Land Invasions and Contemporary Slavery

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Abstract

Do social movements reduce labor coercion? We explore this question with an original panel dataset of contemporary enslaved people and landless movements' invasions into landholdings with serious irregularities. We demonstrate that one land invasion reduces, on average, 14%-31% of modern-day enslaved people in Brazilian municipalities from 1995-2013. We create a formal model exploiting the deterrence effect of the landless movement's invasions on landowners' decision to employ slave workers. We further examine how the private sector, public services, local politics, and public spending influence the likelihood that municipalities have both land invasions and slavery. Finally, we show that the relationship between land invasions and slavery is strongest in the Northeast — a large, poor, and rural region of Brazil. Our findings have broad implications for the quality of democracy and the working conditions of some of the world's most vulnerable citizens.

Keywords: Modern-day slaves, land invasion, human rights, development studies.

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1 Introduction

Coercive labor relations have been common throughout history and are still usual in many less-developed countries. Even though slavery is morally abject, the debate surrounding slave work is part of the history of social thought. For Aristotle, it is in the slaves' best interest to serve a master because some people are natural slaves (Aristotle, 1984). Locke rejects the idea that a person could consent to enslavement; however, he accepts the enslavement of those guilty of capital offenses or captured in war (Locke, 1947). Marx describes the capitalist-worker relationship as a form of "wage slavery" (Marx, 1971). Recently, Acemoglu and Wolitzky (2011) argue that standard economic models assume that transactions in the labor market are non-coercive despite coercion in the workplace being the norm for most of human history and still common nowadays.

The consequences of the Atlantic slave trade have received much attention (e.g., Fogel and Engerman, 1995 and Nunn, 2008). Yet, a few quantitative researchers have studied contemporaneous coercive labor relations (Beber and Blattman, 2013; Hernandez and Rudolph, 2015). One reason for this scarcity is that modern slavery is a hidden human rights violation. Even the State often does not have easy access to remote areas where modern enslaved people work (Scott, 2010). Thus, we take advantage of a rare opportunity to study modern slavery quantitatively. Our dataset comprises enslaved people rescued due to inspections from Brazil's Ministry of Labor and Employment (MTE) during 1995-2013. Our definition of slavery is in line with Brazil's legislation, which is also a product of the many international treaties ratified by the country. Brazil's Penal Code defines conditions analogous to slavery as i) forced labor, ii) exhausting working hours, iii) degrading working conditions, and iv) debt bondage.[1]

This paper uses a combination of formal theory and empirical analysis to check if social movements can curb contemporary slavery in developing countries. Most quantitative studies on the relationship between social movements and slavery focus on historical slavery in the United States (Carpenter and Moore, 2014; Young, 2002), where slavery was an ideological problem. Our main contribution is to show that social movements constrain slavery when the government cannot enforce antislavery poli-

[1] For further detail on the definition of slavery according to Brazilian law, see Section 2 and Appendix Table B.1.

cies due to state capacity constraints. Our study explores the actions of the most active Brazilian landless movement — the Landless Rural Workers' Movement, or *Movimento dos Trabalhadores Rurais Sem Terra* (MST). MST is a movement motivated to defend rural workers. As a result, it has a normative stance against slave labor. As a former-modern enslaved person and current member of MST declares: *"I was a slave on many farms, and my children, my grandchildren, and great-grandchildren will continue to be enslaved. We are the ones who have to organize ourselves to stop and say 'no' to slavery. The way to overcome world hunger and misery is land distribution."*[2]

We develop a formal model where rural conflicts curb slavery by imposing a cost for enslavers to hide evidence of slavery if they need to ask the help from the government to guarantee their property rights. Theoretically, the landless movement is an entity that internalizes the utility of enslaved people due to material and normative commitments. The landless movement identifies rural properties likely to be confiscated by the federal government following an invasion.[3] Once MST identifies a target property, rural workers develop plans for invasions, often involving violent struggles with the current landowners (Hidalgo et al., 2010; Albertus and Kaplan, 2013). Invasions are often repelled by landowners, who count on the government to guarantee their private property. The mechanism works even if we assume: 1) partial irrationality of the landless movement, 2) the presence of damage caused by the landless movement whenever land they invade, and 3) crowding out from governmental audits to the invasions by the landless movement.

Empirically, municipalities with more land invasions have fewer enslaved people than municipalities without land conflicts. Estimates suggest that one land invasion decreases at least 0.15 slaves in Brazilian municipalities from 1995 to 2013. However, sometimes we cannot estimate those results with precision. The results are more robust in the Brazilian Northeast — a poor, rural, and large region. Nonetheless, the link between land invasions and slavery is present in all geographic regions.

Moreover, neighboring land invasions have a sizeable positive effect on invasions in the municipality of interest, confirming the clustering of geographic activities of the landless movement. The number of firms also has a positive impact on land invasions. We have yet to find a significant effect at

[2] http://reporterunesp.jor.br/2019/05/14/trabalho-escravo-no-campo/

[3] According to the 1988 Brazilian Constitution, workers can occupy "economically and socially unproductive land."

the 0.05 level for the number of firms. In contrast, higher salaries decrease invasions. Public services, such as drinking water and sewage, increase land invasions. Vaccines have an insignificant effect at 0.05. Mayoral election years increase land invasions. The number of parties and the mayor's ideology presents an undetectable effect.

We observe behavior related to slavery, not cross-section public opinion responses (e.g., Beber and Blattman, 2013). Nonetheless, there are some pitfalls to relying on the MTE's inspections, as the MTE can only inspect some of the landholdings with slavery-related irregularities. Likewise, many municipalities might not be a good counterfactual for the presence of slavery. They might have different socio-demographic characteristics that make slavery unlikely. To deal with sample selection, we estimate a Weighted Fixed Effects (WFE) model, which creates matching sets based on observable characteristics across time and space — matching methods ease sample selection bias by making control units comparable to the treated units. Also, sample selection in a fixed effects context is only problematic when it correlates with the unobservable error term. Thus, only time-invariant variables unrelated to municipality characteristics might bias our results. We also control for differential trends across municipalities over time. The approach relaxes the parallel trends assumption key to interpreting panel analysis as a generalized difference-in-differences estimator. Our identifying assumption is that slavery can deviate from municipality-year effects by following the trend captured by the interaction between time trends and municipality individual effects.

We consider a battery of robustness checks for our results. Appendix Table D.10 explicit models sample selection employing a fixed-effects Heckman selection model. Appendix Table C.2 restricts the sample to municipalities with at least one observation of slavery. Poisson fixed-effects models — Appendix Table D.6 — drop observations without variation in the dependent variable. In all our estimates, we find a significant negative association between land invasions and the number of enslaved people.

We relate our results to several streams of literature. Our study builds upon theoretical models of coercive labor relations (Domar, 1970; Acemoglu and Wolitzky, 2011), extending these models to situations where the landless movement is present. We also contribute to the quantitative literature on

modern slavery (Beber and Blattman, 2013; Phillips and Sakamoto, 2012), and land conflicts (Hidalgo et al., 2010; Albertus, Brambor and Ceneviva, 2018). As far as we know, we are the first to establish a quantitative link between land invasions and modern-day slavery. Our study also explores different local conditions that favor the emergence of modern slavery and land invasions. Closest to our research finding, Buonanno and Vargas (2019) examine the legacy of chattel slavery on violent crimes in today's Colombia. Hidalgo et al. (2010) estimate how adverse economic shocks, instrumented by rainfall, cause the rural poor to plan and occupy large landholdings, while Albertus, Brambor and Ceneviva (2018) show that local threats triggered by nearby land reforms catalyze landowner organization to repel land invasions. Finally, our research has implications for the debate on the quality of democracy in developing countries to the extent that human rights and dignity are crucial components for a truly free society (Sen, 2001).

The organization of this article is the following. Section 2 presents Brazil's institutional setting on land invasions and labor coercion. Section 3 proposes a game-theoretical model discussing the deterrence effect of the land invaders on the landowner's decisions. Section 4 introduces our data. Section 5 presents our main empirical strategies. Section 6 tests the link between land invasions and modern-day slavery, while section 7 explores differential effects across Brazilian regions. Section 8 concludes the article by debating this study's substantive contribution and limitations.

2 Modern Slavery and Land Conflicts

2.1 Labor coercion

The International Labor Organization (ILO) defines *forced labor* as involuntary work under a penalty. Employer coerces workers through violence, intimidation, debt, retention of identity papers, and threats of denunciation to immigration authorities. In 2016, more than 40 million people worldwide were modern slaves — 25 million were in forced labor, and 15 million were in forced marriage (ILO, 2017).

Brazil was the last country in the Western world to abolish slavery in 1888. Still, the country has not extinguished coerced labor completely. Art. 149 of the 1940 Penal Code asserts that reducing

someone to a condition analogous to slavery is a crime. It is illegal to subject a person to degrading working conditions or restrict their freedom of movement. The penalty for contemporary slavery — established in Art. 149 from the 1940 Penal Code — is 2-8 years of imprisonment and a fine. The penalty applies to employees who restrict the workers' mobility. The penalty increases if the crime occurs against children or teenagers; or because of race, color, ethnicity, religion, or geographic origin.

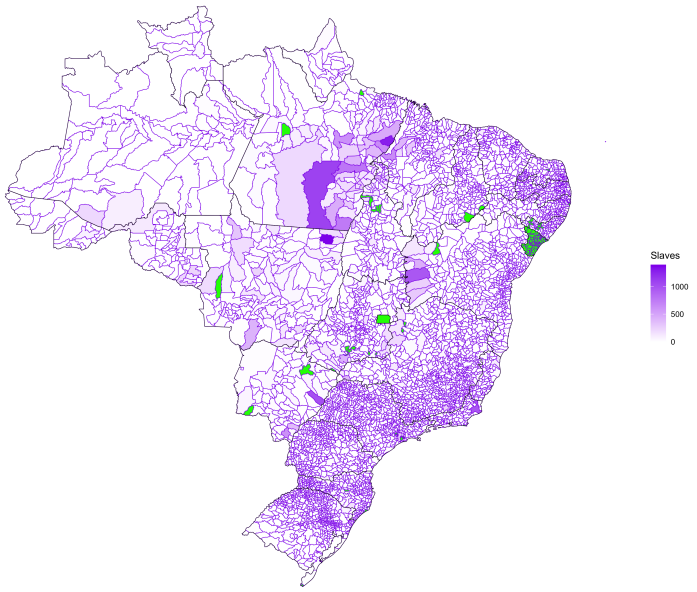
The 1940 Penal Code established the crime of coerced labor. Nevertheless, the Brazilian State only started tackling the problem in 1995 after recognizing slave labor in its territory. Today, the Brazilian institutional anti-slavery apparatus makes the country a crucial case to study modern slavery. In 1995, the federal government created, through Ordinances No. 549 and 550 and Presidential Decree No. 1538, the Special Mobile Inspection Group (*Grupo Especial de Fiscalização Móvel* — GEFM), within the framework of the Secretariat of Labor Inspection (*Secretaria de Fiscalização do Trabalho* — SEFIT), and the Executive Group for the Suppression of Forced Labor (GERTRAF). GEFM investigates complaints of exploitation of slave labor in rural areas.[4] In 2003, the country created the "Register of employers that kept workers under conditions analogous to slavery," otherwise known as the "Dirty List." The list functioned partly as a "naming and shaming" mechanism. Yet, it also cuts off flows of government funds to these companies. The 2005 National Pact for the Eradication of Slave Labor invited firms and employers to commit to the anti-slavery effort. In 2010, the National Pact had more than 130 signatories representing over 20% of Brazil's GDP (Phillips and Sakamoto, 2012). Appendix Table B.1 presents Brazil's actions against slave labor from 1995-2013.

The Brazilian law defines slave labor as "reducing someone to a condition analogous to slavery, by subjecting them to forced labor or exhaustive working hours, by subjecting them to degrading working conditions or restricting their movements."[5] The definition highlights forms of severe exploitation. Modern-day slavery is often contractual. Sometimes the employee has to pay off debt under sub-standard labor conditions. Contractual bondage often lasts the time of the working contract (Bales, Trodd and Williamson, 2009).

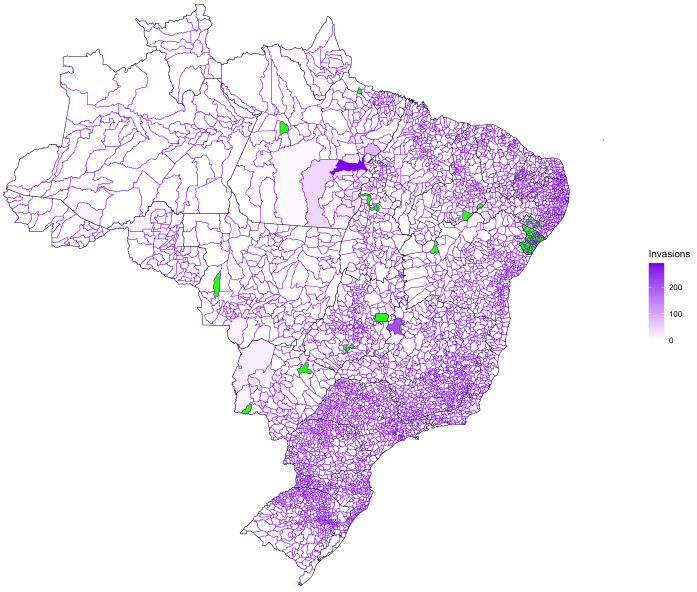
[4]This study analyzes data produced by the Secretariat of Labor Inspection. We obtained this data through a request to the Ministry of Labor and Employment, invoking the Freedom of Information Law (*Lei nº 12.527, de 18 de novembro de 2011*).

[5]Art. 6 of Normative Instruction No. 139, of January 22, 2018, and Art. 149 of Brazil's Penal Code.

Figure 1: Geographic Distribution of Slaves and Land Invasions



(a) Slaves



(b) Land invasions

Notes: The maps depict the number of enslaved people (panel a) and land invasions (panel b) in Brazilian municipalities from 1995 to 2013. The legends show the intensity of slaves and land invasions. Black lines indicate Brazilian States. Missing data are in green.

2.2 Land Invasions

Brazil ratified its constitution in 1988 after a military dictatorship (1964-1985). The Constitution (Art. 170) states that private land has a social function, and the federal government can confiscate land that does not fulfill this norm.

The social function of land presents the following criteria: (1) the economic exploitation of the land must be "rational and adequate"; (2) the exploitation of natural resources has to preserve the environment; (3) the use of land must follow the Brazilian labor code; (4) the exploitation of land should favor landowners and workers well-being. The essential idea here is that the exploitation of land must follow Brazil's labor code, which prohibits modern-day slavery.

The social function is a legal mechanism for enhancing welfare. Land occupations are the most relevant public action asserting rural land rights for the Landless Rural Workers' Movement (MST) (Ondetti, 2016). MST activists occupy the welfare-reducing property to pressure Brazilian authorities. Land redistribution increases in response. Land reform allocation in Brazil is a demand-driven process. Land invasions are generally well-planned occupations (Hidalgo et al., 2010). These invasions occur in high land inequality areas. The government responds to land invasions on private land with expropriation and land reform grants. The government reaction to landless movements protects large landowners from broad, top-down land redistribution in countries like Japan, Peru, and Taiwan (Albertus, 2015). Nonetheless, it creates incentives for land invasions and other forms of rural conflict.

The Landless Movement in Brazil has greater reach than the federal government in the countryside. The total number of prosecutors in the Brazilian Labor Prosecutors' Office in June 2022 was 7748, an urban underpowered staff to curb slavery. The landless movement in Brazil counts with 90.000 families living in camps in 24 Brazilian States. The nationwide presence of the landless movement reduces costs for invasion and makes it more reliable than the government in curbing slavery.

Brazil is one of many countries with land problems. In Colombia, land titling in violent rural areas led to spillover effects in which nearby communities recognized the need to support rebel groups to garner the attention of the government (Albertus and Kaplan, 2013). In Russia, land-based rural rebellion increased as landlords hijacked the reform process to win favorable land allotments after the

emancipation of serfs in 1861 (Finkel, Gehlbach and Olsen, 2015).

Figure 1 suggests a spatial correlation between modern slavery and invasions. Darker purple colors depict the number of enslaved people and land invasions on the maps. The North and Center-West registered fewer enslaved people and invasions. The South, Southeast, and Northeast present a higher incidence of both. The State of Pará — one of the Amazon States — is the most visible outlier. Missing data are in green.

3 Theoretical Argument

We explore the political-economic relations surrounding modern slavery in democratic societies, where incentives for coercive relationships are small because of democracies' redistributive tendencies and protection of human rights (Meltzer and Richard, 1981; Acemoglu and Robinson, 2006; Sen, 2001). Previous economic models investigate why workers accept slave jobs and when coercive relationships are profitable for firms (Acemoglu and Wolitzky, 2011; Chwe, 1990). Our model shows the interaction between the landless movement, landowners, government, and rural workers.

We explore the landless movement's deterrence effect on landowners' decision to enslave workers. Slavery is profitable as it leads to lower labor expenditures by landowners. Enslavement happens whenever landowners decide to 1) offer a job paying an insufficient wage or by limiting fundamental liberties, such as freedom of movement, and 2) when labor search frictions make workers accept these derogatory working conditions.[6] The landless movement deter slavery because, whenever an invasion occurs, landowners cannot ask for the government to protect their property. After all, slavery is a crime. As such, they pay a cost for hiding slavery. Landowners internalize invasion costs and may not adopt slavery in their properties. The deterrence effect holds even if 1) the landless movement does not rationalize the utility of enslaved people, 2) the instability caused by the landless movement leads to the increased propensity of adoption of slavery by landowners, and 3) anti-slavery government operations crowd out and curb landless movement activities.

The choice of the landless movement is about land invasion. There are two types of landless move-

[6] Search frictions are impediments to a match between two parties for a partnership or transaction.

ment. The *Aggressive* Type invades if it is costless to invade. The *Strategic* Type only invades under reasonable expectations of slave work by landowners. Landowners choose the type of work, not knowing the landless movement type. Landowners suffer damages whenever an invasion occurs because of the interruption of production. We assume landowners must demand the government's intervention to regain their lands. So, the landowner must not have slave workers if he intends to call the government.

Finally, the government wants to curb slavery. There may be investigations and slave apprehensions even when the landless movement does not act. For simplicity, we assume the government investigates slavery whenever there is a complaint. Complaints are conditional on whether the landowner employs slave workers in his production. The probability of complaints followed by a governmental audit when employing enslaved people is p_g. Otherwise, this probability is p_n. We assume $p_g > p_n$. The landowner may face prison and land seizure when the government finds slave workers. So, whenever the audit finds slavery, it is a terminal state of the game.

The timing of the game is as follows:

1. Nature decides the game's setup, i.e., whether the government audits the landowner and the type of landless movement.
2. The landless movement receives its type.
3. The landowner decides whether to use slave workers or not.
4. Governmental audits happen. Skip Step 5 if the government finds slave workers in a land.
5. The landless movement decides whether to invade or not.
6. The players receive their payoffs.

The landless movement does not observe Step 3. Thus, the game is simultaneous between landowners and the landless movement. The movement knows that whenever it has an opportunity to invade a property, the government has not audited or found slaves there. The landless movement has information that if the game achieved Step 5, Nature did not select to audit the landowner. In contrast,

the landowner decided to use slave workers in his production. The landless movement follows typical Bayesian reasoning to address this information problem. Hence, we solve this game through a Bayesian Nash Equilibrium analysis.

The Landowner Decision. Landowners face a decision about the working wage they offer to peasants. When landowners manage to hire workers, they receive a unit of rural production. w is the minimum wage. Slavery happens if landowners offer less than w, and workers accept to work. By employing enslaved people, a landowner risks losing its land if invaded by the landless movement or audited by the government. Landowners do not lose their land if the auditor does not find slaves.[7]

Workers decide between accepting a job, receiving the offered wage, or pursuing another work, receiving w in an outside firm. Due to market frictions, there is no guarantee that outside firms will hire workers. Assuming a worker's quasi-concave utility function, a value threshold α_w, $\alpha_w \leq 1$ makes workers accept an offer by a landowner. If the wage offered by the landowner is less than $\alpha_w w$, peasants do not take the job. As any pay smaller than w characterizes slave work, the landowner is not incentivized to offer a salary between $\alpha_w w$ and w. The binary variable s_l captures the landowner's choice. Either he pays the full salary w or below the minimum wage $\alpha_w w$ and faces the potential consequences of employing slave work. We refer to the strategy of paying w as $s_l = 0$ and using slave workers as $s_l = 1$.

Thus, the payoff received by landowners is:

$$U_l(s_l) = (1 - s_l s_g)(1 - \beta s_m) - \alpha_w w s_l(1 - s_m) - (w + c)s_l s_m - w(1 - s_l) \tag{1}$$

where s_l is the strategy chosen by the landowner. s_m is a binary variable on the invasion decision by the landless movement. s_g is a binary variable that Nature selects. It is the probability of the government auditing the land. β is the landowner's loss whenever invaded due to the interruption of his production, and c is the cost of hiding evidence on slavery if invaded. We assume $\beta > 0$ due to the landless movement's negative consequences to rural producers due to property rights violations during invasions

[7]The exploration of the land might present irregularities for reasons other than slavery. Yet, replacing this assumption with a more realistic one would offer no great insight at a high mathematical cost.

(Orellano et al., 2015).

This equation makes explicit that having slave workers ($s_l = 1$) is necessary for risking losing rural property. Yet, it also reduces the cost of production by landowners due to lower payments to workers. There is a cost reversion whenever the landless movement invades slave-owning lands. According to the equation, a smaller w represents a smaller potential economy from exploiting slave workers. w is the level of labor dependence from landowners as it describes the amount of the revenues to pay peasants: the higher w, the more dependent on rural production work. We infer from the equation 1 that labor-dependent landowners appeal to coercive institutions more often.

The Landless Movement Decision. An invasion is a costly activity. Whenever the landless movement decides to invade a land, it costs k. We assume the benefit of invading a land depends on the type of landless movement. With probability p_b, the landless movement is from an *Agressive* Type. The *Agressive* Type has internal reasons for invading a land regardless of landowners' use of slave workers. In this case, every invasion yields a benefit of $b = 1$. The payoff of invading land is $1 - k$, and non-invading is 0. With probability $1 - p_b$, the landless movement is a *Strategic* Type. In this case, the landless movement needs a solid external reason to invade the land. Again, it is legal to invade socially and economically unproductive land in Brazil. Unproductive land — as defined by the notion of the land's social function — involves properties that hire slave work, and slavery increases land invasion's benefit because slaveowners are committing a crime that allows the movement to invade the land. Furthermore, this appeals to the normative motivation of the social movement.[8] If the Strategic landless movement finds slaves working on the land, it receives a benefit $b = 1$. Otherwise, the benefit is $b = 0$.

Hence, the expected payoff for the landless movement is:

$$U_m(s_l, s_m) = \begin{cases} (1-k)s_m, & \text{if Type = Aggressive} \\ (s_l - k)s_m, & \text{if Type = Strategic} \end{cases} \tag{2}$$

[8]The literature knows little about the quantitative link between slavery and land conflicts. Thus, we cannot but hope that some aspects of the Brazilian case can be generalizable to other developing countries and regions. Here, we assume that social movements are strategic and mission-driven agents (Besley and Ghatak, 2005).

With probability p_b, it is profitable to invade a land whenever $k < 1$, while with probability $1 - p_b$ it is advantageous to invade a land when there are slave workers employed there. Additionally, we assume that the landowner does not observe the type of landless movement when he chooses slavery.

Equilibrium Analysis. We can now calculate the Bayesian Nash Equilibrium after specifying the landless movement and landowner utility equations. Proposition 1 summarizes the possible equilibria according to the values of wages w, reservation utilities α_w of peasants, probability of audits p_g, the chance of aggressive-type landless movement p_b, and invading costs k.

Proposition 1 *There are three equilibria in this game:*

- *If the cost of invading is $k > 1$, then there is a unique pure strategy equilibrium where slavery is widespread and no invasion happens: $s_l = 1, s_m = \{0, 0\}$.*
- *If the cost of invading is low $k < 1$ and the labor-dependence of the firm does not compensate the risks of employing slave work $(1 - \alpha_w)w < \frac{p_g(1-\beta p_b)+cp_b}{1-p_b}$, then there is a unique pure strategy equilibrium of no slavery and invasions only by the aggressive type of landless movement: $s_l = 0$ and $s_m = \{1, 0\}$.*
- *In all other conditions, there is a unique mixed-strategy equilibrium with $P(s_l = 1) = \frac{k}{1-p_g+p_g k}$, $P(s_m = 1|\text{Type = Aggressive}) = 1$, and $P(s_m = 1|\text{Type = Strategic}) = \frac{(1-\alpha_w)w(1-p_b)-cp_b-p_g(1-\beta p_b)}{(1-\alpha_w)w(1-p_b)-\beta p_g(1-p_b)+c(1-p_b)}$.*

Proof. See Appendix B.

By comparing the first equilibrium[9] with the other two, we see a pattern: the more expensive it is for the landless movement to act, the more probable landowners' use of slave workers. The only exception to this pattern is when p_g is very high due to a crowding-out caused by governmental activities. Due to state capacity restrictions discussed in Section 2, we argue that this is not the case in Brazil. The landless movement deterrence effect is robust to different levels of p_b and β. Thus, a central corollary and prediction of the model are that:

Corollary 1 *The probability of a landowner employing enslaved workers in his production decreases as the cost for the landless movement invades, k, decreases.*

[9] Where there is no landless movement activity since it is too costly to act.

As mentioned before, the presence of the landless movement curbs contemporary slavery. Our theoretical model has implications for a direct impact of the landless movement in slavery compared to the *status quo* of governmental investigations without the participation of social movements. It also articulates some parameters — k, p_g, p_b, w, β, c, and α_w — that impact both the level of invasions and the use of slave workers in rural properties. Thus, it suggests some confounders that an empirical model should use as controls to produce more reliable estimates. We discuss the control variables in section 4.3.

4 Data and Measures

4.1 Dependent Variable

We construct an annual panel that comprises 5,494 municipalities from 1995 to 2013. The dependent variable is the number of enslaved people in Brazilian municipalities each year from 1995-2013. The minimum number of slaves per municipality is zero, and the maximum is 1,064. The average number of slaves is 0.423. Appendix Table D.3 presents descriptive statistics for all variables.[10]

The term "slaves" refers to all workers in conditions analogous to slavery. After the Ministry of Labor and Employment's rescuing operation, the labor auditor removes workers from the workplace. Then, she starts a set of procedures to repair the damages, such as social assistance and other measures, so that workers do not return to slavery. Reparation includes the termination of the work contract, payment for the end of the agreement, unemployment insurance, and job training programs.

[10]Data quality is likely worse in the 1990s and better in the 2010s. For this reason, Appendix Table D.5 estimates the same OLS regression presented in the main paper splitting the data into three samples: 1995-2000; 2000-2010; e 2010-2013. Results for the 1995-2000 and 2010-2013 periods are weaker and insignificant at 0.05 but present a negative association between invasions and slavery. The 2000-2010 period shows a strong and significant relationship. The differential results might be an artifact of the different sample sizes. Likewise, the point estimates are stable as we dropped one State and one year at a time, and only one regression out of 44 is not significant at the 0.05 level (see Figure D.2). Thus, our results are not dependent on specific years or States.

4.2 Independent Variable

Our independent variable is the number of land invasions in Brazilian municipalities from 1995 to 2013. Land redistribution offers new opportunities in the labor market for poor and unskilled workers. We also use a dummy variable in some models to measure land invasions. We take the data on land invasions from *Dataluta* (Girardi, 2014). The dataset is the most comprehensive and authoritative data source on land invasions (Albertus, Brambor and Ceneviva, 2018). Most information on land invasions in the *Dataluta* comes from the CPT (*Comissão Pastoral da Terra*), a nongovernmental organization with ties to the National Conference of Bishops of Brazil.[11] CPT collects data on land invasions from primary sources such as social movements, trade unions, political parties, government agencies, and churches. It also gathers data from local, State, and national newspapers and police records. *Dataluta* documents 4,825 land invasions from 1995 to 2013. The minimum number of invasions is 0, and the maximum is 31 in a given municipality-year. The average number of land invasions is 0.089.

We create two dummy variables to test spillover effects from one municipality to its neighbors. The variable "neighbors invasions" indicates an invasion in the adjacent municipality if there were at least one invasion in the municipality of interest. "Neighbor-of-neighbors invasions" measure whether there was at least one invasion on neighbors-of-neighbors municipalities if there was at least one invasion in a given municipality. We expect that having land invasions in the proximities lowers the costs of invading land — the parameter k comes from our formal model.

4.3 Control Variables

We want to avoid "bad controls" and omitted variables. They both bias regression coefficients Cinelli, Forney and Pearl (2021). Thus, we choose controls that the literature on land conflict and modern-day slavery considers relevant. Also, we selected covariates recommended by our formal model.

Land reform is a pivotal control to our analyses. INCRA — *Instituto Nacional de Colonização e Reforma Agrária* —collects the land reform variable. Under Brazil's 1988 constitution, the government

[11] CPT is also one of the pioneers in denouncing slave labor in Brazil. https://www.cptnacional.org.br/campanhas-e-articulacoes/campanhas/campanha-de-prevencao-e-combate-ao-trabalho-escravo.

can redistribute socially and economically unproductive land. The government responds to land invaders and other pressure groups (e.g., the public opinion and the media) to start a land reform. These are often areas where land is cheap. Land reform grants in Brazil follow an earlier land invasion (Albertus, Brambor and Ceneviva, 2018). Land invasions often involve well-organized social movements, such as the MST. Landowners are often members of wealthy groups, such as the National Confederation of Agriculture or the UDR (*União Democrática Ruralista*). These organizations help to inform their members about threats from invaders. Land reforms affect landless rural workers' calculations, increasing the risk of nearby invasions. Thus, reforms also relate to the parameter k from the formal model.

Our empirical analysis includes other covariates whose omission may confound our results. Illiteracy rates are the percentage of people above 14 years old who cannot read and write. We only have illiteracy rates for the 2000 and 2010 censuses by the Brazilian Institute of Geography and Statistics (IBGE). For this reason, we employed linear interpolation of the log(+ 0.01) of illiteracy rates with seasonal effects by municipalities. Later, we exponentiate the variable to obtain the Illiteracy (rates) covariate. Illiteracy is a proxy for α_w, representing workers' relative labor market bargaining power.

We collected data on Tax Collection from the Ministry of Finance (or *Ministério da Fazenda*). We took the log (+ 1) of Tax Collection because of the skewness in the data. The variable measures the State's fiscal capacity to extract citizens' revenues (Tilly et al., 1992; Besley and Persson, 2010). We expect fewer enslaved people in areas where the State has a higher capacity to collect taxes. The model prescribes that high p_g may lead to a non-slavery equilibrium due to higher reporting and more effective audits.[12] We collected murder rates from the Ministry of Health/Datasus. The murder rate is less subject to underreporting than other crimes (e.g., rape and robbery) because it is difficult to hide a body. Murder is a "good control" because slavery should correlate with other violent crimes. Likewise, we introduce one control measuring whether there is a municipal police guard in the municipality. We want to control the possibility of fewer enslaved people in areas with more policing. It is also possible that the lack of policing correlates with underreporting of slavery.

[12] Higher State capacity may translate into better reporting on slavery. However, federal transfers account for 65% of the municipal budget (Brollo and Nannicini, 2012, p. 748).

We control for land inequality because it may influence "invading costs." Invasions are likely profitable if the landless people occupy large landholdings. Also, land inequality may reduce observability — p_g — by the influence of great landowners in local politics. Land inequality is taken from the IBGE agricultural censuses and measured using a Gini coefficient. The percentage of the rural population, taken from IBGE, is the percentage of a municipality's rural population. We use this variable as a control because land invasions and modern-day slavery often happen in rural areas.

Finally, we collected the yearly population from IBGE. GDP per capita, also taken from IBGE, is an indicator of local development, proxying w. We took the log (+ 1) of population and GDP per capita because of the skewness in the data.[13] Agricultural productivity may affect land invasions or slavery by changing w and k. Thus, we include different prominent types of crops — cattle, soy, sugar, and coffee — in our regressions. Previous work on slavery and land invasions also included crop types as control variables (Phillips and Sakamoto, 2012; Albertus, Brambor and Ceneviva, 2018). We collected those variables from IBGE. Following Albertus, Brambor and Ceneviva (2018), the logged ratio of the number of cattle per square kilometer corresponds to our cattle dependency measure. The remaining dependency measures are the shares of cultivated land in a municipality used to grow the respective crop.

4.4 Other Variables

Four groups of variables help us further explore the relationship between land invasions and modern slavery. The four groups are (1) the private sector's workings, (2) public services, (3) local politics, and (4) social spending.

For measuring the private sector influence, we collected the number of firms, employees, and annual averages of minimum wages from RAIS (*Relação Anual de Informações Sociais*) to examine outside options for low-skilled and poor workers in the formal labor market. A survey in the State of Maranhão found that at least 28.4% of former slave households have an income between 1 and 2 minimum wages (da Silva, 2018). These wages are not lower than our sample's 1.751 average minimum salaries.

[13] Municipal GDP is only available from 1999 to 2013. We interpolate GDP and divide it by population to obtain the GDP per capita.

Fogel and Engerman (1995) and ILO (2009) find that coerced laborers receive income close to comparable free employees. We expect a broader labor market, more job opportunities, and better salaries to reduce land invasions and slavery.

We use three variables to measure the impact of public services. We take the percentage of households with drinking water and houses with plumbing sewage from IBGE. We also include in our models the number of total doses of vaccines given in the municipalities from the Ministry of Health/Datasus. We expect public services to decrease land invasions and slavery because they should mitigate poverty.

We use three variables to map municipal politics. All variables are from the TSE (*the Superior Eleitoral*). First, we employ an indicator variable defining election years. During our study, there were mayoral elections in 1996, 2000, 2004, 2008, and 2012. Second, we use the number of parties disputing the mayoral election as a measure of electoral competition. The average number of parties is 2.614, with a minimum of one party and a maximum of 14 parties. Third, we create a measure of the mayors' party ideology. Mayors' ideology is a categorical variable with three categories: left, center, and right. We use the classification of previous work on the ideology of Brazilian parties in the federal legislative branch to define mayors' ideology (Mainwaring, Meneguello and Power, 2000; Melo, 2004; Power and Zucco Jr, 2009). See Appendix Table D.4 for further details.[14] We anticipate that left-wing politicians are more preoccupied with social problems — such as land invasions and slavery — and want to solve or reduce them. They may also be more permissive to land invaders and collaborate to rescue enslaved people, making these activities more common or visible in their municipalities. Otherwise, mayors should deliver pro-poor policies if these policies provide electoral benefits regardless of their ideologies (Desai and Frey, 2021). Finally, we also analyze spending on social assistance and pensions, education and culture, and health and sanitation. We collected all social spending measures from the *Ministério da Fazenda/Secretaria do Tesouro Nacional*. We also logged (+ 1) all measures of social spending to reduce skewness in the data. The expectation is that social spending decreases land invasions and slavery. Even so, higher spending does not always translate into better policies. After all, policy implementation faces many obstacles— for instance, poor design, diversion of resources, lack

[14]As there is no work classifying political parties at the municipal level, we inferred it from the classification of the Brazilian legislative.

of bureaucratic effort, and corruption.

5 Empirical Strategy

We start our analysis with an OLS panel regression with fixed effects:

$$Y_{i,t} = \alpha_{i,t} + \beta T_{i,t} + \Gamma X_{i,t} + \delta_i + \gamma_t + \epsilon_{i,t}, \tag{3}$$

$Y_{i,t}$ is our outcome variable, i.e., the number of slaves in municipality v and year t. $T_{i,t}$ is our key independent variable — land invasions —, and $X_{i,t}$ is a set of control variables. δ_i represents municipality fixed effects. γ_t represents year dummy fixed effects. $\alpha_{i,t}$ is the constant and $\epsilon_{i,t}$ is error term.

We first report the results of a series of OLS panel regressions with the municipality and year-dummy fixed effects. Fixed effects models reduce time- and municipality-invariant omitted variable bias. We also include municipality-specific time trends in one of our specifications. In all models, we cluster the standard errors at the municipal level.[15] The first set of OLS regression estimates that one invasion reduces, on average, slavery by 14-15%. In the Appendix, sensitivity analysis (Oster, 2019) shows that unobserved controls are unlikely to change our results.

The Weighted Unit Fixed Effects Estimator is the second statistical method employed in our analysis. Here, we summarize the method and illustrate the generality of the proposed framework (cf. Imai and Kim, 2019). Equation 3 accommodates diverse weighting estimators through their corresponding matched sets $M_{i,t}$. First, we show how to incorporate year-varying confounders $\boldsymbol{Z}_v$ by weighting observations within each municipality based on the values of $\boldsymbol{Z}_v$. For example, the within-unit nearest neighbor matching leads to the following matched set:

$$\begin{aligned} M_{i,t} = \{(i', t') : i' = i, \\ X_{i',t'} = 1 - X_{i,t}, D(\boldsymbol{Z}_{i,t}\boldsymbol{Z}_{i',t'}) = J_{i,t}\} \end{aligned} \tag{4}$$

where $D_{(.,.)}$ is a Mahalanobis distance measure, and

[15] Unless we say otherwise, we control for year and municipality-fixed effects and cluster standard errors at the municipal level.

$$J_{i,t} = \min_{(i,t) \in M_{i,t}} D(\boldsymbol{Z}_{i,t} \boldsymbol{Z}_{i',t'}) \tag{5}$$

represents the minimum distance between time-varying confounders from observations whose treatment status is opposite — municipalities with land invasions and without land invasions. With this definition of matched sets, we can construct the within-unit nearest neighbor matching estimator using the following equation:

$$\hat{\tau} = \frac{1}{\sum_{i=1}^{N} \sum_{t=1}^{T} D_{i,t}} \sum_{i=1}^{N} \sum_{t=1}^{T} D_{i,t} (\widehat{Y_{i,t}(1)} - \widehat{Y_{i,t}(0)}), \tag{6}$$

where $Y_{i,t}(x)$ is observed when $X_{i,t} = x$ and is estimated using the average of outcomes among the units of its matched set when $X_{i,t} = 1-x$. The argument suggests that this within-unit nearest neighbor matching estimator is consistent with the Average Treatment Effect (ATE) so long as matching on $\boldsymbol{Z}_{i,t}$ eliminates the confounding bias.

Imai and Kim (2019) propose a non-parametric framework that connects fixed effects models to matching or weighting methods. The method compares treated (land invasions) and controlled (no land invasions) groups within the same municipalities and years.[16] We mitigate problems related to sample selection bias and random assignment by making treated and control groups comparable. All regressions include a model-based robust standard error, allowing for heteroskedasticity.

The results of both OLS panel regressions and Weighted Unit Fixed Effects (WFE) Estimators have the same sign. OLS presents our estimates' lower bounds. With the WFE, one land invasion decreased, on average, 31% enslaved people in the municipalities, which is an intermediate bound. In Appendix Table D.10, we present municipality and year-fixed effects Heckman-style selection models. Police operations anti-slavery are the dummy dependent variable in the selection equation. After accounting for sample selection, one land invasion decreases more than three enslaved people in the municipality, offering the study's upper bounds.

Our next step is to use land invasions as our dependent variable. We explore the possibility that

[16] One municipality might have more than one anti-slavery operation in a given year. Thus, we have to transform the data to have a unique municipality for each year.

some municipal characteristics influence the likelihood of land invasions. Returning to our OLS panel regressions, we estimate the effect of the private sector, public services, and local politics on modern-day slavery. We find that the number of firms positively impacts land invasions. In contrast, the average number of minimum wages decreases land invasions. Public services, such as drinking water and sewage, increase invasions. Land invasions decrease during electoral years. The possibility of reelecting the mayor also reduces invasions.

6 Results

6.1 Land Invasion and Slavery

Table 1 presents OLS Panel regressions. All models include municipality and year dummy fixed effects and standard errors clustered at the municipality level. In the first column, a bivariate model shows that one land invasion decreases 0.142 slaves in the municipality. The relationship seems sizable. Land invasions reduce, on average, slavery by 14%.[17] When controlling for socio-demographic and agricultural variables, the effect remains stable. Columns 2, 4, and 5 show that one invasion decreases 0.15 slaves in the municipality. The time trends allow treatment and control municipalities to follow different trends. When controlling for municipality-specific time trends in column 3, it is reassuring that the estimated effect continues the same. Time trends allow us to relax the parallel trends assumption, which rarely holds in panel data without the random assignment of the treatment variable.

Past occurrences of land invasions might reduce slavery in the future, e.g., enslavers may avoid these areas because of competition with landless movements, or the authorities might vigorously police these municipalities. Nevertheless, it is implausible that future invasions would decrease contemporaneous levels of slavery, casting doubt on our results. We employ lag- and lead-variables in Appendix Table D.7 to explore whether different pretreatment or posttreatment trends would suggest a nonrandom selection. Our analysis shows that up to three years of lags and leads of land invasions do not significantly

[17] Appendix Table D.3 shows that municipalities have, on average, 0.423 slaves and 0.089 land invasions from 1995 to 2003. As both slavery and land invasions are rare events, we should not expect a massive effect. Still, the lack of similar estimates on modern-day slavery do not allow us to compare our paper's effect size with other estimates.

impact slavery. Thus, the effect of land invasions on slavery happens concomitantly.

In Appendix Table D.6, we replicate Table 1 with (pseudo-)Poisson fixed effects models, which drops municipalities without variance in the dependent variable.[18] As a result, the estimation also prunes all municipalities in the "widespread slavery without report" equilibrium of the theoretical game, allowing us to estimate a potentially less endogenous relationship between invasions and slavery (see section 3). Although dropping many observations, the Poisson regression findings match the main paper's OLS results.[19] Appendix Section C.1 presents a sensitivity test proposed by Oster (2019), where we use the information on observable control variables to estimate the likelihood of unobservable changes in our results. The analysis shows that it is improbable that omitted variables would alter our results. Ultimately, we also restricted the sample to municipalities that experienced at least one invasion during 1995-2013. The restricted sample coefficients for land invasions become four times larger. Hence, the main document's analysis might be a conservative estimate of land invasions' true effect on slavery.

Figure 2 estimates the same model from column 2 of Table 1 but using the Weighted Unit Fixed Effects Estimator (Imai and Kim, 2019). The model presents robust standard errors, allowing for heteroskedasticity. We match the covariates and use year and municipality fixed effects. We have to use a binomial measure of land invasions to match municipalities with and without land invasions in a panel with unique municipalities across years.[20] One means that a municipality experienced a land invasion in a given year, and zero means no invasions. With the Weighted Unit Fixed Effects Estimator, the average treatment effect (ATE) doubles the coefficients from Table 1: changing from no invasion to one invasion decreases the number of enslaved people by roughly 30%.

In the Appendix, the WFE Figure D.4 and the OLS Table D.8 estimate spillover effects (or "placebo" tests) of invasions in neighboring and neighboring-of-neighboring municipalities on the number of slaves. The findings do not reach statistical significance. The results *suggest* that having an invasion in

[18] In non-linear models, the likelihood conditions the fixed effects. For maximization reasons, conditional likelihood estimators only use observations with variation in the dependent variable.

[19] We present most results employing OLS regressions due to the technical and interpretation simplicity of the OLS approach, the impossibility of knowing the data generation process, and because OLS and Poisson's models provide similar results (Angrist and Pischke, 2009).

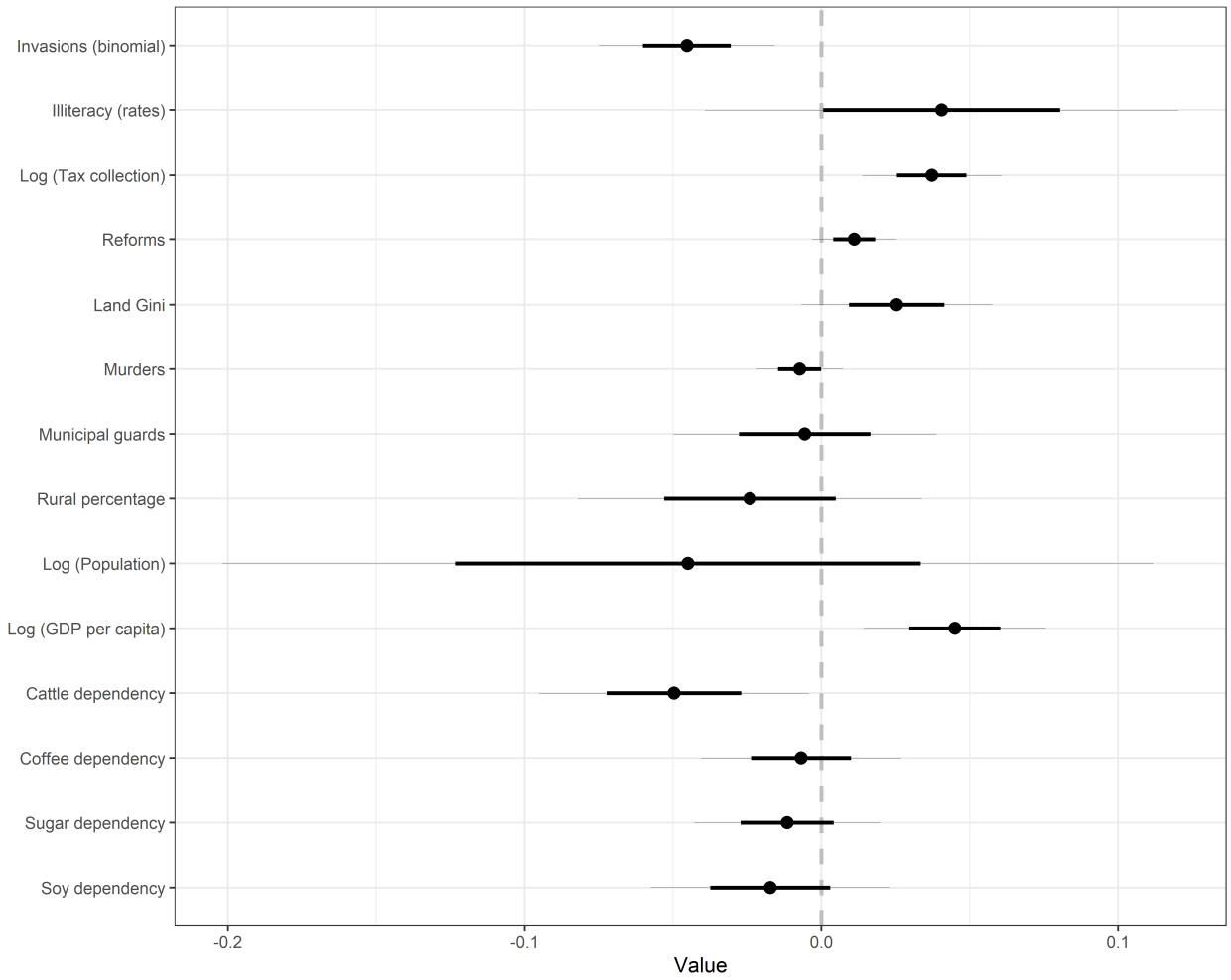
[20] Our original data allows municipalities to have more than one case of slavery per year.

Table 1: OLS Panel Regressions: Impact of Invasions on Slavery

	(1)	(2)	(3)	(4)	(5)
Dependent Variable: Slaves					
Invasions (count)	-0.142*	-0.150**	-0.139*	-0.150**	-0.150**
	(0.057)	(0.056)	(0.061)	(0.057)	(0.057)
Illiteracy (rates)		0.020+	0.124	0.019	0.019
		(0.011)	(0.148)	(0.013)	(0.013)
Log (Tax collection)		0.020+	0.032*	0.024+	0.026*
		(0.011)	(0.016)	(0.013)	(0.013)
Reforms		0.121	0.125	0.128	0.125
		(0.110)	(0.128)	(0.111)	(0.111)
Land (Gini)		1.010*	11.207+	1.034*	1.003*
		(0.413)	(6.427)	(0.443)	(0.442)
Murders		-0.317	-0.520+	-0.318	-0.319
		(0.259)	(0.288)	(0.263)	(0.263)
Municipal guards		0.078	-0.012	0.085	0.081
		(0.093)	(0.128)	(0.094)	(0.096)
Rural percentage		0.623	-1.806	0.746	0.671
		(0.610)	(1.532)	(0.646)	(0.644)
Log (Population)		0.060	0.749	0.050	0.010
		(0.409)	(0.866)	(0.455)	(0.448)
Log (GDP per capita)		0.230+	0.410	0.152	0.151
		(0.134)	(0.271)	(0.146)	(0.143)
Cattle Dependency		-0.115+	0.060		-0.120+
		(0.062)	(0.089)		(0.065)
Soy Dependency		-0.572	-1.418		-0.621
		(0.542)	(1.008)		(0.553)
Sugar Dependency		0.387	0.939+		0.315
		(0.312)	(0.567)		(0.298)
Coffee Dependency		-0.054	-0.618		-0.102
		(0.317)	(0.419)		(0.323)
Log (N. of firms)				-0.038	-0.017
				(0.103)	(0.100)
Log (N. of employees)				0.296**	0.286**
				(0.100)	(0.097)
Min Wages (average)				0.045	0.051+
				(0.029)	(0.029)
R-squared	0.001	0.001	0.103	0.001	0.001
Municipality clusters	5424	5360	5349	5359	5359
N	101870	95323	95312	93156	93156
Year fixed effects	YES	YES	YES	YES	YES
Municipality fixed effects	YES	YES	YES	YES	YES
Municipality-specific time trends	NO	NO	YES	NO	NO

Notes: All specifications include municipality and year (dummies) fixed effects and cluster standard errors at the municipal level (in parenthesis). $+p < .1, *p < .05, **p < .01, ***p < .001$.

Figure 2: Weighted Fixed Effects (WFE): Impact of Invasions on Slavery



Notes: *WFE Estimator.* **Dependent Variable: Slaves**. Municipalities: 5360. Municipalities-years: 93985. N (nonzero weigh): 27100. The plot presents point estimates and 95% confidence intervals. The model includes weighted years and municipal fixed effects. Continuous variables were standardized to improve the visualization of the coefficients. Robust standard errors, allowing for heteroskedasticity, are used. The model includes our baseline model's control variables first presented in column 2 of Table 1.

close-by municipalities is not enough to lower the cost of invasion to the point of reducing slavery.

6.2 Determinants of Land Invasions and Slavery

We return to OLS panel regression estimates to explore possible determinants of land invasions. We hypothesize that the private sector, public services, local politics, and public spending influence the

likelihood of modern slavery and that this influence can occur directly or through land invasions.[21] We also anticipate that invasions in neighboring municipalities influence invasions in the municipality of interest.

Figure 3 explores the effect of neighbor invasions and three groups of variables on invasions in the municipalities of interest — the private and public sectors and local politics. To create the figure, we estimate thirteen different regressions. The plot presents point estimates and 95% confidence intervals. The right axis shows the main independent variables. To improve the visualization, we standardized the coefficients. We preserved the original scale of the categorical variables and included the same control variables of our baseline model from column 2 of Table 1. Most specifications include municipality and year (dummy) fixed effects and cluster standard errors at the municipal level. As an exception, the regression of Election (Mayor) on slavery includes municipality fixed effects and cluster standard errors at the municipal level. We cannot include year-fixed effects because they correlate with the years of Mayoral Elections.

As expected, in Figure 3, neighbor invasion is a strong predictor of land invasions. The result suggests that the landless movement acts in geographic clusters.[22] The results are heterogeneous for the private sector. While the number of firms increases land invasions, the number of employees and the average minimum wages reduce them. The effect of log(n. of employees) is insignificant at conventional levels ($p < 0.05$). The differential results for log(n. of firms) and minimum wages (average) are reasonable because we estimate the private sector's different characteristics. Higher average salaries suggest a vigorous formal job market in the municipality, reducing market friction and making it easier for workers to find non-coercive jobs (i.e., leading to a higher α_w in the model). The impact of more firms is not straightforward in light of the model. We conjecture that more firms might attract more workers to the municipality without guaranteeing them a job. The heterogeneous results do not allow us to know the direction of the labor market's influence on modern-day slavery. Yet, these results might contribute to a more nuanced understanding of the private sector's impact on slavery.

The findings for public services are homogeneous. Drinking water, sewage, and log of vaccines

[21] In the Appendix, we also explore the effect of the expenditure on land invasions and slavery.

[22] Appendix Table D.8 estimates the impact of neighboring invasions on slavery, but we fail to obtain precise estimates.

positively predict land invasions, but vaccines have a statistically insignificant effect. Although surprising, these results are plausible because municipalities with more land invasions should have some infrastructure (drinking water and sewage) to produce agricultural goods. Public goods also impact the quality of living in the landless movement's settlements in a municipality, reducing the cost of invasions.

Finally, we estimate the effect of three variables related to local politics. Land invasions experience a decline during municipal electoral years. The result suggests that mayors and city councilors restrain invasions during electoral years. Municipalities with more parties disputing mayoral elections and with more right-wing ideological mayors also have fewer land invasions. Nonetheless, the results are statistically insignificant.

In Appendix Table D.9, we create a principal component analysis (PCA) index of the private sector, public services, and spending variables. The public services index is the only significant result at the 0.05 level. It corroborates that municipal public services provision increases land invasions.

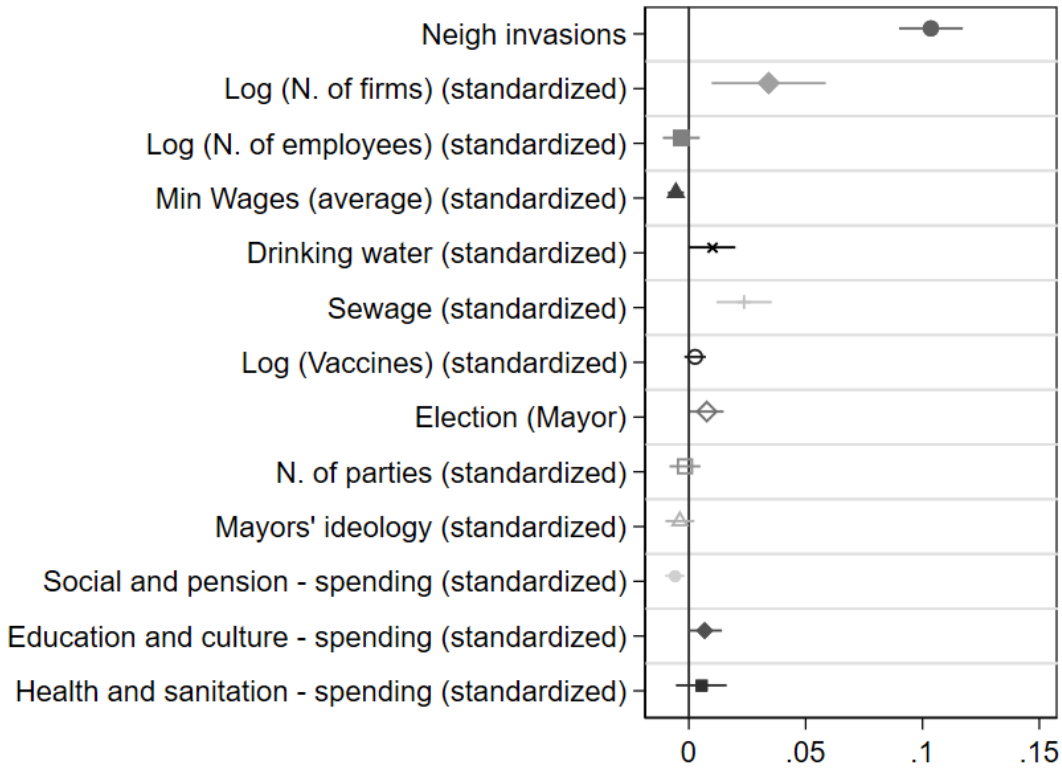
7 Regional Differences

We now return to our analysis of the impact of land invasions on slavery, exploring differential effects across regions. Figure 4 displays two bar plots showing the frequency of slavery and land invasions. Figure 4a on the left highlights the frequency of modern-day enslaved people across the North, Northeast, Southeast, South, and Central West (CW) regions. Figure 4b shows the frequency of invasions across the same areas.

The plots show the distribution of enslaved people and land invasions. They only offer hints about the relationship between our two main variables.[23] The incidence of slavery is the highest in the North (739 slaves, averaging 21.54 per municipality). The CW is in second place with 344 enslaved people, averaging 32.96 slave workers per municipality. The Northeast is in third place (slaves: 260; mean: 29.90). The Southeast has 191 enslaved people, averaging 30.95. Finally, the Southeast had 191 slaves

[23] Land invasions are a more common phenomenon than slavery. The MST is an organized and active social movement that promotes land reform. Left parties support the MST activities, e.g., PT, PCdoB, PCB, PCO, and PSOL. Slavery is a hidden and rare crime.

Figure 3: Panel OLS Regressions: Determinants of Invasions



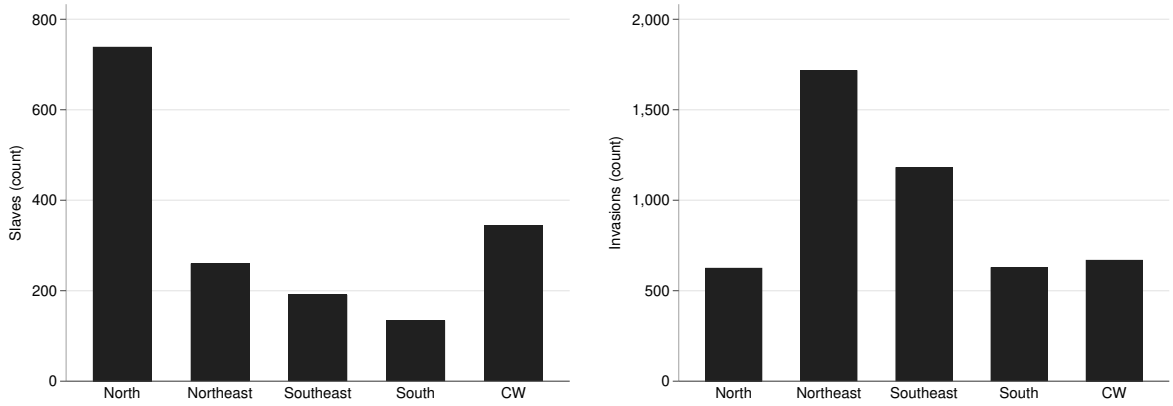
Notes: **Dependent Variable: Land invasions (count).** The plot presents point estimates and 95% confidence intervals. The right axis presents the main independent variables. They were standardized to improve the visualization of the coefficients. We preserve the original scale of the categorical variables. To construct the plot, we estimate thirteen separate linear panel regressions. We included the same control variables (not shown) of our baseline model first presented in column 2 of Table 1. Most specifications include municipality and year (dummies) fixed effects and cluster standard errors at the municipal level. The regression of Election (Mayor) on Slavery does not include year-fixed effects because they correlate with the years of Mayoral Elections.

(mean: 15.86). The distributions of slaves divide the urban South-Southeast and the more rural North-Northeast-CW.

We also observe more invasions in the Northeast (1,718, averaging 1.84 per municipality). The Southeast is the second region with more invasions (1,182 land invasions and a mean of 2.1). With similar figures, CW has 670 invasions (mean: 1.76), the South has 629 invasions (mean: 1.59), and the North has 626 invasions (mean: 1.93). Although the Northeast has the highest incidence of land invasions, we want to explore in greater detail whether there is a geographic division between the developed South-Southeast and the more backward North-Northeast-CW areas.

Figure 5 presents an OLS panel regression with municipalities and year-fixed effects, splitting the

Figure 4: Bar Plots: Slaves and Invasions over Regions



(a) Slaves over regions

(b) Invasions over regions

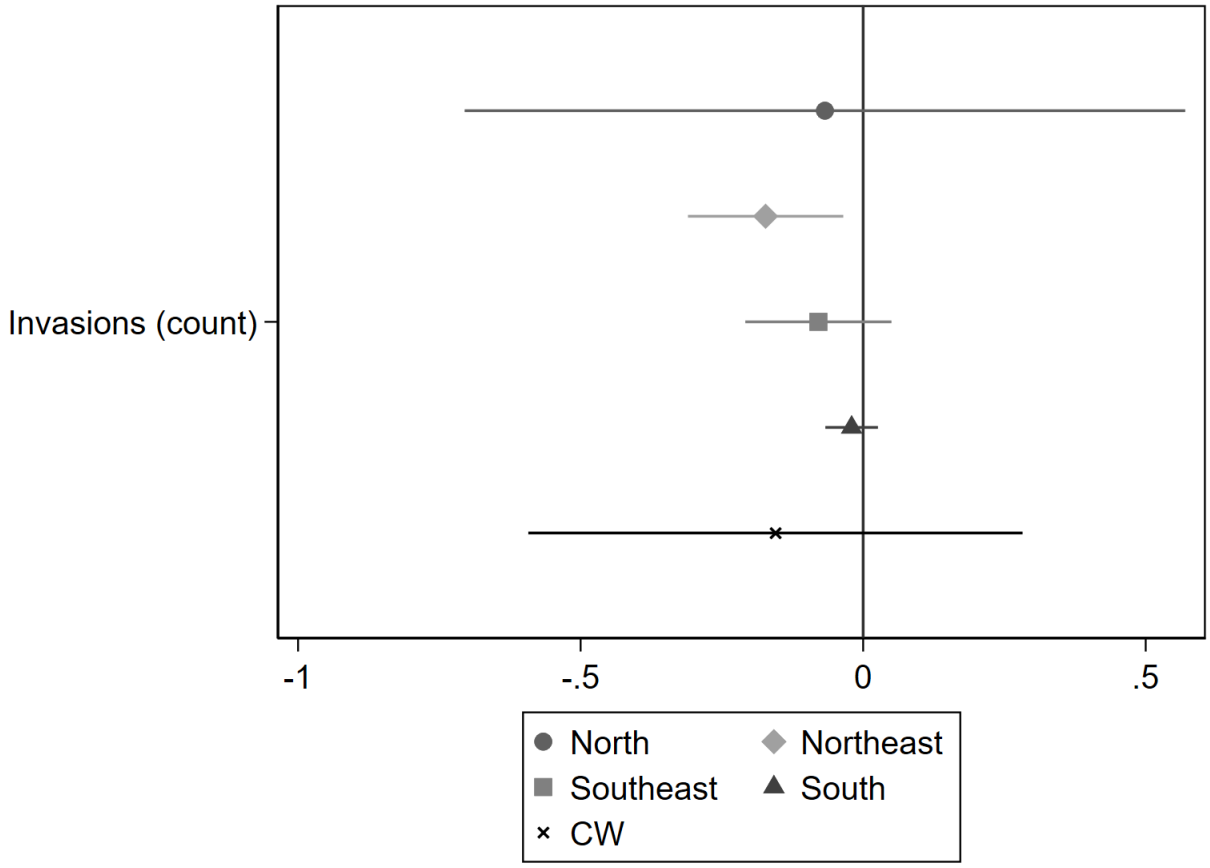
Notes: Bar plot (a) on the left highlights the frequency of modern enslaved people across Brazilian regions. Plot (b) on the right shows the frequency of land invasions across the same regions.

sample across regions. The plot shows point estimates and 95% confidence intervals. The right axis shows the independent variable "invasions (count)." The plot includes the same control variables (not shown) first presented in column 2 of Table 1.

The cross-regional differences are considerable and stark. The impoverished Northeast (NE) is the only region with significant results. It also presents the largest point estimate. The link between invasions and slavery for the impoverished Northeast (-0.17) is roughly double of the urban Southeast (-0.08) and is around 3-9 times that of the developed South (-0.02). Other researchers have found similar patterns. In their study on *Bolsa Família*[24] and child labor, Cepaluni et al. (2022) found that the Northeast has more than five times child labor than the Southeast and more than two and a half times that of the South. In addition, they do not find an effect for the North or the Central West. From this, we infer that geography matters insofar as variance in local economy, poverty, and State capacity results in differing levels of forced labor, crime, and human rights abuses. For instance, there are more people employed in the agricultural sector in the Northeast than in other Brazilian regions (da Silva, Amarante and Amarante, 2022). Research also has shown the extreme transportation obstacles poor people in the Northeast face to obtain public goods (Benevenuto and Caulfield, 2020). For this reason, contemporary

[24]The world's conditional cash transfer (CCT).

Figure 5: Panel OLS Regressions: Impact of Invasions on Slavery — Heterogeneous Effects by Regions



Notes: *Panel OLS regressions: Heterogeneous effects by regions.* **Dependent Variable: Slaves.** The left axis presents our main independent variable: Invasions (count). The plot presents point estimates and 95% confidence intervals. It includes the same control variables (not shown) first presented in column 2 of Table 1. The specification includes municipality and year (dummies) fixed effects and cluster standard errors at the municipal level. The legends identifying the regions are at the bottom of the figure.

scholars are researching the relationship between politics (e.g., clientelism, corruption, and electoral incentives) and problems common in the poor municipalities (e.g., water cisterns in drought-prone areas and Zika virus) in Brazil's Northeast (Boas, Hidalgo and Melo, 2019; Bobonis et al., 2022; Frey, 2022).

Appendix Figure D.3 replicate our estimates with WFE models. The results are similar as we still find a rural divide between municipalities. CW still presents the largest negative coefficient, which is now significant at conventional levels. The Northeast is the second largest coefficient, significant at the traditional level ($p < 0.05$). The Southeast presents the third largest negative coefficient ($p < 0.05$).

Finally, we cannot distinguish from zero the impact of invasions and slavery on Brazil's North and South.

8 Discussion and Conclusions

Adam Smith argues that slavery was generally inefficient. He also observes that, despite its inefficiencies, slavery is persistent (Smith, 1978). The persistence of slavery in human history and its long-term effects are central concerns of modern social scientists (North et al., 2009; Dell, 2010; Nunn, 2008; Nunn and Wantchekon, 2011).

Slavery was the most common form of labor contracts in many ancient civilizations — Greece, Egypt, Rome, and several Islamic, Asian, and pre-Columbian civilizations (Meltzer, 1993; Davis, 2006). Slavery was also central to agricultural economies in the Caribbean (Curtin and Curtin, 1998; Klein and Vinson III, 2007), in the South of the United States, and Latin America (Fogel and Engerman, 1995; Lockhart and Schwartz, 1983; Dell, 2010). Although formal slavery has been rare in Europe since the Middle Ages, forced labor was a relevant type of "employment contract" until the 19th century (Gingerich and Vogler, 2021). Human trafficking of immigrants and refugees, often considered "modern-day slavery," is still recurrent in today's Europe (Hernandez and Rudolph, 2015; Buonanno and Vargas, 2019). The United Nations' International Labor Organization (ILO) estimated that there are over 24.9 million forced laborers worldwide (ILO, 2017).

This paper explores a rare opportunity for quantitatively studying such a pressing topic. We estimate that one land invasion decreased at least 0.14-0.31 slaves in Brazilian municipalities from 1995 to 2013. A formal model of the effect of the landless movement's invasions on the employer's choices to hire enslaved people to help us to interpret our findings. Landless movements have a normative position against modern-day slavery and other forms of extreme labor exploitation. Also, the notion of land's social function allows social movements to invade properties with slave workers.

There may be underreporting of modern-day slavery. A lack of policing, State capacity, political ideology, or data quality can generate underreporting. We tried to mitigate these potential problems in

many ways. Our theory models rural crimes' hidden activities acknowledging that some level of slavery is unobservable. Our models control for unobserved heterogeneity, including year and municipality-fixed effects. We employed different statistical techniques, obtaining comparable results. Our main results are robust to a rich set of controls, several model specifications, and different sample selections. We find a stronger relationship between invasions and slavery when we model sample selection. Each invasion reduces three enslaved people in the municipality. So, the results in the main paper underestimate the actual effect. Above all, we take our measure of slavery from Brazilian law and the Brazilian State's corresponding actions. Thus, we do not have some measurement biases common in survey research — for example, social desirability bias or a mismatch between an abstract category and a behavioral phenomenon.

We examine how different municipal characteristics influence slavery and land conflicts. First, we find evidence that the number of firms increases invasions, and average salaries decrease land conflicts. We also find that more employees are associated with more enslaved people. Second, public goods increase land invasions because it is necessary to have a basic infrastructure to have productive land worth an invasion. Finally, the desire to stay in power and win elections incentivizes local politicians to reduce land invasions, not slavery. Slavery is an illegal, hidden activity. Land invasions have legal justifications as an instrument for land redistribution. Hence, it is reasonable that politicians seeking power want to focus on land invasions, a more salient problem than slavery.

Researchers associate previous coercive labor relations with different contemporaneous levels of democratic governance. Paige (1998) states that the Guatemalan elite was agrarian, marked by debt servitude, serfdom, and other forms of bonded labor. As a result, coerced labor institutions inhibited popular mobilization and created a keen interest in authoritarian political structures to control the unfree population. There was more land distribution in Costa Rica, and local elites found that land conflicts could be managed by extending the franchise to rural property owners. Gingerich and Vogler (2021) find that areas hit harder by the Black Death adopted more democratic institutions because the corresponding population reduced the likelihood of repressive labor regimes. Moreover, one study found an association between higher levels of democracy and lower modern-day slavery cases in a

cross-country comparison (Landman and Silverman, 2019). In this sense, the study of modern slavery might have long-term consequences for the quality of democracy in countries that still have coercive forms of labor relations.

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A Online Appendix – Not for Print Publication

B Chronology — 1995-2013

Table B.1: Chronology of actions, laws and public policies against slave labor in Brazil — 1995-2013

Year	Event
1995	Brazil recognizes before the UN the existence of slaves in its territory. Ordinances 549 and 550 of June 14, 1995, and Presidential Decree No. 1538 of June 27, 1995, created the Special Mobile Inspection Group (GEFM), the Secretariat of Labor Inspection (SIT), and the Executive Group for the Suppression of Forced Labor (GERTRAF).
1998	The country adopts the "ILO Declaration on Fundamental Principles and Rights at Work." Law 9,777 amends Articles 132, 203 and 207 of the Brazilian Penal Code. It defines crimes related to slave labor and its legal sanctions. Brazil has its first final criminal sentence related to slave labor (*Fazenda Alvorada, Água Azul do Norte, Pará*).
2002	Resolution No. 306, of November 6, 2002, establishes the Unemployment Insurance for Rescued Workers. After that, rescued slaves can receive three months of unemployment insurance. The federal government creates a Special Committee in the Council for the Defense of Human Rights (CDDPH) in the Ministry of Justice and the National Committee for the Eradication of Slave Labor (CONAETE) in the Labor Public Prosecution Office.

(To be continued)

Year	Event
2003	Brazil launches the First National Plan for the Eradication of Slave Labor (the first PNETE) as part of the National Program for the Eradication of Slave Labor (CONATRAE). The National Plan complies with the provisions of Brazil's National Human Rights Plan. Brazil signs a friendly settlement on the José Pereira case at the Inter-American Court of Human Rights. Ordinance No. 1,234 of the Ministry of Labor and Employment (MTE) creates a "Dirty List of Slave Labor." The list prevents the granting of credits and financing to enslavers. Law No. 10,803 modifies Art. 149 of the Penal Code, defining the following labor conditions analogous to slavery: i) forced labor, ii) exhausting working hours, iii) degrading working conditions, and iv) debt bondage.
2004	Brazil recognizes before the UN the existence of at least 25 thousand people in slavery annually. During the Unaí massacre, four MTE employees were murdered during an investigation into allegations of slave labor.
2005	The Brazilian government creates the National Pact for the Eradication of Slave Labor. About 400 national and multinational companies committed to not buying raw materials from suppliers who use slave labor.
2006	Brazil's Supreme Federal Court decides that the Federal Justice must handle the trials on modern slavery crimes.
2008	CONATRAE launches the Second National Plan for the Eradication of Slave Labor. First formal expropriation in Brazil of a farm (Cabaceiras, in Marabá / PA) because of slave labor. After five years of experience with the First National Plan, on April 17, 2008, Brazil launched the Second National Plan for the Eradication of Slave Labor, updating anti-slave labor actions.

(To be continued)

Year	Event
2009	Brazil creates the National Day to Combat Slave Labor on the date of the Unaí massacre (January 28). The State of Mato Grosso promotes the qualification for workers rescued from slavery.
2010	First National Meeting for the Eradication of Slave Labor.
2013	State Law 14,946 cancels the registration of companies involved in slave labor in the State of São Paulo.

B.1 Proof of Proposition 1

To prove Proposition 1, we analyze three equilibria.

First, we show that *not to invade* dominates *to invade* if $k > 1$ for both *Aggressive* and *Strategic* Types, as shown in equation 2. If the landless movement never invades, it is optimal for landowners to exploit slave workers. This is the first equilibrium $s_l = 1, s_m = 0$.

Second, if $c < 1$, the *Aggressive* Type of landless movement always invades. Yet, the *Strategic* Type would not invade if it is irrational for the landowner to play $s_l = 1$. The second equilibrium, given the probabilities of audit (p_g) and invasion by the *Aggressive* Type (p_b), produce the expected benefit of employing slave workers — if the *Strategic* Type never invades:

$$(1 - p_g)(1 - \beta p_b) - \alpha_w w(1 - p_b) - (w + c)p_b < 1 - \beta p_b - w \tag{7}$$

Under this setting, it is not rational to play "slavery" — regardless of the *Strategic* Type game plan. Solving equation B.1, the equilibrium happens if the benefit from adopting slavery $w(1-\alpha_w)$ is smaller than the expected cost of the strategy $\frac{cp_b+(1-\beta p_b)p_g}{1-p_b}$.

There is a Bayesian mixed-strategy equilibrium in this game. In the third equilibrium, the *Aggressive* Type invades as shown in equation 2. Yet, now it is profitable for the landowner to enslave workers. If

the game reaches this stage, the *Strategic* Type landless movement knows that — if Nature selects the government to audit a land — the land has no enslaved people. So, if *Strategic* Type chooses to act, it knows that the game did not end in Step 4. Hence, he considers his strategy in a Bayesian manner:

$$E[U_m(s_m)] = [P(s_l = 1|\text{Step 5}) - c]s_m \tag{8}$$

where, by the Bayes Theorem, we have:

$$P(s_l = 1|\text{Step 5}) = \frac{P(\text{Step 5}|s_l = 1)P(s_l = 1)}{P(\text{Step 5}|s_l = 1)P(s_l = 1) + P(\text{Step 5}|s_l = 0)P(s_l = 0)} \tag{9}$$

To find a mixed-strategy equilibrium for this game, we need to find a $q_l = P(s_l = 1)$ that ensures equation 8 has $E[U_m(0)] = E[U_m(1)]$.

We know that $P(\text{Step 5}|s_l = 1)$ is equal to the probability of not auditing $1 - p_g$, and that $P(\text{Step 5}|s_l = 1) = 1$ as the game always achieves the fifth step if the landowner does not enslave workers. Combining these pieces of information with equations 8 and 9, we find:

$$\frac{q_l(1 - p_g)}{q_l(1 - p_g) + (1 - q_l)} = k \tag{10}$$

which yield:

$$q_l = \frac{k}{1 - p_g + kp_g} \tag{11}$$

Likewise, the landowner knows that with probability $1-(1-p_g)(1-p_b)$, the *Aggressive* Type will either audit or invaded. Hence, the utility of the landowner is:

$$\begin{aligned} E[U_l(s_l)] = (1 - s_l p_g)[1 - \beta p_b - \beta(1 - p_b)q_m] - \alpha_w w s_l[1 - p_b - (1 - p_b)q_m] \\ -(w + c)s_l[p_b + (1 - p_b)q_m] - w(1 - s_l) \end{aligned} \tag{12}$$

where q_m is the probability attributed to the landless movement (strategic type) to play $s_m = 1$. To find a mixed-strategy equilibrium, we need to find a q_m that ensures equation 12 has $E[U_l(0)] = E[U_l(1)]$.

Algebraic manipulations yield:

$$q_m = \frac{(1-\alpha_w)w(1-p_b) - cp_b - p_g(1-\beta p_b)}{(1-\alpha_w)w(1-p_b) - \beta p_g(1-p_b) + c(1-p_b)} \tag{13}$$

This value is between 0 and 1 as long as $w(1-\alpha_w) > \frac{cp_b+(1-\beta p_b)p_g}{1-p_b}$. We have found a third equilibrium with $P(s_l = 1) = \frac{c}{1-p_g+p_g c}$, $P(s_m = 1|\text{Type = Aggressive}) = 1$, and $P(s_m = 1|\text{Type = Strategic}) = \frac{(1-\alpha_w)w(1-p_b)-cp_b-p_g(1-\beta p_b)}{(1-\alpha_w)w(1-p_b)-\beta p_g(1-p_b)+c(1-p_b)}$.

C Sensitivity analysis

C.1 Degree of omitted variable bias based on observables

We calculate the bounds on potential bias estimating the variable of interest — land invasions — that could result from selection on unobservables (Altonji, Elder and Taber, 2005; Oster, 2019). The test proposed by Oster (2019) uses information from changes in the point estimates and R^2 values derived from a model specification without any controls and a specification that includes the observed controls.

Oster (2019) defines the parameter δ as the extent to which the unobserved variables are as important as the observed variables in producing a treatment effect equal to zero. With $\delta = 1$, unobserved variables are as important as the observed ones. Delta greater than one ($\delta > 1$) implies that the unobserved variables can bias the estimates to zero. Delta smaller than one ($\delta < 1$) means that unobservables are less critical than observables. For instance, a value of $\delta = 2$ suggests that unobservables need to be twice as important as the observables to produce zero treatment effect. Following Altonji, Elder and Taber (2005), Oster (2019, p. 20) suggests that assuming $\delta = 1$ is an appropriate upper bound on δ because the researchers should select the variables that they believe are the most relevant controls.

Oster (2019) defines the hypothetical R^2 of a model with both observed and unobserved controls as R_{max}. If $R_{max} = 1$, observed and unobserved controls explain all the variation in the outcome, with no idiosyncratic (i.e., white noise) component to the outcome data generation process. The R_{max} value is undefined because we cannot estimate a model with unobserved covariates. Yet, we make an assump-

tion on R_{max} relative to the R^2 value from the regression with observed control variables. Suppose we let $\tilde{R}$ denote the R^2 from a specification with the treatment and controls. In that case, we can define $R_{max} = \pi\tilde{R}$, where π is a parameter that varies in the extent to which unobserved covariates increase the R^2 — relative to R — when added to the specification. Thus, $\pi = 1$ means that all unobserved covariates explain no further variation in the outcome. In contrast, $\pi = 2$ means that unobserved covariates explain as much variation in the outcome as treatment and the observed variables. Based on the replication of a series of randomized control trials, Oster (2019, p. 3) suggests that researchers use an $\pi = 1.3$. In her study, 90% of randomized articles survive this standard, whereas only about 45% of non-randomized studies survive it.

Table C.2: Sensitivity to Selection on Unobservables

	(1)	(2)
	Full Sample	Restricted Sample
Dependent Variable: Slaves		
Invasions (count)	-0.150**	-0.609**
	(0.0563)	(0.202)
Controls	YES	YES
Year fixed effects	YES	YES
Municipality fixed effects	YES	YES
δ	1965.1	50.93
Bias-adjusted β	-0.150	-0.603
R-squared	0.00124	0.0103
Municipalities	5360	578
N	95323	11191

Notes: The Invasions (count) coefficients, standard errors, and R-squares's were taken from a model that includes the same control variables (not shown) of our baseline model first presented in column 2 of Table 1. The second column restrics our samples to municipalities that had at least one slave rescued. Deltas and bias-adjusted betas were calculated comparing the models with the the usual controls and without any controls. All specifications include municipality and year dummy fixed effects and cluster standard errors at the municipal level (in parenthesis). $+p < .1, *p < .05, **p < .01, ***p < .001$.

Table C.2 reports the results from two models. The first one is the same model presented in column 2 from Table 1 in the main paper. The second model restricts our sample to municipalities with at least one enslaved person rescued from 1995 to 2013. The only difference between these models is

that, in the second model, we restricted our sample to municipalities with at least one case of slavery from 1995-2003.[25] The first column repeats the estimate first presented in column 2 from Table 1 in the main paper. Standard errors are in parenthesis. We report the δ value under the assumption $R_{max} = 1.3X\tilde{R}$ and $\beta_{Invasions} = 0$. The inclusion of controls is unlikely to bias our results towards zero. Deltas (δ) suggest the unobservables should explain 1965.1 (in the full sample) and 50.93 times (in the restricted sample) of the observed covariates' variations, including our treatment, to bias our estimates to zero. We report the bias-adjusted $\beta_{Invasions}$ assuming $\pi = 1.3$ and $\delta = 1$ (Oster, 2019, p. 6). The robustness of our main result can also be estimated by the Bias-adjusted β's. The bias-adjusted estimates in the first and the second columns do not alter the land invasions' coefficients. We use the R^2 values to calculate the R_{max}.

Figure C.1 shows by how much the $\beta_{Invasions}$ from our first model changes as we vary δ, while assuming that $\delta = 1$. The blue line marks the $\pi = 1.3$ rule of thumb (Oster, 2019, p. 6). The results indicate that $\beta_{Invasions}$ negatively increases as we employ progressively larger values of π. Given the conservative assumption that the importance of the unobserved variables is the same as the observed variables, the inclusion of new controls would make the results presented in the main paper stronger. In short, these sensitivity tests suggest that the effect of land invasions on slavery presented in the first table of the main paper is (again) likely a conservative estimation of the true effect.

[25]The model presented in the main paper is the lower bound of the impact of land invasions on slavery. The sensitivity analysis second model offers an intermediate bound for this relationship. Appendix Table D.10 presents a fixed effects selection model, which is the study's upper bound.

Sensitivity Analysis of the Full Sample: Impact of Invasions on Slavery

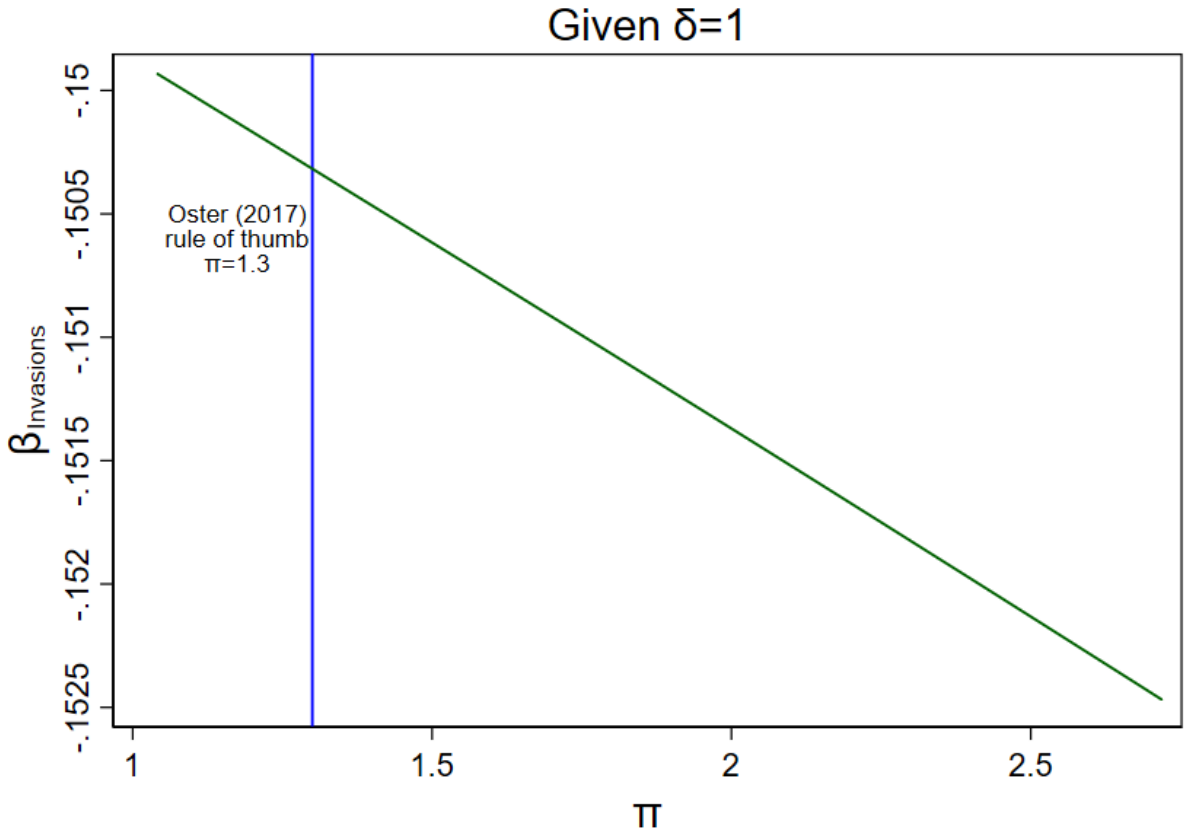


Figure C.1: *Sensitivity to bias from selection on unobservables.* **Dependent Variable: Slaves.** The model uses the full sample. The Invasions (count) coefficient, standard error, and R-square were taken from a model that includes the same control variables (not shown) of our baseline model first presented in column 2 of Table 1. Deltas and bias-adjusted betas were calculated by comparing the models with our usual controls and without any controls. All specifications include municipality and year dummy fixed effects and cluster standard errors at the municipal level (not shown).

D Extra analysis: Descriptive Statistics and Robustness Checks

Table D.3: Summary Statistics — Panel Data

Variable	Obs	Mean	Std. Dev.	Min	Max
Slaves	101870	.423	8.448	0	1064
Slaves (binomial)	101870	.016	.127	0	1
Invasions (count)	101870	.089	.574	0	31
Invasions (binomial)	101870	.047	.212	0	1
Illiteracy (rates)	101870	18.455	11.618	.575	97.192
Log (Tax collection)	96153	12.427	2.332	0	23.575
Reforms	101870	.082	.497	0	22
Land (Gini)	101069	.713	.123	.01	.99
Murders	101870	.013	.233	0	22
Municipal guards	101870	.144	.351	0	1
Rural percentage	101180	.393	.226	0	1
Log (Population)	101870	9.376	1.114	6.48	16.285
Log (GDP per capita)	101870	1.862	.757	.01	8.309
Cattle Dependency	101870	1.703	1.196	0	10.208
Soy Dependency	101870	.099	.203	0	1
Sugar Dependency	101870	.107	.232	0	1
Coffee Dependency	101870	.056	.162	0	1
Log (N. of firms)	99505	4.02	1.729	.693	12.467
Log (N. of employees)	100688	2.106	.725	.693	8.538
Min Wages (average)	100688	1.751	1.074	0	30.165
Drinking water	99751	.759	.251	0	1
Sewage	99751	.114	.145	0	.909
Log (Vaccines)	101870	8.957	1.721	0	16.414
Mayors' ideology	69316	2.227	.721	1	3
Election (mayor)	101870	2001.677	5.604	1992	2012
N. of parties	71110	2.614	1.044	1	14
Neigh invasions	101870	.209	.406	0	1
Neigh-of-neigh invasions	101870	.375	.484	0	1
Log (Social and pension) - spending	91350	12.945	2.048	0	22.579
Log (Education and culture) - spending	91350	14.847	1.497	0	22.86
Log (Health and sanitation) - spending	91350	14.42	1.713	0	22.748

Table D.4: Mayors' Ideology

Old name	Old and new name	Ideology
DEM	DEM/PFL	Right
NOVO	NOVO	Right
PAN	PTB/PAN/PSD(old)	Right
PC do B	PC do B	Left
PCB	PCB	Left
PCO	PCO	Left
PDT	PDT	Left
PEN	PEN	Center
PFL	DEM/PFL	Right
PGT	PR/PL/PRONA/PST/PGT	Right
PHS	PHS	Right
PL	PR/PL/PRONA/PST/PGT	Right
PMB	PMB	Center
PMDB	PMDB	Center
PMN	PMN	Center
PP	PP/PPB	Right
PPB	PP/PPB	Right
PPL	PPL	Left
PPS	PPS	Center
PR	PR/PL/PRONA/PST/PGT	Right
PRB	PRB	Right
PRN	PTC/PRN	Right
PRONA	PR/PL/PRONA/PST/PGT	Right
PROS	PROS	Center
PRP	PRP	Right
PRTB	PRTB	Right
PSB	PSB	Left
PSC	PSC	Right
PSD	PSD	Center
PSD(old)	PTB/PAN/PSD(old)	Right
PSDB	PSDB	Center
PSDC	PSDC	Right
PSL	PSL	Right
PSOL	PSOL	Left
PST	PR/PL/PRONA/PST/PGT	Right
PSTU	PSTU	Left
PT	PT	Left
PT do B	PT do B	Right
PTB	PTB/PAN/PSD(old)	Right
PTC	PTC/PRN	Right
PTN	PTN	Right
PV	PV	Center
REDE	REDE	Center
SD	SD	Center

Notes: We use previous work on the ideology of Brazilian parties to construct our classification (Mainwaring, Meneguello and Power, 2000; Melo, 2004; Power and Zucco Jr, 2009).

Table D.5: OLS Panel Regressions: Impact of Invasions on Slavery — Heterogenous Effect by Decades

	(1) 1995-2000	(2) 2000-2010	(3) 2010-2013
Dependent Variable: Slaves			
Invasions (count)	-0.012	-0.304**	-0.001
	(0.012)	(0.096)	(0.117)
Illiteracy (rates)	-0.010	0.064	0.320
	(0.011)	(0.043)	(0.227)
Log (Tax collection)	0.002	0.079+	-0.029
	(0.008)	(0.044)	(0.036)
Reforms	0.051	0.199	0.129
	(0.090)	(0.124)	(0.213)
Land (Gini)	2.198*	0.554	-3.069
	(1.042)	(1.273)	(4.263)
Murders	-0.220	-0.996*	-0.270
	(0.219)	(0.398)	(0.207)
Municipal guards	0.051	0.027	0.076
	(0.075)	(0.112)	(0.152)
Rural percentage	0.579	-0.845	-4.971
	(0.682)	(1.892)	(4.051)
Log (Population)	0.004	-0.451	-0.789
	(0.280)	(0.789)	(1.497)
Log (GDP per capita)	-0.074	-0.101	0.109
	(0.119)	(0.271)	(0.286)
Cattle Dependency	-0.054	-0.333*	0.169*
	(0.105)	(0.140)	(0.083)
Soy Dependency	0.678	-1.133	-1.887**
	(1.153)	(1.042)	(0.726)
Sugar Dependency	-0.022	0.884	-2.107
	(0.055)	(0.617)	(2.032)
Coffee Dependency	-0.005	0.059	-2.786
	(0.225)	(0.506)	(2.225)
R-squared	0.001	0.001	0.003
Municipality clusters	5343	5345	5320
N	27571	57235	21028
Year fixed effects	YES	YES	YES
Municipality fixed effects	YES	YES	YES

Notes: All specifications include municipality and year dummy fixed effects and cluster standard errors at the municipal level (in parenthesis). $+p < .1, *p < .05, **p < .01, ***p < .001$.

Table D.6: Poisson Panel Regressions: Impact of Invasions on Slavery

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: Slaves						
Invasions (count)	-0.131**	-0.128*	-0.132*	-0.232**	-0.242*	-0.247*
	(0.049)	(0.063)	(0.059)	(0.073)	(0.104)	(0.099)
Illiteracy (rates)		0.109**	0.103*		0.119**	0.118*
		(0.039)	(0.042)		(0.044)	(0.050)
Log (Tax collection)		0.111	0.092		0.149+	0.119
		(0.092)	(0.084)		(0.080)	(0.074)
Reforms		0.046	0.063+		-0.007	0.016
		(0.041)	(0.037)		(0.047)	(0.042)
Land (Gini)		2.084	1.336		1.469	0.917
		(1.633)	(1.732)		(1.587)	(1.810)
Murders		-0.147**	-0.137*		-0.144*	-0.135*
		(0.054)	(0.053)		(0.058)	(0.058)
Municipal guards		0.505+	0.527*		0.724*	0.601*
		(0.306)	(0.247)		(0.294)	(0.257)
Rural percentage		-1.038	-2.801		-2.037	-3.914
		(2.908)	(3.181)		(3.152)	(3.376)
Log (Population)		-1.647***	-1.582**		-1.554**	-1.590*
		(0.459)	(0.574)		(0.572)	(0.712)
Log (GDP per capita)		-0.815*	-0.585		-1.080**	-0.874*
		(0.394)	(0.387)		(0.356)	(0.376)
Cattle Dependency		-0.423***			-0.490***	
		(0.120)			(0.133)	
Soy Dependency		-1.207			-0.877	
		(0.758)			(0.795)	
Sugar Dependency		1.526+			2.419*	
		(0.814)			(0.997)	
Coffee Dependency		-2.086+			-0.983	
		(1.236)			(1.539)	
Log (N. of firms)			-0.815*			-0.745+
			(0.379)			(0.393)
Log (N. of employees)			0.695**			0.717**
			(0.232)			(0.242)
Min Wages (average)			0.180			0.250+
			(0.197)			(0.144)
Pseudo R2	0.330	0.353	0.346	0.360	0.398	0.391
Log pseudolikelihood	-85530.294	-75922.287	-75270.281	-61592.881	-53326.519	-53089.551
Municipality clusters	583	562	561	544	525	523
N	12139	10960	10401	5938	5394	5223
Year fixed effects	YES	YES	YES	YES	YES	YES
Municipality fixed effects	YES	YES	YES	YES	YES	YES

Notes: The models drop observations that are singletons or separated by fixed effects. Singletons — groups with only one observation — occur when we have only one observation within the fixed effects clusters. Separation occurs when independent variables (or set of them) perfectly predicts your outcome variable. All specifications include municipality and year dummy fixed effects and cluster standard errors at the municipal level (in parenthesis). $+p < .1, *p < .05, **p < .01, ***p < .001$.

Table D.7: OLS Panel Regressions: Impact of Invasions on Slavery — Lags and Leads

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: Slaves						
Invasions (t - 1)	-0.054					
	(0.072)					
Invasions (t - 2)		-0.116+				
		(0.062)				
Invasions (t - 3)			0.056			
			(0.079)			
Invasions (t + 1)				0.230		
				(0.299)		
Invasions (t + 2)					-0.127+	
					(0.068)	
Invasions (t + 3)						-0.041
						(0.075)
Illiteracy (rates)	0.027*	0.037*	0.044*	0.023+	0.020	0.021
	(0.014)	(0.017)	(0.020)	(0.013)	(0.015)	(0.018)
Log (Tax collection)	0.029+	0.015	0.011	0.028*	0.033**	0.037**
	(0.015)	(0.022)	(0.025)	(0.012)	(0.012)	(0.013)
Reforms	0.151	0.132	0.158	0.097	0.086	0.079
	(0.103)	(0.106)	(0.115)	(0.112)	(0.112)	(0.115)
Land (Gini)	1.001*	0.896	0.395	1.202*	1.343*	1.757*
	(0.474)	(0.555)	(0.606)	(0.475)	(0.575)	(0.711)
Murders	-0.366	-0.392	-0.520+	-0.348	-0.395	-0.421
	(0.266)	(0.312)	(0.290)	(0.260)	(0.264)	(0.267)
Municipal guards	0.106	0.120	0.122	0.093	0.087	0.080
	(0.096)	(0.100)	(0.103)	(0.100)	(0.108)	(0.123)
Rural percentage	0.813	0.612	0.291	0.936	0.898	0.943
	(0.776)	(0.936)	(1.046)	(0.698)	(0.775)	(0.910)
Log (Population)	-0.380	-0.690	-0.860	0.179	0.314	0.478
	(0.454)	(0.497)	(0.527)	(0.459)	(0.512)	(0.586)
Log (GDP per capita)	0.174	0.113	0.149	0.260+	0.297+	0.334+
	(0.162)	(0.184)	(0.169)	(0.148)	(0.160)	(0.174)
Cattle Dependency	-0.147*	-0.166*	-0.173*	-0.164*	-0.167*	-0.162+
	(0.070)	(0.076)	(0.081)	(0.074)	(0.083)	(0.098)
Soy Dependency	-0.763	-1.074	-1.359+	-0.414	-0.290	-0.144
	(0.620)	(0.709)	(0.810)	(0.550)	(0.560)	(0.585)
Sugar Dependency	0.404	0.395	0.428	0.357	0.506	0.641
	(0.333)	(0.346)	(0.365)	(0.347)	(0.393)	(0.474)
Coffee Dependency	-0.041	-0.018	0.094	-0.010	0.041	-0.115
	(0.366)	(0.407)	(0.486)	(0.324)	(0.330)	(0.315)
R-squared	0.001	0.001	0.001	0.001	0.001	0.001
Municipality clusters	5358	5351	5349	5358	5356	5353
N	90077	84925	80027	90072	85097	79928
Year fixed effects	YES	YES	YES	YES	YES	YES
Municipality fixed effects	YES	YES	YES	YES	YES	YES

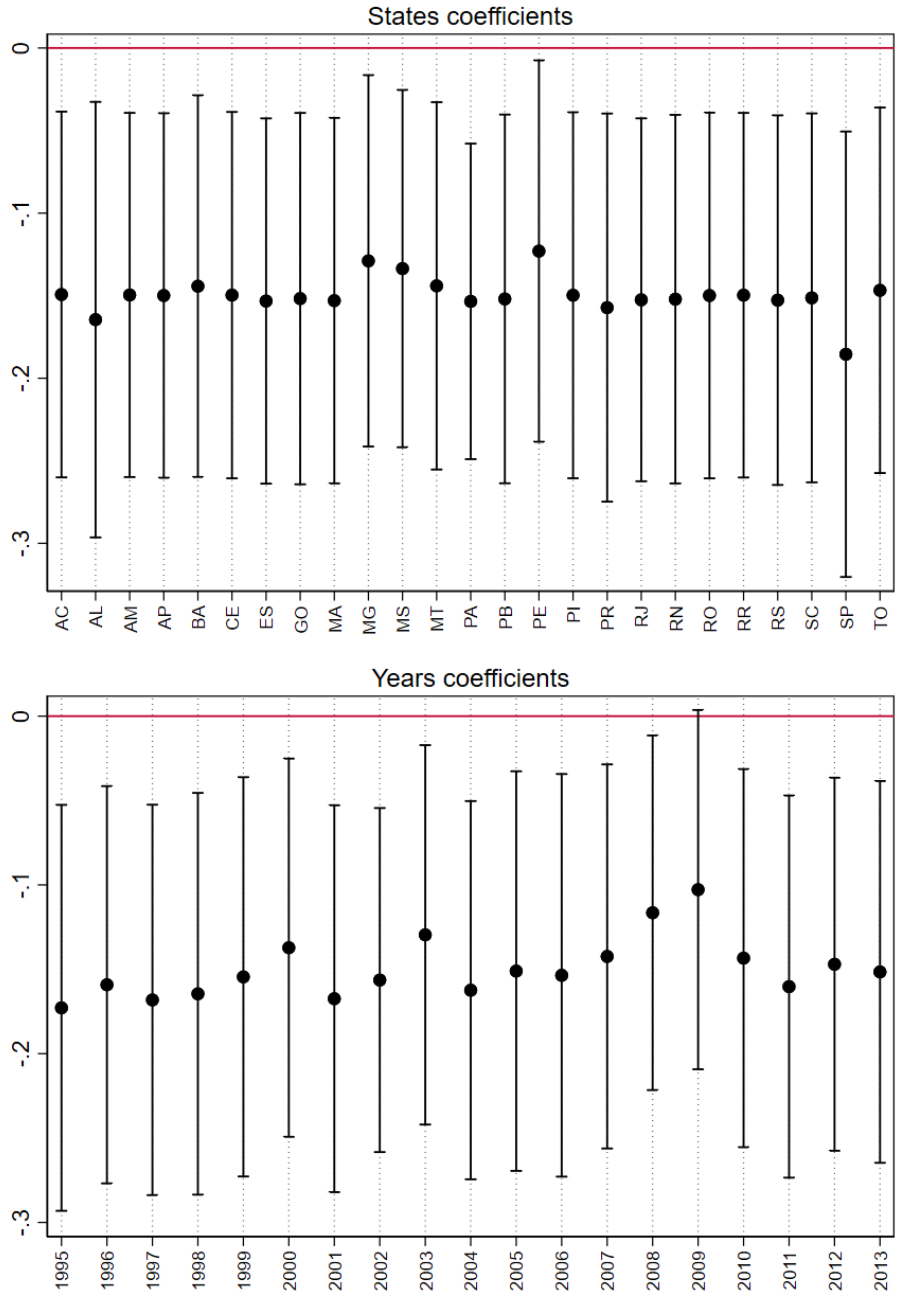
Notes: All specifications include municipality and year dummy fixed effects and cluster standard errors at the municipal level (in parenthesis). The calculations to create "lags" and "leads" leave us with progressively smaller sample sizes. $+p < .1, *p < .05, **p < .01, ***p < .001$.

Table D.8: OLS Panel Regressions: Impact of Neighbor invasions on Slavery

	(1)	(2)
Dependent Variable: Slaves		
Neigh invasions	0.143	
	(0.097)	
Neigh-of-neigh invasions		0.004
		(0.049)
Illiteracy (rates)	0.020+	0.020+
	(0.011)	(0.011)
Log (Tax collection)	0.021+	0.020+
	(0.011)	(0.011)
Reforms	0.113	0.114
	(0.110)	(0.110)
Land (Gini)	0.986*	0.996*
	(0.410)	(0.411)
Murders	-0.338	-0.337
	(0.256)	(0.256)
Municipal guards	0.079	0.080
	(0.094)	(0.094)
Rural percentage	0.627	0.641
	(0.610)	(0.610)
Log (Population)	0.062	0.061
	(0.409)	(0.409)
Log (GDP per capita)	0.230+	0.230+
	(0.134)	(0.134)
Cattle Dependency	-0.116+	-0.115+
	(0.062)	(0.062)
Soy Dependency	-0.558	-0.564
	(0.542)	(0.543)
Sugar Dependency	0.387	0.390
	(0.313)	(0.313)
Coffee Dependency	-0.055	-0.057
	(0.317)	(0.317)
R-squared	0.001	0.001
Municipality clusters	5360	5360
N	95323	95323
Year fixed effects	YES	YES
Municipality fixed effects	YES	YES

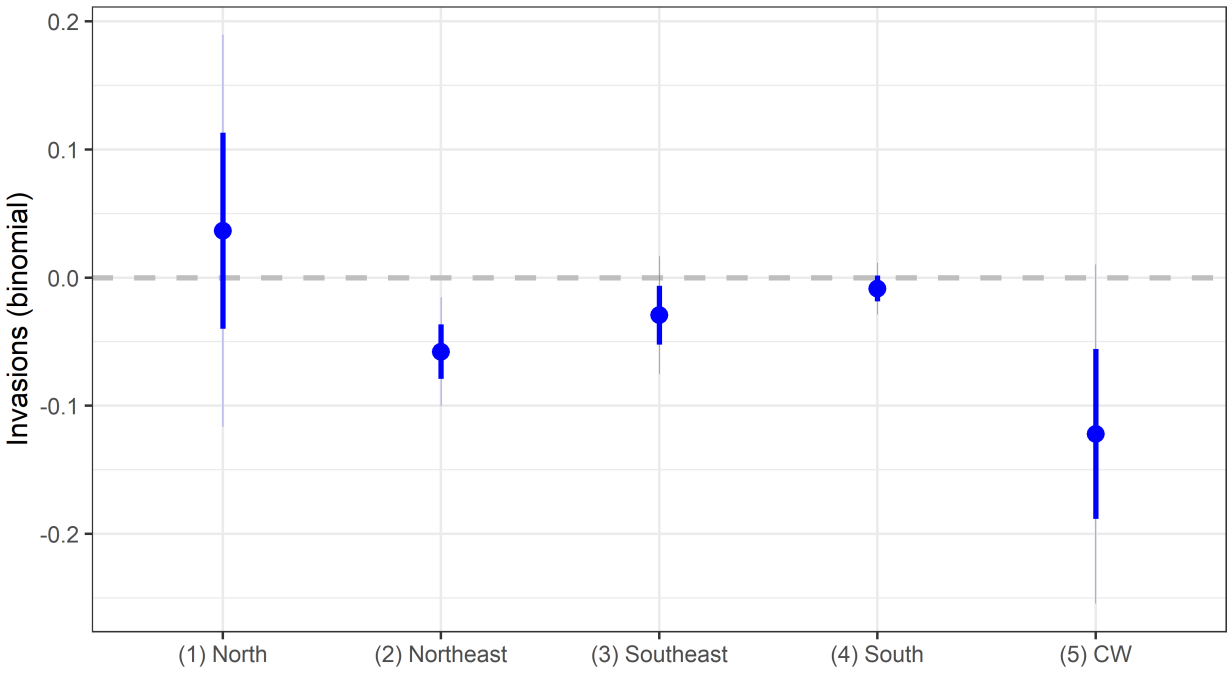
Notes: All specifications include municipality and year dummy fixed effects and cluster standard errors at the municipal level (in parenthesis). $+p < .1, *p < .05, **p < .01, ***p < .001$.

Figure D.2: Leave-One-Out Checks: Impact of Invasions on Slavery



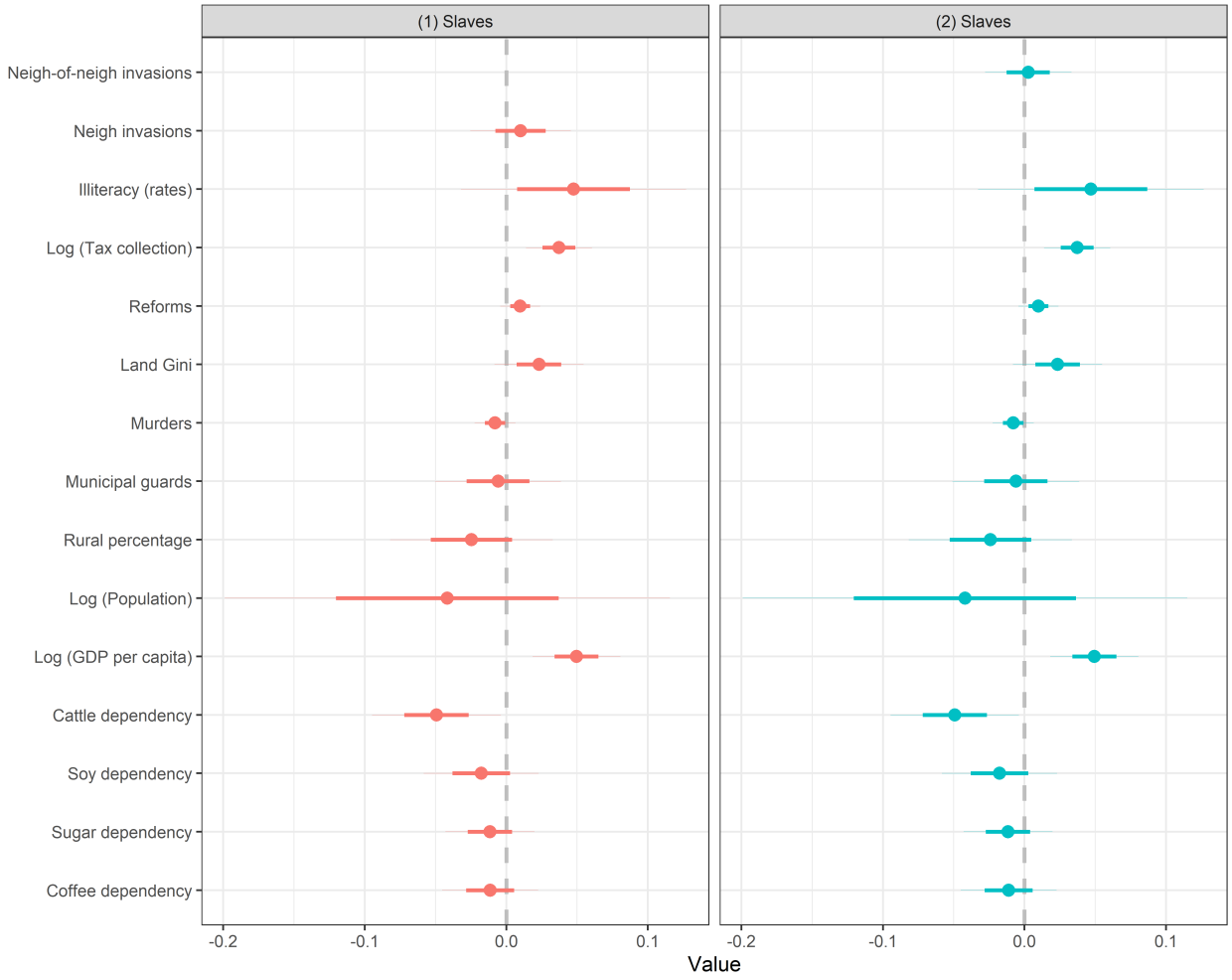
Notes: Leave-One-Out Checks for the Panel OLS models. **Dependent Variable: Slaves.** Each estimate is based on a sample that omits States and years on the x-axis. The top graph presents the analysis for the OLS model, dropping one State at a time. Data from Sergipe is unavailable because the Ministry of Labor and Employment acts independently in this State. The bottom graph leaves out one year at a time. Dots are coefficients; bars are 95% CIs. The dependent variable is the number of enslaved people. All models include the same control variables (not shown) of our baseline model first presented in column 2 of Table 1. All specifications include standard errors cluster at the municipal level.

Figure D.3: Weighted Fixed Effects (WFE) Estimator: Impact of Invasions on Slavery — Heterogeneous Effects by Regions



Notes: WEF Estimator: Heterogeneous effects by regions. **Dependent Variable: Slaves**. Municipalities: (North: 443; Northeast: 1693; Southeast: 1634; South: 1154; CW: 436). Municipalities-years: (North: 7083; Northeast: 28703; Southeast: 29406; South: 21004; CW: 21004). N (nonzero weigh): (North: 2321; Northeast: 9496; Southeast: 6716; South: 4726; CW: 4726). The plot presents point estimates and 95% confidence intervals. The models include weighted years and municipal fixed effects. Robust standard errors, allowing for heteroskedasticity, are used. We included our baseline model's control variables (not shown) first presented in column 2 of Table 1.

Figure D.4: Weighted Fixed Effects (WFE) Estimator: Impact of Neighbor invasions on Slavery



Notes: WFE Estimator. **Dependent Variable: Slaves.** Municipalities: 5360. Municipalities-years: 93985. N (nonzero weigh): 27100. The plots present point estimates and 95% confidence intervals. The models include weighted years and municipal fixed effects. Continuous variables were standardized to improve the visualization of the coefficients. Robust standard errors, allowing for heteroskedasticity, are used. We included the same control variables (not shown) of our baseline model first presented in column 2 of Table 1.

Table D.9: OLS Panel Regressions: Determinants of Invasions — PCA Indexes

	(1)	(2)	(3)
Dependent Variable: Land Invasions			
Private sector index	-0.003		
	(0.004)		
Public goods index		0.010*	
		(0.005)	
Spending index			-0.003
			(0.003)
Illiteracy (rates)	-0.002*	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
Log (Tax collection)	-0.002	-0.003*	-0.001
	(0.002)	(0.002)	(0.002)
Reforms	0.047***	0.049***	0.043***
	(0.012)	(0.012)	(0.012)
Land (Gini)	0.092	0.096+	0.087
	(0.060)	(0.057)	(0.060)
Murders	0.136	0.136	0.131
	(0.095)	(0.097)	(0.105)
Municipal guards	-0.013	-0.012	-0.012
	(0.017)	(0.016)	(0.018)
Rural percentage	-0.128	-0.118	-0.130
	(0.088)	(0.085)	(0.086)
Log (Population)	-0.006	-0.013	-0.016
	(0.020)	(0.019)	(0.020)
Log (GDP per capita)	0.001	-0.000	-0.002
	(0.013)	(0.012)	(0.011)
Cattle Dependency	0.003	0.001	0.001
	(0.005)	(0.005)	(0.005)
Soy Dependency	-0.048	-0.060+	-0.050
	(0.032)	(0.032)	(0.033)
Sugar Dependency	-0.022	-0.017	-0.015
	(0.029)	(0.029)	(0.028)
Coffee Dependency	0.016	0.026	0.028
	(0.030)	(0.028)	(0.032)
R-squared	0.011	0.011	0.010
Municipality clusters	5359	5310	5353
N	93156	94033	90513
Year fixed effects	YES	YES	YES
Municipality fixed effects	YES	YES	YES

Notes: All specifications include municipality and year dummy fixed effects and cluster standard errors at the municipal level (in parenthesis). $+p < .1, *p < .05, **p < .01, ***p < .001$.

Table D.10: Panel Regressions: Heckman Fixed Effects — Main Equation

	(1)	(2)	(3)
Dependent Variable: Slaves			
Invasions (count)	-3.176^{+}	-3.007*	-3.276*
	(1.681)	(1.470)	(1.442)
Mean of Invasions (count)	3.877	0.789	2.296
	(4.515)	(4.001)	(3.973)
Mean of Log (Tax collection)	1.005	0.516	0.939
	(0.926)	(0.917)	(1.079)
Mean of Municipal guards		-1.615	-3.181
		(3.970)	(4.084)
Mean of Land (Gini)		22.947^{+}	29.958*
		(13.672)	(14.565)
Mean of Log (GDP per capita)			0.756
			(3.080)
Municipality clusters	5423	5415	5415
N	94776	94040	94040
Year fixed effects	YES	YES	YES
Municipality fixed effects	YES	YES	YES
Year interactions fixed effects	YES	YES	YES
Municipality interactions fixed effects	YES	YES	YES

Notes: The Heckman fixed effects selection model is based on Wooldridge (1995). All specifications include municipality and year dummy fixed effects and cluster bootstrap standard errors at the municipal level (in parenthesis). These computationally intensive models included 200 replications, but some did not converge. The selection equation estimates a Tobit model due to its flexibility to include fixed effects. Next, we re-estimate the OLS using the selected sample. The models include municipality interactions fixed effects with covariates. $+p < .1, *p < .05, **p < .01, ***p < .001$.