Payments Under the Table:

Employer-Employee Collusion in Brazil[*]

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Abstract

We study formal workers who receive part of their salary *off the books*, which we refer to as "payments under the table" (PUT). Using a novel survey of Brazil's formal employees, we provide the first direct evidence of PUT. A quarter of formal employees admit to receiving PUTs for about 20% of their wages, shifting priors on the effectiveness of third-party reporting to prevent employer-employee collusion. Our estimates suggest that PUTs represent revenue losses for 4.74% of the income tax and 2.32% of social security contributions, driven mostly by high-wage earners who evade a larger share of their income. Guided by a Nash Bargaining framework, we study how employers' and employees' incentives shape collusive tax evasion. On the employer side, we leverage novel data on PUT-related labor lawsuits matched to employer-employee records to show that employers increase the reported wages of other employees in response to a PUT-related lawsuit triggered by a conflict in the workplace. The mechanisms in place are consistent with an increase in employers' risk of engaging in PUTs, with modest responses relative to the full-compliance scenario. Finally, we exploit variations in employee benefits linked to wage reporting. Bunching evidence and an information provision experiment reveal that, even when employers report employees' wages, the reporting patterns are consistent with the employees' benefit schedules through adjustments in PUTs. *JEL* Codes: H26, O17, J46

1 Introduction

Tax evasion is a prevalent problem that significantly impacts governments' ability to deliver public goods while weakening tax systems' efficiency and equity. Governments dedicate significant resources to tackling tax evasion and designing new forms of tax collection and enforcement instruments (Slemrod 2007). One of the most important developments in this area has been the widespread use of third-party reporting and withholding of employees' wages. The underlying assumption is that employer-employee collusion is fragile in modern economies (Kleven et al. 2016).

However, countries significantly differ in enforcement structures, government capacity, and the incentives that employers and employees face to engage in collusive tax evasion. This raises the concern that third-party reporting may not work as a silver bullet to fight tax evasion independently of the context. Developing countries, in particular, face their own challenges related to informal employment and weak institutions, leading to low revenue collection and social security coverage (Bachas et al. 2021, Best 2014, Carrillo et al. 2017). While the public finance literature has made strides in understanding informal employment through household and labor force surveys (Ulyssea 2020), the role of informal ties within formal employment, especially those subject to third-party reporting and withholding, remains underexplored. This gap has led to an oversight of cases where formal employees collude with employers to underreport wages.

This paper fills this gap, directly addressing the phenomenon of formal workers receiving part of their wages *off the books*, a practice we refer to as "payments under the table" (PUT). We designed a novel and unique large-scale survey in Brazil to provide the first direct and systematic evidence of PUT and an exhaustive characterization of who engages in this practice. We then develop a conceptual framework to guide further empirical analyses leveraging rich administrative data, studying how employers' and employees' incentives shape collusive tax evasion, which informs us about complementary policies to limit the practice of PUT.

We set the scene, presenting the results of our novel survey in Brazil. We find that 24% of formal private employees admit to receiving PUTs for about 20% of their wages. Moreover, high-wage employees underreport a larger share of their wages. Formal employees in the top 5pc of the wage distribution underreport up to three times more than those in the bottom 50pc. Employees working in small establishments are twice as likely to receive PUTs than those in large firms. In addition, we provide direct evidence of collusive behavior between employer and employee. Even after controlling for demographics, income, and firm size, a higher degree of interaction between employer and employee strongly predicts engagement in PUTs. When analyzing the payment methods, we find that cash explains between 40-50% of all PUTs, but it becomes less relevant as we move upwards in the wage distribution. For high-wage earners, bank transfers and virtual payments become more important.

A conservative accounting exercise suggests that PUTs imply revenue losses for 4.72% of the labor income tax and 2.49% of Social Security Contributions. Together, this accounts for 0.32% of

the GDP, representing about a third of the revenue losses from classic informality. However, more than 50% of the amount evaded for PUTs can be allocated to the top 10pc of the wage distribution, while this number is only 27% for classic informality. This highlights that PUTs is significantly more regressive than classic informality.

Validation is critical when providing the first direct measures on a largely understudied topic. We provide complementary evidence to all our results based on two different sources. First, we conduct additional surveys with firm owners and extensive interviews with accountants to evaluate the consistency of the responses from the other side of the collusion. Second, we collected and processed labor lawsuit documents in which employees sued employers in labor courts for paying under the table. These documents contain rich information on payment methods, amounts paid under the table and reported in the payroll, evidence of conflict in the workplace, etc. We use ChatGPT 4-o to process, recover, and organize the information contained in these documents.[1] These alternative approaches provide similar results to the main survey of employees, validating our findings.

Having established the extent and distribution of PUTs, we move to understand how employers' and employees' incentives shape collusive tax evasion and which policies can help complement third-party reporting to limit the extent of PUTs. We develop a simple conceptual framework to illustrate the trade-offs employers and employees face when engaging in PUTs. On the employer side, we study the leading risk employers face when paying under the table: lawsuits in labor courts. On the employee side, we study the ceiling in the social security system which breaks the link between wage reporting and pension benefits.

We use novel data on PUT-related labor lawsuits merged with matched employer-employee data to study the role of the primary whistle-blowing institution in limiting PUTs. In this context, we can identify firms and employees who are part of a labor lawsuit for PUT-related issues and track their behavior over time. We begin by showing that labor lawsuits are entirely triggered by conflict in the workplace. All lawsuits take place after the employment relationship concludes. Conflicting separations are associated with 40 to 50 times higher likelihood of suing the firm than non-conflicting separations.

Second, we use a *stacked matching difference in difference* to show that employers increase the reported wages of other employees by 1% in response to a former employee's lawsuit, compared to no effects for firms sued for non-PUT related issues. In line with the survey results, where certain employees are more likely to receive PUTs, we find that effects are significantly larger for workers in small firms and managerial positions. Compared to the extent of PUTs, this estimate suggests modest effects of labor courts at limiting PUTs. Back-of-the-envelope calculations suggest that the full-compliance response to a lawsuit would imply an increase in reported wages between 8-12%. We then test the mechanisms behind these effects. Our interviews with accountants reveal

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[1]Each lawyer writes the document in their own way. Therefore, conventional text analysis tools are not suitable in this setting. Appendix E provides a detailed description of the procedure, robustness checks, and replication package to adapt to other settings.

that the employer's risk of engaging in PUTs with other employees increases after a lawsuit for two reasons. First, the employers underestimate the likelihood of a workplace conflict that can trigger a lawsuit. Second, other employees become more likely to sue in response to a former employee's lawsuit. Coworkers are called to testify in labor courts, where they may learn how to carry out a lawsuit, the likelihood of winning, etc. Consistent with the latter mechanism, we find suggestive evidence of learning in networks of coworkers. Using an event study design, we show that employees become more likely to sue their employers for PUTs after a new coworker with lawsuit experience arrives at the firm compared to a control group that faces the arrival of a new coworker without lawsuit experience. We show that results are driven by those coworkers who are more likely to interact with the lawsuit-experienced employee.

We then explore how employees' costs affect collusion in wage reporting. We leverage a regulation that only increases employees' costs of engaging in PUTs to show that, even when the employer reports employees' wages, employees' incentives also shape collusive tax evasion. Reporting wages has several employee benefits, including social security benefits and proof of income. Pension benefits phase out above the ceiling of the social security system, discontinuously changing the incentives to report wages. Below the ceiling, employees can increase their pension by reporting additional wages. Above the ceiling, the pension is capped at a maximum, meaning there is no subsequent gain in pension from reporting higher wages. We find that employees close to retirement age bunch at the ceiling of the social security system. We rule out labor supply responses in three ways. First, we show heterogeneity analysis around the ceiling, showing that bunchers significantly differ from non-bunchers in ways consistent with the survey evidence on PUTs. Second, we use the ceiling annual updates to study bunchers' wage dynamics. We show that, even when labor contracts are non-flexible, they adjust their reported wages from one year to the next to precisely target the new ceiling, while they do not show any wage change within a given year. Finally, we provide indirect evidence of the *true* wages of those employees who report the ceiling versus those who report a few dollars more or less. We find that bunchers are 40% less likely to receive any aid from federal programs and twice as likely ever to own a good-quality firm than those who report slightly above or below the ceiling. This indicates how PUTs respond to employees' incentives even when employers report their wages.

Our results show that PUTs are widespread and sizeable in a context like Brazil. They also show how employers' and employees' incentives contribute to shaping collusive tax evasion, providing valuable insights on designing policies that complement third-party reporting to increase its efficacy in reducing this practice. Cooperation between tax authorities and labor courts can enhance tax enforcement by triggering targeted tax audits that increase the propagation effects of a PUT-related lawsuit, restoring the prediction of standard models. Moreover, employees' responses to the ceiling of the social security system suggest that strengthening the link between reported wages and benefits reduces employees' incentives to engage in collusive tax evasion.

Our paper contributes to several strands of the literature. First, we contribute to the literature on tax evasion and third-party reporting. The *Internal Revenue Service* has released tax gap reports

for the last 20 years (IRS 2022 for the latest). They consistently show no misreporting for income subject to third-party reporting and withholding. Kleven et al. (2011) use of random audits to unmask the evasion rate of different types of income in Denmark. Similarly to the United States, they find no evidence of misreporting for income subject to third-party reporting, such as wages. An extensive literature studying tax evasion using *traces of income* has evolved under the critical assumption that income is accurately reported for wage and salary earners (Feldman and Slemrod 2007, Artavanis et al. 2016, Bazzoli et al. 2021, Schmutz 2018). In the seminal paper Chetty et al. (2013), the authors interpret the bunching responses of self-employed as purely reporting, while the wage earners' responses are interpreted as adjustments in actual earnings. Kleven et al. (2016) develops a model of third-party reporting as the crucial tool to rationalize why governments can tax so much in modern economies. In a nutshell, the authors propose that collusion between employer and employee is fragile. If any employee can report PUTs to the tax authority, this would trigger a tax audit that uncovers all PUTs in the firm, no one will find it profitable to engage in collusive tax evasion as the number of employees increases, exponentially increasing the probability that at least one employee reports.

Despite the received wisdom of third-party reporting as a silver bullet to fight tax evasion, recent papers have shown that collusive tax evasion can be prevalent in many contexts, undermining the efficacy of third-party reporting. Doerr and Necker (2021) shows evidence of collusive tax evasion for service provision in Germany, where the client receives a lower price while the contractor does not provide an invoice to evade taxes. In Brazil, Naritomi (2019) shows that consumers can get a lower price at the last stage of the VAT chain while the retailer evades VAT payments. They also show how interventions that reduce consumers' incentives to participate in collusive tax evasion substantially increase tax compliance. Carrillo et al. (2017) shows that the effectiveness of third-party reporting for VAT can be limited when tax authorities face constraints to credible enforcement in Ecuador. More recently, Carrillo et al. (2023) shows that collusive tax evasion between firms can go far enough that they release "ghost" invoices so their clients can claim them as deductions.

Other papers have investigated PUTs but always through an indirect approach. Interestingly, this emerging literature covers many countries, from Latin America to Eastern Europe. Even in Norway, Bjørneby et al. (2021) provides experimental evidence of PUTs in small firms. Some have considered the interaction of PUTs and the minimum wage (Bíró et al. 2022, Gavoille and Zasova 2023). Others have interpreted responses to pension or health insurance regulations in reported wages as adjustments in PUTs (Lauletta and Bérgolo 2023, Bergolo and Cruces 2014, Kumler et al. 2020). Paulus (2015), Kumler et al. (2020), Calijuri et al. (2023) have addressed the measurement of PUTs using indirect methods. An exemption is Williams and Padmore (2013), which conducts a survey for several European countries about PUTs.[2] This survey has several limitations. First, it mostly captures the extent of formal wages paid under the table but does not provide much disaggregation to understand who engages in this practice. Second, it is more focused on cross-

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[2]Referred to as *envelope wages*.

country comparisons without providing revenue or inequality implications. Finally, it does not speak to the incentives that employers and employees face when engaging in PUTs.

Our paper provides the first direct and systematic evidence, documenting the extent of PUTs, their revenue and distributional implications, and how employers' and employees' incentives shape collusive tax evasion in the same setting. We expect this paper to finally remove priors on third-party reporting as a silver bullet to prevent wage misreporting. Even for economists who are more agnostic about the efficacy of third-party reporting, this paper provides comprehensive evidence and concrete numbers that were previously ignored regarding an important phenomenon. Moreover, it studies how incentives shape collusive tax evasion and what kind of policies can contribute to reducing this practice.

Second, this paper contributes to the large literature on informal employment in developing countries. A vast amount of research studies the spread and consequences of informality. However, there is no uniform definition of informality (Guha-Khasnobis et al. 2006). The seminal book Levy (2010) defines informal workers as self-employed and employees not registered in the social security system. This definition is not synonymous with illegality. We separate from this definition and only focus on employer-employee relationships, ignoring self-employed individuals. Moreover, we explicitly focus on illegal behavior, referring to all employee payments that should be reported as wages, income taxes, or social security contributions. This brings us closer to the informality literature that aims to rationalize the existence of informal employer-employee relationships, non-compliant with regulations.

The traditional view of informality highlighted firms' decisions to comply or not with regulations. Therefore, all workers employed in unregistered firms are hired informally (Rauch 1991, La Porta and Shleifer 2014). Ulyssea (2018) extended this view of informality by considering registered firms that hire some of their workers *off-the-books*. More recently, Haanwinckel (2020) uses a compensating differentials model to show that high-productive workers can be hired informally in unregistered establishments. These two papers have made significant progress on adding layers of complexity to the informality phenomenon. Yet, informality remains a binary concept defined at the worker level. This paper shows the importance of extending the definition of informality further, at the wage rather than the worker level.

2 Context

2.1 The Brazilian labor market

Brazil is the largest country in Latin America, with 220 million inhabitants. In 2022, the GDP per capita in PPP was 19,398 US$, similar to other Latin American countries. Furthermore, despite progress at the beginning of the 20th century, Brazil remains one of the most unequal countries in the world: the Gini Index was 53.4 in 2020.

Like most developing countries, informal labor relations are a large component of the Brazil-

ian labor market. Individuals with no link to social security represent 31.3% of Brazilian employees.[3] Among workers in an employer-employee relationship, 78% are formally employed, meaning their employers listed them in the payroll, making contributions on their behalf.

In Brazil, identifying formal and informal employees is straightforward and salient to workers, employers, and authorities. Every formal employee must have a document called *Carteira de Trabalho*, in which all her job contracts must be documented. Employees must sign this booklet. Nowadays, it is a virtual booklet in which employees can observe the monthly wages that their employers report each month. Therefore, Brazil is a context where not only formality status is salient for the employee but also how much the employer reports. Furthermore, there are no significant penalties to the employee if she works with an unsigned *Carteira de Trabalho*. Thus, there is no evidence of individuals under-reporting their informality status because of fear of being sanctioned.[4]

Formal labor ties are associated with benefits and costs for the employee and employer. Employees with a *signed Carteira de Trabalho* are entitled to severance payments, pensions for disabilities, maternity leave (restricted to women), and unemployment insurance. They also have to contribute to the social security system (the contribution schedule is detailed in Appendix F) and abide by the Brazilian Labor law that, among other things, governs the number of hours worked, paid vacation days, and work conditions. In turn, employers must comply with minimum wages, union wage floors, and contributions to the social security system for each employee.

Formal employees' wages face third-party reporting by the employer. Income taxes are withheld. The rates are sharply increasing in income, reaching a top marginal income tax of 27.5% for individuals in the top 8% of the wage distribution. About 50% of all formal employees earn below the exemption threshold, meaning they pay no income tax (see Figure A19).

In Table A1, we provide descriptive statistics of the Brazilian Labor Market and the differences between formal and informal employees. Informal employees are less educated, younger, and their average monthly wage is around 50% of the average wage of employees with signed *Carteira Assinada*.

2.2 Payments under the table

In Brazil, paying under the table implies a violation of the Tax and Labor Laws. In the first case, employers and employees violate several articles of the Tax Law. For example, Article 113 defines the primary tax obligations, stating that taxpayers must declare all income and fulfill tax obligations. Employees are not paying income taxes, and employers do not pay contributions when incurring PUTs. Article 1 in Law N° 8137/1990 states (see Apendix C for more details):

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[3]Among Self-Employed individuals, who comprise 33% of the Brazilian Labor force, this share is even higher. Calculations made with PNAD-C in the first trimester of 2022.

[4]If anything, the matching between administrative registries of employer-employee relationships and the survey conducted to receivers of a federal aid program suggest misreporting of the formality status not to lose access to those programs.

It constitutes a crime against the tax system to suppress or reduce taxes, social contributions, or any accessory through the following conduct:

1. Omit information or make a false statement to the tax authorities;

2. Defraud tax inspection by inserting inaccurate elements or omitting operations of any nature in a document or book required by tax law;

Setting penalties of imprisonment of two to five years and a fine.

However, the Labor Courts have jurisdictions different from the laws and codes mentioned above. First, Labor Courts are responsible for processing and judging disputes arising from labor relationships.[5] This means that they mediate employer-employee relationships and obligations with each other. They do not process or judge the obligations that each of them has with the tax authority or the government. Second, regarding the subject matter, the Labor Courts' jurisdiction is determined based on the cause of action of the claim filed. If an action is filed and it is found that the cause of action and the claim itself are based on a labor relationship governed by the "Consolidation of Labor Laws" (CLT - *Consolidação das Leis do Trabalho*, the jurisdiction is of the Labor Court.[6] Articles related to employees' payments are specified in the first chapter of the CLT. It specifies that employers have an obligation to report salaries in the employees' booklet (*Carteira do Trabalho*) regardless of payment method. Article 39 states that employees can bring omissions in the booklet to Labor Courts. Section VIII explicitly mentions the penalties for employers failing to report employees' wages properly.[7] Therefore, only the employer violates the labor law when engaged in PUTs. This makes Labor Courts safe institution for employees to report PUTs, where they can get compensated and not expose themselves to the judgment of other civil responsibilities.

3 Data

This paper combines several data sources. First, we collect our own data based on a survey of formal employees, firm owners, and accountants. We complement these data with the Brazilian household survey to reweight our sample and recover informality estimates. Second, we use several sources of administrative data. These include the matched employer-employer (RAIS), ownership records, labor lawsuit records, and registries of all federal aid programs' recipients. In what follows, we present a brief description of each data source. Appendix D and E provide further information.

3.1 Our Surveys

We conducted surveys to formal employees, firm owners, and accountants in order to provide a comprehensive picture of PUTs. Appendix G.1 contains the questionnaires. We make all data

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[5]Constitutional Amendment N° 45/2004 expanded Labor Courts' umbrella beyond employment relationship to any labor relationship.

[6]Competência da Justiça do Trabalho e Comum - Jurbrasil

[7]Full document: *Consolidação das Leis do Trabalho*

publicly available for other researchers interested in the topic.[8]

3.1.1 Employees

Using the online survey platform Lucid MarketPlace [9], we conducted the first large-scale survey on PUT in March 2022. We surveyed an initial sample of 12,000 Brazilian employees.[10] That sample had already excluded self-employed, part-time workers, and those under 18. Furthermore, we excluded informal employees and those employed in the public sector. We proceeded in the same way as the official Brazilian household survey. We ask whether the employee holds *carteira de trabalho assinada* or not. This is a salient question because this booklet gives formal employees in Brazil access to social security benefits.[11] Our final sample comprises 9,000 formal employees and 7,297 private-sector employees. As it is common with online surveys, our sample over-represents educated people and high-income earners compared to the National Household Survey (PNAD-C). Table (A2) provides a balance table comparing our survey with PNAD-C. We reweight our sample based on workers' demographics, firm characteristics, and earnings (Appendix D.1.1 presents a detailed explanation of the reweighting procedure).

When asking sensitive questions about illegal activities, such as PUTs, an additional concern is the willingness to report the truth. If some respondents are unwilling to admit receiving PUTs, this would imply that our estimates are a lower bound of the actual fraction of employees participating in this illegal activity. We conducted a *List experiment* to address this issue. The discrepancy between the *List experiment* is important to evaluate the accuracy of our direct question and can also be informative. For example, a large discrepancy may be interpreted as a low social stigma of engaging in PUTs. Figure A1a shows that the *List experiment* reveals that 27% of formal employees participate in PUTs. We read this as evidence of a low social stigma to admit the truth in the context of PUTs (see Appendix D.1.2 for details on the methodology).

3.1.2 Firm Owners

We partner with Oppen Social, a prestigious survey company in Brazil, to conduct 313 phone surveys, making sure that we were talking to the firm owner or a high-ranked manager with knowledge of the firm's wage-setting policy. The goal was not to conduct a representative survey, but rather to learn about PUTs from the firm's perspective. The sample selection were based on the following criteria. The vast majority of surveyed firm owners (222) were randomly selected from the population of small and medium-sized firms. To have external information as a source of validity check, we targeted firms that were sued for PUTs between 2014 and 2019 (in our administrative data). We were able to reach 63 of them. Then, we also reached 28 firms whose employees appear to be bunching at the ceiling of the social security contribution (Section 6.2 shows why

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[8]Email jfeinmann@berkeley.edu to request the data.

[9]See Coppock and McClellan (2019) for a study on its external validity

[10]Respondents were compensated for their participation in the survey.

[11]See Section 2 for more details on this booklet.

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these firms are suspected of participating in PUTs).

In Figure A2a, we show that more than 30% of the firm owners admitted to paying under the table to their employees, and about 50% of them are aware of at least one PUT situation. We claim that the results are a lower bound of the true share of firms participating in PUTs.[12]

We asked several questions about why PUTs are useful for firms, making firm owners think about what they would have to change if PUTs were impossible. Furthermore, we ask about the risks associated with PUTs. In particular, we asked whether they have ever been sued for PUTs. Consistent with our targeting strategy, Figure A8 shows that those in our administrative data of labor lawsuits for PUT-related cases are significantly more likely to admit having a PUT-related lawsuit. This validates that we are reaching out to the firms we are supposed to.

3.1.3 Accountants

We surveyed 55 accountants in two ways. We conducted 36 in-depth interviews for 30/40 minutes and collected the remaining answers through short versions of the questionnaire distributed through the *WhatsApp* group of the Sao Paulo School of Accountants. As in the firm survey, the goal was not to collect a representative survey but to learn about the accounting side of PUTs. In all interviews, the accountants accepted to participate, previously informed about the sensitive content of the questions.

3.2 Pesquisa Nacional por Amostra Domiciliar - Continua (PNAD-C)

We use PNAD-C, a national household survey conducted by the Brazilian Institute of Geography and Statistics (IBGE). The survey has been collected quarterly since 2012. PNAD-C contains individual-level data on demographics and labor market information, such as wages and hours worked for employees in both formal and informal sectors. In this project, we want to compare and link our survey results to PNAD-C. Given that our survey was collected in March 2022, we use PNAD-C corresponding to the first quarter of 2022.

We use this data for two reasons. First, it allows us to build the correct weights for our survey of formal employees (Appendix D.1.1 provides the methodology). Second, we need PNAD-C to recover information on classic informal employees, which is used to benchmark the accounting exercise presented in Section 4.

3.3 Relação Anual de Informações Sociais (RAIS)

RAIS is a matched employer-employee data set that covers the universe of workers in the Brazilian formal labor market and is collected by the Ministry of Labor. Firms must submit annual informa-

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[12]Asking about illegal activities to firm owners is even more sensitive than to employees. As explained in Section 2, employers break two laws when engaging in PUTs.

tion on all formal job contracts established in the previous year to the federal government, which uses this information to calculate a series of worker and firm benefits. Firms' compliance in reporting this information is high, as failing to report complete records leads to significant penalties. RAIS only tracks hired workers and does not show firm owners.

Workers in RAIS are identified by their name and CPF,[13] which allows us to follow them across time and match the information in RAIS to other identified data sets. Among other variables, we observe December wages, contracted hours, type of contract (temporary or regular), age, gender, schooling, separation and hiring dates, sector, and occupation. Importantly, this data contains the employees' wages reported by their employers, meaning that it includes the third-party reporting feature, which is at the core of the paper.

3.4 Lawsuit Data

Through a partnership with Data Lawyer, we collected the universe of lawsuits related to PUT (*pagos por fora* in Portuguese) in Brazil between 2014 and 2019. These 220,000 lawsuits are cases where an employee sues an employer in the Labor Court for receiving PUTs (and losing the benefits linked to reporting). The data contains detailed information on the case, including employees and employer identifiers, judges, and lawyers involved, the amount of money claimed and paid, and the resolution. These cases provide evidence of collusion breakdown, which we use to understand why collusion may fail and how employers learn about the risks associated with PUT.

Finally, we access a random subsample of 100,000 PDFs containing the claim sent by employees' lawyers to the judge. These documents contain valuable information about the amount of PUT, how it was paid, conflict in the workplace, and more. Because each lawyers write the document in their own way, applying standard text analysis techniques is not feasible. We developed a program that uses AI technology to process and interpret the lawsuits' PDFs. In Appendix E, we present the full methodology. We will make the codes available for anyone interested in processing non-systematized text information.

3.5 Other Datasets

We complement the previous data with two additional datasets. We collected ownership registries comprising the universe of firm owners in Brazil, creating a unique owner-firm-employee database. We also use *Cadastro Único*, which is a comprehensive administrative registry made by the Ministry of Social Development covering the universe of households that receive a federal social welfare program. See Appendix D for details.

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[13]CPF is the *Cadastro de Pessoa Fisica* and is an equivalent to the Social Security Number

4 Payments Under the Table: The Big Picture

This section shows the results of our novel survey about PUT in Brazil. We focus our attention on formal employees working full-time in the private sector. Appendix G.1 provides the exact questions we ask to get the final sample. One advantage of our setting is that there is a clear definition of formal employees who must have a booklet that provides access to social security benefits. We use this definition, which the Brazilian government uses as well.

Like most online surveys, it overrepresents high-income earners and highly educated individuals. We rely on the national household survey to reweight our sample (see Appendix D.1.1 for details). Table A2 presents a balance table comparing our survey with the government household survey. Column (2) uses our survey re-weighted. We can approximate most of the summary statistics, which makes our results more reliable in representing the Brazilian labor force population.[14]

We complemented the employee survey with surveys to firm owners and accountants to validate our results. We collected 313 firm owners' responses and about 50 interviews with accountants. These complementary surveys are not intended to be representative but as an additional source of information about accounting and employers' incentives. Finally, we used ChatGPT 4-o to process 100,000 PDFs related to labor lawsuits for payments under the table (*pagos por fora*, in Portuguese). This provides a novel and unique source of information to validate the main results.

4.1 Extent of PUT

The first challenge of a survey on illegal payments is to communicate to respondents what we mean by PUTs. Note that the concept entails very different situations, from receiving half the salary in cash every month to using the firm's credit card for personal expenditures. We want to capture at least three general features. First, the illegal nature of PUTs, meaning that taxes or social security contributions should legally be paid for these payments. Second, some degree of periodicity, meaning that it has to correspond to payments made in the concept of wages. Third, we want to refer to situations where some degree of employer-employee collusion exists. This means that, at the minimum, they are both informed. The following paragraph is the exact explanation we provide to respondents about PUTs.[15]

> *"In Brazil,* **some formal workers (with CTA[16]) receive part of their wages under the table, meaning that they are not registered on the firm's payroll.** *Therefore, total wages*

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[14]We did not recover location, so we cannot use regions as an additional input in the reweighting process. However, the survey company we partnered with confirmed that they collected their sample to represent all regions in Brazil accurately. In a follow-up paper, where we replicate the survey in several Latin American countries, we include a question on location that we use in the analysis.

[15]Own translation from Portuguese

[16]Card that gives access to social security benefits (formal employees hold a CTA, informal employees don't)

have two parts:

- ***In firm's payroll*** *(paying taxes and making contributions to social security)*
- ***Not registered in firm's payroll*** *(saving taxes or social security contributions)*

*The following questionnaire concerns this type of informality: formal employees (with CTA) who receive part of the wage under the table. **It is important to remember that all responses are anonymous 100% and only used for this research project. We thank you for your collaboration.***"

We first document that about 24% of formal private employees (21% of all private employees) admit to receiving PUT. On average, PUT receivers underreport 20% of their wages.

Figure 1: Payments Under the Table in the Brazilian Labor Market
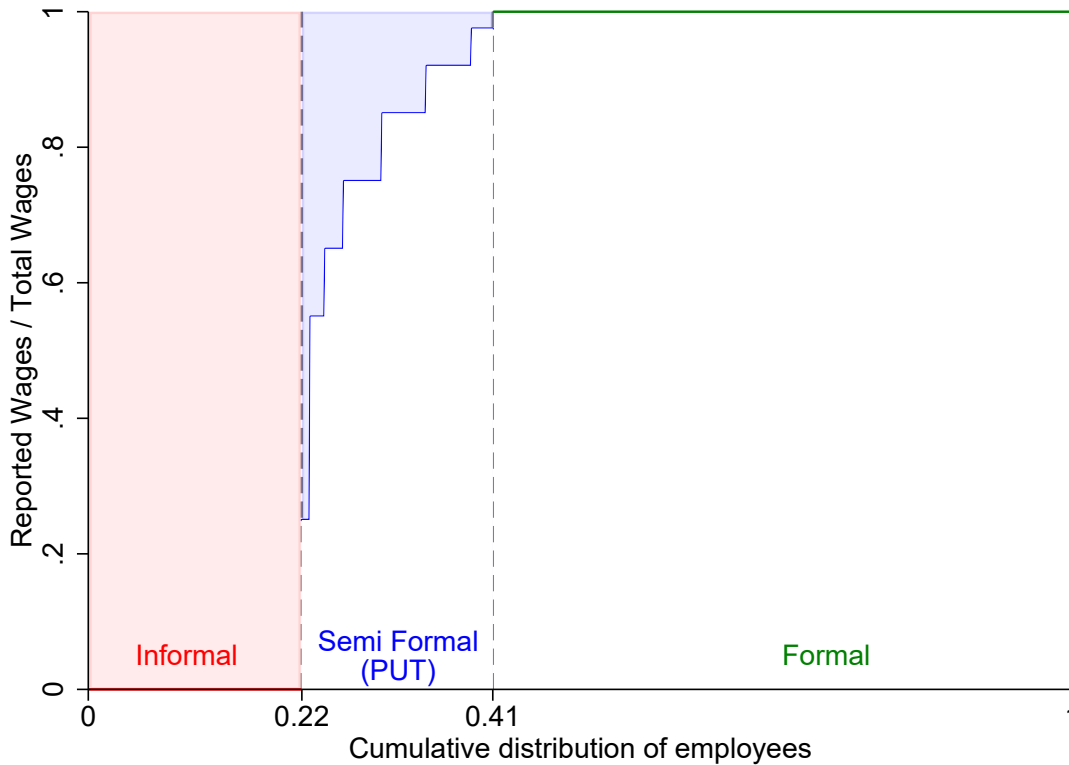
Notes: This Figure shows the ratio of reported wages over total wages for employer-employee relationships in the Brazilian economy. The red shaded area represents the 22% of employees who are informally employed. The remaining 78% of employees are separated between fully formal (in green) and semi-formal (in blue). Semi-formal employees represent the PUT receivers. The blue shaded area represents the additional under-reported wages documented in this paper. We input that the entire wage is not reported for fully informal employees, contrary to fully formal employees, who we input as full reporting. All results are re-weighted based on the Brazilian Household Survey.

Figure 1 has two purposes. First, it summarizes the extensive and intensive margin of PUTs in

a single plot. Secondly, it emphasizes that informality should be understood as a spectrum rather than the traditional binary concept.

When validating the extensive margin, a classic concern with sensitive questions is the willingness of respondents to admit the truth. We follow the current literature to design a List Experiment (Castañeda et al. 2020, Coffman et al. 2017), which confirms our result. Appendix D.1.2 provides details on the experiment implementation. In line with these results, about 30% of firm owners admitted to paying their employees under the table, and almost 50% of them know a case of PUTs. Considering that most surveys to employers were by phone, we expect significant under-reporting. Consistently, our interviews with accountants reveal a widespread practice of payments under the table.

We use the PUT-related lawsuit documents to validate the intensive margin by recovering the fraction paid under the table. As explained in Section 3, these documents are written by the employee's lawyer to begin a lawsuit, meaning they address the judge. Given the lack of structure, we use ChatGPT 4-o as a way of processing them to emulate actual reading at a very large scale. Figure A2b clearly shows that the distribution of the fraction paid under the table is shifted to the right in the lawsuit documents compared to the survey responses. This is consistent with selection into reporting and with lawyers over-claiming PUTs to get larger compensations for their clients. However, the order of magnitude is not very different and the shape of the distribution is similar.

4.2 *Who* receives PUTs?

The next step is to describe who, among the formal employees, are the PUT receivers. Understanding the distribution of PUTs across the wage distribution is critical for the distributional implications of this form of tax evasion. Figure 2 clearly shows that PUTs are proportionally larger for high-wage earners. Moreover, this result is explained both for the extensive and the intensive margin. Strikingly, workers in the top 5% of the wage distribution evade almost three times more than workers in the bottom 50% as a percentage of their income.

Figure 2: Distribution of Payments under the Table across the Wage Distribution

(a) Total Payroll

(b) Extensive Margin
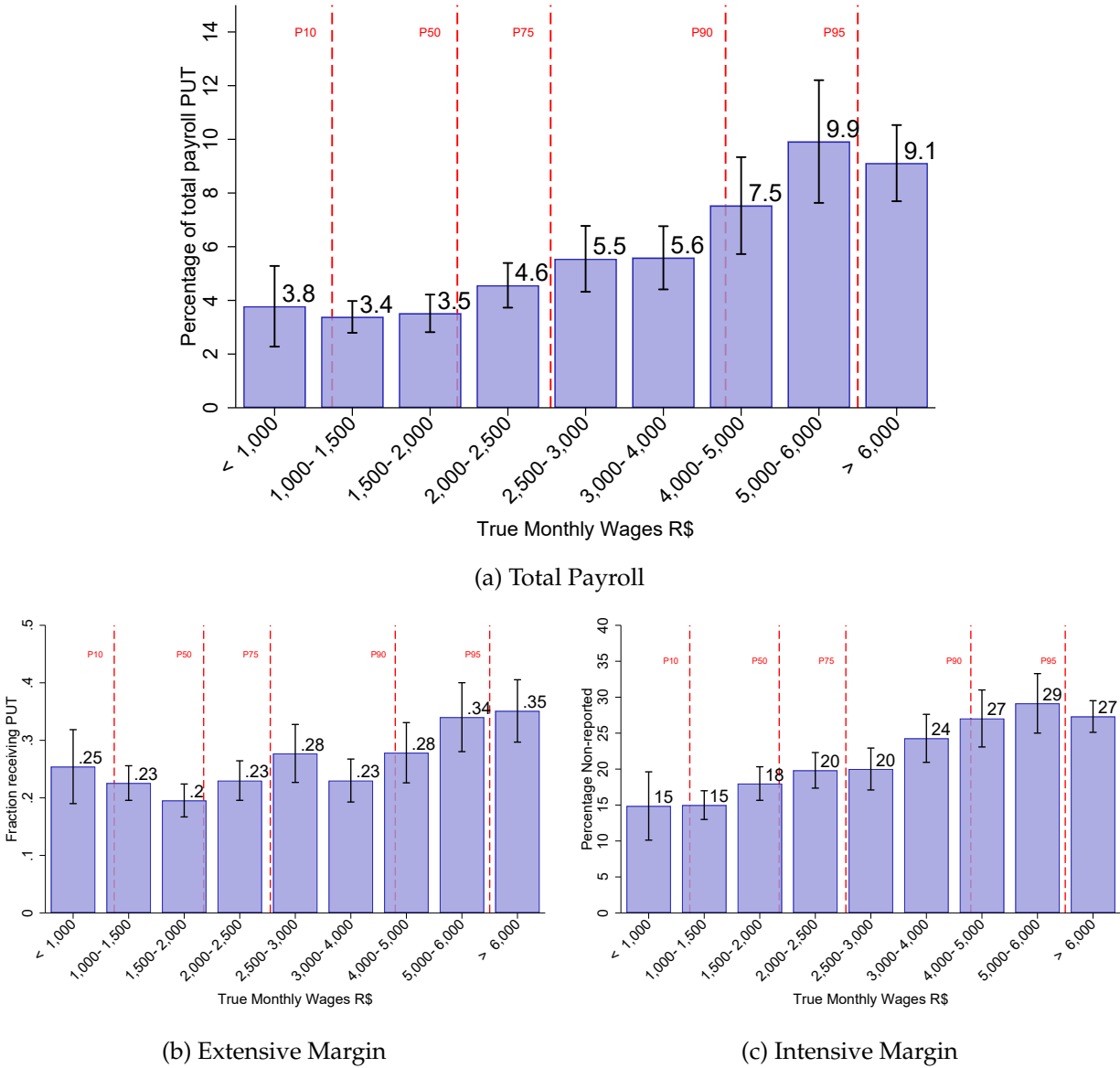
(c) Intensive Margin

Notes: Panel (a) shows the fraction of the total payroll paid under the table for each wage group. It combines the extensive and the intensive margin by inputting a zero for those who do not receive PUTs. Panel (b) shows the fraction of formal private employees receiving PUT for each reported wage group. Panel (c) shows the average percentage of the underreported wage for each true wage bin. It is calculated on the basis of the midpoints of the bin options provided to respondents. The x-axis in panel (b) corrects the reported salary to account for underreporting based on a follow-up question in which we asked if they answered their salary thinking about their total or reported salary. Results are robust to such correction. The black vertical lines represent 95% confidence intervals. We reweighted all statistics based on *sex, age, education, establishment size, and income group*.

Figures A3 and A4 validate these important results. Firm owners report that they are more likely to pay under the table to high-skill and more tenured workers, as well as managers. On the intensive margin, the PUT-related labor lawsuits reveal a very sharp pattern in which employees

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with higher total wages were receiving a larger fraction of their wages under the table.

Several features may explain the regressivity of PUTs, which differs from the classic informality. First, income tax rates are increasing, making incentives to evade stronger for high-wage earners. Second, there is a mechanical component that makes this form of tax evasion relevant for high-wage earners, which is the interplay with the minimum wage. If you are an unproductive formal employee, meaning that your true wages are low, there is not much room to pay under the table, given that, at least, the minimum wage must be reported. In addition, as with any form of collusive tax evasion, interaction between the employer and the employee can contribute to a successful collusion. Higher-paid employees, who are closer to managerial positions, may find it easier to interact with owners or personnel in charge of wage setting. We provide direct evidence of the role of employer-employee interaction to facilitate PUTs. We asked questions regarding the employer-employee relationship, including *family business*, *managerial position*, and *frequency of interaction with owners*. In Appendix B, we provide the results for all proxies for proximity in both the extensive and intensive margins. In what follows, we use our variable about *frequency of interaction* to run the following regression and present the results in Figure 3.[17]

$$\text{PUT}_i = \alpha + \beta_S \mathbf{1}[Z_i = \text{Sometimes}] + \beta_U \mathbf{1}[Z_i = \text{Usually}] + \beta_A \mathbf{1}[Z_i = \text{Always}] + \gamma X_i + \varepsilon_i \qquad (1)$$

Where PUT_i is the fraction of total payroll paid under the table (extensive and intensive margin together). Z_i is a categorical variable indicating how often the employee interacts with the owner. We left in the base the category *"Never"*. X_i is a set of controls, including demographics, the other proximity variables, and fixed effects by income and firm size.

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[17]Surveys of firm owners and accountants confirm that collusion is usually an agreement between the two parties. We show these results in Figures A14.

Figure 3: *How often do you interact with the owners?*
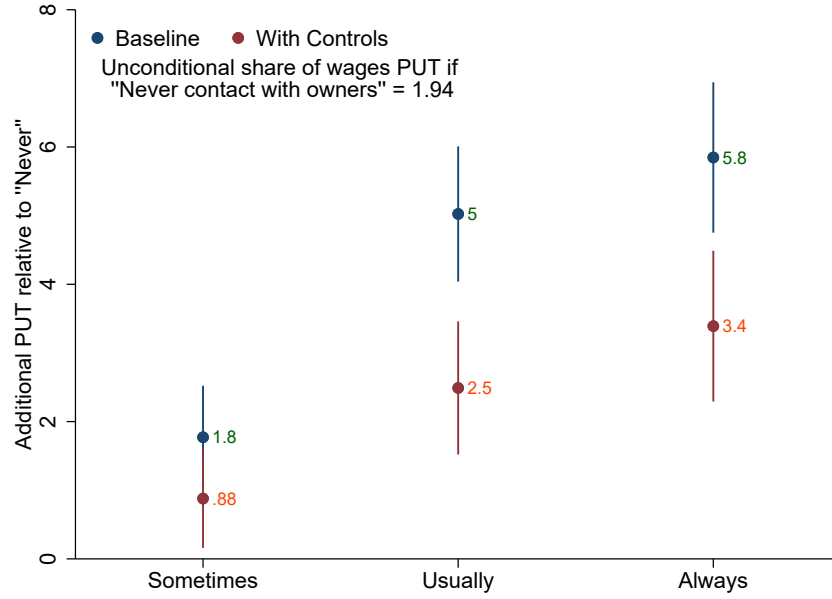
Note: This figure plots the estimated coefficients β from Equation 1. Coefficients in red include the set of controls specified in X_i. The y-axis shows the additional fraction of the total payroll paid under the table relative to those employees who never had contact with the owner. Observations are reweighted. Lines around the coefficient represent 95% confidence intervals.

Firms' characteristics are also relevant for PUTs. Proximity between the employer and a significant fraction of the employees is less likely to happen in larger corporations. Moreover, small and medium-sized firms are more likely to trade with informal firms, implying unreported revenues (possibly in cash) that can be used to pay under the table. Finally, large firms are more likely to be audited, increasing the risks of paying under the table. Kleven et al. (2016) shows that an employer's risk increases exponentially with firm size as long as a single employee reporting triggers a tax audit. They also show that, even in large corporations, a fraction of high-wage employees will receive PUTs if only PUT receivers can report. Consistently, Figure 4 shows evidence that PUTs are more relevant in small and medium-sized firms than large corporations. However, PUTs are non-negligible in large corporations, suggesting that even large firms have found a way to carry out PUTs.

Figure 4: Proportion receiving PUT by firm size
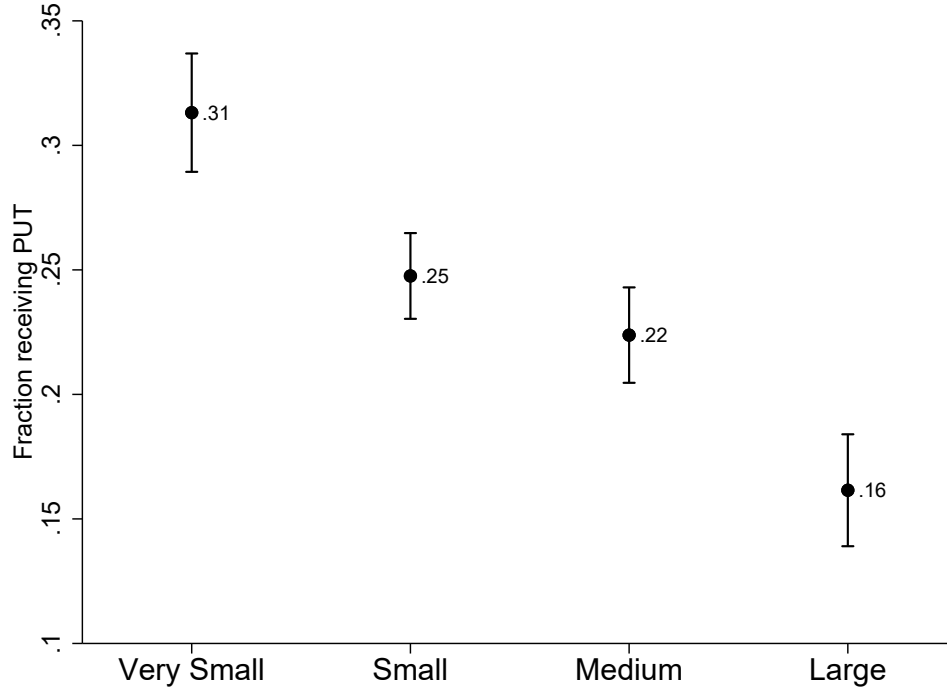
Notes: This figure shows the proportion of survey respondents that report receiving PUT for each firm size. *Very Small* refers to firms with 1 to 10 employees. *Small* refers to firms with 11 to 100 employees. *Medium* refers to firms with 101 to 1000 employees. *Large* refers to firms with more than 1000 employees.

These findings are consistent with accountants' interviews, where they find PUTs more likely in small and medium-sized firms, but still common across the board (see Figure A6). Table **??** in Appendix B has detailed information on firm size distribution, comparing our survey, the Brazilian Household Survey, and the administrative records (*RAIS*).

4.3   Revenue Implications

To gain perspective on the importance of PUT, we conducted a simulation exercise in which we recovered the revenues that the government would collect if all PUT were eliminated with full compliance on earnings reporting. In particular, we focused on revenues coming from income tax and social security contributions (both from the employer and the employee). As a benchmark, we carried out the same exercise for "classic" informality.[18] This exercise presents challenges and requires several assumptions. However, it is important to provide a back-of-the-envelope calculation of the fiscal costs of this type of informality. Appendix F explains all the assumptions we made to develop credible estimates. While credible, we try to follow the most conservative assumptions, interpreting our back of the envelope calculations as lower bounds.

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[18]Those employees without *Carteira do Trabalho Assinada*.

Table 1: Revenue Losses for PUTs and Informality in 2022

Sources of Evasion by Type of Informality	% of GDP	% of Labor Income Tax	% of Soc. Sec. Contributions
Payments Under the Table (PUT)			
Income Taxes	0.11%	4.74%	-
Contributions to Social Security	0.21%	-	2.32%
Total	**0.32%**	**-**	**-**
Classic Informality			
Income Taxes	0.10%	4.92%	-
Contributions to Social Security	0.79%	-	9.05%
Total	**0.91%**	**-**	**-**

Notes: This table reports the back-of-the-envelope calculation for revenue gains due to eliminating classic informality and payments under the table. The exercise registers all PUTs in the economy and formalizes all informal employees without adjusting for behavioral responses. We use the social security contribution and income tax schemes to calculate how much the government would collect. We apply the corresponding income tax deductions and consider the profit taxes that would not be paid due to an increase in payroll reporting. More details in Appendix F.

The first takeaway is that while classic informality is 3.52 times larger regarding total payroll evaded, it is only 2.78 times larger regarding tax evasion because PUTs are more relevant for high-wage earners. Second, this gap is entirely explained by the evasion of social security contributions, which everyone pays regardless of their wage level. On the other hand, PUTs and classic informality imply similar evasion of the income tax, which shows that the unequal distribution of PUTs compensates that classic informality entails under-reporting the full wage. It is worth noting that we do not simulate the government expenses on social security associated with PUT formalization. As mentioned before, many social security benefits are linked to the amount reported, so they would also increase (with the same logic applied to classic informality). In this sense, while the only component of our calculations that should be considered pure revenue lost is the income tax, evasion of social security contributions reduces the state's capacity to provide social benefits. Finally, because PUT receivers are richer than informal employees, and the progressivity of the Brazilian tax structure, we find that 50% of all revenues loses due to PUTs can be allocated to the top 10% of the wage distribution, while only half of it corresponds to the top 10% when it is due to classic informality.

4.4 Mechanics

We use our surveys to characterize how these payments are made. This implies looking at the two sides of the same coin: how the employees receive the PUTs and how the employers do their accounting. The answer to this question is complex, given that PUTs are not a simple concept. It can range from simple cases where an employee receives a complementary salary in cash to cases of misuse of benefits and usage of corporate credit cards and others. This section aims to learn about this feature of PUTs by providing the first direct evidence on payment methods and accounting strategies.

The first striking result is that almost 50% of PUT receivers report using cash. The survey

of firm owners and the information recovered using ChatGPT 4-o to process PUT-related lawsuit documents validate this. Moreover, about 40% of employees claimed to receive PUTs using *PIX*, the main virtual app in Brazil.[19] We listed other payment methods, which appear to be less common, such as *good and services*.[20]

Second, payment methods change across the wage distribution. High-wage earners are more likely to use more "sophisticated" methods. For example, cash is 14% less likely for the top 10% than for the bottom 50%. Instead, virtual apps and contractor arrangements are 21% and 81% more likely for the top 10% than for the bottom 50%, respectively. [21] Once more, Figure A7 validates these facts using artificial intelligence to process PUT-related lawsuit documents.

Figure 5: Payments Methods

| (a) Methods | (b) Difference by Income Group |
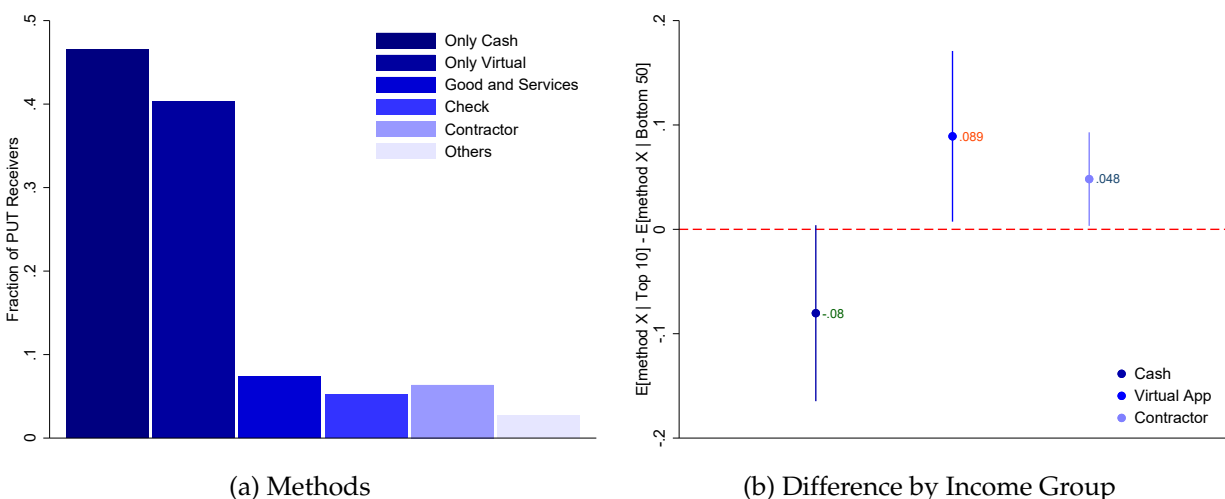
Notes: Panel (a) shows the proportion of workers who report receiving PUT under each payment method. Panel (b) shows the difference between the top 10 and the bottom 50 of the wage distribution on using *Cash* (dark-blue), *Virtual Apps* (blue), and *Contractor Arragements* (light-blue) to receive the PUTs. Vertical bars represent 95% confidence intervals.

To understand the employer's side, we interviewed accountants to learn about the accounting side of these payments. We group their answers into three main groups related to how it affects the booking, and how common they are based on accountants' interviews.

1. Inside the official books: employers/accountants under-report payroll and over-report "other costs". There are many items within this general category. Two things are critical. First, there

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[19] *PIX* was introduced in 2019 and became widespread in 2020. Unfortunately, we have labor lawsuits from 2014 to 2019, meaning we cannot validate this result with the survey to firm owners.

[20] The categories we used are not consistent across surveys and lawsuit PDFs. The reason is that we have learned along the way what the best way of asking these questions is. For example, in the employee survey, we didn't include the option *Bank Transfer*, which turned out to be very important. We expect *Virtual Payments* to capture part of it.

[21] The latter refers to cases in which an employee's relative or the employee herself opens a firm to be hired as a contractor on top of the employee contract. This is a tax avoidance strategy because the effective tax rate plus contributions on that excess income is significantly smaller than when reported as wages.

are no labor costs associated with these costs. Second, there is very little reporting and control over these items, especially for small and medium-size firms.

2. Outside the official books: non-reported revenues that never enter the official books are used to pay under the table. Typically requires double-booking.

3. Shifting the accounting problem: owners can distribute profits (the dividend tax rate is zero in Brazil) and send the money to the employees from their personal bank accounts.

5   Conceptual Framework

This section presents a conceptual framework to capture the cost-benefit trade-off that employers and employees face when engaging in PUTs. Intuitively, the benefits of the collusion are all wage-related taxes. Some are paid by the employer (social security contributions and other labor costs), and some by the employee (income taxes, employee contributions, and others). The sum of these benefits mirrors the government's losses.[22]

On the other hand, employers and employees face different costs related to PUTs. Employers get exposed to the risk of whistle-blowing, detection in a tax audit or labor inspection, union complaints, etc. Moreover, employers must deal with booking PUTs, informally called *cooking the books*. For the employees, PUTs imply losing access to several benefits related to social security (e.g. unemployment insurance, pension) and proof of income (e.g. access to credits). Workers are likely to differ in how much they value such benefits. This means that, under the same rules, employees may demand different amounts of PUTs.

Given that the benefits of collusion can be shared, but the costs are different for employer and employee, conflict of interest is crucial in preventing collusive tax evasion. In other words, the strength of third-party reporting relies on the opposite incentives of the parties. We capture this intuition in a Nash Bargaining framework, where employer and employee bargain over a surplus that the government taxes.[23]

The structure of the model is as follows: An employer-employee match produces an exogenous surplus $(y - z)$.[24] They bargain over this surplus determining the official wage (w_o) and the unofficial wages or PUTs (w_u). The government can tax the official wage but not the PUTs. For simplicity, we assume linear income taxes (τ) paid by the employee.[25] We model employers' and

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[22]This includes cases where firms are subject to profit taxes and can deduct reported wages and reduce taxable profits. In such a case, the profit tax rate reduces the total surplus. See Appendix H.2 for a detailed discussion.

[23]Since stable collusion requires no agents to have incentives to deviate, solving the bargaining process with a Nash Equilibrium is appealing.

[24]This assumption implies that taxation only splits the pie between the government and the private sector rather than reducing it. This simplifies the model by not looking at misallocation. The framework presented here can be incorporated into a more general DMP model, where the surplus becomes endogenous.

[25]Adding employers' social security contributions only changes the relative price of giving one dollar to the employer or the employee, but the solution's intuition remains unchanged.

employees' costs in a general way, calling $C_f(w_u)$ and $C_e(w_u)$ the cost faced by the employer and the employee, respectively.

$$U_e = (1 - \tau)w_o + w_u - C_e(w_u) - z \tag{2}$$

$$U_f = y - w_o - w_u - C_f(w_u) \tag{3}$$

$$S(\cdot) = U_f + U_e \tag{4}$$

The optimization problem is:

$$\max_{w_o \geq 0;\ w_u \geq 0} \left\{ \left((1 - \tau)w_o + w_u - C_e(w_u) - z\right)^\phi \left(y - w_o - w_u - C_f(w_u)\right)^{1-\phi} \right\}$$

Where ϕ represents the employee's bargaining power. In addition, the strict concavity of the problem does not allow for corner solutions in both the official and unofficial wages. Therefore, the problem is set up such that the employer-employee match can be achieved. However, the setting is flexible enough to allow corner solutions in one of the two control variables, keeping Equations 2 and 3 positive in the optimum. Because we are interested in PUTs, we focus only on cases where $w_o > 0$ (formal employees have some reported wages). Then, we only look at the slackness condition for w_u.

Setting up the Lagrangian and taking first-order conditions we get:

1. First-Order Condition with respect to w_o:

$$\frac{\partial \mathcal{L}}{\partial w_o} = \phi(1 - \tau)U_e^{\phi-1}U_f^{1-\phi} - (1 - \phi)U_e^\phi U_f^{-\phi} = 0$$

Simplifying this expression:

$$\phi(1 - \tau)U_f = (1 - \phi)U_e \tag{5}$$

Note that in the presence of taxation, the *effective* bargaining powers are affected by the tax rate because it changes the relative value of giving a dollar to the members of the collusion.

2. First-Order Condition with respect to w_u:

$$\frac{\partial \mathcal{L}}{\partial w_u} = \phi(1 - \tau)\left((1 - C_e'(w_u))(U_e)^{\phi-1}(U_f)^{1-\phi}\right) - (1 - \phi)\left((1 + C_f'(w_u))(U_e)^\phi(U_f)^{-\phi}\right) + \lambda = 0$$

Combining similar terms and simplifying:

$$\phi(1-\tau)(1-C'_e(w_u))U_f = (1-\phi)(1+C'_f(w_u))U_e - \lambda \tag{6}$$

Where λ is the Lagrangian multiplier for the condition $w_u \geq 0$, which represents the shadow price of paying one dollar under the table when $w_u < 0$.

3. Complementary Slackness Condition:

$$\lambda w_u = 0 \tag{7}$$

Equation 7 implies:

- If $w_u = 0$, then $\lambda \geq 0$ (extensive margin)

- If $w_u > 0$, then $\lambda = 0$ (intensive margin)

5.1   Extensive Margin ($\lambda > 0$ and $w_u = 0$)

To determine if $w_u = 0$ is optimal, we check the non-negativity of λ. Let's set $w_u = 0$, then the condition simplifies to:

$$\phi(1-C'_e(0))U_f = (1-\phi)(1+C'_f(0))U_e - \lambda$$
$$\lambda = (1-\phi)(1+C'_f(0))U_e - \phi(1-C'_e(0))U_f$$
$$\lambda = (1-\phi)(1+C'_f(0))U_e - \phi(1-C'_e(0))U_f > 0$$

Then,

$$\phi(1-C'_e(0))(y-w_o) < (1-\phi)(1+C'_f(0))((1-\tau)w_o - z)$$

Therefore:

$$\frac{(y-w_o)}{((1-\tau)w_o - z)} < \frac{(1-\phi)(1+C'_f(0))}{\phi(1-C'_e(0))} \tag{8}$$

With $w_o = \frac{\phi(1-\tau)y + (1-\phi)z}{1-\tau}$. This expression highlights the importance of employers' and employees' fixed costs of engaging in PUTs in the extensive margin.[26] For example, beginning a collusion may involve logistical costs regarding accounting strategies. Second, several costs associated with a PUT-related labor lawsuit do not depend on the amount paid under the table. Most of the labor lawsuits also include compensation for *moral damage*, and others fines.

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[26]Note that if $C'_f(0) = 0$ and $C'_e(0) = 0$, then this inequality doesn't hold for any ϕ (you get $\frac{\phi}{1-\phi} < \frac{\phi}{1-\phi}$), meaning that you get $w_u^* > 0$.

5.2 Intensive Margin ($\lambda = 0$ and $w_u > 0$)

Replacing Equations 4 and 5 into 6, we find that the optimal amount of PUTs (w_u^*) satifies:

$$\tau = \frac{\frac{\partial C_f(w_u^*)}{\partial w_u} + \frac{\partial C_e(w_u^*)}{\partial w_u}}{1 + \frac{\partial C_f(w_u^*)}{\partial w_u}} \tag{9}$$

Note that this equality holds as long as $\frac{\partial C_e(\cdot)}{\partial w_u} < 1$, because $\tau \in (0,1)$. Importantly, this expression shows that, for an interior solution, the optimal level of PUTs depends on the tax rate and marginal cost of evasion. Whether the employer or the employee has more bargaining power becomes irrelevant. The optimal level of PUTs maximizes the private surplus, at the expense of government revenues and total surplus. The latter is due to the real cost of evasion, which gets lost. Using Equation 5, and replacing for the optimum w_u we get:

$$(1 - \tau)w_o^* = \phi(1 - \tau)[y - w_u^* - C_f(w_u^*)] + (1 - \phi)[z + C_e(w_u^*) - w_u^*] \tag{10}$$

This expression is very similar to the solution for wages in a standard search and matching model. However, there are a few differences. First, note that w_u^* enters linearly in both terms, meaning there is a perfect substitutability component between the official and unofficial after-tax wage. However, it also enters indirectly through the cost functions of both employers and employees. This means that the official wages also change to compensate for the evasion costs.

Important for our applications in the following section, under mild assumptions (see Appendix H), it is easy to prove that:

1. w_u^* increases in τ and decreases in the employer's and employee's marginal cost

2. w_o^* increases when w_u^* decreases and vice versa

3. The substitution rate between the official and unofficial wages depends on the tax rate, relative convexity of the cost functions, and the bargaining powers

The conceptual framework is helpful for several reasons. At a general level, it allows us to conceptualize the collusion at the employer-employee level. The option of paying under the table increases the private surplus to the detriment of government revenues. Note that even when the employer does not pay labor costs directly but faces evasion costs, she still has incentives to engage in PUTs as long as it implies paying a lower pre-tax wage and the employee receives a higher post-tax wage. However, if doing positive PUTs does not increase private surplus, we return to the standard Nash bargaining problem with no tax evasion. Therefore, even when Nash Bargaining is a model of agreement, this framework does not require positive PUTs in equilibrium, as stated in the slackness condition. In addition, it makes explicit that employers and employees face different types of costs. There must be firms for which it is very expensive to engage in PUTs. For others,

it may only pay off if the employees have very low evasion costs (e.g., they do not value social security benefits). A natural concern with this model is that it does not capture misallocation due to evasion opportunities. There are several ways to extend the analysis (beyond the scope of this paper), such as treating the outside option (z) as an endogenous variable. In Appendix H.1, we use this conceptual framework to investigate questions related to incidence and welfare.

More concretely, we use this framework to interpret how changes in employers' and employees' evasion costs translate into changes in reported wages in the administrative data. Leveraging particular (but relevant) variations in incentives to engage in collusive tax evasion, we show that there are complementary policies to third-party reporting that can help limit PUTs. In the next section, we explain the variation in $C_f(w_u)$ and $C_e(w_u)$ that we use in our empirical analysis.

6 Breaking the Collusion Down: empirical applications

The functional forms for the optimal reported (w_o^*) and unreported wages (w_u^*) highlight the importance of employers' and employees' costs to determine the amount of PUTs. On the employer side, small firms may be less likely to be audited than large firms. Cash-intensive firms may find it easier to fund PUT without affecting their accounting. Similarly, not all employees value the benefits linked to reported wages in the same way. Early career employees may put a higher value on wage proofing, while workers closer to retirement may value pensions more. This section tests whether changes in employers' and employees' evasion costs affect PUTs.

Figure 6: Main components of PUT costs for employers and employees

(a) Main PUT risks for the firm　　　　(b) Employees' reasons to lower PUT
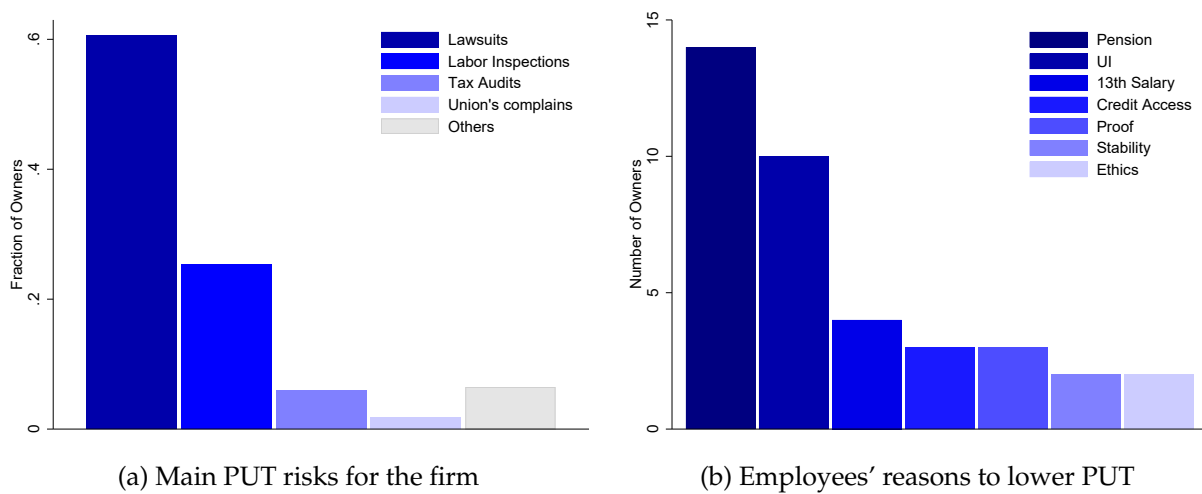
Notes: This figure is based on responses to the survey of firm owners. Panel (a) asks *what is the main risk that firms face when participating in PUT?*. We restrict the sample to those who believe that PUT is a widespread practice. Panel (b) builds on two questions. The first asks whether an employee has ever asked to lower PUT. Conditional on answering *yes*, we ask the main reason for doing so. Then, Panel (b) orders the options we listed to firm owners.

To guide our analysis of the key elements inside $C_f(w_u)$ and $C_e(w_u)$, we asked firm owners about the main risks they face when engaging in PUTs, as well as the main reason for employees to request lower PUTs. Figure 6a shows that labor lawsuits are the critical risk PUTs entail for firms. On the other hand, Figure 6b shows that pension is the most important reason for which employees want to reduce PUT. We leverage a regulation that shuts down the pension benefits linked to reporting to show that wage reporting is consistent with the employee's benefit schedule.

6.1 Employers' cost: Labor Lawsuits

6.1.1 Institutional context

A labor lawsuit is a particular whistle-blowing institution where employees report employers in labor courts for not complying with the *Labor Law*. These labor courts are specialized forums to handle labor disputes. Their origin goes back to the European legal traditions, particularly those of Spain, France, and Portugal (Botero et al. 2004). This institution is present in most of Latin American countries. On the other hand, countries with a *Common Law Tradition*, such as the United States, have historically addressed labor disputes within the framework of general courts. They have also developed specialized agencies outside the judiciary system. For example, the Department of Labor in the United States has strong whistle-blowing programs that trigger labor and tax inspections.[27]

However, labor lawsuits were not designed to trigger tax audits or labor inspections, and they do not do so. Employer and employee resolve their dispute with a judge assigned to their case. Unlike other whistle-blowing institutions, labor courts may efficiently resolve disputes but have less severe consequences for the firm by not triggering a tax audit. Moreover, the incentives for employees to report PUTs to the tax authority are limited. PUTs also violate the *Tax Code*. In this case, the employee also commits an offense when evading the income tax. Indeed, we find that 65% of employees suing their employers in labor courts for PUTs would be paying income taxes on the under-reported income.

We partnered with Datalawyer[28], which is a company compiling all labor lawsuits in Brazil since 2014. Among all cases in Brazil, there is a particular category for *Pagos por Fora* (Payments under the Table, in English). We accessed the universe of PUT cases initiated between 2014 and 2019 for this category. This accounts for 220,669 cases, covering 207,848 unique employees and 132,787 unique firms.[29]

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[27]The Wages and Hours Division (WHD) recovered more than $ 230 million in back wages for over 190,000 workers in fiscal year 2021. This is a result of investigations triggered by complaints, including those submitted by whistleblowers.

[28]Know more in their website.

[29]Figure A10 shows the evolution over time of the total number of labor lawsuits. It shows a clear drop in the number of cases after 2017, which is consistent with a reform that made suing costlier for employees.This was a federal and more comprehensive labor reform, which makes its evaluation harder. Having access to only PUT-related lawsuits makes exposure measures of very little help. These are the key reasons for not studying this reform in the context of PUTs.

6.1.2 Labor lawsuits to limit PUTs

Whistle-blowing is a powerful institution to limit PUTs when it makes collusion between employer and employee fragile. Kleven et al. (2016) formalize this idea in a theory of tax enforcement in modern economies. There are two key elements in this model. First, employees can report to the tax authority that the firm pays under the table. Second, such a report triggers a tax audit that unmasks every employer-employee collusion in the firm. The probability that at least one employee reports you grows exponentially with firm size. Moreover, large firms need to have the *true* books of the firm (for operational reasons), which are uncovered by a tax audit. These elements imply that collusive tax evasion cannot be sustainable in large firms.[30]

Then, understanding *who* can report and its effects on the collusion with other employees (*propagation effect*) is crucial. This becomes even more important when reporting does not go to the tax authority (triggering a tax audit) but to labor courts. While smaller, there are still reasons to expect some propagation effects of labor lawsuits. As in many audit studies, employers may get scared after a lawsuit happens, correcting their behavior (Bergolo et al. 2023). It could also be consistent with employers underestimating the actual probability of being reported, as the interviewed accountants mentioned to us.

> *"Yes, lawsuit risks are underestimated, mostly for those who never went through a lawsuit. Sometimes, they are not aware of the damage PUT can cause."* (Accountant B)

> *"They underestimate the risks; they never think it will happen to them"* (Accountant C)

Finally, a labor lawsuit could increase the true risks of being reported by other employees in the firm. This is consistent with the complexity of carrying out a lawsuit. The interviewed accountants informed us that coworkers would likely be called to testify in the labor courts, allowing them to learn about the process (see Figure A11).

In what follows, we do three things. First, we show what triggers a labor lawsuit. This provides a better understanding of *who* sues. Second, we estimate the causal effect of a labor lawsuit of a former employee on other employees' wages. Finally, we provide suggestive evidence on the mechanisms.

(i) Lawsuit and conflict in the workplace

The first thing to notice is that employees have left the firm once they start a lawsuit against their employers. Moreover, lawsuits happen relatively soon since the job separation. For the employees who end up suing, Figure 7a shows that their probability of having an active contract in the firm they sue drops to zero at the moment of the lawsuit. We can also see that the probability

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[30]It is an asymptotic argument that relies on who can report and its effect on unmasking the rest of PUTs in the firm. Indeed, the authors show that when not everybody, but only those receiving PUTs can report, then it is possible to sustain collusive tax evasion between the employer and the highest-paid employees.

of being outside the formal labor market drastically increases when the lawsuit happens.[31] This is consistent with employees having less incentives or motivation to go through a lawsuit if they have already found a new job.

Figure 7: Employees' Dynamics and Lawsuits

(a) Employment

(b) Lawsuit delay
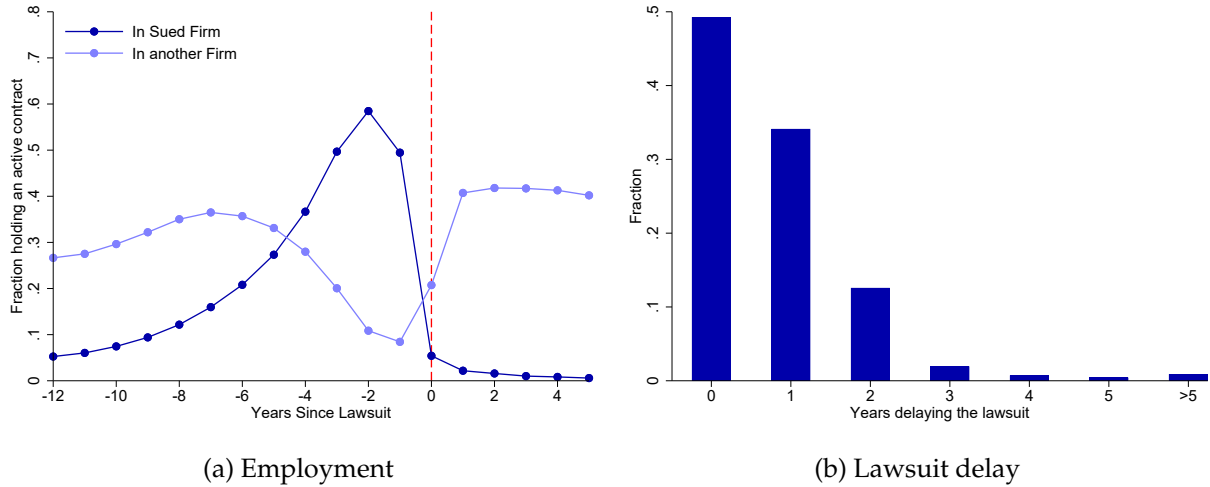
Notes: Panel (a) shows the employee's dynamics around the lawsuit. The x-axis is the years relative to when the lawsuit happened. The dark blue line plots the probability that the worker who ends reporting has an active contract in December of the given year in the reported firm. The light blue line shows the probability that such a worker is employed in another firm. The red dashed line indicates the year when the lawsuit happened. Panel (b) shows how many years have passed between the lawsuit and the employee's separation from the firm.

An advantage of our rich administrative data is that we can observe employees' separation and motives.[32] We show that conflicts in the workplace precede labor lawsuits. Restricting our sample to those employees who separate from their firm, we study how suers differ from their coworkers regarding the reason for separation.[33] We regress each possible reason for separation on a *dummy* variable that indicates whether an employee ends up suing the firm. We add several demographics as regressors to benchmark the size of the coefficients.

We find that those who end up suing are 31% more likely to be fired by the employer compared their coworkers who separated from the firm in the same time frame. Moreover, they are 44% less likely to have voluntarily quit. When we look at quitting driven by a preceding conflict with the employer, those who end up suing are 150% more likely than their coworkers to report such a reason. Finally, when looking at non-conflictive separations suers are 50% less likely to separate due to a pre-specified termination date of the labor contract, 22% less likely to separate due to a transfer within the firm, and 75% less likely to separate due to retirement.

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[31]This is simply one minus the sum of both lines. Alternatives to formal employments are unemployment, informality or outside the labor force.

[32]Including retirement, quitting, reallocation, firing with and without a fair reason, and others.

[33]Table A5 incorporates separation and reason for separation in a prediction model of starting a lawsuit

Table 2: Conflict at the Workplace

	P(Reason = X if Separation = 1)					
	Fired	Quit w/o reason	Quit w/ reason	Contract	Transfer	Retirement
Suer	0.177***	-0.092***	0.003***	-0.071***	-0.011***	-0.003***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)
Female	0.000	0.000	0.000***	-0.000	0.000**	0.000***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Nonwhite	-0.003***	-0.006***	-0.000***	0.013***	-0.002***	-0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Less than High School	0.043***	-0.066***	0.001***	0.019***	-0.001***	0.003***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
High School	0.031***	-0.045***	0.000**	0.014***	0.000	0.001***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Dep. Var Mean - Coworkers	.57	.21	0.002	.14	.05	0.004
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4.6M	4.6M	4.6M	4.6M	4.6M	4.6M

Notes: This table shows how employees' characteristics predict different separation motives. The sample contains all employees in firms where at least one employee sued the firm they worked for. The variable "Suer" is an indicator variable identifying the employees that ended up suing at most one year after they appeared as employees. Those for who the "Suer" variable is zero are coworkers who also separated from the same firm as the Suer in the same time frame. The different columns have outcome variables as indicators of the possible reason for separation. "Fired" refers to those employees who were fired with or without cause. "Quit w/o reason" refers to those who unilaterally finished the labor contract without cause. "Quit w/ reason" refers to employees who had a cause to finish the labor contract unilaterally. Appendix C explains the possible reasons, mostly linked to pre-existing conflict in the workplace. The last three columns refer to separation motives with no explicit conflict associated. "Contract" refers to cases where the labor contract had a pre-specified termination date. "Transfer" refers to changes in the labor contract within the same firm. "Retirement" refers to labor contract termination due to retirement. All regressions have occupation, age and firm times year fixed effects. Standard errors are clusterized at the fixed effect level.

(ii) How do employers respond to a lawsuit from a former employee?

We next explore if lawsuits affect wages. We propose a *matching staggered difference in difference* to causally estimate the effects of a lawsuit on the wages of other employees in the firm (propagation effects). To do so, we merged our administrative records on labor lawsuits with the Brazilian matched employer-employee data. We look for the firms that were sued. We classify these firms in cells based on *industry, number of employees, legal form, state, and year of opening* (using a pre-lawsuit period). We then create a one-to-one matching, searching for firms that were never sued but correspond to the same cell. For both sued and non-sued firms, we condition on survival for three periods before and after the lawsuit. Finally, we define incumbent workers as those who remain in the same firm for the six years around the lawsuit. [34] This sample guarantees that we are looking at the reported wages of employees for whom the employer sets their wages rather than picking wage variation from movers. We provide robustness checks to rule out that employers

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[34]We make sure that keeping only incumbent workers does not affect the one-to-one matching by dropping observations that lose their matching observation because that firm has no incumbent workers during the entire period.

adjust other margins, such as hours worked and tasks performed by their employees.

The key identification assumption is parallel trends in incumbent workers' wages for those in treated and nontreated firms. This rules out concerns related to survival bias, meaning that incumbent workers in sued firms are likely to be the most productive and, therefore, high-wage employees. This average level difference between workers in treated and control firms would represent that the pre-trends do not overlap. Our identification assumption relies not on overlapping pre-trends but on parallel ones. In addition, we add firm fixed effects to control for time-invariant characteristics.[35] Equation 11 shows the exact regression.

$$\ln w_{jt} = \gamma_j + \delta_t * \alpha_{c(j)} + \sum_{k \neq -1} \beta_k \mathbf{1}(k = t)\mathbf{1}(j \in \text{treated}) + \varepsilon_{jt} \tag{11}$$

Here, the sub-index t refers to the year relative to the lawsuit (ranging from -3 to 3), and the sub-index (j) refers to a given firm j. β_ks are our coefficients of interest, which capture the increase in average wages in treated versus nontreated firms relative to the difference in the year before the lawsuit ($k = -1$). We add firm fixed effects. Because we are stacking different "cohorts" of lawsuits, we add time fixed-effects interacted with cohort fixed-effects. This strategy avoids the problems of staggered dif-in-dif approaches when there may be heterogeneous treatment effects over time by saturating unit- and time-fixed effects with indicators for dataset identifiers (Baker et al. 2022). Finally, we cluster standard errors at the firm level (treatment level). In Appendix I, we explain the matching process and sample selection in detail.

We find that firms respond to a former employee's lawsuit by increasing, on average, the reported wages of other employees by 1%. Furthermore, we do not find evidence of different pretrends between the treated and control individuals. Then. we modify Equation 11 to exploit heterogeneity at the individual level. We run the regression at the individual level, including individual fixed effects rather than firm fixed effects. Clusters remain at the firm level. From Section 4, we know that PUTs are decreasing in firm size and are more prevalent for managerial positions. Figures 8b and 8c are consistent with these facts. Smaller firms and managerial positions show stronger responses than larger firms and non-managerial positions.

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[35]We add worker fixed effects when we look at heterogeneity at the employee level

Figure 8: Lawsuit effects on average wages of incumbent workers

(a) All firms

(b) By firm size

(c) By managerial position
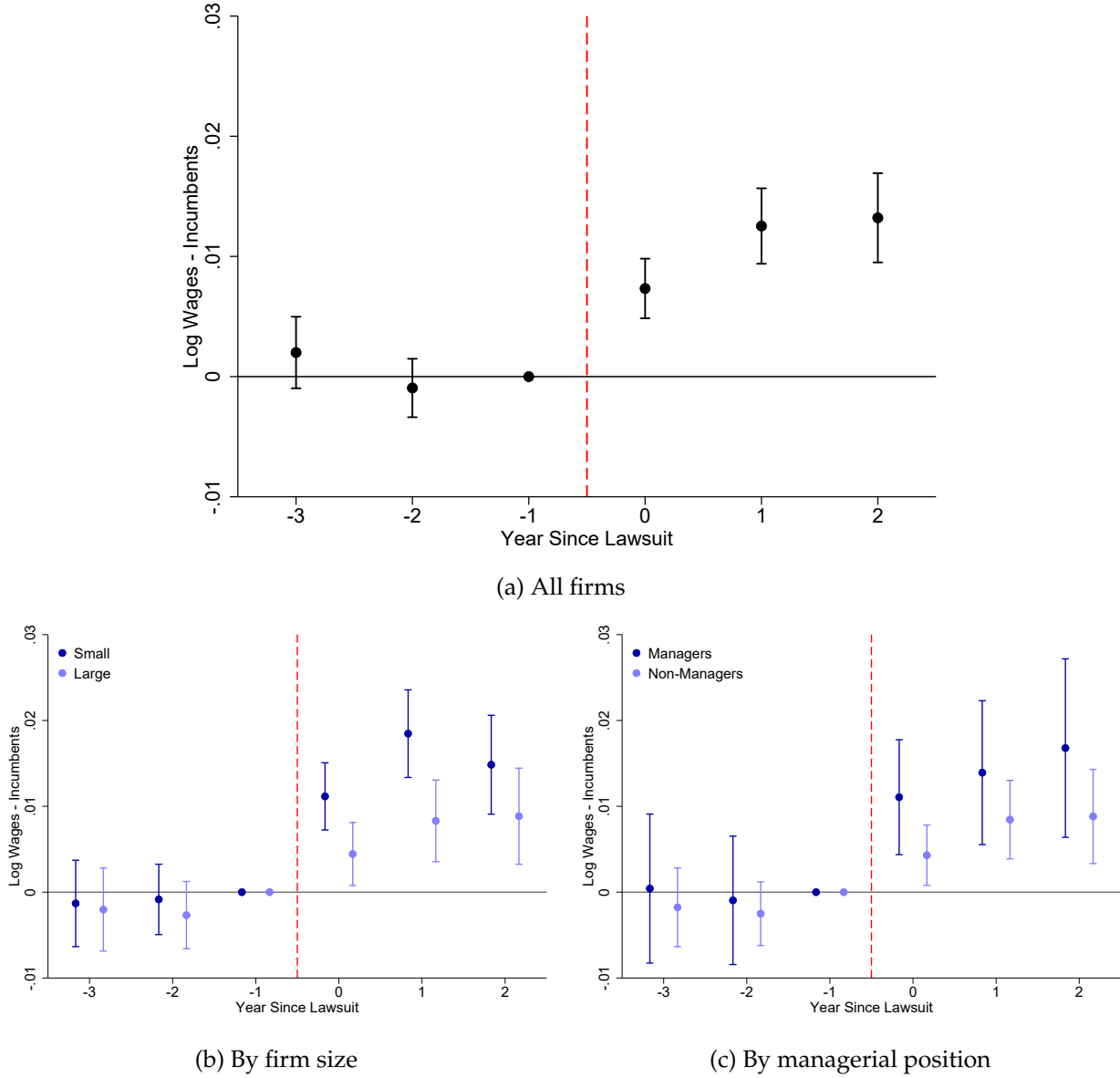
Notes: This Figure shows coefficients β_k in Equation 11. The sample comprises active employees who have worked in the same firm for the entire period but never appear in the lawsuit data. Treatment is defined at the firm level. The treated group contains firms that were sued for PUT. The control group contains firms that match the treated firms one-to-one based on their characteristics in the pre-period. A combination of *industry, number of employees, legal form, state, and year of opening* form a cell. Event time is centered in the lawsuit year. We include unit fixed effects and cluster standard errors at the firm level (treatment level). Panel (a) shows results at the firm level. Panel (b) runs separate regression for incumbent workers in small and large firms. We define small firms as those in the bottom 25% of the firm size distribution in the year the matching is conducted. Panel (c) runs separate regressions for incumbent workers who hold managerial positions and those who do not.

Robustness Checks

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Conceptually, we are interested in estimating the propagation effect of a lawsuit on other employer-employee collusion. The first distinction is that this parameter is not the same as the overall effect of a lawsuit on PUTs. The latter also incorporates the effect of employees who leave the firm because of a lawsuit and may find a job where they receive more or less PUTs. For example, if a lawsuit generates the dismissal of one employee who finds a job in the informal sector, that will increase the overall effect in PUTs because now this employee is evading the entire wage.

Two things can happen for the effect of a lawsuit on other employer-employee collusion in the firm (the parameter of interest). The job relationship may survive or not. The latter reflects cases with a positive surplus only due to collusive tax evasion. However, our conceptual framework is informative for the first case, where the employer and employee decide how much to pay under the table, conditional on a match surviving. This is the main reason why we study the effect on reported wages of incumbent employees in the firm. However, this presents several challenges because the other existing margins of response. In what follows, we present a series of results that validate our estimates and interpretation.

First, we show that firms do not respond to the lawsuit by increasing employees' working hours or changing their tasks. These are responses consistent with lawsuits as income shocks that could drive the increase in reported wages. We run specification 11 using hours worked and changes in occupation[36], showing null effects of lawsuits in these margins.

Second, we replicate the same identification strategy but for non-PUT-related labor lawsuits. We accessed a small sample of other labor lawsuits unrelated to PUTs.[37] These are labor lawsuits that we should not expect much effect on reported wages, at least coming from a reduction in PUTs. These labor lawsuits are about sexual harassment in the workplace and unfair dismissal for maternity reasons. They are as expensive as the ones for PUTs, making the income shock channel comparable. Using these labor lawsuits, we find no effects on the reported wages of other employees in the firm. Even with the small number of non-PUT-related labor lawsuits, we can reject the coefficient equal to that of the PUT-related lawsuits.

Finally, to avoid using sued firms as the treated group, we built a network of firms connected through ownership. This allows us to estimate the effect of a lawsuit in firms that are connected to the one that was sued because the same individual owns them. When using this strategy, we still find positive and significant effects on the reported wages of other employees in connected firms.

Appendix J provides a detailed discussion of the robustness exercises together with the formal presentation of these results.

Mechanisms

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[36]We use 3 and 5-digit level specification, both results show null effects.

[37]This data came as part of a parallel project.

The results presented in Table A6, together with the robustness analysis in Appendix J, are consistent with an increase in the marginal cost of employers for engaging in PUT with their employees. At the same time, it rules out alternative interpretations regarding adjustment in other margins (e.g. more hours worked, promotion, change in occupation). However, we can be more precise in understanding what the key drivers of the employer's marginal cost adjustment are. On the one hand, it is possible that employers had wrong perceptions of the probability of being sued, and they update after a lawsuit happens. On the other hand, when an employee sues, other employees in the firm can learn about this possibility (or its benefits), leading to an increase in real (rather than perceived) risks. [38]

We can leverage our rich administrative data to test for the *change in the real risks employers face*. We developed a strategy based on *suers-movers*. These are defined as employees who sued their firm and moved to work for another firm later on. We define the new coworkers at the firm where the suer-mover arrives as the treatment group.

Two potential sources of endogeneity come up from how we define the treatment group. First, employers who hire workers who sued in the past may differ from those who prefer not to do it. Second, employees who had sued will likely move to specific types of firms, perform certain tasks, etc. The first source of endogeneity is not concerning in our setting, given that it is very unlikely that employers know whether a new employee has gone through a lawsuit in the past. However, the second source of endogeneity is still concerning. Therefore, we built a control group of new coworkers of a non-suer-mover (a random mover with no previous lawsuit experience). If employees work in the type of industry, occupation, or region where lawsuits are more common, that would be reflected in higher lawsuit probabilities (in levels) between treatment and control. However, as long as the lawsuit probability of the two groups has been growing with the same trend, we can identify the additional effect of having a new coworker with lawsuit experience in the firm (assuming trends would continue in the absence of the move). Equation 12 specifies the model.

$$s_{it} = \alpha_i + \delta_t + \sum_{k \neq -1} \beta_k \mathbf{1}[D_{it} = 1]\mathbf{1}[k = t] + \varepsilon_{it} \tag{12}$$

Where $D_{it} = 1$ for the employees who had a *suer-moving* coming to their firm, and $D_{it} = 0$ to those employees who had a random mover (with not suing experience) moving to their firms. α_i and δ_t indicate individual and time fixed effects. Time is measured relative to the moving quarter.

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[38]Our qualitative evidence from the interviews with accountants suggests that both margins may play a role. We present this result in Figure A11.

Figure 9: Effects of having a suer-mover on the probability of reporting

Probability of Suing

Quarter Since Suer Moved
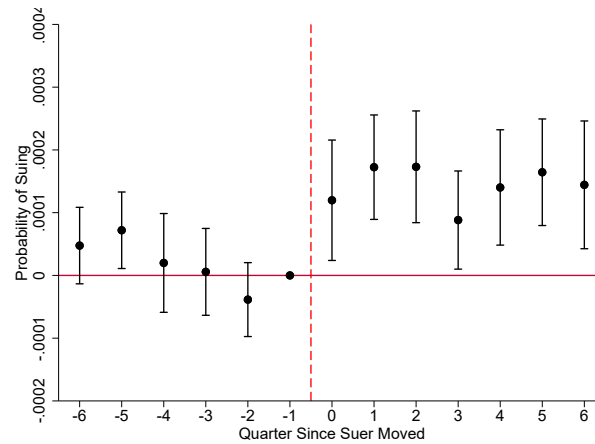
Notes: This plot shows the effect of being exposed to a coworker with lawsuit experience in the probability of starting a lawsuit. The sample is constructed as follows. The *suer-movers* are defined as employees who carried out a lawsuit in 2015 and moved to a new firm in the same year. This allows us to observe reporting behavior for some periods pre- and post the treatment. The *non-suer-movers* are taken at random from the sample of new hires in 2015. The treatment group is defined as the *suer-mover*'s new coworkers. The control group is defined as the *non-suer-mover*'s new coworkers. We drop new coworkers hired only after the arrival of the *movers*.

Figure 9 shows that new coworkers increase the probability of suing for PUT-related motives after the suer-mover arrives at the firm. In addition, Table 3 explores homophily heterogeneity to show that coworkers more likely to interact with the suer-mover (measured as sharing characteristics) drive the results. For example, coworkers who share gender, race, age, and occupation with the suer-mover are 4.26 times more likely to sue after meeting the suer-mover relative to the control group.[39]

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[39]This comes from summing all the coefficients and dividing the result by the dependent variable mean.

Table 3: Effect of suer-mover on new coworkers

	Probability of Suing (x100)
Treated x Post	.00027
	(.002)
Treated x Post x Gender	.01541***
	(.0043)
Treated x Post x Gender-Race	.02112***
	(.0043)
Treated x Post x Gender-Race-Age	.01734**
	(.0068)
Treated x Post Move x Gender-Race-Age-Occupation	.03443***
	(.0.107)
Dep. Var Mean	0.0207
Time + Individual FE	Yes
N (Individual x Quarter)	61,058,258

Notes: This table expands the results for Equation 12 to include interactions for homophily characteristics. We create variables for whether the new coworker and the *mover* share certain characteristics. We create these dummies as sets that include the previous ones. Therefore, each coefficient should be interpreted as the effect on the lawsuit probability of the additional matching characteristic.

6.1.3 Discussion

The mechanisms highlighted in the previous section suggest employers' risk of engaging in PUTs with other employees increases after a lawsuit. One interpretation is that the perceived risk increases (see Figure A11a). Another interpretation is that the actual risk increases because employees become more likely to report (see Figure A11b). Regardless of which of the two mechanisms is more relevant, from the employer's point of view, both look like an increase in the risk of engaging in PUTs. Therefore, we use our conceptual framework to interpret the results we found.

Let's assume $C_f(w_u) = p \left(\frac{w_u^\gamma}{\gamma} + F \right)$, where p is the perceived probability of being sued; w_u is the amount paid under the table or unofficial wages; γ sets the convexity of the marginal cost of paying an additional dollar under the table; and F is a fixed cost that the employer pays if sued. One interpretation for the convexity on w_u is that costs may increase in w_u because PUT-related lawsuits also include claims for *moral damage* and several other reasons that are more likely to appear if the amount evaded is larger.[40] Administrative costs of going through a lawsuit, such as paying lawyers, motivate the fixed costs F.[41] Finally, a change from p_b to p_a (with $p_a > p_b$) represents an increase in the perceived probability of being reported.

This implies that Equation 9 takes the form:

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[40] An alternative way of modeling is making the probability of reporting a convex function of the amount paid under the table. This is consistent with very few employees willing to sue if they were receiving too few PUTs.
[41] Fixed costs allow to capture effects on the extensive margin.

$$w_u^* = \left(\frac{\tau}{(1-\tau)p}\right)^{\frac{1}{\gamma-1}}$$
$$\frac{\partial w_u^*}{\partial p} = -\left(\frac{1}{\gamma-1}\right)(w_u^*)^{\gamma}\left(\frac{1-\tau}{\tau}\right) < 0 \iff \gamma > 1$$

Therefore, as long as the cost function exhibits some degree of convexity on the unofficial wages, an increase in the perceived probability of being sued reduces payments under the table in equilibrium (as shown in Figure 10a). On the other hand, Equation 10 implies:

$$(1-\tau)w_o^* = \phi(1-\tau)y + (1-\phi)z - \phi\left[p\left(\frac{(w_u^*)^{\gamma}}{\gamma} + F\right)\right] - w_u^*$$
$$\frac{\partial(1-\tau)w_o^*}{\partial p} = \phi\left[\frac{1}{\gamma-1}\frac{(w_u^*)^{\gamma}}{\gamma} - F\right] + \frac{1}{\gamma-1}\frac{w_u^*}{p} > 0$$

A sufficient condition for this expression to be positive is that p is small enough. Moreover, the effects in reported wages are expected to be larger for those evading larger shares. Intuitively, if the payments under the table are large, the reduction in marginal cost is larger than the increase in the direct costs due to the increase in p.

Conceptual framework prediction: Effect of $\uparrow p$ in PUTs and reported wages

(a) Change in optimal PUTs (w_u^*)   (b) Change in optimal reported wages (w_o^*)
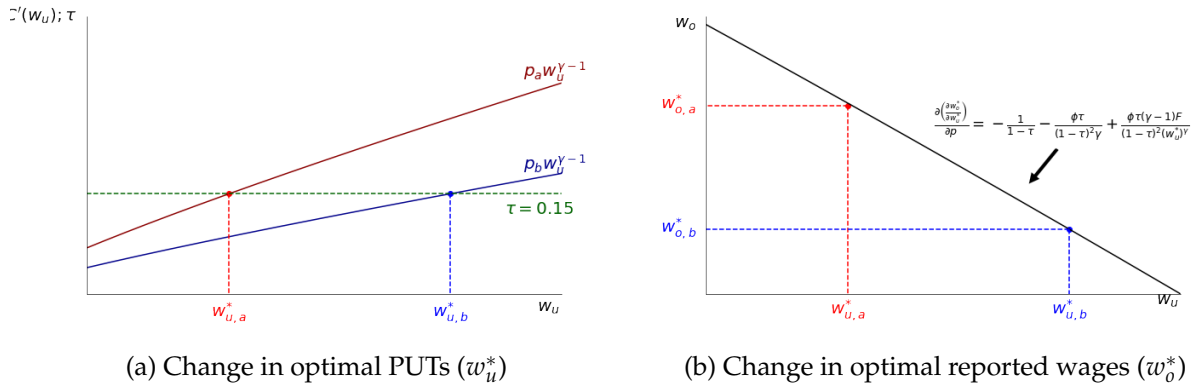
Notes: This Figure shows the effect of changes in the probability of a lawsuit on the unofficial and official wages. The pre-specified parameters are $\gamma = 1.85$; $p_b = 0.0002$; $p_a = 0.00035$; $\tau = 0.15$; $\phi = 0.5$; $F = 1,000$; and $(y - z) = 5,000$. This numeric exercise implies a range of values for $w_u = [500, 3000]$ and $w_o = [1000, 4000]$. Panel (a) plots the marginal cost of PUTs and the tax rate on the unofficial wages. w_{ub}^* and w_{ua}^* show the optimal solution to the unofficial wages in a Nash Bargaining equilibrium (Equation 9) before and after the lawsuit, respectively. Panel (b) plots the optimal official wages for different values of p in the y-axis. The x-axis plots the optimal unofficial wages for different values of p, making explicit the substitution rate between the two in response to changes in p. We use the interval $p \in (0.0002, 0.001)$. w_{ob}^* and w_{oa}^* show the optimal solution to the official wages in a Nash Bargaining equilibrium (Equation 10) for the same pre-specified values of p than in plot (a), respectively.

The previous calculations show that the after-tax wages increase less than one-to-one with respect to a decrease in PUTs. However, the results presented in Figure 8 correspond to the gross wages reported by the employer. Whether gross wages you react more or less than one-to-one with respect to PUTs is not obvious because it depends on the employer's cost of evasion plus the labor cost employers pay for each additional dollar reported (which is not included in the model). For simplicity, we interpret that each additional gross dollar reported comes at a reduction of one

dollar paid under the table. Taking the results from our survey, we know that about 7% of the total payroll is paid under the table.[42] Therefore, with full compliance, we should expect to see an increase in reported wages of almost 8%.[43]. This should be considered a lower bound of the effect with full compliance because it assumes that employees in firms sued for PUTs have the same wage misreporting as the average employee. If we assume that 40% of the employees in sued firms receive, on average, 35% of their wages under the table (see Figure A2b), then we should expect an effect of up to 16.3% increase in reported wages.

In perspective, labor lawsuits seem to have modest propagation effects to limit payments under the table. The effect on the reported wages of other employees is significantly smaller than what we would expect with full compliance, even considering a lower bound.

Regarding policy implications, there are multiple ways to increase the propagation effects of a lawsuit, reducing employers' incentives to pay under the table. Several countries have designed whistle-blowing programs that trigger tax audits or labor inspections. However, it is also possible to put two existing institutions to work together: the labor courts and the tax authority. As explained before, labor lawsuits work as a whistle-blowing institution, where employees' lawyers describe and prove the existence of PUTs in their clients' firms. Next, we show an example of a case's description in a labor lawsuit.

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[42]A quarter of all formal employees admit to receiving 20% of their wages. Weighting this by the wage level of PUT receivers gives almost 7% of the total payroll.

[43]If $w_u + w_o = 1,000$, then $w_u = 70$. The increase in reported wages with full compliance would be $\frac{w_u}{w_0} = 70/930 = 0.0753$

FORM OF PAYMENT

"During the entire employment contract, both the "clandestine" amount and the amounts recorded in the PAYMENT RECEIPTS were received through deposits at Caixa Econômica Federal, branch 637, account 013.000113809-1, where, to make it difficult to identify the depositor, the amounts were entered in the statements under the labels DOC ELET, CRED TED, and DP DIN LOT, as per the statements (doc. 10, pages 01/02 front and back); in comparison with some PAYMENT RECEIPTS (docs. 11 to 14).

As an example, considering that this procedure was adopted throughout the entire employment contract, according to the PAYMENT RECEIPT for the month of March 2016, including the previous advance, the net amount to be received was R$ 1,247.59 (one thousand two hundred and forty-seven reais and fifty-nine cents); however, on April 11, 2016, a deposit of R$ 4,052.00 (four thousand and fifty-two reais) was made.

In the event that the Respondents deny the "clandestine" payments, it is requested that the Court issue an official letter to Caixa Econômica Federal to clarify and identify the depositors. The Respondents adopted clandestine procedures to make these payments, thus violating the Claimant's rights, as demonstrated in article 793-A of the CLT."

This quote shows several points. First, it explains that these payments were made to the worker's bank account. Second, it highlights the employer's intention of not making the payments transparent, labeling the bank statements for the PUTs with confusing sentences. Finally, it also reveals how Courts operate to prove the claims and the lack of communication with the tax authority (which also has the information that the lawyer recommends to get from the private Bank *Caixa Economica Federal* through an official letter). The information contained in these labor lawsuit could be used by the tax authority to carry out targeted tax audits on PUTs, amplifying the propagation effects of a lawsuit.

6.2 Employees' costs: social security benefits

Employees are also part of the collusive tax evasion. Equations 9 and 10 include employees' evasion costs as a determinant of the optimal amount paid under the table. Reporting has several benefits that can be seen as the cost of misreporting. [44]

In what follows, we study the ceiling of the social security system, which shuts down the reporting-benefit link. This means employees' incentives to report to increase their pension disappear above the ceiling. On the other hand, there are no changes in employers' incentives around the ceiling. This is a concrete situation where even when employers report employees' wages, we can observe how employees' incentives shape the reporting behavior, consistent with collusive tax evasion.

First, we discuss the institutional context and the ceiling to social security in the context of Brazil. Second, we present the main results of wage reporting. Third, we provide extensive evidence that the reporting behavior is explained by adjustments in PUTs rather than labor supply responses. Finally, we discuss the results and its implications.

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[44]For example, pension and unemployment insurance are social security benefits that depend on *how much* is reported. Moreover, reported wages work as proof of income, which is helpful for credit access and future salary negotiations.

6.2.1 Institutional Context

Brazil has a pay-as-you-go pension system, meaning that current pensions are funded by current employees, whose pensions will be funded by the next generation of employees, and so on. This is a popular system in many countries around the world (OECD et al. 2014). Benefits typically depend on contributions through a formula that weighs employee's wages and contribution years. Nonetheless, the pay-as-you-go system has a weaker link between the contribution and the benefits relative to privately funded pensions. For example, the formula may put higher weights on specific contribution years than others, reducing the incentives to contribute in the less favorable years (Dean et al. 2024). Second, many countries define a maximum pension for retired employees. This amount is linked to a contribution ceiling, above which reporting an additional dollar does not increase the pension. We will leverage the ceiling of the social security system in the Brazilian context.

In Brazil, the monthly pension is calculated based on the following formula:

$$P = \delta \frac{1}{k} \sum_{i=1}^{k} \max \{w_i, \bar{w}\} \tag{13}$$

Where δ is a coefficient that depends on the number of contributory years, and $\bar{w}$ is the ceiling. w_i and $\bar{w}$ are translated into present values using a pre-specified formula. The k salaries are selected to be the highest 80% of salaries earned during the contributory period. As workers' earnings profile increases in tenure, workers closer to retirement are more likely to affect their pensions with their current salaries (see Figure A12).

While the ceiling caps employees' pensions, it also caps employees' contributions. Figure 11 shows how different rates faced by employers and employees change around the ceiling. Then, the ceiling of the social security system works as follows. On the benefit side, it caps employees' pensions at a maximum. On the tax side, it caps the contributions made by the employee. This means that reporting one dollar above the ceiling cannot increase the pension, but the employee does not pay additional contributions.

Figure 11: Tax and contribution rates by reported income in 2017
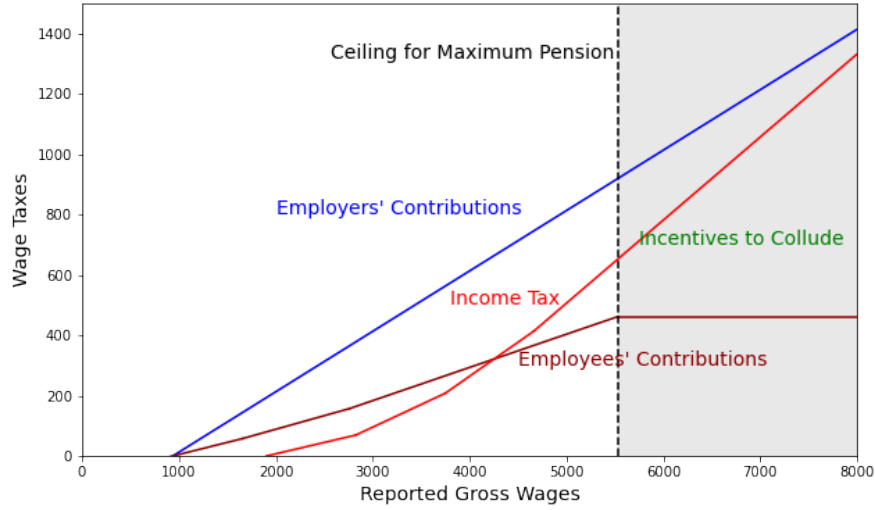
Notes: This figure shows how the marginal tax and contribution rates change with different levels of reported wages. The blue line refers to the employers' contribution to the retirement system (INSS). Firms in the tax regimes of Lucro Real and Lucro Presumido (covering 60% of total employees) pay 20% on contributions. Moreover, all firms pay contributions to unemployment insurance (FGTS) for 12% of the reported wages. The red line shows employees' income taxes. The slope breaks show increments in the marginal tax rate, which becomes 27.5% way below the ceiling. The dark red line shows employees' contributions to social security. This rate is slightly increasing in wages up to the ceiling, where it becomes flat. Mirroring this pattern, the pension is capped at the ceiling.

Looking at the contribution and benefit sides separately. First, taking only the contribution side, a drop in the contribution rate is analogous to a drop in the tax rate. Traditional bunching analysis predicts *anti-bunching* at the ceiling of the social security system. Indeed, several papers have unsuccessfully tried to find such a pattern in different countries (Alvaredo et al. 2017). Second, taking only the benefit side, a cap in the benefits of reporting predicts *bunching* at the ceiling of the social security system because those benefits drove the incentives to report.[45] Therefore, the final prediction will depend on the change in benefits relative to the change in contributions. In what follows, we show a clear bunching pattern, which increases as workers get closer to retirement.

6.2.2 Reported wages and employees' benefit schedule

We use the matched employer-employee data to test for bunching at the ceiling of the social security system. Using data from 2017, Figure 12a shows a clear bunching at the ceiling for those workers who are at most 10 years from retirement age. The ceiling is updated annually[46], meaning we can track this pattern for several years. Figure 12b shows that the bunching is not restricted to this year.

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[45] As far as we know, no one has previously documented this pattern.

[46] In the following link you can find the time series of both contribution rates and ceilings.

While the drop in the contribution rate is the same for every worker who reports above the ceiling, the benefits can be heterogeneous, creating different incentives to bunch. In particular, the proximity to retirement age shapes the size of the benefits for several reasons. On the monetary incentives, young workers with *true* wages above the ceiling are likely to keep earning high wages (see Figure A12). Moreover, they are also more likely to contribute for more years, meaning that one contributory salary is expected to be averaged with more salaries, reducing the marginal effect of reporting on increasing the pension. Finally, pension benefits are likely to not be salient for young workers. [47] These are two quotes from our survey respondents (an accountant and an employee) consistent with this view:

> *Some workers are happy because they avoid paying income taxes and Social Security Contributions. However, they are not thinking ahead. Their pension will be minimal. They realize they did something wrong when they get old.* (Interviewed accountant)

> *These payments under the table were initially beneficial. However, it is currently harmful as I get closer to retirement* (Surveyed employee)

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[47]There is a large literature about behavioral biases on retirement savings, with consensus around the idea that a significant share of workers is present bias and narrow framing, negatively affecting retirement savings (Goda et al. 2015, Shin et al. 2019, Benartzi and Thaler 2007, Goda et al. 2019). Moreover, Dolls et al. (2016) finds that salience about the expected pension benefits increased retirement savings.

Figure 12: Reported wages around the ceiling
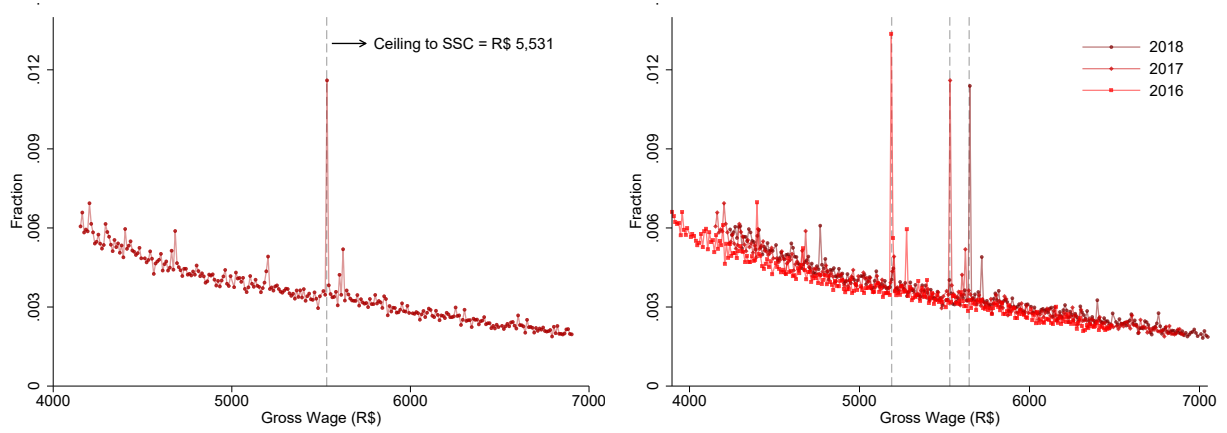
(a) 10 yrs from retirement in 2017

(b) 10 yrs from retirement in 2016-2018
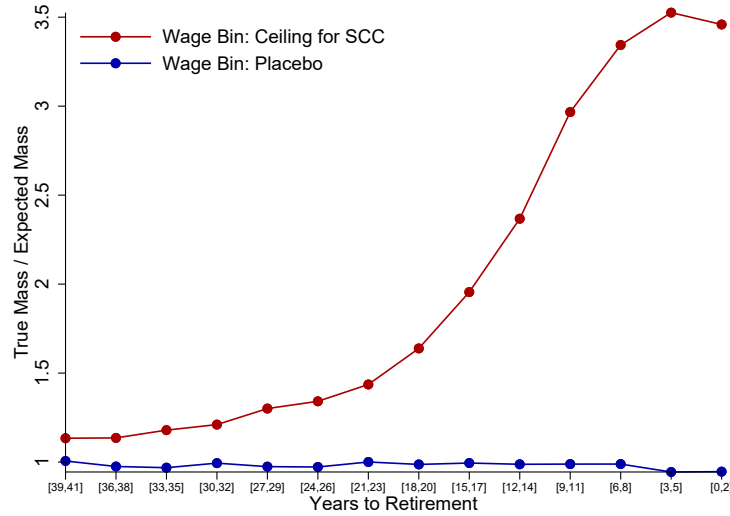
(c) Excess mass by years to retirement

Notes: Panel (a) shows the fraction of workers in each wage bin in 2017. The plot's bandwidth is 25% above and below the ceiling. The dashed line corresponds to the ceiling (R$ 5,531 in 2017). Bin's bandwidth is R$ 10 (about US$ 2). We dropped bins containing rounding numbers for exposition purposes. The x-axis corresponds to the gross wage of active employees in the private sector in December of 2017. Panel (b) replicates plot (a) for 2016 and 2018 when the ceiling had different nominal values. Panel (c) shows the *excess mass* for each group of years to retirement. The *excess mass* is the ratio between the *true mass* and the *expected mass*. The former is based on the actual distribution. The *expected mass* is calculated by fitting a polynomial of degree 3. We recover the *excess mass* for each cohort of years relative to retirement. The x-axis shows these different groups defined by how many years they are far from retirement age. The red line shows the excess mass for the ceiling bin, while the blue line shows the excess mass of another bin (ten above the ceiling). This plot puts together data from 2015 to 2020. Every year is centered at the corresponding ceiling.

Consistent with the fact that the ceiling bites more for workers closer to retirement (because they suffer a larger drop in the value of the benefits), Figure 12c shows that the *excess mass* is increasing as workers get closer to retirement age. We calculate the *excess mass* as the ratio between the *true mass* we observe in the data and the *expected mass*, which comes from fitting a polynomial

and recover the mass we would observe with a smooth distribution. We replicate this exercise for the wage distribution of different years to retirement bins. Finally, we also created a placebo test. We pick another wage bin (different from the ceiling) and replicate the *excess mass* exercise across different years to retirement groups. With no change in incentives for any group, we should expect that the *true mass* equals the *expected mass*. More formally, for each cohort r (years to retirement) separately, we run the following regression to recover $\hat{\beta}_{1r}$, $\hat{\beta}_{2r}$, and $\hat{\beta}_{3r}$. In the regression, we exclude the bin we want to predict the mass. This means that for the red line in Figure 12c, we exclude the wage bin of the ceiling, and for the blue line, we exclude the one ten bins above the ceiling.

$$p_b = \alpha + \beta_1 bin_b + \beta_2 bin_b^2 + \beta_3 bin_b^3 + \varepsilon_b \ \ \forall b \neq c$$
$$\hat{p}_c = \hat{\alpha} + \hat{\beta}_1 bin_c + \hat{\beta}_2 bin_c^2 + \hat{\beta}_3 bin_c^3$$

Where p_b is the fraction of all workers we observe in bin b, bin_b is the order of the bins relative to the ceiling.[48] Sub-index c refers to the bin of the ceiling. Finally we compute the excess mass $= \frac{p_c}{\hat{p}_c}$ for each cohort r.

6.2.3 Ruling out alternative explanations

Figure 12 shows clear evidence that employers cap the reporting of employees' wages when the reporting-benefit link shuts down at the ceiling. However, this pattern is consistent not only with employers adjusting PUTs to report up to the ceiling but also with a pure labor supply story. For example, when workers closer to retirement want to increase their pension, they can also work harder to increase their *true* wages. Therefore, they could be adjusting their labor supply to maximize the benefits they get.[49]

We rule out the labor supply story in several ways. First, we provide evidence that the bunchers' heterogeneity is consistent with the survey evidence, which informs us which type of employees and firms are more likely to engage in PUTs. Second, we study the wage reporting dynamics, leveraging the fact that the ceiling updates annually. Third, we provide indirect evidence that bunchers have higher wages than they are reporting. Finally, we present an *randomized control trial* that we conducted within the survey to elicit whether employees' incentives to reduce PUTs may change with the salience of the benefits.

**Heterogeneity analysis: bunchers vs. non-bunchers**

In Section 4, we presented many results regarding which type of firms and employees are more likely to engage in PUTs. Figure 4 shows that employees working in smaller firms are more

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[48]When appending different years, we center the bins relative to the ceiling of each year.

[49]Work in different contexts has shown that bunching responses are more likely to be driven by evasion rather than real responses. See Saez (2010), Chetty et al. (2011) for individuals and Bachas et al. (2021), Garriga and Scot (2023) for firms.

likely to receive PUTs. Table A4 shows that those employees holding managerial positions are more likely to receive PUTs. Finally, Figure 3 shows higher interaction between employer and employee predicts more PUTs. Consistent with these facts, Figure 13 shows that bunchers are more likely to work in smaller firms and hold managerial positions than those reporting slightly above or below.

Figure 13: Reported wages around the ceiling

(a) Establishment Size

(b) Managerial Position
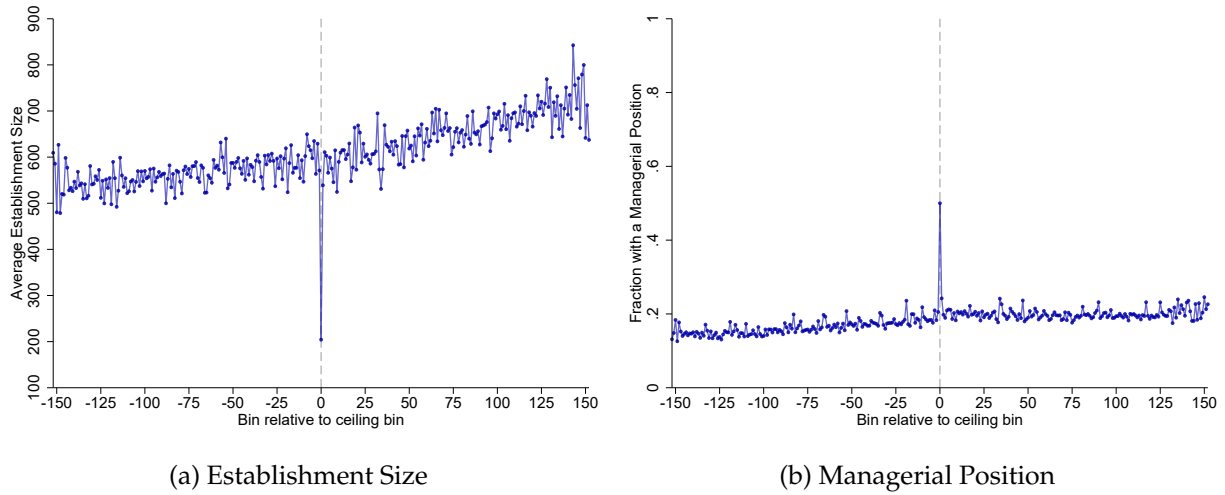
Notes: This figure shows heterogeneity on bunchers and non-bunchers. Panel (a) shows the average establishment size (number of employees) where individuals in each wage bin work. Panel (b) shows the fraction of employees in each wage bin that hold a managerial position. In both cases, the sample was pooled from 2015 to 2020. Each year, we center the bins with respect to the ceiling bin before pooling. Therefore, bin zero refers to the wage bin of the ceiling (dashed line). Positive bins are for individuals earning above the ceiling, and negative bins contain individuals earning below the ceiling.

In addition, Table A7 shows that employees who match demographic characteristics with the owners are likelier to be bunchers. This is consistent with the proximity between employer and employee as a catalyzer of collusive tax evasion.

Wage dynamics

We study bunchers' wage dynamics to document strategic reporting behavior that is consistent with evasion as opposed to real labor supply responses. We compare how reported wages change from one year to another for those workers who report at the ceiling (bunchers) and those who report a little bit more or less.

Therefore, we define as *bunchers* those workers with reported wages in the wage bin of the ceiling, and as *non-bunchers* those with reported wages in the wage bins right above and right below the ceiling (See Figure A15 for an illustration).[50] In the absence of the ceiling c that changes employees incentives to report, we should expect that any outcome y should satisfy the following:

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[50]We don't consider those just below and above to avoid approximation problems.

$$\lim_{w_i^- \to c} y(w_i) = y(c) = \lim_{w_i^+ \to c} y(w_i)$$

However, in the presence of a kink in incentives, discontinuities in variables at *c* can provide helpful information. For example, the difference in wage changes between bunchers and non-bunchers can reveal strategic wage setting. Figure 14a shows that employees reporting exactly the ceiling update their salaries the year after following the new ceiling. This is strong evidence of pure reporting behavior. It is unlikely that workers are able to change their effort and hours of work (special in fixed labor contracts) every year to perfectly match the ceiling. In Figure 14b we show the probability that an employee remains in the same bin within a year. This should be quite unlikely (as it can be observed from the other groups) because in December, employers pay an additional salary to the employees.[51] This additional salary is also subject to income tax and social security contributions, so it is consistent that employers do not report additional wages in December for the bunchers.

Figure 14: Wage changes across and within years

(a) Across years   (b) Within years
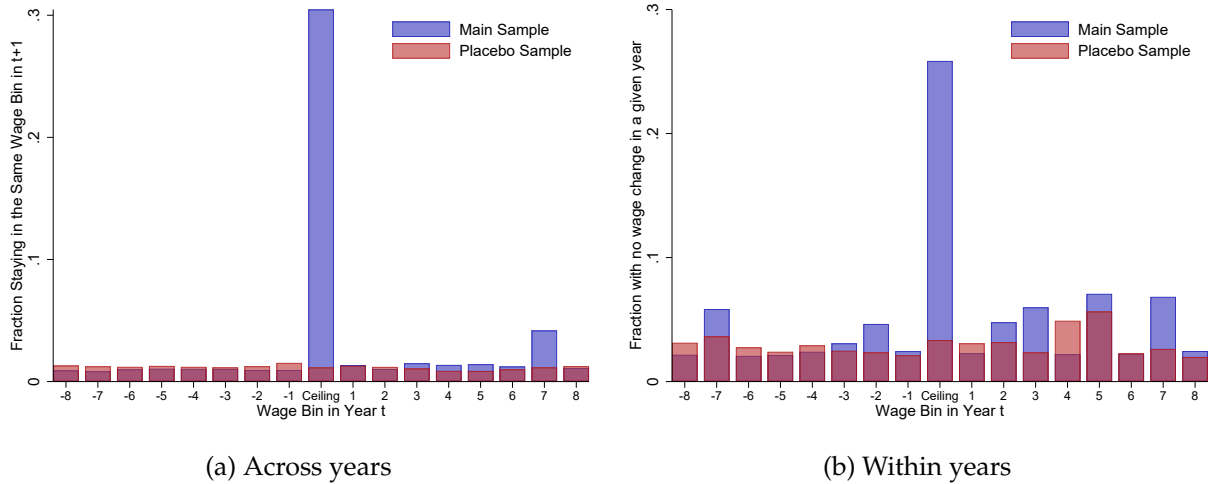
Notes: This figure shows that bunchers and non-bunchers show very different patterns of wage changes. Panel (a) plots the fraction of employees in each wage bin in *t* remains in the same wage bin in *t* + 1. Panel (b) shows the fraction of employees in each wage being with no wage changes between January and December in a given year. Blue bars refer to *bunchers* and *non-bunchers* around the true ceiling, while the red bars are the placebo (where we replicate the exercise for wage bins centered at a fake ceiling). The mid-bar at 0 always refers to the *bunchers'* bins (ceiling), and we show 8 bins to the right and to the left, which correspond to *non-bunchers*.

**Indirect evidence of true wages**

Whether the bunching is driven by adjustments in PUTs or labor supply implies different predictions regarding the true wages of the bunchers. The labor supply explanation implies that employees adjust hours of work or effort to earn the ceiling. This means that their *true* wages are, indeed, the reported ones. The PUTs explanation implies that bunchers earn higher *true* wages

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[51]Known as thirteenth salary and mandatory by law.

than the ones they report, but they adjust how much to report to evade the additional taxes and contributions. We complement the matched employer-employee data with ownership registries and the records of federal aid program receivers (see Section D.4 and D.3 for details). We use these additional data sources to get indirect evidence of the *true* wages of the individuals. Figure A16 shows that these two measures are correlated with wages.

Figure 15 shows local evidence around the ceiling of receiving a federal aid program and owning a good-quality firm. We find that bunchers are significantly less likely to receive a federal aid program but more likely to ever own a good-quality firm. It is not evident that these measures should be correlated with firm size, managerial position, and wage dynamics when conditioning by wages. Indeed, the bias is likely to go the other way around. Conditional on wages, employees in smaller firms may be more likely to fall in unemployment, becoming more likely to receive a federal aid program. We know that bunchers work in smaller firms, but we find that they are less likely to receive a federal aid program rather than more likely.

Figure 15: Indirect evidence of true wages for bunchers

| (a) Federal Aid Program | (b) Ever Owning a Good-quality Firm |
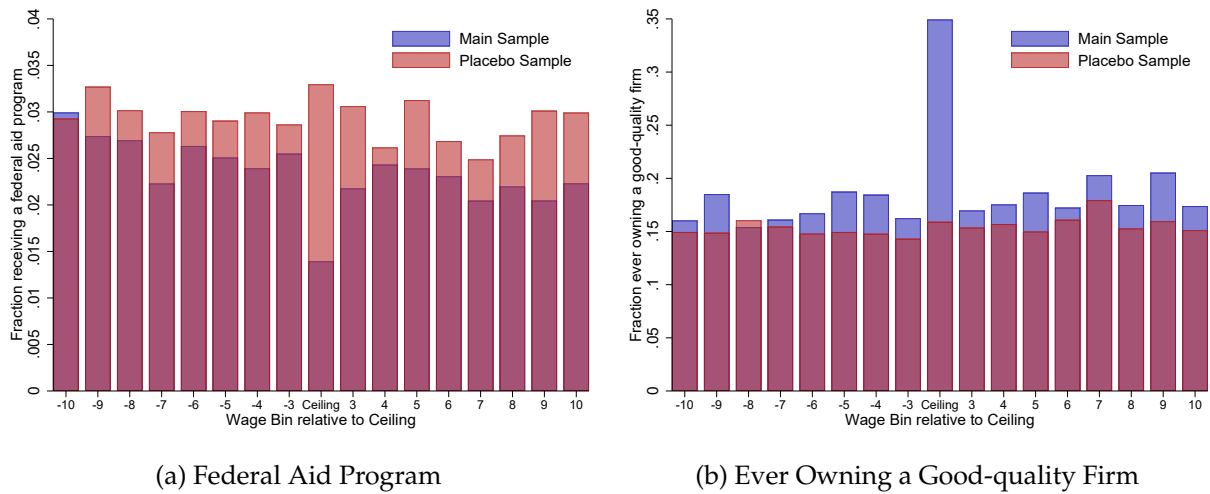
Notes: Panel (a) shows the fraction of employees receiving a federal aid program in each wage bin. Receiving a federal aid program is defined as finding the employee in the dataset *Cadastro Unico* in 2019. Panel (b) shows the fraction of employees who ever owned a good-quality firm. Owning a good-quality firm is defined as finding the employee in the ownership registries of all firms that opened before 2016. Moreover, if employees appear as owners of the same firm that they work for, we don't consider those individuals. The creation of the main (blue) and placebo (red) sample come from A15.

Salience of benefits and intention to report

Our results provide robust evidence that employers cap reported wages when employees' benefit of reporting shuts down. This means that even when employers report employees' wages, collusive tax evasion is sensitive to employees' incentives as well. To complement this analysis, we provide experimental evidence that these incentives can matter beyond the particularity of the ceiling of the social security system.

We conducted a *randomized control trial* on information provision among those who admitted to receiving PUTs. At the end of the survey, we provided information about the benefits of reporting to a randomly selected group of PUT receivers. Then, we asked the final questions of the survey regarding the preferences for increasing or reducing payments under the table.[52] Concretely, we provided the following message to the treatment group:

In this part of the research, we would like to mention certain benefits associated with declaring wages on the official payroll that workers often forget or are unaware of. These benefits include:

<u>Retirement</u>: *For the calculation of the retirement benefits you will receive in the future, only the wages declared on the payroll are taken into account. This means that any portion paid under the table is not considered, and you will receive a smaller pension than if your entire salary had been declared.*

<u>Access to Credit</u>: *Many banks require pay stubs from the last 6 months or 1 year of employment to determine whether they will grant you credit and the interest rates on loans.*

<u>Unemployment Insurance</u>: *The amount used to calculate unemployment benefits is based on the wages declared on the payroll. Therefore, the portion of the salary paid under the table is not considered if you need unemployment insurance.*

<u>Survivor or Accident Pension</u>: *The calculations made by the Social Security System (INSS) for survivor pensions for your dependents or pensions for accidents and disability are also based on the wages declared on the payroll.*

And others!

Then, we study their responses to the following questions:

- *From 1 to 10, what is the probability you will try to renegotiate your salary in order to report higher wages in the next 3 months?*

- *Would you accept a new contract where the **total** salary is 5% lower, but the reported part of the wage is higher?*

- *Next time you start a job, would you choose one with 5% higher **total** salary but part of it non-reported?*

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[52]We expect little demand effects given that both the treatment and control groups answered multiple questions about PUTs before the experiment. However, the experiment's results must be taken as a complementary exercise rather than a main result.

Table 4: Effects of information provision on the intention to reduce PUTs

	Negotiate lower PUT			5% Lower Wage with no PUT			5% Higher Wage with some PUT		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment	.408**	.393***	.346**	.0494*	.0543***	.0532**	-.0309	-.0353*	-.0355*
	(0.202)	(0.141)	(0.139)	(0.029)	(0.021)	(0.021)	(0.026)	(0.019)	(0.019)
Some College		-.0816	-.228		-.009	.0156		-.00508	-.0267
		(0.156)	(0.174)		(0.023)	(0.026)		(0.021)	(0.024)
Female		.0147	.0993		-.0276	-.0258		.0107	.00802
		(0.148)	(0.147)		(0.022)	(0.022)		(0.020)	(0.020)
Dep. Var Mean	5.82	5.82	5.82	.69	.69	.69	.24	.24	.24
Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Size + Income FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	1945	1940	1940	1945	1940	1940	1945	1940	1940

Notes: This table presents the results from the RCT we conducted within the survey. We randomly assigned the respondents who admitted to receiving PUTs to a treatment or control group. The treatment group received information on the benefits of reporting. The outcomes variables are based on the following questions: *From 1 to 10, what is the probability you will try to renegotiate your salary to increase reported wages in the next 3 months?* (Columns 1 to 3), *Would you accept a new contract where the total salary is 5% lower, but the reported part of the wage is higher?* (Columns 4 to 6), and *Next time you start a job, would you choose one with 5% higher total salary but part of it non-reported?* (Columns 7 to 9). "Controls" include *manager, education, gender, family business, age,* and *tenure.* "Size + Income FE" include fixed effects for wage and firm size groups. All results are reweighted using the methodology presented in Apprendix D.1.1.

The results show significant effects on the intention to reduce PUTs across all questions in response to the information provided. The effects are between 5 to 14%, depending on the specific question.

7 Conclusion

This paper reveals a significant presence of informal compensation practices within formal employment relationships, challenging the effectiveness of third-party reported income as a mechanism to ensure tax compliance. In Brazil, approximately 24% of formal employees acknowledged receiving PUT for about 20% of their wages. This widespread practice tends to be more prevalent among higher-income workers, implying a regressive aspect of PUTs. The consequences for government revenue and state capacity are considerable. Back-of-the-envelope calculations suggest that PUTs imply about 7% of income tax losses. These losses are larger than the analogous calculation for classic informal employment, calling for the special attention of policymakers and tax agencies in developing countries.

The evidence strongly points towards collusive behavior between the employer and the employee, which is captured in our conceptual framework. We propose a Nash bargaining determination for PUTs, in which employers and employees bargain over the share they take from the government. This model highlights that third-party reported income is only effective in increasing

tax compliance as long as there is a conflict of interest between the agents involved. Regarding PUTs, the different tax rates faced by employers and employees can be seen as a potential benefit for both, since they can distribute the share evaded discretionary. However, they face different evasion costs, which brings conflict of interest. On the one hand, employees lose several social security benefits (e.g. pension, unemployment insurance), access to credit, income proof, etc. On the other hand, employers get exposed to higher audit and lawsuit risks, booking costs, etc.

We leverage quasi-experimental variation and rich administrative data to study changes in the marginal cost of participating in PUTs for the employee and the employer. Consistent with the model, we find strong evidence of workers closer to retirement bunching at the ceiling of the social security contributions, which was not previously documented in the literature. Furthermore, the model predicts that the size of the bunching will increase as individuals approach retirement. Consistent with the survey evidence, bunchers are more likely to work in smaller establishments, hold managerial positions, own an external firm that can be used to receive the PUT, to exhibit strategic wage reporting behavior. Second, we show that firms increase by 1% the reported wages of incumbent workers who never sued the firm. Based on the evidence from our survey, this increase represents about a sixth of the total wages underreported, which makes the estimates quite sizeable. Consistent with the survey (and bunching) evidence, we find larger effects for smaller firms and managers. On the other hand, we show neither effects on task reallocation nor hours worked within the firm for incumbent workers, ruling out alternative explanations.

Our study presents, to our knowledge, the first attempt to produce a comprehensive picture of the practice of employees receiving part of their salaries off-the-books and its implications for the government's budget. Most of the existing literature on informality has focused on firm- and worker-level informality, with only some papers providing local evidence of the existence of un-reported payments in response to particular policies. We also provide a conceptual framework to think through collusive tax evasion in settings with third-party reported income, allowing us to identify potential policy responses to reduce PUTs. Finally, we also provide the first attempt to investigate the consequences of PUTs related to distortions in economic activity.

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A   Appendix Figures

Figure A1: Extensive and Intensive Margins of PUTS


(a) Extensive

(b) Intensive
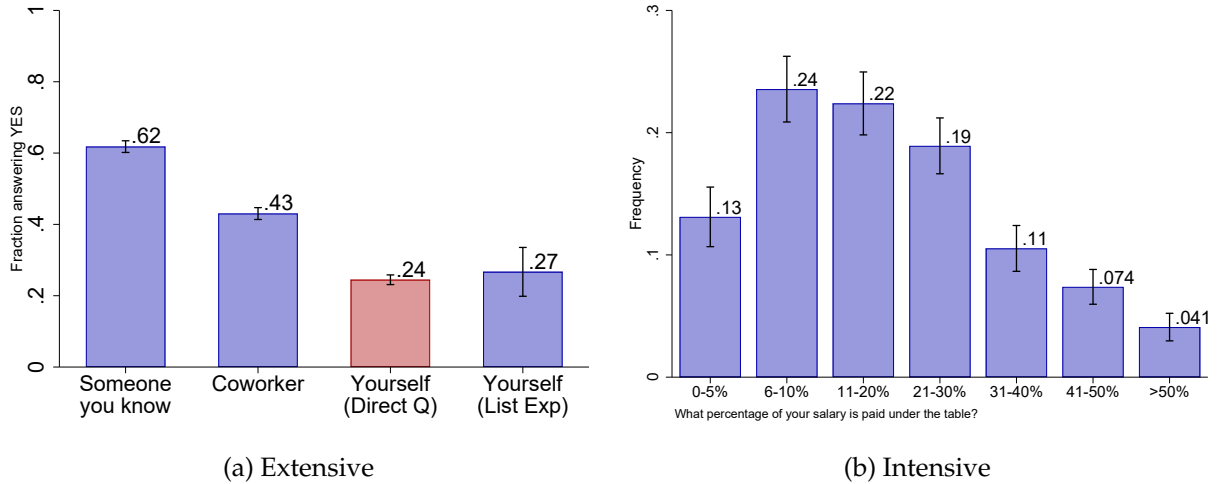
Notes: Panel (a) captures the extensive margin of PUTs. It shows the proportion of respondents in each of the following categories. "Someone you know" is the proportion of respondents that report that they know at least one person that receives part of their salary as PUT. "Coworker" is the proportion of respondents that report that they know at least one coworker at their current establishment who receives part of their salary as PUT. "Yourself (Direct Q)" is the proportion of respondents that report receiving at least some part of their salary as PUT. "Yourself (List Exp)" is the proportion of workers that receive PUT derived from the list experiment. Panel (b) uses only respondents who admitted to receiving PUTs. It shows a histogram of the fraction of the total wage that is paid under the table. All results are reweighted. Vertical bars represent 95% confidence intervals.

Figure A2: Validation of Extensive and Intensive Margins

(a) Firm Owners' Responses

(b) Lawsuit Documents
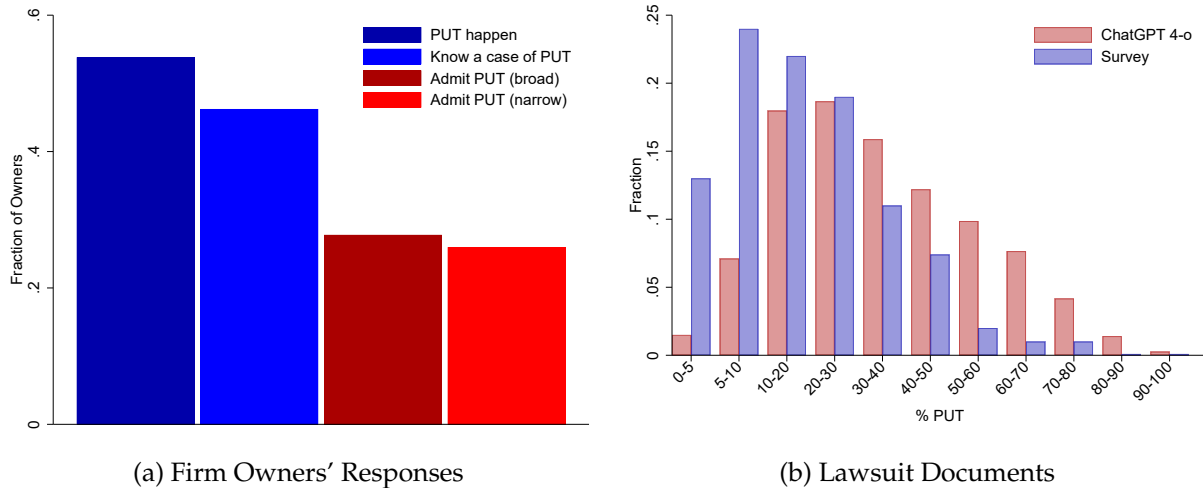
Notes: Panel (a) shows the responses of firm owners when asked about their knowledge of PUTs. We gradually asked 1) whether they know PUTs happen, 2) whether they know a specific case, 3) whether it happens in their firms, including *"I prefer not to answer"* and without including it (4). Panel (b) shows overlapping histograms of the intensive margin of PUTs from the survey results and from the lawsuit PDFs.

Figure A3: Employers' responses to *Who are you more likely to pay under the table?*


(a) Skill

(b) Tenure

(c) Manager

(d) Gender
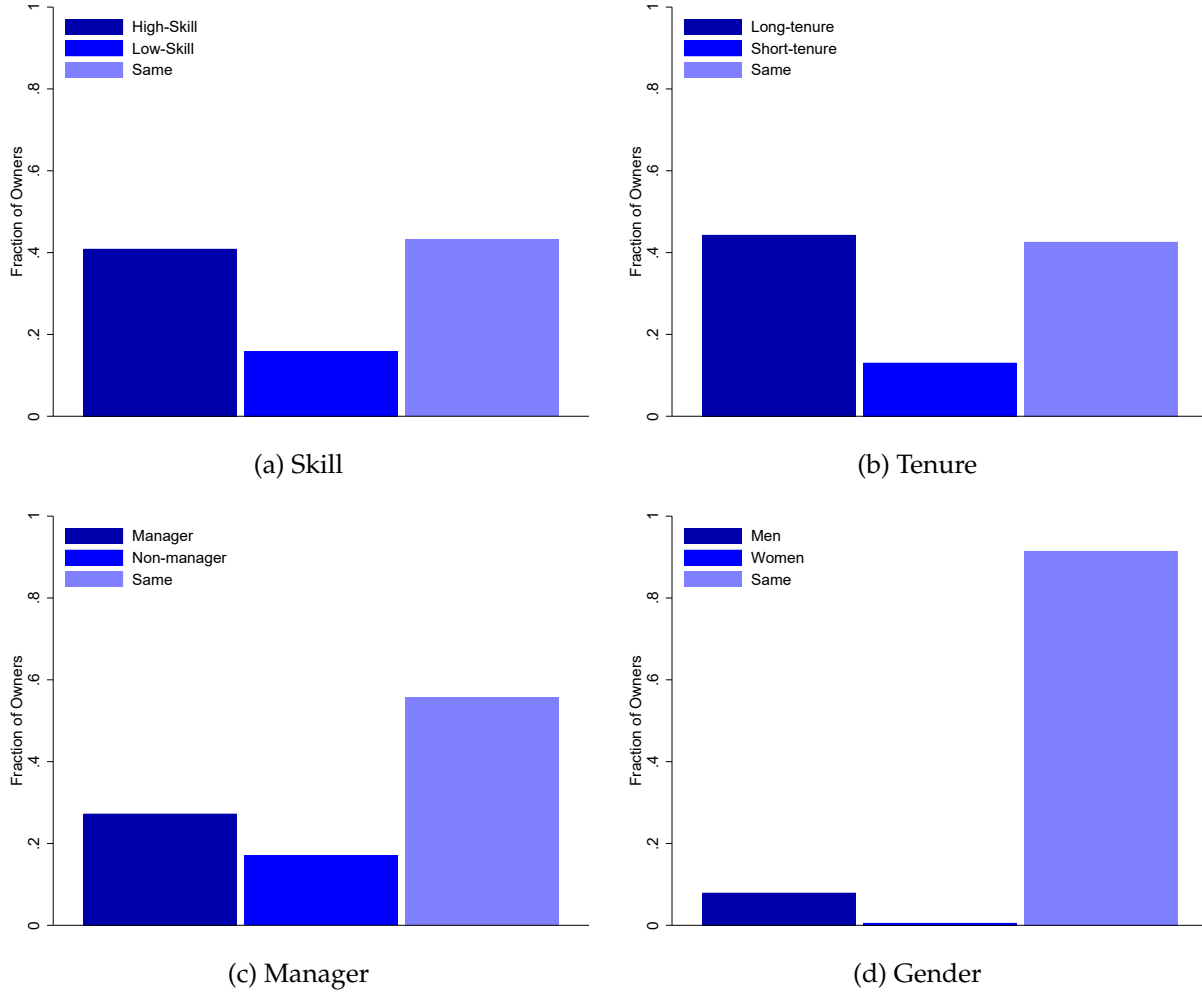
Notes: This figure shows firm owners' responses to question about which type of employees they are more likely to engage on PUT with. Panel (a) asks between high-skill and low-skill; panel (b) between long-tenure and short-tenure; panel (c) between managers and non-managers; and panel (d) between men and women. In all these comparisons we allowed firm owners to respond they are equally likely to collude with both groups.

Figure A4: Fraction paid under the table across the wage distribution (Validation)
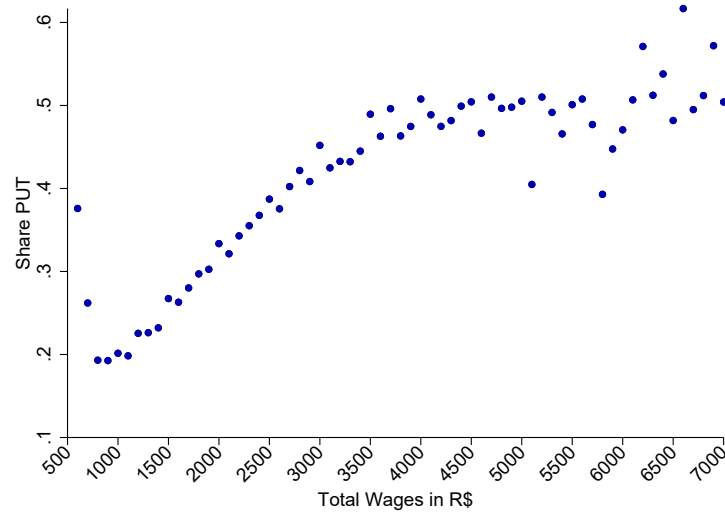

Notes: This figure shows the fraction paid under the table over total wages. PUTs and reported wages are recovered from the PDFs, and used to construct total wages and the ratio. We drop extreme values reported wages way below the federal minimum wage. See Appendix E for a detailed description of the data collection and cleaning.

Figure A5: *Who typically propose the PUTs?*
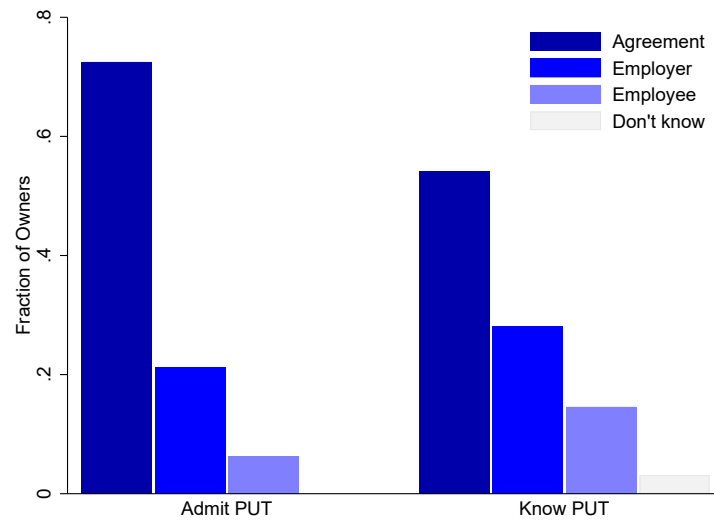
Notes: This plot shows employers' answer to the question *Who typically propose the PUTs?*. The sample is divided into two groups. Firm owners who admitted to paying under the table and those who know about PUT but didn't admit to doing it. We exclude those with no knowledge of PUTs.

Figure A6: Interviews with Accountants - *Where are PUTs more likely to happen?*
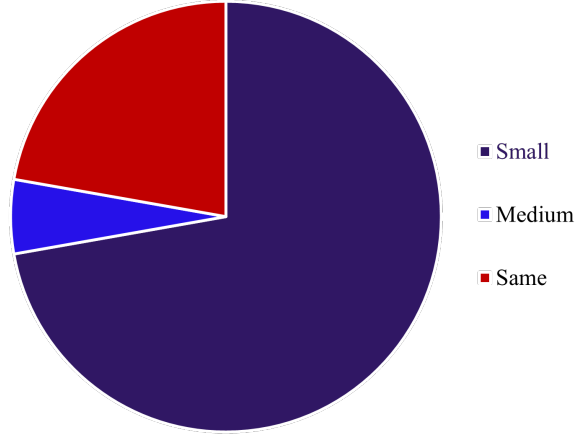
Notes: This pie chart shows accountants' responses about the type of firms where PUTs are more likely to happen. We presented four options: *Small*, *Medium*, *Large*, *Same*, where the last category indicates that the accountants find PUT equally likely to happen for the different firm sizes.

Figure A7: Payments Methods (Validation with ChatGPT 4-0)
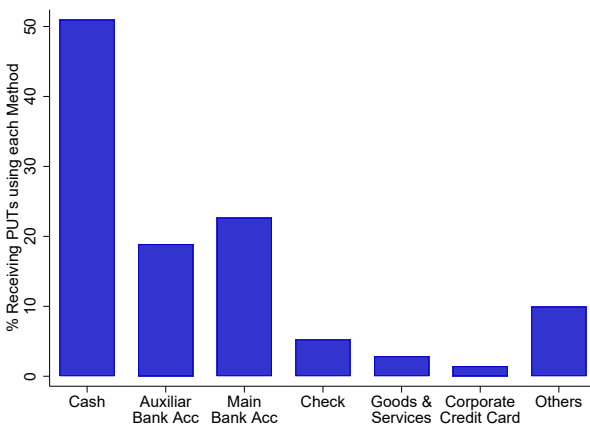
(a) Methods
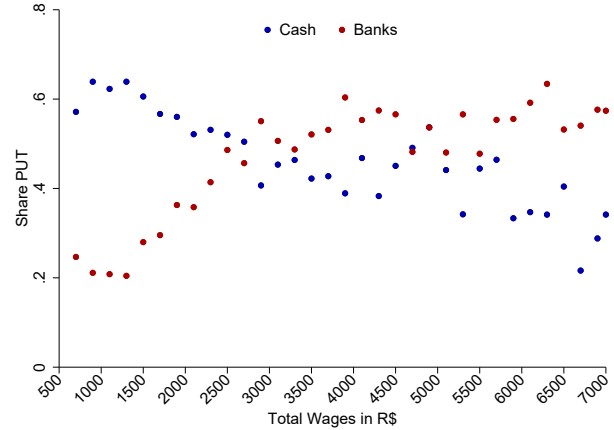
(b) Methods by Income

Notes: Panel (a) shows a tabulation of the payment methods recovered from the PUT-related documents. Categories were pre-specified in the prompt to ChatGPT 4-o. Details on the exact categories provided and the quality of the job performed by ChatGPT 4-o can be found in Appendix E. Panel (b) plots the share of documents reporting cash as a payment method (blue) and the share reporting a bank transfer as a payment method (red). The last group includes both *transfer to the same bank account where wages are paid* and *another bank account*.

Figure A8: Validity Check: Firms sued for PUTs
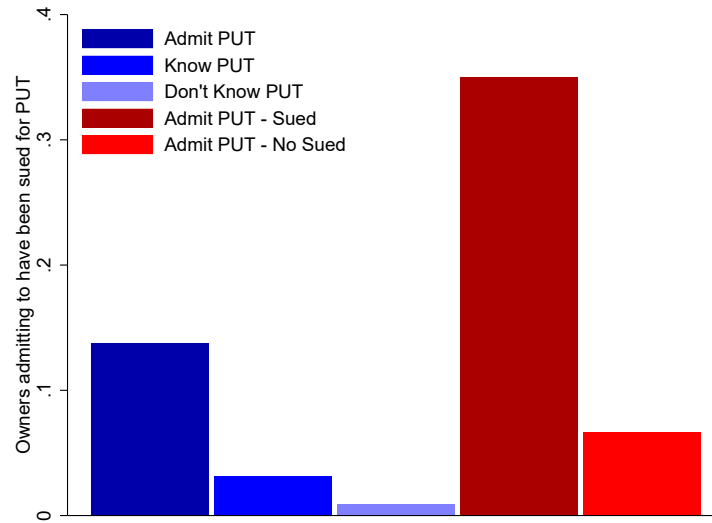
Notes: This figure shows the fraction of firm owners who responded to having experienced a labor lawsuit by groups. Blue bars (from darker to lighter) define the groups based on whether they admitted to paying under the table in their firms, whether they know PUTs happen, or whether they are not aware of this form of collusive tax evasion. The red bars zoom in on those admitted to receive PUT. The darker red bar refers to the owners of firms that appear in our administrative data of PUT-related lawsuits between 2014 and 2019.

Figure A9: Correlation: Number of Coworkers and Wages
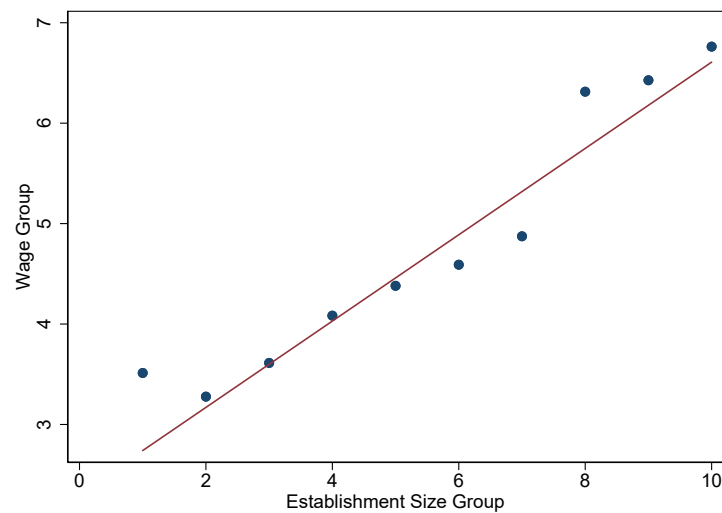
Notes: This figure shows the correlation between establishment group size and wage group reported in our survey of formal employees. As expected, employees working in larger establishments earn, on average, higher wages.

Figure A10: Number of Labor Lawsuits over Time

(a) All Lawsuits

(b) PUT-related Lawsuits
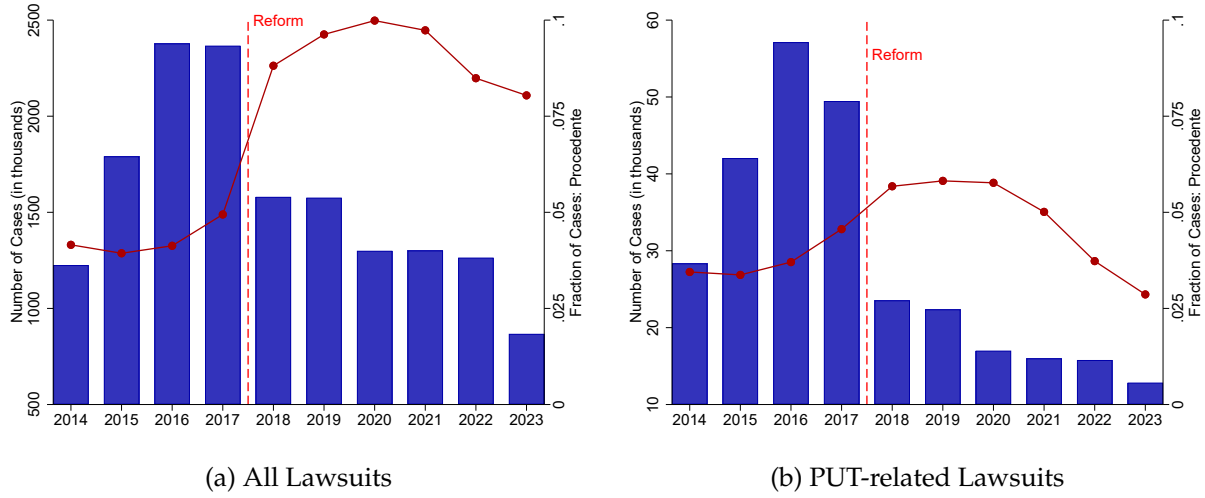
Notes: This figure shows the evolution of labor lawsuits over time and its composition. Panel (a) plots the total number of cases, regardless of its category. Panel (b) zoom into PUT-related labor lawsuits. In both cases, the red dashed line indicates the Brazilian labor reform. The second y-axis shows the ratio of cases that the judge considers to have solid grounds. It is worth noting that most labor lawsuits reach an agreement between the two parties without the need for a judge's intervention.

Figure A11: Accountants' Responses in Interviews

(a) Does a lawsuit trigger other lawsuits?

(b) Do employers underestimate lawsuit risks?
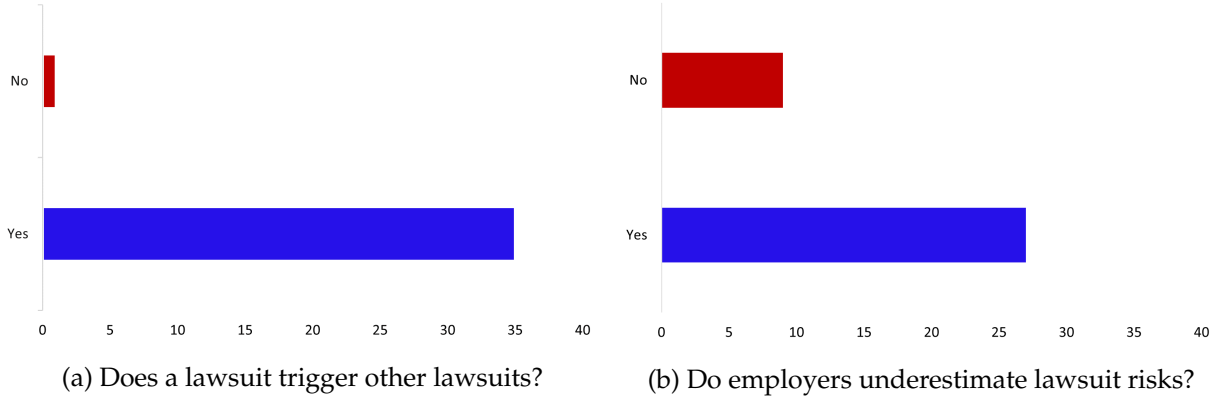
Notes: This figure shows the responses of 36 accountants who agreed to be interviewed about PUTs for about 45 minutes. These responses correspond to the section on risks and lawsuits. Panel (a) shows the accountants' answer to whether a lawsuit can trigger other lawsuits in the firm. Panel (b) shows the accountants' answer to whether employers underestimate lawsuit risks before getting sued.

Figure A12: Average wages across age in 2017

(a) All

(b) By gender
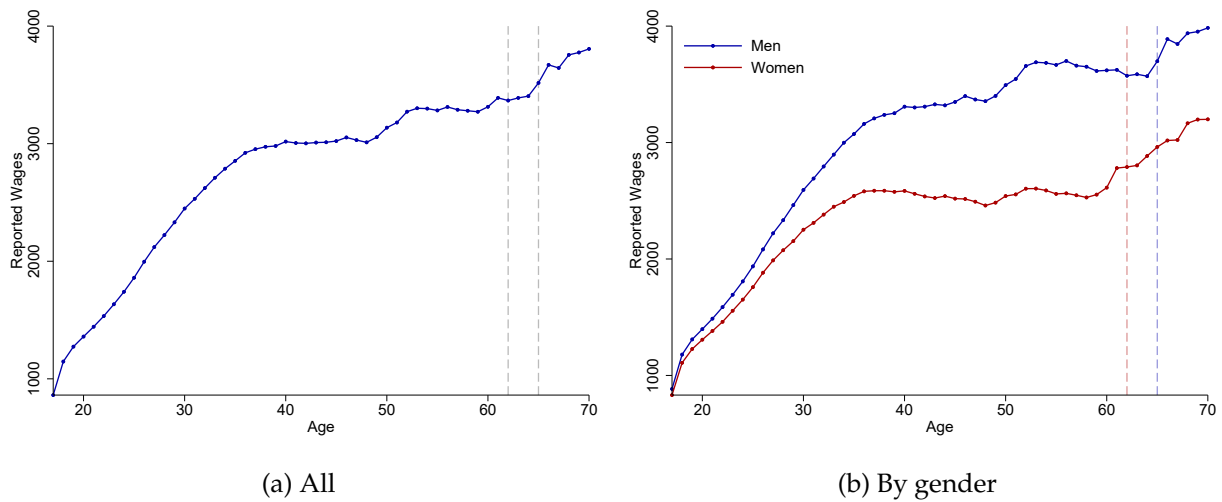
Notes: This figure shows the average wages by age using cross-sectional data for the universe of active employees in the Brazilian formal private sector in 2017. Panel (a) averages across all types of workers. Panel (b) differentiates between men and women. The dashed lines refer to the retirement age for women and men, 62 and 65 in 2017, respectively.

Figure A13: Who proposes PUT?
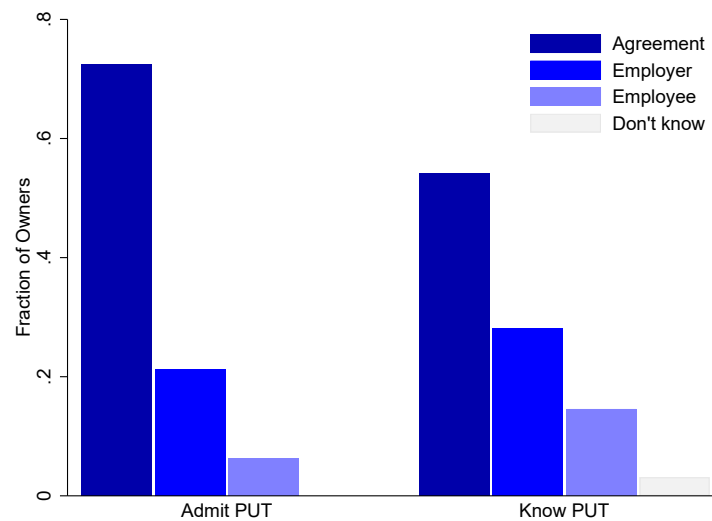
This plot shows

Figure A14: Payment Method (survey of firm owners)
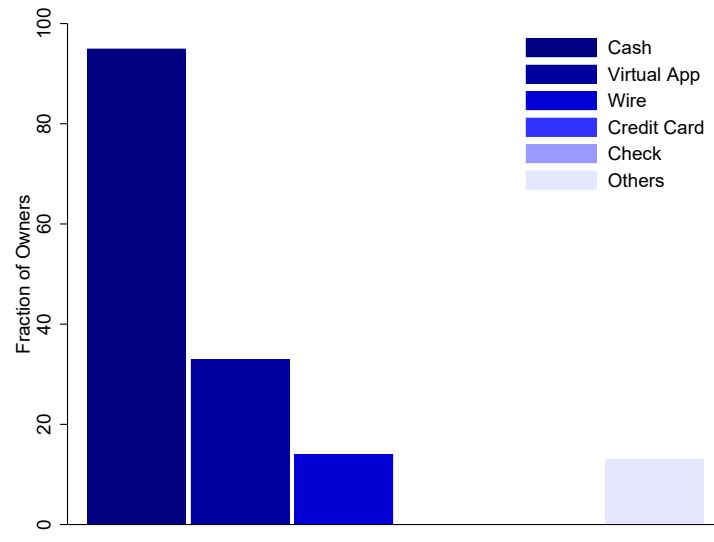
This plot shows

Figure A15: Sample selection for bunchers vs. non-buncher analysis
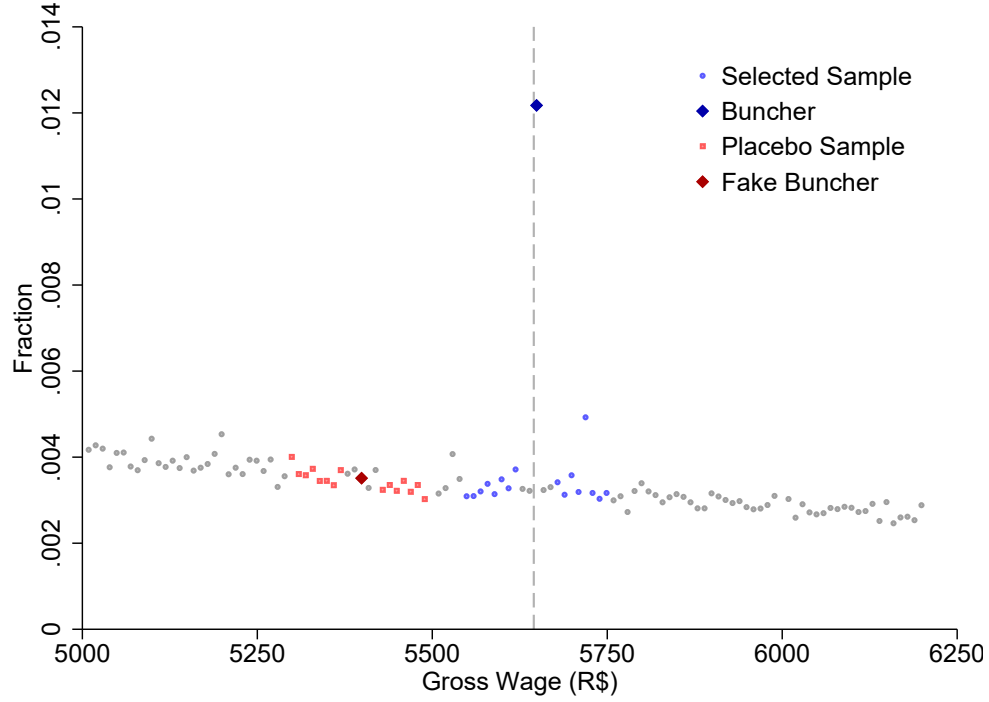
Notes: This figure illustrates our strategy to compare bunchers vs. non-bunchers and the placebo test we build. First, we define as bunchers as all the workers in the wage bin of the ceiling (dark blue diamond). Then, we define as non-bunchers as those who are in the wage bins $[c-8, c-3]$ and $[c+3, c+8]$. This means that the non-bunchers are those who report in one of the ten wage bins surrounding the ceiling and skipping the closest six bins. Each wage bin has a range of about US$ 2, so the comparison is between those who earn at the ceiling bin and those reporting between 6 and 16 dollars more or less. Second, we replicate this sample selection for another part of the wage distribution. We call fake bunchers to the employees working in the bin that plays the role of the ceiling, meaning it's at the center of the non-bunchers in the fake sample.

Figure A16: Indirect measure of true wages

(a) Federail Aid Program

(b) By gender
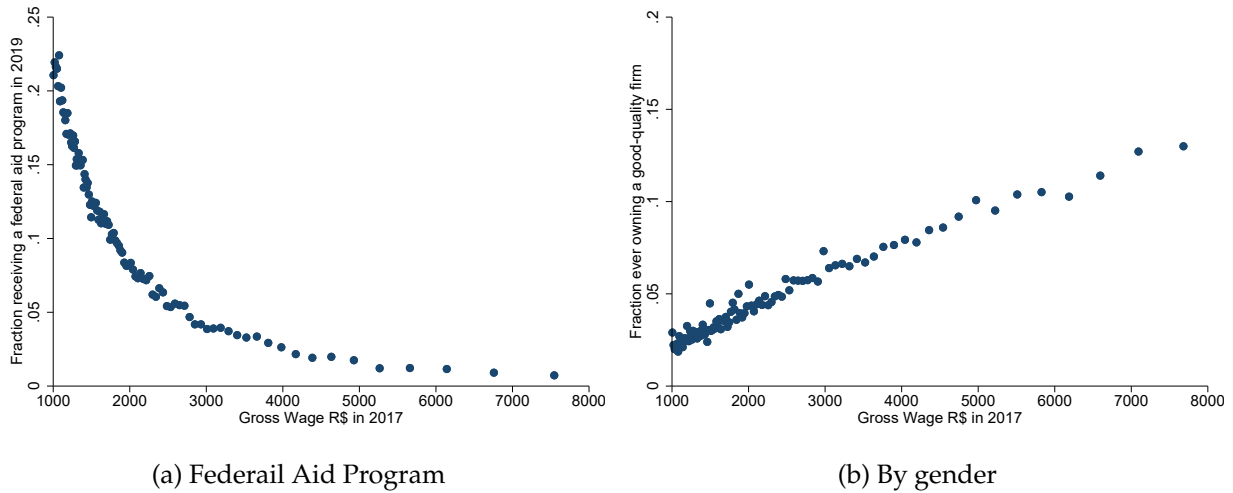
Notes: This figure shows indirect measures of true income. Panel (a) shows that receiving a federal aid program is sharply decreasing in wages for formal employees. The y-axis represents the fraction of employees in each bin that shows up in *Cadastro Unico* (a data set containing all individuals and relatives who receive a federal aid program). Panel (b) replicates this exercise but uses a different proxy for true income: the likelihood of ever owning a good-quality firm. Ever owning a good quality firm is defined as showing up as the owner of a firm that opened before 2016, with a different firm identifier than the firm where they were employees in 2017, and with legal form *limited liability*. It shows a sharp positive relationship between ownership and wages in 2017.

Figure A17: Histogram: Number of Cases by Firm
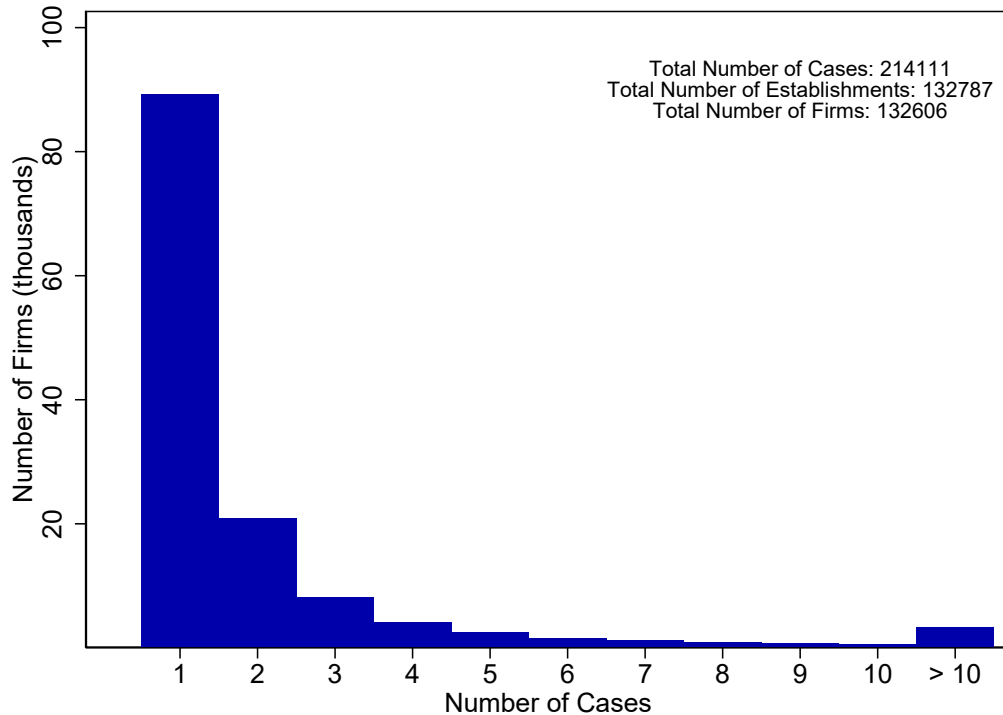
Notes: This figure shows the histogram of cases faced by each establishment. Most establishments only experienced one or two lawsuit between 2014 and 2019.

Figure A18: Labor Lawsuits in Brazil

(a) PUT-related

(b) All
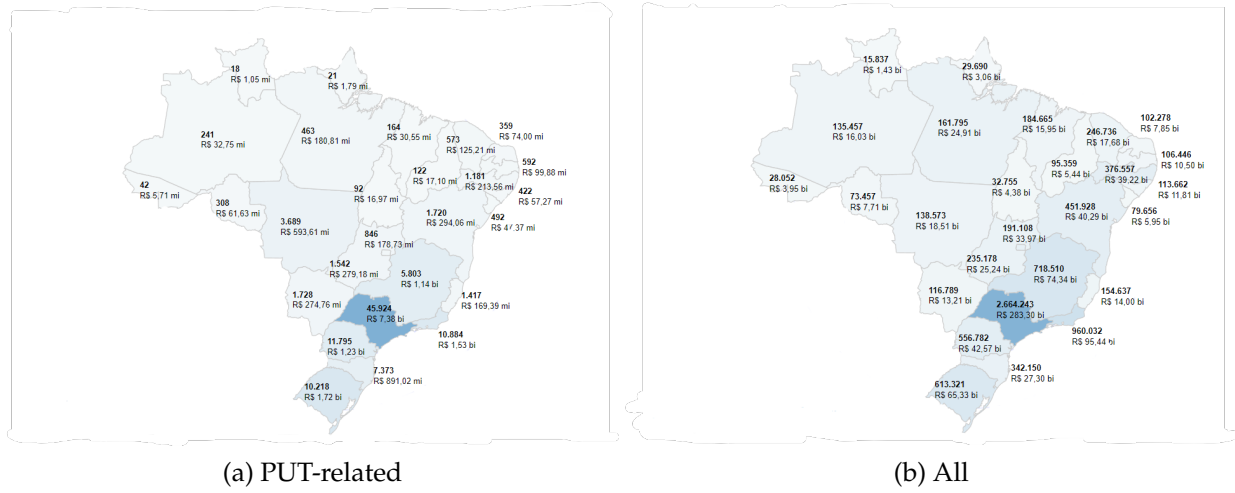
Notes: This plot shows the regional distribution of labor lawsuits. Panel (a) shows the PUT-related lawsuits used in this paper. Panel (b) is constructed with aggregate data on all the labor lawsuit in the country initiated between 2014-2019

Figure A19: Non-linear Income Tax Scheme
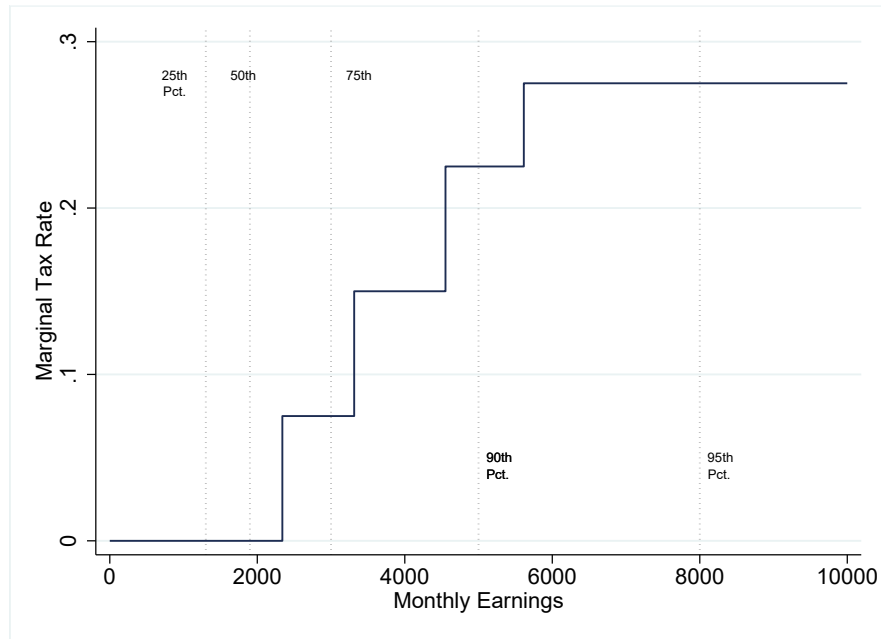
Notes: This figure shows the marginal income tax rate scheme (IFRS) for 2023. The income distribution is calculated using PNAD-continua in 2023, including all formal employees.

B Appendix Tables

Table A1: Descriptive Statistics of Brazilian Labor Market

	(1) All Labor Force	(2) All Employees	(3) Formal Employees	(4) Informal Employees
Sh. Female	0.449	0.479	0.466	0.530
Avg. Age	36.77	35.87	36.19	34.62
Sh. with less than H.S.	0.355	0.313	0.267	0.493
Sh. with High School	0.357	0.372	0.383	0.329
Sh. with Some College	0.288	0.315	0.351	0.177
Sh. Non-white	0.549	0.552	0.534	0.621
Avg. Monthly Wage 2019 BRL	2201.0	2192.2	2427.9	1283.0
Informal	0.313	0.207	0	1
Employee	0.702	1	1	1
Observations	196194	132181	106630	25551

Notes: This table was built using first quarter of PNAD-C in 2019. The sample comprises individuals between 18 and 55 years old. Informality is defined for workers as those who are employed without a signed *Carteira de Trabalho*. For self-employed, employers and other workers in the sample of the first column, informality is defined as if they are contributing to the social security.

Table A2: Balance Table

	(1) Lucid	(2) Lucid Reweight	(3) PNAD
Demographics			
Female	0.478	0.421	0.394
Age: 18-30	0.413	0.343	0.361
Age: 31-45	0.490	0.458	0.427
Age: 46-55	0.0774	0.159	0.152
Age: more 56	0.0187	0.0396	0.0603
Less than Highschool	0.0692	0.160	0.200
Highschool	0.268	0.473	0.518
More than Highschool	0.662	0.366	0.282
Firm Size			
Establishment size: 1 to 5	0.132	0.132	0.124
Establishment size: 6 to 10	0.0883	0.116	0.128
Establishment size: 11 to 50	0.218	0.222	0.207
Establishment size: more than 50	0.561	0.530	0.540
Total Wages			
Income: less than 3000	0.593	0.759	0.788
Income: between 3000 and 6000	0.250	0.170	0.150
Income: more than 6000	0.158	0.0707	0.0622
Observations	7297	7292	57903

Notes: This table compares different summary statistics for our survey (column 1), our survey reweighted (column 2) and the government household survey (column 3). In all cases, the sample is restricted to full-time formal employees older than 18 years old in the private sector.

Table A4: Employer-Employee Relationship

	= 1 if PUT receiver			% of wage as PUT		
	(1)	(2)	(3)	(4)	(5)	(6)
Managerial Position	.225***	.229***	.231***	4.22***	2.71***	1.19
	(0.011)	(0.011)	(0.012)	(0.779)	(0.796)	(0.815)
Family Business	.0628***	.0613***	.0591***	-.38	.299	.933
	(0.010)	(0.010)	(0.010)	(0.754)	(0.755)	(0.754)
Contact with Owners: Always	.122***	.13***	.114***	4.04***	3.92***	3.97***
	(0.015)	(0.015)	(0.016)	(1.404)	(1.401)	(1.434)
Contact with Owners: Usually	.101***	.108***	.097***	3.53**	3.12**	2.89**
	(0.015)	(0.015)	(0.016)	(1.434)	(1.440)	(1.458)
Contact with Owners: Sometimes	.0565***	.0598***	.0519***	.407	.683	.367
	(0.014)	(0.014)	(0.014)	(1.442)	(1.440)	(1.446)
Female		-.0359***	-.0382***		-1.54**	-.824
		(0.010)	(0.010)		(0.778)	(0.775)
Some College or More		-.0391***	-.0272**		4.94***	1.54*
		(0.011)	(0.012)		(0.829)	(0.929)
Dep. Var Mean	.24	.24	.24	22.84	22.84	22.84
Age FE	No	Yes	Yes	No	Yes	Yes
Firm Size x Income Group FE	No	No	Yes	No	No	Yes
Observations	7292	7279	7279	1945	1940	1940

Notes: This table explores how different variables related to employer-employee proximity predict the engagement in PUTs (columns 1-3) and how much is it paid under the table (columns 4-6). Our preferred specifications are columns 3 and 6, which control for firm size and income group, key determinants of PUTs. *Managerial Positions* are typically associated with closer ties to the owner of the firm. *Family Business* also involve some higher level of connection between the employees in the firm. Finally, we asked how often the have *contact with the owners*. We leave in the base those who answer never. We also add some demographics (gender and education) to benchmark the results.

Table A5: Conflict at the Workplace

	Probability of Suing			
	(1)	(2)	(3)	(4)
Fired with cause	0.045***	0.044***	0.044***	0.044***
	(0.001)	(0.001)	(0.001)	(0.001)
Quit with cause	0.058***	0.053***	0.048***	0.048***
	(0.002)	(0.002)	(0.002)	(0.004)
Fired without cause	0.029***	0.029***	0.027***	0.028***
	(0.000)	(0.000)	(0.000)	(0.000)
Quit without cause	0.012***	0.012***	0.010***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)
End of labor contract	0.002***	0.003***	0.004***	0.005***
	(0.000)	(0.000)	(0.000)	(0.000)
Female		-0.002***	-0.003***	-0.003***
		(0.000)	(0.000)	(0.000)
Nonwhite		-0.006***	-0.001***	-0.001***
		(0.000)	(0.000)	(0.000)
Less than High School		-0.002***	0.001***	0.000***
		(0.000)	(0.000)	(0.000)
High School		0.002***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)
Dep. Var Mean - Incumbents	0.003	0.003	0.003	0.003
Controls	No	Yes	Yes	Yes
Ind+Occ+Year+Size FE	No	No	Yes	No
Occ+ YearxFirm FE	No	No	No	Yes
Observations	10.9M	10.9M	10.9M	10.8M

*Notes:*This table shows the effect of different variables on the probability of suing. The outcome variable is a dummy for whether the employee sues the employer. The sample contains all individuals who ended up suing their firm when they were employees in such firms. It also contains all the coworkers they had in at the time. The first five coefficients split for different reasons for separations. Appendix C explains when a firing or quitting has a fair cause. The baseline group contains employees who did not separate. All regressions have year-fixed effects, and standard errors are clusterized at the individual level. Column (4) has firm-fixed effects interacted with year-fixed effects, and standard errors are clusterized at the level as well.

Table A6: Effect of Lawsuit on Incumbent Workers

	Log Wages				Δ Occup	Hours Worked
	(1)	(2)	(3)	(4)	(5)	(6)
Treated x Post Lawsuit	0.0108***	0.0180***	0.0103***	0.0182***	-0.00235	-0.0603
	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)	(0.038)
Sample	All	Small	Large	Manager	All	All
Obs (ind x time)	6937602	487824	6449778	356427	5781335	6864310

Notes: This table shows the coefficient β for the regression $\ln w_{i_{(j)}t} = \gamma_i + \delta_t + \beta \mathbf{1}(t > 0)\mathbf{1}(j \in \text{treated}) + \varepsilon_{i_{(j)}t}$. Columns (1) to (4) explore the heterogeneities shown in Figure 8b and 8c. Columns (5) and (6) use as outcome variable changes in occupation and hours worked, respectively. As the methodology explains, these regressions have saturated fixed effects at the unit x time.

Table A7: Matching characteristics and bunching prediction

	Probability of Being a Buncher	
	True	Placebo
Match Race	0.0280***	-0.000206
	(0.004)	(0.003)
Match Gender	0.00824**	-0.00311
	(0.003)	(0.002)
Nonwhite Owner	0.0110**	0.00261
	(0.004)	(0.003)
Female Owner	0.0281***	-0.00313
	(0.003)	(0.002)
Nonwhite Worker	0.000121***	1.83e-08
	(0.000)	(0.000)
Female Worker	0.0229***	-0.00198
	(0.003)	(0.003)
Dep. Var Mean	.1035343	.0658614
N	57963	51932
Size + Year + Industry FE	Yes	Yes

Notes: This table shows that matching characteristics with the employer is a relevant predictor of bunching. To construct this table, we followed the strategy explained in Figure A15. Both columns show results of regressing a dummy variable indicating whether the employee bunches on several characteristics. Column (1) presents the results for the true sample of buncher and non-bunchers, meaning that the bunchers earn the ceiling to the social security system. Column (2) presents the placebo results, where we run the same regression but create a fake group of bunchers and non-bunchers who do not have differences in incentives. We add several controls, including firm size, year, and industry fixed effects.

C Context

Reason for separation with cause

1. Separation initiated by the <u>employee</u>

    - Culpable failure to make timely payment of compensation
    - Offenses against the worker's physical integrity, freedom, honor, or dignity, punishable by law, including acts of harassment, committed by the employer or their representatives
    - Culpable failure to provide hygienic and safe working conditions
    - Application of abusive sanctions
    - Culpable violation of the worker's guarantees (established by law, the contract, or collective bargaining agreements)
    - Culpable harm to the worker's serious financial interests

2. Separation initiated by the <u>employer</u>

    - Abandonment of employment
    - Physical offenses
    - Act of dishonesty
    - Improper conduct and bad behavior
    - Violation of company secrets
    - Negligence
    - Act of indiscipline or insubordination
    - Others

D Data

D.1 Employees Survey Data

D.1.1 Reweighing

We use the Brazilian household survey to reweight respondents in our survey (see 3.2 for details on the data). First, we restrict the sample to match the sample construction of our own survey. This means that we restrict to full-time formal employees in the Brazilian private sector who are older than 18 years old. PNAD-C already contains a variable indicating frequency weights of each observation. We create cells based on the combination of the following variables:

- Gender

- Education: Less than high school, high school, more than high school

- Age: 18-30; 31-45; 46-55; >55

- Income: Less than 3,000; 3,000-6,000; > 6,000

- Establishment size: 1-5; 6-10; 11-50; > 50

This allows us to sum the frequency weights (coming from PNAD-C) for all the observations in each cell. That gives us the true number of employees in each cell. Then, for each observation in our survey that corresponds to a given cell, we create a new weight equal to the ratio of the true amount of individuals in that cell and the amount that our survey captured in that cell.

D.1.2 List Experiment

Treatment

Next, we present four (4) statements about possible work experiences. You must indicate how many of these statements correspond to your experience. In this way, if you indicate that two cases correspond to your experience, we are not going to identify which are these cases.

For example, if three (3) of the statements presented are true regarding your current work experience, answer as the number "3".

- In the last 12 months, you thought about changing jobs because you are frustrated with your relationship with your boss and/or with your co-workers.

- Although you are offered a 10% higher salary, in a position with similar obligations and the same location, you would prefer to continue your current job.

- Your current salary is made up of two parts: One part that is declared in the payment sheet and in the labor card (on which you pay taxes and contributions) and another part that is not declared on the payment sheet (on which you do not pay taxes or contributions).

- Since you have started you current job, you have witnessed at least one situation of discrimination based on gender, race, religion or physical handicap.

Control

Next, we present three (3) statements about possible work experiences. You must indicate how many of these statements correspond to your experience. In this way, if you indicate that two cases correspond to your experience, we are not going to identify which are these cases. For example, if within the two (2) statements presented are true regarding your current work experience, answer as the number "2".

- In the last 12 months, you thought about changing jobs because you are frustrated with your relationship with your boss and/or with your co-workers.

- Although you are offered a 10% higher salary, in a position with similar obligations and the same location, you would prefer to continue your current job.

- Since you have started you current job, you have witnessed at least one situation of discrimination based on gender, race, religion or physical handicap.

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At the beginning of the questionnaire[53], we randomly split our main sample in treatment and control group. The treatment group is presented with four sentences, while the control group is presented with three. The differential sentence refers to PUTs, as it is highlighted in red. Respondents are asked about how many of these sentences are true for their personal case. We emphasize that, by answering the total number of sentences, we are not able to know which one in particular is true.[54]

We can recover the fraction of respondents who find true the PUTs sentence by comparing the average response of the treatment and the control group. The result is presented in Figure A1a.

D.2   Ownership Data

1) Ownership Information for Brazilian Firms

Cadastro Nacional de Pessoa Jurídica (CNPJ): consists of a registry of all formal establishments in the country. This includes for-profit businesses, public sector establishments, and non-profit organizations [55]. For every firm in the CNPJ, we have their unique firm identifier, name, legal form, date of entry, date of closure (if closed), industry defined at the 7-digit CNAE level, initial capital, and address. Ownership information in the publicly available CNPJ dataset is only recorded for firms with more than one legal owner. Additionally, when owners are identified, it only releases 6 out of 11 digits from the owners' CPF[56], full name, and date of entry into the partnership.

Cadastro Nacional de Empresas (CNE): it used to be organized by the Ministry of Industry and Commerce (MDIC) to create state-level business registers. It was collected until 2017, and its access is restricted and was obtained through direct contact with MDIC. Every business establishment in Brazil must register in federal and state business entities. These state-level entities are called *Juntas Comerciais* and collect information similar to that reported to the Federal Tax Authority. The CNE complements the CNPJ data set by providing us with the name and full CPF of firms with one single owner.

Firm Records from Junta Comercial do Estado de Sao Paulo (JUCESP): is an autarchy of the state government that is responsible for organizing and keeping firm records. According to the Brazilian constitution, every formal business must register in its state's *Junta Comercial*[57]. In Brazil, firm ownership information is, in theory, public. All states' Trade Boards are obliged to make all in-

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[53]The only questions before the List Experiment are the filters to define our relevant sample.

[54]This is only possible if the response is none or all. That is why sentence one and two are designed to correlate negatively.

[55]In Brazil, these organizations are legally considered public entities that should disclose ownership, address, and information on the activity. Nevertheless, this was not easily tracked by researchers. Before 2018, one would have to ask for individual information of each organization to the *Receita Federal* (Brazilian Tax Authority), making it virtually impossible to obtain information on the universe of firms. After a long judiciary process, in 2018, the *Receita Federal* started to release files containing the information of all formal firms. Those files are publicly available at the tax authority website and used in our analysis.

[56]They are always the six digits in the middle, as the data comes in a format *.XXX.XXX-** where we observe the Xs but not the asterisks.

[57]We translate *Junta Comercial* to Trade Board. Still, it can be translated to the commercial registry or business board.

formation they collect public but can charge for it[58]. JUCESP is the only Trade Board that allows Brazilian Citizens to access information for free. However, they do not make it easy. To recover firm records, it is necessary to have a Brazilian Social Security Number (CPF) and registration on JUCESP's website. Each citizen has access to 799 firm records per day. We have collected over 3 million identified firm records for the last four years, covering all formal firms created in Sao Paulo between 2003 and 2023. These records contain full ownership information. Notably, they include the name and total social security number of all founders[59]. See Appendix B for an example of this data. In addition to extending the CNE data for Sao Paulo after 2017, these PDFs track the full history of the firm from creation to closure (if closed). CNE, on the other hand, is a snapshot of ownership in 2017. We developed a text analysis code that reads these standardized PDFs and systematizes the information.

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[58]Almost all states in the country charge exorbitant price rates for firm records stating who are the owners or who created each firm.

[59]If another firm founded the firm, the records contain the firm identifier of the founding firm.

From input data sets to master ownership data set

Figure A20: Building blocks of ownership master data
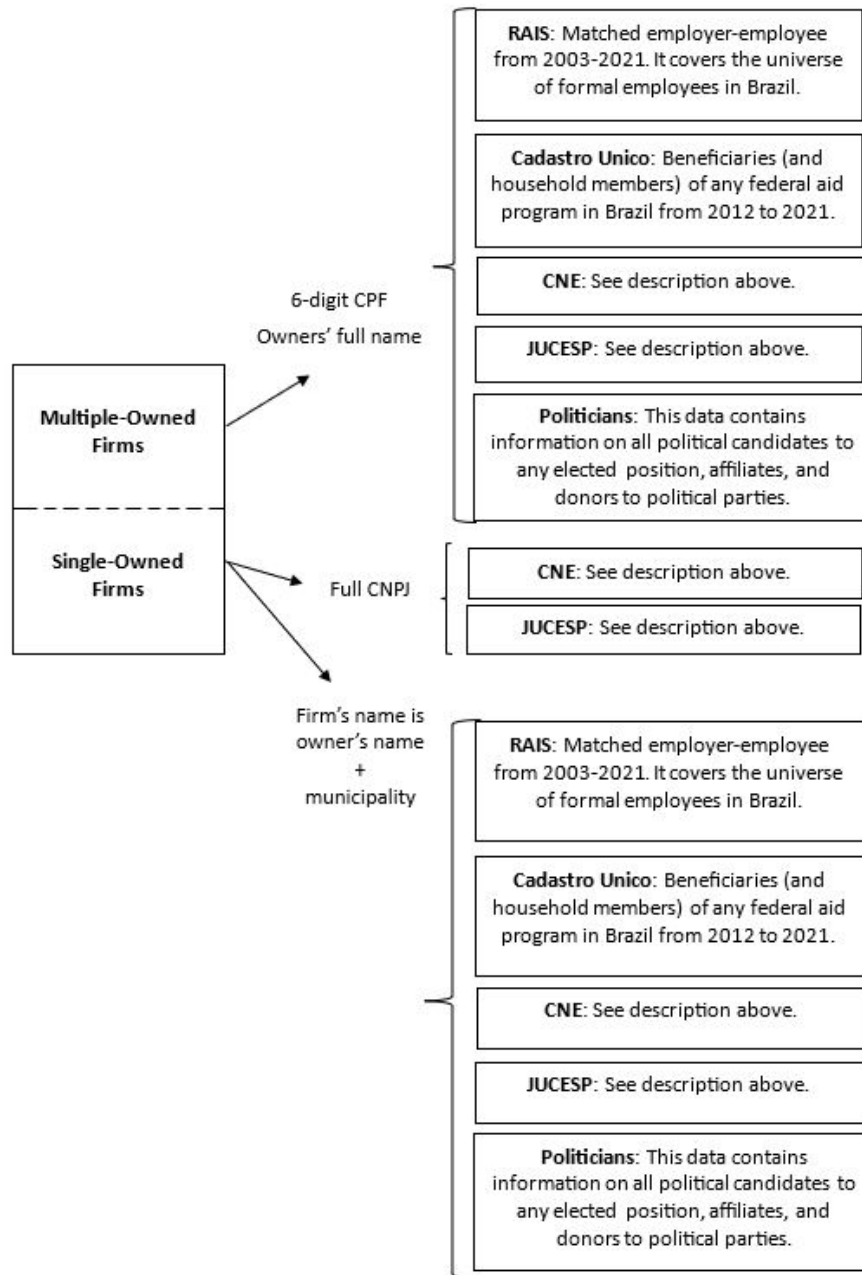
Note: This diagram illustrates how we go from the full list of firms in Brazil (CNPJ data) to the identifiers of their owners. As illustrated, the correct way to do it depends on whether the firm is multiple or single-owned.

Figure (A20) displays how we use our data sets as building blocks of a master ownership data set. We can divide the universe of firms (CNPJ data) into single and multiple-owned firms. These two groups of firms have different rules for ownership reporting. For multiple-owned firms, the data contains one row for each owner, perfectly identified by identification number plus full name. When the owner is a person, the identification number is the CPF. Instead, the identification number corresponds to the CNPJ when the owner is another firm. The caveat is that we never observe the full CPF or CNPJ, just six digits.[60] To merge firms' owner information to other data sets identified at the CPF level (as the education data), we need to recover the full CPF of the owners. Therefore, we sharply merge those six digits and the full names of the owners with our additional data sources listed in the diagram. This allows us to recover the full CPF of *90%* of all owners. This translates into finding that for 95% of all firms with multiple owners, we can recover at least one of their owners. Note that although for some firms, we cannot find the full CPF of all its owners, we can still know how many owners that firm has. This will become very important when classifying the type of entrepreneurial activity that we use as the outcome variables in our regression because the number of owners is a good proxy of the complexity of the firm and the actual economic activity.

The second group of firms is those owned by a single individual. In this case, the CNPJ data does not report ownership information. Fortunately, CNE does. While CNE does not cover the population of single-owned firms in Brazil (especially after 2017), it allows us to recover *67%* of them. Additionally, several single-owned firms register the owner's name as the firm's name. Given that we also know from CNPJ data which municipality each firm is located in, we conduct a sharp merge using complete owners'/firms' names plus municipality with all our extra data sources. This increases the finding rate by *10pp* more. The following Table illustrates the coverage and representative of our final ownership data.

D.3 Federal Aid Program (Cadastro Unico)

The *Cadastro Único* is a comprehensive administrative registry maintained and continuously updated by Brazil's Ministry of Social Development. It is designed to track the socioeconomic conditions of families with a per capita income below half the minimum wage or a total household income below three times the minimum wage. The registry also includes all individuals from families who have ever been beneficiaries of federal social welfare programs. The registry covers around two-thirds of the Brazilian population. Since it provides the informative basis for administering social programs, the registry mainly covers the low and middle parts of the income distribution. It contains individuals' social security numbers (CPF), which can be merged into other datasets. On top of several demographics, such as race, gender, education, etc., it contains household identifiers, allowing us to recover marriages and family structures.

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[60]Full CPF has 11 digits and CNPJ 14 digits.
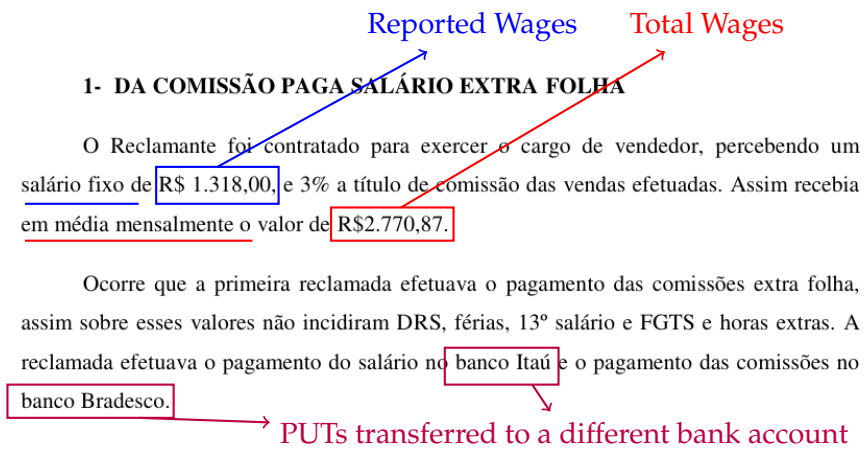
D.4 Ownership Data

In addition to the employer-employee data, we observe who owns the firms. Although RAIS does not record who are firm owners, we built the universe of ownership records from both restricted and publicly available data sources. We cover 95% of all owners. The construction of this data set is detailed in Appendix D.2.

This data contributes to the project in several ways. First, it allows us to study how employer-employee matching characteristics are good predictors of engagement in PUTs in the evidence coming from administrative data. Second, it allows us to clean our sample to rule out employees who also own the firm. Several papers have documented that firm owners may enroll as employees to take advantage of the difference between dividend taxes and top marginal income tax rates (Alstadsæter and Jacob 2016, Harju and Matikka 2016). Because our paper focuses on employer-employee collusive tax evasion, it becomes important to rule out owner-managers setting their wages to take advantage of the tax system. Finally, in Appendix J we present a robustness exercise where we study the effect of a PUT-related lawsuit on connected firms rather than the directly affected ones.

E   ChatGPT 4-o and PUT-related Lawsuit PDFs

In addition to the administrative records on PUT-related labor lawsuits, we purchased a random subsample of X PDFs of the lawsuits. These PDFs are the initial claim made by the employee's lawyer to the judge, where they describe all labor law violations that took place, and the claimed compensation. However, these PDFs are not structured in a standard format, and each lawyer writes the information in their own way. The following examples illustrate the information contained in two different PDFs.

Example 1 - Lawsuit PDF

Reported Wages   Total Wages

1- DA COMISSÃO PAGA SALÁRIO EXTRA FOLHA

O Reclamante foi contratado para exercer o cargo de vendedor, percebendo um salário fixo de R$ 1.318,00, e 3% a título de comissão das vendas efetuadas. Assim recebia em média mensalmente o valor de R$2.770,87.

Ocorre que a primeira reclamada efetuava o pagamento das comissões extra folha, assim sobre esses valores não incidiram DRS, férias, 13º salário e FGTS e horas extras. A reclamada efetuava o pagamento do salário no banco Itaú e o pagamento das comissões no banco Bradesco.

PUTs transferred to a different bank account

Example 2 - Lawsuit PDF

PUTs   Reported Wages

DO CONTRATO DE TRABALHO

O Reclamante foi admitido pela 1ª reclamada em **02.09.2010**, sendo contratado para exercer a função de **técnico instalador Trainee**, sendo promovido ao cargo de Supervisor de Campo em **01.02.2015**, com jornada contratual de 44 (quarenta e quatro) horas semanais, recebendo último salário contratual no valor fixo de **R$ 2.108.78**, além dos salários "por fora", no valor de **R$ 1.831,00**, até fevereiro/2015, não realizou o pagamento de março/15, reduziu o valor pago para R$ 1.000,00 a partir de abril/15, que sempre foram pagos clandestinamente, sem a integração nos demais direitos do reclamante. O reclamante foi demitido sem justa causa em **25.09.2019**, recebendo parcialmente pelas verbas rescisórias devidas TRCT anexo.

While the lawyer in Example 1 writes the reported and total wages, the lawyer in Example 2 mentions the reported wages and the amount paid under the table. Moreover, in Example 1, we can explicitly find how the payments were made. The degree of discretion that lawyers have in writing their claims makes conventional text analysis methods impossible. Therefore, we need to use Artificial Intelligence (AI) in order to recover reliable information. We used the most updated version of ChatGPT available when we were writing this paper (4-o). We rely on the API version of the model due to the large amount of information to process. In the next part, we discuss the specific instructions and the output. Then, we explain the additional decisions we have to make based on the output provided by ChatGPT. Finally, we discuss issues of reproducibility, and how we address them given the existing options.

Instructions and Output

We provided the following *query* to ChatGPT:

"You are an extra careful brazilian lawyer looking for data inside pdf related to employment lawsuits. The following is a pdf/html document of an employment trial where the plaintiff is suing their employer over undeclared payments. Extract specific information that is contained in the PDFs and format the response as a JSON with the following fields:

- **under**: the undeclared amount paid (it may say "pago por fora" / "extra folha" or similar)
- **underTitle**: The document section title where the under value was located.
- **over**: The declared amount paid to the employee (it may say "salario").
- **overTitle**: The section title where the over value was found.
- **total**: The total amount the employee perceived, it is the over plus under, but sometimes it doesn't match.
- **totalTitle**: The section title where the total value was located.
- **yearOfPayment**: The year the payment was made.
- **firstYear**: The year the employee started at the firm.
- **paymentMethod**: One of 'cash', 'check', 'PIX or virtual wallet', 'goods and services', 'corporate credit card', 'transfer to the same account as the declared payments', 'bank transfer to another employee's account', 'bank transfer to a friend or family'. If it is different from any of the categories provided input 'other'. Input 'missing' if there's no reference to the payment method.
- **totalMoneyClaimed**: Total monetary claim from the lawsuit.
- **employeeCPF**: CPF number of the employee.

- **employerCNPJ**: CNPJ number of the employer.

Use null for any unavailable data.

If there are variations over time or if there's a range because the amounts weren't fixed for a field, make an array for that field. Avoid adding extra information to the fields "under", "over", "total" that is not the numeric monetary value. Usually, the information is inside sections whose titles look like "Do Salario.", "Pago por fora", "Extra folha". The response is going to be parsed automatically as a JSON, don't add any other comments, just return a JSON.

When adding the identifier of the lawsuit case and the "status" (an indicator for whether the PDF was processed successfully), the output file contains 14 variables. Some of these variables, such as *under*, *total*, *paymentMethod*, *yearOfPayment firstYear* are of main interest. The others are helpful to validate the data and make decisions when multiple values are provided. In our administrative records of the lawsuits, we have information on employees' CPF, employers' CNPJ, and the total amount claimed in the case. We use this information to validate the job performed by ChatGPT.

add plot

Additional Cleaning and Final Sample

It is not uncommon for ChatGPT to return a *missing* in one (or more) of the variables *under*, *over*, and *total*. When only one of the three variables contains a *missing*, we can back up the value using the other two. However, when two or more have *missing* we flag them as *failed* and drop them from the analysis. They represent about 9% of the PDFs. In the vast majority of the PDFs that we checked manually, the information is actually missing.

Another feature of the data is that ChatGPT may recover more than one value for any of the variables *under*, *over*, and *total*. This case is more problematic because it can happen for two very different reasons. First, ChatGPT can get confused when several numbers are provided in different parts of the PDFs. For example, the lawsuit of a worker who receives PUTs for half of his wage *and* extra-hours, may report different amounts of payments under the table both in the "Contract" and in the "Extra Hours" sections of the PDF. Second, a worker who has received PUTs for the last five years is very likely to report different amounts for each year of reference.

In order to deal with the first problem, we will use the variables *underTitle*, *overTitle*, and *totalTitle*. It came to our attention that most of the time the "average" PUTs are reported in the same section than the other two. The reason is that there is a section in which the lawyer describes the labor contract, providing the general facts, which include the PUTs. This type of section typically receives the names of *On the Labor Contract*, *On the Facts*, *On the Payments Under the Table*, etc. Therefore, we decided to prioritize the observations in which *under*, *over*, and *total* we found in the

same section.

When lawyers list multiple values of PUTs that happen in different moments (or they mention a range of values), we take a conservative approach and choose the minimum among all. We do not do the same for *over* and *total*, given that our main variable of interest is the fraction of the total income paid under the table.

Our final sample contains information of X PDFs which were randomly chosen from the population of PUT-related lawsuits and passed the cleaning procedure explained above.

Reproducibility

As any advanced AI language model, when given an input, ChatGPT processes it by predicting the next word in a sequence, leveraging its vast training data to provide relevant and contextually appropriate replies. This means that, when predicting the next word, ChatGPT draws it from a distribution of possible words. The way the next word is picked from its possible values can vary.

1. Greedy Approach: Select the word with the highest probability. This often leads to more deterministic and sometimes repetitive responses.

2. Sampling: Randomly sample a word based on the probability distribution, which can introduce more variability and creativity in the responses. Techniques like temperature and top-k sampling can be applied here:

   - Temperature: Controls the randomness of predictions by scaling the logits before applying softmax. A higher temperature results in more random choices, while a lower temperature makes the model more deterministic.

   - Top-k Sampling: Limits the sampling pool to the top k most probable words, ensuring that only the most likely options are considered.

Setting the *temperature* in zero implies the model effectively behaves like the Greedy Approach. We follow this approach that ensures consistency buy may sacrifice creativity and variety in responses, which is exactly what we do not want. Additional, for a subset of the sample we set the seed, so the model generate the same sequence of tokens for identical prompts and parameters. *Disclaimer: We realized about the possibility of setting the seed once a large part of the processing had already taken place. Given the monetary costs, we were not able to carry out the whole process again*. Even when setting seed and temperature to 0, it is possible to have slight variations in responses due to *backend changes*, *non-deterministic components*, and *tokenization variations*.

F   Back of the Envelope Calculations

The goal of this exercise is to recover an order of magnitude for the government's revenue losses due to PUTs and classic informality. Therefore, the exercise consists in calculation how much revenues the government would collect if we formalize all informal employees and if all PUTs are reported in the payroll. This implies making several decisions that affect the final calculation. This appendix makes these decisions explicit, mentioning how we expect the results to change because of each. As a general rule, we try to keep the estimates as a lower bound, implying that (as long as they are sensible) we prefer conservative assumptions.

We call this exercise *back of the envelope calculation* because it assumes no behavioral responses. This is the first assumption, and it is an important one. Relaxing this assumption is virtually impossible in this setting, given that it would require information on the elasticities of employment and total wages to be forced to move one dollar paid under the table to the books.

The *back of the envelope calculation* requires the following inputs:

1. Total number of workers in each income group

2. Fraction of informal employees, PUTs receivers, and the fraction of the wage under-reported

3. Wage-related tax rates and corporate tax rates (deductions)

We use the Brazilian matched employer-employee (see Appendix 3 for details on *RAIS*) to recover to total number of formal employees in the Brazilian private sector with an active contract in December of 2021 (last year of the data we have access to). This accounts for about 37.4M employees. Using the Brazilian household survey in the first semester of 2022 (see Appendix 3 for details on *PNAD*), we recover the fraction of total employment in the Brazilian private sector that is formal, allowing us to recover the number of 10.5M informal employees (see Appendix 2 for details on the informality definition). In the same way, we can assign these totals to wage bins because the household survey informs us about the proportion in each wage bin. We use the same wage bins we provided in the survey such that we can assign to those bins the percentage that receives PUTs and the fraction paid in that way.

We use the results of our survey to compute the fraction of formal employees who receive PUTs in each wage bin. Table A8 summarizes these results.

Table A8: Number of Employees by Wage Group and Formality Status

Wage Group	Informal	Formal	PUTs
< 1,000	3,232,489	349,880	87,470
(1000, 1500)	4,307,572	1,260,000	2,899,651
(1500, 2000)	1,376,553	8,533,085	1,706,617
(2000, 2500)	849,612	5,256,064	1,208,895
(2500, 3000)	343,243	2,812,451	787,486
(3000, 4000)	462,303	3,475,430	799,349
(4000, 5000)	187,497	1,395,350	390,698
(5000, 6000)	177,105	890,345	302,717
> 6,000	373,129	2,182,611	763,914
Total	10,550,000	37,400,000	

The next step is to compute the average PUTs that individuals in each wage bin receive. For classic informality, this average equals one, given that their whole wages are not reported. For the PUT receivers, we use the average fraction paid under the table that PUT receivers responded to. Given that we gave them intervals, we take the mid-point to calculate the averages. This gives us the average amount evaded by each wage group for both formal and informal employees. Finally, we calculate the taxes and contributions that would be paid if reporting these amounts.

Taxes on Employees

We will consider only two wage-related taxes to employees: social security contributions (only INSS), SSC for short, and income tax (IRRF). The tax base for the second is calculated after deducting SSC. Therefore, we start calculating the revenue losses for employees' SSC, then we deduct them, and we finally calculate the revenue losses for the income tax.

Table A9: Employee's wage-related tax rates in 2022

Contribution Base (R$)	MTR
< R$ 1,212	0.075
1,212 - 2,427	0.09
2,427 - 3,641	0.12
3,641 - 7,087	0.14
> R$ 7,087	0.00

(a) Contributions to the INSS

Tax Base (R$)	MTR
< R$ 1,903.98	0
1,903.98 - 2,826.65	0.075
2,826.65 - 3,751.05	0.15
3,751.05 - 4,664.68	0.225
> R$ 4,664.68	0.275

(b) Income Tax Rate (IRRF)

Taxes on Employers

The employer's side is more complicated because their contributions depend on the tax regime. Moreover, the tax regime also determines whether firms pay taxes on profit or revenues. This is a crucial aspect because, for firms paying profit taxes, increases in reported wages can be deducted

from the profit tax base, reducing the total tax payments. Finally, the profit tax rate varies with profit level and industry.

There are three main tax regimes relevant to employer-employee relationships:

1. SIMPLES (57% firms - 33% employees)

    - Revenue taxes
    - FGTS: ∼ 12% of gross wages
    - INSS: filled in *Documentaco de Arrendacao do Simples Nacional* (DAS)
    - INSS: Firms in Anexo IV subject to normal INSS (20% of gross wages)

2. Lucro Presumido (35% firms - 18% employees)

    - Presumptive profits (effectively revenue taxes)
    - FGTS: ∼ 12% of gross wages
    - INSS: ∼ 20% of gross wages

3. Lucro Real (8% firms - 49% employees)

    - Profit taxes: ∼ 20% if profits >0 (varies by industry and profit level)
    - FGTS: ∼ 12% of gross wages
    - INSS: ∼ 20% of gross wages

These contributions are applied monthly. Moreover, they must be paid for 2.5 additional months. This is because Brazil has a *13th salary* and vacations. Finally, firms in Lucro Real and Presumido (67% of employees) have an additional 10% cost on gross wages for *Sistema S*, *SAT* (work accident insurance), and *salario educacao*. Table A10 shows the details of revenue collection for social security contributions. In the previous description, we have ignored state and municipal contributions, CPSS, PIS, Pasep, and others for the employer. **To keep calculations simple and conservative, we assume a flat employer's contribution rate of 20%, including the deductions in profits**.

Table A10: Contributions on the gross wage by category in 2022 (25.5% total revenues)

Previdência Social	**73.11%**
Empregador	
Contrib. para o INSS - Patronal	41.72%
CPSS - Parcela Governo	2.82%
Previd. dos Estados - Governo	3.97%
Previd. dos Municípios - Governo	1.64%
Empregado	
Contrib. para o INSS - Empregado	16.84%
CPSS - Parcela Servidor	2.07%
Previd. dos Estados - Servidor	1.97%
Previd. dos Municípios - Servidor	0.82%
Contrib. p/ Custeio das Pensões Militares	1.26%
Contribuição Voluntária Montepio Civil	0.00%
Seguro Desemprego	**18.17%**
FGTS	18.17%
Outros	**9.01%**
Salário Educação	3.14%
Sistema ″S″	3.17%
PIS - Folha de pagamento	0.10%
Pasep	2.28%
Cota-Parte Contrib. Sindical	0.00%
Contrib. p/ Ensino Aeroviario	0.03%
Contrib. p/ Ensino Profiss. Maritimo	0.02%
Contrib. Rurais	0.26%
Contribuição para o Fundo de Saúde - PMDF/BMDF	0.00%

Source: *Receita Federal do Brazil*

Table A11: Income Taxes by Category in 2022 (27.43% total revenues)

Pessoa Física	**33.72%**
IRPF	6.03%
IRRF - Trabalho União	27.26%
IRRF - Estados	0.00%
IRRF - Municípios	0.00%
Contrib. s/ Concursos e Prognósticos	0.42%
Pessoa Jurídica	**47.91%**
IRPJ	30.81%
CSLL	17.10%
Retenções não Alocáveis	**18.37%**
IRRF - Não Residentes	6.08%
IRRF - Capital	10.63%
IRRF - Outros	1.66%

Source: *Receita Federal do Brazil*

G   Questionnaires

G.1   Survey to Employees (online survey)

Hello!

We are a group of economics students, and we are studying the experience of workers in Brazil. We invite you to answer some questions about your own experiences as a worker, which will help us better understand the reality of the Brazilian labor market.

This survey lasts approximately 15 minutes, and your responses will be of great help to our project.

Confidentiality: This survey contains some sensitive questions. Individual responses will be combined with those of other respondents and will never be submitted individually. Also, your responses will never be revealed outside this research group and will only be used for this project.

We really appreciate your honesty in your answers.

Thank you for your participation!

Do you currently work?

- Yes

- No

In your main job, does your employer deduct your social security contributions from your paycheck?[61]

- Yes

- No

Is which sector is your main job?

- Private establishments

- Public sector

- Mixed company

- Self-employed (including both MEI and CNPJ)

- Other

Change of Section

(List Experiment)
We present four (three) statements about possible work experiences. You must indicate how many of these statements correspond to your experience. In this way, if you indicate, for example, that two cases correspond to your experience, we are not going to identify which of these cases in particular are.

- In the last 12 months, you thought about changing jobs because you are frustrated with the relationship with your chief and/or coworkers.

- Although you are offered a 10% higher salary in a position with similar obligations and the same location, you would prefer to continue in your current job.

- Your current salary is made up of two parts: one part that is declared in the payment sheet and the labor card (on which you pay taxes and contributions) and another part that is not declared on the payment sheet (on which you do not pay taxes or contributions)

- Since you started your current job, you have witnessed at least one situation of discrimination based on gender, race, religion or physical handicap.

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[61]The version in Portuguese ask for whether the respondent holds a *carteira de trabalho assinada*, which is a card that allows you to access social security benefits.

Change of Section

How old are you?

What is your gender?

What is your education level?

- Incomplete primary school

- Complete primary school

- Incomplete high school

- Complete high school

- Incomplete college

- Complete college

- Post-graduate degree

What was your total labor earnings last month? *Bins of $R 500 from $R 1,000 to $R 10,000*

Change of Section

In addition to you, how many people work at the establishment where you have your main occupation?

- 0

- 1-4

- 5-9

- 10-19

- 20-49

- 50-99

- 100-499

- 500-999

- 1000-5000

- > 5000

Is the establishment where you work at a family business?

- Yes

- No

How long (in years) have you been at this job?

Which of the following sectors best fit the activities carried out in your workplace? *See CNAE 2 digit classification*

Do you perform management or board roles in your workplace?

- Yes

- No

Do you have direct contact with the owners of the establishment where you work at?

- Never

- Very few times

- Very frequently

- Every day

Change of Section

In Brazil, **some formal workers (with a formal contract) receive part of their salary "off-the-books," that is, without it being declared on the company's payroll.**

Thus, the remuneration of these workers has two parts: **A part declared on the payroll** (for which taxes and contributions to the INSS are paid), and **another part outside the payroll** (for which taxes or contributions to the INSS are not paid).

The following questions refer to this informality: *formal employees with a formal contract, but who receive part of their salary outside the payroll.*

It is worth remembering that the answers are 100% anonymous and will only be used for our research project. Under no circumstances will the content of these responses be used in addition to our academic research. We appreciate your collaboration.

What proportion of all total workers do you think are receiving payments under the table?
Slider from 0% to 100%

Do you know **any formal employees** who receive part of their salary outside the payroll declared by the employer?

- Yes

- No

In your current job, do you know any formal employees who receive part of their salary outside the payroll declared by the employer?

- Yes

- No

In your current job, do you receive part of their salary outside the payroll declared by the employer?

- Yes

- No

Change of Section

You replied that you receive a portion of your salary outside the payroll declared by your employer. **Our research is about understanding how common these types of payments are.**

In the following questions, we will ask you how these payments work.

Thank you so much for helping us!

What percentage of your total labor income is paid off the books?

- 0-5%

- 6-10%

- 11-20%

- 21-30%

- 31-40%

- 41-50%

- > 50%

When we started the survey we asked about your total labor earnings last month. What did you think about when answering?

- I answered thinking about total wage (reported and non-reported)

- I answered thinking only about reported wage

- Other

When did the proposal for paying part of the salary under the table come up? Was it your idea or your employer's?

- At the beginning of the employment relationship and suggested by the employer

- At the beginning of the employment relationship and suggested by you

- Sometime after the job started and suggested by the employer

- Sometime after the job started and suggested by you

How are the off-the-books wages paid?

- Cash

- Check

- Virtual Apps

- Good and service (like firm's credit card)

- Through a firm as a contractor

- Other

Since you started the job, what part of the salary has grown the most?

- The reported wages

- The non-reported wages

- Both grew at about the same rate

- I don't know

With regard to the thirteenth salary and paid vacation. Do you receive the equivalent of your total salary or only the part declared on the payroll?

- The equivalent of the total salary

- The equivalent of the salary reported on the payroll

- Other

On many occasions, employees and employers decide the amount non-reported based on laws, taxes, benefits, regulations, etc. In your case, which of the following obligations are relevant in deciding how much is not declared in the payroll?

- Income tax

- Minimum wage

- Employer payroll-taxes

- Social security contributions

- Audits to establishments

- Trash collection tax

- Minimum wage negotiated by unions

- None of the above (other)

G.2   Survey to Firm Owners (phone survey)

Hi, we are a group of researchers from the University of California, Berkeley. We are calling to invite you to participate in a survey about payment practices. Are you the firm's director or owner? If not, may I talk to him/her?

We are interested in understanding how taxes, contributions and regulations may affect how firms pay to employees, and the embedded risks. Would you like to participate?

Do you have knowledge on how wages are paid in the firm?

- Yes

- No

How many years have you been in the firm?

How many employees there are in the firm?

What is the firm's industry?

What is the firm's tax regime?

Change of Section

We are interested in understanding the following practice: employees with *carteira assinada*, but who receive part of their wages outside the paycheck. This practices can be carried out in several ways. We highlights that we are not interested in informal employees (without *carteira*

assinada) **or contractors. This survey is 100% anonymous, and we have no connection with any governmental institution.**

Do you think it is common to pay under the table?

- Yes

- No

What is the share of firms that you think pay under the table?

- 0%

- 1% - 10%

- 11% - 25%

- 26% - 50%

- 50% - 75%

- More than 75%

- I don't know/ I prefer not to say

Among the firms relevant for your market/industry, what is the share of firms that you think pay under the table?

- 0%

- 1% - 10%

- 11% - 25%

- 26% - 50%

- 50% - 75%

- More than 75%

- I don't know/ I prefer not to say

This question is very important for us. Do payments under the table happen in your firm? (remember: these are formal employees receiving part of their wages outside the paycheck)

- Yes

- No

Change of Section

H Conceptual Framework: details and extensions

We copy here the Equations 9 and 10 that determine the optimal unofficial and official wages (w_u^*; w_o^*) for interior solutions:

$$\tau = \frac{\frac{\partial C_f(w_u^*)}{\partial w_u} + \frac{\partial C_e(w_u^*)}{\partial w_u}}{1 + \frac{\partial C_f(w_u^*)}{\partial w_u}}$$

$$(1-\tau)w_o^* = \phi(1-\tau)[y - w_u^* - C_f(w_u^*)] + (1-\phi)[z + C_e(w_u^*) - w_u^*]$$

Proposition 1: Assuming some degree of strict convexity in the sum of cost functions, $\frac{\partial^2 C_f(w_u^*)}{\partial^2 w_u} + \frac{\partial^2 C_e(w_u^*)}{\partial^2 w_u} > 0$, and the existence of an interior solution, then an increase in $\frac{\partial C_f(w_u^*)}{\partial w_u}$ implies a decrease in w_u^*

Proof. Assume that is not true. Then there are two possibilities:

- No change in w_u^*: if this is true, the right-hand side of the equation never equals the left-hand side. To see this, note that the firm's marginal cost has no direct impact on the marginal cost of the employee, but only through wu. Moreover, the left-hand side is fixed and determined by the institutional setting. Therefore, no change in w_u^* implies no interior solution, which violates the proposition's assumption.

- Increase in w_u^*: for this to be true, it requires that increasing the payments under the table will reduce the total marginal cost of engaging in PUTs, bringing the right-hand side of the equation down, making it equal to the left hand side. Formally, this implies that $\frac{\partial^2 C_f(w_u^*)}{\partial^2 w_u} + \frac{\partial^2 C_e(w_u^*)}{\partial^2 w_u} < 0$, which violates the initial assumption of some degree of convexity.

The effects of changes in $\frac{\partial C_e(w_u^*)}{\partial w_u}$ and τ follow the same logic. ∎

Proposition 2: Let's re-write the costs functions $C_e(w_u) = C_e(w_u, \varepsilon_e)$, and $C_f(w_u) = C_f(w_u, \varepsilon_f)$, where ε_e and ε_f are the parameters that control the marginal cost. Then, under the assumptions in Proposition 1, plus $-\frac{\partial w_u^*}{\partial \varepsilon_f}[1 + \phi\frac{C_f}{w_u} + (1-\phi)\frac{C_e}{w_u}] < \frac{C_f}{\varepsilon_f}$, both the pre-and post-tax official wages must increase.[62]

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[62]This assumption guarantees that firm's cost do not explode as a response to a small increase in the marginal cost. In other words, the additional compensation to the firm cannot outweigh the direct effect on the reduction of w_u^* plus the implied indirect reduction in both cost functions.

Proof.

$$(1-\tau)\frac{\partial w_o^*}{\partial \varepsilon_f} = \phi\left[-\frac{\partial w_u^*}{\partial \varepsilon_f} - \left(\frac{\partial C_f}{\partial \varepsilon_f} + \frac{\partial C_f}{\partial w_u}\frac{\partial w_u^*}{\partial \varepsilon_f}\right)\right] + (1-\phi)\left[\frac{\partial C_e}{\partial w_u}\frac{\partial w_u^*}{\partial \varepsilon_f} - \frac{\partial w_u^*}{\partial \varepsilon_f}\right]$$

$$= \underbrace{-\frac{\partial w_u^*}{\partial \varepsilon_f}}_{>0} - \frac{\partial w_u^*}{\partial \varepsilon_f}\underbrace{\left[\phi\frac{\partial C_f}{\partial w_u} + (1-\phi)\frac{\partial C_e}{\partial w_u}\right]}_{>0} \underbrace{-\phi\frac{\partial C_f}{\partial \varepsilon_f}}_{<0} > 0$$

The first term is the one-to-one substitution between unofficial and official wages. The second term captures that because the unofficial wages went down, that leads to reduced costs that both employer and employee face for engaging in PUTs, allowing an additional increase in the official wage. Finally, the last term is the increase in the costs that the employers face associated with the increase in the marginal cost.

The effects of changes in τ and ε_e follow the same logic. ∎

H.1 Functional Forms

H.2 Incidence and Welfare

With taxes and no evasion

$$U_e = (1-\tau)w_o - z \tag{H.14}$$

$$U_f = y - w_o \tag{H.15}$$

$$S(\cdot) = U_f + U_e \tag{H.16}$$

The optimization problem is:

$$\max_{w_o \geq 0}\left\{((1-\tau)w_o - z)^\phi (y - w_o)^{1-\phi}\right\}$$

Solving with respect to w_o we get:

$$w_o^*(1-\tau) = \phi y(1-\tau) + (1-\phi)z$$
$$U_f^* = (1-\phi)\left[y - \frac{z}{1-\tau}\right]$$
$$U_e^* = \phi\left[y(1-\tau) - z\right]$$
$$\frac{\partial U_e^*}{\partial \tau} = -\phi y$$
$$\frac{\partial U_f^*}{\partial \tau} = -\frac{(1-\phi)z}{(1-\tau)^2}$$

The first thing to note is that the total private surplus gets reduced with taxes. The condition for a solution to exist becomes $y > \frac{z}{1-\tau}$. Therefore, increasing taxes will reduce the number

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of matches that exist. On the other hand, if the previous condition holds, taxes will change the optimal w_o. Both employer and employee are weakly worse off with taxes. Finally, increasing τ reduces the employee's utility, and it does it more the larger the employee's bargaining power. Intuitively, if the employee has all the bargaining power, she keeps all the surplus of the relationship, while the employer gets zero utility. The employer cannot have less than zero utility for the match to survive, meaning the employee absorbs all the tax payments.

The exercise is analogous if we assume payroll taxes rather than income taxes. In that case the problem becomes:

$$\max_{w_o \geq 0} \left\{ (w_o - z)^\phi \left(y - w_o(1 + \tau)\right)^{1-\phi} \right\}$$

Where the analogous conditions hold:

$$w_o^* = \tfrac{1}{1+\tau} \left[\phi y + (1 - \phi)(1 + \tau)z\right]$$
$$U_f^* = (1 - \phi)\left[y - z(1 + \tau)\right]$$
$$U_e^* = \phi \left[\tfrac{y}{1+\tau} - z\right]$$
$$\tfrac{\partial U_e^*}{\partial \tau} = -\tfrac{\phi y}{(1+\tau)^2}$$
$$\tfrac{\partial U_f^*}{\partial \tau} = -(1 - \phi)z$$

With taxes and evasion

In this case, we must make assumptions about the employers' and employees' cost functions. We focus on the case of interior solutions to highlight the gains from the collusive tax evasion. This means we won't have fixed costs (which can induce extensive margin responses in PUTs). For simplicity, we also set employers' evasion cost to zero. Let's the employees' cost to have the following functional form: $C_e(w_u) = \tfrac{\varepsilon_i w_u^\gamma}{\gamma}$, where ε_i controls the level of the cost function for individual i[63], and γ its convexity.

Using Equations 9 and 10 we find:

$$w_u^* = \left(\tfrac{\tau}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}$$
$$w_o^*(1 - \tau) = \phi(1 - \tau) \left[y - \left(\tfrac{\tau}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}\right] + (1 - \phi) \left[z + \left(\tfrac{1}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}} \tau^{\frac{\gamma}{\gamma-1}} \tfrac{1}{\gamma} - \left(\tfrac{\tau}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}\right]$$

Note that we can re-write the optimal reported wage after-tax as:

$$w_o^*(1 - \tau) = \underbrace{\phi(1 - \tau)y + (1 - \phi)z}_{=w_{o,NE}^*(1-\tau)} - \left(\tfrac{\tau}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}} (\phi(1 - \tau) + (1 - \phi)) + (1 - \phi)\left(\tfrac{1}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}} \tau^{\frac{\gamma}{\gamma-1}} \tfrac{1}{\gamma}$$

Where $w_{o,NE}^*$ is the optimal gross reported wages in the case of no evasion. Note that the

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[63]It can be interpreted as how much this individual values the benefits linked to reported

after-tax official wage equals to the after-tax official wage in case of no evasion plus two additional terms. Indeed, we can do some algebra and find out that $w_o^*(1-\tau) < w_{o,NE}^*(1-\tau)$ if the following inequality holds:

$$\underbrace{\gamma}_{>1}(1-\phi\tau) > (\tau - \phi\tau)$$

This is always true under the convexity assumption (note that the parenthesis in the LHS is always larger than in the RHS because $\tau \in (0,1)$).

The second interesting comparison is what happens to employees' total wages when PUTs are possible.

$$w_o^*(1-\tau) + w_u^* = w_{o,NE}^*(1-\tau) + \phi\underbrace{\left[\left(\frac{1}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}\tau^{\frac{\gamma}{\gamma-1}}\right]}_{A} + (1-\phi)\underbrace{\left[\left(\frac{1}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}\tau^{\frac{\gamma}{\gamma-1}}\frac{1}{\gamma}\right]}_{B}$$

The first thing to note is that employees' total wages are higher in the case of collusive tax evasion than non-evasion. The second thing to note is that how much more employees get is a convex combination of terms A and B. Suppose the employee has zero bargaining power; then term A goes to zero. All the additional compensation is explained by the cost of receiving PUTs of the employee, leaving the U_e unchanged with respect to the non-evasion case. Later, we show that this means the employer fully captures the gains from evasion. Now, suppose that the employee has all the bargaining power. The term B goes to zero. Note that A is always larger than B. Therefore, in this case, the employee captures the gains from collusive tax evasion. In the background, the official wages adjust when employees receive some amount of PUTs. If the employee has zero bargaining power, then the official wages will adjust more downwards to the point of the utility in the non-evasion case (break-even). If the employee has some bargaining power, official wages will adjust downwards but at a lower magnitude, retaining some additional utility for the employee.

Then, we can calculate the utility for the employee when collusive tax evasion is possible:

$$U_e^{PUT} = U_e^{NE} + \phi\left(\frac{1}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}\tau^{\frac{\gamma}{\gamma-1}}\frac{(\gamma-1)}{\gamma}$$

We can do a similar derivation for the utility of the employer

$$U_f^{PUT} = y - w_o^* - w_u^*$$

$$U_f^{PUT} = y - w_{o,NE}^* - \frac{1}{1-\tau}\left[(1-\phi)\left(\frac{1}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}\tau^{\frac{\gamma}{\gamma-1}}\frac{1}{\gamma} - \left(\frac{\tau}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}(1-\tau\phi)\right] - \left(\frac{\tau}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}$$

$$U_f^{PUT} = U_f^{NE} + \frac{(1-\phi)}{1-\tau}\left(\frac{1}{\varepsilon_i}\right)^{\frac{1}{\gamma-1}}\tau^{\frac{\gamma}{\gamma-1}}\frac{(\gamma-1)}{\gamma}$$

Where the only difference with the expression for the employee is that the additional utility with collusive tax evasion is divided by $(1 - \tau)$, this reflects that if the official wage can go down to fully compensate the increase in PUTs ($\phi = 0$), then that income is not taxed. However, it is taxed if the employee gets it. In other words, because the surplus of the collusion is distributed through the official wage (and in this model, only the employee pays wage taxes), then $(1 - \tau)$ shows the substitution rate of giving a dollar to the employer relative to the employee.

H.2.1 Employers - Profit Taxes and Labor Costs Deductability

This part provides a simple exercise showing that higher profit taxes may reduce PUT. We abstract from the employer-employee collusion and focus on how different tax rates may interact in employers' incentives to engage in PUT. Firms are typically taxed on profits or revenues. Typically, the share of firms taxed on revenues is larger in developing countries. Best et al. (2015) shows that revenue taxation reduces corporate income evasion by 60-70% in Pakistan, a setting with limited tax capacity. This is a very important result because it shows that even when revenue taxes reduce production efficiency, these effects are more than compensated for large cost elasticities related to evasion. However, looking only at corporate income evasion misses a (potentially large) cross-elasticity related to revenue collection due to the reporting of those costs. In settings where PUTs are prevalent, reporting more labor costs implies more taxes. In fact, most of the accountants we interviewed mentioned that PUTs would be more minor if firms in Brazil would pay profit taxes rather than revenue taxes.

To illustrate how the interaction between profit taxes and other labor costs (for simplicity, we only consider payroll taxes), let us assume that a given firm j maximizes profits based on how much wages to report (we fix firm's hiring decisions).

$$\max_{\alpha} \left[F(L) - (1 - \alpha)wL(1 + \tau_l) \right] (1 - \tau_p) - \alpha wL \tag{H.17}$$

Where α is the share of the wages to pay under the table, τ_l and τ_p are the payroll and profit tax rate, respectively. The first order condition to this problem is

$$\tau_l = \frac{\tau_p}{(1 - \tau_p)} \tag{H.18}$$

This means that if the payroll taxes are higher ($\tau_l > \frac{\tau_p}{(1-\tau_p)}$), then evasion is desirable and vice versa. If we expand the setting to add a quadratic cost of evasion, as is typically done[64], the FOC becomes:

$$\alpha^* = \frac{(1 + \tau_l)(1 - \tau_p)}{\kappa_j(wL)} \tag{H.19}$$

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[64] We add $-\frac{k_j}{2}(\alpha wL)^2$ at the end of Equation (H.17)

This expression makes explicit that the relevant tax rate in an employer's decision to evade depends on the *effective* tax rate paid for an extra dollar reported, which depends both on the labor costs and the possibility of deducting it from profit taxes.

# I   Matching staggered difference in difference: details

J   Robustness Checks for the Lawsuits' Effects

Figure A21: PUT-related lawsuit effects on hours worked and tasks performed

| (a) Hours Worked | (b) Tasks Performed |
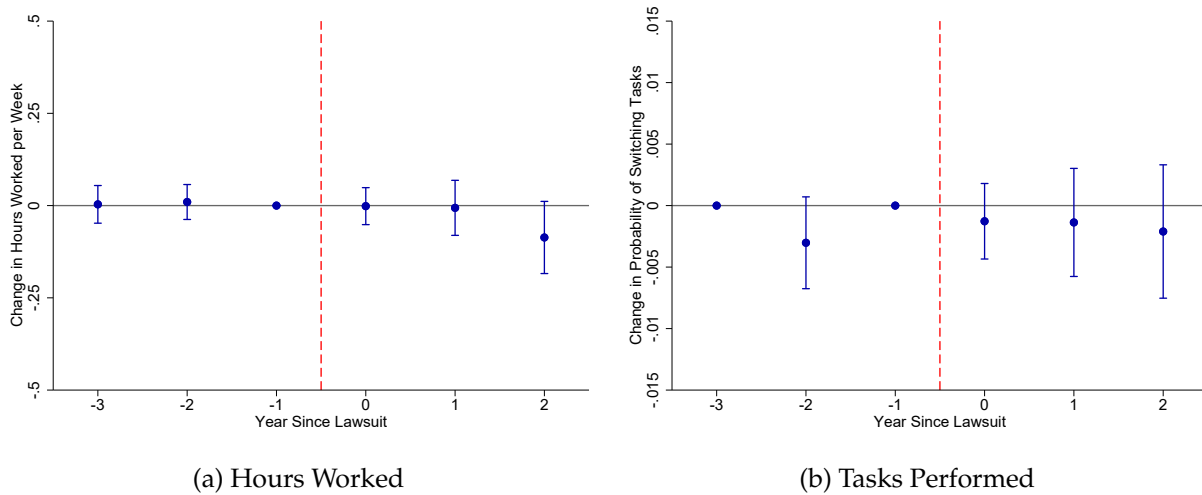
Notes: This plot shows the estimates for Equation 11 using outcomes different from reported wages. Panel (a) shows the effects on hours worked. Panel (b) shows tasks performed. We approximate tasks performed as the occupation reported in the administrative data. We then estimate the probability of switching occupations. Because we are estimating the effects of changes, the first period has no previous one to calculate the difference. The sample contains active employees who have worked in the same firm for the entire period but never appear in the lawsuit data. Treatment is defined at the firm level. The treated group contains firms that were sued for PUT. The control group contains firms that match the treated firms one-to-one based on their characteristics in the pre-period. A combination of *industry, number of employees, legal form, state, and year of opening* form a cell. Event time is centered in the lawsuit year. We include unit fixed effects and cluster standard errors at the firm (treatment) level.

Figure A22: Effects of Non-PUT-related Lawsuits

(a) All

(b) By Firm Size
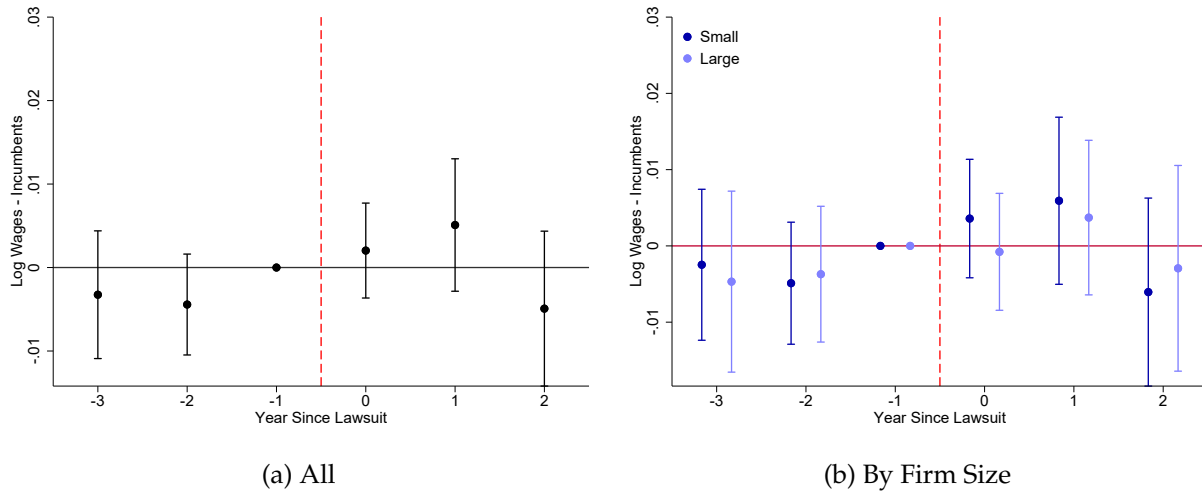
Notes: This plot shows the estimates for Equation 11 using a different sample. Rather than using sued firms for PUT-related reasons as treatment groups, we use those sued for sexual harassment and unfair dismissal for material reasons. We replicate the matching strategy and run Equation (11). Panel (a) presents the overall effects. Panel (b) presents heterogeneity by firm size, replicating Figure (8b). A test of difference between PUT-related and non-PUT-related lawsuits rejects equality with a p-value of 0.0359