Coercion and integration

Vala Elias Pimentel de Oliveira, G.

Publication date
2017
Document Version
Final published version
License
Other

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Coercion and Integration

Guilherme de Oliveira

Coercion and integration are widely used to reduce transaction costs. The threat of fines is often the most efficient way to make people pay their taxes. M&A consulting firms and the European Union exist because companies and countries perceive value in concentrating some of their functions under one legal entity.

Frequently, coercion and integration are virtually indistinguishable. Coercion may depend on whether the parties are integrated: a buyer switches of supplier where an employer fires his employee. Even integration can become a coercive instrument, e.g. the threat of a hostile takeover.

This dissertation uses three historical episodes to establish causal relations between coercion and integration. Time helps to pin down facts, whereas new data opens ground to empirical work. The Italian unification in 1861 gives evidence that integration increased coercion. The distribution of tasks between slavery and labor was explained by the willingness of principals to pay for integration in order to access particular types of coercion. Low outside options for the employees, a mild form of coercion, explained the integration of labor in the farming sector in the US South between 1880 and 1940.

The conclusions of this dissertation hopefully motivate future research. A better understanding of the waltz between coercion and integration sheds light on the current political tension within the EU, the design of policies against human trafficking, or the negative relation between GDP per capita and entrepreneurship.

Guilherme de Oliveira holds a M. Phil. Degree in economics, with a specialization in applied microeconomics, from the Tinbergen Institute. In 2013, he joined the Amsterdam Center in Law & Economics in order to develop his PhD dissertation. He currently works as a PostDoc Research Scholar at the Columbia Law School. His research topics include economic history, political economy and finance. He is eager to read and crunch numbers incessantly until he finds causality.

Coercion and Integration Guilherme de Oliveira

692

Universiteit van Amsterdam

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ISBN: 978 90 5170 993 3
Cover design: Crasborn Graphic Designers bno, Valkenburg a.d. Geul
This book is no. 692 of the Tinbergen Institute Research Series, established through cooperation between Rozenberg Publishers and the Tinbergen Institute. A list of books which already appeared in the series can be found in the back.

Coercion and Integration

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam,
op gezag van de Rector Magnificus
prof. dr. ir. K.I.J. Maex
ten overstaan van een door het College voor Promoties ingestelde
commissie, in het openbaar te verdedigen in de Agnietenkapel
op vrijdag 19 mei 2017, te 12:00 uur
door Guilherme Vala Elias Pimentel de Oliveira
geboren te São Sebastião da Pedreira, Lissabon, Portugal

Promotiecommissie:		
Promotor:	prof. dr. G. Dari Mattiacci	Universiteit van Amsterdam
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Extra financial support:
This dissertation had the precious financial support from the "Fundação para a Ciência e Tecnologia" through the "Bolsa de Doutoramento" number SFRH/BD/76122/2011.

Acknowledgments

This dissertation began in September 1992. Still tanned by another endless Portuguese summer, I attended my first class in a cute public school with a clear goal in mind: get a PhD degree so that I could be like Indiana Jones. Many were the challenges that shook my soul. Many were the storms that damaged my hopes. Many were the objects I punched in bursts of frustration. But here I am writing the most difficult part of my dissertation: a fair recognition of those who helped me to reach this life goal.

I would like to thank my supervisor, Giuseppe Dari-Mattiacci, and my co-supervisor, Carmine Guerriero. Since we began working together in the fall of 2012, they have helped me grow as a researcher on my own way. At the same time, they have always demanded nothing but excellence. This blend undoubtedly made me a strong and independent researcher. The future will certainly prove how important they were for my career.

I must give a special word to Torsten Jochem for helping me in the job market. He always kept the door open for any advice, a valuable service to face off the ups and downs that contaminate the life of a PhD student.

The reputation and experience of the faculty of the Amsterdam Center for Law & Economics were invaluable assets in my development. This research group organized great seminars and workshops, and attracted several distinct scholars whose comments strengthened my research capabilities.

People rarely recognize the role of the administrative staff in this sort of projects. I would like to thank Sidonie Rademaker, Lorena Zevedei, Judith van Kronenburg and Ester van den Bragt for their support in dealing with funding, conferences and other endless sources of paperwork.

All my achievements during the last five years would have been impossible without the most gifted collection of people I could have asked for. I am glad I met the most distinguished member of the African-Estonian community, Erkki Silde, whose dark

humor and nasty remarks are nothing more than manifestations of his vast wisdom. I found in Mehmet Kutluay a great listener and an even greater adviser, which clearly reflects his background as the greatest carpet seller ever stepping this planet. The deep analyses and constant references to 1980s and 1990s pop culture by Stephanie Chan clearly brightened my days and kept my feet on the ground. The talks and the walks with Lennart Ziegler not only cheered me up but they also helped both of us digest the dubious food from the UvA canteen. Ieva Sakalauskaite was a great officemate and an even greater beermate, although I wonder whether one day I will sue her for exposing me to so much second-hand smoke. Alexandra Rusu never hesitated to cheer me up and make her home my home too, despite my incessant and loud speeches in the morning train to Rotterdam. Jindi Zheng's remarks motivated me to improve myself as much as they made me laugh. Tomasz Makarewicz was a great housemate and a reliable friend, who even provided a cat to motivate me to stay longer hours at the office. Thanks to all my colleagues at the ASE, especially those, like Christiaan van der Kwaak, Stephan Jagau and Andrej Woerner, who dare to keep my legacy of questionable humor alive. Thanks to all my colleagues at the ABS, especially those who volunteered to be my victims at foosball. I am grateful for Dorinth van Dijk and Rob Sperna Weiland for translating the dissertation's summary into Dutch (and also for losing in foosball). Thanks to many other people I have met in the Netherlands so that *ik heb normaal genoeg gedaan*. At last, thanks Francisco Gómez Martínez and Martin Wiegand for making sure I was not the last to arrive at every TI class, and for sharing many good moments with me.

A special word goes to my dearest Sofía Juárez Rodríguez. Her endless support in the form of food, time, patience, altruism and love made sure I have finished this PhD with some sanity left. She kept my mind sharp while those morning eggs we shared gave me energy to research properly. In a nutshell, she is simply the best partner in crime ever.

I must give a kind word to Portugal, a *gezellige* country that gave me an excellent education from elementary school up to the PhD without asking much in return. According to my traveling experience, that is a precious gift. Among the people over there who contributed to my upbringing, I will never forget my elementary school teacher Julieta who eagerly accepted my invitation to live in the Amazon rainforest. However, it was a trap to take me back to the classroom and teach me history.

Often distant from my body but always close to my soul, I could not have made it without the support of my family. Thanks to my mother Sofia for those moments when we talked, cooked or studied together, and for always believing in me. I hope we can still share many more books and stories. Thanks to my father Luís for switching the TV channel from cartoons to documentaries. However, I guess my Playmobil figures are still crying because of all those nights in Siberia. Thanks to my brother Miguel for those punches that taught me maths so well and for helping me anywhere, anytime. Thanks to my grandfather Ismael for all the books and the chocolates: they made me fatter but wiser.

All in all, thanks to all people who made me feel the luckiest guy on Earth.

Authors

"Extractive States: The Case of the Italian Unification"

Authors: Guilherme de Oliveira and Carmine Guerriero

This chapter is a follow-up of the M.Phil. thesis of Guilherme de Oliveira at Tinbergen Institute. Guilherme de Oliveira and Carmine Guerriero discussed and formulated together the research project. Guilherme de Oliveira has made the data collection. Guilherme de Oliveira and Carmine Guerriero have solved the theoretical model, performed the empirical exercise, written and edited the paper together.

"Slavery vs Labor"

Authors: Giuseppe Dari-Mattiacci and Guilherme de Oliveira

The research question and methodology of this chapter were jointly discussed between Giuseppe Dari-Mattiacci and Guilherme de Oliveira. Guilherme de Oliveira has collected the data, solved and discussed the theoretical model, and written the chapter. Giuseppe Dari-Mattiacci has also thoroughly edited the model and the paper.

"Turnover or Cash? Sharecropping in the US South"

Author: Guilherme de Oliveira

This chapter was completely prepared and written by Guilherme de Oliveira.

Summary

The use of negative incentives to affect agent choices, known as coercion, is extensively common in economic transactions. Integration of economic agents or political actors into a single legal entity also occurs copiously. Equally intriguing, coercion and integration are often intertwined so that it becomes hard to find a causal direction from one to the other. This dissertation makes use of three historical case studies to shed light on some of the facets of this intricate relationship: whether integration changes coercion; to what extent coercion affects the welfare of the parties involved in the integration process; how the use of coercive instruments drives the decision to integrate; to what extent coercion reduces the transaction costs affecting integration process.

Chapter 2 makes use of the Italian unification in 1861, a rare case of exogenous integration. A set of regions of Italy saw suddenly and unintentionally a transference of political power from their elites to the recently-created unified state. At the same time, the unified Kingdom of Italy had an unprecedented state capacity, and a unique geopolitical agenda that created a clear regional hierarchy in the Italian peninsula. Carmine Guerriero and I have collected novel data on land taxation, which depended on the coercive powers of the state. Overall, we find evidence that coercion dramatically increased with integration, with clear regional discrimination. Moreover, this increase in land taxation explains the North-South gap that still persists in Italy. This historical case-study demonstrates that understanding the determinants of coercion such as tax-collection costs and military interests might explain tensions in political integration processes such as the European Union (EU).

Principals across history had the option to use spot labor markets or to buy slaves. In chapter 3, Giuseppe Dari-Mattiacci and I present a model where the advantage of buying a slave over hiring labor is a function of two coercive instruments: slaves cannot leave at will and slaves can be subjected to levels of physical punishment unattainable with free workers. As our model predicts, slaves tended to be concentrated in the most

complex and in the simplest tasks, where the advantages deriving from the use of slaves were larger. This model also offers intriguing comparative statics with respect to the advantages and the abundance of slavery over labor. For instance, we show that only an increase in the cost of punishments unambiguously improves the welfare of the slave population. Qualitative and quantitative evidence backs these theoretical hypotheses. These results offer a provocative agenda in the fight against slavery and forced labor.

Chapter 4 compares coercion with other ways to reduce transaction costs in an integration process. Employers and employees extensively used sharecropping contracts to run farms across the US South between 1880 and 1940. Employers seem to have used those contracts to save labor turnover costs. However, many employees likely accepted those contracts due to lack of valuable outside options, a mild form of coercion. Using post offices as an exogenous variable that both increased labor turnover and employees' outside option, this chapter finds that the overall effect is negative. In other words, the lack of outside options pushing employees towards sharecropping contracts was more relevant than the labor turnover costs faced by employers. Overall, this chapter sheds light on the persistence of sharecropping, on the emergence of franchising, and on the negative relation between entrepreneurship and GDP per capita.

Contents

Chapter 1

Introduction

Individuals regularly induce others to act in a particular way by using force, threats, penalties or other forms of negative incentives; that is, many transactions involve some degree of coercion (Acemoglu and Wolitzky, 2011). If I fail to complete my PhD thesis within 3 years, I must repay all the money from the scholarship provided by the Portuguese Government. My parents will be fired if they refuse to undergo annual health checks. If my brother had stayed less than 3 years at his current job, he would have had to pay for all the courses his employer provided. Some of my friends face fines and imprisonment if they refuse military draft without a valid legal reason. Others must keep their visas updated under threat of repatriation. All of us must pay taxes or face penalties. I could go on ad infinitum with examples of both much milder and much harsher forms of coercion.

Integration is another omnipresent variable of human existence (Coase, 1937). Economic agents perceive value in concentrating business under one legal entity. Otherwise, for instance, there would be no firms providing consulting services in mergers and acquisitions.[1] Moreover, countries do also integrate (Alesina and Spolaore, 2005): while Portugal remained independent from Spain, Catalonia did not. Many nation-states joined the European Union. Puerto Rico may join the US one day.

Coercion and integration are two widely-used ways to reduce transaction costs. Often, punishments and threats are the most efficient incentives to induce effort (Alchian and Demsetz, 1972) or to solve collective action problems (Alesina and Spolaore, 2005): no one likes to pay taxes or forfeit enticing job opportunities. Teamwork may be

[1]For instance, Bain & Company has a M&A consulting branch: http://www.bain-company.com/consulting-services/mergers-and-acquisitions/index.aspx (last accessed on February 1, 2017)

unattainable with spot market transactions or occasional diplomatic relations. In other words, both coercion and integration provide means to relax the participation constraint and to satisfy the incentive-compatibility constraint of parties in economic or political interactions.

In many cases, coercion and integration complement each other so that they are almost indistinguishable. Contract renegotiation is a case where threats and force enhance the bargaining power of the 'strongest' agent. But the coercive instrument may depend on the type of relation (Alchian and Demsetz, 1972): buyers may switch to a different supplier; employers may fire their employees. Differences in the type of available coercion in a specific relationship may favor or hinder integration.[2] Finally, even integration itself may be used as a coercive instrument, e.g. the threat of a hostile takeover.

This dissertation delves into history to shed light on the apparent symbiotic relation between coercion and integration.[3] Time usually pins down the main stylized facts of past episodes, which is particularly useful to distinguish which is due to coercion and which is due to integration. To a scholar then, history is a movie that may be rewounded or fast-forwarded in order to find natural experiments or exogenous variation. Equally important, recent collection efforts have enhanced data availability, the main challenge in historical analysis.[4] The three chapters of this dissertation leverage on these three advantages: stylized facts are translated into theories with empirically-testable hypotheses; sources of exogenous variation are detected; data collected is scrutinized using the aforementioned hypotheses and exogenous variation.

Chapter 2 concerns the Italian unification in 1861, in which Carmine Guerriero and I find evidence that integration increased taxation, which is a manifestation of increased coercion. In a nutshell, the northern Kingdom of Sardinia suddenly and unexpectedly conquered the remaining Italian states, forging a highly-centralized Kingdom of Italy. This new political unit also had a higher state capacity than any of the predecessor states; at the same time its first governments were dominated by the elite of the pre-unitary Kingdom of Sardinia. Equally important, the northern elite cared more about the social unrest in the regions closer to the two geopolitical rivals, France and

[2]See the case of the fiscal union within the European Union: http://www.debatingeurope.eu/focus/infobox-arguments-for-and-against-fiscal-union/ (last accessed on February 2, 2017).

[3]Acemoglu and Robinson (2012) gives an excellent overview of this type of approach.

[4]The paper Ciccarelli and Fenoaltea (2013) is an excellent example of this trend.

Austria. Therefore, unification implied that not only the remaining regions of Italy had lost control over their public finances but taxation could also grow to unprecedented levels, depending on the region's proximity to a geopolitical rival of the new unitary state.

We formalize the historical facts mentioned above with a two-region, two-social class model that puts side-by-side the determinants of taxation in each region. Before integration, the elite in each region only cares about tax-collection costs and productivity. After integration, taxation of both regions is decided by one of the elites, who also gives more weight to the welfare of their own region than to the welfare of the other region. In case the coercive power of the new state is such that tax-collection costs are low enough, the elite of the integrated state will disproportionally tax more the least-favorite region. Furthermore, taxation in the latter region increases as that region becomes less important for the elite of the integrated state.

The claims of this model are empirically testable. This chapter includes a unique dataset: the land tax revenues in each region of the unified Italian state. We merge that data with other existent datasets to study the evolution of land taxation between 1801 and 1911 in all the regions conquered by the Kingdom of Sardinia. Note that land taxes were the key sources of revenues because the Italian economy before World War I was essentially agrarian. For the same reason, the main proxy for productivity in each region is the profitability of market-oriented farming. Tax-collection costs are captured by the share of the previous decade in which the region partook in external wars. The preferences of northern elite relative to a specific region are a function of the distance between the region's capital and Paris or Vienna, depending on whether France or Austria is the main geopolitical rival in the previous decade.

The results of our regressions provide clear evidence that pre-unification land tax revenues per capita are only explained by the contemporaneous region's farming productivity, whereas the region's political relevance for the northern elite explains the land tax revenues after the unification. We also find that the North-South gap in post-unitary development, culture, and human capital is largely explained not only by tax-collection costs and regional political relevance but also by the difference in actual tax revenues and those that each region would have collected in case the pre-unification states still existed. In summary, this chapter presents evidence that not only coercion changes with integration but also coercion decisively affects outcomes of each party in

an integration process.

In chapter 3, Giuseppe Dari-Mattiacci and I address the choice between slavery and labor as a decision between paying for integration of the labor input in order to access unique types of coercion, and using spot labor market transactions. Slaves and free workers have regularly competed for the same jobs in all slave societies since the dawn of civilization. Our model sheds light on the historical pattern where principals tended to deploy slaves either for the more complex or at the simplest tasks, leaving the remaining tasks to be executed by free workers. The fundamental postulate of our discussion comes also from an historical fact: state power has defined slavery across history. In other words, states have defined what constitutes a slave and what the rights and duties of a slave are. Therefore, the status of an agent is given for the principal.

Our model departs from two facts distinguishing slaves from workers in all human societies: slaves, unlike workers, cannot leave at will, which means that slaves allow the principal to save labor turnover costs; slaves can be subjected to physical punishments, implying that a principal may choose a more efficient mix of incentives with a slave than he could achieve with a worker. The next key ingredient of our analysis is the complexity of the task that the principal wants to be executed. In complex tasks, relation-specific investments are responsible for high turnover costs. At the other end of the spectrum, in simple tasks, the threat of physical punishment is a relatively cheap way to produce incentives as compared to rewards, because effort is easy to monitor. Consequently, principals are willing to pay more for a slave in the most complex and in the simplest tasks, i.e. where coercion is more valuable. The resulting equilibrium price in the market for slaves affects demand in the labor market and induces principals to hire workers for intermediate tasks, where none of the aforementioned advantages of slavery are large enough.

The equilibrium described in the previous paragraph depends on the level of turnover costs, the cost of sticks, and the abundance of slaves. Therefore, our model provides comparative statics for the distribution of tasks between slaves and workers, the proportion of slaves to workers, and the proportion of slaves in complex tasks relative to slaves in simple tasks. These comparative statics tell us that whenever any of the advantages of having a slave or the abundance of slaves decreases the prevalence of slavery in a society. What is interesting for contemporary policymakers is that one of

our propositions underscores that only an increase in the cost of sticks unambiguously increases the proportion of slaves to workers, and the proportion of slaves in complex tasks relative to slaves in simple tasks. Since slaves in complex tasks are incentivized with rewards, while in simple tasks they are subject to physical punishments, this policy reduces the incidence of slavery and improves the living conditions of remaining slaves. In contrast, policies that aim solely at reducing the incidence of slavery, such as curbing the supply of slaves, might cause a decrease in the welfare of the remaining coerced population.

Both the equilibrium described in the model and its comparative statics are tested against historical evidence. Our historical analysis focuses mainly on Ancient Rome and the Americas during European colonization. These two historical periods are unmatched in terms of size of the slave population and of reliance of the economy on slavery. However, data paucity invites us to deploy three types of identification strategies: comparisons of societies which exhibited clearly different values of one of our parameters; variation in geography for one of our parameters; exogenous changes in the supply of slaves. We complement our discussion of qualitative data with the study the unique Brazilian Census of 1872, which is, to our knowledge, the only dataset that records the distribution of occupations among slaves and free workers. Overall, the predictions of our model hold. Therefore, this chapter rationalizes integration of labor as a function of coercive instruments unique to integration.

Chapter 4 studies an episode where the lack of outside options, a mild form of coercion, trumps other transaction costs in explaining integration. I go back to the US South between 1880 and 1940, when the farming sector extensively used sharecropping contracts - a share contract where employers paid employees with a share of the harvested crop. A successful harvest required a steady supply of labor during a season filled with narrow time windows for every task. Hence, wage labor hired in the spot market may have quitted or renegotiated terms in crucial periods. Economic historians have agreed that sharecropping contracts were a good solution for problems with labor turnover. Attaching the bulk of labor income to the season's output motivated employees to supply a steady stream of labor during the whole calendar. In addition, sharecropping implied that an employee had autonomy in managing his farm and other types of perks. However, the US South had a poor economic performance relative to the rest of the US. More importantly, most of the rural population lived isolated in

small villages, oblivious to the economic development happening across the nation. Therefore, many employees might have accepted these sharecropping contracts due to lack of better job alternatives before the season began.

A principal-agent model is used to formalize the problem of managing labor supply during the whole season. At the beginning of the season, each employer (principal) decides whether to hire wage labor, which is subject to turnover and earns a fixed wage, or to hire a sharecropper who runs the farm for the whole season for a share of the output. Also at the beginning of the season, each employee (agent) chooses one of three options: work as a wage laborer; sign a sharecropping contract; work outside the farming sector. Employees differ in management costs, but each employer cannot observe the employee's type and the effort he exerts. That is, the optimal share of the output chosen by each employer is such that some employees are left indifferent between sharecropping and the outside option. Therefore, higher turnover costs make sharecropping a better option for more employers, but a higher outside option makes sharecropping desirable for fewer employees. The model shows that if turnover costs are low enough, a simultaneous increase of turnover costs and of the outside option decreases the proportion of sharecropping farms relative to the total number of farms.

The prediction of the model is empirically testable. Post offices generate an exogenous and simultaneous increase of turnover costs and of the outside option. The US Postal Service was an established institution before 1880, and they distributed letters and newspapers all over the country. The opening of a new post office was a function of access to transportation and population density, which are controlled in this chapter's regressions. During the farming season, laborers were more likely to switch jobs or update their demands after receiving news from elsewhere. That is, employers using wage contracts would face higher turnover costs. At the beginning of the season, employees would be aware of more job opportunities, taking away those employees who were indifferent between sharecropping and the outside option. Both non-parametric and parametric evidence show that more post offices in a county decreased the proportion of farms using sharecropping contracts. A set of difference-in-differences regressions confirms that the effect of post offices on the prevalence of sharecropping contracts works through the channels formalized in the model: a post office increases more the use of sharecropping contracts in counties with higher turnover costs; a post office decreases more the prevalence of sharecropping in counties with a higher outside op-

tion. In short, this chapter finds evidence that transaction costs are at the heart of integration, but it also identifies the types of transaction costs that most matter for integration.

Finally, chapter 5 provides an overview of this dissertation, summarizing the main findings and implications for future research and policy. Overall, this dissertation formalizes and empirically discusses hypotheses about important aspects of the relation between coercion and integration. Chapter 2 finds a situation where integration occurred suddenly and changed the determinants and extension of coercion. Chapter 3 shows that the possibility to use coercive instruments takes one party to unilaterally integrate one part of its production. Chapter 4 provides evidence that coercion can be more important than some types of transaction costs in determining integration. These findings are certainly not definitive and should be taken cautiously. Integrating nations differs from integrating firms in important aspects. Coercion through slavery is much harsher than coercion through the reduction of outside options. Integrating labor supply involves distinct agency problems from those arising from integrating capital goods. Coercion from taxes rests on sovereign powers out of the reach of the vast majority of the employers. Many more of these remarks can be made, but all of them just show how rich the crossroads between coercion and integration are for future research. This dissertation hopefully provides motivation to traverse them.

Chapter 2

Extractive States: The Case of the Italian Unification

"The vast majority of the population [...] feels entirely cut off from our institutions. People see themselves subjected to the State and forced to serve it with their blood and their money, but they do not feel that they are [an] organic part of it." (Sydney Sonnino, *Speech to the Chamber of Deputies*, 30 March 1881).

2.1 Introduction

Despite the huge evidence documenting that extractive institutions and policies can limit the access to rents discouraging in turn innovation (North et al., 2009) and can undermine both property rights protection and contract enforcement (Acemoglu and Robinson, 2012), we still lack a framework that identifies their determinants. Here, we lay out a two-region, two-social class model for thinking about this issue, and we exploit its implications to propose a novel account of the present-day economic divide between North and South of Italy.[1]

A well-known literature has traced back this gap to the diverse political trajectories followed by the two clusters during the Middle Ages (Putnam et al., 1993). In particular, the experience of more inclusive political institutions—i.e., the communes—would have helped Northern Italy develop a stronger culture of cooperation easing economic interactions (Guiso et al., 2016). Recent contributions however have raised several

[1]To elaborate, in 2008 Southern Italy displayed a nine percent lower share of respondents to the European Value Study reporting "tolerance and respect for other people" as important qualities children should be encouraged to learn and a 40 percent lower income per capita than Northern Italy (Iuzzolino et al., 2011).

doubts on this slant. First, Boranbay and Guerriero (2016) show for Europe that instead the main driver of present-day culture has been the medieval need of sharing climate-driven consumption risk and that, up to the 17th century, the two clusters displayed similar cultural endowments. Second, a growing body of research reveals that the two groups were similarly underdeveloped in 1861 (Iuzzolino et al., 2011; Ciccarelli and Fenoaltea, 2013). Inspired by this evidence, we document that the opening of the present-day divide is the result of the region-specific policies selected between 1861 and 1911 by the elite of the Kingdom of Sardinia, which annexed the rest of Italy in 1861. They penalized more the regions farther away from the fiercer enemy of the House of Savoy and so less politically relevant for the Piedmontese elite.

In the model, we consider two regions, which are first independent and then unified by a completely unforeseen shock similar to the one that originated the unitary state. The Northern region represents the Kingdom of Sardinia, whereas the Southern one stands for any of the other states annexed by the Kingdom of Italy in 1861. Each region is inhabited by a mass zero elite and a mass one citizenry, who consumes the untaxed supply of a private good and a region-specific public good whose production is financed through the tax revenues not appropriated by the elite. The private good technology is multiplicative in the region-specific productivity and the citizenry's investment in an input that can be seen as either a culture of cooperation or human capital. The first interpretation links directly our setup to the extant literature on the medieval determinants of the present-day divide. Under autarky, each elite selects her region's tax rate by maximizing the sum of the citizenry's welfare and the rents net of linear tax-collection costs. Thus, equilibrium tax revenues fall with the marginal tax-collection costs and, because these are sizable, with the taxable value and thus the regional productivity. Under political union instead, both region-specific tax rates are selected by the Northern elite, who is less concerned with the Southern citizenry's welfare and appropriates from the South relatively more than the Southern elite can under autarky. In particular, the extractive power of the Northern elite is sufficiently strong to make taxation of the South profitable at the margin. These assumptions are consistent with the fact that the unitary state exercised a tight control on the annexed regions and was dominated by the elite of the Kingdom of Sardinia, who was chiefly interested in the Northern export-oriented farming and industry. The mix between stronger extractive capacity and her limited concerns with the South leads the Northern elite to raise from

this region tax revenues rising with the South's productivity and falling with both the marginal tax-collection costs and the South's political relevance, i.e., the weight the Northern elite attaches to the Southern citizenry's welfare. In addition, extraction from the South is larger than under autarky, provided that the South's technology is not too backward, and pushes the Southern citizenry to prefer private to public good production. Hence, the Southern citizenry's investment and welfare rise with the factors limiting taxation, like the marginal tax-collection costs and the political relevance, and unification damages the South when it is not sufficiently salient for the North.

To test these predictions, we analyze the thirteen present-day Italian regions annexed by the Kingdom of Italy between 1861 and 1911 but not part of the Kingdom of Sardinia. Being the Italian economy essentially agrarian over our 1801-1911 sample, we proxy the extent of extraction first and foremost with the land property taxation. Given the peculiar features of post-unitary taxation however, we do not study land property tax rates but the land property tax revenues per capita. Land property tax rates have been region-specific over the whole sample and, absent developed financial markets, dramatically shaped the landowners' capacity to invest in new farming technologies and the industry. Turning to the regional productivity, we rely upon the geographic drivers of the profitability of the main export-oriented farming sectors, i.e., arboriculture and sericulture. Next, we use as inverse metrics of the marginal tax-collection costs a measure of state capacity, i.e., the share of previous decade in which the state to which the region belonged partook in external wars. Finally, we propose as an inverse proxy for political relevance the distance of each region's main city from the capital of the fiercer enemy of the House of Savoy. Being our model generally applicable to any extent of extraction by the North, these two proxies also capture the impact on the South of the trade, financial, and public procurement distortionary policies selected by the post-unitary government and illustrated in our historical analysis.

Consistent with our model, while the pre-unitary revenues from land property taxes in 1861 lire per capita were shaped by each region's farming productivity but not by its political relevance for the Piedmontese elite, the opposite was true for the post-unitary ones. Moreover, post-unitary tax distortions—proxied with the difference between the observed revenues and the counterfactual ones forecasted through pre-unitary estimates—and the severity of the remaining extractive policies—captured by the re-

gion's taxation capacity and political relevance—determined the North-South gaps in culture, literacy, and development. Since our proxies for the drivers of extraction are driven by either geographic features independent of human effort or events outside the control of the policy-makers, reverse causation is not an issue. Nevertheless, our results could still be produced by unobserved heterogeneity. To evaluate this aspect, we follow a two-step strategy. First, we control not only for fixed region effects, but also for time effects and their interaction with the structural conditions differentiating the two blocks in 1861, i.e., inclusiveness of political institutions, land ownership fragmentation, coal price, and the railway length. Including these controls has little effect on our estimates. Second, we build on Oster (2016), and we calculate that on average selection on unobservables would have to be about 4 times greater than selection on observables to completely explain away our results. Given the very high fit of our regressions, this is unlikely. Finally, the two following patterns in the data rule out the possibility that extractive policies were the acceptable price for the Italian development. First, extraction did not shape the manufacturing sector value added and in turn industrialization. Second, while the pre-unitary length of railway additions in km per square km was only affected by the region's farming productivity, the post-unitary diffusion of the rail system was only driven by the regional political relevance resulting useless in the formation of an unitary market.

Albeit a long literature has related the present-day divide to post-unitary policies (Sereni, 1947; Salvemini 1963; Romeo, 1987; Cafagna, 1989), nobody has provided a framework clarifying how these policies solved the unitary government's trade-off between extraction-related losses—i.e., investment distortions, tax-collection costs, and military weakness—and rent-seeking gains.[2] In doing this, we also contribute to the aforementioned literature on extractive institutions by endogenizing the extent of extraction in a setup sufficiently general to be applied to other instances. Recent examples are the German opposition to the post-2011 rescue packages demanded by Greece (Guiso et al., 2015) and the tensions between the Basque Country (Northern Ireland) and the Spanish (UK) government (Abadie and Gardeazabal, 2003; Besley and Mueller, 2012), whereas a case in point contemporaneous to the natural experiment we focus on is the post-Civil War gap between the ex-Confederate states and the territories that

[2]By studying the determinants of regional tax policies and public spending, we also contribute to the literature on public goods, internal and external conflicts, and the size of nations (Alesina and Spolaore, 2005).

sustained the Union during the war. To confirm the external validity of our analysis, we focus on this last instance, and we provide evidence that the growing divide between the two clusters was related to the tax burdens imposed on them by the federal government, which was initially dominated by the ex-Union states.

The chapter proceeds as follows. In section 2, we review some key facts about 19th century Italy to motivate our model, which we illustrate in section 3. In section 4 then, we state the model empirical implications, which we test in section 5. Finally, we present our conclusions in section 6, and we gather both tables and figures in the appendix.

2.2 Italy Before and After the Unification: A Primer

Next, we describe the political and economic contexts of the Italian regions over the 1801-1911 period, detailing at the same time the evolution of public policies.

2.2.1 The Era of *Risorgimento*

The Congress of Vienna divided Italy in eight absolutists states: the Kingdom of Sardinia, formed by Liguria, Piedmont, and Sardinia and ruled by the Piedmontese House of Savoy; the Kingdom of Lombardy-Venetia under the direct control of Austria; the Grand Duchy of Tuscany and the Duchies of Modena and Parma, all in the hands of branches of the Habsburg dynasty; the Duchy of Lucca then absorbed by Tuscany in 1847; the Papal State; and, to the south of Lazio and Marche, the Kingdom of the Two Sicilies ruled by the Bourbons.[3] This division re-established the status quo preceding the Napoleonic conquests and served two key purposes. First, it deprived the Bourbons of any interest in waging war being their only neighbor the Pope, who in turn was constrained by his religious role. Second, it kept in check Austria and France by establishing the Kingdom of Sardinia as a buffer state between the two powers. Exactly this balance fed the ambitions of the House of Savoy who became the champion of the Italian liberals. Supported by urban workers and lower military ranks, the liberals longed to establish a unitary state by organizing a series of subversive acts in the wake of the unrests of 1820, 1830, and 1848. Even if none of these turmoils overthrew a

[3]Our historical account is based on Killinger (2002), Duggan (2008), Paoletti (2008), and Riall (2009).

pre-unitary regime, they forced the absolutist rulers to implement some of the liberal laws brought about by the Napoleonic armies and inspired by the French revolution.

The liberal wave flooded the whole peninsula but was particularly effective in washing away several long-lived feudal privileges from the Kingdom of the Two Sicilies, where one third of the clerical and common lands were privatized and the feudal system was finally abolished in 1806 (Pescosolido 2014, p. 50-58). Such an institutional discontinuity did not release the Italian peasants from their destitution but allowed a rising class of bourgeoisie, attracted by the mid of the 19th century rise in the international demand, to acquire part of the nester nobility's domains and prioritize export-oriented over substistence farming (Pescosolido 2014, p. 29-30 and 39-400). In particular, arboriculture and sericulture soon gained a net dominance accounting by 1859 for respectively the 33 and 14 percent of total export, while next two—in terms of export relevance—cultivations—i.e., wine and hemp—racked up the seven percent of total export (Ministero dell'Agricoltura, Industria e Commercio, 1864). Albeit more lucrative than wheat breeding—sixty times in the arboriculture case (Dimico et al. 2012, p. 7), both activities were also more capital intensive. Silk indeed is obtained from the fibers of the cocoons of the mulberry silkworm larvae dissolved in boiling water and then spun through reels powered at the time by watermills. This need of water favored the concentration of sericulture in the irrigated Po valley (Federico 2009, p. 18). Over and above irrigation ditches, citrus and olive trees require a temperature above 4 Celsius degrees: this last feature explains their almost exclusive diffusion in the South (Dimico et al. 2012, p. 8).

Farming productivity increased in both the sharecropping-based Northern farms and the Southern latifundia, which maintained a primacy over the 19th century (Federico, 2007).[4] Table 2.1 summarizes these patterns by using our proxies for farming productivity and differentiating the thirteen regions analyzed in our empirical exercise according to their political relevance for the Piedmontese elite as inversely measured by *Distance-to-Enemies*, which is the distance of each region's main city from the capital of the fiercer enemy of the House of Savoy (see section 4 for more details and table 2.A.1 for sources and construction). To illustrate, Veneto displays the lowest average value of *Distance-to-Enemies* being the only region bordering either Austria or France,

[4]The latter supported larger investments by assuring the peasants credit and job security (Petrusewicz, 1996).

Table 2.1: High & Middle Versus Low Political Relevance Regions

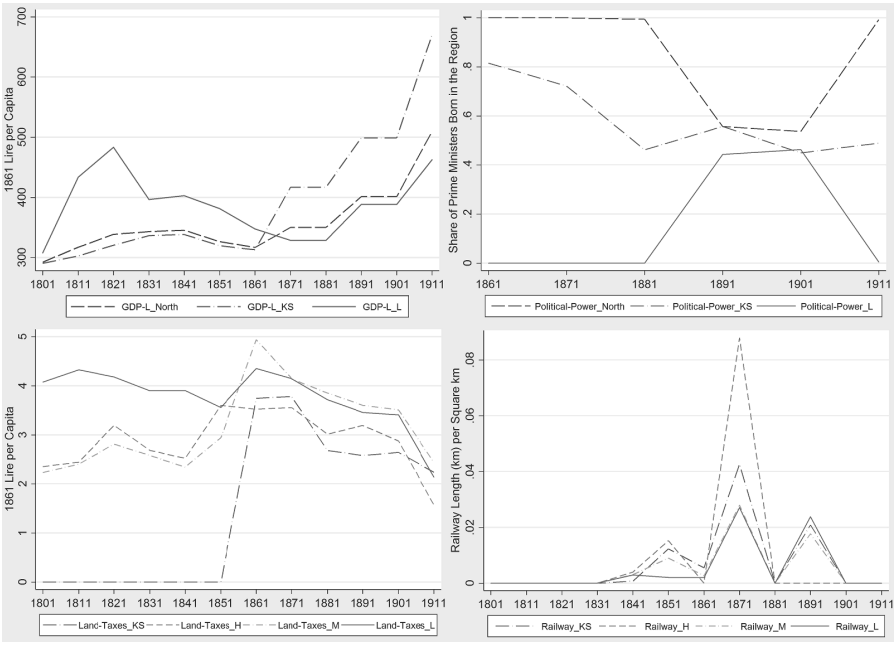
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	1801-1851			1861			1861-1911		
	H&M Political	Low Relevance	(1) - (2)	H&M Political	Low Relevance	(4) - (5)	H&M Political	Low Relevance	(7) - (8)
Culture-L:				0.757	1.017	- 0.260	0.712	0.950	- 0.238
				(0.207)	(0.343)	(0.160)	(0.173)	(0.394)	(0.071)***
Illiterates-L:				74.514	82.933	- 8.419	55.057	70.858	- 15.801
				(11.571)	(8.079)	(5.478)	(19.427)	(13.703)	(3.768)***
GDP-L:	329.880	400.958	- 71.079	317.947	347.510	- 29.563	365.138	374.061	- 8.922
	(39.160)	(53.891)	(10.825)***	(13.036)	(0)	(4.927)***	(72.579)	(112.294)	(21.811)
GSP-L:				71.343	88.133	- 16.790	78.686	96.644	- 17.959
				(15.176)	(24.988)	(11.703)	(17.726)	(27.803)	(5.381)***
VA-T-L:				0.005	0.003	0.002	0.007	0.003	0.004
				(0.003)	(0.002)	(0.001)	(0.007)	(0.002)	(0.001)***
VA-M-L:				0.044	0.040	0.004	0.058	0.050	0.009
				(0.013)	(0.008)	(0.006)	(0.028)	(0.016)	(0.005)*
Land-Taxes:	2.588	3.992	- 1.403	4.739	4.356	0.382	3.635	3.537	0.098
	(1.870)	(1.831)	(0.420)***	(1.678)	(1.375)	(0.847)	(1.260)	(1.112)	(0.269)
Distortion-LT:				1.222	1.385	- 0.163	0.172	0.580	- 0.408
				(1.683)	(1.206)	(0.804)	(1.919)	(1.533)	(0.391)
Railway:	0.0022	0.0008	0.0013	0.002	0.002	0.0003	0.009	0.009	0.0002
	(0.005)	(0.001)	(0.0008)*	(0.003)	(0.003)	(0.0016)	(0.017)	(0.013)	(0.003)
Distortion-R:				- 0.001	- 0.009	0.008	0.005	- 0.003	0.008
				(0.005)	(0.015)	(0.006)	(0.018)	(0.019)	(0.004)*
Sericulture:	0.387	0.211	0.176	0.403	0.220	0.183	0.408	0.224	0.184
	(0.250)	(0.187)	(0.050)***	(0.265)	(0.211)	(0.132)	(0.248)	(0.196)	(0.050)***
Wheat:	0.397	0.146	0.251	0.411	0.153	0.258	0.419	0.158	0.262
	(0.198)	(0.079)	(0.033)***	(0.207)	(0.092)	(0.087)**	(0.192)	(0.087)	(0.033)***
Arboriculture:	0.408	0.708	- 0.299	0.389	0.685	- 0.296	0.394	0.694	- 0.300
	(0.101)	(0.140)	(0.028)***	(0.107)	(0.149)	(0.073)***	(0.100)	(0.139)	(0.028)***
War:	0.005	0.003	0.003	0.012	0.029	- 0.017	0.004	0.006	- 0.003
	(0.014)	(0.006)	(0.002)	(0.013)	(0.012)	(0.007)**	(0.007)	(0.012)	(0.002)
Distance-to-Enemy:	755.786	1143.083	- 387.298	596.286	903.167	- 306.881	649.452	983.139	- 333.687
	(204.068)	(285.051)	(56.996)***	(87.355)	(153.750)	(70.922)***	(155.368)	(231.839)	(45.473)***
Democracy-I:				2.492	1.074	1.418			
				(0.929)	(0.181)	(0.359)***			
Land-Fragmentation-I:				0.340	0.496	- 0.156			
				(0.102)	(0.204)	(0.092)*			
Coal-Price-I:				46.894	40.664	6.230			
				(8.663)	(3.980)	(3.655)*			
Railway-I:				0.015	0.007	0.008			
				(0.008)	(0.004)	(0.003)**			
Deposits-I:				16.963	4.716	12.247			
				(19.550)	(11.119)	(8.672)			
Rivers:				0.068	0.048	0.019			
				(0.052)	(0.059)	(0.031)			
Roads:				0.027	0.028	- 0.001			
				(0.012)	(0.017)	(0.008)			
Trade:				0.236	0.261	- 0.025			
				(0.348)	(0.412)	(0.214)			
Ruggedness:				0.267	0.321	- 0.054			
				(0.060)	(0.104)	(0.048)			
Number of observations	42	36		7	6		42	36	

Notes:
1. *Culture-L*, *Illiterates-L*, *GDP-L*, *GSP-L*, *VA-T-L*, *VA-M-L*, and *VA-E-L* label respectively the share of the active population engaged in political, union, and religious activities, the percentage points of illiterates, the GDP, the gross saleable annual farming product per employee, and the value added in the textile, manufacturing, and engineering sectors (see also table 2.A.1).
2. Columns (1), (4), and (7) (columns (2), (5), and (8)) report the mean and, in parentheses, the standard deviation of each variable over the relevant period in the high and middle (low) political relevance group, whereas columns (3), (6), and (9) display the difference between the mean in the high and middle political relevance group and that in the low political relevance cluster over the relevant period and, in parentheses, its standard error. *** denotes a difference significant at the 1% confidence level based on a t-test with unequal variances; **, 5%; *, 10%. The high and middle (low) political relevance cluster includes Abruzzi, Emilia Romagna, Lombardy, Marche, Tuscany, Umbria, and Veneto (Apulia, Basilicata, Calabria, Campania, Lazio, and Sicily).

and so we treat it as the "high" political relevance cluster. Similarly, we label the other regions with below-average values of *Distance-to-Enemies*—i.e., Abruzzi, Emilia Romagna, Lombardy, Marche, Tuscany, and Umbria—the "middle" political relevance group and the remainder—i.e., Apulia, Basilicata, Calabria, Campania, Lazio, and Sicily—the "low" political relevance group. We also refer to the latter as "South" and to the union of the high and middle political relevance groups with both Liguria and Piedmont, which represented the leading regions of the Kingdom of Sardinia, as "North." As table 2.1 reveals, the South was moderately inferior than the middle and high political relevance cluster in the sericulture and wheat breeding sectors

but greatly (moderately) superior in the arboriculture one (in terms of gross saleable farming product per employee, i.e., *GSP-L*).

Figure 2.1: Income, Political Power, Land Property Taxes, and Railway Diffusion



Note: 1. "Political-Power" is the share of prime ministers born in the region averaged over the previous decade. The underlying information is collected from Corbetta and Piretti (2008). The other variables are defined in tables 1 and 2. The _M (_H) group comprehends Abruzzi, Emilia Romagna, Lombardy, Marche, Tuscany, and Umbria (Veneto), whereas the _KS one gathers Liguria and Piedmont. The _North (_L) cluster includes the _M, _H, and _KS groups (Apulia, Basilicata, Calabria, Campania, Lazio, and Sicily).

After two centuries of decline (Malanima, 2010), the Italian population doubled over the 1800-1860 period but the peninsular economy remained essentially agrarian and so the GDP per capita stagnated until the 1880s against a background of regional differences (see upper-left graph in figure 2.1).[5] To illustrate, the South displayed for all the pre-unitary period an income level significantly higher than the North but this advantage,[6] which was mainly driven by the idiosyncratic shocks to the regional export-oriented sectors,[7] did not help it fill the enormous gap with the leading European

[5]To illustrate, in 1861 the 69 percent of the active population was employed in the agricultural sectors (SVIMEZ, 2011), and only the one percent worked exclusively in the industry (Pescosolido 2014, p. 130).

[6]We express this and the other monetary variables in 1861 lire per capita employing the Malanima's (2006) and Baffigi's (2011) price indexes. While the underlying 1871-1911 data are collected from Vecchi (2011), the 1801-1861 figures are constructed combining the series for the Northern regions reported in Malanina (2006), those for the whole country proposed by Malanima (2010), and population data from SVIMEZ (2011).

[7]The Southern arboriculture sector was hit by the 1825-1834 fall in international prices, while the

countries on the road to industrialization (Pescosolido 2014, p. 77-84). Just to name a few examples, in 1861 the number of spindles in respectively the North and South corresponded to the 0.8 and 0.2 percent of the English one, whereas the 1861 iron production amounted to the even lower levels of 0.46 and 0.04 percent of the UK one (Pescosolido, 2011). The causes of this common backwardness—similarly revealed by the 1861 values added of the textile and manufacturing sectors (see table 2.1)—were multiple and ranged from the scarcity of coal and navigable rivers to the mix of the underdevelopment of railway, roads, and merchant navy and the shortage of both human and real capital (Pescosolido 2014, p. 89-101). None of these initial structural conditions displayed however significantly different values in the low and middle-high political relevance clusters, save for the limited gaps in railway length and coal price (see table 2.1).[8] In this respect, only the Kingdom of Sardinia seemed ready to take on the Second industrial revolution challenge with its significantly larger endowment of human capital and more efficient textile sector both gained through a more vigorous public investment effort (Zamagni 1980, p. 124-126).[9]

The 1848 defeat in the Austro-Sardinian War indeed forced Carlo Alberto to abdicate in favor of his son Vittorio Emanuele II, who upheld a liberal constitution to calm down the internal uprisings and gain support for his territorial ambitions. This change allowed the rising liberal class to obtain a larger public spending in railway and other valued public goods, like literacy, in exchange for the acceptance of larger military expenses. None of the other Italian states could obtain a similar balance (Duggan 2008, p. 261). On the one hand, Vienna avoided unrests and any grant of rights in the Lombardy-Veneto by appeasing local elites through high nonmilitary expenditures and artificially low tax rates (Dincecco et al. 2011, p. 900). On the other hand instead, the Bourbons—scared by the 1820 and 1848 domestic unrests—escaped democratic reforms by rising the military spending and, because of the population's aversion to taxation, by squeezing nonmilitary expenditures (Pescosolido 2014, p. 96). A similar aversion to novel duties, together with less ferocious internal conflicts, kept taxation

Northern silk production was halved by the 1840-1860 Pebrine epidemic (Pescosolido 2014, p. 39-41 and 145).

[8]The financial sector exhibited however the following variation. While the Northern markets were populated by both small institutes—i.e., "casse di risparmio"—and medium-sized commercial banks, the Southern markets were still dominated by a plethora of medieval micro-credit institutions (Pescosolido 2014, p. 90-91).

[9]To illustrate, in 1861 Piedmont and Liguria displayed on average 55.25 percentage points of illiterates and a 0.007 textile industry value added in thousands of 1861 lire per capita (see for sources table 2.A.1).

and spending low in the remaining states (Dincecco et al. 2011, p. 898-899).

Figure 2.1 depicts these patterns. While the bottom-left graph reports, in default of information on the tax rates, the revenues from land property taxes in 1861 lire per capita, the bottom-right one displays the decennial change in the railway network in km per square km. Land property taxes, which represented the largest direct tax and hit the land profitability estimated by one of the nine existing regional cadastres,[10] remained up to the 1850s larger in the South, whereas investments in railway diffusion, which represented the largest nonmilitary expenditure, were trifle before 1840 and barely higher in the North at unification.

2.2.2 Italian Unification and the Rise of the North-South Divide

Over the 1850s, the power of the Kingdom of Sardinia's parliament relative to the king grew steadily and its leader became count Camillo of Cavour, who was appointed prime minister in 1852. Cavour realized that the Savoys could not fight Austria alone and, thus, sustained France in the Crimean War (1853-1856) to win the favor of Napoleon III. This attempt was such a success that the Kingdom of Sardinia and France first signed a secret pact against Austria and then defeated its military in Lombardy in 1859. This victory triggered insurrections in Tuscany, Giuseppe Garibaldi's conquest of the South, and the invasion of the Papal State. The Kingdom of Italy was proclaimed on March 17th 1861.

"A narrow elite of northerners dominated [the new government and] bureaucracy. Not until 1887 did a southerner become prime minister [i.e., Crispi]. The king preferred if he could to have a premier from Piedmont (with whom he could speak in dialect)" (Duggan 2014, p. 141) and, indeed, Piedmontese was the 58 percent of all the 1861-1911 prime ministers, share which rises to the 85 percent when the entire North is considered (see also upper-right graph in figure 2.1) and is similar to what one would obtain by focusing on lower-ranked policy-makers.[11] "In the 1890s [indeed] 60 per cent of the top administrative posts were occupied by Lombards, Venetians, or Piedmontese" (Duggan 2014, p. 141) and the provinces were run by government-appointed

[10] This measure was obtained through either geometrical or descriptive data (Parravicini, 1958).

[11] The share of ex-Kingdom of Sardinia(North)-born ministers was 35 (64) percent (Corbetta and Piretti, 2008).

prefects, each of whom "was a personal friend of the king or the prime-minister and [...] usually came from Piedmont. [Moreover, the commune's] mayor was nominated by the central government [and the prefect could] oversee, and if need be, veto, municipal decisions" (Duggan 2014, p. 139). Empowered by its new European stand and military power (Pescosolido 2014, p. 96), this Piedmontese-led ruling class favored the Northern export-oriented farming and manufacturing industry while selecting trade, financial, and public procurement policies and the Northern population when levying the taxes necessary to finance public spending (Sereni, 1947; Salvemini 1963, p. 286; Romeo, 1987; Cafagna, 1989). Since the underdevelopment of the banking sector and the Malthusian nature of the agrarian economy made the participation in the second Industrial revolution dependent on the after tax farming profits only, these policies dramatically shaped the relative performance of the two clusters (Pescosolido 2014, p. 118-120 and 157).

To begin with, the 1861 introduction of the Piedmontese custom tariffs decreased by 80 percent the average Southern duties (Pescosolido, 2011). This liberal reform initially fostered the very lucrative exports of olive oil, citrus, and silk but then irremediably exposed these activities to the fall in the farm crops prices determined in the 1880s by the mix of the soaring international supply and the advances in maritime transportation (Iuzzolino et al. 2011, p. 20). Between 1887 and 1891, the exports of citrus fruits, oil, and wine roughly halved, whereas those of silk remained stable (Pescosolido 2014, p. 198-201 and 224-228). This juncture allowed the Po Valley nester nobility and the industrial triangle entrepreneurs to form a new ruling coalition and so direct in 1887 a protectionist reform uniquely aimed at protecting wheat breeding and those Northern manufacturing industries that had artificially survived the liberist years thanks to the newborn state intervention (Pescosolido 2014, p. 64, 177-182, and 202). To illustrate, while the Northern textile industry fully dominated the national allocation of the military clothing contracts, the monopoly of both the steamboat construction and the Italian navigation was assigned to Genoese firms with the consequent exclusion of the Neapolitan ones, which albeit more developed at unification went bankrupt in the 1870s (Pescosolido 2014, p. 182-184 and 203). A similar logic guided the organization of land reclamation with only four per cent of the relative spending invested in the South before World War I (Iuzzolino et al. 2011, p. 23), the allocation of coal mining

permits and public contracts to the newborn iron and steel industry,[12] the exclusive assignment to the Piedmontese Banca Nazionale of the faculty of opening new branches and issuing banknotes convertible in the entire country (Pescosolido 2014, p. 151), and above all the public investment in railway, which constituted the 67 (53) percent of the 1861-1881(1911) Italian public spending (Picci, 2002). To elaborate, Liguria and Piedmont enjoyed over the 1861-1881(1911) period an average railway spending of 874 (457)—1861—lire per square km, which was 12 (3) times bigger than that received by Veneto and 18 (4) times higher than that gained by the other regions. Moreover, the 1885 reform handed the vast majority of the property of the railway industry to Northern hands (Pescosolido 2014, p. 159-167). Crucially, the real purpose of this effort "was more the military one of controlling the national territory, especially in the South, than favoring commerce [... The] railway fares acted in many cases as customs duties, making it more economic for the South to export goods abroad by sea rather than try to sell its products to the North via railway" (Iuzzolino et al. 2011, p. 22).

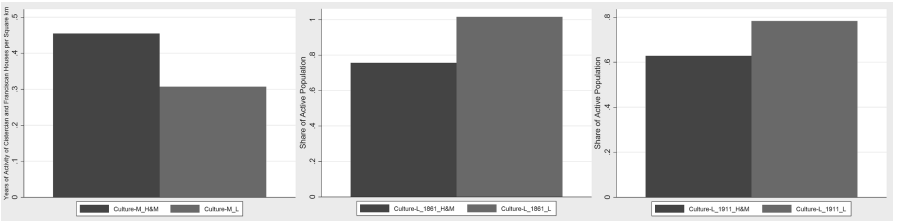
Crucially, such an impressive infrastructural program was financed through highly unbalanced tax rises. After an initial phase in which a 10 percent surcharge was added to the pre-unitary tax rates, the 1864 reform fixed a target revenue to be raised—i.e., "contingente"—equal to the 1863 yield plus 20 millions—i.e., 125 millions—allocating it to nine fiscal districts resembling the pre-unitary states (law 1831/1864).[13] The ex-Papal State took on the 10 percent of the *contingente*, the ex-Kingdom of Two Sicilies the 40 percent, and the rest of the Kingdom of Italy (ex-Kingdom of Sardinia) only 29 (21) percent. To further weigh this burden down, between 1867 and 1868, two other 10 percent surcharges were added to the *contingente* creating the disparities between high and middle-low political relevance regions described in the bottom-left graph in figure 2.1. In complaining about the oppressing nature of these policies, the Sicilian senator Antonino Paternò-Castello denounced that "the excessive amount of the land property tax [...] impacts mainly the small landowners, who find themselves greatly burdened and deprived of the means necessary to organize a rational farming" (Parravicini 1958, p. 163). Eventually, the 1876 achievement of the balanced budget

[12] While the permits to mine for coal in Elba were assigned to the Northern Terni-Banca Commerciale group, the only Southern blast furnace was opened in Bagnoli with Northern capitals (Pescosolido 2014, p. 274).

[13] The law also established a formal 12.5 percent tax rate on the estimated market value of land, rural buildings, and farming activities. In 1866, the last two items became object of autonomous duties (law 2136/1865). From 1867 (1871) on, 3 (13) millions were levied on the new Venetian (Roman) district (Parravicini, 1958).

together with Crispi's political success opened the way to more egalitarian policies like the 1888 removal of all surcharges and the 1886 cadastral reform (law 3682/1886). This last change gradually harmonized the regional tax rates especially after the First World War.[14]

Figure 2.2: Culture



Note: 1. "Culture-M" is the average cumulated discounted number of years of activity of Cistercian and Franciscan houses per square km in every half-century between 1000 and 1600 (see for sources and construction Boranbay and Guerriero, (2016)). The series ending in _H&M (_South) average the values for Abruzzi, Emilia Romagna, Lombardy, Marche, Tuscany, Umbria (Apulia, Basilicata, Calabria, Campania, Lazio), and Veneto (Sicily) except for "Culture-M_H&M," which does not include the data for Umbria. In this case indeed, Umbria is an outlier being the region of origin of Saint Francis and in turn of the Franciscans, who first and foremost expanded by building new houses in neighboring regions (Boranbay and Guerriero, 2016).

At that point however, the combination of the international competition, the definitive loss of public contracts, and the heavy land property taxation squeezed the Southern investment rates to the point that the divergence between the two blocks was irreversible (Nitti, 1993; Pescosolido 2014, p. 205 and 280). In fact, both the manufacturing industry and the advanced export-oriented farming were wiped out from the South, while an embryonic but expanding manufacturing industry was established in the North (Iuzzolino et al. 2011, p. 19-26; Pescosolido 2014, p. 254-269 and 278-279).[15] More important, extraction deteriorated the relationship between the government and the Southern population, who experienced the unification as a seizure (Zamagni 1993, p. 172; Iuzzolino et al. 2011, p. 14). This unchained a civil war going under the name of "brigandage," which between 1861 and 1864 brought about 20,000 Southern victims, imposed a de facto militarization of the area,[16] and opened the way to massive emigration. After the turn of the century indeed, the emigration rate surpassed the

[14]Before the official conclusion of the harmonization in 1956, the tax rate first felt to 7 percent in 1886 (law 3682/1886) and then increased again to 8.8 percent in 1897 (law 23/1897). More important, it was applied in the new geometric particle-cadastre system only when it produced revenues higher than those prescribed by the *contingente* (Parravicini, 1958). This together with the fact that only one third of the cadastres was reformed by 1922 leaves region-specific almost all the tax rates in our sample (Parravicini, 1958).

[15]The balancing policies pushed by Nitti and Sonnino turned out to be too weak (Pescosolido 2014, p. 295-297).

[16]In 1870, half of the Kingdom of Italy's army—120,000 units—policed the South (Felice, 2014).

Northern one, whereas exactly the opposite happened for the repatriation rates (Iuzzolino et al. 2011, p. 21). Moreover, the population started to display a progressively weaker culture as prompted by the fall of the share of active population engaged in political, union, and religious activities (see figure 2.2), which constitutes an outcome-based measure of social capital and was initially higher in the South. Contrary to the claims of the extant literature indeed (Guiso et al., 2016), the present-day advantage of the North does not predate the unification. To see this, the leftmost graph in figure 2.2 shows the homogeneity between clusters in the cumulated discounted number of years of activity over the 1000-1600 period of Cistercian and Franciscan houses. Boranbay and Guerriero (2016) document that these monks met the population's demand for insurance against consumption shocks in exchange for the acceptance of a culture of cooperation and so, at the European level, there is a strong correlation between their expansion and present-day norms of respect and trust.

The fascist regime's aversion to internal migrations and its rush to arming, managed through investments in the Northern heavy industry, have stretched even more the gap, which has been only barely filled by the 1960s booms and state aids (Iuzzolino et al. 2011, p. 26-51). Despite these more recent events however, it is clear at this point that the present-day divide originated in the policies set by the first post-unitary governments.

2.3 Theory

Consider a territory divided in two regions $r \in \{N, S\}$, each inhabited by a mass zero elite and a mass one of equal citizens consuming a region-specific public good g_r and a private good, whose demand and supply are D_r and X_r. In the case of 19th century Italy, N represents the Kingdom of Sardinia and S stands for any of the other states annexed by the Kingdom of Italy in 1861. In each region r, the citizenry produces $X_r = A_r C_r$, where $A_r > 0$ is the region-specific productivity parameter and C_r labels an input provided by citizenry and, in particular, either his culture of cooperation or his human capital. The first interpretation links directly our setup to the extant literature on the medieval determinants of the present-day divide, and it is consistent with the huge evidence according to which a culture of cooperation is pivotal to curb transaction costs, expand market exchange, and facilitate the division of labor (Tabellini, 2010;

Guerriero, 2016). In terms of our historical experiment, X_r is the product of a export-oriented farming activity requiring a progressively more sophisticated technology and higher division of labor, i.e., arboriculture and sericulture.

Timing.—The order of economic and policy choices is the following:

At time zero, the citizenry of region r linearly invests in C_r. When the input is culture, this assumption captures two fundamental insights of evolutionary psychology and Malthusian growth theories: a social group dictates to its members, via natural selection and cross-punishment, cultural norms maximizing its fitness (Barkow et al., 1992; Clark, 2005; Galor, 2011), and these norms are embraced by the group's members the faster the larger the culturally-driven reproductive advantage is (Andersen et al., 2016). Hence, it is reasonable to maintain that in the Malthusian environment discussed in section 2 a citizenry expecting larger returns from cooperation ends up with a larger culture C_r.

At time one and under autarky (political union), the elite of region r (N) selects the rate(s) t_r (t_N^U and t_S^U) at which the private good is then taxed. Under autarky (political union), each tax rate maximizes the regional (Northern) elite's rent net of linear tax-collection costs plus the welfare of the region's citizenry (weighted by a parameter lower than one and increasing with the region's political relevance for the Northern elite in the case of t_S^U).

At time two and under autarky (political union), the private good is produced, and the elite of region r (N) uses a share $\alpha < 1$ (α in the North and $\alpha^U < \alpha$ in the South) of the regional tax revenues to obtain with a linear technology g_r and pockets the rest. Next, the citizenry of region r consumes both g_r and the untaxed private good.

Discussion.—The Northern elite's ability to seize all unitary rents captures the political supremacy of the Piedmontese elite (see section 2). The inequality $\alpha^U < \alpha$ implies furthermore that the Northern elite could extract from the Southern population a rent larger than that possibly obtainable by the Southern elite. This closely squares with the constraints on the pre-unitary rulers' extractive power imposed by the credible threat of unrests on the one hand and with the post-unitary occupation of the Southern regions by the Northern army on the other hand (see section 2). Finally, the restriction on the weight the Northern elite attaches to the Southern citizenry's welfare captures one of the key stylized facts discussed in section 2: the first post-unitary governments privileged the regions closest to the most dangerous foreign enemies and thus most

useful (dangerous) for defense purposes (in case of a treachery). As aforementioned, not only the industries operating in these regions were initially favored by the unitary state's choice of both trade policy and public spending, but the relative populations also gained the most from the 1860s reforms of the *contingente*.

2.3.1 Autarky

Under autarky, the citizenry of region r selects C_r maximizing the objective function

$$\sqrt{D_r + \gamma g_r} - C_r = \sqrt{\left(1 - \hat{t}_r\right) X_r + \alpha\gamma\hat{t}_r X_r} - C_r = \sqrt{\tilde{t}_r A_r C_r} - C_r, \tag{2.3.1}$$

where hats label equilibrium quantities, $\tilde{t}_r \equiv 1 - \hat{t}_r\,(1 - \alpha\gamma)$, and γ gauges the citizenry's relative preferences for g_r *vis-a-vis* D_r. We hypothesize that $\alpha\gamma > 1$, and thus that the citizenry prefers public to private good production. This restriction reflects the urgency of public spending in railway diffusion (land reclamation and harbor development) felt by the Northern (Southern) bourgeoisie up against the backwardness of the local economy (see section 2).[17] The unique and global equilibrium levels of investment and consumption equal $\hat{C}_r = \tilde{t}_r \frac{A_r}{4}$. Therefore, $\hat{D}_r = \left(1 - \hat{t}_r\right) A_r \hat{C}_r$ and the citizenry's welfare is $V_r = \tilde{t}_r \frac{A_r}{4}$. Taking into account the citizenry's choice of C_r, the elite of region r selects a tax policy maximizing

$$(1 - \alpha - K)\, t_r A_r \hat{C}_r + V_r, \tag{2.3.2}$$

where the marginal tax-collection costs are such that $K > \max\left\{1 - \alpha, \frac{\gamma - 1}{\gamma}\right\}$. This last assumption is consistent with the limits to war waging imposed on the pre-unitary states (Kingdom of Italy) by the Congress of Vienna (Triple Alliance) and discussed in section 2. The unique and global solution to problem (2) is $\hat{t}_r = \frac{1}{2A_r(K + \alpha - 1)} - \frac{1}{2(\alpha\gamma - 1)}$, which falls as K increases due to the larger taxation costs and rises with γ because of the larger sub-utility from public good consumption. In addition, $\hat{t}_r$ decreases with A_r since at the margin the social gains from taxation are fixed—i.e., $1 - \alpha\gamma$, whereas the relative social costs net of rents are increasing with the regional productivity. Finally, $\hat{t}_r$ has an uncertain relationship with α, which decreases the elite's rents but augments the sub-utility from public good consumption. Thus, the equilibrium investment and

[17] Allowing the level of public good to shape future investment is an important avenue for further research.

welfare equal $\frac{A_r}{8} + \frac{\alpha\gamma-1}{8(K+\alpha-1)}$, which rises with A_r, γ, and α and falls with K, which is an inverse measure of the feasibility of public good production. Tax revenues $\hat{t}_r A_r \hat{C}_r = \frac{\alpha\gamma-1}{16(K+\alpha-1)^2} - \frac{A_r^2}{16(\alpha\gamma-1)}$ display behaviors similar to $\hat{t}_r$ and thus fall with A_r and K, rise with γ, and have an uncertain relationship with α.

2.3.2 Political Union

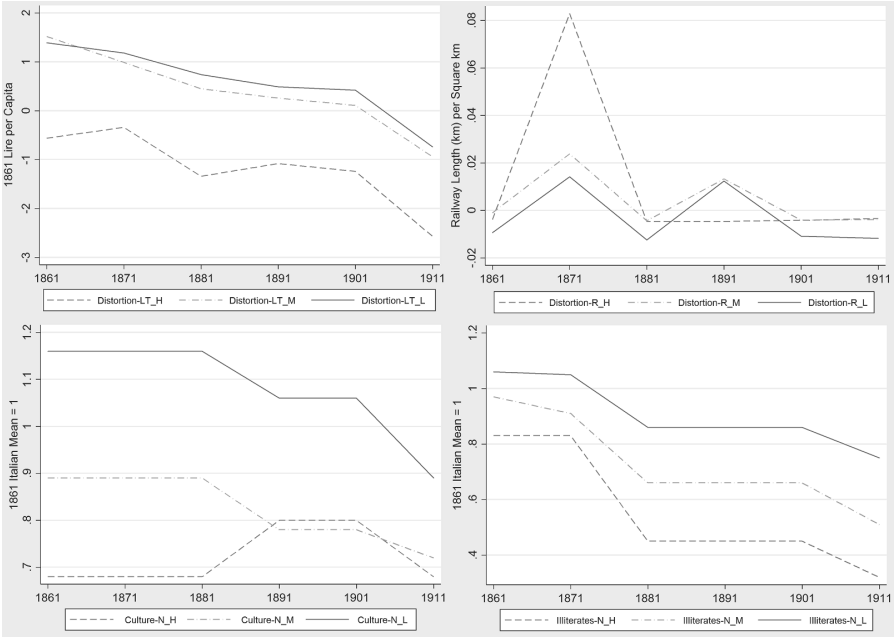
The Northern elite devotes now to the production of the public good g_S only a share $\alpha^U < 1 - K$ of tax revenues. Given our restrictions on K, $\alpha^U < 1 - K < \frac{1}{\gamma}$.[18] In words, we assume that under political union the extent of extraction from the South is sufficiently severe to make at the margin taxation profitable for the Northern elite and, given the assumed limits to state capacity, to endogenously let the citizenry prefer private to public good production. Since the tax revenues not appropriated by the Northern elite from region r finance g_r, the citizenry's problem is as under autarky and $\hat{C}_N^U = V_N^U = \tilde{t}_N^U \frac{A_N}{4} = \tilde{t}_N \frac{A_N}{4} = V_N = \hat{C}_N$, $\hat{C}_S^U = V_S^U = \tilde{t}_S^U \frac{A_S}{4}$, and $\tilde{t}_S^U \equiv 1 - \hat{t}_S^U \left(1 - \alpha^U \gamma\right)$. The Northern elite selects $\left\{t_N^U, t_S^U\right\}$ maximizing

$$(1 - \alpha - K)\, t_N A_N \hat{C}_N^U + \left(1 - \alpha^U - K\right) t_S A_S \hat{C}_S^U + V_N^U + \beta V_S^U, \tag{2.3.3}$$

where $\beta < 1$ is the weight attached to the Southern citizenry's welfare and reflects his political relevance. Since there is no trade between regions, $\hat{t}_N^U = \hat{t}_N$, $\hat{t}_S^U = \frac{1}{2(1-\alpha^U\gamma)} - \frac{\beta}{2A_S(1-\alpha^U-K)}$, and $\hat{t}_S^U A_S \hat{C}_S^U = \frac{A_S^2}{16(1-\alpha^U\gamma)} - \frac{\beta^2\left(1-\alpha^U\gamma\right)}{16(1-\alpha^U-K)^2}$. Thus, the tax revenues raised in the South increase with both A_S and γ, decrease with K, and have an uncertain link with α^U. The first comparative statics is different from the autarky case because now marginal rent-extraction benefits are higher than the marginal tax-collection costs, and thus an increase in regional productivity and so private good production implies more extraction. Finally, $\hat{t}_S^U A_S \hat{C}_S^U$ fall with β and are larger than under autarky when A_S is not too small and $\beta \to 0$. As seen in section 2, over the 19th century the South kept a significant but not extreme technological primacy and displayed the most limited political relevance for the Piedmontese elite. Accordingly, the first post-unitary governments extracted from the South above-average tax revenues per capita, which were also larger than those raised by the Bourbons, as shown by the bottom-left graph in figure 2.1. Proposition 1 summarizes the key aspects of the above analysis:

[18] Envisioning a fall in the quality of g_S under political union would not change the gist of the model.

Figure 2.3: The Rise of the North-South Divide



Note: 1. "Culture-N," and "Illiterates-N" are respectively *Culture-L* and *Illiterates-L* normalized in such a way that their means for Italy in 1861 equal one (see table 2.1). The _H (_L) group comprehends Veneto (Apulia, Basilicata, Calabria, Campania, Lazio, and Sicily). The _M cluster includes Abruzzi, Emilia Romagna, Lombardy, Marche, Tuscany, and Umbria.

Proposition 1: *Under autarky, the tax revenues raised in the South fall with the regional productivity A_S and decrease with the marginal tax-collection costs K. Under political union, they rise with A_S, fall with both K and the political relevance of the South for the Northern elite β, and are larger than under autarky if A_S is not too small and $\beta \to 0$.*[19]

Next, we take stock of the results obtained so far to analyze the impact on investment and economic outcomes of an exogenous shock turning autarky into a political union.

2.3.3 The Rise of the North-South Divide

Under political union, the Southern citizenry's investment and welfare $\hat{C}_S^U = V_S^U = \frac{A_S}{8} + \frac{\beta\left(1-\alpha^U\gamma\right)}{8(1-\alpha^U-K)}$ rise with K, β, and α^U since all these factors curb extraction and so investment distortions. Moreover, a little of algebra shows that, since $1-K < \frac{1}{\gamma}$, the Southern citizenry's welfare is higher under autarky (political union) for β lower

[19] To elaborate, $\hat{t}_S^U A_S \hat{C}_S^U > \hat{t}_S A_S \hat{C}_S$ whenever $\frac{A_S^2}{16(1-\alpha^U\gamma)} + \frac{A_S^2}{16(\alpha\gamma-1)} > \frac{\beta^2\left(1-\alpha^U\gamma\right)}{16(1-\alpha^U-K)^2} + \frac{\alpha\gamma-1}{16(K+\alpha-1)^2}$.

(higher) than $\frac{(\alpha\gamma-1)\left(1-\alpha^U-K\right)}{(1-\alpha^U\gamma)(K+\alpha-1)}$. Going back to our historical experiment, given levels of α^U, γ, and K common to all the annexed regions, those to which the Piedmontese elite assigned a sufficiently large β should have gained from unification, whereas those for which β was moderate or low should have lost. Consistent with this remark, figure 2.3 displays both the negative relationship between distortions in land property taxes and railway diffusion and the regional political relevance and the negative link between the latter and distortions in culture and human capital investments. Proposition 2 summarizes the key elements of the above investigation:

Proposition 2: *Under political union, both the Southern citizenry's investment $\hat{C}_S^U$ and welfare V_S^U rise with the marginal tax-collection costs K and the political relevance β, and they are lower (higher) than under autarky for β sufficiently small (large).*

To assess the relevance of these results, two remarks are crucial. First, our model provides a general theory of endogenous extractive policies in a political or economic union dominated by one of its constituents caring asymmetrically about the remaining members. Accordingly, $\hat{t}_S^U$ can be interpreted as the extent of any of the distortionary policies selected by the unitary government and discussed in section 2—i.e., trade, financial, and public procurement policies. As a result, proxies for both the marginal tax collection cost and the political relevance will be negatively related to the entire array of post-unitary distortionary policies. Second, our analysis can be extended to endogenize the parameter β in order to consider reforms towards a more democratic political process constraining the Northern elite's choices (North et al., 2009; Acemoglu and Robinson, 2012; Boranbay and Guerriero, 2016). Similarly, the elite might be induced to extract less if worried that the South's citizenry could opt out of the modern sector producing X_S and specialize instead in a sector demanding no investments. We leave the first robustness check to future research being less related to our historical experiment, but we discuss in details the second one in the following section.

2.3.4 General Equilibrium Disincentives to Extraction

The Southern citizenry can consume an alternative good T_S—i.e., wheat—produced through a "traditional" technology, which is linear in the productivity parameter L_S with $L_S < \frac{A_S^2}{16} + \frac{\beta A_S\left(1-\alpha^U\gamma\right)}{8(1-\alpha^U-K)} - \frac{3\beta^2\left(1-\alpha^U\gamma\right)^2}{16(1-\alpha^U-K)^2}$. Being the traditional sector technology independent of investment activities, the indirect utility of the citizenry S producing

the good T_S equals $\sqrt{(1-\hat{\tau}_S^U)\,T_S + \alpha^U\gamma\hat{\tau}_S^U T_S} = \sqrt{\tilde{\tau}_S^U L_S}$, where τ_S^U is the tax rate levied on the traditional good in the South and $\tilde{\tau}_S^U \equiv 1-\hat{\tau}_S^U\left(1-\alpha^U\gamma\right)$. In equilibrium, $V_S^U = \frac{\beta\left(1-\alpha^U\gamma\right)}{2(1-\alpha^U-K)}$ because $\tau_S^U = \frac{1}{1-\alpha^U\gamma} - \frac{\beta^2\left(1-\alpha^U\gamma\right)}{4L_S(1-\alpha^U-K)^2}$. Thus, the Southern citizenry selects the traditional sector if $\alpha^U < \frac{3\beta-A_S(1-K)}{3\beta\gamma-A_S} \equiv \overline{\alpha}^U$, even if the Northern elite would always prefer otherwise under our restriction on L_S. Therefore, the latter is now willing to extract a weakly lower surplus by acting as if α^U was at least $\overline{\alpha}^U$ to levy taxes on a more productive activity. The Northern elite will face a similar incentive, should we allow for inter-group trade. In this last case, extraction is curbed by the prospect of cheap imports. Since regional trades were very limited over our sample (Zamagni 1993, p. 10), we leave also this extension to future research.

2.4 Empirical Implications

Our model produces two sets of implications regarding the aforementioned thirteen present-day Italian regions incorporated by the Kingdom of Italy before World War I but not part of the Kingdom of Sardinia. While the first one concerns the determinants of pre-unitary and post-unitary tax policies, the second one deals with the impact of the post-unitary determinants of extractive policies on both post-unitary economic outcomes and investment. These implications can be restated as testable predictions in the following manner:

Predictions: *Pre-unitary tax revenues will fall with both the region's productivity and the marginal tax-collection costs but will be independent of the region's political relevance for the Piedmontese elite. Post-unitary tax revenues will increase with the region's productivity and decrease with both the marginal tax-collection costs and the region's political relevance. Finally, post-unitary economic outcomes and both cultural and human capital accumulation will rise with the marginal tax-collection costs and the region's political relevance.*

2.5 Evidence

To test our predictions, we need, first and foremost, information on the most economically relevant taxes, proxies for the regional productivity, the tax-collection costs, and the regional political relevance, and measures of economic outcomes and both cultural

and human capital accumulation. Furthermore, we require an appropriate empirical strategy.

2.5.1 Measuring Taxation and Its Determinants

Following the extant literature (Ciccarelli and Fenoaltea, 2013), we base our analysis on 10-year benchmarks. Moreover, we focus on the period around the unification over which the thirteen regions we consider kept stable territorial limits and extractive policies remained region-specific, i.e., 1801-1911 (Parravicini, 1958).[20] Elaborating on the first sample feature, we employ present-day regional boundaries, but our results are similar if we switch to the historical ones.[21] For what concerns extractive policies, we look first and foremost at the land property taxation being the Italian economy essentially agrarian over the 19th century. In absence of sufficient information on the pre-unitary fiscal legislation and given the peculiar features of the *contingente* method, we focus on the revenues from land property taxes—i.e., "imposta sul valore fondiario"—per capita in 1861 lire—i.e., *Land-Taxes*—employing the preceding observation for any unavailable observation (see table 2.A.1). Over the sample, land property taxes accounted for 54 percent of direct taxes, have been region-specific, and hit the estimated land profitability shaping in turn the landowner's investment decisions. To show moreover that our results are not driven by the availability of arable land, we document that they are similar if we divide the tax revenues by the arable land (see appendix). Unfortunately, we cannot compare our estimates with those produced by focusing on the milling tax since it was introduced in 1868 and then soon abolished in 1884.

To gauge farming productivity, we exploit the geographic inputs to the technologies producing silk, citrus, olives, and wheat. While the first three correspond to the export-oriented sector analyzed in the basic model, wheat breeding embodies the traditional sector discussed in section 3.4. To the best of our knowledge, there is no information on the land suitability for the other relevant albeit secondary export-oriented cultivations in our sample, i.e., grapevine and hemp (see section 2). Lacking also information on the land suitability for mulberry, we proxy the productivity of sericulture with the normalized first principal component extracted from the share of the region's surface

[20] This is roughly the period elapsing between the 1797 treaty of Campo Formio and World War I.

[21] After having annexed the Venetian and Roman provinces, the Kingdom of Italy entirely incorporated Friuli-Venezia Giulia and Trentino-Alto Adige in 1918 and 1919. Molise was separated from Abruzzi in 1963.

covered by large lakes and rivers and the average growing season precipitation in the previous decade in ml, i.e., *Sericulture*.[22] Turning to wheat farming and arboriculture, we build on the analysis in section 2 and we use principal component analysis to aggregate only those geographic features positively correlated to the underlying "productivity" construct (Rosenthal and Voeten, 2007). Accordingly, we elect as a proxy for the productivity of wheat farming the variable *Wheat*, which is the normalized first principal component extracted from the land suitability for wheat in hundredth and the average growing season precipitation in the previous decade in ml, and as a proxy for the productivity of arboriculture the variable *Arboriculture*, which is the normalized first principal component extracted from the land suitabilities for citrus and olive trees in hundredth and the average growing season temperature in the previous decade in Celsius degrees.[23] Consistent with our measurement strategy, the growing season temperature does not correlate with the first principal component extracted from itself, the land suitability for wheat, and the growing season precipitation, whereas symmetrically the growing season precipitation is unrelated to the first principal component extracted from itself, the land suitabilities for citrus and olive trees, and the growing season temperature.

Table 2.2: Cross-Validating the Proxies for the Productivity of Export-Oriented Farming

Sericulture	0.79***		
Arboriculture		0.46***	0.66***
	Silk-P	*Citrus-P*	*Olive-P*

Notes: 1. *Silk-P* is the regional production of silk in kg, whereas *Citrus-P* (*Olive-P*) is that of citrus fruits in hundreds (olive oil in hectoliters). All variables are obtained from Ministero dell'Agricoltura, Industria e Commercio (1864, 1881, 1892, 1900, and 1912) and the sample consists of 78 observations over the 1861-1911 period.
2. The entries are partial correlations calculated removing the effect of both time dummies and the average land suitability for agriculture, which we directly collected from http://www.sage.wisc.edu/iamdata/ *** labels a partial correlation significant at the 1% confidence level; **, 5%; *, 10%.

To validate this aspect of our measurement exercise, we pursue a two-step strategy. First, we document in table 2.2 the strong and significant—conditional on both time dummies and the average land suitability for agriculture—partial correlation of our proxies with the contemporaneous post-unitary production of respectively silk in kg, citrus fruits in hundreds, and olive oil in hectoliters (Ministero dell'Agricoltura, Industria e Commercio, 1864, 1881, 1892, 1900, and 1912). Second, we show that our

[22]The basin (precipitation) data are in grid format, cover the entire World (Europe) at a 0.5 degrees spatial resolution (for the 1400-1900 period), and are collected from the GLWD dataset (Pauling et al., 2006).

[23]The land suitability (temperature) data are in grid format, cover the entire World (Europe) at a 0.5 degrees spatial resolution (for the 1500-2004 period), and come from the GAEZ dataset (Luterbacher et al., 2004).

estimates are similar when we focus instead on the productivity of either citrus or olive breeding (see appendix 2.D). It is worth to stress that we cannot use directly the land suitabilities for wheat, citrus, and olive trees, the share of surface covered by lakes and rivers, and the growing season temperature and precipitation since the first four will be absorbed by the fixed effects, while the last two will not capture alone the productivity of either arboriculture or sericulture.

Turning to the marginal tax-collection costs, we follow Dincecco et al. (2011) and we incorporate into the analysis the share of previous decade in which the state to which the region belonged partook in external wars, i.e., *War*. A broad literature has shown that a key determinant of a state capacity to raise tax revenues is the provision of common interest public goods, such as fighting external wars (Besley and Persson, 2009). Accordingly, higher values of *War* should correspond to lower marginal tax-collection costs. Our results will be similar, should we consider the share of years from the Congress of Vienna in which the state to which the region belonged partook in external wars (see appendix 2.B).

Finally, we employ as an inverse metrics of a region's political relevance *Distance-to-Enemies*, which is the distance in km between the region's main city and Vienna over the 1801-1813, 1848-1881, and 1901-1914 periods, and Paris otherwise. As further illustrated in appendix 2.D, our choice can be explained as follows. Conquered by Napoleon in 1796, the Kingdom of Sardinia came out from the Congress of Vienna as an independent reign including also Genoa and formally opposed to France. Yet, the Austro-Sardinian War ignited by the Spring of Nations fired up an enmity between the Savoys and Austria that flowed in 1859 and 1866 into respectively the Second and Third Wars of Independence. France took this opportunity to draw up an alliance with the Kingdom of Sardinia with the twofold aim of gaining back Nice and the Savoy and erecting a wall against Austria. The French-Italian coalition ended in 1881 when France established a protectorate in Tunisia. Frustrated in its colonial efforts, Italy secured in 1882 the Triple Alliance with Austria and Germany by committing to mutual support against a French attack. The deterioration of the relationship between England and the Triple Alliance due to Otto von Bismark's "realpolitik" and the conflicts in Africa promoted however the 1902 French-Italian colonial agreements. The revived Paris-Rome axis paved the way to the end of the Triple Alliance and the blast of World War I. To evaluate the appropriateness of this definition, we construct the following placebo

test (see appendix 2.D). First, we define an alternative inverse metrics of a region's political relevance—the average distance in km of its main city from the capital/s of the foreign power/s less salient for the House of Savoy because excluded from the Congress of Vienna and/or from the Triple Alliance and Entente.[24] Second, we document that such an indicator is never statistically significant in our post-unitary regressions.

2.5.2 Endogenous Taxation

We estimate endogenous taxation equations of the type

$$LT_{r,t} = \alpha_r + \beta_{\mathbf{0}}' \mathbf{A}_{r,t} + \beta_{\mathbf{1}}' \mathbf{A}_{r,t}^2 + \gamma_0 S_{r,t} + \gamma_1 S_{r,t}^2 + \delta_0 P_{r,t} + \delta_1 P_{r,t}^2 + \epsilon_{r,t}, \tag{2.5.1}$$

where $LT_{r,t}$ is *Land-Taxes* in region r and year t, the vector $\mathbf{A}_{r,t}$ gathers *Sericulture*, *Wheat*, and *Arboriculture*, $S_{r,t}$ labels *War*, and $P_{r,t}$ is *Distance-to-Enemies*. α_r accounts for time-invariant determinants of taxation such as differences in the regional cadastres (see section 2) and geographic characteristics such as the land suitability for agriculture or the ruggedness of terrain, which, in turn, shaped transportation costs and the arable land (Pescosolido 2014, p. 98 and 129). Including the squared terms of $\mathbf{A}_{r,t}$, $S_{r,t}$, and $P_{r,t}$ incorporates into equation (4) the nonlinearities in the functional forms of the equilibrium tax revenues (see section 3). The key implications to be tested are that the marginal effect of a rise in either *Sericulture* or *Arboriculture* is negative (positive) in the pre(post)-unitary sample, the marginal effect of an increase in *War* is positive, and the marginal effect of a rise in *Distance-to-Enemies* is insignificant in the pre-unitary sample and positive and significant otherwise.[25]

In judging our empirical strategy, it is important to highlight the adequacy of the empirical approach and the exogeneity of the regressors. Starting from the former, the two crucial untested assumptions we embrace are that unification was an exogenous shock and that it did not dramatically change the structure of the regional economies making our positive taxation model inadequate for the post-unitary sample. For what concerns the first point, there is a broad agreement in the historical literature that

[24] This (these) is (are) Istanbul between 1801 and 1815 (Amsterdam, Copenhagen, and Istanbul between 1816 and 1882 and Amsterdam, Copenhagen, Istanbul, Lisbon, and Madrid between 1883 and 1914).

[25] For instance, the second marginal effect can be expressed in terms of the parameters of equation (4) as $\left(\hat{\gamma}_0 + 2\hat{\gamma}_1 \overline{S}\right) \Delta$, where Δ is the rise in *War* from the value $\overline{S}$, whereas $\hat{\gamma}_0$ and $\hat{\gamma}_1$ are estimated coefficients.

"the unification of Italy in 1861 caught almost everyone, both in Italy and abroad, by surprise" (Cohen and Federico, 2003, p. 70). Turning to the second point, the percentage of the active population employed in the industrial sectors grew between 1861 and 1911 period by only four percent—i.e., from 17 to 21—in the North and even felt by three percent—i.e., from 21 to 18—in the South. As stressed by the related historical literature then (Zamagni 1980, p. 136; Pescosolido 2014, p. 211 and 278-279), Italy remained before World War I an intrinsically agricultural economy. Speaking instead of the exogeneity of the regressors, three observations are key. First, the controls encapsulated in $\mathbf{A}_{r,t}$ are exogenous because driven by either climate shocks or features of the region's terrain independent of human effort. Second, *War* is determined by the following six external conflicts: 1. "Austro-Sardinian" War of 1848; 2. "Roman Republic" War of 1849; 3. "Italian Unification" War of 1859; 4. "Italian-Roman" War of 1860; 5. "Neapolitan" War of 1860; 6. "Seven Weeks" War of 1866. As detailed in the appendix 2.B, these clashes were unfold by the pre-unitary foreign policy of the Kingdom of Sardinia, the unrests provoked by the Spring of Nations, and the German realpolitik. Hence, since the Piedmontese elite did not foresee the unification at the inception of the struggles (Duggan 2008, p. 208-213), none of the policy makers selecting extractive policies also shaped the evolution of these external conflicts (Killinger, 2002; Paoletti, 2008; Riall, 2009). Finally, also *Distance-to-Enemies* is determined by events outside the control of the elites of the pre-unitary states and of the Piedmontese elite after the unification, like the Congress of Vienna, the Spring of Nations, the French expansion in Tunisia, and the German realpolitik.[26] Moreover, since *Distance-to-Enemies* is identified by its time variation, it cannot simply reflect the distance from international markets. Finally, multicollinearity is not an issue since the correlation between *War* and *Distance-to-Enemies* is limited.

Columns (1) to (3) of table 2.3 display the estimates for three alternative specifications for the pre-unitary sample, the first excluding both *War* and *Distance-to-Enemies*, the second excluding only *Distance-to-Enemies*, and the third one including all controls. Columns (4) to (6) of table 2.3 have the same structure but are based on the post-unitary sample. To control for arbitrary correlation within groups, we always

[26]For the 1801-1851 sample, we cannot construct a proxy for the political relevance of each region for the elite of the pre-unitary state to which it belonged since the partition of Italy by the Congress of Vienna was precisely aimed to assure that none of these states could attack or be attacked by the neighboring states.

Table 2.3: Endogenous Taxation

	(1)	(2)	(3)	(4)	(5)	(6)
	1801-1851 sample			1861-1911 sample		
	The dependent variable is *Land-Taxes*					
Sericulture	- 5.622	2.046	3.249	- 17.520	- 16.236	- 12.214
	(11.948)	(10.234)	(9.609)	(16.801)	(9.866)*	(10.131)
Wheat	- 3.925	- 5.358	- 3.562	- 23.343	- 12.385	- 12.998
	(7.922)	(5.880)	(6.233)	(12.922)*	(10.645)	(10.001)
Arboriculture	- 12.827	- 8.177	- 5.016	- 5.180	- 5.635	- 5.603
	(5.877)**	(3.657)**	(2.700)**	(15.205)	(16.544)	(18.048)
War		- 13.119	- 11.020		65.296	79.169
		(24.637)	(30.611)		(74.961)	(81.546)
Distance-to-Enemies			0.001			0.0013
			(0.001)			(0.0007)**
Estimation	Fixed Region Effects OLS					
R^2	0.21	0.28	0.30	0.19	0.44	0.45
Number of observations	78	78	78	78	78	78

Notes: 1. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.

2. All specifications incorporate *Sericulture*, *Sericulture*^{2}, *Wheat*, *Wheat*^{2}, *Arboriculture*, and *Arboriculture*^{2}. The specifications in columns (2) and (5) (columns (3) and (6)) also include *War* and *War*^{2} (*War*, *War*^{2}, *Distance-to-Enemies*, and *Distance-to-Enemies*^{2}). The marginal effects of *Sericulture*, *Wheat*, and *War* are calculated for a rise from their lowest values in the low political relevance group, i.e., respectively 0.01, 0.00, and 0 (0.00, 0.01, and 0) in the pre(post)-unitary sample. The marginal effects of *Arboriculture* and *Distance-to-Enemies* are calculated for a rise from their lowest values in the high and middle political relevance group, i.e., respectively 0.18 and 436.

allow for clustering by region.[27] We will obtain similar results, should we deal with generic spatial dependence in the error term by relying on the Conley (1999) standard errors (see appendix 2.D).

For the most part, the results are consistent with the model predictions, and the implied effects are large. First, in the pre-unitary sample a rise in *Arboriculture* from the lowest North's value—i.e., 0.18 in Lombardy—to the highest South's one—i.e., 1 in Apulia—implies a 5.3-standard-deviation fall in *Land-Taxes* in column (1) and is always significant at 5 percent in columns (1) to (3). This is not the case for either *Sericulture* or *Wheat*. These patterns are consistent with the mid-19th century boom in arboriculture exports and the Pebrine epidemic (see section 2). Second, the proxies for farming productivity are insignificant in the post-unitary sample as expected given the rising political power of the industrialists in the aftermath of the agrarian crisis (see section 2). Third, lower marginal tax-collection costs are not significantly related to larger *Land-Taxes*. This result is consistent with the relative higher difficulty of both pre-unitary and unitary states to implement tax rises versus other distortionary policies. To illustrate, the unitary government could easily impose in 1861 the enormous—two thirds of the total—Piedmontese public debt upon the rest of the country, but the share of direct taxes not exacted albeit decreasing was still about the thirty percent in 1866 (Frascani 1988, p. 14; Pescosolido 2014, p. 148-173). Finally, *Distance-to-Enemies* is insignificant in the pre-unitary sample but represents the strongest predictor of post-unitary land property taxes, and indeed a rise from

[27] Our conclusions are the same when we deal with the "few clusters" problems by using the critical values of the T distribution with degrees of freedom equal to the number of clusters (Cameron and Miller, 2015).

its lowest North's value—i.e., 436 in Veneto—to its highest South's one—i.e., 1586 in Sicily—is conducive to a 1.3-standard-deviation increase in *Land-Taxes*, which is significant at 5 percent (see column (6)).

All in all, it is fair to summarize our results stating that pre-unitary tax policies trade-off net tax-collection costs minimization and the citizenry's welfare maximization, whereas post-unitary ones respond only to the asymmetric rent-seeking interests of the Piedmontese elite. Next, we study the impact of this rational extraction process on post-unitary outcomes.

2.5.3 The Rise of the North-South Divide

Given the functional form for $V_S^U = \hat{C}_S^U$, we estimate outcome equations of the type

$$Y_{r,t} = \alpha_r + \beta_{\mathbf{2}}' \mathbf{A}_{r,t} + \gamma_2 S_{r,t} + \gamma_3 S_{r,t}^2 + \delta_2 P_{r,t} + \zeta D_{r,t} + \nu_{r,t}, \tag{2.5.2}$$

where $Y_{r,t}$ is the ratio of one among six development indicators to its 1861 value, i.e., *Culture*, *Illiterates*, *GDP*, *GSP*, *VA-T*, and *VA-M* (see table 2.A.1). These indicators are respectively the share of active population engaged in political, union, and religious activities,[28] the percentage points of the illiterates in the total population over the age of six, the income in 1861 lire per capita, the gross saleable annual farming product per employee, and the value added in the textile and manufacturing industry in thousands of 1861 lire per capita. While *Culture* (*Illiterates*) is positively (negatively) linked to culture (human capital accumulation), the textile and above all the manufacturing value added gauge the profitability of the sectors that became the bulk of the Italian industry between the two wars (Pescosolido 2014, p. 199-204). When needed, we again impute a missing observation with the preceding data point. Crucially, our results are robust to considering an array of differing development indicators and, in particular, the life expectancy, the height of conscripted workers, the logarithm of the population per square km, and the value added in the engineering, chemical, and metal-making industries again in thousands of 1861 lire per capita (see appendix 2.D).

α_r controls for time-invariant drivers of development and, notably, geography, differences in the regional cadastres, and asymmetric initial structural conditions, such

[28] The post-unitary activity rate was 54 (53) percent in the North (South). Felice (2012) constructs another proxy for culture, which however is less reliable being a mix of socio-political participation and crime rates.

as the pre-unitary inclusiveness of the political process, extent of power fragmentation, and availability of local inputs and infrastructures. To avoid moreover that these dimensions, which as discussed in section 2 constituted the only significant differences between clusters in 1861, are biasing our results through a time-variant effect, we document in section 5.4 that the gist of our analysis is robust to experimenting with time dummies and their interaction with proxies for the inclusiveness of political institutions, land ownership fragmentation, coal price, and railway length. Considering in a similar manner any of the other initial structural dimensions reported in table 2.1 or the 1861 human capital level delivers similar results.

$D_{r,t}$ is the difference between the observed *Land-Taxes* and the land property tax revenues per capita forecasted using the specification in column (1) of table 2.3, i.e., *Distortion-LT*. We do not use as forecasting model one of the specifications reported in columns (2) and (3) of the same table since post-unitary values of $S_{r,t}$ and $P_{r,t}$ should be irrelevant in the counterfactual autarky regime. In our model, the severity of post-unitary extraction entails that the Southern citizenry prefers private to public good production, and thus observed tax revenues higher than the counterfactual autarky equilibrium—i.e., positive *Distortion-LT* values—imply excessive taxation. This interpretation is consistent with the evidence on the inefficiency of post-unitary public spending in the South discussed in section 2. In evaluating how appropriate the construction of *Distortion-LT* is, three observations are key. First, our approach is closely related to the synthetic control method whereby the land property taxes that would prevail in the conterfactual scenario without unification and forecasted from the endogenous taxation model run on pre-unitary data can be seen as a synthetic control obtained by the preintervention characteristics of the treated units (see Abadie et al., (2015)). Crucially, a similar variable cannot be constructed building on the preintervention characteristics of untreated units since the two-century-long stagnation of the Italian economy and the peculiarity of the post-unitary Italian tax code make Italian regions an unique case within the most comparable sample of European regions (Malanima, 2010). Second, as discussed in section 3.3, *War* and *Distance-to-Enemies* capture the economic relevance of all post-unitary distortionary policies, whereas *Distortion-LT* chiefly incorporates unobserved components of the region's tax-collection costs and political relevance specific to the selection of land property taxes. Accordingly, we interpret a significant δ_2 and/or a significant marginal effect of a rise in $S_{r,t}$ together

with an insignificant ζ (the way around) as supportive of the primacy of the entire array of distortionary public policies over tax distortions (otherwise). Finally, as for the estimates in table 2.3, *War*, *Distance-to-Enemies*, and *Distortion-LT* should all be considered exogenous because driven by events outside the control of the Piedmontese elite.

A glance at figures 2.1 and 2.3 confirms the model predictions. The two bottom-graphs in figure 2.1 show the opposite post-unitary evolutions of land property tax revenues and railway diffusion. In a nutshell, the regions less politically relevant for the Piedmontese elite experienced both the most hindering tax policies and the weakest public effort in railway construction, whereas the opposite is true for the regions nearest to the French and Austrian borders. A similar pattern arises when post-unitary distortions in land property taxes and those in railway diffusion, which is further discussed in section 5.5, are compared with the evolution of both *Culture* and *Illiterates* (see figure 2.3). To elaborate, *Distortion-LT* is the lowest in Veneto, which enjoyed a 1.188—1861—lire per capita average fall in land property taxes, and the highest in the South, which bore a 0.580—1861—lire per capita average rise in *Land-Taxes*, whereas the post-unitary gap in land property tax distortions between blocks was 0.408—1861—lire per capita or correspondingly a strikingly 651.2—1861—lire per square km of arable land (see table 2.A.1 and appendix 2.D). To put these figures into perspective, a back-of-the-envelope calculation reveals that tax distortions raised of seven times the 1871 start-up cost of a citrus cultivation in the South at the prevailing saving rate of five percent (Della Torre et al., 2006), i.e., from seventeen to 120 months of average after-tax farming profits per square km of arable land.[29] Not surprisingly, braked by this huge spike in investment costs and absent developed financial markets, the South witnessed the sharpest fall in a culture of cooperation and the most limited decline in illiteracy.

Multivariate analysis confirms these relationships (see table 2.4). As expected, the marginal effect of a rise in *War*, δ_2, and ζ are negative (positive if the dependent variable is *Illiterates*) and significant. To illustrate, a one-standard-deviation rise in *War*—i.e., 0.01—from its post-unitary mean—i.e., 0.005—corresponds to a 0.6-standard-deviation

[29] To illustrate, we build on Dimico et al. (2012), Pescosolido (2010), and SVIMEZ (2011), and we calculate that the average pretax farming profits per square km of arable land in Sicily were 5964 lire, which we take as a proxy for the remainder of the South. Moreover, we use the fact that the average (distortions in) land property tax revenues per square km of arable land in the South were 565 (483) lire and that, being seed and labor costs negligible, the main start-up expenses of a citrus cultivation were the five years of land property taxes to be payed while the newly planted trees became productive (Dimico et al. 2012, p. 2).

Table 2.4: The Rise of the North-South Divide

	(1)	(2)	(3)	(4)	(5)	(6)
	The dependent variable is:					
	Culture	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
War	- 8.674	18.692	- 1.741	- 13.535	- 22.031	5.469
	(4.140)**	(5.700)***	(8.959)	(8.390)*	(10.856)**	(10.170)
Distance-to-Enemies	- 0.00012	- 0.00004	0.0001	- 0.0004	- 0.0003	- 0.0002
	(0.00006)**	(0.00004)	(0.0001)	(0.0001)***	(0.0002)	(0.0001)**
Distortion-LT	0.052	0.077	- 0.141	- 0.095	- 0.228	- 0.277
	(0.034)	(0.028)**	(0.040)***	(0.040)**	(0.115)*	(0.054)***
Estimation	Fixed Region Effects OLS					
R^2	0.25	0.81	0.48	0.35	0.26	0.69
Number of observations	78	78	78	78	78	78

Notes: 1. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.
2. All specifications include the proxies for farming productivity—i.e., *Sericulture*, *Wheat*, and *Arboriculture*—as well as *War*, War^2, *Distance-to-Enemies*, and *Distortion-LT*. The marginal effect of *War* is calculated for a rise from its post-unitary mean 0.005.

fall in *Culture*, a one-standard-deviation increase in *Illiterates*, and a 0.5-standard-deviation fall in *GSP*. Similarly, a rise in *Distance-to-Enemies* from the lowest North's to the highest South's value implies a 1.1-standard-deviation decrease in *Culture* and a 1.7-standard-deviation fall in *GSP*, whereas a one-standard-deviation increase in *Distortion-LT* or 1.8—1861—lire per capita leads to a roughly 0.7-standard-deviation decrease (rise) in *GDP*, *GSP*, *VA-T* (*Illiterates*) and 1.4-standard-deviation fall in *VA-M*. All these coefficients are significant at 10 percent or better.

2.5.4 Identifying Causal Relationships

Albeit reverse causation is not an issue (see section 5.2 and 5.4), we cannot exclude that our results are driven by unobserved heterogeneity and, in particular, by differences in 1861 structural conditions. To evaluate whether this is the case, we operate as follows. First, we assess the impact of initial structural dimensions on the estimates discussed in section 5.3. Next, we use selection on observables to assess the bias from unobservables.

Controlling for Observables

To illustrate the first exercise, we consider time dummies and their interaction with the four dimensions displaying significantly different 1861 values in the South and in the North groups (see table 2.1). Crucially, including decennial dummies also controls for another key time-varying confounder, which is the series of end of the 19th century international shocks to the terms of trade of the farming products discussed in section 2 (Barbagallo, 1980).

The first factor we consider is the average over the 1000-1850 period of the constraints on the elite's power developed by Tabellini (2010) and Boranbay and Guerriero

(2016), i.e., *Democracy-I*. Including this observable allows us to directly contrast our framework to the aforementioned literature on the persistent effects of medieval political institutions on present-day culture and outcomes (Putnam et al., 1993). The second structural condition we analyze has been proposed instead by Del Monte and Pennacchio (2011) and it is defined as the 1861 number of payers of land property taxes divided by the agricultural population as reported by in the Inquiry into agriculture and peasant conditions in Italy completed in 1885 by Stefano Jacini, i.e., *Land-Fragmentation-I*. Incorporating this control into equation (5) directly tests the idea that inequality in land ownership and, more generally, power originated an exploiter Southern bourgeoisie (Felice, 2014). We will obtain similar estimates should we employ as alternative proxy for power fragmentation the Gini coefficient proposed by Vecchi (2011). Crucially, considering either *Democracy-I* or *Land-Fragmentation-I* makes also possible to compare our model testable predictions with the alternative idea that the present-day divide originates in either the backwardness of the Kingdom of Two Sicilies (Franchetti and Sonnino, 1876) and/or the persistence of the Southern pre-unitary feudal system (Gramsci, 1966). To understand instead the role of the variation in input availability on the asymmetric spread of the Industrial Revolution (Krugman, 1981), we control for the 1861 coal price per tonne in Genoa, which was the main harbor for its import, augmented for the transport cost to each region in 1861 lire, i.e., *Coal-Price-I*. As clarified by Missiaia (2012), from the 1890s on coal contributed the most to the Italian power needs becoming increasingly pivotal in the success of the industrial sectors. Exploiting instead variation in hydroelectric power, again available from Missiaia (2012), delivers similar estimates. Finally, to explore the role of the initial regional endowments of infrastructures, we include into our analysis the 1861 railway length in km per square km, i.e., *Railway-I*. Crucially, using the predetermined values of these four variables minimizes the likelihood of their endogeneity.

Panels A to D of table 2.5 report the estimates of the specifications considering also time dummies and their interaction with initial structural dimensions. Three are the key observations. First, our results remain qualitatively similar when we condition on observables suggesting that, as discussed in more details in section 5.4.2, selection on unobservables should not be considered an issue. Consistent with this remark, estimates available upon request reveal that the time-variant impacts of the starting conditions are in general statistically insignificant implying that alternative explana-

Table 2.5: The Rise of the North-South Divide — Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Number of observations = 78. The dependent variable is:					
	Culture	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
War	- 19.715	11.934	- 23.083	- 29.142	- 23.754	2.939
	(6.818)***	(7.081)*	(12.170)**	(15.541)*	(25.614)	(4.683)
Distance-to-Enemies	- 0.0001	0.0001	- 0.0002	0.0001	- 0.0001	0.0003
	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0002)
Distortion-LT	- 0.027	0.034	- 0.030	- 0.040	- 0.129	- 0.075
	(0.029)	(0.026)	(0.039)	(0.074)	(0.093)	(0.040)*
P-value for *Democracy-I* × 1861-1901 dummies	[0.17]	[0.02]	[0.02]	[0.01]	[0.00]	[0.05]
Estimation	Fixed Region and Time Effects OLS					
R^2	0.51	0.96	0.79	0.60	0.71	0.91
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel B. Number of observations = 78. The dependent variable is:					
	Culture	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
War	- 17.078	12.141	- 5.630	- 26.703	- 59.223	3.329
	(2.889)***	(4.264)***	(10.364)	(9.296)***	(31.051)**	(3.871)
Distance-to-Enemies	- 0.0001	$8.88E^{-6}$	- 0.00005	0.0002	0.0004	0.0003
	(0.0002)	(0.0001)	(0.00017)	(0.0002)	(0.0004)	(0.0002)
Distortion-LT	- 0.030	0.048	- 0.014	- 0.042	- 0.201	- 0.086
	(0.044)	(0.025)*	(0.067)	(0.075)	(0.120)*	(0.050)*
P-value for *Land-Fragmentation-I* × 1861-1901 dummies	[0.50]	[0.02]	[0.26]	[0.13]	[0.50]	[0.02]
Estimation	Fixed Region and Time Effects OLS					
R^2	0.45	0.94	0.77	0.64	0.38	0.93
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel C. Number of observations = 78. The dependent variable is:					
	Culture	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
War	- 17.365	13.477	- 6.332	- 24.880	- 61.167	3.744
	(2.463)***	(4.547)***	(10.406)	(8.428)***	(26.646)**	(6.000)
Distance-to-Enemies	- 0.0001	$- 1.15E^{-6}$	- 0.0001	0.0002	0.0004	0.0004
	(0.0002)	(0.00006)	(0.0002)	(0.0002)	(0.0005)	(0.0002)
Distortion-LT	- 0.024	0.044	- 0.008	- 0.035	- 0.179	- 0.072
	(0.042)	(0.025)*	(0.066)	(0.080)	(0.126)	(0.052)
P-value for *Coal-Price-I* × 1861-1901 dummies	[0.66]	[0.08]	[0.14]	[0.07]	[0.10]	[0.48]
Estimation	Fixed Region and Time Effects OLS					
R^2	0.43	0.93	0.76	0.57	0.36	0.89
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel D. Number of observations = 78. The dependent variable is:					
	Culture	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
War	- 17.374	13.272	- 9.281	- 30.535	- 44.238	8.534
	(4.192)***	(5.193)***	(11.287)	(10.553)***	(25.327)*	(6.806)
Distance-to-Enemies	- 0.0001	0.00002	- 0.0001	0.0003	0.0001	0.0003
	(0.0002)	(0.00007)	(0.0002)	(0.0002)	(0.0004)	(0.0002)
Distortion-LT	- 0.025	0.042	- 0.012	- 0.047	- 0.151	- 0.065
	(0.035)	(0.020)*	(0.055)	(0.065)	(0.080)*	(0.043)
P-value for *Railway-I* × 1861-1901 dummies	[0.41]	[0.61]	[0.88]	[0.34]	[0.00]	[0.02]
Estimation	Fixed Region and Time Effects OLS					
R^2	0.47	0.94	0.76	0.58	0.65	0.93

Notes: 1. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.

2. All specifications include the proxies for farming productivity—i.e., *Sericulture*, *Wheat*, and *Arboriculture*—as well as well as *War*, War^2, *Distance-to-Enemies*, and *Distortion-LT*. Furthermore, the specifications in panels (A) to (D) incorporate time effects interacted with respectively *Democracy-I*, *Land-Fragmentation-I*, *Coal-Price-I*, and *Railway-I*. Finally, the marginal effect of *War* is calculated for a rise from its post-unitary mean 0.005.

tions of the opening of the present-day gap do not make a dent in explaining the data. Second, the region's taxation and political relevance are, conditional on observables, the only significant drivers of outcomes suggesting that it was the mix of all distortionary policies to really matter. Finally, conditional on observables, distortionary policies do not significantly shape *VA-M*. This pattern crucially implies that extraction did not allow the Northern growth sector to start its chase to the most advanced European industries as the prewar divide clearly suggests (Pescosolido 2014, p. 278-300). Hence, post-unitary distortions cannot be considered the acceptable price that the low political relevance regions had to pay for the industrialization of the only part of the country structurally ready for it and, in turn, of the entire state (Iuzzolino et al., 2011).[30] Such

[30]To illustrate, the divide "was not deliberately constructed [...] to the disadvantage of the South,

a conclusion is consistent with proposition 2 whereby a sufficient rise in the rulers' extractive power decreases the social welfare of all the low political relevance regions.

Using Selection on Observables to Assess the Bias from Unobservables

Despite our attempts to control for observables, our estimates may still be biased by unobservables correlated with either the regional productivity, the region's taxation capacity, or its political relevance. To evaluate this issue, we calculate the index proposed by Oster (2016) to measure how much stronger selection on unobservables, relative to selection on observables, must be to explain away the entire estimated effect. To see how it is calculated, consider a regression with a restricted set of control variables and one with a full set of controls. Next, denote the estimate of the coefficient attached to the variable of interest and the R^2 from the first regression λ^R and R^R, where R stands for "restricted," and those from the second regression λ^F and R^F, where F stands for "full." Then, the index is the absolute value of $\frac{\lambda^F(R^F-R^R)}{(\lambda^R-\lambda^F)(1-R^F)}$. The intuition behind the formula is as follows. The lower the absolute value of $(\lambda^R - \lambda^F)$ is and the nearer R^F is to its maximum 1, the less the estimate of the coefficient attached to the variable of interest is affected by selection on observables, and the stronger selection on unobservables needs to be to explain away the entire effect. Moreover, the higher the absolute value of λ^F and $R^F - R^R$ are, the greater is the effect that needs to be explained away by selection on unobservables, and thus the higher the index is.

In table 4.D.3, we focus on the variables testing the key model predictions, i.e., the proxy for the productivity of arboriculture and the measure of the regional political relevance in the endogenous taxation models run respectively on the pre-unitary and post-unitary samples (see columns (1) and (2)), and *War*, War^2, *Distance-to-Enemies*, and *Distortion-LT* in the outcome equations (see columns (3) to (8)). The covariates incorporated only in the full set are listed in the last three lines of table 4.D.3 and include in the case of the outcome regressions time effects and their interaction with *Democracy-I* since these are the most relevant extra controls in table 2.5. We will obtain similar indexes (available upon request), should we focus instead on one among *Land-Fragmentation-I*, *Coal-Price-I*, and *Railway-I*. The median and the average of the indexes in columns (1) and (2) are 0.72 and 0.96, whereas those in columns (3)

but it was even acceptable in a country [with a differentiated] productive system" (Iuzzolino et al. 2011, p. 26).

Table 2.6: Using Selection on Observables to Assess the Bias from Unobservables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	The dependent variable is:							
	Land-Taxes		*Culture*	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
The ratio is calculated for the variable:								
Sericulture								
Sericulture^2								
Arboriculture	0.11							
Arboriculture^2	0.30							
War			0.98	9.03	1.72	1.12	27.1	0.52
War^2			1.06	30	1.94	1.04	3.29	1.03
Distance-to-Enemies		1.15	2.65	2.39	0.98	0.16	0.39	1.43
Distance-to-Enemies^2		2.30						
Distortion-LT			0.18	2.97	0.40	0.46	2.02	0.52
The extra controls in the full set are {*Sericulture*, *Sericulture*^{2}, *Wheat*, *Wheat*^{2}, *Arboriculture*, *Arboriculture*^{2}, *War*, *War*^{2}},	NO	YES	NO	NO	NO	NO	NO	NO
{*Distance-to-Enemies*, *Distance-to-Enemies*^{2}},	YES	NO	NO	NO	NO	NO	NO	NO
time dummies and {*Democracy-I* × 1861-1901 dummies}.	NO	NO	YES	YES	YES	YES	YES	YES

Notes: 1. The indexes listed in column (1) (columns (2) to (8)) are obtained from regressions run on the pre(post)-unitary sample.
2. Each cell reports an index constructed as explained in section 5.4.2 and based on the coefficients attached to the relevant variable that we obtain from two regressions, one with a "restricted set" of covariates and another with a "full set" of covariates. The regressors included in the restricted sets of covariates are over and above the fixed region effects: 1. those incorporated in the specification reported in column (2) of table 2.3 in the case of column (1) of the present table; 2. *Distance-to-Enemies* and *Distance-to-Enemies*^{2} in the case of column (2) of the present table; 3. those considered in columns (1) to (6) of table 2.4 in the cases of respectively columns (3) to (8) of the present table. The extra variables, possibly included in the full set, are listed in the last three lines of the present table. The sample size is 78.

to (8) are 1.09 and 3.89. Thus, to attribute the entire OLS estimates to selection effects, on average selection on unobservables would have to be about 4 times greater than selection on observables. Given the very high fit of our regressions—i.e., with an average within R^2 of 0.31(0.47) in table 2.3(2.4) and 0.75 in panel A of table 2.5, this is unreasonable.

2.5.5 Post-Unitary Distortions in Public Good Provision

We close our analysis by assessing whether distortions in taxation were accompanied by similar distortions in public spending. To elaborate, we build on our model, and we first identify the pre-unitary determinants of railway diffusion and then assess its post-unitary distortions by estimating public good provision equations of the following type

$$R_{r,t} = \alpha_r + \iota_t + \beta_{\mathbf{3}}' \mathbf{A}_{r,t} + \beta_{\mathbf{4}}' \mathbf{A}_{r,t}^2 + \gamma_4 S_{r,t} + \gamma_5 S_{r,t}^2 + \delta_3 P_{r,t} + \delta_4 P_{r,t}^2 + \tau_0 O_r \iota_t + \eta_{r,t}, \quad (2.5.3)$$

where $R_{r,t}$ is the length in km of railway per square km built in the previous decade, i.e., *Railway*. Following Picci (2002), we also consider the orographic nature of each region as a proxy for railway building costs by including in the specification the terrain

ruggedness O_r in km—i.e., *Ruggedness*—interacted with time dummies ι_t. Since ι_t appears also as extra control, we do not cluster standard errors at the regional level to preserve a sufficient within-region variation. This time, α_r accounts for time-invariant shifters of railway diffusion like the traveling distance from international markets and long-lasting institutions.

Table 2.7: Endogenous Public Good Provision

	(1)	(2)	(3)	(4)	(5)	(6)
	1801-1851 sample			1861-1911 sample		
	The dependent variable is *Railway*					
Sericulture	- 0.165	- 0.126	- 0.138	- 0.356	- 0.397	- 0.404
	(0.085)**	(0.084)	(0.087)	(0.331)	(0.337)	(0.340)
Wheat	0.177	0.172	0.172	0.034	0.122	0.211
	(0.081)**	(0.077)**	(0.078)**	(0.302)	(0.320)	(0.318)
Arboriculture	- 0.022	- 0.011	- 0.028	0.126	0.085	- 0.043
	(0.081)	(0.079)	(0.081)	(0.274)	(0.282)	(0.298)
War		0.332	0.285		- 0.960	- 1.153
		(0.398)	(0.428)		(1.087)	(1.072)
Distance-to-Enemies			- $4.66E^{-6}$			- 0.0001
			($6.86E^{-6}$)			(0.00003)**
P-value for *Ruggedness* × 1861-1901 dummies	[0.45]	[0.86]	[0.74]	[0.92]	[0.93]	[0.99]
Estimation	Fixed Region Effects OLS					
R^2	0.71	0.76	0.77	0.76	0.77	0.79
Number of observations	78	78	78	78	78	78

Notes: 1. The entries are marginal effects, whereas the parentheses gather standard errors. *** labels significant at the 1% confidence level; **, 5%; *, 10%.

2. All specifications incorporate *Sericulture*, *Sericulture*^{2}, *Wheat*, *Wheat*^{2}, *Arboriculture*, and *Arboriculture*^{2}. The specifications in columns (2) and (5) (columns (3) and (6)) also include *War* and *War*^{2} (*War*, *War*^{2}, *Distance-to-Enemies*, and *Distance-to-Enemies*^{2}). The marginal effects of *Sericulture*, *Wheat*, and *War* are calculated for a rise from their lowest values in the low political relevance group, i.e., respectively 0.01, 0.00, and 0 (0.00, 0.01, and 0) in the pre(post)-unitary sample. The marginal effects of *Arboriculture* and *Distance-to-Enemies* are calculated for a rise from their lowest values in the high and middle political relevance group, i.e., respectively 0.18 and 436.

Table 2.7 is structured in the same way as table 2.3 and reveals the following two facts. First, the crucial aim of pre-unitary railway diffusion was the strengthening of the foreign trade of export-oriented farming products and, in particular, wheat in Lombardy-Venetia, which because of the support of Vienna was the only Italian state outside the Kingdom of Sardinia with any spending capacity (Pescosolido 2014, p. 38 and 100). Accordingly, a rise in *Wheat* from the lowest South's value—i.e., 0 in Calabria—to the highest North's one—i.e., 0.87 in Lombardy—implies a huge 42.8-standard-deviation increase in *Railway* in column (1) and is always significant at 5 percent in columns (1) to (3). Second, the post-unitary railway expansion was only shaped by the regional political relevance. In particular, a rise in *Distance-to-Enemies* from the lowest North's value to the highest South's value leads to a 7.6-standard-deviation fall in *Railway*, which is significant at 5 percent (see column (6)).

Placing side to side these with the estimates discussed above, we can conclude that regions farther away from the possible battlefields enjoyed the slowest post-unitary railway diffusion but paid the highest relative costs. Moreover, plotting the differences between the observed post-unitary values of *Railway* and those forecasted using the

specification in column (1) of table 2.7—i.e., *Distortion-R*—across regional clusters reveals that both low and middle political relevance regions experienced periods of both under- and over-investment in railway, whereas the state's effort in the high political relevance region was generally more intense than it would have been without unification (see upper-right graph in figure 2.3). This evidence is consistent with the conclusions we draw in section 5.4 insofar it speaks again against the idea that subsidization of the Northern infrastructures at the South's expenses was optimal. On the one hand indeed, the unitary government failed to provide the South the technical means to replace the foreign markets with domestic outlets in the aftermath of the price shocks of the 1880s further squeezing the after tax profits to be invested in the industry (Iuzzolini et al. 2011, p. 20). On the other hand moreover, to effectively strengthen the newborn advanced manufacturing industry the highest railway spending should have targeted the middle and not the high political relevance regions (Iuzzolini et al. 2011, p. 22).

2.5.6 External Validity

To alleviate concerns that the Italian unification might be a special case, we briefly discuss the closely related case of the post-Civil War divide between Southern and Northern US states, which we illustrate in more details in appendix 2.C.

In the 1850s, slavery was source of mounting political tension between the Southern slave states and the abolitionist North, and accordingly the Republicans, dominant in the North, built the entire 1860 Lincoln's presidential campaign on a complete ban on slave-owning. Lincoln's election was then the final trigger to the secession of eleven Southern states first and a dreadful conflict between them and the rest of the Union then. The war brought about almost one million casualties, the murder of Lincoln, and the tacit understanding among the winners that the "prewar leadership of the Southern slavocrats in national politics was permanently to be replaced in favor of the Northern direction" (Donald and Randall 1961, p. 535). To this end, the new government first split the ex-Confederate states into five military districts under martial law and then steadily raised their property taxes to force redistribution of land from those white planters that, because of the heavier tax burden, were going to be expropriated of their estates to blacks and poor whites (Foner 1988, p. 346-383). Yet, because of this last group's liquidity constraints, Southern land were increasingly acquired by Northern landowners greatly widening the development gap between the two blocks (Foner 1988,

p. 399). Similarly to the Italian case, the Southern rage together with the Northern population's discontent with political instability irremediably put an end, after the Democrats' victory of the disputed 1876 presidential election, to extraction but only when its consequences were already permanent (Donald and Randall 1961, p. 548).

2.6 Conclusions

This chapter has developed a theory of "endogenous extractive policies" grounded on the mix of the heterogeneity in the relevance of the dominated groups for the dominating one and changes in the rulers' extractive power. Crucially, our framework helps shed new light on a key issue in economics, which is the huge divide between North and South of Italy despite more than 150 years of common formal institutions. In particular, we document that its opening is the result of the region-specific policies selected between 1861 and 1911 by the elite of the Kingdom of Sardinia, which annexed the rest of Italy in 1861. To illustrate, pre-unitary land property taxes and railway diffusion were shaped by each region's farming productivity but not by its political relevance for the Piedmontese elite, whereas the opposite was true for post-unitary ones. Moreover, post-unitary tax distortions and the severity of the remaining extractive policies—captured by the region's taxation capacity and political relevance—determined the North-South gaps in culture, literacy, and development but not that in the manufacturing industry value added. Together these two patterns imply that extraction cannot be considered the acceptable price for the Italian development since it neither eased the formation of an unitary market nor favored industrialization.

Since our proxies for the drivers of extraction are independent of the policy-makers' will, reverse causation is not an issue. Nevertheless, our results could still be produced by unobserved heterogeneity. To evaluate this aspect, we follow a two-step strategy. First, we document that our estimates remain robust to the consideration of both fixed region and time effects and the structural conditions differentiating the two blocks in 1861, i.e., inclusiveness of political institutions, land ownership fragmentation, coal price, and the railway length. Second, we build on Oster (2016), and we calculate that on average selection on unobservables would have to be about 4 times greater than selection on observables to completely explain away our results. Given the very high fit of our regressions, this is unlikely.

Our results characterize the crack of the dawn of the North-South divide, and identifying more recent factors aggravating these disparities is a key avenue for further research (Iuzzolino et al. 2011 p. 7-10). More important, our framework can be employed to study related cases as the deep conflicts that are shaking the EU nowadays (see also Guiso et al., (2015)).

Appendix

2.A Variables

Table 2.A.1: Summary of Variables

	Variable	Definition and Sources	1801-1851	1861-1911
Economic outcomes:	*Culture*:	Ratio of the share of the active population engaged in political, union, and religious activities to its 1861 value. Source: SVIMEZ (2011).		0.935 (0.155)
	Illiterates:	Ratio of the percentage points of illiterates in the total population over the age of six to its 1861 value. Source: SVIMEZ (2011).		0.784 (0.191)
	GDP:	Ratio of the income in 1861 lire per capita to its 1861 value. Sources: Malanima (2006, 2010), Baffigi (2011), Vecchi (2011), SVIMEZ (2011).		1.118 (0.285)
	GSP:	Ratio of the gross saleable annual farming product per employee, normalized in such a way that its mean for Italy in 1911 is 100, to its 1861 value. Source: Esposto (1997).		1.123 (0.278)
	VA-T:	Textile industry value added in thousands of 1861 lire per capita over its 1861 value. Source: Ciccarelli and Fenoaltea (2013).		1.213 (0.526)
	VA-M:	Manufacturing—i.e., food, mechanical engineering, leather and footwear, and textiles—value added in thousands of 1861 lire per capita over its 1861 value. Source: Ciccarelli and Fenoaltea (2013).		1.273 (0.354)
Policies:	*Land-Taxes*:	Land property tax revenues in 1861 lire per capita. Sources: Dincecco et al. (2011), Ministero delle Finanze (1863, 1872, 1882, and 1888), Ministero dell'Agricoltura, Industria e Commercio (1900 and 1912).	3.236 (1.970)	3.590 (1.187)
	Distortion-LT:	Difference between *Land-Taxes* and the forecasted land property tax revenues in 1861 lire per capita.		0.360 (1.752)
	Railway:	Length of railway built in the previous decade in km per square km. Sources: SVIMEZ (2011), Romani (1982).	0.0016 (0.0036)	0.0089 (0.0152)***
	Distortion-R:	Difference between *Railway* and the forecasted length of railway built in the previous decade in km per square km.		0.001 (0.018)
Farming technology:	*Sericulture*:	Normalized first principal component extracted from the share of the region's surface covered by lakes and rivers and the average growing season precipitation in ml in the previous decade. Sources: Pauling et al. (2006), http://worldwildlife.org/	0.306 (0.239)	0.323 (0.243)
	Wheat:	Normalized first principal component extracted from the land suitability for wheat ranging between 0 and 100 and the average growing season precipitation in ml in the previous decade. Sources: Pauling et al. (2006), http://www.gaez.iiasa.ac.at	0.281 (0.199)	0.298 (0.201)
	Arboriculture:	Normalized first principal component extracted from the land suitability for citrus and olive trees ranging between 0 and 100 and the average growing season temperature in Celsius in the previous decade. Sources: Luterbacher et al. (2004), http://www.gaez.iiasa.ac.at	0.547 (0.192)	0.532 (0.192)
Other drivers of extraction:	*War*:	Share of previous decade in which the state to which the region belonged partook in external wars. Source: http://www.correlatesofwar.org	0.004 (0.011)	0.005 (0.010)
	Distance-to-Enemies:	Distance in km between the region's main city and the capital of the fiercer enemy of the House of Savoy, i.e., Vienna over the 1801-1813, 1848-1881, and 1901-1914 periods, and Paris otherwise.	934.539 (311.239)	803.462 (255.570)***

Note: 1. The last two columns report the mean and, in parentheses, the standard deviation of each variable in the pre- and post-unitary samples. *** labels a difference between the two means significant at 1% in a t-test with unequal variances; **, 5%; *, 10%.

Summary of Variables - Continuation

	Variable	Definition and Sources	1801-1851	1861-1911
	Democracy-I:	Constraints on the elite's power averaged between 1000 and 1850. Sources: Tabellini (2010), Boranbay and Guerriero (2016).		1.838 (0.961)
	Land-Fragmentation-I:	1861 number of payers of land taxes divided by the agricultural population. Source: Jacini (1885).		0.412 (0.165)
	Coal-Price-I:	1861 coal price per tonne in Genoa augmented for the transport cost in 1861 lire. Source: Missiaia (2012).		44.019 (7.144)
	Railway-I:	1861 railway length in km per square km. Sources: SVIMEZ (2011), Romani (1982).		0.012 (0.007)
Initial structural conditions:	*Deposits-I*:	1861 deposits held in Casse di Risparmio ordinarie in 1861 lire per capita. Source: Missiaia (2012).		11.310 (16.267)
	Rivers:	1861 navigable rivers in km per square km. Source: Ministero dell'Agricoltura, Industria e Commercio (1878).		0.059 (0.052)
	Roads:	1861 accesible national roads in km per square km. Source: Ministero dell'Agricoltura, Industria e Commercio (1878).		0.028 (0.014)
	Trade:	1861 freight shipped through the region's major harbors per capita. Source: SVIMEZ (2011).		0.248 (0.351)
	Ruggedness:	Terrain ruggedness in km. Source: http://gecon.yale.edu/		0.292 (0.082)

Note: 1. The last two columns report the mean and, in parentheses, the standard deviation of each variable in the pre- and post-unitary samples. *** labels a difference between the two means significant at 1% in a t-test with unequal variances; **, 5%; *, 10%.

2.B Establishing the Exogeneity of *War*

Next, we explain why *War* should be correctly considered exogenous.

Austro-Sardinian War

As soon as the revolutionaries expelled the Austrians from Milan in March 1848, the "Italian population enthusiastically supported [Charles Albert's] intervention" (Paoletti 2008, p. 96) since they knew that the Austrian army "could not get reinforcements [...] because of the revolution in Vienna" (Paoletti 2008, p. 96). Mainly driven by the threat of internal unrests, Charles Albert then "moved his troops into Lombardy" (Killinger 2002, p. 107). Yet, the Habsburgs soon tamed the turmoils and then defeated both the Savoys and their allies (Killinger, 2002). The truce was signed in August 1848. All in all, none of the pre-unitary elites shaped the fate of this conflict.

Roman Republic War

Even if Pope Pius IX had granted his own constitution on February 14 1848, the liberals expelled him in the aftermath of the truce the Kingdom of Sardinia reached with Austria and declared the Roman Republic in November 1848. This decision ignited the reactions of both the conservative elite and the Catholic powers who sought to restore the Pope's rule. In particular, "in a politically calculated attempt to win support of French Catholics, Louis Napoleon ordered his armies to restore the Pope to power" (Killinger 2002, p. 109). Meanwhile, Austria defeated again the Kingdom of Sardinia in Novara on March 23 1849, reinstating its power over Italy. In June 1849 a French army invaded the Papal State and defeated the "weak and ill-equipped [Roman Republican army]" (Riall 2009, p. 23). Again, none of the pre-unitary elites shaped the fate of this conflict.

Neapolitan and Italian-Roman Wars

In the aftermath of the 1848 unrests, the Bourbons "concentrated all [their effort] on domestic affairs. [The] army was now intended to be more of a large, well-armed constabulary force" (Paoletti 2008, p. 102). After the royal forces crushed a revolt in Palermo, "Francesco Crispi, one of the revolutionaries, urged Garibaldi to intervene" (Paoletti 2008, p. 110) sure that the Bourbons could be overturned. Garibaldi as-

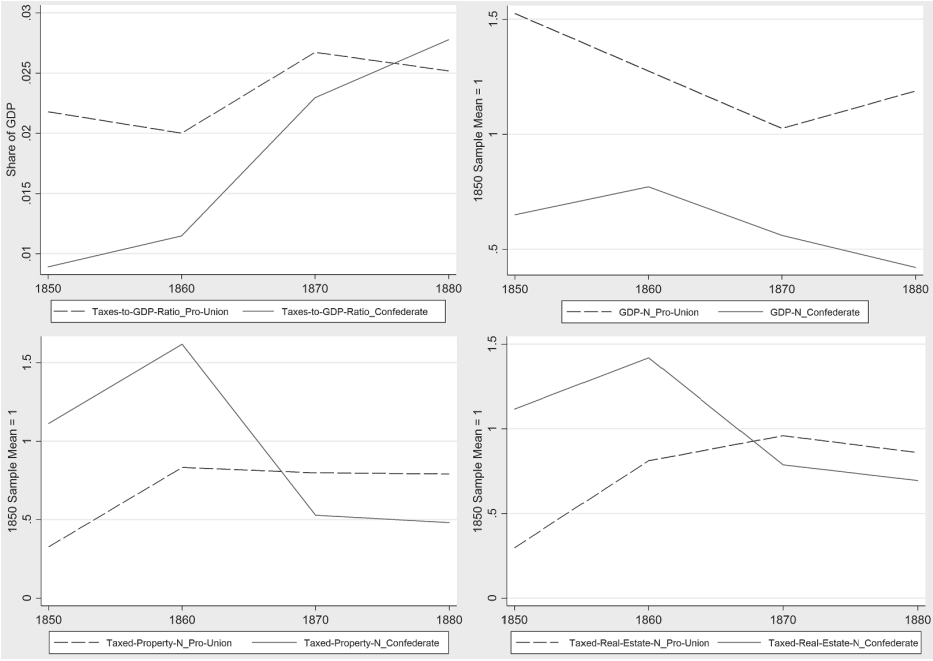
sembled a group of volunteers, who departed from Genoa and reached Sicily in May 1860. Their arrival ignited a large scale revolt to which the Bourbons did not react because scared by "an interposition by US, French, and British" (Paoletti 2008, p. 110). Garibaldi's swift conquest of Sicily worried the European powers and the Kingdom of Sardinia "that the guerrilla leader might move on Naples, Rome, and Venice" (Killinger 2002, p. 116). Garibaldi's conquest of Naples confirmed these suspects and forced Victor Emanuel II to try to stop him before he could put the independence at jeopardy (Paoletti, 2008). With the French approval, the Kingdom of Sardinia's forces moved into the Papal State in September 1860 firing up the Italian-Roman War. The conflict ended a few months later with the Kingdom of Sardinia's conquest of Marche and Umbria and the meeting between Garibaldi and Victor Emanuel II, who was then proclaimed King of Italy (Killinger, 2002). All in all, both conflicts were guided by the expansionist decisions of the Kingdom of Sardinia, France, and England and only barely affected by the—lack of—adequate reactions by both the Kingdom of Two Sicilies and the Papal State.

Seven Weeks War

"In 1866, Prusso-Austrian competition for supremacy in Germany reached its zenith. Prussian chancellor Otto von Bismarck forced Austria to declare war on Prussia. [In] Bismarck's opinion [...], it was better to have Italy as an ally, because it prevented Austria from concentrating its entire army against Prussia" (Paoletti 2008, p. 117). Involved in this conflict, the Kingdom of Italy bore a series of grim defeats until Prussia's victory and the consequent armistice (Paoletti, 2008). Left alone on the battlefront, "Italy had no choice but accept [the end of the war], or face Austria alone" (Paoletti 2008, p. 118). With the Peace of Prague, Italy gained Venice (Paoletti, 2008). All in all, the Kingdom of Italy did not control either the timing of the war nor any of its consequences.

2.C Case Study: The American Civil War Case

Figure 2.C.1: The Case of the American Civil War



Note: 1. "Taxes-to-GDP-Ratio" is collected from Secretary of the Interior (1850, 1860, 1870, 1880) and represents the ratio of total taxes to GDP. "GDP-N" is obtained from Lindert and Williamson (2013) and Klein (2013) and depicts the GDP in 1860 dollars per capita normalized in such a way that its 1850 mean is one. "Taxed-Property-N" ("Taxed-Real-Estate-N") is collected from Secretary of the Interior (1850, 1860, 1870, 1880) and represents the assessed valuation of taxed real and personal property (real estate and improvements) per capita in 1860 dollars normalized in such a way that its 1850 mean is one. The _Pro-Union (_Confederate) group includes Colorado, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah (Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia), and Washington (West Virginia).

In the 1850s, slavery was source of mounting political tension between the Southern slave states and the abolitionist North, and accordingly the Republicans, dominant in the North, built the entire 1860 Lincoln's presidential campaign on a complete ban on slave-owning (Keller, 1977). Lincoln's election was then the final trigger to the secession of eleven Southern "Confederate" states—i.e., Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia—first and then a war between them and both the twenty-three states that remained loyal to the Union and the seven territories that fought on their side, i.e., Colorado, Dakota, Nebraska, Nevada, New Mexico, Utah, and Washington. The war brought about almost one million casualties (Foner, 1988), the murder of Lincoln, and the agreement among the winners that the "prewar leadership of the Southern

slavocrats in national politics was permanently to be replaced in favor of the Northern direction" (Donald and Randall 1961, p. 535).

To this end, the new government opened the "Reconstruction Era" (1865-1877), i.e., a set of South-oriented policies usually divided in "Wartime," "Presidential," and "Radical" phases. While the first one identifies Lincoln's Emancipation Proclamation and the Union's seizure of the Confederate states, the second one refers to the new president Johnson's try to guarantee "the white South a virtual hand in regulating the region's internal affairs" (Foner 1988, p. 199). This attempt to undermine the consequences of the war itself however pushed many Northern Republicans to advocate more stringent limitations of the white elite's power in the South (Keller, 1977).

Such a Radical phase of the Reconstruction era began as soon as the Republicans gained in 1866 the majority of the US Congress, was reinforced by Grant's election in 1868, and "affected every facet of Southern life" (Foner 1988, p. 346). First and foremost, the ex-Confederate states were split into five military districts under martial law to formally enforce black vote but with the de facto aim to restrain the Southern elite's initiative (Foner 1988, p. 377). Second, "property taxes rose steadily" (Foner 1988, p. 383) in the South as illustrated in the upper-left graph of figure 2.C.1, which depicts the ratio of total taxes to GDP averaged for the ex-Confederate states and the pro-Union territories between 1850 and 1890. The Republicans justified these policies as necessary to achieve the coveted redistribution of land property from those white planters that, because of the heavier tax burden, were going to be expropriated of their estates towards blacks and poor whites (Foner, 1988). Yet, because of this last group's liquidity constraints Southern land were increasingly acquired by Northern landowners instead and, for instance, "by 1870, half of [Louisiana] estates had fallen into the hands of Northern investors" (Foner 1988, p. 399). As a consequence, not only wealth inequality remained unaffected but the South also failed to keep "up with the phenomenal progress of the rest of the country" (Donald and Randall 1961, p. 548). Figure 2.C.1 displays these patterns by showing the evolution over the 1850-1890 period of the GDP and the assessed valuations of taxed property and both taxed real estate and improvements across ex-Confederate states and pro-Union territories. As foreseen by our model, less politically relevant states bore the most penalizing tax policies and, as result, experienced the weakest economic development.

The Radical Reconstruction came to an end when the Democrats realized that

"financial criticisms of Republican rule" (Foner 1988, p. 415) by the Northern voters would have brought them and the angered Southern masses together and so won the 1876 presidential election by proposing the full integration of Southern states into American politics.[31] As a first step, the new government removed in 1877 the last Union troops from the South. Exactly as in the case of post-unitary Italy however, at that point the impact of extractive policies was permanent (Keller, 1977; Foner, 1988).

[31] "If Southern economic interests had coincided with those of the rising industrial groups of the North, there would have been no Radical reconstruction" (Donald and Randall 1961, p. 543).

2.D Supplementary Tables

Table 2.D.1: Summary of Variables

	Variable	Definition and Sources	(1) 1801-1851	(2) 1861-1911
Economic outcomes:	*Life*:	Ratio of life expectancy in years to its 1861 value. Source: Vecchi (2011).		1.166 (0.176)
	Height:	Ratio of height of conscripted workers in cm to its 1861 value. Source: Vecchi (2011).		1.007 (0.006)
	Log-Pop-Density:	Ratio of the logarithm of the population per square km to its 1861 value. Source: SVIMEZ (2011).		1.042 (0.034)
	VA-E:	Engineering sector value added in thousands of 1861 lire per capita over its 1861 value. Source: Ciccarelli and Fenoaltea (2013).		1.480 (0.583)
	VA-C:	Chemical industry value added in thousands of 1861 lire per capita over its 1861 value. Source: Ciccarelli and Fenoaltea (2013).		3.330 (4.944)
	VA-ME:	Metal-making industry value added in thousands of 1861 lire per capita over its 1861 value. Source: Ciccarelli and Fenoaltea (2013).		3.053 (7.075)
Policies:	*Land-Taxes-K*:	Land property tax revenues in 1861 lire per square km of arable land. Source: see text.	456.181 (342.565)	711.812 (384.877)***
	Distortion-LT-K:	Difference between *Land-Taxes-K* and the forecasted land property tax revenues in 1861 lire per square km of arable land.		132.841 (477.206)
Farming technology:	*Citrus*:	Normalized first principal component extracted from the land suitability for citrus trees ranging between 0 and 100 and the average growing season temperature in Celsius in the previous decade. Sources: Luterbacher et al. (2004), http://www.gaez.iiasa.ac.at	0.678 (0.200)	0.654 (0.200)
	Olive:	Normalized first principal component extracted from the land suitability for olive trees ranging between 0 and 100 and the average growing season temperature in Celsius in the previous decade. Sources: Luterbacher et al. (2004), http://www.gaez.iiasa.ac.at	0.453 (0.221)	0.432 (0.221)
Other drivers of extraction:	*War-C*:	Share of post-Vienna Congress years in which the regions was involved in external wars. Source: http://www.correlatesofwar.org	0.001 (0.003)	0.008 (0.003)***
	Distance-to-Enemies-P:	Average distance in km between the region's main city and Istanbul (Amsterdam, Copenhagen, and Istanbul) between 1801 (1816) and 1815 (1882) and between the region's main city and Amsterdam, Copenhagen, Istanbul, Lisbon, and Madrid otherwise.	1365.803 (156.292)	1465.145 (149.035)***

1. The last two columns report the mean and, in parentheses, the standard deviation of each variable in the pre- and post-unitary samples. *** labels a difference between the two means significant at 1% in a t-test with unequal variances; **, 5%; *, 10%.

Table 2.D.2: High & Middle Versus Low Political Relevance Regions — Further Evidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	1801-1851			1861			1861-1911		
	H&M Political	Low Relevance	(1) - (2)	H&M Political	Low Relevance	(4) - (5)	H&M Political	Low Relevance	(7) - (8)
Life-L:				32.843	31.050	1.793	38.571	35.706	2.866
				(1.280)	(3.018)	(1.324)	(5.357)	(5.365)	(1.218)**
Height-L:				162.971	160.322	2.649	164.048	161.656	2.391
				(1.543)	(1.129)	(0.743)***	(1.590)	(1.385)	(0.337)***
Log-Pop-Density-L:	1.869	1.790	0.079	1.931	1.961	- 0.030	2.013	2.041	- 0.029
	(0.119)	(0.221)	(0.041)*	(0.411)	(0.343)	(0.209)	(0.398)	(0.346)	(0.084)
VA-E-L:				0.007	0.007	0.0005	0.011	0.009	0.001
				(0.001)	(0.001)	(0.0007)	(0.006)	(0.004)	(0.001)
VA-C-L:				0.0004	0.0006	- 0.0001	0.0015	0.0012	0.0003
				(0.0002)	(0.0003)	(0.0001)	(0.0017)	(0.0010)	(0.0003)
VA-ME-L:				0.0002	0.0002	0.00001	0.0010	0.0004	0.0007
				(0.0001)	(0.0002)	(0.0001)	(0.0019)	(0.0005)	(0.0003)**
Land-Taxes-K:	444.209	470.149	- 25.940	931.715	601.891	329.824	837.966	564.633	273.333
	(326.127)	(364.976)	(78.947)	(496.755)	(441.617)	(260.301)	(369.507)	(352.942)	(81.921)***
Distortion-LT-K:				- 94.120	507.439	-	-	483.460	-
						601.558	167.690		651.151
				(293.988)	(340.597)	(177.993)***	(403.581)	(274.533)	(77.276)***
Citrus:	0.526	0.856	- 0.330	0.491	0.820	- 0.329	0.501	0.833	- 0.332
	(0.133)	(0.085)	(0.025)***	(0.139)	(0.093)	(0.065)***	(0.132)	(0.085)	(0.025)***
Olive:	0.291	0.642	- 0.351	0.261	0.612	- 0.351	0.269	0.622	- 0.353
	(0.100)	(0.165)	(0.032)***	(0.104)	(0.177)	(0.082)***	(0.099)	(0.165)	(0.031)***
War-C:	0.002	0.001	0.001	0.010	0.010	0.0002	0.0079	0.0077	0.0001
	(0.004)	(0.002)	(0.001)	(0.005)	(0.002)	(0.002)	(0.0038)	(0.0022)	(0.0007)
Distance-to-Enemy-P:	1340.222	1395.648	- 55.426	1277.333	1493.889	-	1364.406	1582.674	-
						216.556			218.268
	(124.664)	(183.938)	(36.192)*	(78.501)	(111.630)	(54.380)***	(94.026)	(110.105)	(23.393)***
Number of observations	42	36		7	6		42	36	

Notes:
1. *Deposits-L*, *Life-L*, *Height-L*, *Log-Pop-Density-L*, *VA-C-L*, and *VA-ME-L* label respectively the level of deposits, the life expectancy, the height of conscripted workers, the logarithm of the population density, and the value added in the chemical and metal-making industries (see also table I).
2. Columns (1), (4), and (7) (columns (2), (5), and (8)) report the mean and, in parentheses, the standard deviation of each variable over the relevant period in the high and middle (low) political relevance group, whereas columns (3), (6), and (9) display the difference between the mean in the high and middle political relevance group and that in the low political relevance cluster over the relevant period and, in parentheses, its standard error. *** denotes a difference significant at the 1% confidence level based on a t-test with unequal variances; **, 5%; *, 10%. The high and middle (low) political relevance cluster includes Abruzzi, Emilia Romagna, Lombardy, Marche, Tuscany, Umbria, and Veneto (Apulia, Basilicata, Calabria, Campania, Lazio, and Sicily).

Table 2.D.3: Employing Land Property Taxes per Square km of Arable Land

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	The dependent variable is:							
	Land-Taxes-K		*Culture*	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
Sericulture	698.28	- 2043.43						
	(1453.05)	(2936.18)						
Wheat	- 693.91	- 3388.59						
	(1355.63)	(2027.16)*						
Arboriculture	- 1937.00	- 2476.05						
	(932.69)**	(3961.74)						
War	6137.48	7283.07	- 5.578	22.949	- 9.165	- 18.613	- 29.936	- 7.024
	(3916.00)	(16273.97)	(3.674)	(6.032)***	(9.194)	(8.330)**	(13.168)**	(10.539)
Distance-to-Enemies	0.26	0.44	- 0.0001	- 0.00004	0.0001	- 0.0004	- 0.0002	- 0.0002
	(0.16)	(0.14)***	(0.0001)*	(0.00005)	(0.0001)	(0.0001)**	(0.0001)	(0.0001)**
Distortion-LT-K			0.0001	0.0002	- 0.0005	- 0.0003	- 0.0013	- 0.0012
			(0.0002)	(0.0001)*	(0.0003)*	(0.0003)	(0.0005)**	(0.0003)***
Estimation	Fixed Region Effects OLS							
R^2	0.73	0.24	0.20	0.75	0.34	0.30	0.29	0.61
Number of observations	78	78	78	78	78	78	78	78

Notes:
1. While the first column is based on pre-unitary data, the other columns are built on post-unitary data.
2. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.
3. All specifications include the proxies for farming productivity—i.e., *Sericulture*, *Wheat*, and *Arboriculture*, whereas those in columns (1) and (2) (columns (3) to (8)) also incorporate $Sericulture^2$, $Wheat^2$, $Arboriculture^2$, *War*, War^2, *Distance-to-Enemies*, and $Distance\text{-}to\text{-}Enemies^2$ (*War*, War^2, *Distance-to-Enemies*, and *Distortion-LT*).

Table 2.D.4: Alternative Proxies for Regional Productivity

	(1)	(2)	(3)	(4)
	1801-1851 sample		1861-1911 sample	
	The dependent variable is *Land-Taxes*			
Sericulture	0.585	- 2.188	- 12.387	- 14.177
	(10.585)	(8.029)	(11.415)	(10.775)
Wheat	- 1.924	0.172	- 10.824	- 9.912
	(6.608)	(5.973)	(10.172)	(9.825)
Citrus	- 3.972		9.484	
	(2.221)*		(12.011)	
Olive		- 9.636		0.977
		(3.406)***		(9.420)
War	- 11.335	- 6.096	86.308	71.156
	(30.214)	(32.073)	(90.928)	(89.638)
Distance-to-Enemies	0.001	0.0006	0.002	0.002
	(0.001)	(0.0008)	(0.001)*	(0.001)*
Estimation	Fixed Region Effects OLS			
R^2	0.30	0.35	0.44	0.45
Number of observations	78	78	78	78

Notes: 1. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.
2. All specifications incorporate *Sericulture*, *Sericulture*^{2}, *Wheat*, *Wheat*^{2}, *Arboriculture*, and *Arboriculture*^{2}, *War*, *War*^{2}, *Distance-to-Enemies*, and *Distance-to-Enemies*^{2}. The marginal effects of *Sericulture*, *Wheat*, and *War* are calculated for a rise from their lowest values in the low political relevance group, i.e., respectively 0.01, 0.00, and 0 (0.00, 0.01, and 0) in the pre(post)-unitary sample. The marginal effects of *Arboriculture* and *Distance-to-Enemies* are calculated for a rise from their lowest values in the high and middle political relevance group, i.e., respectively 0.18 and 436.

Table 2.D.5: An Alternative Proxy for the Marginal Tax-collection Costs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			The dependent variable is:					
	Land-Taxes		*Culture*	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
Sericulture	1.001	2.004						
	(9.738)	(9.114)						
Wheat	- 2.808	- 16.690						
	(6.204)	(9.179)*						
Arboriculture	- 5.663	- 31.181						
	(2.863)**	(8.389)***						
War-C	- 13.672	648.881	52.911	52.824	- 28.775	- 89.343	- 86.455	- 106.349
	(114.461)	(212.566)***	(19.593)***	(22.765)**	(54.072)	(55.459)*	(45.146)**	(34.101)***
Distance-to-Enemies	0.001	0.0006	- 0.0001	- 0.00010	0.00002	- 0.0004	- 0.0004	- 0.0004
	(0.001)	(0.0005)	(0.0001)	(0.00003)***	(0.00005)	(0.0001)***	(0.0002)	(0.0001)***
Distortion-LT			0.017	0.021	- 0.082	0.015	- 0.019	- 0.156
			(0.025)	(0.044)	(0.086)	(0.077)	(0.065)	(0.070)**
Estimation	Fixed Region Effects OLS							
R^2	0.29	0.73	0.49	0.82	0.43	0.44	0.48	0.75
Number of observations	78	78	78	78	78	78	78	78

Notes: 1. While the first column is based on pre-unitary data, the other columns are built on post-unitary data.
2. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.
3. All specifications include the proxies for farming productivity—i.e., *Sericulture*, *Wheat*, and *Arboriculture*, whereas those in columns (1) and (2) (columns (3) to (8)) also incorporate *Sericulture*^{2}, *Wheat*^{2}, *Arboriculture*^{2}, *War*, *War*^{2}, *Distance-to-Enemies*, and *Distance-to-Enemies*^{2} (*War*, *War*^{2}, *Distance-to-Enemies*, and *Distortion-LT*).

Table 2.D.6: Endogenous Taxation and the Rise of the North-South Divide — Placebo

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			The dependent variable is:					
	Land-Taxes		*Culture*	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
Sericulture	1.578	- 19.392						
	(6.447)	(15.168)						
Wheat	- 4.591	- 5.261						
	(4.270)	(16.246)						
Arboriculture	2.472	- 5.414						
	(4.409)	(16.967)						
War	- 13.073	- 2.422	- 15.405	14.999	- 4.113	0.979	- 19.834	13.120
	(25.268)	(130.331)	(6.917)**	(7.977)*	(9.537)	(10.012)	(26.637)	(12.636)
Distance-to-Enemies-P	- 0.001	- 0.007	- 0.0008	- 0.0004	- 0.00003	0.0006	- 0.0003	0.0002
	(0.001)***	(0.005)	(0.0005)	(0.0004)	(0.0003)	(0.0007)	(0.002)	(0.0009)
Distortion-LT-K			0.042	0.072	- 0.138	- 0.101	- 0.238	- 0.282
			(0.032)	(0.026)**	(0.041)***	(0.042)**	(0.120)*	(0.055)***
Estimation	Fixed Region Effects OLS							
R^2	0.42	0.47	0.27	0.82	0.47	0.30	0.25	0.68
Number of observations	78	78	78	78	78	78	78	78

Notes: 1. While the first column is based on pre-unitary data, the other columns are built on post-unitary data.
2. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.
3. All specifications include the proxies for farming productivity—i.e., *Sericulture*, *Wheat*, and *Arboriculture*, whereas those in columns (1) and (2) (columns (3) to (8)) also incorporate *Sericulture*^{2}, *Wheat*^{2}, *Arboriculture*^{2}, *War*, *War*^{2}, *Distance-to-Enemies*, and *Distance-to-Enemies*^{2} (*War*, *War*^{2}, *Distance-to-Enemies*, and *Distortion-LT*).

Table 2.D.7: Allowing for Spatial Correlation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	The dependent variable is:							
	Land-Taxes		*Culture*	*Illiterates*	*GDP*	*GSP*	*VA-T*	*VA-M*
Sericulture	3.329	- 12.214						
	(6.554)	(8.090)						
Sericulture^2	- 3.985	-15.455						
	(4.679)	(17.373)						
Wheat	- 3.562	- 13.787						
	(4.538)	(5.497)**						
Wheat^2	4.339	39.441						
	(5.933)	(17.221)**						
Arboriculture	- 9.523	- 16.899						
	(4.125)**	(14.889)						
Arboriculture^2	12.519	31.377						
	(6.855)*	(10.685)***						
War	- 11.020	79.169	- 13.099	25.707	- 5.523	- 18.614	- 33.319	7.582
	(30.902)	(70.326)	(4.926)**	(5.373)***	(9.070)	(11.957)	(12.515)**	(10.036)
War^2	603.872	- 847.463	444.948	- 699.711	375.125	507.176	1125.584	- 216.378
	(483.087)	(2005.941)	(175.653)**	(152.567)***	(264.707)	(293.422)*	(423.743)**	(274.987)
Distance-to-Enemies	0.002	0.002	- 0.00012	- 0.00004	0.00010	- 0.0004	- 0.0003	- 0.0002
	(0.001)*	(0.001)**	(0.00004)***	(0.00003)	(0.00005)**	(0.0001)***	(0.0002)	(0.0001)**
Distance-to-Enemies^2	- 6.42E^{-7}	- 6.03E^{-7}						
	(3.90E^{-7})	(3.52E^{-7})*						
Distortion-LT-K			0.052	0.077	- 0.141	- 0.095	- 0.228	- 0.276
			(0.033)	(0.026)***	(0.031)***	(0.031)***	(0.103)**	(0.045)***
Estimation	Fixed Region Effects OLS							
Number of observations	78	78	78	78	78	78	78	78

Notes:
1. While the first column is based on pre-unitary data, the other columns are built on post-unitary data.
2. The entries are marginal effects, whereas the parentheses gather Conley's (1999) standard errors. *** labels significant at the 1% confidence level; **, 5%; *, 10%.
3. All specifications include the proxies for farming productivity—i.e., *Sericulture*, *Wheat*, and *Arboriculture*, whereas those in columns (1) and (2) (columns (3) to (8)) also incorporate *Sericulture*^{2}, *Wheat*^{2}, *Arboriculture*^{2}, *War*, *War*^{2}, *Distance-to-Enemies*, and *Distance-to-Enemies*^{2} (*War*, *War*^{2}, *Distance-to-Enemies*, and *Distortion-LT*).

Table 2.D.8: Other Measures of Economic Development

	(1)	(2)	(3)	(4)	(5)	(6)
	The dependent variable is:					
	Life	*Height*	*Log-Pop-Density*	*VA-E*	*VA-C*	*VA-ME*
War	- 8.417	- 0.265	- 1.984	3.693	84.580	90.080
	(4.993)*	(0.210)	(1.066)*	(16.126)	(87.556)	(106.250)
Distance-to-Enemies	- 0.00010	5.72E^{-7}	0.00003	- 0.0001	- 0.0020	0.00005
	(0.00003)***	(1.97E^{-6})	(8.74E^{-6})***	(0.0001)	(0.0012)	(0.00151)
Distortion-LT	- 0.074	- 0.0029	- 0.016	- 0.460	- 2.190	- 2.017
	(0.028)**	(0.0008)***	(0.005)***	(0.112)***	(0.639)***	(0.826)**
Estimation	Fixed Region Effects OLS					
R^2	0.60	0.73	0.60	0.65	0.30	0.15
Number of observations	78	78	78	78	78	78

Notes:
1. The entries are marginal effects, whereas the parentheses gather standard errors allowing for clustering by region. *** labels significant at the 1% confidence level; **, 5%; *, 10%.
2. All specifications include *Sericulture*, *Wheat*, *Arboriculture*, *War*, *War*^{2}, *Distance-to-Enemies*, and *Distortion-LT-K*.

Chapter 3

Slavery vs Labor

3.1 Introduction

Every human society has experienced slavery at some point in the course of its history. Even today, about 85% of the world's countries host—or, in much smaller numbers, condone—some form of slavery. Estimates of the current number of victims of forced labor range from 21 million to 46 million. While the exact number might be very difficult to pin down, there is widespread recognition that slavery is a global problem affecting in some cases large portions of the local population, and generating billions of dollars in illegal profits. International treaties and private initiatives to end slavery have proliferated in the last three quarters of a century, and accelerated more recently. Activists, philanthropist and scores of scholars have taken this issue to heart; yet, the problem is far from being solved.[1]

[1] "For most of human history [...] the bulk of labor transactions have been 'coercive'" (Acemoglu and Wolitzky 2011, p. 555). "Few peoples have escaped slavery themselves" (Klein and Vinson 2007, p. 3). See also Nunn (2008). Article 4 of the Universal Declaration on Human Rights (1948) proclaims that "no one should be held in slavery or servitude, slavery in all of its forms should be eliminated." Yet, according to the Global Slavery Index, slavery is present in 167 countries and affects 46 million people; available at http://www.globalslaveryindex.org/ (last accessed on January 23, 2017). The International Labor Organization puts the current number of victims at 21 million and estimates the illegal profits from forced labor at 150 billion dollar yearly, available at http://www.ilo.org/global/topics/forced-labour/lang–ja/index.htm (last accessed on January 23, 2017). See also "Everywhere in (supply) chains: How to reduce bonded labour and human trafficking." *The Economist*, March 14, 2015, available at http://www.economist.com/news/international/21646199-how-reduce-bonded-labour-and-human-trafficking-everywhere-supply-chains (last accessed on January 23, 2017) and "46 million people living as slaves, latest global index reveals" *The Guardian*, June 1, 2016, available at https://www.theguardian.com/global-development/2016/jun/01/46-million-people-living-as-slaves-latest-global-index-reveals-russell-crowe (last accessed on January 23, 2017). For a cautionary view on the data, see "The global slavery index is based on flawed data why does no one say so?" *The Guardian*, November 28, 2014, available at https://www.theguardian.com/global-development/poverty-matters/2014/nov/28/global-slavery-

So far the scholarly discussion has largely focused on slaves alone, providing limited insights into the porous boundary between slavery and free labor. In contrast, slaves and free workers regularly competed for the same jobs in all slave societies and still do so today. Changes in the labor market are bound to affect the slave market and vice versa. Improving our knowledge of the dynamics of slavery requires understanding the drivers of the employer's choice between slavery and labor, its implications for the (free and forced) labor market, and its effects on her agents' behavior and well-being. This chapter provides the first integrated model of slavery and labor, examines the available historical evidence through the lens of the model's findings, and draws implications for current anti-slavery policies.

Slaves differ from free workers along both the participation and the incentives dimension. First, while workers can exit at will, slaves cannot and hence the principal may bear turnover costs only if she hires a worker. Second, slaves can be subjected to physical punishments (sticks) in addition to rewards (carrots), which are instead the only incentive available for workers. Employers factor in these two "advantages" of slaves over workers when choosing between them.

In the model, a principal employs an agent—that is, hires a free worker or buys a slave—to execute a task. The complexity of the task is a key ingredient of the analysis. In complex tasks, relation-specific investments are responsible for high turnover costs, which makes employers prefer slaves over workers. At the other end of the spectrum, in simple tasks, the threat of physical punishment is a relatively cheap way to produce incentives as compared to rewards, because effort is easy to monitor, which again makes slaves the better alternative. Consequently, principals are willing to pay more for a slave in complex and simple tasks than in tasks of intermediate complexity, where both monitoring and labor turnover are only mildly problematic. The resulting equilibrium price in the market for slaves affects demand in the labor market and induces principals to hire workers for those intermediate tasks.

The aforementioned equilibrium depends on the level of turnover costs, the cost of sticks, and the abundance of slaves. Our theory provides comparative statics for the distribution of tasks between slaves and workers, their respective prevalence as agents, and for the proportion of slaves in complex tasks relative to slaves in simple tasks. First, if turnover costs increase, if sticks become cheaper, or if the supply of slaves improves,

index-walk-free-human-trafficking-anne-gallagher (last accessed on January 23, 2017).

then slaves will be employed more frequently overall and, consequently, workers will be employed less frequently. Second, a decrease in the cost of slaves changes the mix of tasks assigned to slaves, raising the proportion of slaves in complex tasks relative to those in simple tasks. An increase in turnover costs and an increase in slave supply raise the proportion of slaves in complex tasks relative to those in simple tasks only if there are enough slaves performing simple tasks.

A critical postulate distinguishes our approach from others. We start from the observation that, throughout history, slavery has been largely a matter of status, defined and enforced by state power. From a principal's perspective, the population is divided into two groups: the free (who can be hired) and the slaves (who can be bought). Whether an individual falls into one or the other category is a matter of law and individual history, rather than the principal's decision. Therefore, the focus of our model is not the question whether the principal will invest resources to coerce the agent. To the contrary, we take an agent's status as given, and reduce the principal's choice to a decision between hiring a worker and buying a slave. In turn, this perspective allows us to study the use of workers and slaves as alternative means of production in state-sponsored slave systems.[2]

Our historical analysis focuses mainly on Ancient Rome and the Americas during European colonization. These two historical periods have no match in terms of size of the slave population and of reliance of the economy on slavery. However, the lack of detailed data makes it hard to find exogenous variations in our model's parameters. We resort to three complementary strategies to elicit variation indirectly: we compare societies which exhibited clearly different values of one of our parameters of interest; we infer variation in one of the parameters from geography; and, finally, we exploit exogenous changes in the supply of slaves, such as wars. We also use these three strategies to study the unique Brazilian Census of 1872, which is, to our knowledge, the only dataset that records the distribution of occupations among slaves and free workers. As we will illustrate in detail, both the qualitative and the quantitative evidence are consistent with our model's predictions.

Finally, this chapter offers a provocative agenda for the ongoing struggle against

[2]Only with some caution can our analysis be applied to the study of human trafficking by criminal organizations, which often have ramifications in countries that officially repudiate slavery. In this case, the slave status is not given. Rather it is the result of investment in coercion by the principal, which is not considered in our model.

forced labor. Beate Andrees of the International Labor Organization asserts that "ending bonded labor will require economic as well as legal measures".[3] Such measures are usually targeted towards cutting the slave supply, which reduces the proportion of slaves to workers. We warn, however, about possible inframarginal effects on the conditions in which remaining slaves will live. Only an increase in the cost of sticks unambiguously moves slaves from tasks mostly enforced by sticks to tasks mostly enforced by carrots. Legal reforms solely aimed at reducing turnover costs or hindering the slave supply might worsen the welfare of the remaining slaves by pushing them towards tasks dominated by sticks.

This chapter is organized as follows: section 3.2 frames our chapter in the current literature; section 4.3 discusses our theory; section 3.4 analyzes the comparative statics of our model; section 3.5 relaxes some of the key assumptions of our theory; section 3.6 tests the results of our model against available evidence; section 3.7 debates the main issues of past and current abolition strategies; section 3.8 summarizes this chapter and sets guidelines for future research.

3.2 Relation to the Literature

In this section we emphasize the two assumptions in which the analysis is grounded—slave status and the integrated market for slaves and workers–and dissect the explanations given in the extant literature for the choice between buying a slave and hiring a worker.

3.2.1 Slave status

State coercion and a system of laws that clearly define slave status are crucial to maintaining a slave population (Wright 2006, p. 12; Davies 2007, p. 352; Coclanis 2010, pp. 490, 500; Scarano 2010, p. 35; Peabody 2011, p. 598). The Roman jurist Gaius epitomizes this point: "the great divide in the law of persons is this: all men are either free men or slaves." (Digest 1.5.3).[4] Roman law further specified the conditions under which a person could be considered a slave, which was viewed as a legal construct

[3]Quoted in from "Everywhere in (supply) chains: How to reduce bonded labour and human trafficking." *The Economist*, March 14th 2015, available at http://www.economist.com/news/international/21646199-how-reduce-bonded-labour-and-human-trafficking-everywhere-supply-chains (last accessed on January 23, 2017).

[4]We use the translations from Watson (2009).

"against nature" (Digest 1.5.4.1 and 1.5.5). Capture in war and birth from a female slave were the most common reasons (Gardner 2007, p. 415; Scheidel 2007, p. 296; Temin 2013, p. 121). This partition was of crucial importance and was meticulously enforced. Most importantly, slaves were considered things that could be bought and sold; harm to a slave was viewed as property damage, just like harm to cattle (Digest 1.5.4.1 and 9.2.2 pr.).

European colonies in the Americas quickly created laws to distinguish African slaves from free or indentured European workers and Native American laborers (Wright 2006, p. 6; Forret 2010, p. 277; Littlefield 2010, p. 203; Peabody 2011, p. 600). Legislation was essential in order to keep "slaves as outsiders, rootless and ahistorical individuals [who were] ultimately held against their will by the threat of force" (Klein and Vinson 2007, p. 30). For instance, a 1712 South Carolina statute read: "All negros, mulattoes, mestizo's or Indians, which at any time heretofore have been sold, or now are held or taken to be, or hereafter shall be bought and sold for slaves, are hereby declared slaves; and they, and their children, are hereby made and declared slaves" (Morris 1999, p. 46).[5] For employers, such state-sponsored slave systems meant that they could "either use Europeans hired on contract as indentured servants; or use Africans, captured and enslaved" (Littlefield 2010, p. 281).

Accordingly, in the model we take an agent's status as exogenously given: a principal cannot coerce a free agent into slavery but can purchase an agent with slave status (as in Lagerlöf 2016). In contrast, Acemoglu and Wolitzsky (2011) focus on the principal's investment in coercion, thereby endogenizing slave status, rather than on purchase. These models have different domains of application. While theirs can be used to explain coercion between individuals or groups—such as human trafficking by criminal organizations or exploitative colonization—our model is tailored towards state-sponsored slavery.

[5]Walsh (2011, p. 413) provides details about the North American British colonies: "[In the second half of the 17th century], in all the colonies, laws [...] secured slave owners' property by declaring that conversion to Christianity did not exempt slaves from bondage, made slavery hereditary by ruling that the status of children followed the condition of the mother, exempted whites from punishment for accidentally killing slaves while correcting them or when capturing runaways, deprived slaves of rights to hold property, increased punishments for miscegenation, and established arbitrary procedures for punishing slaves accused of committing capital crimes." Regulation of slavery also existed in in Sub-Saharan Africa. "Rights-in-persons' (i.e., rights over labor, sexuality, procreation, etc.) exist in all societies but in Africa these rights are explicitly recognized and defined in customary law" (Watson 1980, p. 4). Richardson (2011, p. 566) traces a similar scenario in Europe, Middle East and Africa during the Middle Ages.

3.2.2 Integrated slave and labor markets

There is ample historical evidence that slaves and workers supplied labor in an integrated market, where principals could choose between them and often employed both. It is therefore unsatisfactory to study the slave market and the (free) labor market in isolation. Slave prices and workers' wages were critically related, with supply in one market affecting prices in the other and vice versa. Scheidel (2008, pp. 106, 115) and Temin (2013, pp. 115, 134) have made this point forcefully for the Roman economy. The situation was similar in the Americas and in other slave societies.[6] Forret (2010, p. 276) notes that "[t]ransitions to African slavery in the several colonies of England's emerging empire can be better understood if Britain's Atlantic world is approached as a single if imperfect and fragile labor market and if variations in the composition of the workforce among colonies and within particular colonial regions over time are approached through a focus on the supply and demand for labor". Accordingly, "market prices would adjust to place some employers at the margin of choice between the different types of labor" (Hanes 1996, p. 313).

In both historical episodes, the evidence indicates that slaves and workers were competing inputs across a variety of tasks.[7] Table 3.1 illustrates the range of tasks to which slaves were assigned across history. Competition, however, does not imply interchangeability. As our analysis will show, inframarginal principals were not indifferent between buying a slave and hiring a worker. To the contrary, they preferred slaves to workers and vice versa depending on the characteristics of the task assigned to them and on the prevalent prices in both markets. The point we will demonstrate is that preference for slaves in certain tasks and for workers in others emerges in equilibrium in a predictable way.

3.2.3 Competing explanations for the choice between slaves and workers

The literature offers three main theories of the allocation of tasks between slaves and workers, based on the distinction between effort-intensive and care-intensive activities,

[6] Klein and Vinson (2007, pp. 17, 29)

[7] Weidemann (1981, p. 2); Hanes (1996); Davies (2007, p. 347); Klein and Vinson (2007, p. 3); Forret (2010, p. 276); Walsh (2011, p. 423). In Appendix 3.C, we provide several examples of occupations executed both by slaves and workers in Brazil in 1872.

Activity	Examples of Tasks
Liberal Jobs:	Surgeon, Musician, Healer, Hospital worker, Manager, Tooth puller.
Military:	Soldier, Army officer.
Maritime and Fishing:	Commander, Navigator, Sailor, Sail maker, Shipbuilder.
Industrial and Commercial Top Jobs:	Bookkeeper, Business Agent.
Industrial Workers:	Industry worker, Spinner, Miller, Tanner, Metalworker, Powder works, Brick maker, Indigo maker, Carpenter, Blacksmith, Wheel maker, Cabinet maker, Shoemaker, Goldsmith, Cooper, Rum maker, Woodsman, Silversmith, Mason, Seamstress, Cigar maker, Basket maker, Leather worker Cart maker, Can writer, Baker, Potter, Carver, Painter/plasterer, Tinner, Hat maker, Mattress-maker, Fine china maker.
Agricultural Workers:	Farm Manager, Cowboy, Sugar refiner, Herdsman, Foremen, Driver, Cotton press operator, Lumberjack, Levee worker, Plowman, Horse groomer, Axeman, Sugar worker.
Wage Workers:	Barber, Hunter, Sawyer, Innkeeper, Roofer, Chaser of runaway slaves, Tailor, Vegetable vendor, Milk vendor, Butcher, Street vendor, Tool sharpener, Rower, Caulker, Jockey, Gravedigger, Miner, Daily worker, Laborer.
Domestic Service:	Domestic servant, Cook, Confectioner, Interpreter, Child care, Wetnurse, Watchman, Midwife, Executioner, Launder, Cart driver, Coach driver, Nurse, Gardener.

Table 3.1: Examples of complex and simple tasks executed by slaves across history discussed in section 3.6. Source: Brazilian Census of 1872; Fenoaltea (1984); Fogel (1989); Aubert (1994); Higman (1995); Hanes (1996); Wright (2006); Davies (2007); Frier and Kehoe (2007); Gardner (2007); Harris (2007); Kehoe (2007); Klein and Vinson (2007); Blanchard (2010); Burnard (2010); Childs and Barcia (2010); den Heijer (2010); Lohse (2010); Morgan (2010); Fragoso and Rios (2011); Morley (2011); Phillips (2011); Walsh (2011); Temin (2013); Dari-Mattiacci (2013); Gamauf (2016). We have listed a task if at least one of the sources mentions that that task was performed by slaves. The classification is our own elaboration of the information provided in the literature.

turnover costs, and the labor-land availability ratio.

Effort-intensive vs care-intensive activities. In a ground-breaking paper, Fenoaltea (1984) views slave tasks along a continuum from effort-intensive activities, such as mining or gang labor in plantations, to care-intensive activities, such as crafts or business agency. Pain incentives are adequate for effort-intensive activities but do not suit well care-intensive activities because pain-induced motivation induces anxiety and makes workers careless. Therefore, as we move from effort-intensive to care-intensive activities, we should observe that rewards, such as the prospect of manumission, become more common. Manumission, however, gives the slave control over his participation constraint, which in turn makes a slave more similar to a worker. Therefore,

more slaves than workers should be found in effort-intensive activities, and vice versa in care-intensive activities. This result finds support in the study of slavery in the Antebellum US by Fogel and Engermann (1974).

However, the distinction between effort-intensive and care-intensive activities and the prevalence, respectively, of pain and reward incentives runs against some contradictory evidence in other contexts. Tobacco in the US and Cuba was a care-intensive activity not necessarily dominated by workers; similarly for cereals and vines (Wright 2006, p. 81; Scheidel 2008, p. 108; Barcia and Childs 2010, p. 94). Slaves did not necessarily work in the gangs found in the prototypical effort-intensive cultures. In contrast, "[M]any farmers chose to employ only a few slaves, often just one or two. On small farms, a slave worked alongside family members, performing similar tasks in similar ways" (Hanes 1996, p. 309). Moreover, slaves dominated care-intensive activities such as herding and domestic service in antiquity, despite high rates of manumission.[8] Also in antiquity, there was a proliferation of free rowers in Greece and Rome, and free miners in Roman Spain, Dacia, and Egypt, both very unpleasant and dangerous activities (Scheidel 2008, p. 111). Even in mining, slaves were not necessarily the default unskilled source of labor: in Peru, black slaves supervised Indian labor (Blanchard 2010, p. 72). We move away from the distinction between effort and care and focus on the informational characteristics of tasks. Our perspective gives less consideration to the agent's behavioral reactions to incentives (which is the core of Fenoaltea's (1984) approach, putting instead more weight on the limitations of the principal's ability to observe effort (as in Dari-Mattiacci 2013).

Turnover costs. Hanes (1996), in a study on slavery in British America, views slaves as a way to decrease turnover costs. Whenever a worker quits, an employer must search for and train a new worker. Especially in farming, labor disruptions also decrease production because crucial tasks—such as, for instance, harvesting—are not executed in due time. Since turnover costs decrease with the thickness of local labor markets, the impossibility for slaves to leave at will is especially valuable in thin local labor markets. However, this theory does not handle well cases such as the extensive use of slave labor in Baltimore (Whitman 1997, p. 6-8) and in urban areas across Brazil (Fragoso and Rios 2011, p. 351), which had relatively thick markets.

[8]Slaves also dominated herding in most of the Spanish Americas (Klein and Vinson 2007, p. 25).

There is also evidence that turnover costs were not a problem for many industries, which nevertheless employed slaves (Scheidel 2008, p. 112). A final but important shortcoming of looking at turnover costs alone is that it is difficult to disentangle the exogenous and endogenous components of turnover costs. For instance, population density determines the thickness of the local labor market. Yet, population density depends on exogenous factors such as climate, and on endogenous factors such as the location of industrial clusters. Our approach combines consideration for turnover costs with an analysis of the informational characteristics of the principal-agent relationship between employer and worker.

Labor-land availability ratio. In order to explain differences in African and Asian slave societies, Watson (1980) introduces an "openness" continuum where openness is a function of the probability of manumission and the social status of freedmen. African societies were open societies because manumission was frequent and slaves were usually integrated into the owner's family. Conversely, Asian societies made manumission extremely difficult, also due to social stigma. Similarly to Acemoglu and Wilotzky (2011) and Lagerlöf (2009), Watson (1980, p. 10) explains these differences as a function of the labor-land availability ratio: labor scarcity was the key issue in Africa, whereas lack of land was the central problem in Asia. Therefore, it was natural that Africans would prioritize labor over land. Authors such as Scheidel (2008) apply this framework to rank different societies: Africa and Rome were open societies; Ancient Greece and Brazil were somewhere in the middle of the continuum; the Antebellum US and the Caribbean were closed societies. But it is not clear whether openness of the slave systems affected the allocation of tasks between slaves and workers. In fact, it could well be that it is the use of carrots in general and of manumission in particular that made a particular system more or less open (Dari-Mattiacci, 2013).

Other theories. The literature offers other noteworthy theories related with, although not directly aimed at explaining, the allocation of tasks between slaves and workers. Acemoglu and Wolitizky (2011) offer an extension of their model in which coercion makes workers invest less ex ante in skills valuable to the principal because coercion increases with workers' productivity. In turn, this explains the prevalence of slaves in effort-intensive activities as compared to care-intensive activities. As we

have noted, in our model coercion is exogenous. Moreover, to the extent that worker's productivity is correlated to the complexity of the task assigned to the worker, our model offers the opposite prediction: the principal will use carrots rather than sticks to incentivize more productive slaves.

Coclanis (2010, p. 494) and Esposito (2015) partially explain the use of slaves with geographical characteristics, such as disease environment. However, Wright (2006, p. 85) downplays this factor in favor of well-defined property rights to explain the extensive use of slavery in the Antebellum US. Our chapter accommodates both explanations: property rights are needed to define what a slave is, whereas geography makes a slave worth to use.

Finally, Bradley (2007, p. 245), Klein and Vinson (2007, p. 4) and Scarano (2010, p. 31) agree that "three conditions can be posited as necessary for the emergence of a genuine slave society: private ownership of land, the availability of an appropriate market for disposing of the surplus produced and the absence of an internal labor supply" (Bradley 2007, p. 245).[9] These three conditions can be viewed as determinants of the total slave population in a society. However, they do not help predicting differences in the division of tasks between slaves and workers.

3.3 Theoretical Framework

In the model, a principal employs an agent—that is, she either hires a worker or buys a slave—to perform a task q, where $q \in \left(\frac{1}{2}, 1\right)$ (the principal's type) is an inverse measure of the complexity of the task as explained below.[10] A mass 1 of principals is distributed uniformly along the task-complexity continuum. The principal's pay-off is the following:

$$\Pi_{Principal} = v - \zeta - \tau - \eta \tag{3.3.1}$$

The principal earns a surplus v if the agent exerts effort (and zero otherwise) and pays costs ζ (the purchase price of the slave or the wage of the worker), τ (the turnover costs in case the agent leaves before completing the task) and η (the enforcement costs borne to incentivize the agent), all of which will be specified below. We initially assume

[9] Note that many African societies did not have private ownership of land (Herbst, 2000), but had slavery (Watson, 1980).

[10] The model builds on the model of slavery by Dari-Mattiacci (2013) by adding the possibility to choose workers instead of slaves.

that v is such that $\Pi_{Principal} > 0$ in order to focus on the choice between slaves and workers, not the conditions under which the agents' markets exist. A robustness check in section 3.5 studies the case where v is insufficient to cover all the costs.

To anticipate what follows, these costs will depend on the complexity q of the task. More complex tasks induce higher turnover costs because they require relation-specific investments and training a replacement is costly. In addition, more complex tasks yield higher enforcement costs because monitoring is more difficult. Consequently, principals are willing to pay a premium for a technology that reduces both turnover and enforcement costs. As we will see now, slaves provide that technology.

Agents are of two types: slaves and free workers. Slaves impose no turnover costs—$\tau = 0$, while workers are characterized by $\tau > 0$—and can be subjected to physical punishments (sticks) in addition to rewards (carrots)—while workers can only be incentivized with carrots. To be sure, there is a risk of turnover also with slaves. Since slaves cannot leave at will, slavery implies lower turnover than labor, and we normalize the turnover costs with slaves at zero.[11] Workers might also leave the relation unexpectedly because of poaching for workers among principals (Hanes, 1996), migration (Bradley 2007, p. 245; Klein and Vinson 2007, p. 3), conscription (Aubert 1994, p. 121; Bradley 2007, p. 245; Rihll 2008, p. 130), or health conditions (Klein and Vinson 2007, p. 46; Coclanis 2010, p. 492; Walsh 2011, p. 421; Esposito, 2015). Similarly, also workers can be subjected to some form of punishment—physical threats, dismissal, penalties—but surely less so than slaves and, again, we normalize the worker's sticks to zero.[12]

In order to focus on the core aspects of the problem, we assume that, besides the two differences above, all agents are otherwise homogeneous. In particular, slaves and workers are equally productive[13] and agents do not have *a priori* characteristics that

[11] In the Americans, typical problem faced by employers was the employees' unwillingness to move to a new location to exploit profitable opportunities (Wright 2006, p. 68; Coclanis 2010, p. 492; Phillips 2011, p. 332). Even in Rome employees "could terminate at will or sue in a court of law" (Frier and Kehoe 2007, p. 131).

[12] Although principals across history have used both rewards and punishments with all agents (Fenoaltea, 1984; Klein and Vinson 2007, p. 60; Dal Lago and Katsari 2008, p. 198), the highest levels of punishment were only attainable with slaves (Temin, 2013; Wright, 2006). The literature leaves no room for doubts that other forms of labor offered a smaller advantage *vis-à-vis* slavery. For instance, in Colonial US "existing racial attitudes determined that slaves could be worked harder than servants, that black women could be put to tasks eventually spared English women, and that black men and women could be more closely observed and regulated." (Littlefield 2010, p. 203).

[13] Assuming otherwise would simply add a variable to the model without qualitatively changing our main findings. Note that this also implies that using carrots or sticks does not affect the agent's productivity. For the effects of carrots and sticks on productivity see Fenoaltea (1984).

make them fitter for a particular task.[14] Agents acquire relation-specific skills on the job, as they produce the surplus v.[15] All agents have the following identical pay-off:

$$\Pi_{Agent} = p_c c - p_s s - e \tag{3.3.2}$$

With probability p_c the agent earns a carrot c and with probability p_s he is hit with a stick s; these probability depend on whether the agent exerted effort and will be specified below. If the agent exerts effort, he faces a cost of $e = 1$; otherwise, $e = 0$. The relationship between the principal and the agent unfolds over four dates:

Date 0 - Slavery vs. Labor: The principal either buys a slave or hires a worker.[16]

Date 1 - Carrots vs. Sticks: The principal determines the magnitude of either a carrot or a stick in order to induce the agent to exert effort.

Date 2 - Turnover and effort: The agent might leave and hence impose turnover costs on the principal. The agent—if the agent does not leave—or his replacement—if the agent leaves—decides whether to exert effort.

Date 3 - Monitoring and enforcement: The principal applies the stick or the carrot after observing a signal of effort and pay-offs are realized.

We describe and solve the model backwards starting from date 3.

[14] In other words, all training is on-the-job training. Another way to interpret the model is to see the market as a market segment for slaves (and workers) with specific characteristics. Blanchard (2010, p. 72) reports that both in Rome and in the Americas the "prices [of slaves] varied according to time, gender, age, skills, place of labor, availability of alternative workers, and the potential profitability of the land" (see also Harper 2010; Scheidel 2007, p. 303). The Edict of the *Curule Aediles* made sellers in Rome accountable for hidden information about a slave (Gardner 2007, p. 416), which is evidence of the importance of information on the slave's idiosyncratic characteristics. Skilled jobs in plantations across the Americas were usually seen as rewards to the most productive field hands (Fogel 1989, p. 57).

[15] This assumption conforms to the historical evidence. In Rome, "among the various agricultural tasks very few required any specific training that could not be learned on the job" (Aubert 1994, p. 176). In Dutch Guyana, "planters knew the risks for newcomers and treated them with a certain amount of care. After branding they were allowed to rest for two weeks to help adapt to their new environment. Three months of light work usually followed. During this period the newly imported Africans stayed with experienced slaves who familiarized them with the work and the relations on the plantation. After this process of adjustment these slaves were fully included in the gang-labor regimen" (den Heijer 2010, p. 160).

[16] Note that, without loss of generality, the price paid for the slave can be set as to be net of the resale value of the slave after the completion of the task at date 3 for ease of comparability with the wage that the principal pays of the same period.

Date 3 - Monitoring and enforcement

The principal observes the effort e exerted by the agent through a noisy signal r, as depicted in table 3.1. If the agent exerts effort, $e = 1$, the signal indicates effort, $r = 1$, with probability $q \in \left(\frac{1}{2}, 1\right)$, and no effort, $r = 0$, with probability $1 - q$. Similarly if the agent does not exert effort. Intuitively, q is the chance that the principal correctly punishes or rewards the agent, while $1 - q$ is the probability of a false negative or a false positive.[17] It is very natural to assume that $q > \frac{1}{2}$, that is, that the signal is more informative than a coin toss. After observing the signal r, the principal applies a carrot c if $r = 1$ and a stick s if $r = 0$ depending on how she set c and s at date 1.

	$e = 1$	$e = 0$
$r = 1$	q	$1 - q$
$r = 0$	$1 - q$	q

Table 3.1: Relation between signal r and effort e.

Date 2 - Turnover and effort

If the principal buys a slave at date 0, there is no turnover. If, instead, the principal hires a worker, she must find a replacement in case the worker decides to leave. Turnover brings costs due to the need to train a replacement and the loss of firm-specific knowledge.[18] To keep the model simple, we assume that, if the worker is replaced, the principal bears the turnover cost τ and the replacement is put under the same incentive scheme and wage as the original worker.

Turnover, however, is not equally costly in all tasks. Simple tasks that can be executed by nearly anybody carry with them low turnover costs. Instead, in complex tasks that require investment in firm-specific knowledge turnover may be very costly.

[17] Allowing for different probabilities of type I and II errors complicates the analysis without affecting the main results.

[18] "Firm-specific human capital, for example, is an asset that loses value when an employment relation is broken off. But replacing firm-specific human capital is not the only cost to a firm when a worker quits. It can be costly to find potential replacement workers and collect information about them. Most important, perhaps, is the cost of going without labor while searching for a replacement worker" (Hanes 1996, p. 311). Frier and Kehoe (2007) and Scheidel (2008) make a similar point about Rome. See also Ruef (2012).

That is, turnover costs decrease in q. We assume the following simple functional form:

$$\tau = \beta\,(1-q) \tag{3.3.3}$$

where $\beta > 0$ is a parameter capturing the dependence of turnover costs on complexity and the variable τ captures the expected turnover costs, that is, it includes the probability that the agent might find a more attractive outside option.

The agent—if the agent does not leave—or his replacement—in case of turnover—decides whether to exert effort. Note that also slaves can decide not to exert effort if they are ready to face the punishment.[19] Therefore, we can examine the effort decision in a unified framework for slaves and workers before turning to the difference between them. Given a carrot c for effort and a stick s for shirking, the agent's pay-off equals $qc-(1-q)s-1$, if he exerts effort, $e=1$. Recall table 3.1: the principal concludes that the agent exerted effort with probability q, rewarding him with the carrot c. However, with probability $1-q$ the principal mistakenly infers that the agent shirked, punishing him with a stick s. Effort costs the agent 1. Similarly, when the agent does not exert effort, his pay-off is $(1-q)c-qs$. Comparing the pay-offs, the agent weakly prefers effort to shirking if:

$$c+s \geq \frac{1}{2q-1} \tag{3.3.4}$$

This is the incentive-compatibility constraint (or the non-shirking condition) in the principal's problem. Note that, due to risk neutrality, the effort decision depends on the sum of carrots and sticks, so that it is immaterial for incentives whether the principal relies on carrots or on sticks.[20] Carrots and sticks, however, have different costs for the principal and impact the agents' participation constraint in different ways. Note that since workers cannot be subjected to sticks and slaves are not free to exit, there is no advantage in using a combination of carrots and sticks. Therefore we can focus in what follows on the principal's choice of either carrots or sticks.

[19] "Like a free worker, a slave or indentured servant had to be monitored and given incentive to provide effort" (Hanes 1996, p. 312).

[20] Studying the effect of risk preferences is out of the scope of this chapter. Chwe (1990) offers a model where agents' risk preferences play a central role.

Date 1 - Carrots vs Sticks

The principal chooses to incentivize the agent with a carrot or a stick depending on which enforcement means yield the lowest enforcement costs. Giving a reward c to the agent costs the principal the same amount c. In contrast, imposing a punishment s costs the principal ks, which is typically different from s. Therefore, we can interpret k as the cost that the principal bears for using sticks rather than carrots. This setup fits well, but not exclusively, scenarios where carrots are monetary rewards and sticks are physical punishments. The costs of applying a physical punishment for the principal include, for instance, (temporary) losses of productivity.[21] The expected cost of carrots is $\eta_c = p_c c$, that is, the carrot times the probability of applying it. The agent's incentive constraint (3.3.4) requires that $c = \frac{1}{2q-1}$ for the agent to exert effort. The probability p_c of applying the carrot is simply equal to the probability that, conditional on the agent exerting effort, the principal receives a signal $r = 1$, which is equal to q. Therefore, the cost of inducing compliance through carrots is:

$$\eta_c = \frac{q}{2q-1} \tag{3.3.5}$$

Analogously, the expected cost of sticks is $\eta_s = p_s ks$, which yields:

$$\eta_s = \frac{1-q}{2q-1}k \tag{3.3.6}$$

The principal chooses carrots if $\eta_c < \eta_s$ and sticks otherwise. We can then define q^* as the level of q that leaves the principal indifferent between carrots and sticks ($\eta_c = \eta_s$):

$$q \leq q^* = \frac{k}{1+k} \tag{3.3.7}$$

Note that $q^* < 1$ for any k, and hence there is always an interval of q where sticks are cheaper than carrots. However, we have $q^* > \frac{1}{2}$ only if $k > 1$, so that carrots are used only if sticks are relatively expensive to use.[22] In complex tasks, $q < q^*$, the principal chooses carrots, while in simple tasks, $q > q^*$, the principal chooses sticks.

[21] Note that the cost of enforcement does not come from the cost of monitoring, which is the same under carrots and sticks and hence does not affect our analysis.

[22] Note that k measures both the different cost of the stick for the principal and the agent and the different cost of carrots and sticks for the principal. Only the second effect is important for our analysis. The two effects could be separated at the cost of more cumbersome notation and additional calculations.

The advantage of using sticks is that, if monitoring is perfect, they do not need to be applied upon compliance (Dari-Mattiacci and De Geest 2010). Therefore, enforcement with sticks is relatively inexpensive if q is close to 1. When, however, the quality of enforcement decreases, two effects arise (Dari-Mattiacci 2013). First, greater sticks are needed in order to make up for the noise in enforcement; as can be seen from (3.3.4), for a given c, s decreases in q. Second, sticks are applied more frequently upon compliance because $1-q$ increases. Both effects raise the costs of using sticks and make carrots a more attractive alternative. Figure 3.1 summarizes these results.

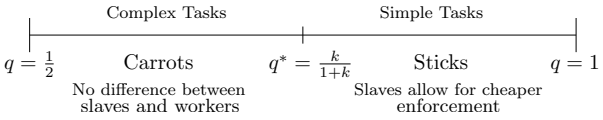


Figure 3.1: Enforcement means applied along the q-axis when $k > 1$.

The principal can only apply sticks on slaves, not workers. Therefore, buying a slave reduces enforcement costs for simple tasks, $q > q^*$. Since q^* is monotonically increasing in k, carrots are preferred over sticks at lower levels of q's as sticks become relatively more expensive. If $k < 1$, it is cheaper to use sticks for any q. Focus on the more interesting case of $k > 1$, we have the following enforcement-cost advantage of sticks over carrots:

$$\eta_c - \eta_s = \frac{q - (1-q)k}{2q-1} \tag{3.3.8}$$

The denominator $2q-1$ captures the enforcement noise, which requires the principal to use greater carrots or sticks. The numerator depicts the costs of doing so with carrots—at a marginal cost of 1—rather than with sticks—at a marginal cost of k. Figure 3.2 depicts the consequences of the principal's choice between carrots and sticks for the pay-off of slaves and compares it to the pay-off of workers along the task-complexity continuum. An decrease in q increases the agent's pay-off from carrots because greater information rents are paid when monitoring is more noisy. For the same reason, the expected disutility from sticks decreases as q increases. The figure also shows that if the principal uses sticks, the slave has a negative pay-off and participates only because he cannot do otherwise.

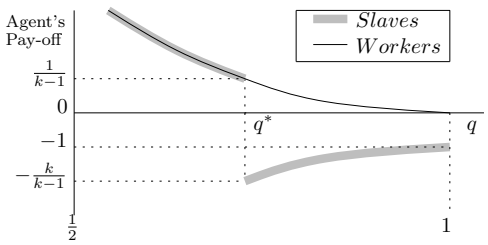


Figure 3.2: Agents' pay-off along the task-complexity continuum.

Date 0 - Slavery vs Labor

The principal is a price-taker who buys a slave or hires a worker depending on the complexity q (her type) of the task she needs the agent to complete. Individual principals' decisions aggregate to determine demand in the markets for slaves and workers. In the equilibrium, a principal buys slaves and uses carrots for low values of q, hires workers for intermediate values of q, and buys slaves but uses sticks for high values of q. The proof requires finding two values of q that leave the principal indifferent between slaves and workers, $\{\underline{q}, \bar{q}\}$.

The Choice of the Representative Principal

The principal maximizes her pay-off subject to the subgame choices described above. Since v is a constant, we can focus on the minimization of the sum of employment, turnover and enforcement $\zeta + \tau + \eta$. If the principal hires a worker these costs are $w + \tau + \eta_c$. The principal pays the wage w, bears the turnover costs τ and spends η_c to incentivize the worker with carrots. If instead the principal chooses a slave, her costs are $p + \min\{\eta_c, \eta_s\}$, because the slave costs p, cannot leave and can be incentivized with sticks.

For simplicity, we assume that the worker's outside option at date 0 is 0 and hence we set $w = 0$. We can then interpret p as the premium that the principal pays for buying a slave rather than hiring a worker.[23] Paying the slave premium only makes sense if p does not exceed the sum of the savings in turnover costs, τ, and—if the task

[23]The historical evidence suggests that "slaves skilled in crafts and services were commonly valued at twice or three times the value of an unskilled slave," even in antiquity (Rihll 2008, p. 136). Prices of slaves in the US in the turn of the eighteenth to the nineteenth century fluctuated between $5000 and $14000 in 2003 dollars depending on skills (Coleman and Hutchinson, 2005; Littlefield 2010, pp. 209, 210). Therefore our assumption that the premium is constant in q may seem unwarranted. However, also workers are typically paid more if they are more skilled and, since we are interested in the difference between slaves and workers, such skill-premia will typically cancel out.

is simple enough, $q > q^*$—in enforcement, $\eta_c - \eta_s$. Therefore, we have:

$$p \leq p^*(q) = \begin{cases} \tau & q \leq q^* \\ \tau + \eta_c - \eta_s & q > q^* \end{cases} \tag{3.3.9}$$

This leads to the following lemma.

> *Lemma 1*: For a given slave premium p, there are two cutoff levels of the task-complexity q such that the principal buys slaves for the most complex tasks, $q \leq \underline{q}$, and for the simplest tasks, $q \geq \bar{q}$, while she hires workers for tasks of intermediate complexity, $\underline{q} \leq q \leq \bar{q}$.

In the discussion that follows we assume that both cutoff levels of q fall in the relevant interval $\left(\frac{1}{2}, 1\right)$. In subsection 3.4.1 we explain what happens if this is not the case. Note that the core of our argument remains the same. Figure 3.3 illustrates Lemma 1. The proof is in appendix 3.A.1. For more complex tasks, i.e. tasks where $q \leq \underline{q}$, slaves only outperform workers in turnover because both slaves and workers are incentivized with carrots. The savings in turnover costs decrease in q. In simpler tasks, i.e. tasks where $q \geq \bar{q}$, the most salient advantage of slaves over workers is in the possibility to use sticks (while the advantage in turnover is minor at low levels of q). The costs saved by using sticks increase in q. Therefore, the difference in the principal's pay-off when buying slaves rather than workers has a U shape and is lowest in for intermediate values of q, where it is more advantageous to hire workers.

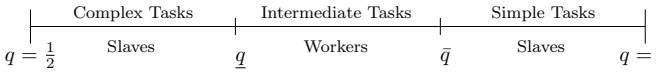


Figure 3.3: Agents used by the principals along the task-complexity continuum in Proposition 1.

Markets for Slaves and Workers

We now examine the equilibrium level of the slave premium p as a result of the meeting of demand and supply in the labor and slave markets. Given our uniformity assumption in the distribution of principals, the quantity demanded of each type of agent is proportional to the length of the intervals delimited by the thresholds $\bar{q}$ and $\underline{q}$. A fraction $\mathbf{D}_W \equiv 2(\bar{q} - \underline{q})$ of the principals demand workers, while the remaining fraction

$\mathbf{D}_S \equiv 2\left(1 - \bar{q} + \underline{q} - \frac{1}{2}\right)$ demand slaves.[24] On the supply side, workers take any job that offers a non-negative pay-off in expectation. The supply of slaves equals $\mathbf{S}_S \equiv \gamma p$, where $\gamma > 0$ represents the abundance of slaves relative to workers. That is, the more slaves are available, the higher γ; conversely, the more workers are available, the lower γ, so that γ captures in a reduced form also changes in the supply of workers or in their reservation utility. In equilibrium:

$$\mathbf{S}_S = \mathbf{D}_S \Leftrightarrow p^* = \frac{1 - 2(\bar{q} - \underline{q})}{\gamma} \tag{3.3.10}$$

which identifies the market premium for slaves over workers.

> *Proposition 1*: There is a market equilibrium in which the price of slaves is such that principals buy slaves for the most complex tasks and for the simplest tasks, and hire workers for intermediate tasks.

Figure 3.4 illustrates Proposition 1, under the assumption that both cutoff levels of q fall in the relevant interval $\left(\frac{1}{2}, 1\right)$. In subsection 3.4.1 we deal with degenerate cases. The intuition is similar to that of Lemma 1, but the price of slaves is now endogenous. Principals hire workers to carry out tasks of intermediate difficulty, with $q \in \left(\underline{q}, \bar{q}\right)$, whereas the remaining tasks are executed by slaves.

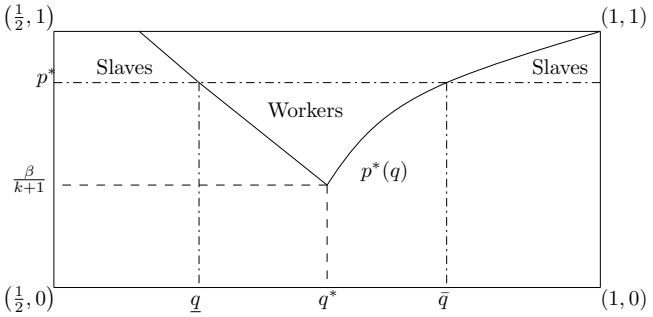


Figure 3.4: Thresholds in the q-p plain when $p \leq 1$.

The curve $p^*(q)$ in figure 3.4 depicts the price p that leaves the principal indifferent between slaves and workers for each type of task. Again, principals in complex tasks

[24] The thresholds in the q-axis are used to partition the mass of principals in three segments. Then, we multiply the new demands by 2 because q-axis is $\frac{1}{2}$ in length, while the mass of principals equals 1. Note that these demand functions depend on p via $\bar{q}$ and $\underline{q}$ in an intuitive way: the demand for slaves decreases in p.

only save turnover costs when using slaves, while principals in simple tasks also save by enforcing with sticks instead of carrots.

Notice that depending on the combination of parameters, $\underline{q}$ and/or $\bar{q}$ may not exist or might be outside of the interval $\left(\frac{1}{2}, 1\right)$. This becomes clear with the derivatives of these thresholds. For instance, $\underline{q}$ always decreases when turnover costs become smaller, i.e. when β decreases. Hence, there is a point where $\underline{q}$ is only infinitesimally larger than $\frac{1}{2}$. Intuitively, there are very few slaves in complex tasks when savings in turnover costs generated by the use of slavery are negligible. This and other combinations of parameters lead to degenerate equilibria, which we discuss in more detail in subsection 3.4.1.

3.4 Comparative Statics

We are interested in the effect of changes in the incidence of turnover costs, β, the cost of sticks relative to carrots, k, and the abundance of slaves relative to workers, γ, on the proportion of slaves to workers in the economy—which gives a measure of the overall prevalence of slavery—and the proportion of slaves in complex tasks relative to those in simple tasks—which instead indirectly measures the quality of the slaves' living conditions, given that carrots provide slaves with more comfort, better lodging, companionship, the prospect of freedom, and so forth.[25]

> *Proposition 2* - Proportion of slaves to workers: An increase in turnover costs β, a decrease in the cost of sticks k, or an increase in the abundance of slaves, γ, increases the overall use of slaves relative to workers.

The intuition behind this proposition is straightforward: principals prefer slaves when the advantages of using them become greater, or when there are more slaves available in the market. An increase in turnover costs increases the advantage of using slaves in all tasks—although more pronouncedly so in complex tasks, where turnover is more problematic—as represented by the jump ① in the indifference curve in figure 3.1 and hence increases the principals' overall reliance on slaves relative to workers. Jump ② stands for the increase in the slave premium which is caused by increased demand for slaves, which tends to reduce the prevalence of slaves and partially offsets the previous effect. The net effect is an increased use of slaves.

[25] See examples in den Heijer (2010, p. 161), Lohse (2010, p. 53) and Temin (2013, p. 124).

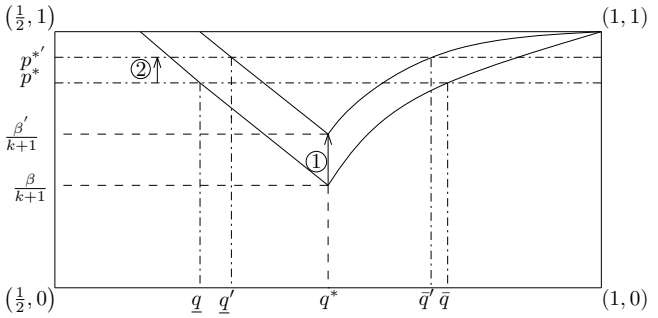


Figure 3.1: Effect of an increase in β.

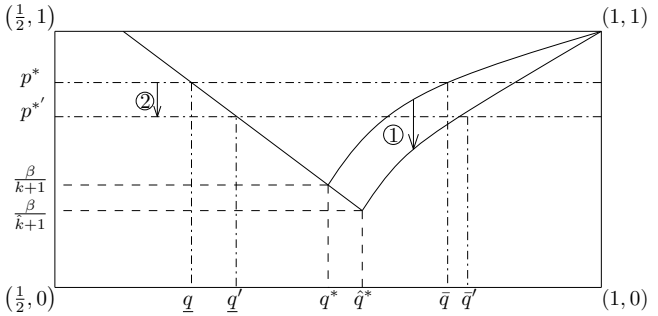


Figure 3.2: Effect of an increase in k.

Jump ① in figure 3.2 shows that an increase in the cost of sticks only directly affects the use of slaves in simple tasks because the principal uses carrots in complex tasks. This leads to a reduction in the demand for slaves and a corresponding decrease in prices depicted by jump ②. In turn, principals in complex tasks react to the price reduction by incrementing the use of slaves in those tasks, which partially offsets the previous result. The net effect is a decrease in the overall use of slaves.

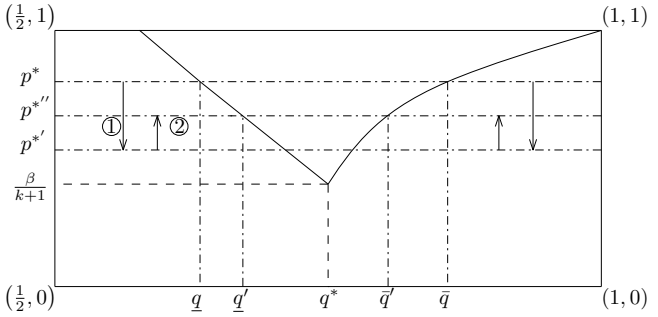


Figure 3.3: Effect of an increase in γ.

Changes in the abundance of slaves do not affect the indifference curve: the effect

is directly on the price. An increase in the abundance of slaves makes slavery cheaper for every principal, as represented by jump ① in figure 3.3. However, prices increase as more principals buy slaves to carry out tasks previously performed by workers, as depicted by jump ②, which only partially offsets the result. The net effect is an increase in the use of slaves.

Proposition 3 - Proportion of slaves in complex to those in simple tasks: The use of slaves in complex tasks relative to simple tasks:

- increases with an increase in the turnover costs, β, if there are few slaves in complex tasks relative to simple tasks.
- decreases with an increase in the turnover costs, β, if there are many slaves in complex tasks relative to simple tasks.
- increases with an increase in the cost of sticks, k.
- increases with an increase in the abundance of slaves, γ, if the quantity of slaves in simple tasks is large enough.
- decreases with an increase in the abundance of slaves, γ, if the quantity of slaves in simple tasks is small enough.

Proposition 3 reflects the fact that principals buying slaves at one extreme of the task-complexity continuum affect principals at the other extreme of that continuum through the price of slaves. The threshold for the effect of a shock in turnover costs is intuitive: principals save more turnover costs when using slaves in complex tasks than in simple tasks. However, by using more slaves in simple tasks, principals also save on enforcement costs, an advantage that is absent in complex tasks where carrots dominate. If there are many slaves in simple tasks, the marginal slave executes a relatively complex task (low $\underline{q}$), for which both turnover costs and enforcement costs are high. Therefore, cost savings are higher for simple tasks than for complex tasks. If instead only few slaves are employed in simple tasks, the marginal slave has a relatively simple task (high $\underline{q}$), which brings about meager savings and reverses the result.

The intuition when the cost of sticks increases is much more straightforward. The higher the cost of sticks, the less valuable slaves become in simple tasks. In turn, the decrease in demand for slaves in simple tasks makes slaves cheaper for principals in complex tasks.

An increase in the abundance of slaves affects directly the price of slaves, while leaving the indifference curve unchanged. The increase in the use of slaves in complex relative to simple tasks depends on the slope of the indifference curve in the simple tasks region. If there are already many slaves employed in simple tasks, then the marginal slave employed in a simple task carries out a relatively complex task (low $\underline{q}$) and the marginal advantage of using an extra slave is small. Hence, the principals will prefer to increment the use of slaves in complex tasks more. If instead there are only few slaves in simple tasks, then the marginal slave with a simple task carries out a relatively simple task (high $\underline{q}$) and marginal gains in using more slaves in that region outweigh the marginal gains in using slaves in complex tasks.

3.4.1 Alternative Equilibria

Above we have assumed that the two cutoff levels $\underline{q}$ and $\bar{q}$ fall within the relevant interval for q, so that the model produces a partition of the range $\left(\frac{1}{2}, 1\right)$ in three intervals. When these conditions are relaxed, the model displays either one of two degenerate equilibria, where slaves are used only in complex or in simple tasks, but not in both. If turnover costs are relatively low and sticks are cheap to apply, slaves will be used only in simple tasks, where sticks dominate, with workers taking over the remaining jobs because turnover is not problematic. This was the case in the early Roman Republic, in the Caribbean and the Antebellum US, where most slaves worked in agriculture.[26] Figure 3.4 depicts this equilibrium

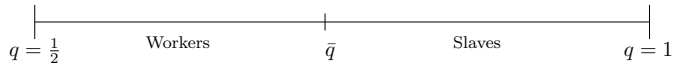


Figure 3.4: Agents used by the principals along the task-complexity continuum - "slaves in simple tasks" equilibrium.

In contrast, if turnover costs are relatively high and sticks are relatively expensive to use, we have an equilibrium in which slaves are used only in complex tasks, where they are very valuable. The high cost of sticks makes workers preferable in simple tasks where sticks would possibly be used with slaves. This is a rare occurrence in history, but one that resembles the late Roman Empire, where slaves dominated high-level jobs in the imperial administration. Moreover, the model predicts a smaller advantage

[26] 80% of the Antebellum US slaves were employed in agriculture (Wright 2006, p. 76), and 95% traded were unskilled (Ruef 2012).

of using slaves in the simplest tasks, $q = 1$, than in the most complex task, $q = \frac{1}{2}$. Therefore, slaves disappear first in simple tasks when the supply of slaves relative to workers begins to dwindle, giving rise to this equilibrium in situations of scarce slave supply (as it was in the late Roman period). Figure 3.5 illustrates this case.

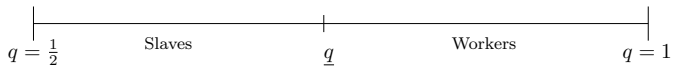


Figure 3.5: Agents used by the principals along the task-complexity continuum - "slaves in complex tasks" equilibrium.

Historical evidence shows an association between an extremely low slave supply and a concentration of slaves in complex tasks, such as crafts or domestic service.[27]

3.5 Robustness Checks

In this section we illustrate six robustness checks. The first is straigthforward, while the remaining five are examined more in details in appendix 3.B. First, our model assumes that the surplus v is always high enough to guarantee a nonnegative pay-off. However, if the surplus generated is so low that many activities are not performed, changes in the surplus might be confounded with changes in any other parameter discussed in Propositions 2 and 3. For instance, the surplus generated by the different farming commodities certainly explains trends in the Spanish Americas (Blanchard 2010, p. 73).[28] Equally important, the model assumes the same surplus for all types of tasks.[29] But women might have generated a higher surplus than men because women provided children who were also slaves (Wood 2014, p. 514). This explains why prices of slave women were higher than the prices of slave men in Africa (Watson 1980, p. 13) and in the Antebellum US (Ruef, 2012). When considering variation in v, our results hold if v decreases at a constant rate in q, as the task becomes simpler, and if tasks are still profitable with workers. As v decreases, principals first cease to use slaves in tasks in the middle of the distribution, leaving the equilibrium in Proposition 1 unchanged. Consequently, also the comparative statics still hold.

[27] See section 3.6.

[28] Among other events, the Haitian revolution in 1791 stimulated the use of slaves in Puerto Rico through a price increase of sugar (Scarano 2010, p. 32).

[29] The predominance of carrots across towns in Rome (Temin 2013, p. 123) and in the Americas (Fragoso and Rios 2011, p. 355) might be explained by a lower surplus in simple tasks relative to that in complex tasks.

Second, the Non-Compete Clause (NCC) is a micro-foundation of the savings in turnover costs, τ, principals make when buying a slave. Workers might leave the principal to switch to a better paid position. Hence, each principal must pay a premium to keep her worker. Indeed, evidence shows that in places where slavery was absent, "workers were not free to change jobs at will until near the end of the nineteenth century" (Naidu and Yuchtman, 2013; Temin 2013, p. 117). Also doctors in Rome could prohibit their freedmen to compete with them:

> "Where a physician, who thought that if his freedmen did not practice medicine he would have many more patients, demanded that they should follow him and not practice their profession, the question arose whether he had the right to do this or not. The answer was that he did have that right, provided he required only honorable services of them; that is to say, that he would permit them to rest at noon, and enable them to preserve their honor and their health. (1) I also ask, if the freedmen should refuse to render such services, how much the latter should be considered to be worth. The answer was that the amount ought to be determined by the value of their services when employed, and not by the advantage which the patron would secure by causing the freedmen inconvenience through forbidding them to practice medicine. " *Digest 38.1.26).*

This robustness check has minor implications for our model if all the assumptions of the extension hold. However, if we drop the assumption that turnover costs increase with task complexity, then we may either have the "slaves in complex tasks" equilibrium described in subsection 3.4.1, or the same equilibrium as the robustness check where turnover costs are homogeneous across tasks, discussed above in the current section.

Third, in our model, the cost of sticks, k, is exogenous to market conditions. But a principal forfeits value whenever a slave is whipped or confined. Both reasons are well approached by assuming that the cost of sticks increases with the price of slaves, which is a proxy of productivity or the cost of finding a (temporary) replacement. That yardstick tells that an increase in the price of slaves increases the proportion of slaves motivated with carrots relative to those motivated with sticks. However, it is hard to separate the price effect from other factors affecting the cost of sticks. Lastly, this assumption generates the "slaves in complex tasks" equilibrium because the advantages in turnover costs and in enforcement strictly increase with task complexity.

Fourth, a positive relation between turnover costs and task-complexity is the most important assumption made in this model. However, it is not a strong assumption: considering turnover costs homogeneous along the task-complexity continuum generates the equilibrium described in Proposition 1 when the price of slaves equals turnover costs.

Fifth, we have assumed that $k > 1$. If we considered $k < 1$ instead, sticks would be so cheap that it would be optimal to enforce all tasks with sticks. However, the savings in enforcement costs would never dominate the savings in turnover costs, i.e. the advantage of having a slave would always be decreasing in the task-complexity continuum. Thus, the only possible equilibria would be a society only with slaves or a society only with slaves in complex tasks. This is at odds with the ample evidence of slaves in simple tasks in Rome and in the Americas.

Sixth, one point underplayed in the model involves the role of carrots on the worker's participation constraint. The implicit assumption is that agents have a zero reservation utility. Hence, because carrots yield a pay-off above the cost of effort, they always satisfy the participation constraint of every agent. However, a more careful analysis is needed if agents' reservation utility is positive, i.e. $\bar{u} > 0$. Recall that the expected pay-off of each agent given by carrots decreases in q. That is, the simpler the task, the cheaper it is for the principal to motivate the agent to exert effort. Then, it is straightforward to conclude that there is a $\breve{q}$ such that every task with a higher q does not pay high enough carrots to satisfy the reservation utility.[30] In that case, the principal must pay a nonzero fixed wage $w = \bar{u} - p_e c$ on top of the expected carrots to satisfy the worker's participation constraint.

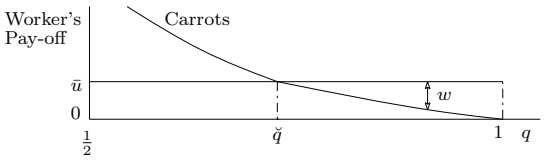


Figure 3.1: Worker's pay-off when their reservation utility is positive.

Figure 3.1 illustrates the gap that wage w fills. Intuitively, workers in more complex tasks earn an information rent, whereas workers in simpler tasks only earn their reservation utility. As shown in appendix 3.B, relaxing these six assumptions does not

[30] Carrots in equilibrium equal $p_e c = \frac{q}{2q-1}$. It follows that $p_e c \leq \bar{u} \Leftrightarrow q \geq \breve{q} = \frac{\bar{u}}{2\bar{u}-1}$. This restriction is active whenever $\bar{q}$ is high enough, i.e. $\bar{u} > \frac{1}{2}$.

qualitatively change the implications of the model.

3.6 Evidence

3.6.1 Turnover Costs, Cost of Sticks and Slave Supply across History

We use the results of the model to shed light on the available historical evidence. Unsurprisingly, there is ampler evidence of the equilibrium described in Proposition 1 than of the comparative statics in Propositions 2 and 3. Slavery was a persistent system of property rights. Exogenous variation in the parameters within one society in a particular historical period, which is the most common unit of analysis in the literature, was rare. To complement our mostly qualitative analysis, we exploit a unique dataset: the Brazilian Census of 1872. To our knowledge, this is the only dataset that displays the division of labor between slaves and workers side by side in the same list of occupations.

Following Fenoaltea (1984), Scheidel (2008) and Dari-Mattiacci (2013), this section essentially discusses slavery in Rome and in the Americas, with occasional references to other episodes. Slave population in Rome and the Americas has no parallel in history: the Romans enslaved more than 100 million people for more than 1000 years (Dari-Mattiacci, 2013); Europeans imported about 12.5 million Africans, which is "one of the largest forced migrations in world history".[31] Moreover, slavery in those societies permeated several layers of the economy so that many sectors depended heavily on slave labor (Klein and Vinson 2007, p. 5). Slaves in other societies were relegated to either heavy, menial tasks such as mining, or to household-level production, such as family farming or domestic services.

Rome was a society where slaves reached absolutely every economic activity (Scheidel 2008, p. 105). First, Roman legislation and social attitudes implied that slaves could easily perform different roles, from business agents to miners (Dari-Mattiacci, 2013; Gamauf 2016, p. 388; Mouritsen 2016, p. 402). Second, manumission was easy and freedmen acquired almost full citizenship (Mouritsen 2016, p. 403), meaning that manumission as a carrot was certainly more valuable than in the Americas. Finally,

[31] Statement from the Trans-Atlantic Slave Trade Database, available at slavevoyages.org (last accessed on January 23, 2017).

as already mentioned, estimates point to a slave population 10 times higher than in the Americas in total. Even taking into consideration the different time spans, the Roman slave population per century is almost the same size as all the enslaved population exported to the Americas. Hence, Romans had plenty of slaves even compared with other major slave societies. Data scarcity is a big issue when studying Roman slavery (Scheidel 2007, p. 289). Joshel's (1992) data on epitaphs is virtually the only quantitative source mentioning social status and occupations of slaves, freedmen, and freemen (Dari-Mattiacci, 2013).

Unlike in Rome, slavery in the Americas was based on race, which limited slaves' access to many complex tasks (Dari-Mattiacci, 2013).[32] However, the Americas offer much more quantitative data than Rome. In addition, geographic diversity and different colonizers also open several avenues for exogenous variation. For instance, Portuguese and Spanish legislation may have raised the cost of sticks relative to the other European powers (Peabody, 2011), while geography might have made the cost of sticks lower in islands than in the mainland (den Heijer, 2010).

The analysis of the implications of Propositions 1 to 3 uses three strategies to open the door to cautious causality claims. First, we compare societies differing in one of the aforementioned parameters.[33] Second, geography is associated with crucial, human-independent variables, such as the Malthusian level of population density. This last procedure allows safer conclusions when studying one society in a specific historical period.[34] Finally, this discussion makes use of successful enslavement episodes and other sudden shocks in the supply of slaves.[35]

[32]For instance, slaves and freedmen were forbidden to be goldsmiths in eighteenth century Brazil (Klein and Vinson 2007, p. 67).

[33]Temin (2013, p. 120) compares Roman and Antebellum US due to their differences in the use and cost of sticks. Scheidel (2008, p. 111) and Watson (1980, p. 6) also describe differences in enforcement costs and, hence, in types of slavery between Greece, Rome, Antebellum US, Brazil and Africa.

[34]For instance, Blanchard (2010, pp. 72, 73) uses differences in landscape and Indian population density in the use of slaves and workers in mines between Peru and the rest of Spanish South America. Watson (1980, p. 11) uses analogous arguments to explain the differences between African and Asian slavery systems.

[35]The conquests of the late Roman Republic generated some of the largest slave influxes in world history, and the literature regards them as determinant for the composition of occupations in the slave population for the rest of the history of Rome (Aubert 1994, p. 138; Harris 2007, p. 527; Dari-Mattiacci, 2013).

3.6.2 Division of Labor between Slaves and Workers (Proposition 1)

The jobs allocated to slaves "tended to be the most unpleasant and dangerous" (Weidemann 1981, p. 7) in farming, animal husbandry, mining or shipping.[36] However, table 3.1 confirms a pattern already present in table 3.1: not only were significant portions of the slave pupulation not in menial activities but they also performed very different tasks within each activity. Up to 30% of the slaves in a plantation worked in complex activities.[37]

Type of Position	Proportion (%)
Field hands	70-85
Skilled, semi-skilled and supervision positions	10-20
Domestic service	5-10

Table 3.1: Rough proportions of slaves' employment in plantations in the British Caribbean. Source: own elaboration on Morgan (2011, p. 388).

Across history, slaves often occupied top jobs in the farming sector. In Rome, slave farm managers were widespread (Aubert 1994, p. 157; Scheidel 2008, p. 106). Both in Rome (Kehoe 2007, p. 553) and in the Spanish Americas (Lohse 2010, p. 52), workers often performed seasonal tasks not carried out by the permanent slave labor force.[38] Fogel (1989, p. 46) also finds this pattern of temporary workers performing undifferentiated tasks while the permanent slave labor force executes the skilled activities in arboriculture in British America.[39] Therefore, although the majority of the slaves performed menial tasks in the countryside, it also seems to be the case that more

[36]See examples in Aubert (1994, p. 118), Davies (2007, p. 347), Hanes (1996), Kehoe (2007, p. 553), Scheidel (2008 p. 106, p. 110), Weidemann (1981, p. 7) and Wright (2006, p. 73). All point to the same pattern: "And while the slave as status symbol remained a constant throughout the history of slavery in Spanish South America, the vast majority of the new imports were destined to occupy far more demanding and onerous positions as manual laborers and domestic servants" (Blanchard 2010, p. 70).

[37]Hanes (1996, p. 307) also reports that, in Anglo America, "as many as 30 percent of American slaves in 1790 were in areas without a staple crop base."

[38]In Rome, evidence can be found in Aubert (1994, p. 118), Kehoe (2007, pp. 553, 554), and Scheidel (2008, pp. 110, 130). Phillips (2011, p. 340) shows similar evidence from the Portuguese and Spanish colonization of Madeira and the Canary Islands in the fifteenth and sixteenth century. Lohse (2010, p. 52) and Klein and Vinson (2007, p. 71) make a similar point relative to Central America and Brazil. Fragoso and Rios (2011, p. 351) mentions that slave and workers shared occupations in Brazilian farms.

[39]Scarano (2010, p. 38) gives us a compelling picture from nineteenth-century Puerto Rico where "estate slaves and even rented slaves, typically more skilled in the industrial tasks of the sugar mills, labored in these higher-reward tasks [...] [while] hired peasants [...] supplement the fixed workforce in the more unskilled agricultural occupations."

frequently slaves, not workers, performed the complex tasks.[40]

This pattern of workers essentially filling positions of intermediate complexity emerges in urban areas, too. In Rome, many slaves were administrators, agents, authors, and domestics (Scheidel 2008, p. 106; Temin 2013, p. 129), whereas they shared tasks with workers in manufacturing (Rihll 2008, p. 135). In every society in the Americas, "slave labor sometimes blurred with the jobs of the free to the extent that in a number of societies, free blacks, whites, and mestizos worked in many of the professions that were also staffed by skilled slaves" (Klein and Vinson 2007, p. 41). In the Spanish Americas and in Brazil, slaves and workers shared tasks in livestock, industry and in navigation. Slaves in Brazil often worked "along with unskilled laborers", at least seasonally, as carpenters, blacksmiths, coopers, sailors in whalers, and as factory workers (Klein and Vinson 2007, p. 71) as well as musicians, painters, artisans, and cowboys, and "in every kind of urban employment imaginable" (Fragoso and Rios 2011, p. 351).[41] In the US, slaves and workers split tasks in mining, ironworks, canal and railroad construction, and domestic service.[42]

In conclusion, slaves tended to dominate complex tasks and simple tasks, whereas workers were in tasks where neither turnover nor enforcement were especially problematic.[43]

[40]Aubert (1994, p. 168) goes one step further and states that the use of slave-based farming in Rome depended on the existence of free labor to execute seasonal work: "the availability of temporary wage laborers depended on the existence of small plots worked by independent farmers or tenants, whose activities were somewhat different from that performed on the estate managed by the *vilicus*" (Aubert 1994, p. 168).

[41]See (Lohse 2010, p. 53) for slaves and workers competing for jobs in livestock in Latin America. In Mexican cloth-weaving factories, "black slaves [...] were generally used for the operations that required skill, whereas the native workers provided the unskilled labor" (Phillips 2011, p. 341). Towards the end of slavery in 1888, in Brazil "coffee absorbed only a small fraction of even the rural slaves within the province. Nor were the counties with the most slaves those most associated with coffee. Cattle-ranching, food-processing, and the production of grains and root crops were all slave- as well as free-labor activities" (Klein and Vinson 2007, p. 109).

[42]Relative to industrial jobs, Hanes (1996) refers that slaves were more common in rural than in urban establishments. Yet Dari-Mattiacci (2013) reports on evidence suggesting that slaves stayed longer than workers in a factory in Baltimore, which might indicate that slaves were the skilled part of the labor force. Indeed, already in Colonial US, "acculturated native-born slaves were also more often trained as country artisans and were increasingly employed as carpenters, coopers, blacksmiths, shoemakers, boatmen, and wagoners" (Walsh 2011, p. 423).

[43]Portuguese and Spanish colonization of the Americas is a revealing case study. "In the first century and a half of slavery in the Spanish Americas, there were two systems of slavery: one for the domestics, artisans, and assistants of all sorts, and another for the gang slaves on the plantations and in the mines. The first was a continuation of the pattern of acquiring slaves as supplemental laborers and domestics that was practiced in the medieval Christian states of the Mediterranean. The second stemmed from a different pattern of gang slavery that can be seen in the ancient Roman world and in some Islamic examples in the Middle Ages. The first system predominated in the sixteenth century; later, the second system eclipsed it" (Phillips 2011, p. 338). Even the slavery system after the sixteenth century offers the distribution predicted by this chapter's model: "Black slaves worked in all

3.6.3 Effect of Changes in the Parameters on the Proportion of Slaves to Workers (Proposition 2)

Variations in Turnover Costs

Cross society comparisons help to identify variations in turnover costs and the resulting effects on the division of labor between slaves and workers. For instance, low military commitment in the Aztec empire decreased labor turnover among the free population, which helps to explain the low incidence of slavery among the Aztecs relative to Rome and to the Americas during the European colonization (Scheidel 2008, p. 121). However, geographic factors offer more scope for exogenous variation within a specific society or civilization. The harsh climate of the Andean highlands reduced the benefits from African slavery so that native labor force dominated mining in Peru but not necessarily in Chile, Colombia or Venezuela (Blanchard 2010, p. 73).[44] The presence of native populations also affected the patterns of land tenure and, hence, the difference in labor turnover costs between slaves and workers.[45]

The model predicts that whenever slave supply was extremely low, slaves were concentrated in very complex tasks or in very simple tasks. That is, checking for variations in slave supply also helps to make sense of the role of turnover costs in the proportion of slaves to workers. In Rome, before the third century BC conquests, slaves were concentrated in agriculture. Even during the late Republic and the early Empire periods, slaves were concentrated in domestic service and crafts in the regions with lower slave populations.[46] In the Americas, the first black slaves in the Spanish Mexico

the steps necessary to produce sugar, and Amerindians often provided supplementary, unskilled labor. The majority of the unskilled slaves worked in teams directed by overseers, often slaves themselves. There were numerous skilled positions to fill on the sugar estates, which were both agricultural and manufacturing centers. Almost from the beginning, some slaves found themselves assigned to tasks with more responsibility, for which skill, not brute force, was needed. The skilled positions that slaves held in the sugar mills did not necessarily mean easier lives for them. Conditions of labor in the mills were so harsh that the Spanish crown prohibited Amerindians from working in them" (Phillips 2011, p. 340).

[44] An equally curious case is the cholera epidemic of 1855-6 in Puerto Rico, which took planters to hire more workers and less slaves (Scarano 2010, p. 35).

[45] In Spanish South America, "where small and medium-sized farms competed with big estates and reduced the planters' profits, for example, slave labor was less attractive, keeping slave prices low" (Blanchard 2010, p. 72). However, this relation might have not hold in Rome, where perhaps there was a reduction of slaves in complex tasks, not of the use of slaves in general, as free tenancy became more common (Aubert 1994, p. 131). Moreover, it is also not crystal clear if the decrease in large slave farms was due to innovations on tenancy or just an answer to a dwindling slave supply (Aubert 1994, p. 138; Harris 2007, p. 527).

[46] In Roman Egypt, "slave-ownership was limited in scope: only 15 per cent of households in well-preserved census texts owned any slaves, and most of those only one or two. This suggests that slaves

and in Cuba served as skilled workers, supervisors and personal servants; whenever slavery was marginal across the Spanish Americas, slaves were usually concentrated in the cities.[47] Hanes (1996) also finds slaves in domestic service independently of the slave concentration in Anglo-America. Finally, slaves in the Middle Ages were relegated to domestic service and mining, even in sophisticated societies. For instance, the first black slaves brought by the Portuguese to Europe in 1444 became domestic servants (Klein and Vinson 2007, p. 11).[48]

Variations in the Cost of Sticks

Unlike turnover costs, the cost of sticks is almost exclusively the result of legislation. Worse, the lack of hard quantitative evidence makes it impossible to distinguish the law from its effective application. Then, cross-societies comparison is the only remaining possibility to discuss the comparative statics of the cost of sticks. Even in this case, caution is required: various legal frameworks emerged in different stages of the development of slavery. For instance, the New Laws issued by Charles V in 1542 restricting the use of Indian labor preceded African slavery in the Spanish Americas (Blanchard 2010, p. 70) but slaves in North America predated the slave codes in those colonies (Wright 2006, p. 6; Littlefield 2010, p. 203).

The differences in punishments between Latin America and the rest of the Americas (Peabody, 2011) offer the best case study available. Originating from Medieval

were mostly employed as domestics. We have no evidence for large slave-staffed estates: tenancy and wage labour appear to have been the norm" (Scheidel 2007, p. 290). Morley (2007, p. 267) mentions that "in the West [...] slavery was marginal; war captives might be kept in the household for personal service or might be compelled to practise some craft, but increasingly in the last two centuries BC they were sold to slave-traders or merchants, to fuel the slave system of Italy.".

[47] For the evidence in Mexico, see Barcia and Childs (2010, p. 91) and Lohse (2010, p. 46 & p. 51). For Cuba, Barcia and Childs (2010, p. 94) mention sugar and tobacco plantations working without slaves. Fogel (1989, p. 41) also notes this pattern "in societies where slavery was economically marginal, such as in Peru during the late sixteenth and early seventeenth centuries, in Mexico about the same period, or in Cuba before 1760, the share of slaves in the total population was smaller, and a large proportion, perhaps a majority, of the slaves worked in cities. Even the rural slaves tended to work on small produce farms close to the cities."

[48] "Many pre-15th-century societies held slaves, in most cases such slaves were only a minor part of the labor force and were not crucial producers of goods and services for others [...] [even in complex societies] slaves were relegated to very specialized work for the elite-domestic service in the better households- and sometimes very hazardous state enterprises, such as mining, to which even obligated peasants could not be assigned to work" (Klein and Vinson 2007, p. 4). Note that "slaves were sometimes to be found in rural occupations but never as a significant element in the local agricultural labor force. Given their high costs, and the availability of cheap peasant labor, African slaves in continental Europe would not play a significant role in the production of basic staples, and a slave system, as defined by the classical Roman model, did not develop inside continental Europe in the 15th and 16th centuries" (Klein and Vinson 2007, p. 14).

institutions, Iberian slave codes were probably more benevolent than those of other European powers (Peabody 2011, p. 610).[49] For instance, abusing of a slave very rarely lead to prosecution in the British Caribbean, while in the Spanish Americas could lead to the freeing of the slave (Peabody 2011, p. 607)[50] Iberian slave systems also offered more carrots, such as manumission through payments in installments[51] and through marriage.[52] Therefore, if the cost of sticks relative to carrots was higher in the Iberian colonies, principals in those colonies would save less enforcement costs by using a slave in simple tasks than principals in other colonies. This helps to explain why free labor executed hazardous tasks in nineteenth century Brazil that usually were performed by slaves in the Caribbean (Klein and Vinson 2007, p. 108). There is also abundant evidence of slaves arriving to supervision and skilled positions in the Spanish Americas than in British Caribbean earlier in history.[53]

Variations in the Abundance of Slaves

Like turnover costs, geography and supply shocks are the most promising ways to capture exogenous variations in the abundance of slaves. Still, any comparison must make sure that the change in the supply of slaves in a certain place was caused by an unexpected event, by a persistent historical or geographical feature, or by labor market conditions elsewhere.[54]

The Malthusian level of population density implied that regions able to sustain more population are also those where naturally less slaves would be used. That helps to explain the almost exclusive use of slaves in domestic service in Roman Egypt (Scheidel 2007, p. 290) and the marginal role of slavery in the Aztec Empire (Scheidel 2008, p. 121). A vast indigenous population, together with the lack of access to the

[49]Scheidel (2008, p. 113) classifies Brazil as an intermediary step between more benevolent Rome and the harsher Antebellum US and the Caribbean.

[50]For instance, rape and other forms of physical assault were not target of legal or social penalties in English and American slavery (Wood 2010, p. 514).

[51]Both Portuguese and Spanish colonies allowed slaves to acquire their freedom through installments, 'coartación', which was absent in other European colonies (Peabody 2011, p. 621).

[52]The Portuguese colonial law made freedom through marriage, and the creation of a family was easier for slaves in Brazil than elsewhere in the Americas (Peabody 2011, p. 611).

[53]Slaves were immediately employed in skilled positions in the mines of early colonial Peru (Blanchard 2010, p. 72), but it took quite a while for slaves to occupy many of the skilled positions in plantations across the British Caribbean (Fogel 1989, p. 43). Also, the abundance of evidence of people in the Spanish Americas acquiring slaves with the intent to train and, then, renting them in skilled positions (Lohse 2010, p. 52) resembles Cato's business in Rome of buying, educating, and reselling slaves (Temin 2013, p. 129).

[54]For instance, the Haitian revolution was a major factor behind the boost of the Puerto Rican slave economy in the nineteenth century (Scarano, p. 32).

Atlantic coast, explains the low incidence of slavery in Bolivia, Ecuador, Peru, and Paraguay (Blanchard 2010, p. 72). In the case of the Antebellum US, environment gave room to the only slave population in the Americas with positive natural growth (Forret 2010, p. 227), which explains the use of slaves in sectors other than plantations (Hanes, 1996).[55] In colonial US, Esposito (2015) concludes that slaves were a higher proportion of the population in regions with higher malaria exposure, i.e. where whites had a higher mortality rates than blacks.[56]

Portugal's and Spain's limited access to slaves in the fourteenth and fifteenth century meant that sugar plantations in Madeira and in the Canary Islands never reached the size and the amount of slaves of the counterparts in the Americas (Phillips 2011, pp. 326, 328). Likewise, Portugal and Spain eagerly adopted Indian and slave labor in their American colonies when they finally had access to plentiful slave sources (Klein and Vinson 2007, p. 19).[57] Littlefield (2010, p. 203) makes a similar point when he mentions that profitability of the Caribbean plantations deviated slaves from the still incipient slave societies in North America.[58]

[55]Hanes (1996, p. 319) explains that "enterprises located near towns found workers easily, taking advantage of thick local labor markets." Thus, these enterprises would use fewer slaves. Still, as mentioned above, his discussion does not distinguish human from geographic factors driving population density.

[56]The Lowcountry of South Carolina was one of those regions. Walsh (2011, p. 423) states that "given the shortage of free or indentured white workers in the Lowcountry, slaves became the main source of craft and service workers both in the port cities and on plantations."

[57]Scheidel's (2008, p. 122) depiction of the evolution of slavery in Portugal is completely supported by exogenous factors: "the crucial determinants were the expansion of Portugal's reach into sub-Saharan Africa from 1440s onwards, opening up abundant slave markets that replaced earlier sources of supply which had depended on successful conflict with Muslim polities; and an endemic and intensifying labor shortage caused by the ambition of a tiny population of some 1.5 million Portuguese to establish some measure of control over vast parts of the planet, and consequent (and often permanent) losses to the domestic labor supply [...] Whilst concentrated in the cities, especially the capital of Lisbon, slavery spread into both care-intensive and effort-intensive sectors of the economy (viz. artisanal and commercial activities, and work in foundries, on river barges, etc., respectively). Slavery subsequently declined in the seventeenth and eighteenth centuries in response to a demographic recovery, a decline in wages, and the increasing pull of the Brazilian labor market that drove up slave prices."

[58]In the Spanish Americas "conditions were different by the early seventeenth century, and the slave system had changed. There were more European settlers. The indigenous population had declined, and a complex set of rules and regulations prevented the uncontrolled exploitation of the remaining Amerindians. There was by then a sizable free population of mestizos and mulattos. They filled the intermediary roles that some black slaves had previously occupied. After the middle of the seventeenth century, Spaniards imported African slaves almost solely for their labor value, for the work they could do in the plantations, mines, and other large-scale establishments. New World slavery became more exclusively gang slavery, and important parts of the Spanish Americas became slave societies" (Phillips 2011, p. 346). Also Klein and Vinson (2007, p. 104) state that, in Brazil, "from the beginning coffee was produced on plantations by slave labor. Thus the growth of coffee in the central provinces of Rio de Janeiro, Minas Gerais, and São Paulo, the top three producers, was closely associated with the growth and expansion of the Atlantic slave trade to Brazil, which reached enormous proportions in the 19th century." Klein and Vinson (2007, p. 108) attributes the use of workers in Brazil in unpleasant rural tasks that usually performed by slaves in the Caribbean due to the availability of more free labor

Causality is even easier to claim in sudden supply shocks. The large slave influx due to the late Roman Republic conquests was crucial for the distribution across occupations of slaves and workers in Rome (Aubert 1994, p. 138; Bradley 2007, p. 247; Harris 2007, p. 527; Dari-Mattiacci, 2013). However, unsurprisingly, the resulting slave populations were mainly tapped into Italy, the core region of the Roman Empire (Temin 2013, p. 136). Therefore, industries like ceramics outside of Italy used less slaves than their Italian counterparts (Kehoe 2007, p. 562).[59]

3.6.4 Effect of Changes in the Parameters on the Allocation of Slaves Between Complex and Simple Tasks (Proposition 3)

Variations in Turnover Costs

Comparisons between societies and geography are the most promising avenues to test Proposition 3 relative to turnover costs. Beginning with the first avenue, Roman legislation set few restrictions on occupations where slaves could be deployed (Dari-Mattiacci, 2013), and principals could run business with limited liability by employing slaves as business agents (Gamauf 2016, p. 389). As already mentioned above, not only were slaves kept away from many occupations in the Americas but also skilled slaves in factories of the Antebellum US lost the human capital quickly because they could not follow the latest technological developments.[60] That is, slaves in the Antebellum US were less valuable in complex tasks than slaves in Rome. This possibility sheds light on the evidence proving that slaves in the Antebellum US were more concentrated in simple tasks than in Rome (Dari-Mattiacci, 2013).[61]

during the nineteenth century. But again, this last point is obscured by the fact that perhaps the end of slave importations in 1850 created the conditions for that free population to emerge (Klein and Vinson 2007, p. 108).

[59] Kehoe (2007, p. 562) also refers that several freedmen became foremen or managers of the workshops of their former patrons, whereas outside Italy these workshops were ran by free workers.

[60] "The expertise of these skilled slaves tended to be frozen in time because they were unable to travel extensively and follow new technological developments, an activity their free-labor counterparts took for granted" (Wright 2006, p. 76). Ruef (2012) has also reduced acquisition of human capital in the Antebellum US to relation-specific investments, and slave's health and reproduction.

[61] This conclusion also illuminates the observation made by Temin (2013, p. 137) for the fact "that slave prices were low relative to wages in Athens and high in Rome" (Temin 2013, p. 137): "Scheidel explained [the differences in slave prices between Athens and Rome] by differences in quantities of slaves available in the two places and times. It is more likely that the price difference comes from the different qualities of slaves in the two systems than the different quantities. Just as wages of educated and skilled workers were high, the prices of educated and skilled slaves were high."

Differences in geography help to have an idea of the effect of turnover costs. For instance, it might have been harder to escape contracts in small islands, that is, they had lower turnover costs than large islands or continental territories. That would explain why in US plantations had more supervisors than Caribbean plantations.[62]

Crop suitability is another crucial byproduct of geography. The unique combination of skills demanded by each crop might explain the differences in the proportion of skilled slaves to unskilled slaves across the Caribbean observed by Higman (1995, p. 159).[63] Likewise, geography also affected the skill set of native societies. In Spanish Peru, slaves were herdsmen of European animals except sheep due to the similarities with llamas, an endemic local species.[64] A related point consists of the differences in the level of civilization across the American continent. For instance, forced labor institutions over the native population were readily available in Mexico and Peru for rural economic activities (Dell, 2010; Klein and Vinson 2007, p. 20). That is, at least in rural markets, turnover among workers was probably much lower in these regions than in parts of the Americas. This is a possible cause behind the concentration of slaves in urban areas and in skilled trades in Peru and Mexico.[65]

[62]Fogel (1989, p. 52): "plantations [...] the ratio of adult field hands to all drivers was about 15 to 1; the corresponding ratio for Trinidad was 30 to 1." Another good example comes from a comparison across the different Dutch possessions: "Suriname's maroon communities, the largest of which as *imperium in imperio* presented a serious problem to white rule. By the mid-eighteenth century perhaps as many as one in ten of all of Suriname's plantation slaves qualified as deserters. The colony's extensive jungle provided favorable terrain in which to secure enclaves based on hunting and subsistence agriculture. Villages formed from which the maroons conducted hit-and-run operations on plantations to acquire females, weapons, tools, and other necessities for survival. The Dutch islands in the Caribbean, in contrast, without a bush, lacked sizable enclaves of runaways, although they did yield maritime maroons" (den Heijer 2010, p. 164).

[63]In the British Caribbean, the proportions of skilled, semiskilled, and unskilled slaves "varied considerably from place to place. Sugar plantations, for example, often had twice as many skilled personnel but only half as many domestics as did coffee or cotton plantations. On some sugar plantations, at any rate, tradesmen were remarkably versatile, even spending about a quarter to a third of their time doing unskilled agricultural work" (Morgan 2011, p. 388).

[64]"Ranching of European animals was also a specialty of the African slave population, except for sheep-herding which was quickly adopted by the Indian population along with their herds of llamas" (Klein and Vinson 2007, p. 25).

[65]In Peru, "in the skilled trades [slaves] predominated in metal-working, clothing, and construction and supplies, and they were well represented in all the crafts except the most exclusive such as silversmithing and printing. In semiskilled labor they were heavily involved in coastal fishing, as porters and vendors, in food-handling and -processing, and were even found as armed watchmen in the local Lima police force. Every major construction site found skilled and unskilled slaves working alongside white masters and free blacks of all categories as well as Indian laborers" (Klein and Vinson 2007, p. 25).

Variations in the Cost of Sticks

Similar to the comparative statics of turnover costs, comparison of different societies and geographic factors are the most promising roads ahead to study the effects of variations in the cost of sticks. Freedmen faced much less social prejudice in Rome than in the Americas, which means manumission was much more valuable for Roman than American slaves (Temin 2013, p. 123; Mouritsen 2016, p. 403).[66] Hence, freedom was a more valuable carrot for slaves, which made sticks a relatively more expensive enforcement mean. To be sure, manumission was easily accessible to any master in Rome (Peabody 2011, p. 600; Mouritsen 2016, p. 404).[67] These two facts take Temin (2013, p. 125) to classify Roman slavery as 'short-term slavery', just like indentured service in North America. In fact, there is much more evidence of slaves in high-ranked positions in Rome, such as bankers or traders (Frier and Kehoe 2007, p. 133; Scheidel 2008, p. 112) and of manumissions (Scheidel 2008, p. 114; Dari-Mattiacci, 2013) than in the Americas.[68]

Recalling a point made in subsection 3.6.3, more expensive sticks in Latin America than in the North America and the Caribbean might explain why only 58% of the slave population surveyed in the nineteenth century in Brazilian coffee plantations were field hands (Klein and Vinson, 2007, p. 108), whereas between 70-85% of the slaves in a typical Caribbean plantation were field hands (Morgan 2011, p. 388).[69]

A final consideration involves the urban-rural distinction in slave markets: differences in the composition of sticks and rewards noticed by the literature may be attributed to the fact that tasks were inherently more complex in cities and towns than in the countryside. If the last assumption is realistic, the urban-rural distinction was certainly more important in Rome[70] than in the Americas, where urban areas were

[66] "The Romans appear to have granted citizenship to former slaves" (Mouritsen 2016, p. 403). Other examples come from the value given to testimonials by slaves and freedmen: "Roman slaves were permitted to offer testimony in certain cases [...] In many American colonies (e.g., Suriname, Jamaica), neither slaves nor free blacks were permitted to testify against whites" (Peabody 2011, p. 608).

[67] "A master could free his slaves with relatively few restrictions, whether by an act of manumission or by testament." (Peabody 2011, p. 600).

[68] Overall, the literature seems to agree that slave systems with better carrots "permitted the application of reward-rich incentive strategies in human capital-intensive occupations" (Scheidel 2008, p. 114).

[69] These numbers by Morgan (2011) are derived from surveys as those made available in Higman (1995).

[70] "Slaves in urban households were more likely to be manumitted than those remoter from the master, on country estates" (Gardner 2007, p. 430).

an auxiliary part of the plantation economy.[71] Hence, it is unsurprising to find that half of the Roman slaves were in urban environments in certain periods (Temin 2013, p. 123), whereas less than 10% of the economically active slaves in Brazil in 1872 lived in cities larger than 20,000 inhabitants (Klein and Vinson 2007, p. 112).[72]

Variations in the Abundance of Slaves

Like in the analysis of changes in the abundance of slaves in Proposition 2, geographic heterogeneity and supply shocks are the two most promising avenues for causal claims. As mentioned before, the higher the Malthusian level of population density, the smaller the range of tasks executed by slaves. Mexico is a great example of this trend in the Spanish Americas: as the indigenous population recovered during the seventeenth and nineteenth century, slaves were progressively concentrated in complex tasks (Lohse 2010, p. 53).[73] In Central America, slaves were always scarce and they always worked as "skilled laborers [...] supervisors of Indian work gangs" (Klein and Vinson 2007, p. 34).

There is evidence consistent with the threshold mentioned in Proposition 3. Spanish and Portuguese colonies usually had more slaves concentrated in complex tasks than the rest of the Americas (Fogel 1989, p. 41) and, as predicted by our theory, a decrease in slave abundance usually lead to an increase in the proportion of slaves in complex tasks relative to those in simple tasks. At the same time, plantations in British America saw first slaves in simple tasks and only then slaves in complex tasks as slave abundance increased (Fogel 1989, p. 43).

In Rome until the third century BC, slaves were concentrated in family farming,

[71] Evidence points to urban areas as places for slaves to make some extra money and ease restrictions in their private lives: "these very urban areas so dependent on plantation slavery tended to muddle it by granting the enslaved room for maneuver. They enhanced opportunities to earn money, acquire property, obtain manumission, communicate with friends and patrons, and plug into information from the outside world" (Paquette and Smith 2010, p. 8).

[72] Fogel (1989, p. 41) confirms that "in the gang-system economies of the nineteenth century the great majority of slaves labored in agriculture, the urban proportion of the population was generally under 10 percent."

[73] As slave population in Mexico dwindled to about 6000 people by the late eighteenth century (Klein and Vinson 2007, p. 31), in workshops "slaves concentrated in such skilled occupations as master weaver, and wages and the promise of freedom were replacing simple coercion as the motivation for labor" (Lohse 2010, p. 54). Garrigus (2010, p. 186) confirms the same idea in French colonies. Fogel (1989, p. 41) extends this pattern across the Americas: "In societies where slavery was economically marginal, such as in Peru during the late sixteenth and early seventeenth centuries, in Mexico about the same period, or in Cuba before 1760, the share of slaves in the total population was smaller, and a large proportion, perhaps a majority, of the slaves worked in cities. Even the rural slaves tended to work on small produce farms close to the cities."

with conditions not different from those of the Roman peasantry. After a series of conquests that suddenly enslaved vast amounts of workers, slaves emerged disproportionately more in complex tasks (Gardner 2007, p. 426), a pattern that remained at least in urban areas (Morley 2007, p. 278).[74] It is interesting that the concentration of slaves increased disproportionately from simple to complex tasks because it is consistent with the existence of the threshold of Proposition 3. In other words, when there are enough slaves in simple tasks, such as the tasks involved in family farming, an increase in the abundance of slaves increases the proportion of slaves in complex tasks relative to those in simple tasks.

3.6.5 Evidence from the Brazilian Census of 1872

After the abolition of slavery in the US in 1865, Brazil became the largest slave society in the Americas (Klein and Vinson 2007, p. 102). The Brazilian Census of 1872 provides quantitative evidence of the division of labor between 8.4 million freemen and 1.5 million slaves in 17 occupations. Equally relevant for a proper analysis, Brazil's geography is such that the country can be divided into macro areas dominated by different cash crops. Therefore, this dataset provides unique conditions to find some exogenous variation to test the predictions embedded in Propositions 1 to 3.

Appendix 3.C provides further details about the dataset and the classification of each occupation as a complex, an intermediate or a simple task. This classification leaves domestic service aside due to its undefined status in the literature. We still add a robustness check where domestic service is included as a complex task since more recent literature classifies it as an information-intensive activity (Hanes, 1996; Dari-Mattiacci, 2013). Also in appendix 3.C, each state is classified in terms of turnover costs, abundance of slaves, and cost of sticks. Turnover costs, β, varies between 1 and 3, depending on the state's exportable cash crops. The abundance of slaves, γ, changes from 1 to 3 according to whether the state has access to the Atlantic coast, and to whether the state is located in the coffee producing region. Lastly, the cost of sticks, k, increases with the distance between the state capital and Brazil's capital, Rio de Janeiro.

Figures 3.1 and 3.3 are consistent with Proposition 1: the proportion of slaves to

[74] Among other reasons, this conclusion should be taken cautiously given the increase of military activity also implied the removal of many Roman workers from the labor force (Dari-Mattiacci, 2013), that is, the advantage in turnover costs when using slaves increased.

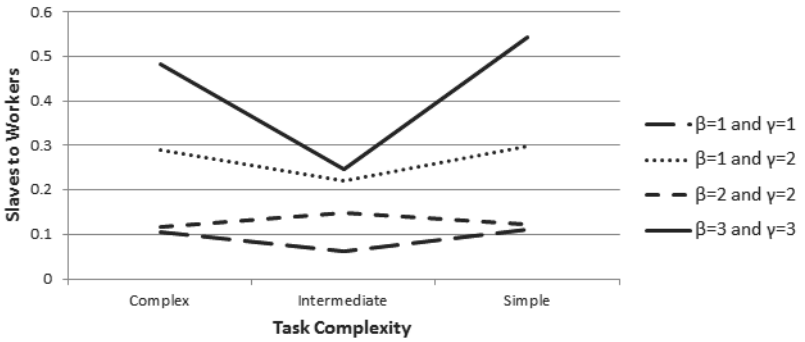


Figure 3.1: Proportion of slaves to workers along the task complexity continuum given β and γ - Men.

workers tends to be higher in complex and simpler tasks than that in intermediate tasks. However, figure 3.2 suggests that Proposition 1 does not hold among women because slave prevalence decreases with the complexity of the tasks. Still, this result is explained by the fact that men executed most of the complex tasks in plantation economies. Thus, without counting domestic service, women's division of labor is better described by the "slaves in simple tasks" equilibrium of subsection 3.4.1.

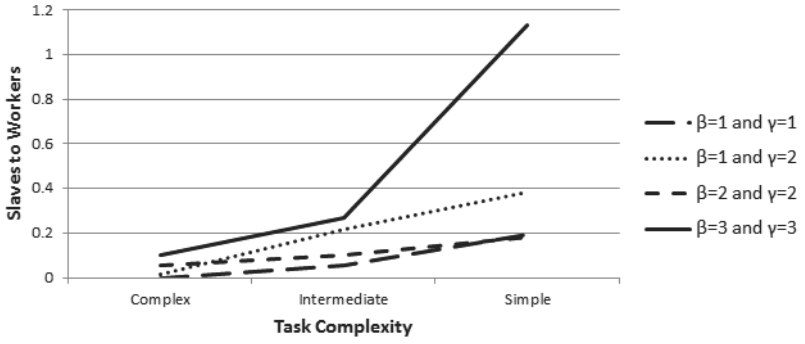


Figure 3.2: Proportion of slaves to workers along the task complexity continuum given β and γ - Women.

Increases in the abundance of slaves, γ, are always associated with increases in the proportion of slaves to workers in any sort of task. This result also holds in the only case where turnover costs remain constant, $\beta = 1$: when the abundance of slaves increases from 1 to 2, the proportion of slaves to workers increases in all categories. Increases in turnover costs, β, are also associated with increases in the proportion of slaves to workers. However, in the only case where the abundance of slaves remains

constant, $\gamma = 2$, an increase in turnover costs decreases the proportion of slaves across all tasks. The only exception to this last result are women in complex tasks, as shown in figure 3.2.

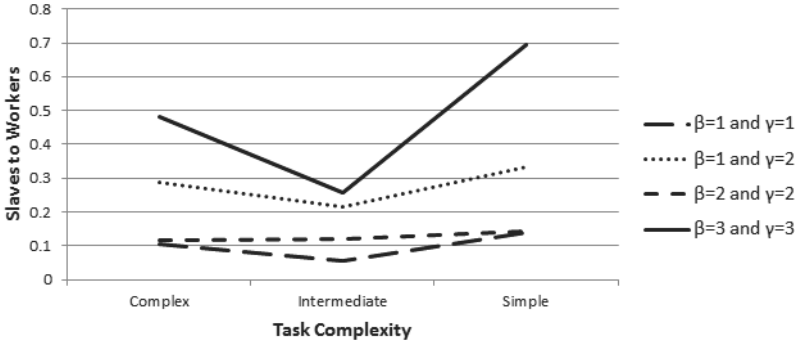


Figure 3.3: Proportion of slaves to workers along the task complexity continuum given β and γ - Total.

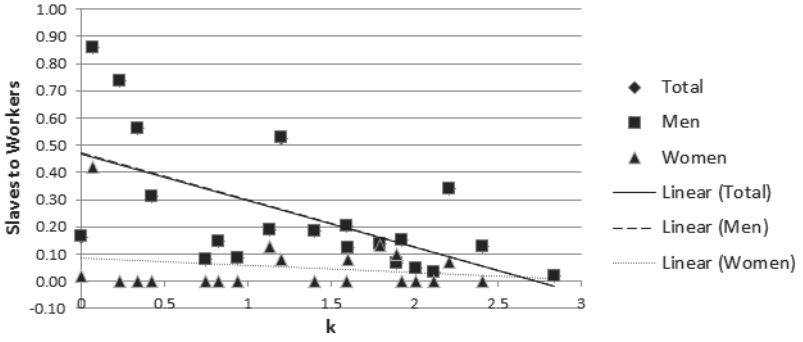


Figure 3.4: Proportion of slaves to workers along the task complexity continuum given k - Complex Tasks.

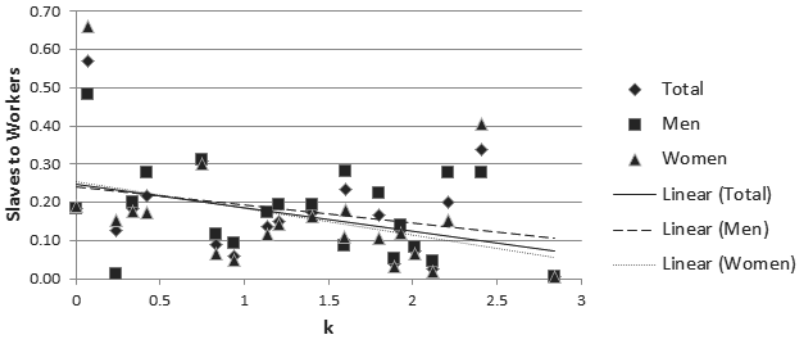


Figure 3.5: Proportion of slaves to workers along the task complexity continuum given k - Intermediate Tasks.

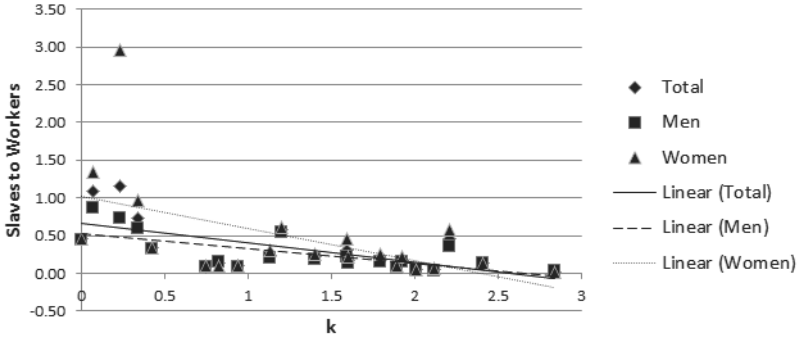


Figure 3.6: Proportion of slaves to workers along the task complexity continuum given k.

Figures 3.4 to 3.6 give evidence that the proportion of slaves to workers decreases with the cost of sticks, which is in line with Proposition 2. Note that the relation is the weakest among the intermediate tasks, the category where the advantage of slaves over workers is predicted to be the smallest, according to our model. The relation is also stronger in simple tasks than in complex tasks, which suggests that the advantage in enforcement costs is more important in simpler tasks. However, a flat relation between the cost of sticks and the proportion of slaves to workers in complex tasks would be more consistent with the model of section 4.3. Still, figure 3.4 is consistent with the robustness check where sticks are cheap enough to become the best enforcement mean for slaves in any task.

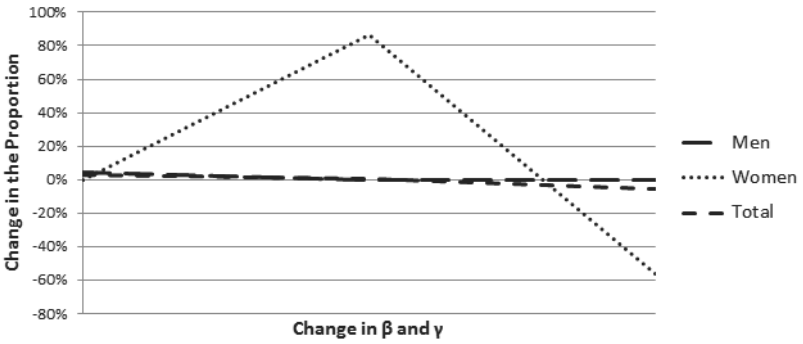


Figure 3.7: Proportion of slaves in complex tasks to those in simple tasks along β and γ.

Figure 3.7 shows that the changes in the proportion of slaves in complex tasks relative to those in simple tasks go from positive to negative as β and γ increase. This pattern is consistent with Proposition 3, that is, the signs of the changes in β and γ depend on the initial proportion of slaves in complex tasks relative to those in simple tasks. Figure 3.8 shows a negative relation between the change in the proportion, and the initial proportion. Finally, figure 3.9 gives no evidence of a relation between the cost of sticks and the proportion of slaves in complex tasks relative to those in simple tasks.[75]

According to figure 3.10, the proportion of slaves to workers in domestic service, both among men and women in a state increase with turnover costs. This result gives further support for including domestic service as a complex task. The figures

[75]There is only a negative relation among men, which is clearly driven by two outliers.

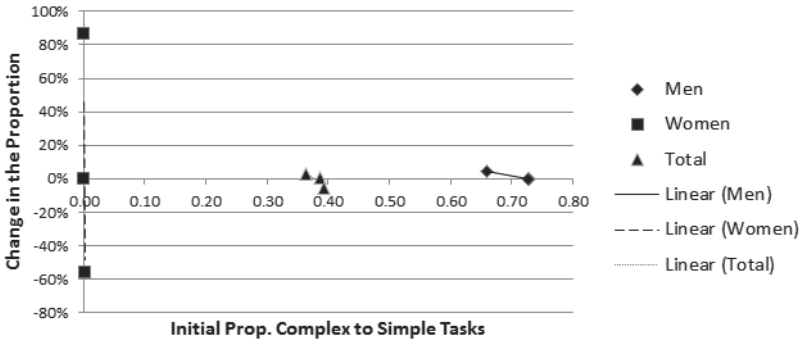


Figure 3.8: Threshold in the change of the proportion of slaves in complex tasks relative to those in simple tasks along β and γ.

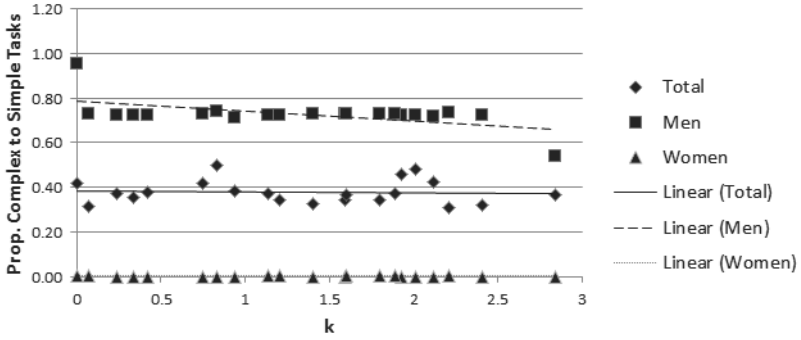


Figure 3.9: Threshold in the change of the proportion of slaves in complex tasks relative to those in simple tasks along k.

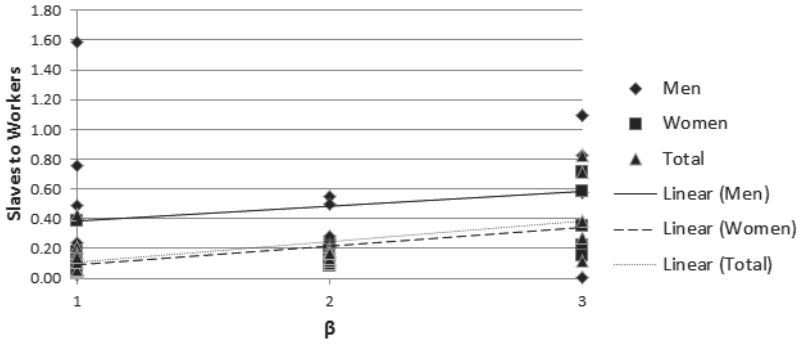


Figure 3.10: Proportion of slaves to workers in domestic service given β.

of this robustness check are displayed in Appendix 3.C. Almost all the conclusions of the baseline dataset remain with the inclusion of domestic service. The only relevant qualitative differences are: Proposition 1 seems to hold among women; the proportion of slaves in complex tasks relative to those in simple tasks appears to be negative for low levels of β and γ; the proportion of slaves in complex tasks relative to those in simple tasks decreases in the cost of sticks among men and in the total population but increases among women.

3.7 Optimal Abolition Strategies

Slavery is a property rights system that creates a type of agent with two valuable characteristics relative to free workers: he cannot leave at will and his effort can be enforced by methods deemed unacceptable for the free members of society. These two characteristics create a "slave advantage" in the labor market in very complex and very simple tasks. Our model shows that if either of these two advantages loses importance or if the slave supply falls, employment of slaves in the economy decreases. However, the model also predicts that these changes might result in a substitution from complex to simple tasks. Only an increase in the cost of punishments unambiguously moves slaves away from tasks mostly enforced by punishments (the simple tasks) into those mostly enforced by carrots (the complex tasks). Changes in turnover costs and the abundance of slaves simultaneously affect principals in complex and principals in simple tasks so that principals in simple tasks may be willing to pay more for the use of slaves than principals in complex tasks after the change occurs. Consequently, an abolition strategy focused in improving labor mobility and/or the reduction of the supply of slaves unambiguously leads to a reduction in slavery, but the remaining slaves may be driven into worse jobs.

The abolition strategy used by the British from 1808 onwards may have had adverse effects. In a nutshell, the British tried to stop the slave imports from Africa into the Americas (Stauffer, p. 565). This strategy was entirely focused in curbing the supply of slaves.[76] In 1823, a slave rebellion broke out in British Guyana demanding

[76]The British also decided to recognize the independence of only those Spanish colonies that abolished slavery (Schmidt-Nowara 2010, p. 584). On the other front, all across the Americas, planters often accepted abolition in exchange for apprenticeship periods and other labor schemes that reduced labor mobility (Hanes, 1996; Stauffer 2010, p. 569). The US approved the fugitive slave act in 1850 (Stauffer 2010, p. 573), which made mandatory for slave-free states to return fugitive slaves. These

better treatment at the workplace (Stauffer, p. 567), a sign of deterioration in working conditions. As mentioned earlier, one of the most vicious slave societies ever recorded, the Antebellum US, emerged after this embargo began. Slave imports to Brazil only stopped in 1850, but an internal trade network ensured that slaves were diverted from urban jobs into the coffee sector (Klein and Vinson 2007, p. 111).

Many contemporary actors understood the need to have a multilevel approach to abolition. In 1792, the French warranted the same rights to freemen independently of race, which was a way of making manumission more valuable for slaves (Stauffer 2010, p. 565). That is, they increased the cost of sticks relative to carrots. Today, however, the approach of the United Nations and other organizations is closer to the 1808 British strategy of cutting the slave supply rather than to an effort that tackles the advantages of using slaves. The UN Convention on Slavery of 1956 only mentions measures against slave trade. Only point 2 of article 6 of the "Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children, Supplementing the United Nations Convention Against Transnational Organized Crime" has instructions aiming at the cost of sticks: the UN asks the signing nations to facilitate judicial remedies for victims of human trafficking.

A possible objection to our approach is that state-sponsored slavery is only a minor problem today, while human trafficking by criminal organizations is on the rise. However, Anti-Slavery International provides several examples of societies where states promote or do nothing to fight modern slavery: "In around 10 per cent of cases the State or the military is directly responsible for the use of forced labour. Notable examples where this takes place are Uzbekistan, Burma, North Korea and China".[77] In West Africa and South Asia, several ethnic groups are still regarded and treated as slave races, with the implicit approval of local authorities.

Anti-Slavery International points to one big reason for the use of slaves in domestic service all across the world[78]: employers can use corporal punishments and avoid labor turnover. According to Anti-Slavery International, this is only possible because domestic service is often an unregulated and unsupervised activity. The Gulf states still harbor the *Kafala*: this "system entails middlemen who travel to Southeast Asia and

two last pieces of evidence suggest the importance of slavery as a way to reduce turnover costs (Hanes, 1996).

[77]See http://www.antislavery.org/english/slavery_today/forced_labour/ (last accessed on January 23, 2017).

[78]See Belser (2008) for more evidence on this point.

sell the right to work in the Gulf to prospective migrants".[79] Then migrant workers must pay back that sponsorship. The Gulf States guarantee that workers do not run away by, among other measures, seizing the passports of migrant workers upon arrival or requiring exit visas. To be sure, Gulf States massively use migrant labor: Qatar in 2014 had a population of 300,000 native citizens and used 1.8 million foreign workers. Some countries have tried to stop this sort of migration. Moreover, just like what happened in the Americas in the nineteenth century, some organizations have started to recognize the need to adopt an approach that directly undermines the advantages of using slave labor. For instance, in 2014 "Saudi Arabia and Indonesia inked an agreement to grant Indonesian workers in the kingdom greater rights, including the right to keep their passports, communicate with family members, get paid on a monthly basis and have time off".[80]

3.8 Concluding Remarks

Under the assumption that the supply of slaves was exogenous to the principals, this chapter studies markets in which slaves and workers compete for the same jobs. We identify two crucial advantages of slaves *vis-à-vis* workers: slaves cannot leave at will and slaves' effort can be enforced by sticks. The size of these advantages vary along a task-complexity continuum: effort in complex tasks is harder to observe, and there are more relation-specific investments; likewise effort in simple tasks is easier to observe, and there are less relation-specific investments. The advantage of avoiding turnover increases in task complexity, but the advantage of using sticks decreases in task complexity, because complex tasks are more cheaply incentivized by carrots. Consequently, principals use slaves in the most complex and in the simplest tasks, leaving intermediate tasks for workers. This result emerges in a market equilibrium where the price also depends on the abundance of slaves.

Comparative statics relative to turnover costs, costs of sticks, and relative abundance of slaves allow us to study the effect of changes in those three parameters on the proportion of tasks performed by slaves relative to those executed by workers and

[79] See "Kingdom of Slaves in the Persian Gulf." in *The Nation*, September 16th 2014, available at https://www.thenation.com/article/kingdom-slaves-persian-gulf/ (last accessed on January 23, 2017).

[80] See "Kingdom of Slaves in the Persian Gulf." in *The Nation*, September 16th 2014, available at https://www.thenation.com/article/kingdom-slaves-persian-gulf/ (last accessed on January 23, 2017).

on the proportion of slaves executing complex tasks relative to those performing simple tasks. Whenever the advantage of having slaves decreases or there are less slaves available in the market relative to workers, principals use fewer slaves. However, only an increase in the cost of sticks unambiguously increases the proportion of slaves in complex tasks relative to those in simple tasks, whereas the final effect of an increase in turnover costs or an increase in the abundance of slaves depends on the initial level of slaves performing complex and simple tasks.

Our model can easily accommodate two additional equilibria recurrently observed in history: all slaves only perform complex tasks, and all slaves only perform simple tasks. We also derive six robustness checks related to crucial assumptions behind our model. We demonstrate that a more structural approach to both labor turnover among workers or to the cost of sticks offers similar insights to the reduced-form approach of the baseline model. Similarly, dropping the assumption of decreasing turnover costs along the task-complexity continuum, or the assumption that sticks are more expensive than carrots does not fundamentally change the gist of our results. Finally, having workers with a positive reserve utility does not affect qualitatively our results.

A possible avenue for future research is further empirical work to test the three propositions resulting from this chapter's model. Seminal work such as Fogel and Engerman (1974) dramatically improved our understanding of slavery, a fundamental characteristic of pre-industrial human civilization (Lagerlöf, 2009). However, previous literature has generically failed to identify the fundamental, exogenous factors taking principals to use slaves instead of workers. Furthermore, data collection must be done respecting the methodology already used by Fogel (1984)'s, Higman (1995)s, and Scheidel (2008)'s qualitative approaches: either several societies are compared, or long time periods are analyzed. The dominance of case studies focused on one particular society in a particular period makes it hard to find variation in exogenous factors and, hence, establish causality.

We focus in this chapter on enslavement as a collective enterprise, where principals depended on legislation to define the status of slaves. State-sponsored slavery is still significant today according to anti-slavery organizations. Therefore, by solely focusing on the choice between buying a slave and hiring a worker, this model offers important guidelines for the current fight against bonded labor. We identify a possible unwanted effect of policies aimed at cutting the slave supply: the living conditions of remaining

slaves could deteriorate. Instead, focusing on making it more difficult or costly for principals to punish agents reduces reliance on slaves and at the same time improves their living conditions.

Appendix

3.A Proofs

3.A.1 Lemma 1

Proof. The principal weakly prefers to buy a slave instead of hiring a worker, and consequently pay the premium p if:

$$p \leq p^*(q) = \begin{cases} \tau & q \leq q^* \\ \tau + \eta_c - \eta_s & q > q^* \end{cases} \tag{3.A.1}$$

A slave is preferred to a worker as long as p does not exceed the sum of the slave's advantages in turnover, τ, and in enforcement if $q > q^*$, $\eta_c - \eta_s$. Note that $p^*(q)$ has five relevant properties:

1. $p^*(q \mid q \leq q^*) = \beta(1-q)$ and it is strictly decreasing in q.
2. $p^*(q \mid q > q^*) = \beta(1-q) + \frac{q-(1-q)k}{2q-1}$ and it is strictly increasing if $\{\beta, k\} : \frac{k-1}{(2q-1)^2} > \beta$.
3. $p^*(q = q^* \mid q \leq q^*) = \lim_{q \to q^*} p^*(q \mid q > q^*) = \frac{\beta}{k+1}$.
4. $\lim_{q \to 1} p^*(q \mid q > q^*) = 1$.
5. $p^*(q)$ is continuous for any $q \in \left(\frac{1}{2}, 1\right)$.

All these properties are intuitive. Below q^* sticks are not used, so that buying a slave only gives an advantage in turnover, which decreases in q. Above q^*, slaves bring an advantage both in enforcement costs and in turnover costs, where the former must increase more than the latter decreases for $\frac{\partial p^*(q|q>q^*)}{\partial q} > 0$. $p^*(q = q^* \mid q \leq q^*) = \lim_{q \to q^*} p^*(q \mid q > q^*)$ since at $q = q^*$ sticks and carrots provide the same payoff. $\lim_{q \to 1} p^*(q \mid q > q^*) = 1$ because when $q = 1$ only carrots are applied, whereas sticks are never applied and turnover costs nothing. Since $p^*(q)$ is composed of two continuous functions in $q \in \left(\frac{1}{2}, 1\right)$, and they have the same value when $q = q^*$, then $p^*(q)$ is a continuous function.

The five properties above support three claims:

Claim 1: $p^*(q)$ has a quasi u-shape form with a minimum in q^*.

Claim 2: Each value of p crosses $p^*(q)$ at most once in each interval, i.e. there is no more than one threshold below and one above q^*.

Claim 3: If $p > \frac{\beta}{k+1}$, p crosses $p^*(q)$ twice.

These three claims show that the following two conditions define a pair $\{\underline{q}, \bar{q}\}$:

1. $p = \beta(1 - \underline{q})$ where $\underline{q} \leq q^*$.
2. $p = \beta(1 - \bar{q}) + \frac{\bar{q} - (1-\bar{q})k}{2\bar{q}-1}$ where $\bar{q} > q^*$.

p consists of the market premium of buying a slave over hiring a worker. Going back to condition (3.3.9), if $q \leq \underline{q}$ or $q \geq \bar{q}$, the advantages brought by a slave outweigh the market premium p. For other values of q, a principal hires a worker.

□

3.A.2 Proposition 1

Proof. The proposition is proven in the text. □

3.A.3 Proposition 2

Proof. $\underline{q}$ and $\bar{q}$ are defined by:

$$\underline{q} : p = \tau\left(\underline{q}\right) \tag{3.A.2}$$

$$\bar{q} : p = \tau\left(\bar{q}\right) + \eta_c\left(\bar{q}\right) - \eta_s\left(\bar{q}\right) \tag{3.A.3}$$

Where $p = \frac{1-2(\bar{q}-\underline{q})}{\gamma}$. The application of the implicit function theorem makes comparative statics possible. We can define $\phi(\underline{q}, \bar{q}, \beta, k, \gamma)$ such that:

$$\phi(\underline{q}, \bar{q}, \beta, k, \gamma) = \begin{bmatrix} \phi_1 = p - \tau\left(\underline{q}\right) \\ \phi_2 = p - \left(\tau\left(\bar{q}\right) + \eta_c\left(\bar{q}\right) - \eta_s\left(\bar{q}\right)\right) \end{bmatrix} \tag{3.A.4}$$

The implicit function theorem establishes the following relation when studying the effect of β on $\{\underline{q}, \bar{q}\}$:

$$\frac{\partial \Lambda}{\partial \beta} = -\left(\frac{\partial \phi}{\partial \Lambda}\right)^{-1} \frac{\partial \phi}{\partial \beta} \tag{3.A.5}$$

Note that $\frac{\partial \Lambda}{\partial \beta} = \begin{bmatrix} \frac{\partial \underline{q}}{\partial \beta} \\ \frac{\partial \bar{q}}{\partial \beta} \end{bmatrix}$, $\frac{\partial \phi}{\partial \Lambda} = \begin{bmatrix} \frac{\partial \phi_1}{\partial \underline{q}} & \frac{\partial \phi_1}{\partial \bar{q}} \\ \frac{\partial \phi_2}{\partial \underline{q}} & \frac{\partial \phi_2}{\partial \bar{q}} \end{bmatrix}$, and $\frac{\partial \phi}{\partial \beta} = \begin{bmatrix} \frac{\partial \phi_1}{\partial \beta} \\ \frac{\partial \phi_2}{\partial \beta} \end{bmatrix}$.[81] Replacing terms:

$$\frac{\partial \underline{q}}{\partial \beta} = \frac{-\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial \tau(\bar{q})}{\partial \beta} + \frac{\partial \tau(\underline{q})}{\partial \beta}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.6}$$

$$\frac{\partial \bar{q}}{\partial \beta} = \frac{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial \tau(\underline{q})}{\partial \beta} - \frac{\partial \tau(\bar{q})}{\partial \beta}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} + \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\right)}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.7}$$

Notice that $\frac{\partial \tau(\underline{q})}{\partial \beta} = 1 - \underline{q} > 0$, $\frac{\partial \tau(\bar{q})}{\partial \beta} = 1 - \bar{q} > 0$, $\frac{\partial \tau(\underline{q})}{\partial \beta} > \frac{\partial \tau(\bar{q})}{\partial \beta}$, $\frac{\partial p}{\partial(\bar{q}-\underline{q})} = -\frac{2}{\gamma} < 0$, $\frac{\partial p^*(\underline{q})}{\partial \underline{q}} = -\beta < 0$, and $\frac{\partial p^*(\bar{q})}{\partial \bar{q}} = -\beta + \frac{k}{(2\bar{q}-1)^2} > 0$.

It is straightforward that $\frac{\partial(\bar{q}-\underline{q})}{\partial \beta} = \frac{\partial \bar{q}}{\partial \beta} - \frac{\partial \underline{q}}{\partial \beta}$:

$$\frac{\partial \bar{q}}{\partial \beta} - \frac{\partial \underline{q}}{\partial \beta} = \tag{3.A.8}$$
$$= \frac{-\frac{\partial \tau(\bar{q})}{\partial \beta}\frac{\partial p^*(\underline{q})}{\partial \underline{q}} + \frac{\partial \tau(\underline{q})}{\partial \beta}\frac{\partial p^*(\bar{q})}{\partial \bar{q}}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)}$$

Since the denominator is always negative, for the last expression to be negative:

$$\frac{\frac{\partial \tau(\bar{q})}{\partial \beta}}{\frac{\partial p^*(\bar{q})}{\partial \bar{q}}} > \frac{\frac{\partial \tau(\underline{q})}{\partial \beta}}{\frac{\partial p^*(\underline{q})}{\partial \underline{q}}} \tag{3.A.9}$$

Always true since $\frac{\partial p^*(\underline{q})}{\partial \underline{q}} < 0$ and all the other elements are positive. Therefore, an increase in β increases the number of slaves and decreases the number of workers.

The implicit function theorem applied to k:

$$\frac{\partial \Lambda}{\partial k} = -\left(\frac{\partial \phi}{\partial \Lambda}\right)^{-1}\frac{\partial \phi}{\partial k} \tag{3.A.10}$$

[81] Notice that $\frac{\partial \phi}{\partial \Lambda}$ is invertible because its determinant is always negative.

Where $\frac{\partial \Lambda}{\partial k} = \begin{bmatrix} \frac{\partial \underline{q}}{\partial k} \\ \frac{\partial \bar{q}}{\partial k} \end{bmatrix}$ and $\frac{\partial \phi}{\partial k} = \begin{bmatrix} \frac{\partial \phi_1}{\partial k} \\ \frac{\partial \phi_2}{\partial k} \end{bmatrix}$. As a result of replacing terms:

$$\frac{\partial \underline{q}}{\partial k} = \frac{-\frac{\partial p^*(\bar{q})}{\partial k}\frac{\partial p}{\partial(\bar{q}-\underline{q})}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.11}$$

$$\frac{\partial \bar{q}}{\partial k} = \frac{-\frac{\partial p^*(\bar{q})}{\partial k}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} + \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\right)}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.12}$$

Where $\frac{\partial p^*(\bar{q})}{\partial k} = -\frac{1-\bar{q}}{2\bar{q}-1} < 0$. Similarly to the derivatives for β, $\frac{\partial(\bar{q}-\underline{q})}{\partial k} = \frac{\partial \bar{q}}{\partial k} - \frac{\partial \underline{q}}{\partial k}$:

$$\frac{\partial \bar{q}}{\partial k} - \frac{\partial \underline{q}}{\partial k} = \frac{\frac{\partial p^*(\bar{q})}{\partial k}\frac{\partial p^*(\underline{q})}{\partial \underline{q}}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.13}$$

Since the denominator is negative, the last expression is only positive if:

$$\frac{\partial p^*(\bar{q})}{\partial k}\frac{\partial p^*(\underline{q})}{\partial \underline{q}} > 0 \tag{3.A.14}$$

Since $\frac{\partial p^*(\bar{q})}{\partial k} < 0$ and $\frac{\partial p^*(\underline{q})}{\partial \underline{q}} < 0$, this condition always holds. Thus, whenever k decreases, the number of slaves bought increases and the number of workers hired decreases.

The application of the implicit function theorem to find the derivative to γ involves the following system of equations:

$$\frac{\partial \Lambda}{\partial \gamma} = -\left(\frac{\partial \phi}{\partial \Lambda}\right)^{-1}\frac{\partial \phi}{\partial \gamma} \tag{3.A.15}$$

Where $\frac{\partial \Lambda}{\partial \gamma} = \begin{bmatrix} \frac{\partial \underline{q}}{\partial \gamma} \\ \frac{\partial \bar{q}}{\partial \gamma} \end{bmatrix}$ and $\frac{\partial \phi}{\partial \gamma} = \begin{bmatrix} \frac{\partial \phi_1}{\partial \gamma} \\ \frac{\partial \phi_2}{\partial \gamma} \end{bmatrix}$. Replacing each term:

$$\frac{\partial \underline{q}}{\partial \gamma} = \frac{\frac{2(\bar{q}-\underline{q})-1}{\gamma^2}\frac{\partial p^*(\bar{q})}{\partial \bar{q}}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.16}$$

$$\frac{\partial \bar{q}}{\partial \gamma} = \frac{\frac{2(\bar{q}-\underline{q})-1}{\gamma^2}\frac{\partial p^*(\underline{q})}{\partial \underline{q}}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.17}$$

The denominators are negative and, since $\bar{q}-\underline{q} < \frac{1}{2}$, the numerator of $\frac{\partial \underline{q}}{\partial \gamma}$ is negative

and the numerator of $\frac{\partial \bar{q}}{\partial \gamma}$ is positive. This makes $\frac{\partial \underline{q}}{\partial \gamma} > 0$ and $\frac{\partial \bar{q}}{\partial \gamma} < 0$. Consequently, $\frac{\partial \bar{q}}{\partial \gamma} - \frac{\partial \underline{q}}{\partial \gamma} < 0$. Hence, whenever γ increases, the number of slaves bought increases and that of workers decreases.

□

3.A.4 Proposition 3

Proof. This proof uses results from the proof of Proposition 2. Beginning with the derivatives of $\{\underline{q}, \bar{q}\}$ in order to β:

$$\frac{\partial \underline{q}}{\partial \beta} = \frac{-\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial \tau(\bar{q})}{\partial \beta} + \frac{\partial \tau(\underline{q})}{\partial \beta}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.18}$$

$$\frac{\partial \bar{q}}{\partial \beta} = \frac{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial \tau(\underline{q})}{\partial \beta} - \frac{\partial \tau(\bar{q})}{\partial \beta}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} + \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\right)}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.19}$$

Both denominators are negative. An increase in β increases the number of slaves more in complex tasks than in simple tasks if $\frac{\partial \underline{q}}{\partial \beta} > -\frac{\partial \bar{q}}{\partial \beta}$:

$$\frac{\frac{\partial \tau(\bar{q})}{\partial \beta}}{\frac{\partial \tau(\underline{q})}{\partial \beta}} < \frac{2\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}}{2\frac{\partial p}{\partial(\bar{q}-\underline{q})} + \frac{\partial p^*(\underline{q})}{\partial \underline{q}}} \tag{3.A.20}$$

That is, $\underline{q}$ must be small enough relative to $\bar{q}$ so that the impact of β is large enough in the turnover costs at $\underline{q}$ relative to those at $\bar{q}$.

The derivatives of $\{\underline{q}, \bar{q}\}$ in order to k are the following:

$$\frac{\partial \underline{q}}{\partial k} = \frac{-\frac{\partial p^*(\bar{q})}{\partial k}\frac{\partial p}{\partial(\bar{q}-\underline{q})}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.21}$$

$$\frac{\partial \bar{q}}{\partial k} = \frac{-\frac{\partial p^*(\bar{q})}{\partial k}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} + \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\right)}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.22}$$

The denominators are the same as in the derivatives to β. Both numerators are also negative. Thus, a decrease in k decreases the number of slaves in complex tasks, and increases those in simple tasks.

The derivatives relative to γ are inspected below:

$$\frac{\partial \underline{q}}{\partial \gamma} = \frac{\frac{2(\bar{q}-\underline{q})-1}{\gamma^2}\frac{\partial p^*(\bar{q})}{\partial \bar{q}}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.23}$$

$$\frac{\partial \bar{q}}{\partial \gamma} = \frac{\frac{2(\bar{q}-\underline{q})-1}{\gamma^2}\frac{\partial p^*(\underline{q})}{\partial \underline{q}}}{\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right)} \tag{3.A.24}$$

The denominators are negative, but the numerators differ. For an increase in γ to increase the number of slaves more in complex tasks than in simple tasks, $\frac{\partial \underline{q}}{\partial \gamma} > -\frac{\partial \bar{q}}{\partial \gamma}$. Rewriting this last condition:

$$\frac{\partial p^*(\bar{q})}{\partial \bar{q}} > -\frac{\partial p^*(\underline{q})}{\partial \underline{q}} \tag{3.A.25}$$

Replacing the terms gives us:

$$(2\bar{q}-1)^2 < \frac{k-1}{2\beta} \tag{3.A.26}$$

The last condition splits into two:

$$\bar{q} < \frac{1}{2} + \frac{1}{2}\sqrt{\frac{k-1}{2\beta}} \tag{3.A.27}$$

$$\bar{q} > \frac{1}{2} - \frac{1}{2}\sqrt{\frac{k-1}{2\beta}} \tag{3.A.28}$$

The second condition not relevant since $\bar{q} > \frac{1}{2}$ by definition. Therefore, the first condition determines that $\bar{q}$ must be small enough, that is, there must be enough slaves on simple tasks.

□

3.B Robustness Checks

3.B.1 Non-Compete Clause (NCC)

This appendix explains the foundation of the assumptions that $\tau > 0$ and τ decreases in q.

Workers can leave. Aware of that, principals offer contracts with a non-compete clause (NCC). Basically, for an extra fee n, workers agree to a clause that does not allow them to leave and work for another principal. In absence of a NCC, a worker in a task $\tilde{q}$ has the following pay-off:

$$\Pi(\tilde{q}) = w + \frac{\tilde{q}}{2\tilde{q} - 1} - 1 \tag{3.B.1}$$

But she knows that with a chance $\sigma \in (0, 1)$, a worker leaves a principal for an exogenous reason (conflict with a principal's decision, migration, conscription, or sickness due to a worker-specific health condition). Hence, if he leaves the current principal, he earns the following pay-off:

$$\Pi(Leave) = \sigma \left(\frac{\bar{q} - \tilde{q}}{\bar{q} - \underline{q}} \Pi(q_h > \tilde{q}) + \frac{\tilde{q} - \underline{q}}{\bar{q} - \underline{q}} \Pi(q_l < \tilde{q}) \right) \tag{3.B.2}$$

$\frac{\bar{q}-\tilde{q}}{\bar{q}-\underline{q}} \left(\frac{\tilde{q}-\underline{q}}{\bar{q}-\underline{q}} \right)$ stand for the probability that he takes the job of some other employee in a task with $q > \tilde{q}$ ($q < \tilde{q}$). Notice that $\frac{\bar{q}-\tilde{q}}{\bar{q}-\underline{q}}$ ($\frac{\tilde{q}-\underline{q}}{\bar{q}-\underline{q}}$) decreases (increases) in $\tilde{q}$. Also notice that $\Pi(q_h > \tilde{q}) < \Pi(\tilde{q}) < \Pi(q_l < \tilde{q})$ (q_h and q_l are the average pay-off in the interval above and below $\tilde{q}$, respectively) since the value of carrots, $\frac{q}{2q-1}$, strictly decreases in q - enforcement in less noisy tasks requires less carrots. Hence, the higher $\tilde{q}$ is, the higher are the chances for a worker to improve the carrots he earns. Therefore, the principal at a task with $\tilde{q}$ needs to pay $n \geq \Pi(Leave) - \Pi(\tilde{q})$ so that the worker accepts the NCC. In turn, the higher $\tilde{q}$, the higher n must be.

At the same time, the noisier the task is, the more expensive principal-specific training is. That is, turnover costs f where $\frac{\partial f}{\partial q} < 0$. Since there is a σ probability of a worker leaving, all that training can be lost.

Combining these two stories, we have that workers are more expensive than slaves since the latter have a $\sigma = 0$. Then, we just need $\left| \frac{\partial f}{\partial q} \right| > \frac{\partial n}{\partial q}$ to guarantee a decreasing gap between workers and slaves along q. Thus, the assumptions behind expression

(3.3.3) are just a reduced-form story.

Extra note about $\left|\frac{\partial f}{\partial q}\right| > \frac{\partial n}{\partial q}$:

$$n = \Pi(Leave) - \Pi(\tilde{q}) = \sigma\left(\frac{\bar{q}-\tilde{q}}{\bar{q}-\underline{q}}\Pi(q_h > \tilde{q}) + \frac{\tilde{q}-\underline{q}}{\bar{q}-\underline{q}}\Pi(q_l < \tilde{q})\right) - \Pi(\tilde{q}) \tag{3.B.3}$$

If $\tilde{q} = \bar{q}$:

$$\sigma\Pi(q_l < \bar{q}) - \Pi(\bar{q}) \tag{3.B.4}$$

Which is positive for a significantly large σ. In case $\tilde{q} = \underline{q}$:

$$\sigma\Pi(q_h > \underline{q}) - \Pi(\underline{q}) \tag{3.B.5}$$

This is always negative. Therefore, since n is a continuous function, there must be a $q = q^i$ in the interval $(\underline{q}, \bar{q})$ such that $n = 0$. Therefore, principals with a $q < q^i$ that would simply not use a NCC.

3.B.2 Endogenous Sticks

Assume $k = \chi p$ where $\chi > 0$. That is, the cost of punishing increases in the price paid for a slave. In equilibrium, $k = \chi p = \frac{\chi}{\gamma}\big(1 - 2(\bar{q} - \underline{q})\big)$. Note that:

$$\frac{\partial p^*(\bar{q})}{\partial \bar{q}} = -\beta + \frac{\chi p - 1}{(2\bar{q}-1)^2} \tag{3.B.6}$$

This derivative is positive if:

$$\chi > \frac{1}{p}\big(1 + (2\bar{q}-1)^2\beta\big) \tag{3.B.7}$$

In that case, Proposition 1 still holds.

In propositions 2 and 3, note that $\underline{q}$ also appears in ϕ_2 of the vector (3.A.4). As a result, the denominator of every derivative becomes the subsequent expression:

$$\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\partial \bar{q}} - \frac{\partial p^*(\underline{q})}{\partial \underline{q}}\left(\frac{\partial p}{\partial(\bar{q}-\underline{q})} - \frac{\partial p^*(\bar{q})}{\partial \bar{q}}\right) + \frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\underline{q}} \tag{3.B.8}$$

The difference between the denominator in the main model and that in this robust-

ness check consists of $\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\underline{q}}$. Notice that:

$$\frac{\partial p^*(\bar{q})}{\underline{q}} = -2\frac{\chi}{\gamma}\frac{1-\bar{q}}{2\bar{q}-1} < 0 \tag{3.B.9}$$

And notice that:

$$\frac{\partial p}{\partial(\bar{q}-\underline{q})}\frac{\partial p^*(\bar{q})}{\underline{q}} > 0 \tag{3.B.10}$$

Hence. to keep the denominator and, thus, the comparative statics of β and γ unchanged, it is sufficient to assume that:

$$\frac{\partial p^*(\bar{q})}{\partial \bar{q}} > -\frac{\partial p^*(\bar{q})}{\partial \underline{q}} \tag{3.B.11}$$

This is true when

$$\chi > \frac{\gamma}{1-2(\bar{q}-\underline{q})}\left(1+(2\bar{q}-1)^2\beta\right) \tag{3.B.12}$$

Finally, although k is not a parameter in propositions 2 and 3, a similar result applies to χ. The exercise is completely analogous to that in the proof of propositions 2 and 3, but take into account that:

$$\frac{\partial p^*(\bar{q})}{\partial \chi} = -(1-\bar{q})\frac{1-2(\bar{q}-\underline{q})}{\gamma} < 0 \tag{3.B.13}$$

3.B.3 Homogeneous Turnover Costs

By homogeneous turnover costs means they do not vary across q. A way of imposing this idea consists of setting $\tau = \beta$. In turn, there is a change in the properties of $p^*(q)$ in expression (3.3.9):

1. $p^*(q \mid q < q^*) = \beta$. Hence, constant along q;
2. $p^*(q \mid q \geq q^*) = \beta + \frac{q-k(1-q)}{2q-1}$. Hence, strictly increasing given that $k > 1$;
3. $p^*(q = q^* \mid q \leq q^*) = \lim_{q\to q^*} p^*(q \mid q > q^*) = \beta$;
4. $\lim_{q\to 1} p^*(q \mid q > q^*) = \beta$;
5. $p^*(q)$ is continuous for any $q \in \left(\frac{1}{2}, 1\right)$.

Therefore, the only case where we might have slaves in both extremes and wage workers in the middle of the q-axis is when $p = \beta$. If $p > \beta$, principals only buy

slaves for low-noise tasks. If $p < \beta$, principals only hire wage workers. However, $\underline{q}$ is indeterminate. With $p = \beta$, principals are indifferent between slaves and wage workers for any $q < q^*$.

3.B.4 Cheap Sticks

In subsection 3.3 we assume $k > 1$. Basically, k must be larger than 1 so that $q^* > \frac{1}{2}$, i.e., sticks must be more expensive than carrots so that carrots are used as an enforcement mean in some tasks. Now, we assume $k < 1$, implying that the principal applies sticks for slaves in any task. Therefore, going back to expression (3.3.9), $\eta_c - \eta_s$. So the expression equals:

$$p \leq p^*(q) = \tau + \eta_c - \eta_s \tag{3.B.14}$$

Therefore, expression (3.3.9) has now the following properties:

1. It is strictly decreasing since $\frac{k-1}{(2q-1)^2} > \beta$ is never satisfied;
2. $\lim_{q \to 1} p^*(q) = 1$;
3. $p^*(q)$ is continuous for any $q \in \left(\frac{1}{2}, 1\right)$.

Thus, $p^*(q)$ crosses p at most once. That is, depending on the parameters β, k and γ, we mostly have slaves in complex tasks. This makes sense: slaves now have both advantages in any task, but those advantages are mostly salient in tasks with low q. All the comparative statics become straightforward.

3.B.5 Positive Reserve Utility

Recall from subsection 3.5 that $\breve{q}$ is the level of q above which principals must pay a fix wage $w = \bar{u} - p_e c$ together with carrots to satisfy worker's participation constraint. Assuming for simplicity that $\breve{q} > q^*$, when $q > q^*$, the advantage of using slaves instead of workers if $q \geq \breve{q}$ is given by:

$$\eta_c - \eta_s = \bar{u} - \frac{(1-q)k}{2q-1} \tag{3.B.15}$$

Basically, in simple tasks, the advantage of slaves over workers in enforcement means is not anymore the difference between expected sticks and expected carrots: instead, the difference is between the expected sticks and the reservation utility. This change

just makes slaves a more attractive option: the reservation utility is larger than the expected carrots $\bar{u} > p_c c$, that is, workers become more expensive in simple tasks as the reservation utility increases from zero to a positive level. This implies that in the expression reflecting the premium of buying a slave instead of hiring a worker, p:

$$p \leq p^*(q) = \tau + \eta_c - \eta_s \tag{3.B.16}$$

$\eta_c - \eta_s$ becomes larger. Despite this modification, all the other properties required to verify Lemma 1 are satisfied in the interval $q > \breve{q}$:

1. $p^*(q \mid q \leq q^*) = \beta(1-q)$ and it is strictly decreasing in q.
2. $p^*(q \mid q > q^*) = \beta(1-q) + \bar{u} - \frac{(1-q)k}{2q-1}$ and it is strictly increasing if $\{\beta, k\}$: $\frac{k}{(2q-1)^2} > \beta$.
3. $\lim_{q \to 1} p^*(q \mid q > q^*) = \bar{u}$.

Furthermore, $\frac{\partial p^*(\bar{q})}{\partial \bar{q}} = -\beta + \frac{k}{(2\bar{q}-1)^2} > 0$ and $\frac{\partial p^*(\bar{q})}{\partial k} = -\frac{1-\bar{q}}{2\bar{q}-1} > 0$. That is, the only two conditions in the proofs of both propositions keep the sign. Hence, the gist of Propositions 2 and 3 remains unchanged.

3.C Technical notes on the analysis of the Brazilian Census of 1872

3.C.1 Quality of the Data and Task Classification

Rodarte and Júnior (2008) detect several problems in this census, some as basic as counting and summation errors. However, they conclude that most problems decrease as the unit of analysis increases. That is, state-level data should give an accurate picture of reality. More worryingly for the purposes of this chapter, there is no documentation left clarifying the criteria used by the census takers when placing occupations in the available categories (Rodarte and Júnior, 2008). Census takers had to fill a sheet per household, which included the job of each household member. Then, the census takers would place each person in one of the occupational categories available in the census' tables. The instructions given to the census takers for this last step are unknown (Rodarte and Júnior, 2008). This problem is aggravated by the fact that the census only distinguishes some jobs in some economic categories, such as legal workers. Moreover, the complexity is much easier to evaluate in certain categories, e.g. 'Artists', than in others, e.g. 'Tanner'. In light of these problems, this chapter classifies as parsimoniously the different occupational categories as possible. Table 3.C.1 summarizes the baseline classification, which is based on Chapter 6 of Klein and Vinson (2007).

As already extensively discussed in this chapter, men performed all the skilled tasks at the plantations. Hence, we assume that all women involved in farming performed simple tasks. Further, we consider that 58% of the men performed simple tasks and the remaining performed complex tasks. This division arises from the fact that 58% of the farm laborers in Brazilian coffee plantations were field hands (Klein and Vinson 2007, p. 108). Note that 'Artists' are unambiguously complex tasks (Dari-Mattiacci, 2013).

Industrial jobs in table 3.1 include complex and simple tasks. Since there is no way to know what is exactly in each category, all industrial jobs categories are classified as intermediate tasks. The only exception is the category 'Carpenters, pavers, miners, and undertakers', which only has, with exception of 'Carpenter', simple tasks. Lastly, day laborers, and errand boys or girls are considered intermediate tasks because they were probably embedded in different farming and industrial tasks (Klein and Vinson

2007, p. 111).

Domestic service in table 3.1 also includes complex and simple tasks. There is an ongoing dispute about the fundamental nature of this sort of tasks: Fenoaltea (1984) considers it a menial task, while Hanes (1996) and Dari-Mattiacci (2013) underline the amount of information and relation-specific investments involved between a domestic servant and his employer. Hence, domestic service is excluded from the baseline classification, but it is included in an extension as a complex task.

This analysis excludes all those categories where no slave worked at. Racism was certainly behind the absence of slaves in most of these occupations (Dari-Mattiacci, 2013). However, only the criteria used by the census takers could explain the absence of slaves in 'Midwives' and 'Farm breeders', two categories typically associated to slavery across history. Finally, this analysis excludes a category of the census named 'Without Job', which apparently referred to young children between 0 and 10 years old (Rodarte and Júnior, 2008).

		Occupations	
	Complex	Intermediate	Simple
Male Slaves	42% of the farm laborers, and artists.	Maritime workers, fishermen, Metal workers, Wood workers, weavers, builders, tanners, dyers, tailors, hat makers, shoemakers, day laborers, and errand boys.	58% of the farm laborers, carpenters, pavers, miners and undertakers.
Female Slaves	Artists.	Seamstresses, weavers, tanners, dyers, hat makers, day laborers, and errand girls.	Farm laborers.
Undefined Occupation:			
Domestic Service.			
Excluded Occupations:			
Religious Jobs, Judges, Lawyers, Attorneys, Notaries, Bailiffs, Doctors, Surgeons, Pharmacists, Midwives, Professors and teachers, Civil Servants, Military, Capital Owners, Factory owners, Commercials, Business Agents, Salesmen, Farm breeders.			

Table 3.C.1: Complexity of each occupational category of the Brazilian Census of 1872. Source: Klein and Vinson (2007); IBGE.

3.C.2 Values of each parameter

Chapter 6 of Klein and Vinson (2007) also provides most of the historical facts used to generate the parameter levels on table 3.C.2. The abundance of slaves, γ, and turnover costs, β, are essentially functions of the most economically active states and how close they were to the traditional sources of slaves. In 1872, coffee producing regions were the economic powerhouses of Brazil, whereas sugar production was practiced all across the states north of São Paulo. The only exception to this scenario was the state of Maranhão whose cotton production dramatically increased after the outbreak of the US Civil War (1861-65). Slave imports were dramatically decreased after the 1850 prohibition[82] and the coastal regions definitely had an historical price advantage when buying slaves since the total slave population completely depended on imports from Africa. At the same time, coffee regions were buying slaves from other regions to feed their economic activity. Again, only Maranhão escaped this last pattern because its cotton sector could still generated enough surplus to afford slavery.

Relative to the abundance of slaves, landlocked states have $\gamma = 1$; $\gamma = 2$ stands for the coastal states; $\gamma = 3$ for coastal states that either produce coffee or cotton. Note that Minas Gerais is an exception because of its historically high slave population. Relative to turnover costs, $\beta = 1$ when there is no production of any cash crop, $\beta = 2$ when there is sugar production, and $\beta = 3$ when there is not only sugar but also coffee or cotton production.

Sections 3.2 and 4.3 argue that slavery was a state-sponsored system. Furthermore, a vast literature equates state capacity to distance to the capital of the polity (Herbst, 2000). Applied to this chapter, the closer to the capital a principal is, the cheaper is for her to apply sticks because, for instance, the state can more easily fight the formation of maroons (den Heijer 2010, p. 164). Therefore, k of each state in table 3.C.2 increases with the distance between the state capital and the country capital, Município Neutro - City of Rio de Janeiro.

An obvious caveat of the estimation illustrated in table 3.C.2 is that they are geographically correlated. Thus, every conclusion out of this analysis must be taken cautiously.

[82] According to the The Trans-Atlantic Slave Trade Database, less than 9000 slaves were imported after 1850, a minimal contribution in the almost 3.5 million slaves imported to Brazil between 1551 and 1850

	Parameters		
State	γ	β	k
Amazonas	1	1	2.842
Pará	2	1	2.409
Paraná	2	1	0.750
Santa Catarina	2	1	0.829
Rio Grande do Sul	2	1	1.205
Goiás	1	1	0.940
Mato Grosso	1	1	1.596
Espírito Santo	2	1	0.339
Piauí	2	2	1.927
Ceará	2	2	2.121
Rio Grande do Norte	2	2	2.014
Paraíba	2	2	1.894
Pernambuco	2	2	1.798
Alagoas	2	2	1.599
Sergipe	2	2	1.404
Bahia	2	2	1.135
Município Neutro - City of Rio de Janeiro	3	3	0.000
State of Rio de Janeiro	3	3	0.073
São Paulo	3	3	0.424
Minas Gerais	3	3	0.235
Maranhão	3	3	2.212

Table 3.C.2: Value of the parameters of each Brazilian state in 1872. k column in thousands of kms. Source: Klein and Vinson (2007).

3.C.3 Figures with the inclusion of domestic service

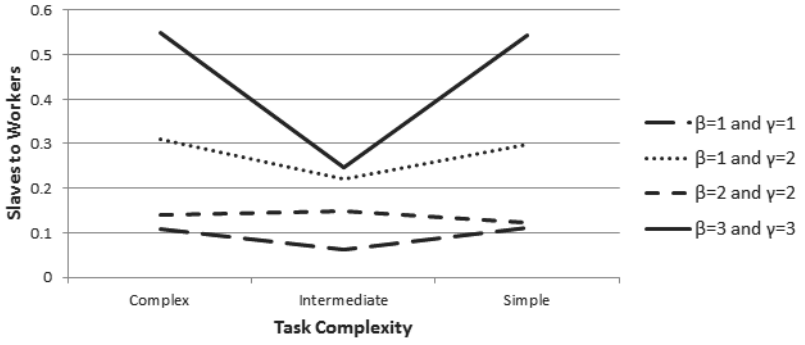


Figure 3.C.1: Proportion of slaves to workers along the task complexity continuum given β and γ - Men including domestic service.

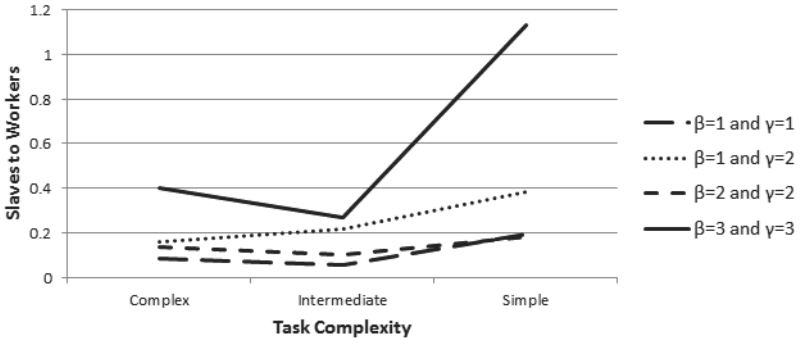


Figure 3.C.2: Proportion of slaves to workers along the task complexity continuum given β and γ - Women including domestic service.

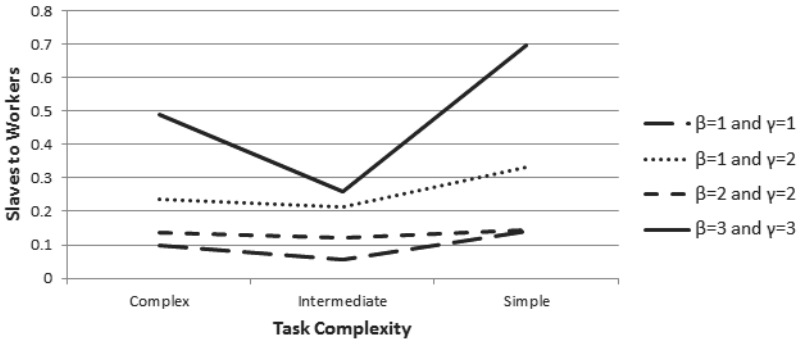


Figure 3.C.3: Proportion of slaves to workers along the task complexity continuum given β and γ - Total including domestic service.

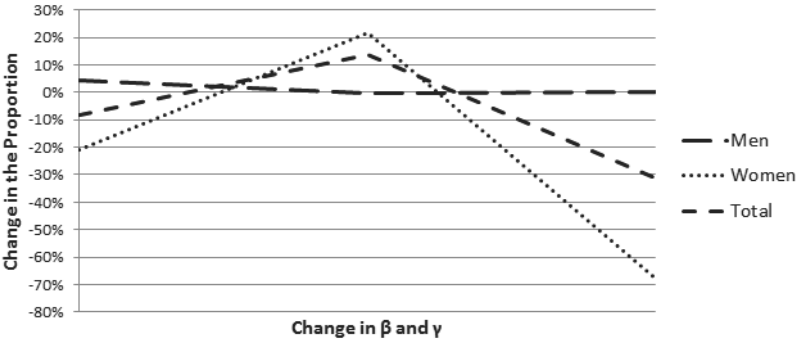


Figure 3.C.4: Proportion of slaves in complex tasks to those in simple tasks along β and γ - including domestic service.

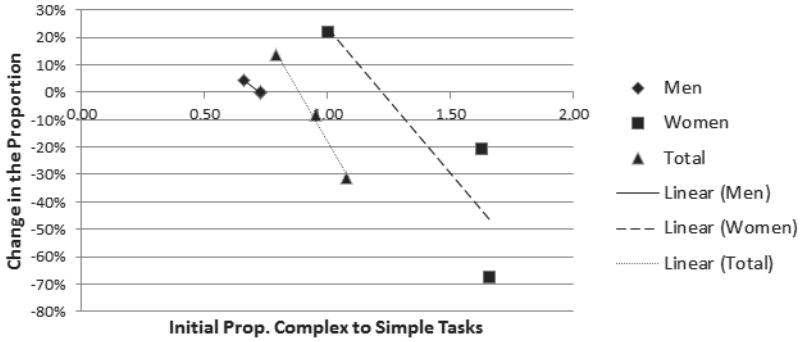


Figure 3.C.5: Threshold in the change of the proportion of slaves in complex tasks relative to those in simple tasks along β and γ - including domestic service.

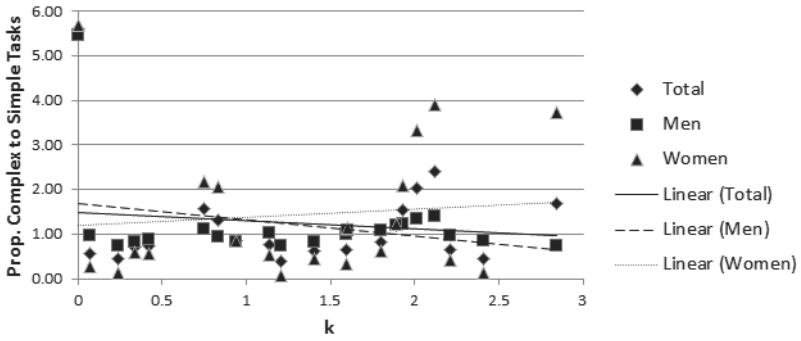


Figure 3.C.6: Threshold in the change of the proportion of slaves in complex tasks relative to those in simple tasks along k - including domestic service.

Chapter 4

Turnover or Cash? Sharecropping in the US South

4.1 Introduction

Understanding what it takes for an employer and an employee to agree on a labor relationship is a fundamental but intricate problem in economics. This chapter sheds light on this issue by using a historical episode where the reasons for employers and employees to enter a specific contract in a specific sector are well documented. Equally important, there is an observable source of exogenous variation of crucial parameters. In the farms of the US South between 1880 and 1940, many employers used sharecropping - a share contract where employers paid employees with a share of the harvested crop - to avoid labor turnover costs, whereas many employees signed those contracts for lack of outside options. The introduction of post offices eased communication between rural and industrial areas, increasing both labor turnover and outside options in the farming sector. The core result is that the overall effect of post offices on the prevalence of sharecropping contracts in a county was negative, which is consistent with the idea that this share contract was extensively adopted mostly because employees lacked outside options.

Share contracts are one of the core issues in the economics literature. First, they are ubiquitous (Allen and Lueck, 1993; Dana and Spier, 2001; Burke, 2015): taxi and Uber drivers work in piece-rate contracts (Hall and Krueger, 2016); CEO's have their remuneration attached to several performance indicators; franchising contracts are paramount in the modern economy (Dana and Spier, 2001), counting as much

as 10% of Canada's GDP, and employing 11 million US workers (Pruett and Winter, 2011). Second, share contracts are the solution for a wide range of problems (Ackerberg and Botticini, 2002) such as risk sharing between principals and agents (Cheung, 1969; Townsend and Mueller, 1998), screening of employees' ability (Hallagan, 1978; Ackerberg and Botticini, 2002), labor turnover costs (Lazear, 1996) or transaction costs along a supply chain (Allen and Lueck 1992, 1993; Dana and Spier, 2001).

Between 1880 and 1940, sharecropping played a central role in the economy of the US South. Farms run with sharecropping contracts increased dramatically, from 24% in 1880 to 37% in 1940 of the total number of farms, peaking at 48% in 1930. Economists and economic historians have largely attributed this phenomenon to labor turnover costs. For instance, the demand for labor was extremely inelastic in crucial periods of the season. For the employer, sharecropping outperformed the use of wage labor by not only postponing most of the cash payment to the end of the season, but also making that payment dependent on a steady labor supply by the employee during the whole season. In other words, sharecropping minimized the employer's labor turnover costs.

Employees accepted the postponement of their income and the increased exposure to risk in sharecropping contracts because employers gave several perks during the season,[1] and because employers did not micromanage sharecroppers. However, those contracts had an asymmetric impact. Employees with smaller families found it more difficult to run a farm alone, and did not benefit so much from the provision of educational services. Therefore, many employees were left indifferent between sharecropping and available outside options. The US South economy fared poorly during this period: "at the turn of the twentieth century, real income per worker in the South was less than half that in the rest of the United States" (Collins and Wanamaker, 2015). Furthermore, employees in Southern farms often lived in ignorance of the changes occurring in the rest of the economy, a situation worsened by several laws targeted at labor recruitment and job searching.

Thus, it was unclear whether the surge in sharecropping contracts between 1880 and 1940 was mostly due to labor turnover costs or the outside option. A way to solve this problem consists of increasing simultaneously both variables: if labor turnover costs were the dominant reason, sharecropping contracts used in a county would in-

[1]Examples: food rations, access to consumption credit, schooling, health care, and public safety.

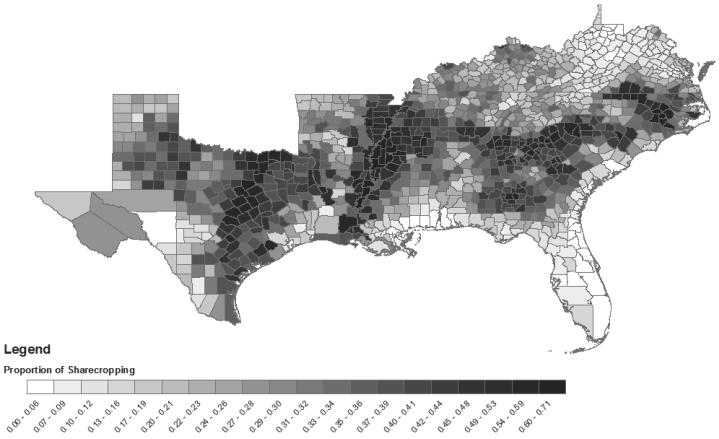


Figure 4.1: Number of sharecropping farms over the total number of farms, 1880-1940 average. Source: NHGIS (2011).

crease; if the outside option was the most relevant reason, sharecropping contracts in a county would decrease. The model in section 4.3 concludes that a simultaneous increase in labor turnover costs and in the outside option decreases the proportion of sharecropping-run farms relative to all active farms in a county (herein, proportion of sharecropping) as long as labor turnover costs are low enough. Empirically speaking, this chapter uses the fact that the opening of post offices increased both labor turnover and outside options. US Post Offices were an established institution that distributed letters and newspapers all over the country: during the farming season, laborers were more likely to switch jobs after receiving news from elsewhere, increasing the labor turnover affecting employers who used wage contracts; at the beginning of the season, employees would be aware of more job opportunities, decreasing the number of employees taking sharecropping contracts. Note that the literature denies that post offices coincided with local economic development or with the capacity of the federal government to undermine local labor market institutions. In order to definitely rule out these alternative channels, several control variables are included in all regressions and extra robustness checks are run. Therefore, the introduction of post offices was an exogenous source of variation.

A county-level, decennial data panel provides both non-parametric and parametric

evidence that the impact of an extra post office on the proportion of sharecropping was negative. Figures 4.1 and 4.2 illustrate a statistically-significant, negative correlation between the proportion of sharecropping and post office density. This effect survives controlling for population density and distance to the nearest railroad, the two determinants of the number of post offices in a county. This empirical exercise includes two exogenous treatments to make sure that the variable *Post Office* acts in the aforementioned channels. The treatment *Rain* follows the idea that turnover costs are higher where the rain is very erratic in crucial periods of the farming calendar, whereas the treatment *Coal* equates the presence of a coal deposit to a higher outside option. As predicted by the model in section 4.3, new post offices decrease less the proportion of sharecropping in counties in the treatment *Rain*, while they decrease more the proportion of sharecropping in counties in the treatment *Coal*. Overall, depending on the treatments affecting each county, it is found that a one-standard-deviation increase in post office density corresponded to an average decline in the proportion of sharecropping between 2.8% and 5.6%. Overall, note that these results do not deny that labor turnover costs played a key role in the proportion of sharecropping (Alston, 1981): they simply give evidence of a dominant role of outside options. Indeed, the findings in this chapter are consistent with previous findings of employees' having their choices distorted by the Southern elites (Roback, 1984; Naidu, 2010; Hornbeck and Naidu, 2014).

All in all, this chapter finds evidence that the role of the employees' outside options deserves further attention in future research about share contracts. A back-of-the-envelope calculation suggests a significant resource distortion since a one-standard-deviation increase in post office density in the past would have increased the GDP per capita in 2014 somewhere between 0.5% and 1.1% at the county level. Moreover, outside options may be behind the persistent use of sharecropping contracts in developing economies or the rise of franchising contracts: the lack of economic diversity in income generation takes employees with low managerial skills to accept these sorts of contracts. Finally, share contracts like franchising provide a path towards entrepreneurship (Pruett and Winter, 2011). Thus, the same explanation might shed some light on the following puzzle: there is a negative relation between GDP per capita and entrepreneurial activity.

The chapter proceeds as follows: section 4.2 presents the historical background;

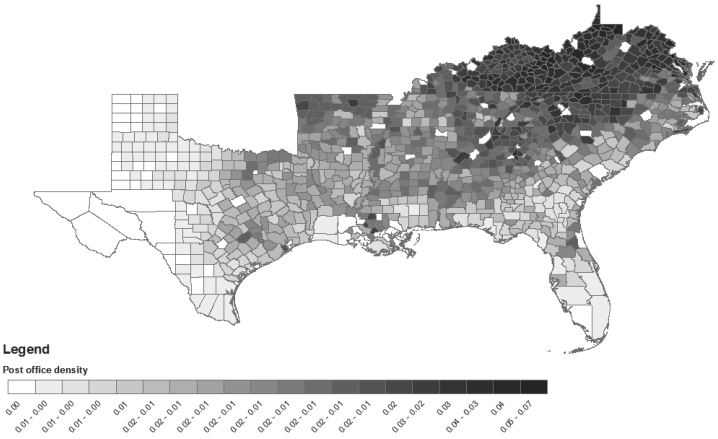


Figure 4.2: Post office density, 1880-1940 average. Source: Postal History.

section 4.3 frames the discussion in a theoretical model; section 4.4 sets up an empirical strategy, and discusses the results; section 4.5 summarizes the main conclusions of this chapter and suggests a future research agenda.

4.2 Historical Background

This section makes three points. First, sharecropping in the US South was driven by labor turnover affecting employers and by the employees' outside option. Second, this historical episode is a great laboratory to test the dominance of a sector-level factor against the outside options. Third, news about job opportunities affected both factors, and post offices spread such news.

The farming sector experienced an iterative process when dealing with the fluid labor market created by the American Civil War (1861-65) and the abolition of slavery (1865). Employers attempted but failed to collude when tackling labor turnover. Many employees desired the autonomy common to family farms. Sharecropping solved both problems: employees had to wait for the end of the season for the bulk of the revenues, giving them a reason to stay the whole season; employers could compensate that wait with the provision of consumption and other non-pecuniary perks, such as management autonomy. However, some employees benefited from sharecropping more than others.

In case an outside option emerged, some employees would consider to work as wage farm laborers in the spot labor market, or to leave the farming sector.

This historical period provides a very clean setting. Labor contracts, including sharecropping, were standardized by the 1870s. Farming was a labor-intensive, technically unsophisticated sector. Therefore, this is a world of mostly binary choices of choosing direct management or a tenancy contract for employers, and of working or not in the farming sector for employees.

Another especially important point relates to the isolation in which agents lived in that period: "Life in the south in the late nineteenth and early twentieth centuries, particularly for the black sharecroppers, was striking in its isolation and its lack of connection to the modern world" (Gordon 2016, p. 266). Outside of the Southern villages, industrialization was in full swing (Gordon 2016, p. 14). Therefore, certainly any news would affect job choices of those still stuck in the rural South. The postal service was ready to provide information because it was fully functional even before the war. It brought letters and newspapers to every corner of the US economy. Post Offices were harbingers of economic development: people knew that they ought to have a post office to improve their living standard. Further, the public service mission of the Post Office Department implied a service that preceded local development. Post offices improved communication of news in an industrializing economy, certainly increasing labor turnover and the outside option simultaneously.

4.2.1 Employers and Employees

Sharecropping contracts were a key feature of the US South[2] economy after the American Civil War and the abolition of slavery.[3] The use of sharecropping exploded in the 1870s: those two shocks left employers and employees vulnerable to a fluid labor market in agriculture.[4] On the one hand, employers struggled to stabilize their labor force, that is, they wanted to avoid labor turnover during the season. On the other hand, employees desired a decent living in a backward region of an industrializing US economy.

[2]The South was composed by the states of Alabama, Arkansas, Florida, Georgia, Mississippi, Louisiana, North Carolina, South Carolina, Tennessee, Texas, and Virginia.

[3]Literature used for this section: Donald and Randall (1961), Foner (1988), Keller (1977), McPherson (2013), and Roback (1984).

[4]Sharecropping contracts had already existed before 1861, but not nearly at the same scale (Shlomowitz, 1984; Wright 2006, p. 5).

The abolition process itself makes these problems apparent. The federal government enforced the abolition of slavery throughout the Reconstruction Era (1863-77). This historical period had three distinct stages: Wartime (1863-65); Presidential (1865-66); Radical (1866-77). The "Wartime" period consisted of the conquest of the Southern states, liberating slaves in each of them. The "Presidential" period began with the rise of President Johnson in 1865, and promoted a quick reintegration of the Southern states into the US without interfering in their internal affairs. Southern states seized the chance to control the labor supplied by former slaves, the freedmen, through a series of laws known as Black Codes.[5] However, Radical Republicans took over the US Congress in 1866, and began an interventionist agenda to guarantee the creation of a free labor economy in the South. This policy included military occupation, suspension of the Black Codes, and promotion of wage employment among freedmen through the Freedmen's Bureau. Lack of popularity, a financial crisis, and a stalemate in the presidential election of 1876 precipitated the end of the Radical Reconstruction period.[6]

Employers sought a substitute for slavery in their farms (Ransom and Sutch, 1977). Labor turnover was the most pressing problem created by abolition: crops had strict calendars, and were vulnerable to climatic shocks (Wright, 1986; Hanes, 1996).[7] Since this was common knowledge, employers also faced the threat of labor contract renegotiation (Hanes, 1996; Roback, 1984; Shlomowitz 1979, 1984). More importantly, these problems affected cotton, the most important Southern cash crop (Shlomowitz, 1979; Wright, 1986).[8] Cotton had two labor peaks during the crop year, planting and harvesting (Roback, 1984; Wright 2006, p. 86); cotton also required twice as much labor as any other crop (Alston, 1981). Not surprisingly, employers tended to poach labor from each other during the critical cotton-picking season (Higgs 1977, p. 45). To be

[5]There were already laws of this nature before the war but by "the mid-nineteenth century criminal prosecutions for enticing a servant had become virtually nonexistent, and civil cases were rare" (Roback 1984, p. 1166).

[6]"The states and the years of military withdrawal are Alabama (1874), Arkansas (1874), Florida (1876), Georgia (1874), Louisiana (1876), Mississippi (1874), North Carolina (1874), South Carolina (1876), Tennessee (1874), Texas (1874), and Virginia (1874)" (Naidu 2010, p. 428).

[7]Example of climatic shock: sudden precipitation that might have destroyed a whole cotton harvest in a few days.

[8]The other two major cash crops, cane sugar and tobacco, were also vulnerable. Cane Sugar had at least one labor peak and "sugarcane, once harvested, cannot be stored because of sucrose decomposition" (Britannica, 2015). Therefore, "the time between cutting and processing" had to be minimized (Britannica, 2015). Tobacco had at least three labor peaks: seeds preparation; transplanting, and harvesting. "The prime requisite for successful tobacco culture is a supply of well-developed healthy seedlings that is available at the proper time for transplanting" (Britannica, 2015). Before harvesting tobacco "may be left in the field from a few hours to two days to wilt" (Britannica, 2015).

sure, collusion in labor contracting failed during the Reconstruction Era (Higgs, 1977): employers were too many and too heterogeneous and employees could easily move to exploit deviations (Higgs, 1977; Ransom and Sutch, 1977; Shlomowitz, 1984; Wright, 1986; Collins and Wanamaker, 2015). Indeed, "there was [...] a labor market in the South between 1870 and 1930, and it operated to reduce wage differentials and some form of wage discrimination" (Wright 1986, p. 120 and "intercounty mobility rates were high" (Wright, 1986, p. 65).

After extensive experimentation, employers opted for sharecropping (Ransom and Sutch, 1977; Shlomowitz, 1984).[9] Employers began by postponing the payment of wages to the end of the season to stabilize the workforce (Shlomowitz, 1979; Alston, 1981; Roback, 1984). But employees had to finance their consumption during the season, and desired autonomy in the management of family farms (Du Bois, 1935; Ransom and Sutch, 1977; Wright 1978, 2006; Shlomowitz, 1979; Roback, 1984). At the same time, employers struggled to pay enough cash during the season to compensate the lack of autonomy in wage labor (Shlomowitz, 1979), and they had high management costs to enforce effort among employees (Higgs 1977, p. 45; Alston, 1981). Sharecropping offered a satisfactory solution. It was a share contract where labor earned a share of the final output at the end of the season. "Since the worker had a stake in the crop on that particular farm, he was not likely to abandon his job" (Roback 1984, p. 1173). The employer usually sold the crop and deducted whatever advances in consumption goods he gave in the beginning and during the season to the employee. Furthermore, employees gave many non-pecuniary perks such as food rations, access to credit,[10] medical care or education (Ransom and Sutch, 1977; Alston and Ferrie, 1993; Naidu, 2010), and the chance to cultivate food crops on the side (Wright, 1978).[11]

Overall, sharecropping "offered the potential of a higher income than could be obtained working for the fixed standard wage" (Ransom and Sutch 1977, p. 95). Hence, employees who had families and some inputs, like a mule, would seize the chance to work as sharecroppers (Du Bois, 1935; Ransom and Sutch, 1977; Wright

[9]Shlomowitz (1979, p. 560) witnesses a "wide variety of payment schemes" during these early postbellum years (1865-1880): Standing Wages; Share of the Crop or Sharecropping; Sharing of Time; Standing Rent; Wages in Kind; Other various explicit incentive schemes.

[10]Often employers would not directly provide current consumption: merchants and local shopkeepers financed it in exchange of a portion of the final production (Wright, 1986; Du Bois, 2007). This paid off for employees in an environment where the credit market was especially expensive (Wright, 1986).

[11]Employers also provided protection from violence, an especially valuable good for black employees (Alston and Ferrie, 1993). Note that many of these non-pecuniary benefits of sharecropping also compensated employees to the exposition to risk (Alston, 1981).

1978, 2006). Wage labor was tightly supervised, and the extreme mobility demanded to wage laborers mostly attracted young men (Ransom and Sutch 1977, p. 95; Wright 1986, p. 103).

Nevertheless, note that "wage workers received money and rations at regular intervals during the course of the crop year. Tenants and owners, on the other hand, needed to spend both for personal consumption and for farm operations throughout the year, but not until they had produced and sold a crop would they receive any income" (Higgs 1977, p. 55). That is, an employee accepted a postponement of liquidity when he became a sharecropper, because he earned most of his cash income at the end of the season. The underlying transfer of liquidity costs was so good for employers that they often preferred to write-off debt created by the advancements than losing the employee (Wright, 1986), or they would accept to just roll it over to the next season (Naidu, 2010; Ager, 2012). Furthermore, many of the non-pecuniary perks given by the employers only worked because cash wages were low in the first place (Wright, 1986), and local elites controlled the access to those goods (Alston and Ferrie, 1993).[12] Thus, consumption decisions were frequently distorted by employers. No wonder that after World War 2 the increase in cash wage made a black employee "to buy where he thought he was getting the best values for his money, and where he was treated with the most consideration" (Alston and Ferrie 1993, p. 866).

Above all, most employees did not have cash themselves to explore different alternatives. There was no land redistribution after the war, meaning that millions of freedmen and poor whites had no access to land (Higgs, 1977; Foner, 1988). Rural bankers did not provide short-term credit at all (Ransom and Sutch, 1977), and banks were forbidden to accept land as collateral (Wright, 1986). Thus, a "wealthy farmer might choose to operate as a tenant or sharecropper, but a poor man could not simply choose to become a cash tenant" (Wright 1978, p. 177) because fixed-rent tenancy required the employee to supply many more inputs than in sharecropping. Thus, most rural employees were stuck between being wage laborers or sharecroppers.

Those not acquainted with this historical period might find it odd to equate wage labor with forms of tenancy.[13] Yet Shlomowitz (1984) establishes a relation between

[12] Additionally, blacks were often humiliated and cheated (Alston and Ferrie, 1993; Higgs, 1977).

[13] In fact, Wright (1986, p. 70) states that "sharecroppers, renters and small farmers were not wage laborers; they were not involved, directly at least, in the market we have been describing." But he contradicts somewhat with himself when he states that the choice between "wage labor, sharecropping, and rental [...] depended on relative wage levels and rental rates" (Wright 1986, p. 90).

wage levels and the capability of employers to pay a premium for the lack of autonomy compared to that offered by sharecropping or tenancy. Alston and Ferrie (1993, p. 863) go further and state that "sharecroppers are legally wage workers paid with a share of the crop."

Training was irrelevant in agriculture at that time.[14] Ransom and Sutch (1977, p. 125) classify farmers of the US South after the war as "inexperienced and illiterate." Collins and Wanamaker (2015) suggest that southern employees after the war were less skilled than in the rest of the US. Alston and Ferrie (1993, p. 857) regard the agriculture of the time as "pre-mechanized and non-science-based." Furthermore, the high number of employees changing employer between seasons supports the idea of low relation-specific investments (Wright, 1986).[15]

Lastly, the main parameters of the different labor contracts were standardized before 1880 (Ransom and Sutch, 1977). The division of the output depended on the quality of the land and on the amount of inputs supplied by each party.[16] Higgs (1977) and Ransom and Sutch (1977) report that often contract terms were subjected to small adjustments in other terms, such as food rations provided during the season by the employer.

In conclusion, sharecropping certainly helped employers to curb labor turnover, especially those for whom it was harder to manage wage labor. Similarly, sharecropping had an asymmetric impact across employees: many were ready to take the chance to be their own managers, and to access goods that were valuable for farm operations and for their family life. But for other farmers, the benefits of sharecropping were not enough to make it more than a labor contract with uncertain payment (Du Bois, 2007) or even a piece-rate wage labor regime (Wright, 1978). So, unsurprisingly, a witness saw that people had been "moving cityward, entering other occupations, migrating west or north-where more money is to be made" (Higgs 1977, p. 62). Letters and

[14] Already in slavery times, human capital consisted of slaves health and reproductive capacity (Ruef, 2012), which were absent in the US South (Du Bois, 2007; Ruef, 2012). Moreover, most skill acquisition for slaves occurred in domestic service (Ruef, 2012) whereas by "1850, nearly 80 percent all slaves were engaged directly in agriculture" (Wright 2006, p. 84). Further, Rueff (2012) presents records of 57977 slaves sold in the market: about 95% had no skills.

[15] Among the blacks' labor force, trust and deference were the crucial characteristics to access sharecropping (Higgs, 1977; Ransom and Sutch, 1977; Wright, 1986).

[16] "For example, in 1876, the U.S. Department of Agriculture reported: 'Contracts vary widely in details, but are most generally based upon the following equivalents. Bare labor, one-fourth of cotton in rich land, one-third in poor soils; labor and rations, one-half as a general rule, four-tenths in some very productive lands; labor, rations, stock and supplies, two-thirds to three-fourths of the product'" Shlomowitz (1979, p. 565).

newspapers distributed by mail certainly informed these decisions.

4.2.2 Post Offices as Communication Centers

Post Offices[17] were a well-established communication system well before the American Civil War.[18] "The Post Office Department [...] developed new services that have lasted into the 21st century and subsidized the development of every major form of transportation" (USPS 2007, p. 10). Even before 1861, populations already perceived the benefits brought by the introduction of a mail service:[19] the "new territories and states, as well as established communities, pressed the Post Office Department for more routes and faster delivery" (USPS 2007, p. 10). Furthermore, community debates about postal delivery always reflected their importance for business development. For instance, 'business logic' was behind the adoption of free rural delivery at the end of the 19th century: "Rural people needed the important information provided by newspapers [...] Young people might stay on the farm if correspondence and magazines eased their isolation" (USPS 2007, p. 22).

Evidence indicates that new post offices preceded economic development (Acemoglu, Moscona and Robinson, 2016). Indeed, the Post Office Department "ultimately made decisions in the 19th century that reflected public service as its highest aim. It funded post routes that supported national development and instituted services to benefit all residents of the country" (USPS 2007, p. 11). The opening of a new post office was a function of the number of new customers and distance to a transportation route (POD, 1980), which after 1864 equated to the nearest railroad.[20] Typically, the Post Department would require a report from the nearest postmaster of an existing post office. That report would also include suggestions for the postmaster position at the new post office, who had to be a local inhabitant.[21] Usually, postmasters were storekeepers who kept their normal jobs while on duty.

[17] The main reference of this subsection is USPS (2007).

[18] "The 19th century saw the growth of the United States. The Post Office Department, the communications system that helped bind the nation together" (USPS 2007, p. 10).

[19] Universal service to customers in all the US was established by the Act of March 3, 1863 (12 Stat. 704). The act also formalized the three types of goods delivered by mail: letters; newspapers; other heavier items, such as catalog-ordered consumption goods (like can syrup or soap bars). These items were delivered along mailing routes.

[20] The use of steamboats peaked in 1853.

[21] Naturally, the local community or the local congressmen had a saying in the matter. For the largest post offices, the postmasters were directly nominated by the US President, while the Postmaster General filled the remaining positions.

A final point relates to effects of an improved communication system. The industrialization of the US economy was at full swing after the American Civil War (Gordon, 2016). Thus, thinking that more news about employment outside agriculture necessarily increased labor turnover during the season and the employees' outside option is a realistic assumption. In fact, emigrant-agent legislation targeted newspapers that advertised jobs outside of the US South (Roback, 1984). Domestic service and rural factories often advertised new positions through newspaper ads and word of mouth (Hanes, 1996). Even Alston and Ferrie (1993, p. 858) recognize that "out-migration of labor or in-migration of capital[22] would have raised reservation wages."

In summary, post offices provided a crucial mean of communication for any local community at a time when job postings traveled mouth to mouth (Higgs, 1977; Alston, 1981; Wright, 1986; Du Bois, 2007). The public service mission of the Post Office Department implied a service that preceded local development. The opening of a new post office essentially depended on local population size and accessibility. All these characteristics suggest that a new post office dramatically changed the available information about job prospects of individuals and households in the US South:

> *Life in the south in the late nineteenth and early twentieth centuries, particularly for the black sharecroppers, was striking in its isolation and its lack of connection to the modern world. Many members of farm families never traveled outside the county in which they were born. Roads were poor to nonexistent, and the only means of travel available were by foot, horseback, or wagon. Striking was the absence of medium to large-sized cities that were typical in the northeast and Midwest. Most towns were merely crossroads* (Gordon 2016, p. 266).

4.3 Model

"In a sense, the adoption of sharecropping was the result of a compromise between the laborers' pursuit of independence and higher incomes and the landlords' desire to retain control and minimize risk" (Ransom and Sutch, 1977 p. 94). This section formalizes how different economic conditions outside agriculture upset this compromise.

[22]There was a Postal Savings System from 1910 on (USPS 2007, p. 29). However, it did not extend loans to local inhabitants. Hence, Post Offices did not substitute banks or any other credit institution.

The analysis is conducted using a principal-agent model where the principal is the "employer" and the agent is the "employee." The employer wants to run a farm for one season using one of two options: direct management with wage labor hired on the spot labor market during the season, which implies that the employer faces labor turnover, or sharecropping, which eliminates labor turnover since it locks in the employee for the whole season. Because employers differ according to management costs when using wage labor, some employers can accommodate labor turnover costs better than others.

Wage labor gives to the employee a fixed income and no management costs. The employer cannot observe the employee's effort under a sharecropping contract, which brings information rents that can compensate management costs. Since employees differ in management costs when running a sharecropping farm, the higher management costs are, the more likely the employee opts for wage labor. Alternatively, the employee can choose an option outside the farming sector. This fact generates a participation constraint that the employer must take into account both in wage labor and in sharecropping contracts. The fixed income in wage labor equals the outside option because the employer chooses the effort level of the employee; sharecropping may bring more income to the employee depending on the size of the information rents net of management costs.

Before proceeding, note that a static setting is applied because it only discusses what happens during one season. This approach reflects that employer-employee pairs changed frequently from one season to another (Wright, 1986).

4.3.1 Setup

Employers (employees) are uniformly distributed along a continuum $\delta \in [0,1]$ ($\alpha \in [0,1]$), where δ (α) is the cost of managing a farm. The employer (employee) cannot observe the employee's (employer's) type, but he knows the distribution of types.[23]

Employees have three employment options: wage labor in agriculture, sharecropping, or an outside option such as a job in the industrial sector. Wage labor implies that the employer chooses the employee's effort level a and pays him a fixed wage w

[23]Note that both populations are risk averse. The literature supports this view. Ransom and Sutch (1977, p. 97) states that "the poor black was probably less averse to assuming risk than the comparatively wealthy landlord." At the same time, Alston (1981, p. 214) defends that "agricultural workers are relatively more absolute risk averse than landowners because they are less wealthy and have less access to credit markets". This model assumes that all agents have the same risk preferences: the object is the role of risk, not of risk preferences, in the composition of farm contracts.

throughout the season. With sharecropping, the employee manages his own effort, and earns a share s of the production at the end of the season. Self-management brings a cost α and makes effort unobservable to the employer. The outside option pays $\bar{u}$.

y, the farm's output, is a random variable. $y = a + \beta\epsilon$, where $\epsilon \sim N(0, \sigma^2)$. a is the employee's effort level and β is a proxy for turnover costs. $\beta = 1$ if the farm is operated by a sharecropper, and $\beta > 1$ if run with wage labor. That is, the danger of turnover or renegotiation by wage laborers amplifies the effect of production's risk. In conclusion, an employee has the following payoff as a wage laborer:[24]

$$\Pi_{wage} = w - \frac{a^2}{2} \tag{4.3.1}$$

Where $\frac{a^2}{2}$ is the cost of exerting effort a. The employee has the following payoff as a sharecropper:

$$\Pi_{share} = sa - \frac{a^2}{2} - \alpha - s^2\frac{\sigma^2}{2} \tag{4.3.2}$$

Finally, the payoff of the outside option payoff for the employee:

$$\Pi_{outside} = \bar{u} \tag{4.3.3}$$

In an analogous fashion, each employer chooses to run his farm using wage labor or to let it be operated by sharecroppers. The advantage of using sharecropping contracts consists of minimizing the increase in risk created by labor turnover, β, and save the management cost, δ. However, wage labor lets employers to directly control the effort level exerted by their wage laborers. Thus, wage labor pays the employer:

$$\Pi^E_{wage} = a - w - \delta - \beta^2\frac{\sigma^2}{2} \tag{4.3.4}$$

And for sharecropping:

$$\Pi^E_{share} = (1 - s)\left(a - (1 - s)\frac{\sigma^2}{2}\right) \tag{4.3.5}$$

The employer must satisfy a participation constraint when choosing either w or s: employees have a reservation value of $\bar{u}$. If neither wage labor nor sharecropping

[24]The following payoffs are certainty equivalents. They make use of the fact that $E\left[-e^{\delta\epsilon}\right] = -e^{\delta^2\frac{\sigma^2}{2}}$ where $\epsilon \sim N(0, \sigma^2)$.

satisfy the participation constraint, the employee chooses to work outside the farm sector. Additionally, employers must satisfy an incentive-compatibility constraint for employees when using sharecropping contracts, which generates information rents to the employee.

4.3.2 Results and Discussion

The results proven in appendix 4.B revolve around three thresholds. There is a level of management costs that leaves employers indifferent between inactivity and wage labor, and another that leaves them indifferent between wage labor and sharecropping. Likewise, employees are always indifferent between wage labor and the outside option, but there is a level of management costs below which sharecropping is attractive. The proportion of sharecropping, $\mathbf{p}$, depends on these 3 thresholds, which in turn vary with turnover costs β and the outside option $\bar{u}$.

With wage labor, employers impose the level of effort a to the employees. Employers just need to pay the employees enough to compensate the cost of effort and the outside option $\bar{u}$, leaving employees indifferent between wage labor and the outside option. Wage labor is only profitable when the employer's type δ is lower or equal to δ_w, where:

$$\delta \leq \delta_w \equiv \frac{1-\beta^2\sigma^2}{2} - \bar{u} \tag{4.3.6}$$

Therefore, if turnover costs and/or the outside option are high enough, employers with higher management costs are driven out of the market. Appendix 4.B shows that $\delta_w < 1$, that is, there are always inactive farms.

The second threshold comes from employees indifferent between sharecropping and the two other options. The employer sets the share s that maximizes the effort exerted by the employee given that the employer cannot observe employee's effort. The optimal $s = s_s$ always satisfies the incentive-compatibility constraint. Yet, the sharecropper, unlike the wage laborer, faces management costs. Hence, the optimal level of effort must not only pay effort exerted and the outside option, but it must also compensate for those management costs. There is a level of management costs, α_s, below which every employee earns information rents:

$$\alpha \leq \alpha_s \equiv \frac{1-\sigma^2}{2}\left(\frac{1+\sigma^2}{2+\sigma^2}\right)^2 - \bar{u} \tag{4.3.7}$$

The existence of an information rent is consistent with the necessity of a non-monetary premium for employers to convince employees to take sharecropping contracts (Alston and Ferrie, 1993). Consequently, management costs must go down to compensate for a higher outside option. Thus, a higher $\bar{u}$ lets fewer employees to sharecropping.[25]

The final threshold defines when employers choose sharecropping over wage labor:[26]

$$\delta \geq \delta_s \equiv \frac{1-\beta^2\sigma^2}{2} - \frac{1}{2\left(2+\sigma^2\right)} - \bar{u} \tag{4.3.8}$$

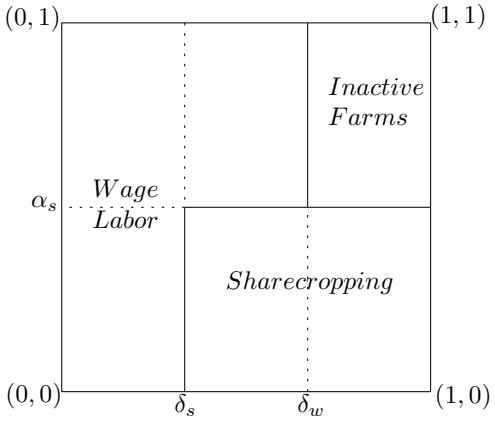


Figure 4.1: Thresholds and type of contracts signed in equilibrium.

Figure 4.1 summarizes the type of contracts signed in equilibrium between employers and employees in the farming sector. There are $1-\delta_s$ employers and α_s employees willing to sign sharecropping contracts. In other words, there is a $(1-\delta_s)\alpha_s$ chance that an employer and an employee meet in the market and, hence, sign a sharecropping contract for the season. Therefore, in equilibrium there are $(1-\delta_s)\alpha_s$ sharecropping farms. However, for employers with very high management costs, $\delta > \delta_w$, only sharecropping is profitable. So, $(1-\delta_w)(1-\alpha_s)$ employers are inactive in equilibrium, i.e. only $1-(1-\delta_w)(1-\alpha_s) = \alpha_s + (1-\alpha_s)\delta_w$ farms are active. Combining the number of sharecropping farms and the number of active farms gives the proportion of

[25]There is another interesting change from condition (4.3.6) to condition (4.3.7). Since $\beta > 1$, threshold α_s would always be higher than threshold δ_w if employees would get all the output. The term $\left(\frac{1+\sigma^2}{2+\sigma^2}\right)^2$ is smaller than 1 because a sharecropper, unlike an employer using wage labor, does not get all the production. Note that this term increases with σ^2 since an employer needs to give a higher share of the output to the sharecropper to compensate the increase in the risk of output.

[26]Appendix 4.B demonstrates that sharecropping always yields a positive pay off to the employers.

sharecropping, $\mathbf{p}$, in equilibrium:

$$\mathbf{p} = \frac{(1-\delta_s)\alpha_s}{\alpha_s + (1-\alpha_s)\delta_w} \tag{4.3.9}$$

The sum of the derivatives of $\mathbf{p}$ with respect to turnover costs and to the outside option is the following:

$$\frac{\partial \mathbf{p}}{\partial \bar{u}} + \frac{\partial \mathbf{p}}{\partial \beta} \tag{4.3.10}$$

This derivative is negative if turnover costs are low enough. Intuitively, higher turnover costs reduce the number of active employers under wage labor, δ_w, at the same time they increase the number of employers who prefer sharecropping to wage labor contracts, $1-\delta_s$. This becomes clear when thinking of the case when no employer is profitable with wage labor, $\delta_w \leq 0$, because of very high turnover costs: $\mathbf{p} = 1$, that is, all active farms are sharecropping farms because that is the only profitable arrangement for the employers.

> **Proposition 1**: A simultaneous increase in turnover costs, β, and the outside option, $\bar{u}$, decreases the proportion of sharecropping, $\mathbf{p}$, if turnover costs are low enough. Otherwise, the proportion of sharecropping increases.

There is a corollary that follows from Proposition 1. The following interpretation assumes a negative effect on the proportion of sharecropping of a simultaneous raise in labor turnover and in the outside option. First, the proportion of sharecropping decreases less with a simultaneous increase in turnover costs and of the outside option if turnover costs are higher. As turnover costs increase, sharecropping is increasingly more desirable for employers.

Second, if the outside option increases, the proportion of sharecropping decreases more with a simultaneous increase in turnover costs and of the outside option. Intuitively, sharecropping becomes increasingly less desirable for the employees as the outside option increases, making concerns with turnover costs relatively less important.

> **Corollary 1**: If there are not too many employees wanting sharecropping contracts, and the proportion of sharecropping does not react too much to turnover costs, the second derivatives of the proportion of sharecropping

with respect to turnover costs, β, and the outside option, $\bar{u}$, are such that a simultaneous increase in turnover costs and of the outside option:

- decreases less the proportion of sharecropping if turnover costs increase.
- decreases more the proportion of sharecropping if the outside option increases.

Proposition 2 tells that a simultaneous increase in turnover costs and the outside option decreases the number of active farms. Sharecropping farms are only affected by the will of employees through α_s: better outside options make sharecropping less attractive. Farms run with wage labor depend on both employers and employees. Turnover costs reduce the number of employers that can afford wage labor. The outside option may have an ambiguous effect: it reduces the number of active employers but at the same time it reduces employees in sharecropping. In other words, there are less employers offering wage labor contracts, but there are more employees willing to take them. However, for every employee dropping out of sharecropping, only a fraction δ_w goes to wage labor. Hence, this leakage of employees from sharecropping to wage labor never compensates the fall in sharecroppers in absolute terms.

Proposition 2: A simultaneous increase in turnover costs, β, and the outside option, $\bar{u}$, decreases the number of active farms.

There is also a corollary following Proposition 2. This corollary has a more straightforward intuition: both turnover costs and the outside option decrease the total number of active farms. Moreover, they affect linearly the calculation of employers and employees, i.e. their effect is the same no matter how many employees and employers are out there. So, as the number of active farms decreases, the relative effect of either an increase in turnover costs or an increase in the outside option.

Corollary 2: The second derivatives of the total number of active farms with respect to turnover costs, β, and with respect to the outside option, $\bar{u}$, are such that a simultaneous increase in turnover costs and of the outside option:

- decreases more the proportion of sharecropping if turnover costs increases.

- decreases more the proportion of sharecropping if the outside option increases.

4.4 Empirics

This section empirically tests the model of section 4.3. An increase in the density of post offices in each county identifies the simultaneous increase in labor turnover and in the outside option discussed before. Intuitively, more post offices enhanced the chances of news about job opportunities. This section brings further qualitative and quantitative evidence backing subsection 4.2.2, which rules out a coincidence of post office density with local development and a countervailing presence of the federal government. Overall, the evidence discussed in this section gives support to the idea that employees' outside options, not employer's labor turnover costs, determined the prevalence of sharecropping contracts in the counties of the US South.

4.4.1 Identification

The job creation due to the fast industrialization of the US economy makes it possible to equate new information to good news about employment. Post offices facilitated the diffusion of information. News during the season certainly diverted wage laborers from agriculture to other occupations such as mining, i.e. they increased turnover costs, β. Letters and newspapers affected the calculations of those employees who benefited less from sharecropping arrangements relative to jobs in cities like Chicago (Roback, 1984), that is, there was an increase in the outside option, $\bar{u}$. However, post offices opened with respect to the immediate access to transportation and to population density. Hence, a correct statistical model must include controls for population density and existing transportation.

The first question about this identification mechanism is whether more post offices are just a sign of the local economic development. More post offices might also bring more jobs or other economic opportunities across the county. Yet post offices preceded economic development, as they were part of the public service mission of the Post Office Department at least since 1863. Even in the case of established counties, USPS (2007) presents evidence of the postal service giving subsidies to the development of railroads and other means of transportation through allowances for delivery to transportation

companies.

Mail may have affected the relative prices of inputs that, in turn, influenced the costs of managing a farm. If that were the case, employees could find better places to use their family labor force or other inputs such as mules or tools. However, it is not clear why that effect would impact sharecropping farms more than farms with other types of tenure. Equally relevant, that same effect can be easily described by a change in the reservation utility of employees instead of an adjustment in the costs of managing a farm. Intuitively, employees could simply make more cash somewhere else with those inputs, while the yield of those inputs in a sharecropping farm remained unchanged.

Acemoglu et al. (2016) raises the concern that post office presence equated to a stronger presence of the federal state, whose policies could have interfered with local labor markets. That seems highly unlikely. King and Lieberman (2009) and Novak (2008) argue that the federal state before World War 2 was stronger than previously thought, but that does not imply that the federal state was indeed a powerful entity in every realm of the US economy. Even if it was a strong entity, Alston and Ferrie (1993) and Higgs (1977) present concrete evidence of how the federal state did not interfere in the southern labor market. Equally important, the persistence of separate labor markets between the US south and the rest of the US (Wright, 1986) is a sign of the limited role that any federal intervention might have had.

Another point of contention arises with the mobility of people, especially before World War 1. This is essential to assume that employees could actually seize job opportunities elsewhere. First, there is plenty of evidence of inter-county mobility of wage laborers and of occasional labor in non-farming sectors for this period (Wright, 1986). Second, Alston (1981) and Higgs (1977) present contemporary testimonials of recruitment in urban areas for agricultural jobs, and of several black employees moving to the cities for better jobs in industry. Finally, several US markets were already integrated.[27]

Finally, there may be doubts about whether post offices and the proportion of sharecropping interact through the desired channels, labor turnover during the season and the outside option at the beginning of the season. The empirical discussion in

[27]The cotton market is a good example. Any farmer could easily ship their cotton production from anywhere in the South (Higgs, 1977). Atack (2013) confirms that the price of cotton was the same nationwide before the 1880s.

subsection 4.4.3 clarifies those mechanisms using two exogenous treatments defined in table 4.A.1, *Rain* and *Coal*.[28] *Rain* is a proxy for turnover costs using the fact that the more erratic the rain is during the cotton harvesting season, the more costly it is to have uncertainties in labor supply. *Coal* stands for the stylized fact that the first industrial areas were located nearby coal mines (Cameron, 1993). Atack (2013) correlates railway access with the location of inanimately-powered, larger manufacturing establishments, which had higher productivity than smaller establishments. Therefore, more mines and/or industry associated to coal certainly meant higher reservation values for employees in the farming sector.

4.4.2 Dataset and Empirical Implications

Several panel-data regressions are run in a sample of 1119 counties across the southern states.[29] Note that the sample size was reduced to only include counties where there is data for the number of post offices.[30] The US census data on land tenure spans from 1880 to 1940 with a decennial frequency. The only year after abolition left out of the dataset is 1870, when the South still tested post-slavery institutions (Ransom and Sutch 1977; Shlomowitz 1979, 1984; Roback, 1984). 1940 is taken as the last data point, before the mechanization of cotton production (Alston, 1981; Holley, 2000; Britannica, 2015) and the effects of the New Deal and of the World War 2 in the southern labor markets (Alston, 1981; Wright, 1986). Finally, this chapter follows Naidu (2010) and considers the eleven Confederate states plus Kentucky and West Virginia: Kentucky had slavery and passed legislation restricting labor mobility after the war just like the Confederate states[31]; West Virginia was simply a strategic breakaway from Virginia at the beginning of the American Civil War.[32]

The dependent variable is the proportion of farms run with a sharecropping contract relative to the total number of farms in each county (*Sharecropping* herein). Studying

[28] Exogenous because both are geographical variables, as shown in table 4.A.1: *Rain* is constructed from contemporary data on precipitation. *Coal* is based on existent coal deposits, not mines, so it is not influenced by human behavior.

[29] I use 1880 borders, as defined by the maps available in NHGIS (2011). The robustness check in table 4.D.1 demonstrates that dropping states with more county-border changes does not affect the conclusions of this chapter.

[30] Table 4.A.1 demonstrates that variables differ in the number of observations. Since *Post Office* is the crucial component of the identification strategy, the sample was subordinated to the availability of that variable.

[31] See figure 4.C.1.

[32] Again, table 4.D.1 demonstrates that dropping these states leaves the gist of the results untouched.

the proportion in place of the absolute number of sharecropping farms distinguishes changes common to all farms from those only affecting sharecropping farms. For instance, a positive shock in the size of the local labor force makes labor equally cheaper for every farm.[33]

The identification variable, the number of post offices per county, is divided by the county area. Table 4.1 presents a statistically significant correlation of -0.24 across the whole sample. Equally interesting, table 4.2 and table 4.1 demonstrate that *Post Office* is not significantly correlated to *Coal* across the whole sample, weakly related to *Industry*, and negatively related with *Wage*. There is an interesting flip in the correlation sign across time, that is, *Coal* and *Wage* are negatively correlated with *Post Office* until 1900, becoming positively from 1910 on. These numbers give quantitative support to the claim that post offices preceded local development. Table 4.1 also shows that *Post Office* is significantly correlated with several variables, namely population density and available transportation that were discussed in subsection 4.2.2. Thus, meaningful regressions must control for all these variables.

Table 4.1: Correlation between *Post Office* with *Sharecropping*, *Farms*, treatments and control variables.

		Post Office						
	Whole Sample	1880	1890	1900	1910	1920	1930	1940
Sharecropping	-0.24***	0.01	0.02	0.09***	-0.29***	-0.38***	-0.43***	-0.36***
Farms	0.08***	0.18***	0.04	0.02	0.05*	-0.03	-0.06*	0.03
Rain	-0.22***	-0.20***	-0.21***	-0.20***	-0.28***	-0.28***	-0.30***	-0.29***
Coal	-0.01	-0.14***	-0.13***	-0.10***	0.07*	0.1***	0.1***	0.10***
Rural Pop. Dens.	0.44***	0.69***	0.66***	0.63***	0.36***	0.39***	0.39***	0.37***
Wage	-0.09***	-0.33***	-0.41***	-0.30***	-0.05*	0.11***	0.36***	0.36***
Urban Pop. Dens.	0.05***	0.12***	0.11***	0.11***	0.04	0.05*	0.05	0.04
Industry	0.02*	0.17***	0.14***	0.11***	0.02	0.04	0.03	0.02
Dist. Railway	-0.16***	-0.43***	-0.30***	-0.28***	-0.09***	0.02	0.04	0.04
Avg. Farm Size	0.04***	0.29***	0.21***	-0.06**	-0.22***	-0.24***	-0.22***	-0.22***
Prop. of Blacks	-0.07***	-0.07***	-0.12***	-0.11***	-0.15***	-0.15***	-0.17***	-0.16***
Temperature SD	0.04***	0.27***	-0.12***	0.34***	0.33***	0.34***	0.09***	0.16***
Precipitation SD	-0.05***	-0.16***	0.00	0.02	-0.15***	-0.25***	-0.22***	-0.05

This table presents the correlation between the crucial identification variable, *Post Office*, and every treatment and every control variable. 'Whole sample' includes all within and between variation. This table justifies the need to control for several variables identified in historical literature, and to separate within and between variation. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

Figures 4.1, 4.1 and 4.2, and table 4.2 give evidence of the effect of the treatments in the farming sector, and support the claim that *Post Office* acted as a source of news and not a sign of coincidental local development. Comparing figure 4.1 with

[33]Note that *Sharecropping* is a continuous variable, while the total number of farms is a count variable. This fact would bring extra complications in case this chapter opted to regress sharecropping farms using the total number of farms as a control variable (Cameron and Trivedi, 2005).

figure 4.1, clusters of *Sharecropping* coincide with areas of erratic rain, such as the Mississippi river basin. The positive, significant difference in *Sharecropping* between treated and nontreated counties in table 4.2 also establish a positive relation between more erratic rain and sharecropping contracts. Also note that the treatment *Rain* has a significant correlation of -0.30 with the number of cotton harvesting days. That correlation makes clear that treatment *Rain* represents turnover costs because the fewer days there are to harvest cotton, the more costly the lack of laborers is.[34] A mixed scenario emerges with the treatment *Coal*: despite a negative relation between *Sharecropping* and *Coal* in Texas and in the Appalachians visible in figure 4.2, table 4.2 shows that *Coal* increases both *Sharecropping* and *Farms*. However, this goes in the direction that, in the absence of communication, *Coal* might simply shift the historical levels of *Sharecropping* through an effect on local institutions, among others. Lastly, *Post Office* is negatively affected by *Rain*: if there is an association between higher risk and lower economic development, then perhaps there is a correlation between post offices and local development. But this last piece of evidence is contradicted by the non-significant relation between the*Post Office* and treatment *Coal*, a variable with positive and significant impact on *Wages* and a negative and significant impact on *Industry*.

Table 4.2 demonstrates that treatments *Rain* and *Coal* affect other variables not discussed by the model of section 4.3. *Wage* is negatively affected by *Rain* but positively affected by *Coal*, which brings evidence that erratic weather depresses the wage paid to laborers, whereas the potential existence of more nonfarm jobs increases wages. Oddly, *Industry* is strongly and positively correlated with *Rain* and weakly and negatively with *Coal*. Perhaps erratic rain makes farming less profitable, releasing inputs to the nonfarming sector, while *Coal* might be associated with industries placed in the countryside or of more specific sectors. This last explanation is consistent with the findings that *Urban Pop. Dens.* is also correlated positively with *Rain* and negatively with *Coal*, and that *Avg. Farm Size* is not correlated with *Rain* but it is positively correlated with *Coal*.

A last piece of non-parametric evidence is brought by table 4.3. If the treatment

[34]USDA (1997) provides the number of harvesting days in cotton cultivation for the year 1996 in each US state. Because modern agriculture is certainly more efficient and less labor-intensive than traditional farming, this number of days is closer to turnover costs driven by environmental, human-independent factors than using contemporary calendars.

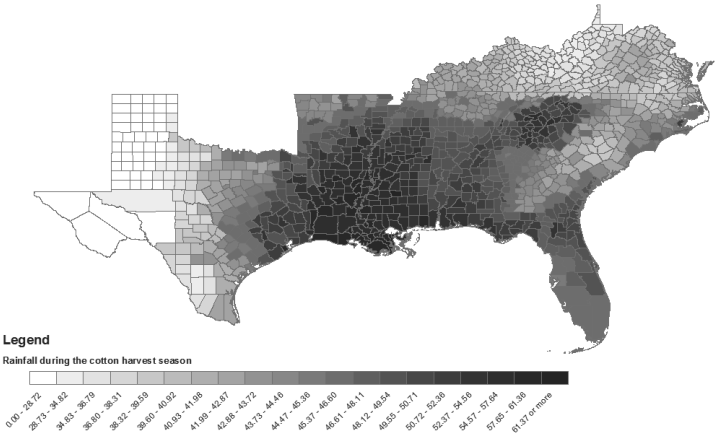


Figure 4.1: Standard Deviation of Precipitation during cotton harvesting, 1880-1840 average. Source: NOAA (2016) and Hong (2013).

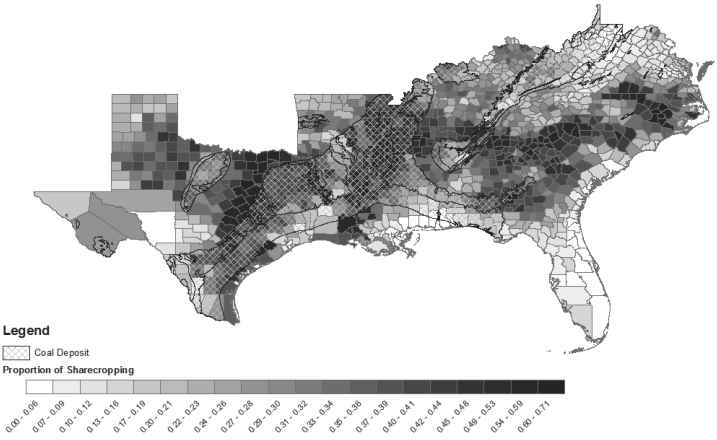


Figure 4.2: Sharecropping Farms and Coal Deposits. Source: USGS (1996).

Table 4.2: Mean differences in variables due to the *Rain* and *Coal* treatments.

	Rain	*No Rain*	*Dif.*	*Coal*	*No Coal*	*Dif.*
Sharecropping	0.33	0.26	0.07***	0.31	0.29	0.03***
	(4,056)	(4,002)	(8,058)	(2,475)	(5,583)	(8.058)
Farms	0.12	0.11	0.00***	0.12	0.11	0.01***
	(4,056)	(4,034)	(8,090)	(2,475)	(5,615)	(8,090)
Post Office	0.11	0.17	-0.01***	0.01	0.01	0.00
	(3,885)	(3,955)	(7,840)	(2,429)	(5,411)	(7,840)
Rural Pop. Dens.	11.66	12.54	-0.88***	11.69	12.28	-0.59***
	(4,056)	(4,066)	(8,122)	(2,475)	(5,647)	(8,122)
Wage	1.03	1.13	-0.09***	1.13	1.06	0.08***
	(4,074)	(4,074)	(8,148)	(2,492)	(5,656)	(8,148)
Industry	3.76	2.49	1.28***	2.71	3.31	-0.60*
	(4,074)	(4,074)	(8,148)	(2,492)	(5.656)	(8,148)
Dist. Railway	10.15	20.80	-10.65***	12.92	16.60	-3.68***
	(4,074)	(4,074)	(8,148)	(2,492)	(5.656)	(8,148)
Urban Pop. Dens.	4.74	3.34	1.40**	2.95	4.52	-1.57***
	(4,056)	(4,066)	(8,122)	(2,475)	(5,647)	(8,122)
Avg. Farm Size	703.67	695.58	-8.09	725.02	688.43	36.60***
	(4,056)	(4,107)	(8,073)	(2,475)	(5,598)	(8,073)
Prop. of Blacks	0.34	0.19	0.16***	0.27	0.26	0.01**
	(4,057)	(4,047)	(8,104)	(2,475)	(5,629)	(8,104)

This table shows the effect of the treatments *Rain* and *Coal* on the independent, identification and control variables. Below the mean of each variable in the treatment and control groups, there is the number of observations in parentheses. The value and signs of the differences between treatment and control groups gives an extra argument for the inclusion of control variables. ***, ** and * indicate 1%, 5% and 10% significance level, respectively. Find the number of observations in parentheses.

Coal changes when the rain is not so erratic, i.e. *Rain* = 0, *Sharecropping* decreases. Otherwise, *Sharecropping* increases with *Coal* if *Rain* = 1. In case *Rain* changes, *Sharecropping* increases independently of the level of *Coal*. Both these regularities are consistent with the analysis in section 4.2: turnover costs were an important driver of sharecropping contracts; the proportion of sharecropping was affected by non-farming factors.

Table 4.3: Average of *Sharecropping* conditional on "Rain" and "Coal" treatments.

	Coal=1	*Coal*=0
Rain=1	36.85%	30.43%
Rain=0	21.45%	27.07%

Sample average depending on treatments' combinations. Table 4.8 gives the fitted values controlling for other factors.

A parametric analysis connected to the model of section 4.3 is required to have definitive answers. Proposition 1 of subsection 4.3.2 contains the core implication of the model: the effect of a simultaneous increase in labor turnover and of the outside option in the proportion of sharecropping depends on the level of the turnover costs. As discussed in subsection 4.4.1, an increase in *Post Office* is equivalent to a simultaneous raise of both labor turnover and of the outside option. Hence, the following regression is estimated:

$$Sharecropping_{c,d} = \gamma_c + \gamma_d + \zeta_1 Post\ Office_{c,d} + \bar{\zeta} X_{c,d} + \epsilon_{c,d} \tag{4.4.1}$$

Where c, d stands for county c in decade d, γ_c is the county-fixed effects term, γ_d is the decade-fixed effects term, and $X_{c,d}$ includes all the control variables in table 4.A.1, and $\epsilon_{c,d}$ is the idiosyncratic error.

> **Prediction 1**: If turnover costs (the outside option) is the dominant reason behind *Sharecropping*, then *ceteris paribus Sharecropping* increases (decreases) with *Post Office*: $\zeta_1 > 0$ ($\zeta_1 < 0$).

Following Proposition 1, when the outside option is low, employees want sharecropping contracts more than employers. Since the latter use sharecropping contracts to avoid labor turnover, turnover costs dominate *Sharecropping*. Hence, increased information brought about by *Post Office* increases *Sharecropping*. When the outside option

is highly valuable, employers want sharecropping contracts more than employees. The latter are driven by the outside options: so when news come, *Sharecropping* decreases.

However, further evidence of the interaction between *Post Office* and labor turnover and the outside option helps to establish which is the dominant force, as discussed in Corollary 1. Hence, a difference-in-differences regression is ran using two treatments, *Rain* and *Coal*:

$$\begin{aligned} &Sharecropping_{c,d} = \gamma_c + \gamma_d + \zeta_1 Post\ Office_{c,d} \\ &+ \zeta_2 Post\ Office_{c,d} \times Rain_c + \zeta_3 Post\ Office_{c,d} \times Coal_c + \bar{\zeta} X_{c,d} + \epsilon_{c,d} \end{aligned} \tag{4.4.2}$$

Note that the level effects of *Rain* and *Coal* are included in the county fixed effects. In case the turnover costs are already large enough:

Prediction 2: In counties with high turnover costs, *ceteris paribus Sharecropping* decreases less with *Post Office*: $\zeta_2 > 0$.

Prediction 3: In counties with a higher outside option, *ceteris paribus Sharecropping* decreases more with *Post Office*: $\zeta_3 < 0$.

The interactions between *Post Office* and the treatments should reflect Corollary 1. The final check on the mechanism predicted by the model involves the total number of farms. Proposition 2 states that the number of farms decreases with a simultaneous increase in labor turnover and the outside. Corollary 2 states that the number of farms decreases more with a simultaneous increase in labor turnover and the outside option when a county has higher turnover costs or higher outside options.

$$\begin{aligned} &Farms_{c,d} = \gamma_c + \gamma_d + \eta_1 Post\ Office_{c,d} \\ &+ \eta_2 Post\ Office_{c,d} \times Rain_c + \eta_3 Post\ Office_{c,d} \times Coal_c + \bar{\eta} X_{c,d} + \epsilon_{c,d} \end{aligned} \tag{4.4.3}$$

Regression 4.4.3 has similar components and, hence, a similar interpretation to those in regression 4.4.2.

Prediction 4: *Ceteris paribus Farms* decreases with *Post Office*: $\eta_1 > 0$. In addition, $\eta_2 < 0$ and $\eta_3 < 0$.

Table 4.4: Regressions including "Rain" and "Coal" treatments.

	Sharecropping			
	(1)	(2)	(3)	(4)
Post Office	-1.2246***	-1.5222***	-0.3724	-0.6585**
	(0.2289)	(0.2470)	(0.2673)	(0.2904)
Post Office×*Rain*		1.3355***		1.0877**
		(0.4275)		(0.4340)
Post Office×*Coal*			-2.2794***	-2.1624***
			(0.4057)	(0.4176)
Enticement laws	0.0017	0.0020	0.0056	0.0057
	(0.0076)	(0.0075)	(0.0076)	(0.0076)
Contract Enforcement laws	-0.0120*	-0.0126*	-0.0137**	-0.0141**
	(0.0069)	(0.0070)	(0.0069)	(0.0069)
Vagrancy laws	0.0272***	0.0266***	0.0211***	0.0210***
	(0.0065)	(0.0064)	(0.0066)	(0.0066)
Emigrant-agent laws	-0.0022	-0.0018	-0.0025	-0.0022
	(0.0052)	(0.0052)	(0.0052)	(0.0052)
Convict-lease system	-0.0105***	-0.0120***	-0.0122***	-0.0133***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)
Rural Pop. Dens.(-1)	0.0012*	0.0014**	0.0014**	0.0016**
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Wage	-0.2450***	-0.2522***	-0.2432***	-0.2491***
	(0.0138)	(0.0142)	(0.0140)	(0.0143)
Urban Pop. Dens.(-1)	-0.0006***	-0.0006***	-0.0006***	-0.0006***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Avg. Farm Size(-1)	0.0001***	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Prop. of Blacks(-1)	0.0005	0.002	0.0022	0.0025
	(0.0402)	(0.0400)	(0.0402)	(0.0401)
Industry	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Dist. Railway	-0.0001	-0.0001	-0.0002	-0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Temperature SD	0.0015	-0.0044	-0.0013	-0.0037
	(0.0113)	(0.0114)	(0.0113)	(0.0114)
Precipitation SD	0.0020***	0.0020***	0.0019***	0.0019***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
County Fixed Effects	Yes	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes	Yes
N	7,609	7,609	7,609	7,609
R-Squared	0.4376	0.4388	0.4415	0.4423

These regressions examine whether the increase in the density of post offices in a county from one decade to another increases or decreases the use of sharecropping contracts relative to all types of farm contracts. Column (1) uses the simplest identification strategy, whereas the remaining tables use difference-in-differences strategy. The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

4.4.3 Baseline Results

Column (1) in table 4.4 brings the results from regression 4.4.1: ζ_1, the coefficient of *Post Office*, is negative. According to Prediction 1, the outside option seems to be the dominant driver of *Sharecropping*. The treatment *Rain* is added in column (2) and it yields the sign predicted in Prediction 2: *Sharecropping* decreases less with a new *Post Office* in counties with higher turnover costs. The treatment *Coal* in column (3) has the sign expected by Prediction 3, but the coefficient of *Post Office* becomes insignificant. This last step might suggest that the results in columns (1) and (2) are completely driven by the counties in this treatment. In fact, table 4.8 brings evidence that the biggest jump in *Sharecropping* occurs when the treatment $Coal = 1$. However, column (4) presents the estimation results from regression 4.4.2 and confirms the patterns expected in Predictions (1) to (3): *Sharecropping* is mostly driven by the outside option perceived by the employees.

Again, it is unlikely that *Post Office* is a sign of local development. These regressions give quantitative backing to this conclusion. *Sharecropping* significantly decreases with *Industry* but the latter does not explain away the effect of *Post Office*. Similarly, population density is frequently used in economics literature to approximate economic development (Michalopoulos and Papaioannou, 2013): both *Rural Pop. Dens.* and *Urban Pop. Dens.* do not explain away the effect of *Post Office*. Finally, *Wage* is a state-level variable, which allows causality claims assuming that none of the counties is relevant enough to drive individually the market of farm wage labor. Also, the model concludes that wages in farms are determined by the outside option. That is, the wage in the market of farm wage labor is a proxy for the outside option of the employees. As predicted in section 4.3, *Wage* decreases *Sharecropping* but without subtracting the effect of *Post Office* and the effect of any of the treatments.

There is another concern with the variable *Post Office*. USPS (2007, p. 25) refers an increase in the number of rural delivery routes, replacing smaller Post Offices after 1901. That is, the overall number of post offices peaks in 1901 and decreases from then until the end of the sample. On the one hand, this policy might have actually made the current empirical analysis to downplay the role of each office. That fact would imply a downward bias on the estimations displayed in table 4.4. On the other hand, more worryingly, there can be a trend affecting the validity of the estimations. Therefore, a regression including interaction terms between *Post Office* and decade dummies is

run. The gist and the significance of the results stay the same: the marginal effect of *Post Office* is still negative and significant at the 1% level.[35]

The treatment *Coal* might also relate to the labor turnover level of a region: Wright (1986) provides examples of young laborers temporarily leaving the fields during the farming season to work in mining. But that would involve an underestimation of the coefficient of *Coal* in *Sharecropping* because labor turnover just affects those employers indifferent between inactivity and wage labor, whereas the outside option affects both those same employers and employees indifferent between sharecropping and the outside option. That is, even if the treatment *Coal* increases more labor turnover than the outside option, the effect must be strong enough to compensate for the fact that labor turnover affects less economic agents than the outside option does.

Analyzing the other controls in column (4), the variables concerning legislation reveal some interesting patterns with possible, intuitive explanations.[36] Because those laws were approved and enforced at the state level, causal claims at the county level can be made.[37] *Contract Enforcement laws* has a negative sign in all regressions. These laws were designed to avoid that employees working as sharecroppers leave the contract in the middle of the season: thus, as the costs to renegade a contract in the middle of the season increases, the contract becomes less desirable for the employees. Similarly, *Vagrancy laws* prevented laborers to look for better jobs. Hence, unsurprisingly *Vagrancy laws* increase *Sharecropping*. Then, *Convict-lease system* was a way of decreasing labor turnover during the season and decreasing outside options: convicts provided private contractors cheap labor that could not leave at will. Thus, *Convict-leasing system* naturally decreases *Sharecropping*.

Table 4.5 displays the estimation results of regression 4.4.3. According to Prediction 5, the results confirm that the outside option dominated labor turnover as a driver of *Sharecropping*. So, a simultaneous increase in labor turnover and the outside option decreased the number of farms. Unfortunately, the second part of the Prediction 5 is not confirmed: *Farms* does not decrease more in turnover costs or in the outside option. A possible explanation for this might be that the effect of *Post Office* alone is so strong that extra variation brought by *Rain* and *Coal* does not add information. Also

[35]The same conclusion was reached when regressing *Sharecropping* on the difference between *Post Office* and the sample average of *Post Office* in each decade.

[36]See Appendix 4.C for further details about this legislation.

[37]Similarly to *Wage*, the underlying assumption is that no county or set of counties is especially important to impose this legislation alone to the whole state.

Table 4.5: Regressions on the total number of Farms.

	Farms			
	(1)	(2)	(3)	(4)
Post Office	-2.0058*	-1.4516	-3.2016***	-2.6368**
	(1.0958)	(1.2315)	(1.0471)	(1.1733)
Post Office×*Rain*		-2.4867		-2.1467
		(1.9029)		(1.8837)
Post Office×*Coal*			3.1980	2.9672
			(2.0362)	(2.0083)
Enticement laws	0.0823***	0.0817***	0.0768***	0.0766***
	(0.0261)	(0.0262)	(0.0257)	(0.0258)
Contract Enforcement laws	0.0741***	0.0752***	0.0766***	0.0774***
	(0.0269)	(0.0267)	(0.0271)	(0.0269)
Vagrancy laws	-0.0344	-0.0333	-0.0260	-0.0257
	(0.0242)	(0.0243)	(0.0247)	(0.0247)
Emigrant-agent laws	0.0850***	0.0844***	0.0855***	0.0849***
	(0.0213)	(0.0214)	(0.0213)	(0.0214)
Convict-lease system	0.0221*	0.0249**	0.0245**	0.0268**
	(0.0123)	(0.0125)	(0.0122)	(0.0125)
Rural Pop. Dens.(-1)	0.0463***	0.0460***	0.0460***	0.0457***
	(0.0061)	(0.0062)	(0.0061)	(0.0062)
Wage	-0.3910***	-0.3776***	-0.3935***	-0.3818***
	(0.0641)	(0.0650)	(0.0638)	(0.0648)
Urban Pop. Dens.(-1)	-0.0009	-0.0009	-0.0008	-0.0008
	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Avg. Farm Size(-1)	0.0001***	0.0002***	0.0001***	0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Prop. of Blacks(-1)	-0.3620**	-0.3629**	-0.3644**	-0.3650**
	(0.1586)	(0.1590)	(0.1585)	(0.1589)
Industry	-0.0018*	-0.0018*	-0.0018*	-0.0018*
	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Dist. Railway	0.0007***	0.0008***	0.0008***	0.0008***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Temperature SD	0.0497	0.0551*	0.0495	0.0541*
	(0.0320)	(0.0321)	(0.0319)	(0.0322)
Precipitation SD	0.0026***	0.0027***	0.0027***	0.0027***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
County Fixed Effects	Yes	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes	Yes
N	7609	7609	7609	7609
R-Squared	0.5223	0.5226	0.5228	0.5229

Analogous exercise to that of table 4.4 but applied to *Farms* in place of *Sharecropping*. The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

in the upside, the interaction terms do not have significant coefficients with opposite signs. That is, the results do not confirm but also do not contradict the second part of Prediction 4.

Like table 4.4, *Contract Enforcement laws* and *Convict-leasing system* are also significant but with positive signs. *Contract Enforcement laws* makes it harder for employees to break contracts in the middle of the season, making farming profitable for more employers. *Convict-leasing system* makes wage labor profitable for more employers. Differently from table 4.4, *Vagrancy laws* are not significant, but *Enticement laws* and *Emigrant-agent laws* have a positive, significant relation with *Farms*. *Enticement laws* made it a crime for an employer to poach employees from another employer. *Emigrant-agent laws* prevented employment agents hiring employees across states, especially those moving workers out of the South.

Table 4.6: Marginal Effects of column (4) of table 4.4, including "Rain" and "Coal" treatments.

	Sharecropping				
	Marginal Effect	*Marginal S.D.*	*Full Sample Avg.*	*1880 Avg.*	*1940 Avg.*
Post Office	-0.6585**	-0.8 p.p.	-2.8%	-3.7%	-2.5%
	(0.2904)				
Post Office with *Rain*	-0.1117	-0.1 p.p.	-0.5%	-0.6%	-0.4%
	(0.2907)				
Post Office with *Coal*	-1.3360***	-1.6 p.p.	-5.6%	-7.6%	-5.2%
	(0.2464)				
Post Office with *Rain* and *Coal*	-0.7892***	-1.0 p.p.	-3.3%	-4.5%	-3.0%
	(0.2612)				

From table 4.A.1, the standard deviation of *Post Office* is 0.0123. In column *Marginal S.D.*, the value equals the standard deviation of *Post Office* times the value in column *Marginal Effect* (where p.p. stands for "percentage point"). The four last columns equal the value in column *Marginal S.D.* divided by the average of *Sharecropping* in the full sample, in 1880, in 1930, and in 1940, respectively. The averages of *Sharecropping* across counties in the full sample, in 1880, in 1930, and in 1940 are 29.38%, 21.71%, and 31.85%, respectively.
The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

Table 4.6 introduces the marginal effects from column (4) of table 4.4. The first line implies that a one-standard-deviation increase in *Post Office* in a county without higher turnover costs nor a higher outside option decreases *Sharecropping* in 0.8 percentage points. This effect becomes insignificant in counties with higher turnover costs, different from what happens in counties with higher outside option, where the effect stays significant and changes to -1.6 percentage points. The effect in a county

with higher turnover costs and a higher outside option is about -1.0 percentage points. The remaining columns give both a better understanding of the scale of these effects and how they change in importance across time. In the whole sample, a one standard deviation increase in *Post Office* would decrease *Sharecropping* by a number between between 2.8% and 5.6%, depending on the level of turnover costs and of the outside option. In 1880, the same type of change would decrease *Sharecropping* between 3.7% and 7.6%. The range in 1940 changes to an interval between -2.5% and -5.2%. The decrease of the effect of *Post Office* on *Sharecropping* from 1880 to 1940 stems from three sources: the relative importance of mail decreased with the appearance of new communication technologies such as the radio and the telephone (Gordon, 2016); the first wave of migration out of the South after 1914 (Collins and Wanamaker, 2015); the Jim Crow era, and hence the benefits from employer paternalism, strengthened after 1900 (Higgs, 1977; Alston and Ferrie, 1993).[38]

These marginal effects demonstrate that labor turnover was a strong reason behind *Sharecropping* across the US South, as thoroughly documented in section 4.2. The effect of post offices in counties with higher turnover costs is always lower or even insignificant. But, overall, there is evidence to conclude that the lack of outside options in counties across the US South was the dominant driver of the rise of sharecropping after the American Civil War. Employers were certainly affected by increased labor turnover during the season, but their effect on the market seemed to have been smaller than that of the employees indifferent between sharecropping and other jobs.

4.4.4 Robustness Checks

Effect of the treatments *Rain* and *Coal*

Table 4.7 splits the sample between treated and untreated samples according to the treatments, *Rain* and *Coal*. In the case of the treatment *Rain*, *Post Office* only has a significant effect in the untreated counties. This gives support to the discussion in section 4.3 when the outside option is high enough: low enough turnover costs suffice for a simultaneous increase in labor turnover and the outside option to decrease the proportion of sharecropping. Comparing the results of the treatment *Coal* with Proposition 1, the proportion of sharecropping increases with a simultaneous increase

[38] In fact, table 4.6 documents that *Sharecropping* increased between 1880 and 1940.

Table 4.7: Regressions depending on whether the county is in the treatment *Rain* (*Coal*).

	Sharecropping				
	Rain	*No Rain*	*Coal*	*No Coal*	*Dist. Coal*
Post Office	0.2058	-1.3172***	-2.3726***	-0.1862	-1.5800***
	(0.5140)	(0.2606)	(0.3611)	(0.3037)	(0.2875)
Post×Dist. Coal					0.0083**
					(0.0034)
Enticement laws	-0.0218**	0.0523***	0.0501**	0.0047	0.0040
	(0.0094)	(0.0128)	(0.0212)	(0.0079)	(0.0077)
Contract Enforcement laws	-0.0131	-0.0186	0.0085	-0.0172**	-0.0122*
	(0.0084)	(0.0137)	(0.0126)	(0.0077)	(0.0069)
Vagrancy laws	0.0233**	0.0205**	0.0500***	-0.0066	0.0249***
	(0.0117)	(0.0085)	(0.0139)	(0.0074)	(0.0066)
Emigrant-agent laws	-0.0024	-0.0073	-0.0026	-0.0102**	-0.0030
	(0.0078)	(0.0069)	(0.0113)	(0.0057)	(0.0052)
Convict-lease system	0.0072	-0.0268***	-0.0115	-0.0091**	-0.0110***
	(0.0058)	(0.0047)	(0.0080)	(0.0042)	(0.0037)
Rural Pop. Dens.(-1)	0.0046***	-0.0009	0.0003	0.0026***	0.0013**
	(0.0011)	(0.0006)	(0.0007)	(0.0008)	(0.0006)
Wage	-0.3037***	-0.2332***	-0.3255***	-0.1620***	-0.2452***
	(0.0299)	(0.0178)	(0.0247)	(0.0168)	(0.0139)
Urban Pop. Dens.(-1)	-0.0008***	-0.0005	-0.0006	-0.0005***	-0.0006***
	(0.0003)	(0.0003)	(0.0005)	(0.0002)	(0.0001)
Avg. Farm Size(-1)	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Prop. of Blacks(-1)	-0.0009	0.0356	-0.0970	0.0891*	-0.0001
	(0.0476)	(0.0707)	(0.0607)	(0.0507)	(0.0402)
Industry	-0.0005**	-0.0001	-0.0003	-0.0005***	-0.0004***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
Dist. Railway	-0.0002	-0.0001	-0.0002	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Temperature SD	-0.0020	-0.0007	-0.0277	0.0073	-0.0012
	(0.0166)	(0.0162)	(0.0198)	(0.0136)	(0.0113)
Precipitation SD	0.0012***	0.0026***	0.0023***	0.0019***	0.0019***
	(0.0003)	(0.0004)	(0.0005)	(0.0003)	(0.0003)
County Fixed Effects	Yes	Yes	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	3,825	3,784	2,384	5,225	7609
R-Squared	0.4784	0.4144	0.5819	0.3855	0.4383

In place of the interaction terms in table 4.4, the regressions in this table are split according to treatments *Rain* and *Coal*. The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

in labor turnover and the outside option as long as turnover costs do not become too high.

There is an especially interesting pattern emerging from both treatments: if *Post Office* is simply a proxy for local development, then the significance and the sign of its coefficient would not change much across samples. But the effect of *Post Office* varies across treated and untreated groups in both treatments, whereas other variables related to local development, such as *Wage* and *Industry* have a much stabler behavior.

The last column of table 4.7 gives more evidence that *Post Office* approximates communication, not local development. Similarly to regression 4.4.2, the marginal effect of *Post Office* on *Sharecropping* is put together with an interaction term between that marginal effect and the distance of each county to the closest coal deposit. As in all regressions of table 4.4, *Post Office* not only has a significant, negative impact on *Sharecropping* but this effect becomes less negative as the distance to a coal deposit increases. Then, it seems that *Post Office* becomes less important as the further away job opportunities are. Taking into account that other controls for local development are used and that *Dist. Coal* is weakly correlated with *Industry*,[39] *Post Office* much more likely explains the impact of enhanced communication than any coincidental local development.

Table 4.8: Average Fitted Value of *Sharecropping* conditional on "Rain" and "Coal" treatments.

	Coal=1	*Coal*=0
Rain=1	35.38%	29.88%
Rain=0	16.54%	29.87%

The regressions ran with all control variables except the identification variable *Post Office* used in the regressions of table 4.7. Then, the fitted values were averaged out across all counties and all decades.

Confirming the analysis of table 4.3, table 4.8 shows that turnover costs definitely played a role: *Sharecropping* increases from counties with $Rain = 0$ to $Rain = 1$. Yet note again that the treatment *Coal* determines the size of that change: changes in *Rain* barely increases *Sharecropping* in counties with $Coal = 0$, whereas *Sharecropping* more than doubles where $Coal = 1$. Also note that if $Rain = 1$, *Sharecropping* increases

[39] *Dist. Coal* and *Industry* share a 0.02 correlation. This correlation is only significant at the 10% level.

with a change of from $Coal = 0$ to $Coal = 1$. Therefore, even when controlling for other factors, the proxy for the outside option seems to have a determinant impact for *Sharecropping*. This is further evidence supporting the possibility that the outside option played the dominant role in the sharecropping phenomenon in the US South.

Local Power vs Federal Power

Post offices, as a branch of the federal government, may have decreased the political clout of the local elites. By consequence, that would interfere with the size of the paternalistic perks given by the local elites. Ager (2013) uses a measure of property inequality in 1860 to demonstrate that prewar elites still played a central role in local politics. Consequently, a treatment is used to split the sample according to whether a county is on the bottom or top 50% of counties in terms of land inequality in 1860: the more unequal land distribution was in 1860, the more powerful the local elite was.

The results on table 4.9 demonstrate that the size, sign, and significance of the coefficient do not change across treated and untreated groups. It is true that the effect of *Post Office* becomes stronger in the *Bottom Land* regression, but the sign and significance level remain the same. These results are hardly surprising in the light of the discussion of section 4.2: the state capacity of the federal government is still under debated by social scientists, and evidence points that the federal government was at best indifferent to the evolution of labor institutions in the US South.

The remaining controls in the first two controls present the same pattern: most variables keep their significance and their signs from the treated to the untreated groups. Also the fact that most counties are in the top 50% of land inequality in 1860 becomes enlightening when combined with the analysis by Ager (2013) and Alston and Ferrie (1993). Elaborating, most counties had politically powerful local elites that could distort public provision to improve the sharecropping option in the eyes of the employees relative to other employment options.

Tenure Composition

Table 4.10 displays two extra regressions that inspect the proportion of fixed-rent farms and the proportion of owner-managed farms, respectively, relative to the total farms applying the same model as in regression 4.4.2. Although the model of section 4.3 does

Table 4.9: Regressions depending on whether the county is in the treatment *Land*.

	Sharecropping		
	Top Land	*Bottom Land*	*Dif-in-Dif*
Post Office	-1.0868***	-1.4061***	-1.0659***
	(0.3250)	(0.3231)	(0.2994)
Post Office×*Land*			-0.3266
			(0.3487)
Enticement laws	0.0072	-0.0061	0.0019
	(0.0101)	(0.0109)	(0.0076)
Contract Enforcement laws	-0.0085	-0.0090	-0.0120*
	(0.0089)	(0.0109)	(0.0069)
Vagrancy laws	0.0288***	0.0163*	0.0273***
	(0.0089)	(0.0099)	(0.0065)
Emigrant-agent laws	-0.0044	-0.0061	-0.0021
	(0.0067)	(0.0084)	(0.0052)
Convict-lease system	-0.0063	-0.0207***	-0.0105***
	(0.0048)	(0.0058)	(0.0037)
Rural Pop. Dens.(-1)	0.0017*	0.0009	0.0012*
	(0.0009)	(0.0007)	(0.0006)
Wage	-0.2498***	-0.2303***	-0.2448***
	(0.0188)	(0.0201)	(0.0139)
Urban Pop. Dens.(-1)	-0.0008	-0.0005***	-0.0006***
	(0.0005)	(0.0001)	(0.0001)
Avg. Farm Size(-1)	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)
Prop. of Blacks(-1)	0.0763	-0.0667	0.0001
	(0.0472)	(0.0716)	(0.0402)
Industry	-0.0005*	-0.0003*	-0.0004***
	(0.0003)	(0.0002)	(0.0001)
Dist. Railways	-0.0003*	0.0001	-0.0001
	(0.0002)	(0.0003)	(0.0001)
Temperature SD	0.0060	-0.0072	-0.0015
	(0.0135)	(0.0202)	(0.0114)
Precipitation SD	0.0020***	0.0020***	0.0020***
	(0.0003)	(0.0004)	(0.0003)
County Fixed Effects	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes
N	4522	3087	7609
R-Squared	0.4913	0.3713	0.4377

This table uses a treatment that proxies the power of political elites, *Land*. The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

not include all the steps in the tenancy ladder,[40] these results conform to what can be predicted from the literature.

Comparing the column *Fixed Rent* to column *Sharecropping*, the proportion of fixed-rent farms also decreases with a simultaneous increase in labor turnover and in the outside option but it decreases less when the outside option increases and does not react to an increase in turnover costs. This is consistent with the fact that those employees most suited for sharecropping eventually became fixed-rent tenants (Ransom and Sutch, 1977; Wright, 1986). According to the model of section 4.3, more employees on the border between sharecropping and the outside option drop when the latter improves. But that also means that the population of remaining sharecroppers has a higher average managerial ability. Hence, following the heuristics given by the literature, it is expected that a core of fixed-rent tenants remains even with very high outside option because they have extremely low management costs.[41]

Interesting results also arise from analyzing column *Owner vis-à-vis* column *Sharecropping*. As predicted by the model of section 4.3, *Owner* increases with a simultaneous increase in labor turnover and the outside option, but this derivative is only significantly affected by the level of turnover costs hinged by the treatment *Rain*. This result lends support to the idea that labor turnover was only a problem for employers and higher wages could be absorbed with tenancy agreements.

Inspecting the remaining variables is also quite illuminating. *Enticement laws*, which do not affect *Sharecropping*, appear to transfer farms from *Owner* to *Fixed Rent*, which is consistent with an increase in the value of fixed-rent contracts to employers due to lower chance of contractual breach. *Contract Enforcement laws* seem to carry an extra burden only for sharecroppers, which again is consistent with the idea that fixed-rent tenants were the most able tenant farmers and, hence, less affected by marginal changes in the value of the contract. Consistent with the idea that *Vagrancy laws* increased job search costs and, hence, depressed the outside option, this set of laws increases both types of tenancy and decreases the importance of owner-run farms. *Emigrant-agent laws* and *Convict-leasing system* depress labor turnover and the outside option. Yet they only increase *Fixed Rent*, having a negative or insignificant impact

[40] Steps of the tenancy ladder: wage labor, sharecropping, fixed-rent tenancy, and ownership of the land (Shlomowitz, 1984; Alston and Kauffman, 2001; Naidu, 2010).

[41] In addition, the model of this chapter assumes that employers and employees are uniformly distributed. The comparative statics might change when assuming a distribution skewed to employers and employees with high management costs.

Table 4.10: Regressions on *Fixed Rent* and *Owner* compared with regression on *Sharecropping*.

	Fixed Rent	*Owner*	*Sharecropping*
Post Office	-0.8110***	1.4172***	-0.6585**
	(0.1837)	(0.3020)	(0.2904)
Post Office×*Rain*	0.0501	-1.1985***	1.0877**
	(0.3079)	(0.3576)	(0.4340)
Post Office×*Coal*	1.9493***	0.1985	-2.1624***
	(0.3132)	(0.3550)	(0.4176)
Enticement laws	0.0196***	-0.0258***	0.0057
	(0.044)	(0.0066)	(0.0076)
Contract Enforcement laws	0.0005	0.0097*	-0.0141**
	(0.0055)	(0.0073)	(0.0069)
Vagrancy laws	0.0113**	-0.0324***	0.0210***
	(0.0050)	(0.0053)	(0.0066)
Emigrant-agent laws	0.0054***	0.0009	-0.0022
	(0.0038)	(0.0040)	(0.0052)
Convict-lease system	0.0186***	-0.0019***	-0.0133***
	(0.0038)	(0.0033)	(0.0037)
Rural Pop. Dens.(-1)	0.0010**	-0.0021**	0.0016**
	(0.005)	(0.0005)	(0.0006)
Wage	0.0841***	0.1612***	-0.2491***
	(0.0099)	(0.0113)	(0.0143)
Urban Pop. Dens.(-1)	0.0000	0.0005***	-0.0006***
	(0.0001)	(0.0002)	(0.0001)
Avg. Farm Size(-1)	0.0000	-0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)
Prop. of Blacks(-1)	0.2630***	-0.2809***	0.0025
	(0.0288)	(0.0368)	(0.0401)
Industry	0.0001	0.0002*	-0.0004***
	(0.0001)	(0.0001)	(0.0001)
Dist. Railways	-0.0003***	0.0004***	-0.0002
	(0.0001)	(0.0001)	(0.0001)
Temperature SD	0.0316***	-0.0300**	-0.0037
	(0.0089)	(0.0118)	(0.0114)
Precipitation SD	-0.0007***	-0.009***	0.0019***
	(0.0002)	(0.0002)	(0.0003)
County Fixed Effects	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes
N	7,609	7,609	7,609
R-Squared	0.2088	0.4314	0.4423

Column *(Sharecropping)* is the same as column (4) of table 4.4. This table shows the impact of *Post Office* in the composition of the farming contracts. The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

in the other two types of land tenure. Lastly, *Wage* has a positive impact on both *Fixed Rent* and *Owner*. This result is consistent with the idea that the outside option was mostly a concern for employees indifferent between sharecropping and other types of jobs, that is, employees with higher management costs. If *Wages* was essentially a consideration in the cost structure of employers, that would decrease *Owner*, not increase it. Furthermore, a positive effect on *Fixed Rent* has a similar interpretation to the derivative between *Fixed Rent* and *Post Office*. After each simultaneous increase in labor turnover and the outside option, the remaining fixed-rent tenants are those with the lowest management costs.

Extra robustness checks

Three extra robustness checks are run. Table 4.D.1 addresses concerns with the states included in the sample. First, the county borders changed quite significantly in Florida and Texas (NHGIS, 2011), a potential sign of underlying changes in the settlement in those regions. Kentucky and West Virginia did not join the confederates in the American Civil War. Moreover, figures 4.1 and 4.2 shows that all these states have a higher sample average of *Post Density* and a low sample average of *Sharecropping*. Overall, all results, although the magnitude and significance of the results vary somewhat, excluding these states in particular does not change the gist and the significance of the results shown in column (1) of table 4.4.[42]

The second extra robustness uses random effects estimation circumvents the fact that treatments *Rain* and *Coal* are time invariant.[43] Although the model in section 4.3 does not handle hypothetical long-term effects of those treatments, interpreting those treatments gives further evidence to the main conclusion of this chapter. Briefly, the treatment *Rain* has no significant level effect on *Sharecropping* but the treatment *Coal* has a positive level effect on *Sharecropping*. Path dependence gives one possible story. Since employers had slaves in cotton plantations before the American Civil War, the

[42] *Postal History*, the source of the variable *Post Office*, classifies the data of Post Offices in Virginia as 'subpar'. However, excluding Virginia does not affect the results.

[43] Although a random-effect estimator allows for time-invariant components, it also requires a stricter assumption on exogeneity. Bearing this last shortcoming in mind, regression 4.4.2 is run using a random-effects estimator, and including the level of each treatment in the set of control variables. At a first glance, table 4.D.2 shows that almost all coefficients keep their significance and sign when changing from a fixed-effects estimation to a random-effects estimation. The R-Squared also does not change by much. These findings give some extra confidence when reading the coefficients of time-invariant variables.

labor turnover problem in cotton cultivation proxied by the treatment *Rain* was not a problem. Likewise, the outside options brought by the treatment *Coal* already existed before the American Civil War, which affected choices in other crops besides cotton. An alternative story relates to the possibility that *Coal* captures labor turnover that is not explained by the treatment *Rain*. That effect would be consistent with the predictions of the model. In other words, the treatment *Coal* alone mostly increases labor turnover permanently but, when combined with more post offices, it also improves the chances of news about new job openings that shift the outside option.

The final extra robustness check tackles the effect of selection in unobservables on the results in table 4.4. Although the dataset provides enough variables to capture the thresholds of the model of section 4.3, this empirical exercise uses aggregate observational data to test decisions taken at employer and/or employee level. This chapter follows the methodology proposed by Altonji, Elder, and Taber (2005) and improved by Oster (2016), which gives a ratio to analyze the variation in the coefficient of each variable from a regression model with less variables, called the *restricted* model, to the regression model with all the variables used in the regressions of this section, called the *full* model. The numerator consists of the coefficient of the full model, β_F. The denominator consists of the difference between the coefficient of the restricted model, β_R, and β_F. Overall, the larger the absolute value of this ratio, the stronger the selection on unobservables must be to explain away the findings of this model. Oster (2016) proposes that ratio to be multiplied by another ratio where the numerator is the difference between the R-Squared of the full model, R_F, and that of the restricted model, R_R, and the denominator is the difference between the R-Squared of the model including the unobservables, R_{Max}, and R_F.[44]

The first line of table 4.D.3 tests the robustness of the coefficient of *Post Office* presented in column (1) of table 4.4, whereas the next three lines test the robustness of the coefficients of *Post Office* and its interactions with the treatments *Rain* and *Coal*. Note that the restricted model in columnes (1) to (4) includes the variables that historical evidence in subsection 4.2.2 identifies as drivers of *Post Office*: population density and proximity to railroads. Following a suggestion by Oster (2016), columns (3) and (4) measure how strong the selection on unobservables would have to be to

[44]Oster (2016) recommends a $R_{Max} = 1.3R_F$ due to the chance that all variables, including the proxies for unobservables, would have some measurement error in the real world.

make those coefficients equal to their asymmetric value.

The results in the first line prove the robustness of the coefficient *Post Office*. In columns (1) and (2), the selection on unobservables would have to be 44% to 100% (2.88 and 3.99 times) stronger than the selection on observables to make the coefficient insignificant (to invert the sign of this coefficient). Therefore, it is unlikely that some unobserved heterogeneity can explain away the findings in column (1) of table 4.4. However, in the next three lines, only the coefficient of the interaction term between *Post Office* and the treatment *Coal* has a similar performance, which raises doubts about the coefficients of column (4) of table 4.4. But, again, the first line hints that the coefficient of *Post Office* is robust to unobservables. Thus, two extra treatments are perhaps noisy proxies to labor turnover and the outside option, contaminating the coefficient of *Post Office*. The R-Squared increases very little from column (1) to column (4) in table 4.4. Also table 4.8 signals that the greatest drop in *Sharecropping*, almost 20 percentage points, occurs when the treatment *Rain* changes in counties with $Coal = 1$. So, the increased noise of *Post Office* might be caused by the fact that *Sharecropping* decreases much more when turnover costs decrease in counties with a higher outside option. This story is consistent with the core message of the chapter: whenever there are more news of better jobs outside of agriculture, turnover costs need to be dramatically high for an increase in the proportion of sharecropping to happen. Above all, to contradict the core conclusion of this chapter, the coefficient signs would have to be the opposite: selection on unobservables would have to be stronger than that on observables to explain away the interaction terms.[45]

4.5 Concluding Remarks and Future Research

The rise of sharecropping contracts in the US South between 1880 and 1940 offers a neat case study to disentangle the dominant driver behind a specific labor contract: economists and economic historians agree on the primacy of labor turnover in the emergence of these share contracts; the terms of these share contracts were standardized before 1880, meaning decisions of both employers and employees were mostly on the extensive margin; some employees benefited more from sharecropping than others; the rural South lived in isolated and, thus, unaware of large transformations brought by in-

[45] As reported in the last footnote of table 4.D.3, Oster (2016) warns for several serious limitations to this method.

dustrialization; also before 1880, the Post Office service was already a well-established, capable communication service that could counteract isolation. Hence, an additional post office certainly increased labor turnover and the outside option, affecting both employers indifferent between sharecropping and wage labor, and employees indifferent between sharecropping, wage labor and the outside option.

The propositions discussed in subsection 4.3.2 demonstrate that if the outside option is low enough, a simultaneous increases in labor turnover and the outside option increase the proportion of sharecropping. In other words, the proportion of sharecropping is driven by employers who wish to minimize labor turnover. Otherwise, if the outside option is high enough, the proportion of sharecropping will be driven by employees who are left indifferent between sharecropping and any other option inside or outside the farming sector. In that case, a simultaneous increase in labor turnover and the outside option decreases the proportion of sharecropping. Section 4.4 translates these propositions into empirically-testable predictions using the variation in post office density at county level as the identification variable of a simultaneous increase in labor turnover and the outside option.

The gist of non-parametric and parametric empirical evidence is unambiguous: labor turnover faced by the employers was certainly not the dominant force behind the proportion of sharecropping; all the evidence gives that role to the outside option of the employees. The proportion of sharecropping is negatively correlated to the post office density. The baseline regression in column (1) of table 4.4 presents a statistically-significant, negative coefficient of post office density. The treatments *Rain* and *Coal*, respectively measuring turnover costs and the outside option, give further evidence of the adherence of the propositions from subsection 4.3.2 and, again, that all the evidence points in favor of the dominance of the outside option. Several robustness checks do not only reinforce the key message of this chapter but they also downplay the role of post office as a proxy for local development or for the presence of the federal government.

Figure 4.1 demonstrates the relevance of the issue at hand: the higher the proportion of sharecropping in a county between 1880 and 1940, the lower GDP per capita in 2014. This descriptive statistic points for a possible distortion in resource allocation that still affects the economy nowadays. A back-of-the-envelope calculation using the marginal effects of table 4.6 tells that a one-standard-deviation increase in post office density in the past would have increased the GDP per capita in 2014 somewhere in

between 0.5% and 1.1%. The discussion in subsection 4.4.3 tells that these values most likely underestimate the impact of communication: mailing delivery routes improved in this time, increasing the efficiency of each post office; more communication means were made available to the population, such as the radio; the first wave of migration out of the South happened after 1914 as direct result from World War 1; after 1900, the Jim Crow era meant diminished labor mobility and increased paternalistic benefits for employees. All in all, according to section 4.2, sharecropping was a great solution among the feasible arrangements to solve labor supply problems in the farming sector. However, the present study gives robust evidence that sharecropping mostly resulted from employees who took those contracts due to low outside options. The negative relation between sharecropping and GDP per capita entices future research about a possible significant cost that the US South still bears today.

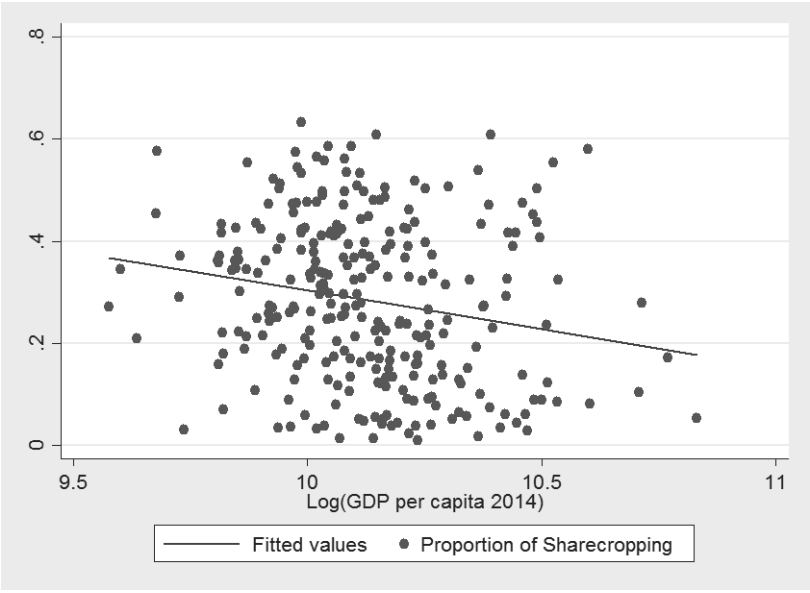


Figure 4.1: Correlation between GDP per capita in 2014 and number of sharecropping farms over the total number of farms, 1880-1940 average. Correlation: -0.20, significant at 1%. Sources: NHGIS (2011).

As discussed in the introduction, share contracts abound in the modern economy. The literature found several reasons inside of particular firms or industries to use them. However, this chapter finds evidence of the adoption of a share contract mostly due to a low outside options for employees created by deficient communication. This is a phenomenon that might well explain the persistence of sharecropping in developing

economies nowadays (Townsend and Mueller, 1998). Using non-parametric evidence, Hall and Krueger (2016) also discuss the role of outside options to make sure they do not affect the rapid increase in the number of Uber's driver-partners. The emergence of franchising contracts (Pruett and Winter, 2011) might also be affected by the level of the outside option: the same way sharecropping contracts gave access to a crucial input, land, to several impoverished farmers, less-able entrepreneurs nowadays might only find some crucial inputs, such as branding, through franchising contracts.

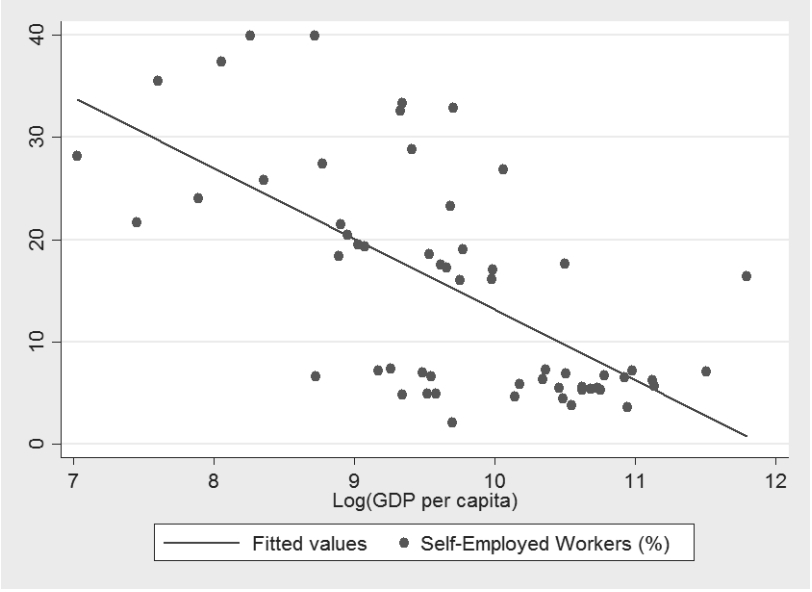


Figure 4.2: Correlation between GDP per capita and Entrepreneurial Activity. Correlation: -0.65, significant at 1%. Sources: The Economist; International Monetary Fund.

Since franchising is a form of entrepreneurship (Pruett and Winter, 2011), this chapter gives a possible interpretation of figure 4.2: the higher the GDP per capita, the less important entrepreneurs are in the labor force. Further evidence of the role of the outside option is brought by table 4.1 and GEM (2015). First, the top 5 most entrepreneurial countries are poorer than any of the bottom 5 countries. Although Suriname and Russia are not necessarily very sophisticated or diversified economies, it is easy to see the role of the outside option when comparing any of the Top 5 economies with Italy, Hong Kong and Japan, all economies with a long, established tradition of world-class entrepreneurs. Second, GEM (2015) states the proportion of Spanish workers who became entrepreneurs out of necessity increased from 14.8% in 2008 to

29.8% in 2014 at the same time the total entrepreneurial activity rate decreased from more than 7% in 2008 to 5.5% in 2014. That is, when the financial crisis depressed a modern economy like Spain, the proportion of entrepreneurs potentially with a binding participation constraint more than doubled. Thus, future research should take steps along the lines of Paulson, Townsend and Karaivanov (2006) in order to investigate the dominant factors behind entrepreneurship.

Table 4.1: Top 5 and bottom 5 countries in terms of Entrepreneurial Activity.

Highest	*Lowest*
Nigeria (39.9%)	Suriname (2.10%)
Zambia (39.9%)	Hong Kong (3.60%)
Cameroon (37.4%)	Japan (3.83%)
Uganda (35.5%)	Italy (4.42%)
Namibia (33.3%)	Russia (4.69%)

Definition: percentage of active population who are either a nascent entrepreneur or a owner-manager of a new business. Source: The Economist.

Appendix

4.A Variables

Table 4.A.1: Main Variables

Variable	Definition and Sources	Median Value (Standard Deviation)	Obs.
Sharecropping:	Number of sharecropping farms relative to total number of farms in each county. Source: NHGIS (2011).	0.2938 (0.1775)	8,058
Farms:	Number of farms relative to the total area of each county. Source: NHGIS (2011).	1.5020 (0.9459)	8,106
Post Office:	Number of post offices per square kilometer in each county. Source: Postal History, https://postalhistory.com/.	0.0136 (0.0123)	7,840
Rain:	1 if the county belongs to the top 50% of the counties with the highest average, monthly standard deviation of precipitation from September to December, 0 otherwise. Source: NOAA (2016) and Hong (2013).		8,148
Coal:	1 if the county sits on a coal deposit, 0 otherwise. Source: USGS (1996).		8,148
Laws and *Convict-lease system*:	1 if the county is in a state where this legislation is enforced in each decade, 0 otherwise. Source: Figure 4.C.1.		
Rural Pop. Dens.:	Population per square kilometer living in locations with less than 2.500 inhabitants in each county. Source: NHGIS (2011).	12.0981 (8.7294)	8,122
Wage:	Farm labor wage rates per day without board per state. Source: USDA (1942).	1.0778 (0.4033)	8,148
Urban Pop. Dens.:	Population per square kilometer living in locations with more than 2.500 inhabitants in each county. Source: NHGIS (2011).	4.0397 (27.3124)	8,122
Avg. Farm Size:	Average size of farms in square meters in a county. Source: NHGIS (2011).	699.6453 (456.2196)	8,073

All variables cover the period 1880 and 1940, one data point per decade. Number of observations equals to the product of the cross-section and the time-series dimensions. *Sharecropping* variable definition varies according to data availability. Between 1880 and 1900, the census just mentions share tenants. After 1910, there is still significant variation from census wave to census wave. For a matter of consistency, sharecropper, share tenant, share cash tenant, sharecropper and other tenants are all included in the *Sharecropping*. The treatments *Rain* and *Coal* are proxies for turnover costs and the outside option, respectively.

Main Variables - Continuation

Variable	Definition and Sources	Median Value (Standard Deviation)	Obs.
Prop. of Blacks:	Proportion of black labor force relative to white labor force in the county. Source: NHGIS (2011).	0.2647 (0.2341)	8,104
Industry:	Industrial production in millions of dollars. Source: NHGIS (2011).	3.1234 (15.0550)	8,148
Dist. Railway:	Distance of the county's centroid to the nearest railway line. Source: Atack (2013).	15.4724 (37.1110)	8,148
Temperature SD:	Average monthly standard deviation of the average temperature. Source: NOAA (2016) and Hong (2013).	1.6752 (0.2532)	8,126
Precipitation SD:	Average monthly standard deviation of precipitation. Source: NOAA (2016) and Hong (2013).	46.4452 (9.3920)	8,126

All variables cover the period 1880 and 1940, one data point per decade. Number of observations equals to the product of the cross-section and the time-series dimensions.

Table 4.A.3: Robustness Variables

Variable	Definition and Sources	Median Value (Standard Deviation)	Obs.
Fixed Rent:	Number of fixed rent farms relative to total number of farms in each county. Source: NHGIS (2011).	0.1054 (0.1197)	8,058
Owner:	Number of owner-run farms relative to total number of farms in each county. Source: NHGIS (2011).	0.5928 (0.2046)	8,058
Dist. Coal:	Distance to the closest coal deposit to each county centroid in kilometers. Source: USGS (1996).	64.95882 (85.2052)	8,148
Land:	1 if the county belongs to the top 50% of the counties with the highest land inequality in the 1860 census, 0 otherwise. Source: Nunn (2008).		8,148

All variables cover the period 1880 and 1940, one data point per decade. Number of observations equals to the multiplication of the cross-section and the time-series dimensions, and varies according to data availability. *Sharecropping* variable definition varies according to data availability. *Fixed Rent* and *Owner* farms face the same data availability issues as *Sharecropping*.

4.B Solution of the Model in Section 4.3

There are three thresholds that determine whether employees or employers are setting the proportion of sharecropping contracts. One of those thresholds also reveals whether all employers are active.

Wage Labor

Each employer sets a. Thus, $w = \frac{a^2}{2} + \bar{u}$ to satisfy the participation constraint of the employee. In equilibrium, $a = 1$, giving the employer:

$$\Pi^E_{wage} = \frac{1 - \beta^2\sigma^2}{2} - \bar{u} - \delta \tag{4.B.1}$$

Therefore, wage labor is only profitable when employers have a δ lower or equal than δ_w:

$$\delta \leq \delta_w = \frac{1 - \beta^2\sigma^2}{2} - \bar{u} \tag{4.B.2}$$

Notice that all employees working as wage laborers earn $\bar{u}$. That is, they are indifferent between the outside option and wage labor.

Furthermore, given that $\bar{u} > 0$, $\delta_w < 1$. To see this, let us suppose that $\delta_w \geq 1$. Then:

$$\bar{u} \leq -\frac{1 + \beta^2\sigma^2}{2} \tag{4.B.3}$$

This is impossible. Thus, there is always a number of inactive employers and, hence, of farms.

Sharecropping

The employee chooses effort such that $a = s$. Then, the employer chooses s to maximize his payoff facing the following participation constraint:

$$\frac{s^2}{2}\left(1 - \sigma^2\right) - \alpha \geq \bar{u} \tag{4.B.4}$$

The employers know the distribution of α. So, they set s so that all the employees with $\alpha \leq \alpha_s$ take the sharecropping contract:

$$s \geq s_s = \sqrt{2\frac{\bar{u} + \alpha_s}{1 - \sigma^2}} \tag{4.B.5}$$

The first-order condition of the problem can be used to find the optimal α_s after plugging $s = s_s$ in:

$$\alpha_s = \frac{1-\sigma^2}{2}\left(\frac{1+\sigma^2}{2+\sigma^2}\right)^2 - \bar{u} \tag{4.B.6}$$

Thus, sharecropping gives the employer:[46]

$$\Pi^E_{share} = \frac{1}{2\left(2+\sigma^2\right)} \tag{4.B.7}$$

Employees with $\alpha = \alpha_s$ working as sharecroppers earn $\bar{u}$, while all employees with $\alpha < \alpha_s$ working as sharecroppers earn more than $\bar{u}$. Thus, employees working as sharecroppers earn an information rent. That is consistent with the necessity of a premium for employers to convince employees to take sharecropping contracts in the US South (Alston and Ferrie, 1993).

Employer's choice

Employers choose sharecropping over wage labor when δ is such that $\Pi^E_{share} \geq \Pi^E_{wage}$:

$$\delta \geq \delta_s = \frac{1-\beta^2\sigma^2}{2} - \frac{1}{2\left(2+\sigma^2\right)} - \bar{u} \tag{4.B.8}$$

To be sure, $\delta_s > 0$ as long as $\bar{u}$ and β are low enough:

$$\frac{\beta^2\sigma^2}{2} + \bar{u} \leq \frac{1}{2}\left(1 - \frac{1}{2+\sigma^2}\right) \tag{4.B.9}$$

Proportion of Sharecropping Contracts and Active Farms

The discussion finds 2 key values on the δ continuum and 1 key value on the α continuum:

1. δ_w: employers with $\delta \leq \delta_w$ remain active.

2. δ_s: employers with $\delta \geq \delta_s$ seek sharecropping contracts; employers with $\delta < \delta_s$ always use wage labor contracts.

3. α_s: employees with $\alpha \leq \alpha_s$ seek sharecropping contracts. The remaining employees always choose to work as wage laborers or the outside option.

[46] Note that $s \geq 1 \Leftrightarrow \alpha \geq \frac{1-\sigma^2}{2} - \bar{u}$, which is always larger than the equilibrium α. That is, sharecropping never becomes unprofitable.

Hence, $1-\delta_s$ employers and α_s employees are available to work together in a sharecropping arrangement. The probability that one employee meets an employer that wants a sharecropper equals to the proportion of sharecropping farms relative to the total number of farms divided by total number of active farms, $\mathbf{p}$:

$$\mathbf{p} = \frac{\alpha_s(1-\delta_s)}{Active\ Farms} \tag{4.B.10}$$

The underlying assumption is that there are some search costs both for employers and employees that stop them for looking continuously for a sharecropping contract. For instance, there is a time limit to begin farm work because crop calendars are exogenous to any of the agents. Meanwhile, the number of active farms is lower than 1:

$$Active\ Farms = 1-(1-\alpha_s)(1-\delta_w) \tag{4.B.11}$$

There are $1-\delta_w$ employers who are only active with sharecropping contracts. Yet $1-\alpha_s$ of those employers cannot find an employee willing to work with a sharecropping contract. Thus, $(1-\alpha_s)(1-\delta_w)$ employers become inactive. *Active Farms* can be rewritten into a new expression:

$$Active\ Farms = \alpha_s + (1-\alpha_s)\delta_w \tag{4.B.12}$$

Hence, the proportion of sharecropping can also be rewritten into a different form:

$$\mathbf{p} = \frac{\alpha_s(1-\delta_s)}{\alpha_s + (1-\alpha_s)\delta_w} \tag{4.B.13}$$

Proposition 1 and Corollary 1 - Derivatives of Proportion of Sharecropping Contracts

For simplicity, this solution focus on the case when $\delta_w \geq 1$, i.e. all employers are active. The derivatives of δ_s and δ_w with respect to β and $\bar{u}$:

1. $\frac{\partial \delta_s}{\partial \beta} = \frac{\partial \delta_w}{\partial \beta} = -\beta\sigma^2$.
2. $\frac{\partial \delta_s}{\partial \bar{u}} = \frac{\partial \delta_w}{\partial \bar{u}} = -1$.

The derivatives of α_s with respect to β and $\bar{u}$:

1. $\frac{\partial \alpha_s}{\partial \beta} = 0$.

2. $\frac{\partial \alpha_s}{\partial \bar{u}} = -1$.

Now, it is straightforward to find the derivative of $\mathbf{p}$ with respect to β and $\bar{u}$:

1. $\frac{\partial \mathbf{p}}{\partial \beta} = \alpha_s \frac{\delta_w + \alpha_s(2-\delta_w-\delta_s)}{(\alpha_s+(1-\alpha_s)\delta_w)^2}\beta\sigma^2$.

2. $\frac{\partial \mathbf{p}}{\partial \bar{u}} = -(1-\delta_s)\frac{\delta_w - \alpha_s(1-\alpha_s)}{(\alpha_s+(1-\alpha_s)\delta_w)^2}$.

Clearly, $\frac{\partial \mathbf{p}}{\partial \beta}$ is always positive, and $\frac{\partial \mathbf{p}}{\partial \bar{u}}$ is only negative if $\delta_w > \alpha_s(1-\alpha_s)$. In case $\frac{\partial \mathbf{p}}{\partial \bar{u}}$ is negative, the total effect of a simultaneous increase in β and $\bar{u}$ on p is negative if β is low enough:

$$\beta < \bar{\beta} = \frac{1}{\sigma^2}\frac{(1-\delta_s)\delta_w}{\alpha_s(1-\delta_s+\delta_w+\alpha_s(1-\delta_w))} \tag{4.B.14}$$

Otherwise, a simultaneous increase in β and $\bar{u}$ on p is positive. This shows the statement in Proposition 1: depending on the size of labor turnover and/or turnover costs, a simultaneous increase in labor turnover and in the outside option may decrease or increase the proportion of sharecropping.

The second derivatives with respect to β and to $\bar{u}$:

$$\begin{aligned}
&\frac{\frac{\partial \mathbf{p}}{\partial \beta} + \frac{\partial \mathbf{p}}{\partial \bar{u}}}{\partial \beta} = \\
&\left(\frac{1}{\beta} + \alpha_s\beta^2\sigma^4\left(\frac{2\alpha_s - 1}{\delta_w + \alpha_s(2-\delta_w-\delta_s)} + \frac{2(1-\alpha_s)}{\alpha_s+(1-\alpha_s)\delta_w}\right)\right)\frac{\partial \mathbf{p}}{\partial \beta} + \\
&\beta\sigma^2\left(\frac{1}{1-\delta_s} - \frac{1}{\delta_w - \alpha_s(1-\alpha_s)} + \frac{2(1-\alpha_s)}{\alpha_s+(1-\alpha_s)\delta_w}\right)\frac{\partial \mathbf{p}}{\partial \bar{u}}
\end{aligned} \tag{4.B.15}$$

$$\begin{aligned}
&\frac{\frac{\partial \mathbf{p}}{\partial \beta} + \frac{\partial \mathbf{p}}{\partial \bar{u}}}{\partial \bar{u}} = \\
&\left(\alpha_s\beta\sigma^2\left(2\frac{2-\delta_w-\alpha_s}{\alpha_s+(1-\alpha_s)\delta_w} - \frac{2-\delta_w-\delta_s+1-2\alpha_s}{\delta_w+\alpha_s(2-\delta_w-\delta_s)}\right) - \frac{1}{\alpha_s}\right)\frac{\partial \mathbf{p}}{\partial \beta} + \\
&+\left(\frac{1}{1-\delta_s} + 2\frac{2-\delta_w-\alpha_s}{\alpha_s+(1-\alpha_s)\delta_w}\right)\frac{\partial \mathbf{p}}{\partial \bar{u}}
\end{aligned} \tag{4.B.16}$$

It is true that $\frac{\frac{\partial \mathbf{p}}{\partial \beta} + \frac{\partial \mathbf{p}}{\partial \bar{u}}}{\partial \beta} > 0$ if:

$$\frac{\partial \mathbf{p}}{\partial \beta} > \frac{\alpha_s\beta\sigma^2}{\alpha_s+(1-\alpha_s)\delta_w}\frac{1-2\alpha_s}{2(1-\alpha_s)} \tag{4.B.17}$$

This last condition always holds in case $\alpha_s < \frac{1}{2}$.

Finally, it is true that $\frac{\frac{\partial \mathbf{p}}{\partial \beta} + \frac{\partial \mathbf{p}}{\partial \bar{u}}}{\partial \bar{u}} < 0$ if:

$$\frac{\partial \mathbf{p}}{\partial \beta} < \frac{\alpha_s \beta \sigma^2}{2(\alpha_s + (1-\alpha_s)\delta_w)} \left(1 + \frac{1 - 2\alpha_s}{2 - \delta_w - \alpha_s}\right) \tag{4.B.18}$$

Proposition 2 and Corollary 2 - Derivatives of Active Farms

The total number of active farms always decreases on $\bar{u}$ and β when $\bar{u} \geq \bar{u}_h$. The derivatives of the active farmers with respect to β and to $\bar{u}$:

1. $\frac{\partial Active\ Farms}{\partial \beta} = -(1-\alpha_s)\beta\sigma^2 < 0$
2. $\frac{\partial Active\ Farms}{\partial \bar{u}} = \alpha_s + \delta_w - 2 < 0$

Note that $\alpha_s + \delta_w < 2$ because $\alpha_s, \delta_w < 1$. This shows the statement in Proposition 2: when there are inactive farms, a simultaneous increase in β and $\bar{u}$ unambiguously decreases the number of active farms.

Corollary 2 is also quite forward to demonstrate by analyzing the second derivatives:

$$\frac{\partial \frac{\partial Active\ Farms}{\partial \beta} + \frac{\partial Active\ Farms}{\partial \bar{u}}}{\partial \beta} = -(1 + \beta - \alpha_s)\sigma^2 < 0 \tag{4.B.19}$$

$$\frac{\partial \frac{\partial Active\ Farms}{\partial \beta} + \frac{\partial Active\ Farms}{\partial \bar{u}}}{\partial \bar{u}} = -(\beta\sigma^2 + 2\bar{u}) < 0 \tag{4.B.20}$$

Notice that $1 + \beta - \alpha_s > 0$ since $\alpha_s < 1$.

4.C Extra control variables

Enticement, *Contract Enforcement*, *Vagrancy*, *Emigrant-agent laws*, and *Convict-Leasing System*

After 1877, the South progressively revived the Black Codes. This body of legislation was part of the Jim Crow Era, during which blacks were relegated to a *de facto* second-class citizen status until the 1960s. Wright (1986) states that employers used racial discrimination to drive wages to whites and blacks alike. Naidu (2010) finds that a negative impact of that legislation over different labor market outcomes, such as returns on working experience. Roback (1984) also defends the need for this sort of legislation to enforce sharecropping contracts. Figure 4.C.1 summarizes the evolution of the enactment of those laws:[47]

- Enticement and Contract Enforcement laws - The former "made it a crime for an employer to 'entice' a laborer who had a contract with another employer", whereas the later guaranteed that "a laborer who signed a contract and then abandoned his job could be arrested for a criminal offense." These laws reduced competition to the beginning of the season, when employers and employees could sign new contracts.

- Vagrancy laws - These "essentially made it a crime to be unemployed or out of the labor force", increasing the search cost for better jobs.

- Emigrant-agent laws - These laws prevented agents hiring workers across states, especially those moving workers out of the South.

- Convict-lease system - It was a penalty for transgressors of contract enforcement and vagrancy laws. The government would lease prisoners to private entities, relinquishing any monitoring of day-to-day use of those prisoners.

Rural Pop. Dens. and *Urban Pop. Dens.*

The US census also provides rural and urban population. Population density is used in place of the absolute number to control for the county size. These variables are strongly correlated with the number of post offices in an area, as discussed in subsection 4.2.2, as well with the use of sharecropping contracts (Alston, 1981).

[47] The quotes in the following descriptions are from Roback (1984).

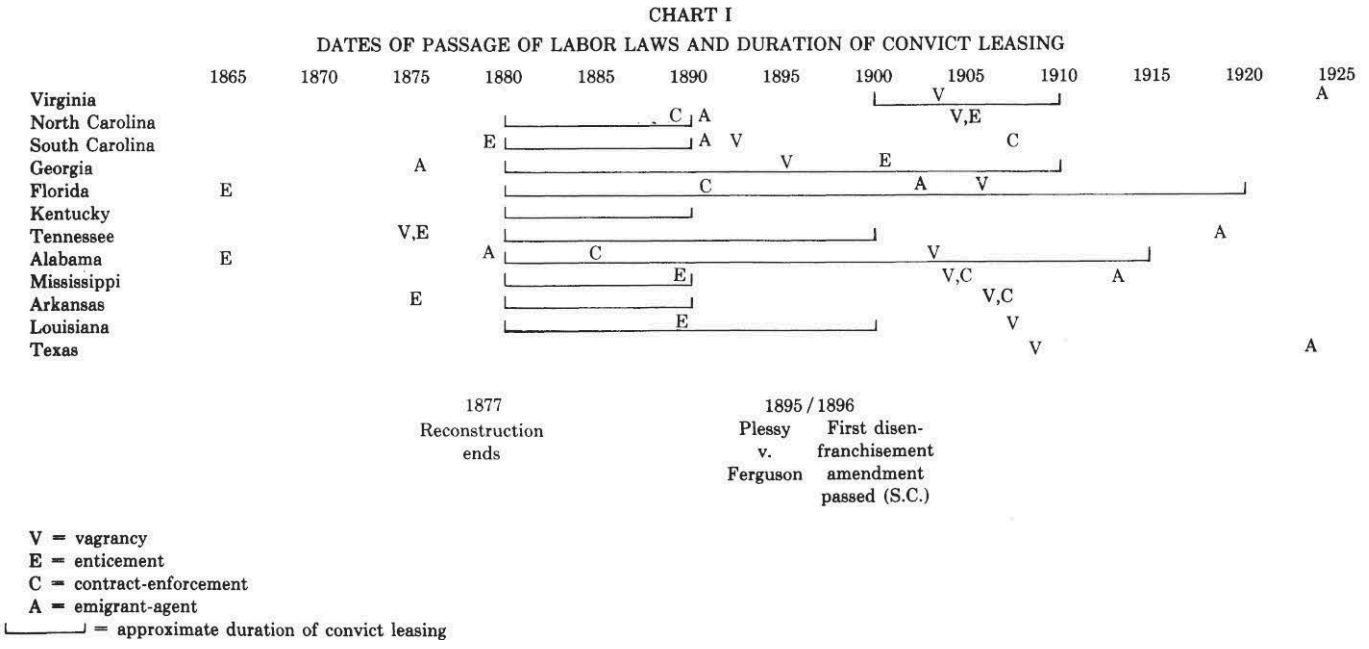


Figure 4.C.1: Laws restricting labor mobility approved across the South (1865-1925). Source: Roback (1984).

Wage

The wage of agricultural laborers measures the competition for the local labor force. The literature agrees on a competitive rural labor market for the entire period, even across racial lines (Roback, 1984; Shlomowitz, 1984; Wright, 1986; Alston and Kauffman, 2001; Naidu, 2010; Collins and Wanamaker, 2015). Also recall from section 4.2 that farm and non-farm labor markets mutually affected each other. Consequently, *Wage* directly controls for the cost of farm labor, and indirectly gauges the job opportunities in the non-farm sector. This assumption follows the result in section 4.3 where the outside option equals farm wages in equilibrium.

Avg. Farm Size

The regressions also include the average farm area in the county. This was a crucial decision variable in sharecropping contracts and, consequently, in the crop mix of each farm (Ransom and Sutch, 1977; Wright, 1978). Alston (1981) argues that it affected farm supervision costs, too. Finally, farm size might also relate to how powerful the local elite was and, thus, the value of many of the non-pecuniary perks included in sharecropping contracts (Alston and Ferrie, 1993; Ager, 2013).

Prop. of Blacks

The proportion of blacks in the whole population is controlled because of the role of racial relations, as discussed in section 4.2. Alston and Ferrie (1993) present evidence of sharecropping contracts as a source of paternalistic protection from racial violence, such as racially-motivated lynching (Ager, 2013). Wright (1986) also presents evidence that the distribution of skills of the black population had lower average, median and variance relative to that of the white population.

Industry

Wright (1986) and Roback (1984) provide plenty of evidence of the possibilities farm workers had to move to non-farm sectors. Moreover, Roback (1984) states that *Emigrant-agent laws* were particularly targeted to avoid this possibility.

Dist. Railway

As argued in section 4.2.2, they were one of the decision variables behind the opening a new post office. Atack (2013) provides county-level evidence of the impact of railways on the opening of new banks, on urbanization, on farm productivity, and on land value.

Temperature SD and *Precipitation SD*

In order to distinguish risk from the augmented costs associated to labor turnover, the regressions include average monthly standard deviations of temperature and precipitation, decade by decade. Note that the model of section 4.3 includes these variables. These variables are also based upon a vast literature that regards sharecropping as a risk-sharing contract (Cheung, 1969).

4.D Extra robustness checks

Table 4.D.1: Regressions excluding certain states.

	Sharecropping		
	Sub-Sample 1	*Sub-Sample 2*	*Whole Sample*
Post Office	-0.4830*	-1.1854***	-0.6585**
	(0.2851)	(0.3832)	(0.2904)
Post Office×*Rain*	1.3000***	2.3558***	1.0877**
	(0.4361)	(0.5420)	(0.4330)
Post Office×*Coal*	-2.0554***	-3.3632***	-2.1624***
	(0.4049)	(0.9337)	(0.4176)
Enticement laws	0.0102	-0.0042	0.0057
	(0.0077)	(0.0087)	(0.0076)
Contract Enforcement laws	0.0122	-0.0121*	-0.0141**
	(0.0075)	(0.0069)	(0.0069)
Vagrancy laws	0.0098	-0.0211**	0.0210***
	(0.0072)	(0.0101)	(0.0066)
Emigrant-agent laws	0.0032	-0.0010	-0.0022
	(0.0067)	(0.0060)	(0.0052)
Convict-lease system	-0.0246***	-0.0074*	-0.0133***
	(0.0037)	(0.0043)	(0.0037)
Rural Pop. Dens.(-1)	0.0013**	0.0053***	0.0016**
	(0.0006)	(0.0009)	(0.0006)
Wage	-0.2461***	-0.2334***	-0.2491***
	(0.0146)	(0.0185)	(0.0143)
Urban Pop. Dens.(-1)	-0.0005***	-0.0006***	-0.0006***
	(0.0001)	(0.0002)	(0.0001)
Avg. Farm Size(-1)	0.0000***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)
Prop. of Blacks(-1)	0.0191	0.1083**	0.0025
	(0.0477)	(0.0430)	(0.0401)
Industry	-0.0004	-0.0007***	-0.0004***
	(0.0002)	(0.0002)	(0.0001)
Dist. Railways	-0.0002	-0.0002*	-0.0002
	(0.0002)	(0.0001)	(0.0001)
Temperature SD	0.0324***	-0.0003	-0.0037
	(0.0122)	(0.0130)	(0.0114)
Precipitation SD	0.0026***	0.0013***	0.0019***
	(0.0003)	(0.0003)	(0.0003)
County Fixed Effects	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes
N	5963	5821	7609
R-Squared	0.4472	0.4743	0.4423

Column *Whole Sample* is the same as column (4) of table 4.4. *Sub-Sample 1* excludes Florida and Texas because of changes in the counties' borders. *Sub-Sample 2* excludes Kentucky, Tennessee and West Virginia because of historically low dependence on slave labor and on cotton production. The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

Table 4.D.2: Regressions using Random Effects.

	Sharecropping	
	Random Effects	*Fixed Effects*
Post Office	-1.8264***	-0.6585**
	(0.2666)	(0.2904)
Rain	-0.0018	-
	(0.0098)	
Post Office×*Rain*	1.7342***	1.0877**
	(0.3973)	(0.4330)
Coal	0.0571***	-
	(0.0094)	
Post Office×*Coal*	-1.5951***	-2.1624***
	(0.3720)	(0.4176)
Enticement laws	-0.0181***	0.0057
	(0.0064)	(0.0076)
Contract Enforcement laws	-0.0113*	-0.0141**
	(0.0065)	(0.0069)
Vagrancy laws	0.0287***	0.0210***
	(0.0062)	(0.0066)
Emigrant-agent laws	-0.0077	-0.0022
	(0.0050)	(0.0052)
Convict-lease system	-0.0252***	-0.0133***
	(0.0036)	(0.0037)
Rural Pop. Dens.(-1)	0.0014**	0.0016**
	(0.0006)	(0.0006)
Wage	-0.2222***	-0.2491***
	(0.0139)	(0.0143)
Urban Pop. Dens.(-1)	-0.0005***	-0.0006***
	(0.0001)	(0.0001)
Avg. Farm Size(-1)	0.0001***	0.0001***
	(0.0000)	(0.0000)
Prop. of Blacks(-1)	0.0475***	0.0025
	(0.0169)	(0.0401)
Industry	-0.0005***	-0.0004***
	(0.0002)	(0.0001)
Dist. Railway	-0.0001	-0.0002
	(0.0001)	(0.0001)
Temperature SD	0.0277***	-0.0037
	(0.0100)	(0.0114)
Precipitation SD	0.0015***	0.0019***
	(0.0002)	(0.0003)
Decade Fixed Effects	Yes	Yes
N	7609	7609
R-Squared	0.4368	0.4423

Column *Fixed Effects* is the same as column (4) of table 4.4. The standard-deviations, below each coefficient in parentheses, are clustered at the county level. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

Table 4.D.3: Effects from selection in unobservables.

	Sharecropping			
	Insignificant Coefficients		*Opposite Sign*	
	(1)	*(2)*	*(3)*	*(4)*
Post Office	2.00	1.44	3.99	2.88
Post Office	0.58	0.40	1.16	0.80
Post Office×*Rain*	1.16	0.80	2.33	1.61
Post Office×*Coal*	2.40	1.54	4.80	3.01
Variables included in the restricted model:				
Rural Pop. Dens.(-1), Urban Pop. Dens.(-1) and Dist. Railway				
Variables included in the full model:				
Wage, *Avg. Farm Size*(-1), *Prop. of Blacks*(-1), *Industry*, *Temperature SD*, *Precipitation SD*, *Enticement*, *Contract Enforcement*, *Vagrancy* and *Emigrant-agent laws*, and *Convict-lease system*				
All columns include County Fixed Effects and Decade Fixed Effects.				

The values in the first four lines follows the work by Altonji et al. (2005) and Oster (2016): the higher the value in each cell, the higher selection on unobservables would have to be relative to selection on observables to explain away the OLS coefficients. Altonji et al. (2005) and Oster (2016) recommend a value equal or greater than 1.

In each pair of columns, the column to the left solely uses the absolute value of the ratio $\frac{\beta_F}{\beta_R - \beta_F}$, where β_F is the coefficient in the full model and β_R is the coefficient in the restricted model. The column to the right brings the contribution by Oster (2016) of multiplying the previous ratio by $\frac{R_F - R_R}{R_{Max} - R_F}$, where R_F and R_R are respectively the R-Squared of the full and that of the restricted model, and R_{Max} is the R-Squared of a model with all observable and unobservable variables. Following Oster (2016), $R_{Max} = 1.3R_F$.

In columns (3) and (4), it is used $\frac{\beta_F - (-\beta_F)}{\beta_R - \beta_F}$ in place of $\frac{\beta_F}{\beta_R - \beta_F}$. That is, the exercise is the same as in the remaining columns, but instead of calculating the power from selection on unobservables needed to make the coefficient insignificant, it is calculated the power from selection on unobservables needed to obtain a symmetric coefficient.

Oster (2016) warns that "the baseline assumptions underlying the linear model" do not support the inclusion and exclusion of observables as way to test the size of the omitted variable bias. Furthermore, the approach proposed by Altonji et al. (2005) makes "the extreme assumption that the relationship between treatment and unobservables can be fully recovered from the relationship between treatment and observables" (Oster, 2016). Even if the previous assumption is valid, the stability of the coefficient of the treatment variable is not enough: in case the set of observables has lower variance than the unobservables, the coefficient is more stable not "not because the bias is smaller but simply because less of the [...] outcome [variable] is explained by the controls" (Oster, 2016).

Chapter 5

Conclusion

The use of negative incentives to affect agent choices, known as coercion, is extensively common in economic transactions. Integration of economic agents or political actors into a single legal entity also occurs copiously. Equally intriguing, coercion and integration are often intertwined so that it becomes hard to find a causal direction from one to the other. This dissertation makes use of three historical case studies to shed light on some of the facets of this intricate relationship: whether integration changes coercion; to what extent coercion affects the welfare of the parties involved in the integration process; how the use of coercive instruments drives the decision to integrate; to what extent coercion reduces the transaction costs affecting integration process.

The Italian unification in 1861 brings a rare case of exogenous integration. A set of regions of Italy saw suddenly and unintentionally a transference of political power from their elites to the recently-created unified state. At the same time, the unified Kingdom of Italy had an unprecedented state capacity, and a unique geopolitical agenda that created a clear regional hierarchy in the Italian peninsula. Carmine Guerriero and I have collected novel data on land taxation, which depended on the coercive powers of the state. Overall, we find evidence that coercion dramatically increased with integration, with clear regional discrimination. Moreover, this increase in land taxation explains the North-South gap that still persists in Italy.

Principals across history had the option to use spot labor markets or to buy slaves. Giuseppe Dari-Mattiacci and I present a model where the advantage of buying a slave over hiring labor is a function of two coercive instruments: slaves cannot leave at will and slaves can be subjected to levels of physical punishment unattainable with free workers. As our model predicts, slaves tended to be concentrated in the most complex

and in the simplest tasks, where the advantages deriving from the use of slaves were larger. This model also offers comparative statics with respect to the advantages and the abundance of slavery over labor. Qualitative and quantitative evidence backs the theoretical hypotheses.

Employers and employees extensively used sharecropping contracts to run farms across the US South between 1880 and 1940. Employers seem to have used those contracts to save labor turnover costs. However, many employees likely accepted those contracts due to lack of valuable outside options, a mild form of coercion. Using post offices as an exogenous variable that both increased labor turnover and employees' outside option, this chapter finds that the overall effect is negative. In other words, the lack of outside options pushing employees towards sharecropping contracts was more relevant than the labor turnover costs faced by employers.

Although these case studies do not address all the aspects of crossroads between coercion and integration, they certainly motivate future research and give provoking policy recommendations. The case study about the Italian unification is a clear demonstration that understanding the determinants of coercion such as tax-collection costs and military interests might explain the divide between winners and losers in economic and political integration processes. The role of coercion within the European Union (EU) may enlighten the tensions between periphery member-states and Germany. The challenge is again the causal link between coercion and integration. Different empirical strategies must be applied since accession to the EU is a long and voluntary process. Perhaps a better way consists of finding experimental shocks in coercion motivated by sudden fluctuations in political capital, such as those provoked by the reactions to the refugee crisis in 2015.[1]

The chapter on the comparison between slavery and labor also demonstrates that the fight against the remaining pockets of forced labor is far from linear. Although the model supports the idea that reducing the advantages and the abundance of slaves unambiguously reduces slavery, the effect on the welfare of the remaining slaves is unknown. The theory predicts that decreasing the capacity of principals to retain slaves, and decreasing the supply of slaves might leave the remaining slaves in activities where physical punishment is the optimal enforcement method. The chapter reports that

[1]See the following article for extra information: http://www.economist.com/news/europe/21672296-after-historic-embrace-refugees-german-public-opinion-turning-merkel-her-limit (Last accessed on February 2, 2017.

UN conventions have almost focused solely on fighting the supply of slaves. However, recent trends in the fight against forced labor in the Gulf Countries have shown the multi-level approach that the model prescribes. At the methodological level, the qualitative and quantitative analysis performed in the chapter advocate that future research on slavery must leave the dominant tendency of case studies confined to a particular period in a particular society in order to make causal and, hence, conclusive claims.

The historical episode of sharecropping in the US South highlights the role of lack of opportunities and, perhaps, inequality. The fact that an increase in the average post office density in one county between 1880 and 1940 increases that county's GDP per capita in 2014 between 0.5% and 1.1% demonstrates the relevance of the issue at hand. The lack of outside options per se may explain the persistence of sharecropping contracts in many developing economies. Lack of outside options might also be product of input inequality: the same way land was the main source of income generation in the rural US South, branding is a key input in income generation in nowadays' developed economies. That may explain the recent rise in franchising and other share contracts. Finally, share contracts like franchising provide a path towards entrepreneurship. Thus, the lack of outside options might explain the negative relation between GDP per capita and entrepreneurial activity documented in this chapter.

The overall message of this dissertation is that coercion and integration matter to each other in complicated ways. Herein we have cases where integration was an opportunity to coerce more and cases where coercion pushed for integration. Moreover, coercion seemed to be the main driver for integration. The welfare consequences hinted in all chapters give a strong call to understand better a relationship between two recurrent elements in economic and political debate.

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Nederlandse Samenvatting

Het gebruik van negatieve prikkels om keuzes van agenten te benvloeden, "dwang", wordt veelal gebruikt bij economische transacties. Daarnaast is er regelmatig sprake van integratie tussen politiek en economische agenten. Intrigerend genoeg zijn dwang en deze integratie vaak met elkaar verweven waardoor het lastig is een causaal verband vast te stellen. Deze dissertatie bevat drie historische cases om meer inzichten te krijgen in deze ingewikkelde relatie. Daarbij worden de volgende zaken behandeld: of integratie van invloed is op dwang; in welke mate dwang het welzijn van de integrerende partijen benvloed; hoe het gebruik van een dwanginstrument van invloed kan zijn op de beslissing om te integreren; in hoeverre dwang de transactiekosten van het integratieproces verlaagd.

In hoofdstuk 2 speelt de Italiaanse eenwording in 1861 een belangrijke rol, een zeldzaam geval van exogene integratie. Hierbij verloor de elite in een aantal Italiaanse regio's te macht, ten faveure van de recent opgerichte centrale staat. Tegelijkertijd had het Koninkrijk Italië ongehoord veel middelen en een unieke geopolitieke agenda, wat ervoor heeft gezorgd dat er een duidelijke hiërarchische structuur is ontstaan op het Italiaanse schiereiland. Carmine Guerriero en ik hebben data verzameld op het gebied van landbelasting. Deze belasting is een typisch voorbeeld van een dwanginstrument gebruikt door de staat. De resultaten laten zien dat de integratie heeft geleid tot een sterke toename in dwang. Daarbij is duidelijk regionale discriminatie zichtbaar. Bovendien verklaart deze toename in belasting de kloof tussen Noord en Zuid, welke vandaag de dag nog steeds zichtbaar is in Italië. Deze historische casus laat zien determinanten van dwang, zoals de kosten van het heffen van belasting en militaire belangen, wellicht een verklaring kunnen zijn voor spanningen bij politieke integratie zoals de Europese Unie (EU).

Door de geschiedenis heen hebben principalen de mogelijkheid gehad om de normale arbeidsmarkt te gebruiken of om in slaven te handelen. In hoofdstuk 3 ontwikkelen

Giuseppe Dari-Mattiacci en ik een model waarbij de beslissing om een slaaf te kopen in plaats van arbeid in te huren een functie is van twee dwanginstrumenten: slaven kunnen niet vertrekken uit vrije wil en slaven kunnen, in tegenstelling tot arbeiders, worden onderworpen aan fysieke straffen. Conform onze theoretische verwachtingen, zien we dat slaven veelal worden ingezet bij de ingewikkeldste en simpelste taken, waar de voordelen van het gebruik van slaven het grootst zijn. Dit model biedt daarnaast interessante inzichten met betrekking tot de voordelen van het gebruik van slavernij ten opzichte van arbeid, maar ook waarom er in de geschiedenis een overvloed van slaven was. Wij laten bijvoorbeeld zien dat louter een toename in de kosten van het dwanginstrument het welzijn van slaven verbetert. Deze hypothesen worden ondersteund door zowel kwalitatieve als kwantitatieve bewijzen. De resultaten bieden een provocatieve agenda bij het gevecht tegen slavernij en dwangarbeid.

In hoofdstuk 4 wordt dwang vergeleken met andere manieren om tot een reductie van transactiekosten bij het integratieproces te komen. Werkgevers en werknemers maakten tussen 1880 en 1940 veelvuldig gebruik van pachtcontracten bij de exploitatie van boerderijen in het zuiden van de Verenigde Staten. Werkgevers maakte gebruik van deze contracten om te besparen op kosten bij het in- en uitdienstreden van werknemers. Echter, waarschijnlijk accepteerde werknemers deze contracten alleen omdat ze nauwelijks alternatieve mogelijkheden hadden; een milde vorm van dwang. We gebruiken de opkomst van postkantoren als een exogene schok, welke zorgde voor zowel meer arbeidsmobiliteit als alternatieve mogelijkheden voor werknemers. Het algehele effect is negatief: het gebrek aan alternatieven, wat werknemers drijft om de contracten te accepteren, is belangrijker dan de kostenbesparingen voor werkgevers. Dit hoofdstuk biedt inzichten in het voortbestaan van pachtcontracten, het ontstaan van de franchisecultuur en de negatieve relatie tussen ondernemerschap en bbp per capita.

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