affect informality trends across areas, it could potentially affect salaries. However, as I discuss below, I find no significant effects of the payroll tax increase on salaries.

payroll tax rate reallocated workers to smaller firms –that account for most informality– and reduced the already smaller share of formal employment in such firms. This dynamic is different from the effect of the tax cut, and potentially explains part of the difference in point estimates between the two cases. In addition, and similarly to the effects of the tax cut, the tax hike increased the reliance on short-tenure recently-hired workers, and the increase in informality is primarily driven by higher informality among recently hired workers. Finally, I find no immediate effects on salaries, either for formal or informal workers, albeit there seems to be a minor increase in wages of informal workers, which could potentially be driven by a composition effect (for example, if workers who become informal have higher wages than incumbent informal workers).

This paper contributes to several branches of the literature. First, it contributes to the Public Finance literature studying the effects of payroll taxes on labor markets, which has found important effects on employment, wages, and firm behavior. However, much of this literature has mostly focused on high-income countries where labor informality is low (Saez et al., 2019; Ku et al., 2020; Bennmarker et al., 2009; Murphy, 2007; Anderson and Meyer, 1997) or has mostly studied the formal labor market in developing countries (Gruber, 1997; Kugler and Kugler, 2009; Cruces et al., 2010), leaving policy recommendations for reducing payroll taxes to reduce informality without solid empirical foundations.[6] In this regard, this paper contributes by explicitly studying the effects of payroll taxes on labor markets with widespread informality, uncovering novel facts about the dynamics of how payroll tax rate changes affect informal employment and wages.

This paper also contributes to the literature studying informality in labor markets in developing countries. This literature has found that informal work arrangements account for a substantial fraction of total employment in developing countries (La Porta and Shleifer, 2014), and informal jobs are associated to lower wages, benefits, and job security (Gerard and Gonzaga, 2016). Despite the existence of some debate as to the exact nature and dynamics of the informal sector (e.g. Ulyssea, 2018; Günther and Launov, 2012; Pratap and Quintin, 2006; Maloney, 2004; La Porta and Shleifer, 2014), there is substantial interest in understanding how public policies can affect the level and dynamics of informality (Djankov et al., 2002; Fajnzylber et al., 2011). Among the policies studied are changes in the minimum wage (Dinkelman and Ranchhod, 2012), firing costs (Adhvaryu et al., 2013), openness to trade (Ponczek and Ulyssea, 2021), investments in transit infrastructure (Zárate, 2021),

[6] Cruces et al. (2010) is especially related to this paper, since they also analyze the process of payroll tax cuts that took place in the 1990s in Argentina, but using administrative data on employment counts and wages at the area level. However, they explore different periods of tax cuts: the drop in late 1995 after having temporarily raised taxes and the minor tax cuts that took place in 1998 and 1999. In this paper, I explore the initial tax cut of 1993 that lowered tax rate across the country for selected industries, which they do not explore due to the unavailability of administrative records for that period.

and establishment inspections (Samaniego de la Parra and Bujanda, 2020). Regarding evidence on the effectiveness of policies that attempt to encourage reductions in informality, such as increasing enforcement or reducing the costs of operating formally, recent research shows limited results (see Ulyssea, 2020 for a recent survey).

Regarding payroll taxes specifically, Rocha et al. (2018) find that a reduction of registration costs and social security contributions for micro-entrepreneurs in Brazil led to higher business registration, and De Farias and Hsu Rocha (2021) find this effect to be substantially larger when using more comprehensive data. Some papers have studied the 2012 tax reform in Colombia (which included a payroll tax cut for workers earning less than 10 times the minimum wage) and found some increases in formality (Kugler et al., 2017; Fernández and Villar, 2017; Morales and Medina, 2017), although other elements of the reform could confound the effect, such as a minimum wage increase and the introduction of a new profit tax. This paper contributes to this literature by also studying the effects of a payroll tax cut on worker-level informality, in addition to a broader set of labor-market outcomes (such as wages and new hiring), while also studying the effects of a payroll tax hike. To the best of my knowledge, all previous research has studied exclusively bundle policies that included payroll tax cuts among its features, while the effects of a payroll tax increase have not been explored before. I uncover novel facts about the effects of payroll taxes in labor markets with widespread informal employment, documenting similarities and differences between the effects of a tax increase and a tax cut.

My findings are consistent with the recent literature studying informality in developing countries, which has found that policies that reduce the cost of formality can be effective for reducing informality but their effects can be too modest for these to be considered cost-effective (Ulyssea, 2020). In this particular case, my findings indicate that large payroll tax cuts are needed to significantly reduce informality, which potentially renders the policy not cost-effective. However, the variation leveraged in this paper only allows for medium term analysis of the tax cut and it is plausible that informality could potentially have fallen further in the longer term. Regarding the effect of a payroll tax increase, the fact that informality does not increase in the short term but it does in the medium term raises dynamic concerns: for instance, an attempt to increase revenue by increasing payroll taxes may have the intended effect in the short term, but it may end up reducing future revenue by increasing informality in the medium to long term. In addition, I find no effect of payroll tax changes on overall new hiring and unemployment, suggesting that payroll tax changes are unlikely to affect employment levels and are more likely to induce shifts in the share of informal employment relative to formal employment.

The rest of the paper is structured as follows. Section 2 describes the context and the

data. Section 3 describes the econometric strategy and main results for the response to a tax cut. Section 4 describes the econometric strategy and main results for the response to a tax hike. Section 5 concludes.

2. Context and data

2.1 Institutional context

Argentina is a middle-income country in South America, with GDP per capita of around US$11,683 as of 2018, according to data from the World Bank. Employers are required by law to register all of their wage-earning employees with the tax authority and to pay monthly payroll taxes. However, as is common in low and middle-income countries in Latin America, a substantial proportion of employment is informal and therefore not subject to taxation and labor regulations, such as the minimum wage, limits to hours worked, paid medical leave, and so on. Recent estimates of the percentage of informal workers are typically around 40% to 50%.[7]

Argentina is a federal country that collects taxes at the federal, provincial, and municipal levels. Payroll taxes are levied at the Federal level and are used to fund the welfare and social security systems (such as pensions and healthcare).[8] In the aftermath of the economic collapse and hyperinflation in the late 1980s, the government started a series of structural market-oriented reforms. After consolidating the payroll tax rate at a flat 33% for employers and 16% for employees in 1991, a law in 1993 gave the Executive power instruments for reducing the tax incidence on labor costs. The main instrument was to allow the Executive power to determine reductions on payroll taxes for employers.

In December 1993, the Federal Government started a process of payroll tax cuts. Based on the assumption that payroll tax cuts would have positive effects on labor markets, areas farther away from the City of Buenos Aires and with higher poverty rates in the 1991 census received larger reductions in payroll tax rates. The initial system consisted on assigning reduction coefficients c by area (such that the tax rate in a given area was $0.33(1-c)$).[9] These

[7] Figure A.1 shows ILO estimates for the percentage of employment that is informal for various Latin-American countries. These vary between 25% for countries like Chile and Uruguay, to over 70% for countries like Honduras and Guatemala. The estimate for Argentina, the country studied in this paper, is about 45%.

[8] Specifically, payroll taxes on employers consisted of 5 components: (i) retirement contributions, (ii) unemployment insurance, (iii) family subsidies, (iv) healthcare for active workers, (v) healthcare for retired workers. Payroll taxes on employees consisted of 3 components: (i) retirement contributions, (ii) healthcare for active workers, (iii) healthcare for retired workers. Employers were required to make only one payment comprising the full amount of all of these components.

[9] The process was done completely by the Federal government and was fairly transparent with no room for manipulation from local authorities (Cruces et al., 2010).

coefficients ranged from 0.3 to 0.8, which brought the national tax rate of 33% to values ranging between 6.6% and 23.1%.[10] Initially, the tax cut only applied to Primary Production, Manufacturing, Construction, Tourism, and R&D, leaving other sectors unaffected (e.g. Transportation, Commerce, Financial Services, Real Estate, etc). Thus, define T as the set of targeted sectors that received the tax cut, the payroll tax rate τ in sector s in area a is given by $\tau_{sa} = 0.33 \times (1 - c_a \mathbb{1}\{s \in T\})$.

In March of 1995, taxes were increased temporarily due to fiscal concerns during the Mexican currency crisis, and they were later reduced again and applied to all sectors.[11] A new process of additional minor tax cuts started in 1998 but it was halted before reaching its final stage in 1999 due to government budget deficit concerns (Cetrángolo and Grushka, 2004). This left different tax rates by area, ranging from 9.2% to 19.7%. Finally, in an effort to control the government budget deficit, all tax cuts were repealed halfway through 2001 with the adoption of a uniform tax rate across areas of 23%.[12] Figure A.2 shows a stylized timeline with the payroll tax rate variation leveraged for the analysis. Cruces et al. (2010) use administrative data on taxes effectively collected that shows that the tax changes were effectively implemented.

2.2 Data

Data on the tax rate changes were transcribed and reconstructed from the relevant executive orders and ordinances from the tax authority. Tax rates at the time of the initial tax cut were reconstructed by applying the corresponding reduction coefficients to the tax rate prevailing in each area for the economic sectors that the tax cut applied to. Tax rates at the time of the tax hike period were transcribed from several executive orders and ordinances from the tax authority that stated the corresponding rates for each area.[13]

I combine these data on tax rates with labor market household surveys at the area level (called the "Permanent Household Survey" or *Encuesta Permanente de Hogares*).[14] These

[10] Tax rates before the tax cut were not completely uniform since southern provinces had a minor tax benefit for payroll taxes for family subsidies that was eliminated in 1996.

[11] The government introduced a minor change at this point: the component for contributions for healthcare for active workers was not allowed to go below 5%. This effectively meant a lower tax cut than initially implemented.

[12] Tax rates were not completely uniform at this point since very large businesses whose main activity was services were subject to a slightly higher tax rate of 27%. For the analysis, I simply assume the payroll tax rate to be 23% at this point.

[13] Figure B.1 in the appendix shows an example of a table from an ordinance from the tax authority, detailing the rates applicable for each component of payroll taxes depending on the percentage of reduction assigned to each area. All of these tables are publicly available in the website for the Argentinean Revenue Authority: http://biblioteca.afip.gob.ar/.

[14] All the micro-data used for the analysis is publicly available at the website for Argentina's National Institute of Statistics and Censuses: https://www.indec.gob.ar/indec/web/

surveys are the main source of labor market information in Argentina and, at the time, consisted of repeated cross sections at the area level carried out twice a year (first wave in April-May and second wave in October-November). I match the area on the surveys to the areas specified in the executive orders to assign the tax rate corresponding to each area. I have data for 17 areas for the tax cut period and 30 areas for the tax hike period.[15] I begin the tax cut period sample in the first semester of 1992, which is the earliest pre-tax cut period for which there is data for multiple areas, and end it in the first semester of 1995, which is the last period before taxes were temporarily increased and the tax cut was extended to all sectors. For the tax hike period, I begin the sample in the second semester of 1999, which is the first wave after which the second minor tax cut process was halted, and end it in the first semester of 2003, when the survey was temporarily interrupted and the new administration implemented several new policy changes for different areas. The Permanent Household Survey contains standard labor market questions such as employment status, education, hourly earnings, age, and family composition. In addition, they also collect information on the sector of employment, which I match to the sectors in the executive order for the tax cut.[16]

Regarding the definition of informality, respondents are asked whether their employer provides them with the work-related social security benefits to which they are entitled to by law (pension contributions, unemployment insurance, paid medical leave, etc). Following the literature, I use a version of the "social protection" definition (see Tornarolli et al., 2014) and define a worker as informal if they report having no access to any work-related social security benefits whatsoever. I then define a dummy variable for informal employment equal to 1 if the worker reports having no access to any work-related social security benefits and zero otherwise.[17] Finally, self-employed individuals pose a challenge since they are not asked

`Institucional-Indec-BasesDeDatos`.

[15] This discrepancy in the number of areas across time is due to the fact that when the Census Institute started releasing the survey data, it initially released temporary datasets that contain less detailed information for some areas, with the intent of eventually updating these to permanent datasets with all the information, which did not end up happening (Cattaneo, 2001). These temporary datasets contain less detailed information in general and, specifically, they do not contain data on whether the worker is formal or informal, so I cannot use them for the analysis.

[16] The economic sectors are categorized as defined by the Census Institute: primary production; manufacturing of foods, drinks, and tobacco; manufacturing of textiles, clothing, and shoe-wear; manufacturing of chemical products, oil, and nuclear fuel; manufacturing of metallic products and machinery; other manufacturing industries; supply of electricity, gas, and water; construction; wholesale commerce; retail commerce; restaurants and hotels; transportation; services linked to transportation and communication; financial intermediation; real estate services; public administration and defense; teaching; social and health services; other social and community services activities; repair services; domestic services at private homes; other personal services. The treated sectors are primary production, the manufacturing sectors, construction, and restaurants and hotels.

[17] A standard way to categorize employees as informal is if they report not contributing to the pension system (e.g. Tornarolli et al., 2014). Unfortunately, this specific answer was not coded in the datasets at the

questions to determine their formal or informal status, which is expected given that they do not have an employer to make their pension contributions or pay them during medical leave. However, this does not mean that they are informal, since they could still be filing their taxes as independent contractors. One approach in the literature is to consider low-skill self-employed individuals as informal since they are unlikely to be filing taxes (Tornarolli et al., 2014), so I consider an alternative definition of informality that counts self-employed workers who have not completed high school as informal, and present results using this definition as a robustness check.

Table 1 presents summary statistics. Panel A presents statistics for the tax cut period sample and Panel B for the tax hike period sample.[18] The variable "Informal worker" is a dummy variable equal to 1 if the worker is an employee whose employer does not give them any of the social security benefits that they should by law, which is about 23% of wage earners. The average worker makes AR$3.21 per hour, which at the time was equal to US$3.21 due to a fixed parity between the Argentine peso and the US dollar.[19] Finally, the data also contains demographic controls such as gender, age, and indicators for education, in addition to the payroll tax rate corresponding to the sector-area level.[20] Panel B presents summary statistics for the tax hike period sample. The share of wage earners that are informal is about 40%. The average worker makes AR$2.79 per hour, which is no longer equal to the same amount in US dollars since the fixed exchange rate was repealed in 2002. The data contains the same demographic variables as before, which indicates a slightly higher presence of females and slightly higher indicators of education relative to the sample in the tax cut period.

3. Response to a tax cut

3.1 Econometric strategy

Leveraging the fact that the initial payroll tax cut only affected some economic sectors, I begin my analysis with a standard event study approach, comparing the evolution of workers in sectors that received the tax cut to workers in sectors that did not. The equation to

time, so I rely on a similar definition but for not having any social security benefits whatsoever.

[18] One production sector was excluded from the analysis for the tax cut period: "industrial production of tobacco, food, and beverages", because of a law that passed around the same time that created several regulations about the production and taxation of tobacco (*Ley 24,291*, passed on December of 1993).

[19] This fixed parity between the peso and the dollar was implemented as a way to stabilize inflation in 1991, which was in the single digits throughout the decade.

[20] Table 2 shows a comparison between the affected and unaffected sectors, showing a slightly higher rate of informality, lower education levels, and a significantly lower proportion of women in the sectors that received the tax cut. Thus, I control for these factors in several specifications to account for these differences.

estimate is given by:

$$Y_{isat} = \sum_{k=-4}^{k=2} \beta_k d_{tk} \times TargetedSector_s + X'_{isat}\delta + \alpha_a + \theta_s + \mu_t + \varepsilon_{isat} \quad (1)$$

where Y_{isat} is any of our outcomes of interest for worker i working in sector s in area a at time t, X'_{isat} is a vector of controls, α_a is a fixed effect for geographic area, θ_s is a fixed effect for sector, μ_t is a fixed effect for time, $TargetedSector_s$ is a dummy variable equal to 1 if sector s received the tax cut, and ε_{isat} is the error term. The coefficients of interest here are the β_k, which measure the difference in trends between workers in sectors that received the tax cut and workers in sectors that did not. For negative values of k, the β_k coefficients allow us to assess the evolution of the trends before the tax cut, and for positive values of k the coefficients indicate the dynamics of the effect.

I also estimate a variation of equation 1 by including the numerical value of the tax rate instead of the difference-in-differences coefficients:

$$Y_{isat} = \beta TaxRate_{sat} + X'_{isat}\delta + \alpha_a + \theta_s + \mu_t + \varepsilon_{isat} \quad (2)$$

where $TaxRate_{sat}$ is the payroll tax rate for sector s in area a at time t, measured from 0 to 100. Estimating this equation exploits variation in the tax rate by sector, area, and time to identify the effect of payroll taxes. The coefficient of interest is β, which captures the effect of increasing the payroll tax rate by one percentage point on the outcome of interest Y_{isat}. The main outcomes of interest are an indicator of being informally employed and the hourly salary from the main occupation. In addition, I will analyze the effects of the tax rate on an indicator of having been recently hired and the firm size for additional results. In all specifications, I report standard errors clustered at the sector-by-area level, which is the dimension in which the payroll tax rate varies.

3.2 Results

Figure 1 reports OLS estimates for the event study coefficients from equation 1 for several dependent variables. In panel (a), the dependent variable is an indicator of the worker being informally employed. The pattern indicates stable trends between affected and non-affected sectors before the tax cut, which diverge with a minor reduction in informality after the tax cut takes place. On average, the probability of a worker being informal falls by about 3 percentage points after the tax cut compared to workers in sectors unaffected by the policy. This is reflected in columns 1 and 2 of table 3, which reports OLS estimates of several variations of equation 2, regressing the dummy variable for being informal on the payroll tax

rate corresponding to the sector-area-time. The estimate is stable across specifications and it indicates that a 1 percentage point increase in the payroll tax rate increases the probability of being informal by about 0.13 percentage points on average. Conversely, a reduction of the payroll tax rate of 10 percentage points implies a reduction in the probability of being informal by about 1.3 percentage points on average. Across specifications, the coefficient on the payroll tax rate is statistically significant at the 5% level.

Overall, these results indicate that payroll tax cuts reduce informality, although the effect is modest. A 10 percentage point reduction in the payroll tax rate represents a substantial tax reduction (payroll tax rates typically oscillate around 10% to 35% across countries), while a 1.5 percentage point reduction in informality is a minor effect relative to how widespread informality is (about 27% of workers in the sample are informal in this period). This is consistent with recent research in informality that finds that, although reducing the costs of formality can be effective at reducing informality, the effects can be too modest for these policies to be considered cost-effective (Ulyssea, 2020). Admittedly, however, the variation exploited in this paper only allows for medium-term analysis of the policy (about 18 months), so it could be possible that informality would have been reduced even further in the long term.

To further understand the effect on informality, I analyze the role of firm size. As is common in developing countries, most informal employment is concentrated in small firms (Ulyssea, 2018). In the survey, wage earners are asked how many employees work in the establishment they work in, I define a firm as small if the firm has up to 25 employees.[21] Panel (b) of figure 1 presents OLS estimates of the event study coefficients from equation 1 where the dependent variable is a dummy variable equal to 1 if the worker works in a firm of up to 25 employees. Notably, there is no significant break in trends after the tax cut, indicating that the tax cut did not induce a shift of employment either into or away from small firms. This is reflected in the OLS estimates of equation 2 reported in columns 1 and 2 of panel D of table 3, indicating small and non-statistically significant coefficients. Panel B of table 3 presents OLS estimates of equation 2 interacting the payroll tax rate with the dummy variable of small firm, indicating that the payroll tax rate significantly reduced informality in non-small firms, while this effect is completely canceled out for small firms. Thus, the payroll tax cut only reduced informality in large firms (which account for little informality to begin with), while not affecting informality in the firms that account for most of it (small firms).

I then analyze whether workers in sectors that received the tax cut are more likely to

[21] This exercise results in a drop in the number of observations because workers can report not knowing how many people work in their establishment.

have been recently hired, since informality is more widespread among recently hired workers. Panel (c) of Figure 1 presents OLS estimates of the event study coefficients from equation 1 where the dependent variable is a dummy variable equal to 1 if the worker started working on their current job at most one year ago. There is a minor reduction in the share of workers that have been recently hired after the tax cut. This is reflected in the OLS estimates of equation 2 reported in panel D of table 3, which shows small and non-significant coefficients. Panel C presents OLS estimates of equation 2 interacting the payroll tax rate with the dummy variable of recently hired, indicating that the effect is entirely driven by reductions in informality of recent hires. This suggests that payroll tax cuts affect the flow more so than the stock of informality.

I then turn to the effects of payroll taxes on salaries. Panel (d) of figure 1 shows OLS estimates of event-study coefficients from equation 1, where the dependent variable is the natural logarithm of the hourly income from the main occupation. Notably, there is no significant pattern of effects on wages. This is reflected in the OLS estimates of several variations of equation 2 reported in columns 3 and 4 of table 3, where the dependent variable is the natural logarithm of the hourly wage from the main occupation. The estimate is stable across specifications, indicating a small and non-statistically significant effect: a 1 percentage point increase in payroll taxes implies a 0.13% increase in hourly salaries. Panel B indicates that a tax cut induces an increase in wages for workers in large firms, and that this effect is canceled out for workers in small firms. Panel C indicates that a tax cut reduces salaries among new hires, with little effect on workers with longer tenure on the job.[22]

These findings on the effects on salaries contradict predictions from standard models with only one (formal) labor market. In such models, a reduction in payroll taxes produces an outward shift in the labor demand, which should result in an increase in (post-tax) wages, while the estimates shown above indicate a negligible effect of the tax cut. Notably, running the event studies for formal and informal workers separately indicates that the evolution of wages for formal and informal workers is similar after the tax cut, as shown in panel (e) of Figure 1, although statistical power is low after splitting the samples. Interpretation should be cautious here, however, since this analysis relies on a post-treatment split of the sample.

To sum up, evidence in this section indicates that the payroll tax cut reduced informality in the labor market, although the effect is modest. The tax cut reduced informality only in larger firms (which account for little informality), without shifting workers away from smaller firms (which account for most informality). This reduction in informality is driven primarily by lower informality among recently hired workers in affected sectors, with a reduction in

[22] This could potentially be driven by a composition effect given that informality falls among new hires. For instance, if "higher productivity informal workers" are the ones who transition into formal employment, then the workers who remain informal are those with lower productivity and, potentially, lower wages.

the total share of newly hired workers. Taken at face value, these estimates indicate that large tax cuts would be needed to significantly reduce informality, although the variation only allows for medium-term analysis. Regarding effects on salaries, there is no evidence of strong effects of the tax cut on salaries, either for formal or informal workers.

3.3 Robustness checks

In this subsection, I present several robustness checks for the main empirical analysis. First, recall that the main analysis does not include self-employed workers, since they are not asked the questions to determine informal status. However, this does not mean that they are informal, since they could be paying taxes as independent contractors. One approach in the literature has been to include self-employed individuals who are low-skilled as informal, since they are unlikely to be registered (e.g. Tornarolli et al., 2014). I follow this approach and construct an indicator of informality that includes self-employed individuals who have not completed high school as informal and those with higher educational attainment as formal, in addition to the definition for wage earners previously used. Panel A of table C.1 reports the OLS coefficients of the effect of the payroll tax rate on the probability of being informal and the hourly wage from equation 2 while including self-employed individuals in the sample. Across specifications, the main results remain very similar to the baseline specification when including the self-employed in the estimation.

Second, recall that some individuals have missing data regarding the firm size and how long ago they started their current job. This is because individuals can report not being sure how many workers are employed in their establishment or how long ago they started working in their current job. Although this is plausibly unrelated to the payroll tax cuts, I conduct an additional robustness check including in the sample only individuals who have no missing data for the indicator of informality, firm size, and how long ago they started their current job. The results from this exercise can be found in panel B, which shows qualitatively similar results to the baseline specification, albeit the coefficients for the effect on earnings become statistically significant in the expected direction (lower taxes increase post-tax wages).

Third, the main specification exploits sector-by-area-by-time variation in the payroll tax rate to identify the effect on informality and wages. A potential concern is that the results could be driven by differential trends at the area level that happen to be correlated with the sizes of the tax cuts. To assess whether potential differential trends across areas are driving the results, I control for area-by-time fixed effects, exploiting only the sector-by-time variation in the payroll tax rate. Results from this exercise can be found in panel C, which shows similar results to the baseline specification.

Fourth, given the limited number of areas available for analysis, one could be concerned

that the results are driven by the evolution of some specific area. To assess this concern, I conduct a series of leave-one-out robustness checks, where I estimate the effect of the payroll tax rate on informality and hourly wages while sequentially dropping one of the areas from the analysis. The results from this exercise can be found in figure C.1, where panel (a) shows the coefficients for the effect on the probability of being informal and panel (b) shows the effect on the natural logarithm of the hourly wage. In both panels, the coefficient of interest remains stable across specifications, indicating that the effect is not driven by some specific area.

4. Response to a tax hike

4.1 Econometric strategy

I now turn to the effects of a tax increase. Exploiting that, starting from different tax rates across areas in 1999, a higher uniform tax rate for all areas was adopted in mid-2001, I estimate a modified event-study specification interacting the event study dummy variables with the change in the payroll tax rate:

$$Y_{iat} = \sum_{k=-4}^{k=3} \beta_k d_{tk} \times \Delta TaxRate_a + X'_{iat}\delta + \alpha_a + \mu_t + \varepsilon_{iat} \tag{3}$$

where $\Delta TaxRate_a$ is the increase in the tax rate at the area level (normalized by 5 percentage points for easier interpretation), X_{iat} is a vector of individual controls, α_a is a fixed effect for area, μ_t is a fixed effect for time, and ε_{iat} is the error term. The coefficients of interest here are the β_k, which measure the difference in trends between workers in areas that received a larger tax increase compared to workers in areas that received a smaller tax increase. For negative values of k, the β_k coefficients allow us to assess the evolution of the trends before the tax hike, and for positive values of k the coefficients indicate the dynamics of the effect.[23]

As for the analysis for the tax cut, I also estimate a variation of equation 3 by including the numerical value of the tax rate instead of the difference-in-differences coefficients:

$$Y_{iat} = \beta TaxRate_{at} + X'_{iat}\delta + \alpha_a + \mu_t + \varepsilon_{iat} \tag{4}$$

where $TaxRate_{at}$ is the payroll tax in area a at time t, measured from 0 to 100. Estimating this equation exploits variation in the tax rate by area and time to identify the effect of payroll

[23] A potential concern for the tax increase analysis is that the results could be driven by differential trends related to potential long-run effects of the original tax cut years earlier. The assumption for this analysis is that, whatever the long-run effects of the tax cuts were, a new steady state state has been reached by the time of the tax increase, which seems plausible given the lack of significant pre-treatment trends.

taxes. The coefficient of interest is β, which captures the effect of increasing the payroll tax rate by one percentage point on the outcome of interest Y_{iat}. Again, the outcomes of interest are: (i) a dummy variable equal to 1 if a worker is informal relative to formal (using both definitions of informality), (ii) the hourly salary from the main occupation, and (iii) a dummy variable if the worker was recently hired. I report standard errors clustered at the area level, which is the dimension in which the payroll tax rate varies.

4.2 Results

Figure 2 reports OLS estimates of the event study coefficients from equation 3 for several dependent variables. In panel (a), the dependent variable is an indicator equal to 1 if the worker reports being informal and zero otherwise. Notably, there is no significant break in trends immediately after the tax increase, and a significant increase in informality is noticeable 1.5 years after the tax hike. Given the normalization of the change in the tax rate by 5 percentage points for this figure, these coefficients indicate that increasing the payroll tax rate by 5 percentage points has little effect in the short run, but implies an increase in the probability of a worker being informal by about 2.5 percentage points in the medium run.

Panel A of table 4 reports OLS estimates of equation 4. In columns 1 and 2, I normalize the dependent variable to be equal to 100 if the worker is informal and zero if not to simplify the interpretation of the coefficient. The coefficient is not statistically significant at conventional levels, which reflects the fact that the effect is not apparent immediately after the tax hike. These coefficients indicate that a 1 percentage point increase in the tax rate increases the probability of a worker being informal by about 0.2 percentage points. Panel B separates between the short-run and long-run effect of payroll taxes, indicating a significant increase in informality in the long-run across specifications.

Overall, these results indicate that increasing payroll taxes increases the proportion of workers who are informal. Importantly, this increase in informality is not evident immediately after the tax increase, but rather becomes significant in the medium term. The economic context at the time can potentially explain this: this was a time of severe economic recession and political instability, with unemployment increasing across the board, as shown in the evolution of the probability of being unemployed reported in panel (a) of figure 3.[24] This increase in unemployment is not differential across tax areas, as shown in panel (b), where areas with larger tax increases have a similar evolution of unemployment relative to areas with lower tax increases. The differences in informality after the tax increase arise as

[24] For this exercise, we include self-employed individuals in the sample (not just wage earners), to account for the full labor force.

economic recovery starts to kick in and unemployment falls, which suggests that the increase in payroll taxes could be crowding out formal jobs in the recovery. Panel (c) investigates this by reporting the event study coefficients of equation 3 by separating respondents into three categories: (i) unemployed, (ii) informal, and (iii) formal, finding that the increase in informal employment is mirrored by a reduction of formal employment, with little effect on unemployment.[25]

To further understand the effect on informality, I analyze the role of firm size. Similarly as for the tax cut analysis, I define a firm as small if the firm has up to 25 employees. Panel (b) of figure 2 presents OLS estimates of the event study coefficients from equation 3 where the dependent variable is a dummy variable equal to 1 if the worker works in a firm of up to 25 employees. Notably, and contrary to the tax cut analysis, there is a significant increase in the share of workers employed in small firms after the tax hike. This is reflected in the OLS estimates of equation 4 reported in panel E of table 4, which indicate that higher payroll taxes increase the share of workers employed in small firms. Specifically, a 10 percentage point increase in the payroll tax rate increases the probability of working in a small firm by about 2 to 3 percentage points. Panel B of Table 4 presents OLS estimates of equation 2 interacting the payroll tax rate with the dummy variable of small firm, indicating that the payroll tax rate significantly increases informality in small firms (which already have more informality), with no effect on larger firms. Thus, the payroll tax increase shifted workers towards smaller firms, which have more informality, and reduced their already smaller share of formal workers.

I then analyze whether workers in areas that received a larger tax rate hike are more likely to have been recently hired, since informality is more prevalent among recently hired workers. Panel (c) of figure 2 presents OLS estimates of the event study coefficients from equation 1 where the dependent variable is a dummy variable equal to 1 if the worker started working on their current job at most one year ago. Although confidence intervals are wide, there is a significant increase in the share of workers that have been hired recently, who are more likely to be informal. This is reflected in the OLS estimates of equation 4 reported in panel E of table 4, which that the tax hike increased the share of workers who have been recently hired. Panel D of table 4 presents OLS estimates of equation 2 interacting the payroll tax rate with the dummy variable of recently hired, indicating that the effect is entirely driven by increases in informality among recent hires.

I now turn to the effects of payroll taxes on salaries. Panel (d) of figure 2 presents OLS estimates of the event study coefficients from equation 1, where the dependent variable is

[25] This type of analysis on crowd out of formal jobs due to changes in payroll taxes is not feasible for the tax cut period, since the variation exploited for that analysis is by sector and unemployment is not a sector-specific variable.

the natural logarithm of the hourly income from the main occupation. Similarly as was the case for the tax cut, there is no substantial effect on the evolution of salaries after the tax hike. Panel (e) shows the event study coefficients separately for formal and informal workers, indicating a flat evolution for formal workers while there is an increase in wages. This could potentially be driven by a composition effect, for instance, if workers who become informal have higher wages than incumbent informal workers. However, the interpretation here should be cautious, not only for the sample split based on post-shock behavior (as was the case for the tax cut analysis), but also because statistical power is low and confidence intervals include large effects.[26]

These results are reflected in OLS estimates of equation 4 reported in columns 3 and 4 of table 4. In both specifications, the estimated coefficient is small and not statistically significant at conventional levels. Panel B interacts the payroll tax rate with the indicator of being employed in a small firm, indicating no significant effect of payroll taxes on wages, either for small or large firms. Panel D interacts the payroll tax rate with an indicator of having been recently hired, showing no effect of payroll taxes on wages for workers with a long tenure on their job, and a minor increase among recent hires, albeit with inconsistent significance across specifications.

Results on the effects on salaries reveal a similar pattern to the one found for the effect of a tax cut: negligible effects and a similar evolution between formal and informal workers. Again, this contradicts findings from a standard only-formal market model, which would predict a reduction in (post-tax) wages following a tax increase, due to a reduction in the labor demand. Interestingly, the evolution of wages for formal and informal workers is similar immediately after the tax increase, while there is an increase in the wages of informal workers.

Summing up, evidence in this section indicates that the payroll tax hike increased informality in the labor market, with little effect on salaries and overall new hiring. Although the effect is not evident in the short term, a 10 percentage point increase in the payroll taxes increases informality by about 4 percentage points in the medium term. The recessionary context potentially plays a role in explaining this fact, since employment is falling across the board, and the differences in informality rates across tax areas become evident as the economic recovery begins. This increase in informality is mirrored by a reduction of formal jobs, with no significant effects on unemployment, suggesting that the higher payroll taxes are crowding out formal jobs during the economic recovery. Firm size plays a key role: after the tax cut, workers are more likely to work in small firms (which account for more informality) and, reduced their already smaller share of formal employment. Similarly to the tax cut,

[26] For instance, although the point estimates for the effect on salaries of formal workers are close to zero, some of the confidence intervals include hypothetical pass-through values of substantial magnitude (for example 40%).

the increase in informality is primarily driven by increased informality among recent hires, suggesting that payroll taxes affect the flow of informality more so than the stock. Regarding effects on salaries, there is no evidence of strong effects of the tax hike on wages, save for an increase among informal workers in the medium term.

4.3 Robustness checks

In this subsection, I present several robustness checks for the main empirical analysis. First, recall once again that the main analysis does not include self-employed workers, since they are not asked the questions to determine informal status even though they could be paying taxes as independent contractors. To include self-employed workers, I construct an indicator of informality that includes self-employed individuals who have not completed high school as informal and those with higher educational attainment as formal, in addition to the definition for wage earners used in the main specification. Panel A1 of table C.2 reports the OLS coefficients of the effect of the payroll tax rate on the probability of being informal and the hourly wage from equation 4 while including self-employed individuals in the sample. Panel A2 separates between the short-run and the long-run effect. Across specifications, the main results remain very similar to the baseline specification when including the self-employed in the estimation.

Second, recall once again that some individuals have missing data regarding the firm size and how long ago they started their current job, since respondents can report being unsure as to how many workers are employed in their establishment or how long ago they started working in their current job. Although this is plausibly unrelated to the payroll tax increase, I conduct an additional robustness check including in the sample only individuals who have no missing data for the indicator of informality, firm size, and how long ago they started their current job. The results from this exercise can be found in panels B1 and B2, both of which show qualitatively similar results to the baseline specification, albeit the coefficients for the effect on earnings become statistically significant in the expected direction (lower taxes increase post-tax wages).

Third, given the limited number of areas available for analysis, concerns could arise that the results are driven by the evolution of some specific area. To assess this concern, I conduct a series of leave-one-out robustness checks, where I estimate the effect of the payroll tax rate on informality and hourly wages while dropping one of the areas from the analysis. The results from this exercise can be found in figure C.2, where panel (a) shows the coefficients for the effect on the probability of being informal and panel (b) shows the effect on the natural logarithm of the hourly wage. In both panels, the coefficient of interest remains stable across specifications, indicating that the effect is not driven by the evolution of some specific area.

5. Conclusion and discussion

In this paper, I analyze how labor markets with high informality respond to reductions and increases in employer-borne payroll tax rates. I leverage a process of area-varying payroll tax cuts that took place in Argentina in the 1990s, which culminated with the adoption of a uniform tax rate in 2001. Results show modest effects on informality in expected directions: tax cuts reduce the share of informally-employed workers while tax hikes increase it. Firm size plays a key role in mediating these effects: the tax cut reduced informality only in larger firms without any effect on smaller firms (which account for most informality to begin with), while the tax increase shifted employment towards smaller firms (where most informal employment takes place) and reduced their already smaller share of formal employment. In addition, higher payroll taxes increase reliance on recently hired workers, who are more likely to be informal, while tax cuts reduce it, and the changes in informal employment are driven by recently hired workers, indicating that payroll taxes affect the flow more so than the stock of informality. I find no significant effects on salaries for the tax cut or the tax hike, for either formal or informal workers.

Results regarding the effect of a payroll tax cut are consistent with recent research regarding policies for reducing informality in developing countries, which has found that policies that reduce the cost of formality can be effective for reducing informality, but their effects can be too modest for such policies to be cost-effective (Ulyssea, 2020). Taken at face value, my results indicate that unrealistically large tax cuts are necessary to obtain substantial reductions in informality: for instance, reducing informality by 3 percentage points would require a reduction in the payroll tax rate of about 20 percentage points, which is higher than the actual payroll tax rate in many countries. This modest effect is explained by the fact that the tax cut seems to have reduced informality only in large firms, which account for little informality to begin with.

The analysis of the effect of a payroll tax increase indicates no significant effect in the short term, but a significant increase in informality in the medium term. This creates dynamic concerns, since an attempt to increase revenue by increasing payroll taxes can have the intended effect in the short term, but it can also reduce future tax revenue by increasing informality in the medium term. In addition, the increase in informal employment is due to a crowd-out of formal employment, with little effect on overall employment. This suggests that discussions on the effects of increasing payroll taxes in developing countries should focus less on effects on overall employment and more on potential crowding-out effects of formal employment in favor of informal employment.

Finally, the negligible effects on salaries found for both the tax cut and the tax hike could

potentially be explained by the existence of informal payments for formal workers. Recent literature has found that paying formal workers a fraction of the salary "off the books" to avoid taxes is commonplace in developing countries (Bergolo and Cruces, 2014; Kumler et al., 2020), and it is plausible that workers include these payments in the income reported in surveys, since the salary question is interpreted as asking about post-tax "take-home" pay. Therefore, the negligible effects on salaries could arise if employers and employees arrange to substitute between reported and unreported payments in response to payroll tax changes in a manner that leaves the "take-home" income unchanged. This presents potential avenue for future research.

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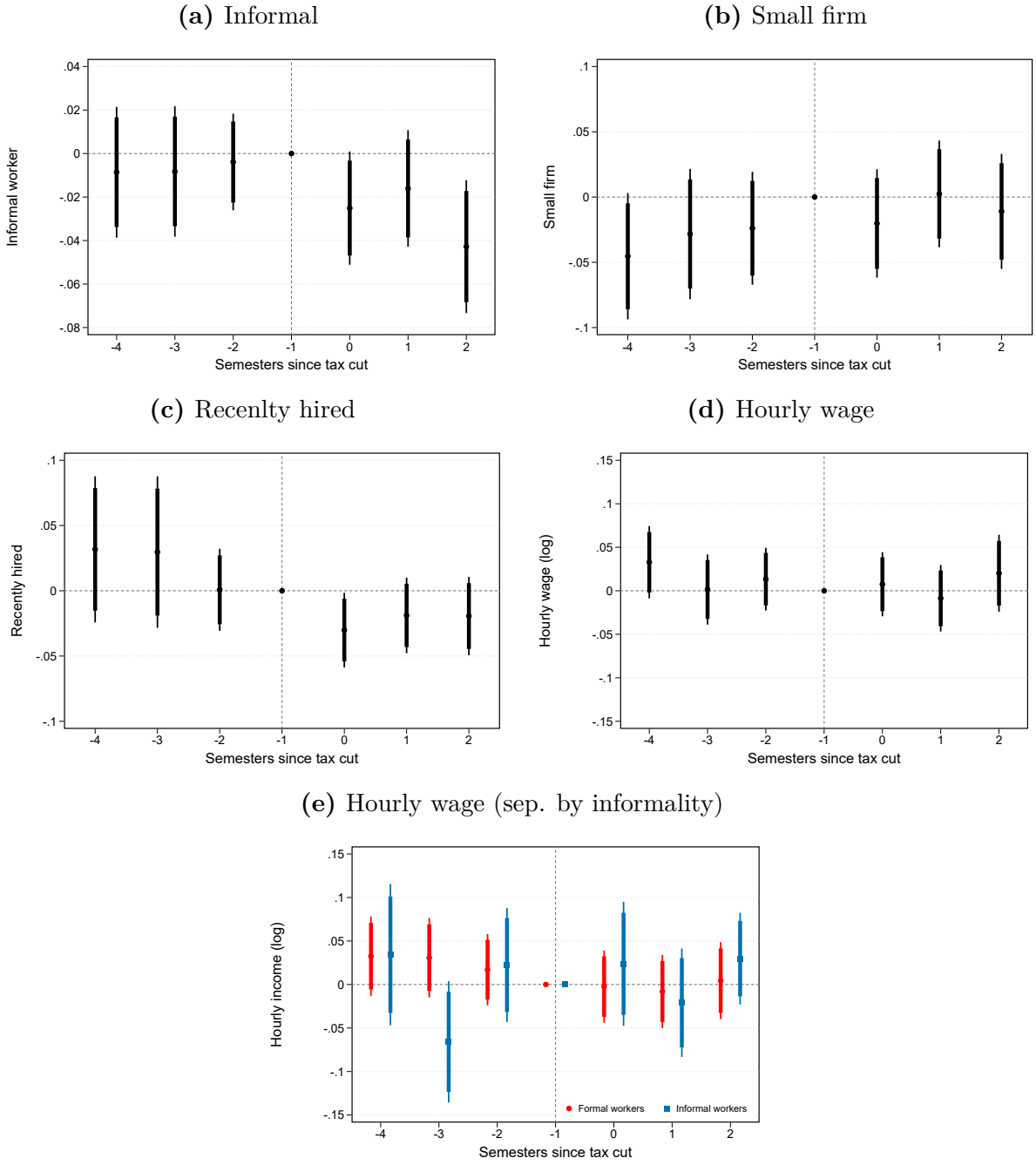
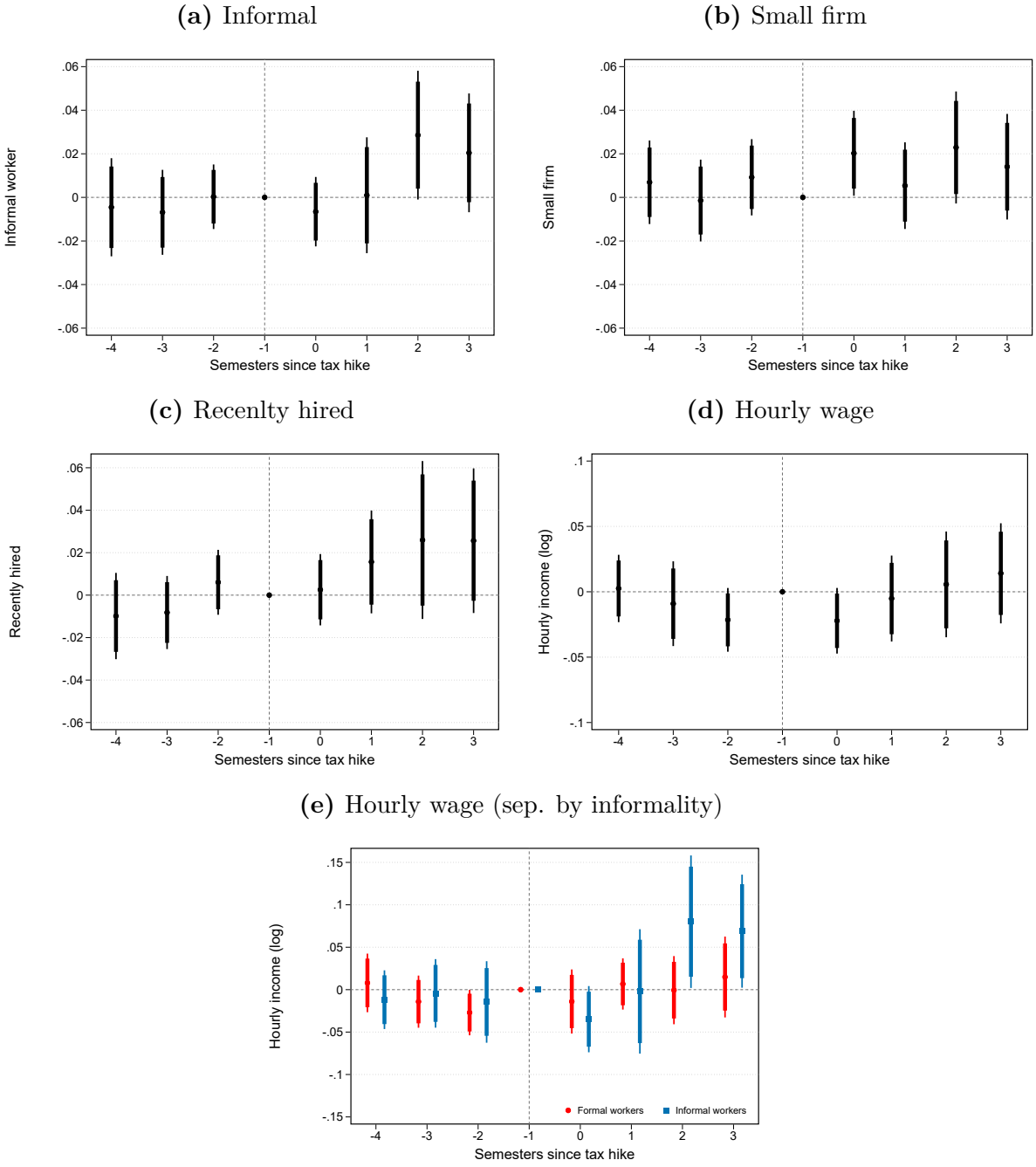
A. Figures

Figure 1: Main effects of the tax cut - event study coefficients



Notes: This figure shows OLS estimates for the event-study coefficients from several variations of equation 1. In panel (a) the dependent variable is an indicator of whether the worker is informal. In panel (b) the dependent variable is an indicator equal to 1 if the worker is employed at at a small firm (up to 25 employees). In panel (c) the dependent variable is an indicator of whether the worker started their job up to one year ago. In panels (d) and (e) the dependent variable is the natural logarithm of the hourly wage. Panel (e) separately estimates the event-study coefficients for formal workers (in red) and informal workers (in blue). Standard errors are clustered at the sector-by-area level. Thick vertical bars represent 90% confidence intervals and thin vertical bars represent 95% confidence intervals.

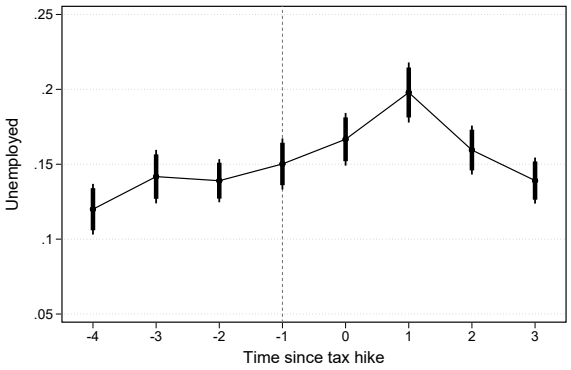
Figure 2: Main effects of the tax hike - event study coefficients



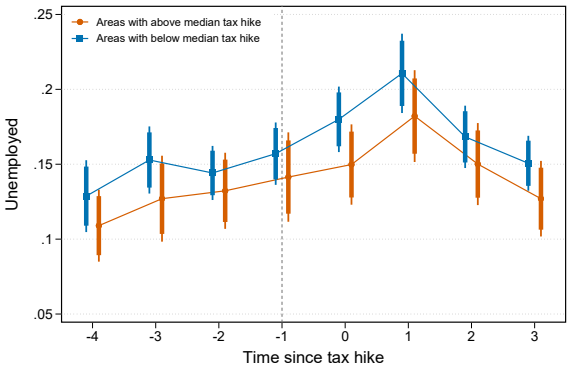
Notes: This figure shows OLS estimates for the event-study coefficients from several variations of equation 3. In panel (a) the dependent variable is an indicator of whether the worker is informal. In panel (b) the dependent variable is an indicator equal to 1 if the worker is employed at at a small firm (up to 25 employees). In panel (c) the dependent variable is an indicator of whether the worker started their job up to one year ago. In panels (d) and (e) the dependent variable is the natural logarithm of the hourly wage. Panel (e) separately estimates the event-study coefficients for formal workers (in red) and informal workers (in blue). Standard errors are clustered at the sector-by-area level. Thick vertical bars represent 90% confidence intervals and thin vertical bars represent 95% confidence intervals.

Figure 3: Tax hike, unemployment, and formality crowd-out

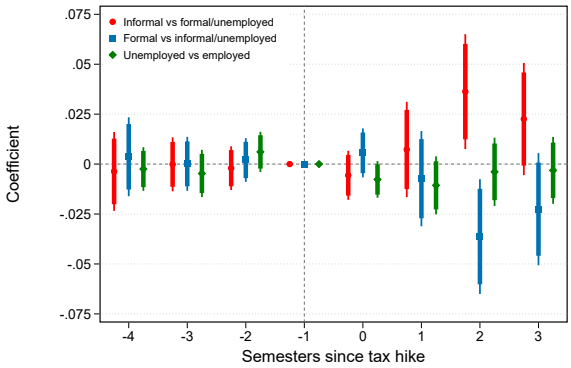
(a) Unemployment level



(b) Unemployment level (by tax hike size)



(c) Crowd-out event-study



Notes: This figure shows the evolution of the probability of being unemployed over time and OLS estimates for the event-study coefficients from several variations of equation 3. Panel (a) shows the probability of being unemployed over time for the whole sample. Panel (b) shows the probability of being unemployed over time separating by the size of the tax hike: areas that received below-median tax hikes are in blue and areas that received above-median tax hikes are shown in orange. Panel (c) shows OLS coefficients from several variations of equation 3. Coefficients in red correspond to the event study of the probability of being informal relative to being formal or unemployed. Coefficients in blue correspond to the event study of the probability of being formal relative to being informal or unemployed. Coefficients in green correspond to the event study of the probability of being unemployed relative to being formal or informal. Standard errors are clustered at the area level. Thick vertical bars represent 90% confidence intervals and thin vertical bars represent 95% confidence intervals.

B. Tables

Table 1: Summary statistics

	Observations	Mean	Standard Deviation	Median
Panel A. Tax cut period				
Informal worker	97,897	0.270	0.444	0.000
Hourly wage	94,081	3.305	2.921	2.500
Hours worked	83,902	40.640	15.520	43.000
Small firm	76,587	0.664	0.472	1.000
Recently hired	85,476	0.316	0.465	0.000
Payroll tax rate	97,897	30.473	5.549	33.000
Age	97,897	35.123	12.138	34.000
Female	97,897	0.420	0.494	0.000
Primary school incomplete	97,202	0.095	0.294	0.000
Primary school complete	97,202	0.490	0.500	0.000
Secondary school complete	97,202	0.289	0.453	0.000
College complete	97,202	0.125	0.331	0.000
	Observations	Mean	Standard Deviation	Median
Panel B. Tax hike period				
Informal worker	129,444	0.400	0.490	0.000
Hourly wage	162,477	3.292	3.686	2.310
Small firm	173,660	0.783	0.412	1.000
Unemployed	225,101	0.166	0.372	0.000
Recently hired	187,764	0.324	0.468	0.000
Payroll tax rate	225,101	18.865	4.459	19.700
Age	225,101	37.386	13.149	36.000
Female	225,101	0.408	0.491	0.000
Primary school incomplete	225,101	0.096	0.295	0.000
Primary school complete	225,101	0.461	0.498	0.000
Secondary school complete	225,101	0.311	0.463	0.000
College complete	225,101	0.132	0.339	0.000

Notes: Informal worker is a dummy variable equal to 1 if the worker is an informal wage earner and zero if formal. Self-employed is a dummy variable equal to 1 if the worker reports being self-employed. Recently hired is a dummy variable equal to 1 if the worker has a tenure of one year or less at their current job. Income per hour is the hourly income from the main occupation in AR$. Small firm is a dummy variable equal to 1 if the respondent works in a firm of up to 25 workers. Payroll tax rate is the payroll tax rate at the sector by area level. Age is the age in years. Female is a dummy variable equal to 1 if the respondent is female. Primary school incomplete is a dummy variable equal to 1 if the respondent has not completed primary school. Primary school complete is a dummy variable equal to 1 if the respondent has completed primary school. Secondary school complete is a dummy variable equal to 1 if the respondent has completed secondary school. College complete is a dummy variable equal to 1 if the respondent has completed any college degree.

Table 2: Pre-cut comparison between targeted and non-targeted sectors

	(1)	(2)	(3)
Variable	Targeted	Non-targeted	Difference
Informal worker	0.283	0.263	-0.020***
	(0.450)	(0.440)	(0.003)
Hourly wage	3.039	3.419	0.380***
	(2.874)	(2.940)	(0.021)
Recently hired	0.373	0.294	-0.079***
	(0.484)	(0.456)	(0.004)
Primary school incomplete	0.133	0.080	-0.053***
	(0.339)	(0.271)	(0.002)
Primary school complete	0.608	0.443	-0.165***
	(0.488)	(0.497)	(0.004)
Secondary school complete	0.219	0.318	0.099***
	(0.413)	(0.466)	(0.003)
College complete	0.041	0.159	0.118***
	(0.198)	(0.366)	(0.002)
Female	0.176	0.519	0.342***
	(0.381)	(0.500)	(0.003)
Age	34.532	35.379	0.846***
	(12.095)	(12.146)	(0.086)
Observations	27,894	69,415	97,897

Notes: Informal (wage earner) is a dummy variable equal to 1 if the worker is an informal wage earner and zero if formal. Self-employed is a dummy variable equal to 1 if the worker reports being self-employed. Recently hired is a dummy variable equal to 1 if the worker has a tenure of one year or less at their current job. Income per hour is the hourly income from the main occupation in AR$. Primary school incomplete is a dummy variable equal to 1 if the respondent has not completed primary school. Primary school complete is a dummy variable equal to 1 if the respondent has completed primary school. Secondary school complete is a dummy variable equal to 1 if the respondent has completed secondary school. College complete is a dummy variable equal to 1 if the respondent has completed any college degree.

Table 3: Main effects of the tax cut

	=100 if informal		Hourly wage (log)	
	(1)	(2)	(3)	(4)
Panel A. Overall effect				
Payroll tax rate	0.163**	0.131**	0.00104	0.00137
	(0.0643)	(0.0584)	(0.00111)	(0.000936)
Controls		✓		✓
Observations	97309	96623	93509	92859
R Squared	0.185	0.239	0.286	0.415
Panel B. Heterogeneity by firm size				
Payroll tax rate	0.365***	0.307***	-0.00322**	-0.00216**
	(0.109)	(0.104)	(0.00130)	(0.00104)
Small firm	31.90***	27.14***	-0.392***	-0.272***
	(4.681)	(4.300)	(0.0444)	(0.0365)
Payroll tax rate × Small firm	-0.383***	-0.322**	0.00673***	0.00506***
	(0.144)	(0.136)	(0.00145)	(0.00120)
Controls		✓		✓
Observations	76053	75498	73051	72524
R Squared	0.237	0.281	0.339	0.457
Panel C. Heterogeneity by new worker				
Payroll tax rate	-0.0322	-0.0336	-0.000457	-0.000538
	(0.0706)	(0.0693)	(0.00104)	(0.000885)
Recently hired	17.87***	14.30***	-0.352***	-0.268***
	(3.678)	(3.547)	(0.0348)	(0.0321)
Payroll tax rate × Recently hired	0.338***	0.317***	0.00437***	0.00468***
	(0.113)	(0.110)	(0.00112)	(0.00104)
Controls		✓		✓
Observations	84890	84295	81356	80789
R Squared	0.274	0.299	0.337	0.450
	=100 if small firm		=100 if recently hired	
Panel D. Small firm and new hiring				
Payroll tax rate	0.0250	0.0120	0.193*	0.149*
	(0.0815)	(0.0794)	(0.0984)	(0.0856)
Controls		✓		✓
Observations	76053	75498	84890	84295
R Squared	0.233	0.247	0.0693	0.168

Notes: Standard errors clustered at the sector-by-area level are reported in parentheses. In columns 1 and 2 from panels A, B, and C the dependent variable is a binary variable equal to 100 if the worker is informal and 0 if formal. In columns 3 and 4 of panels A, B, and C the dependent variable is natural logarithm of the hourly wage. In columns 1 and 2 of panel D the dependent variable is a binary variable equal to 100 if the worker is employed at an establishment of up to 25 workers. In columns 3 and 4 of panel D the dependent variable is a binary variable equal to 100 if the worker was hired up to one year ago. Payroll tax rate is the payroll tax rate at the sector by area level, measured from 0 to 100. Controls include an indicator for gender, age, age squared, and indicators for the highest degree of education achieved. Small firm is an indicator of the establishment having up to 25 workers. Recently hired is a dummy variable equal to 1 if the worker was hired up to one year ago. All specifications include sector fixed effects, area fixed effects, and time fixed effects. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Table 4: Main effects of the tax hike

	=100 if informal		Hourly wage (log)	
	(1)	(2)	(3)	(4)
Panel A. Overall effect				
Payroll tax rate	0.177	0.229	0.00255	0.00252
	(0.161)	(0.198)	(0.00290)	(0.00292)
Controls		✓		✓
Observations	156176	156173	140736	140736
R Squared	0.0273	0.291	0.0978	0.438
Panel B. Separating short-run and long-run				
Payroll tax rate (short-run effect)	-0.0367	-0.00731	0.0000535	0.000523
	(0.135)	(0.146)	(0.00218)	(0.00225)
Payroll tax rate (long-run effect)	0.456**	0.537*	0.00576	0.00508
	(0.214)	(0.278)	(0.00410)	(0.00406)
Controls		✓		✓
Observations	156176	156173	140736	140736
R Squared	0.0275	0.291	0.0979	0.438
Panel C. Heterogeneity by firm size				
Payroll tax rate	-0.0636	-0.0462	0.00201	0.00191
	(0.198)	(0.216)	(0.00240)	(0.00262)
Small firm	36.78***	17.26***	-0.523***	-0.179***
	(3.146)	(2.079)	(0.0420)	(0.0253)
Payroll tax rate × Small firm	0.219	0.350***	0.00242	0.000871
	(0.138)	(0.122)	(0.00172)	(0.00114)
Controls		✓		✓
Observations	138113	138113	125825	125825
R Squared	0.191	0.347	0.201	0.456
Panel D. Heterogeneity by new worker				
Payroll tax rate	-0.130	-0.103	0.00335	0.00311
	(0.125)	(0.161)	(0.00290)	(0.00285)
Recently hired	34.08***	17.61***	-0.527***	-0.214***
	(2.925)	(2.368)	(0.0262)	(0.0227)
Payroll tax rate × Recently hired	0.527***	0.732***	0.00326***	0.000618
	(0.129)	(0.117)	(0.00111)	(0.00109)
Controls		✓		✓
Observations	156176	156173	140736	140736
R Squared	0.211	0.369	0.187	0.452
	=100 if small firm		=100 if recently hired	
Panel E. Small firm and new hiring				
Payroll tax rate	0.254*	0.362**	0.315**	0.310*
	(0.145)	(0.136)	(0.145)	(0.168)
Controls		✓		✓
Observations	138113	138113	156176	156173
R Squared	0.0276	0.238	0.00830	0.181

Notes: Standard errors clustered at the sector-by-area level are reported in parentheses. In columns 1 and 2 from panels A, B, C, and D the dependent variable is a binary variable equal to 100 if the worker is informal and 0 if formal. In columns 3 and 4 of panels A, B, C, and D the dependent variable is natural logarithm of the hourly wage. In columns 1 and 2 of panel E the dependent variable is a binary variable equal to 100 if the worker is employed at an establishment of up to 25 workers. In columns 3 and 4 of panel E the dependent variable is a binary variable equal to 100 if the worker was hired up to one year ago. Payroll tax rate is the payroll tax rate at the sector by area level, measured from 0 to 100. Controls include an indicator for gender, age, age squared, indicators for the highest degree of education achieved, and sector fixed effects. Small firm is an indicator of the establishment having up to 25 workers. Recently hired is a dummy variable equal to 1 if the worker was hired up to one year ago. All specifications include area fixed effects and time fixed effects. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

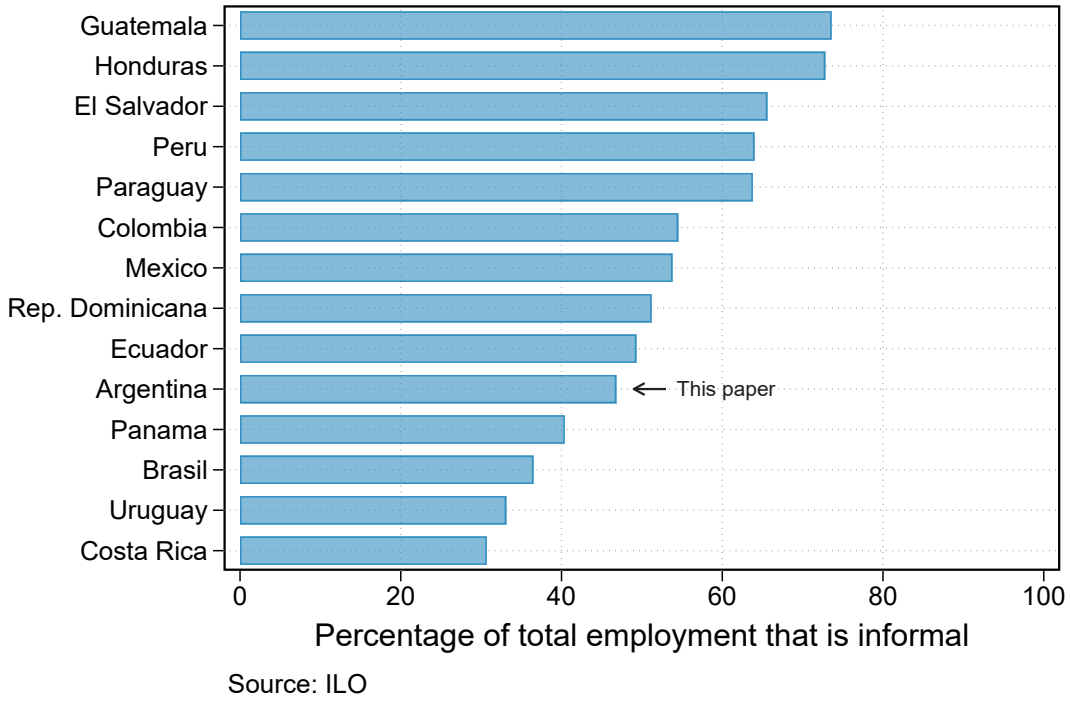
Payroll Taxes, Informal Employment, and Wages: Evidence from Argentina

Appendix

Maximiliano Lauletta[27]

A. Additional figures

Figure A.1: Informality in Latin America



Notes: This figure shows estimates from the International Labor Organization for the percentage of total employment that is informal for several countries in Latin America. The country studied in this paper (Argentina) is highlighted.

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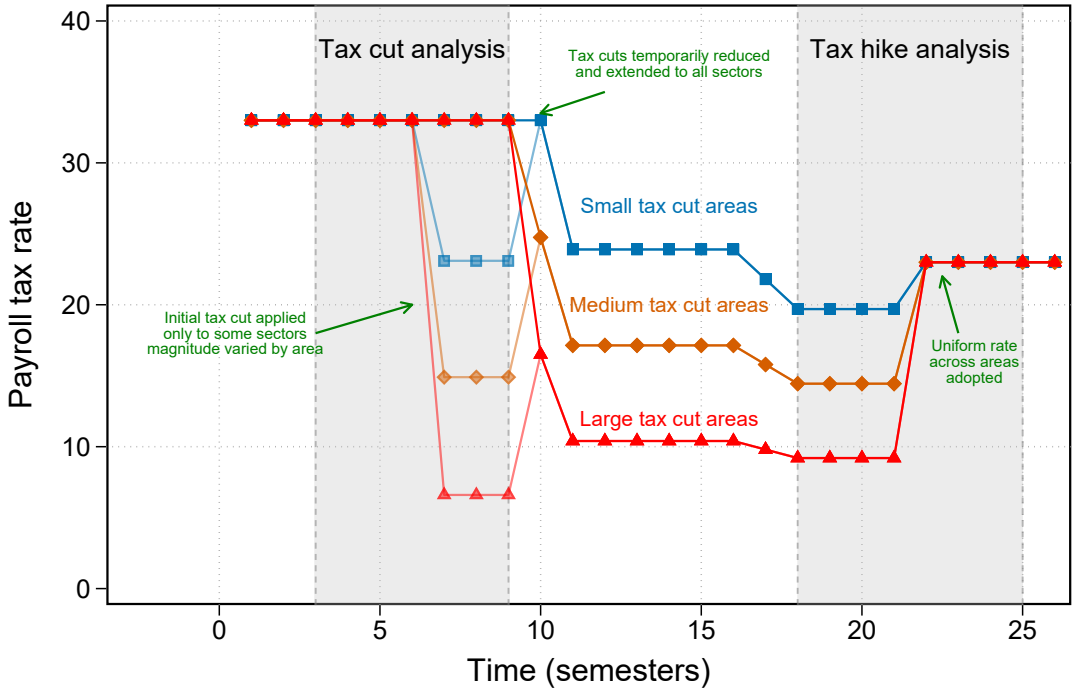
Figure A.2: Timeline and variation example



Notes: This figure shows a stylized visualization of the variation of the payroll tax rate over time across different areas and sectors. In practice, there were 11 categories of payroll tax rate reduction, this figure shows three categories for illustrative purposes: (i) areas that received the smallest tax cuts (in blue), (ii) areas that received a medium-sized tax cut (in orange), and (iii) areas that received the largest tax cut (in red). The shaded areas indicate the sample periods used for the tax cut and tax hike analysis.

B. Snapshots of tax rates assignment and tax filing software

Figure B.1: Rates by category example

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TABLA DE ALICUOTAS DE CONTRIBUCIONES GENERALES Y REDUCIDAS SEGUN DTO. 2.609/93 Y SUS MODIFICACIONES

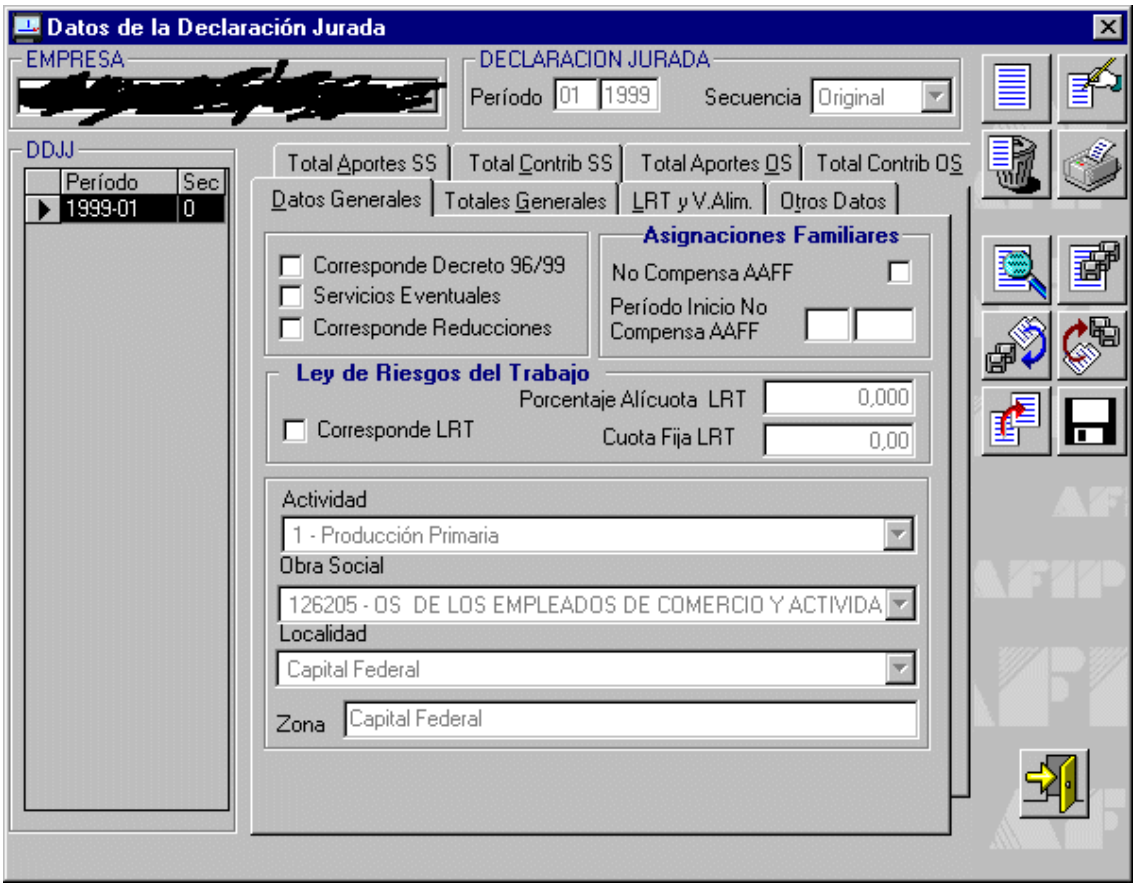
(Dto. 2.609/93: desde 7/94 hasta 2/95)

T04

% de reducc.	Contrib. de Seg. Soc.	Asig. famil.	Asig. fam. Zona Sur	F.N.E.	I.N.S.S.J.P.	Obra social
	A	b0	b1	c0	d	e0
0	16.00	7.50	3.00	1.50	2.00	6.00
30	11.20	5.25	2.10	1.05	1.40	4.20
35	10.40	4.87	1.95	0.97	1.30	3.90
40	9.60	4.50	1.80	0.90	1.20	3.60
45	8.80	4.12	1.65	0.82	1.10	3.30
50	8.00	3.75	1.50	0.75	1.00	3.00
55	7.20	3.37	1.35	0.67	0.90	2.70
60	6.40	3.00	1.20	0.60	0.80	2.40
65	5.60	2.62	1.05	0.52	0.70	2.10
70	4.80	2.25	0.90	0.45	0.60	1.80
75	4.00	1.87	0.75	0.37	0.50	1.50
80	3.20	1.50	0.60	0.30	0.40	1.20

Notes: This figure shows a snapshot of one of the tables in ordinances from the Tax Authority from which the payroll tax rates were digitized. The first column indicates the reduction coefficient for each category. The second column indicates the rate for social security contributions. The third and fourth columns indicate the rate for family allowances. The fifth column indicates the rate for unemployment insurance. The sixth column indicates the rate for contributions to healthcare for retired workers. The seventh column indicates the rate for contributions to healthcare for active workers.

Figure B.2: Tax filing software snapshot



Notes: This figure shows a snapshot of the software for filing payroll taxes that was used at the time. Note that the entry boxes for area and economic activity are fixed and tax filers could not change them using the software.

C. Robustness checks tables and figures

Table C.1: Robustness checks - tax cut

	=100 if informal		Hourly wage (log)	
	(1)	(2)	(3)	(4)
Panel A. Including self-employed				
Payroll tax rate	0.122**	0.124**	0.00156	0.00162*
	(0.0537)	(0.0509)	(0.000973)	(0.000842)
Controls		✓		✓
Observations	137059	135763	130780	129552
R Squared	0.234	0.323	0.255	0.370
Panel B. Including only wage earners with no missings				
Payroll tax rate	0.137**	0.302***	-0.00322**	-0.00219**
	(0.0673)	(0.103)	(0.00130)	(0.00104)
Controls		✓		✓
Observations	75702	75156	72862	72340
R Squared	0.199	0.281	0.340	0.458
Panel C. Area-by-time fixed effects				
Payroll tax rate	0.181***	0.151***	0.00121	0.00149
	(0.0597)	(0.0537)	(0.00113)	(0.000952)
Controls		✓		✓
Observations	97309	96623	93509	92859
R Squared	0.188	0.242	0.289	0.417

Notes: Standard errors clustered at the sector-by-area level are reported in parentheses. In columns 1 and 2 the dependent variable is a binary variable equal to 100 if the worker is informal and 0 if formal. In columns 3 and 4 the dependent variable is natural logarithm of the hourly wage. Payroll tax rate is the payroll tax rate at the sector by area level, measured from 0 to 100. Controls include an indicator for gender, age, age squared, and indicators for the highest degree of education achieved. All specifications include sector fixed effects, area fixed effects, and time fixed effects. Panel A includes self-employed workers in the sample, considering self-employed workers who have not completed high-school as informal. Panel B uses only observations from wage earners that have no missing values in informality, small firm, and recently hired. Panel C includes area-by-time fixed effects instead of area fixed effects and time fixed effects. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

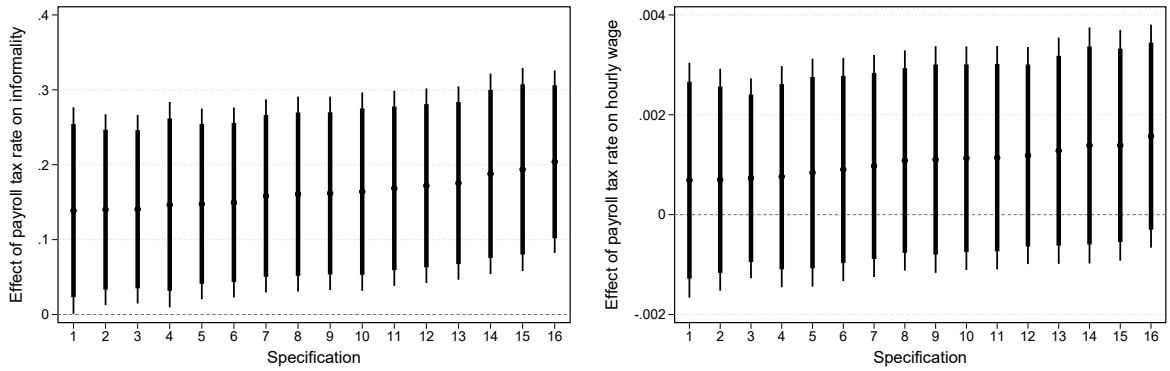
Table C.2: Robustness checks - tax hike

	=100 if informal		Hourly wage (log)	
	(1)	(2)	(3)	(4)
Panel A1. Including self-employed				
Payroll tax rate	0.0966	0.108	0.00286	0.00268
	(0.145)	(0.158)	(0.00323)	(0.00336)
Controls		✓		✓
Observations	203362	203362	180223	180223
R Squared	0.0236	0.274	0.100	0.337
Panel A2. Including self-employed (short-run and long-run)				
Payroll tax rate (short-run effect)	-0.0934	-0.0229	0.000530	0.000413
	(0.128)	(0.136)	(0.00241)	(0.00244)
Payroll tax rate (long-run effect)	0.346*	0.472**	0.00586	0.00396
	(0.182)	(0.227)	(0.00455)	(0.00462)
Controls		✓		✓
Observations	203362	203359	180223	180223
R Squared	0.0237	0.351	0.100	0.403
Panel B1. Including only wage earners with no missings				
Payroll tax rate	0.185	0.172	0.00238	0.00283
	(0.133)	(0.151)	(0.00303)	(0.00303)
Controls		✓		✓
Observations	138113	138113	125825	125825
R Squared	0.0295	0.211	0.105	0.391
Panel B2. Including only wage earners with no missings (short-run and long-run)				
Payroll tax rate (short-run effect)	0.00754	0.00788	-0.000480	-0.000299
	(0.118)	(0.124)	(0.00232)	(0.00234)
Payroll tax rate (long-run effect)	0.415**	0.386*	0.00605	0.00683
	(0.200)	(0.212)	(0.00422)	(0.00422)
Controls		✓		✓
Observations	138113	138113	125825	125825
R Squared	0.0296	0.211	0.105	0.391

Notes: Standard errors clustered at the sector-by-area level are reported in parentheses. In columns 1 and 2 the dependent variable is a binary variable equal to 100 if the worker is informal and 0 if formal. In columns 3 and 4 the dependent variable is natural logarithm of the hourly wage. Payroll tax rate is the payroll tax rate at the sector by area level, measured from 0 to 100. Payroll tax rate (short-run effect) is the interaction of the change in the payroll tax rate before and after the tax hike interacted with an indicator of the time period being 1 or 2 survey waves after the tax increase. Payroll tax rate (long-run effect) is the interaction of the change in the payroll tax rate before and after the tax hike interacted with an indicator of the time period being 3 or 4 survey waves after the tax increase. Controls include an indicator for gender, age, age squared, indicators for the highest degree of education achieved, and sector fixed effects. Panels A1 and A2 include self-employed workers in the sample, considering self-employed workers who have not completed high-school as informal. Panels B1 and B2 use only observations from wage earners that have no missing values in informality, small firm, and recently hired. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Figure C.1: Leave-one-out robustness check - tax cut

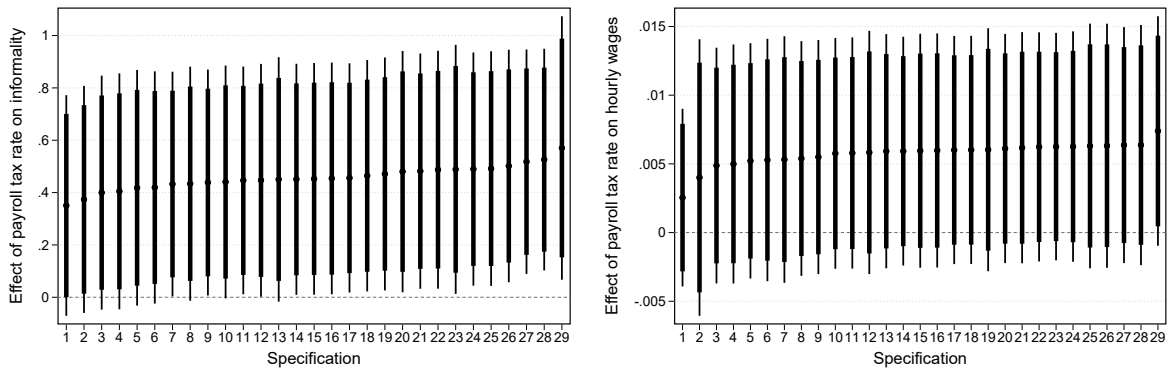
(a) Informality **(b)** Hourly wage



Notes: This figure shows several OLS estimates of the main coefficient from equation 2 for the tax cut period. Each coefficient corresponds to an estimate calculated by dropping one of the areas from the sample. Panel (a) reports the effect of the payroll tax rate on the probability of being informal. Panel (b) reports the effect of the payroll tax rate on the natural logarithm of the hourly wage. Standard errors are clustered at the sector-by-area level. Thick vertical bars represent 90% confidence intervals and thin vertical bars represent 95% confidence intervals.

Figure C.2: Leave-one-out robustness check - tax hike

(a) Informality **(b)** Hourly wage



Notes: This figure shows several OLS estimates of the coefficient for the long-run effect of the payroll tax rate from equation 2 for the tax hike period. Each coefficient corresponds to an estimate calculated by dropping one of the areas from the sample. Panel (a) reports the effect of the payroll tax rate on the probability of being informal. Panel (b) reports the effect of the payroll tax rate on the natural logarithm of the hourly wage. Standard errors are clustered at the area level. Thick vertical bars represent 90% confidence intervals and thin vertical bars represent 95% confidence intervals.