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Fines, externalities, and transaction costs:
essays in common-pool resources management

Multas, externalidades e custos de transação:
ensaios sobre gerenciamento de recursos comuns

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To my Family

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“Studies serve for delight, for ornament, and for ability. Their chief use for delight is in privateness and retiring; for ornament, is in discourse; and for ability, is in the judgment, and disposition of business. For expert men can execute, and perhaps judge of particulars, one by one; but the general counsels, and the plots and marshalling of affairs, come best, from those that are learned. . . . Crafty men condemn studies, simple men admire them, and wise men use them; for they teach not their own use; but that is a wisdom without them, and above them, won by observation. Read not to contradict and confute; nor to believe and take for granted; nor to find talk and discourse; but to weigh and consider . . . Histories make men wise; poets witty; the mathematics subtile; natural philosophy deep; moral grave; logic and rhetoric able to contend. *Abeunt studia in mores.*”

– Francis Bacon, *Of Studies*, 1625

RESUMO

Magalhães, M. A. (2017). *Multas, externalidades e custos de transação: ensaios sobre gerenciamento de recursos comuns*. (Tese de doutorado). Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo.

A presente tese avalia a dinâmica interna de um tipo específico de recurso comum, um “*information commons*”. Utilizando uma nova base de dados contendo mais de 800.000 transações ocorridas em distintas bibliotecas, ao longo de um período superior a 10 anos (2005-2015), o trabalho busca responder distintas questões relacionadas às áreas de economia das organizações, direito econômico e economia do setor público. A tese contém três capítulos, em formato de artigos, além da introdução e conclusão. O segundo capítulo da tese avalia as respostas comportamentais de usuários de uma biblioteca a sanções monetárias, ao explorar variação no *timing* de introdução de multas, assim como diferenças entre usuários, em termos de incidência dessas multas. No caso deste capítulo, são reportados dois resultados: em primeiro lugar, a introdução da multa tende a reduzir atrasos dos usuários, conforme previsto por modelos convencionais de cumprimento da lei. Em segundo lugar, uma análise dos efeitos dinâmicos de instauração da multa sugere que ela perde eficácia ao longo do tempo, uma vez que seu valor nominal permanece o mesmo, desde a data de instauração. O terceiro capítulo da tese apresenta estimativas das magnitudes de externalidades em um recurso comum. Neste capítulo, são estimados os impactos das ações de usuários da biblioteca sujeitos a uma sanção não-monetária (professores e funcionários) sobre usuários sujeitos a uma sanção monetária (alunos). Adicionalmente, são estimados efeitos sobre pares (*peer effects*), considerando o número de itens emprestados por usuários da biblioteca. A análise da magnitude de efeitos externos leva à descoberta de um efeito “*crowding-out*”: para cada unidade adicional emprestada por professores e funcionários, há uma redução, na escala de um por um, nos empréstimos de estudantes. No caso de estimações de efeitos sobre pares, um aumento nos empréstimos por parte do grupo ao qual um usuário pertence é correlacionado com seus próprios empréstimos, o que constitui evidência favorável à ocorrência de efeitos positivos sobre pares, no caso. Finalmente, no quarto capítulo, explora-se a interação entre recursos comuns e custos de transação. Especificamente, busca-se responder a seguinte questão: o que ocorre quando custos de transação são reduzidos em um contexto envolvendo recursos comuns? Para tanto, explora-se a variação no *timing* de introdução de uma tecnologia redutora de custos de transação (caixas de devolução), assim como seus impactos sobre medidas de desempenho na biblioteca. No caso deste capítulo, tem-se um resultado onde a instauração de caixas de devolução tende, em média, a aumentar a probabilidade de atrasos entre usuários da biblioteca, assim como a duração efetiva dos empréstimos, contrariamente a argumentos baseados em custos de transação. Os resultados reportados nesta tese têm importantes implicações para teorias baseadas no gerenciamento de recursos comuns, assim como correspondem a um novo conjunto de evidências empíricas relacionadas às áreas de direito econômico, economia do setor público e economia das organizações.

Palavras-chave: Bens públicos. Custos de transação. Direito econômico. Normas sociais. Recursos naturais.

ABSTRACT

Magalhães, M.A. (2017). *Fines, externalities, and transaction costs: essays in common-pool resources management*. (Doctoral dissertation). Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo.

The present dissertation evaluates the internal dynamics of a specific type of common-pool resource, an information commons. Employing a novel dataset related to more than 800,000 transactions in distinct libraries during a 10-year period (2005-2015), I address distinct questions in the fields of organizational economics, law and economics, and public economics. This dissertation contains three chapters in the format of academic papers, besides the introduction and conclusion. The second chapter evaluates the behavioral responses of library users to monetary sanctions. I exploit variation in the timing of introduction of fines in a library, as well as differences among users, in terms of fine incidence. In the case of this chapter, I report two results: first, the introduction of fines reduces users' delays, as predicted by standard models of law enforcement. Second, when evaluating the dynamic effects of such an introduction, I uncover a result in which fines lose efficacy over time since its nominal value remains the same after instauration. The third chapter measures externalities in an information commons. I estimate the magnitude of the impacts of actions of library users who were subject to a non-monetary sanction (professors and university employees) over users who were subject to a monetary sanction (students). Additionally, I estimate peer effects among users, considering the number of items they borrow from the library. When investigating external effects, I uncover a "crowding-out" effect: for an additional unity in professors and employees' counts, there is an approximate one-to-one decrease in students' counts. In the case of peer effects, I find that a rise in the borrowings of a user's peer group correlates with her own borrowings, an evidence of positive peer effects. Finally, the fourth chapter explores the interplay between common-pool resources and transaction costs. In particular, I try to answer the following question: what happens when transaction costs go down in a common-pool resource setting? I exploit variation in the timing of introduction of a cost-saving technology (return boxes) and its impacts on library performance measures. Contrarily to standard arguments based on transaction costs, I find a result in which the instauration of return boxes tend, on average, to raise the probability of delays and borrowings' effective durations. The results reported in this dissertation have important implications for theories based on common-pool resources' management, and constitute novel empirical evidence for the areas of law and economics, public economics, and organizational economics.

Keywords: Public goods. Transaction costs. Law and economics. Social norms. Natural resources.

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1. INTRODUCTION

“Books, the children of the brain.”
– Jonathan Swift, *A Tale of a Tub*, 1704

Pure public goods have two distinct characteristics: they are non-rival (one individual’s consumption of the good does not preclude other individuals’ consumption) and non-exclusive (it is hard to exclude individuals from consuming the good). Examples of such goods are national defense, public education and organizational knowledge, just to cite a few (Olson, 1965; Samuelson, 1954). On the other hand, common-pool resources are also defined as non-exclusive, but rival (one individual’s consumption of the good may reduce other individuals’ consumption). Examples of this kind of good are fisheries, forests and irrigation systems (Bardhan, 1993; Dietz, Ostrom, & Stern, 2003; Vollan & Ostrom, 2010). Table 1.1 contains a brief description of four distinct types of goods: public goods, common-pool resources, club goods, and private goods (Hess & Ostrom, 2007a).

Table 1.1 – Different types of goods. Exclusion and subtractability			
		SUBTRACTABILITY	
		Low	High
EXCLUSION	Difficult	Public goods <i>Useful knowledge</i> <i>Sunsets</i>	Common-pool resources <i>Libraries</i> <i>Irrigation systems</i>
	Easy	Club goods <i>Journal subscriptions</i> <i>Daycare centers</i>	Private goods <i>Personal computers</i> <i>Doughnuts</i>

Source: adapted from Hess and Ostrom (2007a).

The table contains four cells, separated by difficulty of exclusion (represented by the table’s lines) and subtractability of use (columns) for each type of good. In the figure, the upper left cell contains pure public goods, since they present lower subtractability but higher difficulty of exclusion, when compared to other types of goods (in the limit, they are non-exclusive and non-rival). The upper right cell contains common-pool resources, given their high difficulty of exclusion (as public goods), but high subtractability of use (rivalry). The lower left cell contains club goods, characterized by lower subtractability

and easy exclusion (theaters and country clubs correspond to examples of this kind of goods). Finally, the lower right cell displays private goods, which have high exclusion and subtractability properties (one can easily exclude others from the use of her own private goods, such as clothes and personal computers, for example)¹.

Both public goods and common-pool resources are important for the social benefits they generate. For instance, although it may be expensive for a private firm to supply transportation services for a city's population (by building a subway), its aggregate (societal) benefits can be quite large (thousands of people use the subway on a daily basis). However, since benefits diffuse across society, private agents may not have sufficient incentives to supply such services. In these occasions, one may observe either an undersupply of public goods (Olson, 1965) or an overexploitation of common-pool resources (Hardin, 1968).

The main goal of this dissertation is to understand the internal dynamics of a specific type of common-pool resource, an information commons. By employing a novel dataset related to more than 800,000 transactions in distinct libraries during a 10-year period (2005-2015), I address distinct questions related to the fields of organizational economics, law and economics, and public economics. While most contributions in economics focus exclusively on public goods provision – both in theoretical and empirical terms (Chaudhuri, 2011; Ledyard, 1995; Zelmer, 2003) – the research related to common-pool resources management presents an excessive emphasis on environmental themes such as forests, fisheries, and wildlife in general (Cárdenas & Ostrom, 2004; Fehr & Leibbrandt, 2011; Rustagi, Engel, & Kosfeld, 2010). The present dissertation contributes to these areas by evaluating the behavior of individual users in different situations in a specific type of common-pool resources, an information commons.

Libraries constitute an ideal field setting for studying behavior in situations involving common-pool resources. Today there is a scattered volume of contributions related to the economic importance of libraries (Getz, 1989; Koechlin, 2010; McMullen, 2008; Van

¹ Coase (1960) represents a seminal contribution to social dilemmas, with an emphasis on situations involving what the author calls “social cost problems”. Olson (1965), Samuelson (1954), and Tiebout (1956) correspond to pioneering references related to public goods, while Hardin (1968) and Ostrom (1990) correspond to discussions related to common-pool resources. See Buchanan (1965) for a classical treatment of club goods. Chetty and Bruich (2012) and Stiglitz (2000) provide comprehensive treatments on the field of public economics.

House, 1984). Part of this literature uses the term “learning commons” to refer to a new working model for libraries that “. . . integrates library, information technology and other academic support services to provide a continuum of services to the user It is a dynamic place that encourages learning through inquiry, collaboration, discussion and consultation” (McMullen, 2008). When studying “information commons”, Hess and Ostrom (2007a, p. 3) define the term as “. . . a resource shared by a group of people that is subject to social dilemmas”. The simplicity of a library setting constitutes a major strength of this dissertation. I study ordinary situations in which I can observe the way the library creates its own rules and enforcement mechanisms. This setting allows me to focus on specific aspects of users’ behavior, as well as their responses to distinct phenomena. In the following sections, I explore the basic properties of an information commons to answer relevant questions related to the importance of fines, externalities, and transaction costs in a field setting².

1.1. Relevance

There are two important questions related to public goods and common-pool resources. The first question is the following: will people take part in collective actions involving public goods if they notice that government provision may happen, regardless of individual contributions? According to some authors, rational individuals who seek to maximize their private gains would probably not contribute to public goods provision, since they expect that the government perform such a task. This theoretical situation, known as the “zero contribution thesis”, corresponds to a rational explanation for opportunistic behaviors, such as free-riding (Olson, 1965; Ostrom, 2000).

The second question asks whether the nature of common-pool resources may lead to its overexploitation. In this case, Hardin (1968) predicted that such a situation would inevitably occur, given that individualistic attitudes may prevail in both the short and long run. For instance, forest degradation would be a natural result in a setting where individuals and firms try to maximize their own private gains, the so-called “Tragedy of the Commons” (Hardin, 1968). In both cases, there is a situation named “social dilemma”:

² In terms of terminology, I follow Hess and Ostrom (2007a, 2007b), by employing the terms “information commons” and “learning commons” as synonyms in the sections below.

society may gain by having public goods and common-pool resources, but individuals do not have incentives to provide the former nor to preserve the latter. In this context, some individuals may try to obtain benefits from public actions, even when not contributing to them (Olson, 1965)³.

The results described in this dissertation are relevant for at least two reasons. First, they dialogue with a well-established literature related to situations involving common-pool resources' management. As stated above, most of this literature focus on environmental themes, such as fisheries, forests, and irrigation systems (Bardhan, 1993; Cárdenas & Ostrom, 2004; Dietz et al., 2003; Rustagi et al., 2010), with few contributions related to alternative settings. The present dissertation contains findings that dialogue to different kinds of settings, such as libraries, organizational knowledge, and the Internet, for example. Second, and related to the latter point, these results apply to other contexts related to social dilemma situations. For instance, it is a well-documented fact that opportunistic behavior can emerge in distinct organizational settings, either public or private in nature (Alchian & Demsetz, 1972; Cabrera & Cabrera, 2002). In this sense, the present results add to an established literature in organizational economics and management (N. J. Foss & Mahoney, 2010; Simon, 1991; Stiglitz, 1991; Williamson, 1991, 2002, 2005).

1.2. Methods

To answer the questions proposed in this dissertation, I employ econometric methods. In particular, I make use of quasi-experimental variation derived from the occurrence of natural experiments in distinct settings (Angrist & Krueger, 2001; Rosenzweig & Wolpin, 2000). Over the last years, the literature derived from natural experiments has grown into an important research program in economics, focused on the impact evaluation of alternatives policies (Angrist & Pischke, 2010)⁴.

³ Critical appraisals on traditional results related to public goods' provision and common-pool resources' management correspond to Bardhan (1993), Buchanan (1975), Dietz et al. (2003), Ostrom (1990, 1999, 2000, 2005), Volland and Ostrom (2010), Wilson et al. (2013), and Zylbersztajn (2010). Coleman (1990) provides an extensive discussion of several related themes, with an emphasis on collective action and interpersonal comparisons of well-being among individuals. See also Sen (1999) on the latter theme.

⁴ See Card and DellaVigna (2013), Ellison (2002), and Hamermesh (2013), who present evidence related to publication patterns in economics over the last decades.

In the case of two chapters of this dissertation, I exploit variations derived from distinct institutional changes in libraries to evaluate the impacts of specific policies. Given the nature of the institutional changes under study, I employ difference-in-differences techniques to evaluate the responses of library users to aggregate changes, which affect the inner workings of libraries. These techniques have the advantage of allowing researchers to compare the behavior of distinct groups (treatment and control), before and after the implementation of specific policy changes⁵.

In the case of a specific chapter, focused on the estimation of externalities, I do not rely on quasi-experimental methods. Instead, I employ traditional econometric techniques, such as ordinary least squares (OLS), instrumental variables (IV) and count models, to estimate the magnitudes of external and peer effects in an information commons⁶. I detail the content of each chapter below⁷.

1.3. Structure

The present study has five parts, including this introduction, which describes a general overview of the dissertation. In the next three parts, I present the results of independent papers related to a main unifying theme, common-pool resources' management, namely. Finally, in the conclusion, I discuss the main limitations of this study, and suggest possible routes for future research.

⁵ Angrist and Pischke (2009) present a detailed exposition of difference-in-differences research designs. See Card (1992), and Card and Krueger (1994) for pioneering uses of difference-in-differences in the labor market. Allen (2015), Aragón (2015), Butcher, McEwan, and Weerapana (2014), Di Tella and Schargrodsky (2004), Duflo (2001), Estevan, Gall, and Morin (2016), Gentzkow, Shapiro, and Sinkinson (2011), La Ferrara, Chong, and Duryea (2012), Lennon (2016), Moser and Voena (2012), and Pischke (2007) correspond to examples of applications related to distinct settings.

⁶ In this case, see Angrist and Krueger (2001), Baum (2007), Blevins, Tsang, and Spain (2015), Fávero (2015), Fávero, Belfiore, Takamatsu, and Silva (2013), and Trivedi (2010). See Acemoglu, Johnson and Robinson (2001), Breza (2012), and Levitt (1997) for examples of applied studies involving instrumental variables. Fisman and Miguel (2007) and Marmaros and Sacerdote (2006) correspond to examples related to count models focused on measuring corruption practices and social ties, respectively.

⁷ The data and Stata do-files used in this dissertation are available from the author upon request. I base the empirical analysis described below on Angrist and Pischke (2009), Baum (2016), Bettis, Gambardella, Helfat, and Mitchell (2014), Cameron and Trivedi (2009), Gentzkow and Shapiro (2014), Hamermesh (2007), and Schwabish (2014).

In preparing three independent papers related to a single theme, I intend to transform them in academic papers, with the goal of future submission to professional journals in the areas of management and economics. I present these papers as dissertation chapters, in the following order:

Chapter 2 - “Effects of monetary sanctions on behavior: evidence from library fines”.

In chapter 2, I revisit an important discussion in the field of law and economics, related to the merits of alternative ways to deter illicit behavior. In particular, I try to answer the following question: how does the introduction of a monetary sanction affect behavior in a field setting? By exploiting variation in the introduction of a fine in a library during a specific year, I uncover a causal effect of such a sanction over user behavior. Before 2006, the library studied in this chapter had a sanctioning system based on non-monetary sanctions (daily suspensions) for all of its users. After that year, the library started charging monetary sanctions (fines) for students with late items, while maintaining a non-monetary sanction for professors and university employees.

One particular advantage of this setting is that the change in the type of sanction was not the same for all library users. This unique feature of the data allows me to employ a difference-in-differences research design to evaluate the effects of the policy implemented by the library. Two main results emerge, in this case. First, in aggregate terms, the introduction of a monetary sanction reduces delays, as predicted by standard models of law enforcement. Second, when considering the dynamic effects of this type of sanction, I uncover a result in which the fine loses efficacy over time, since its nominal value remains the same for the entire period after instauration.

Chapter 3 - “Measuring externalities in an information commons: the case of libraries”.

In chapter 3, I explore the basic properties of common-pool resources: non-exclusiveness and rivalry. These properties may generate competition among resource users, as well as externalities. Given these possibilities, I estimate the magnitude of external effects, considering the actions of library users who were subject to a non-monetary sanction (professors and university employees) over users who were subject to a monetary sanction

(students). Specifically, I test the hypothesis that the actions of professors and employees may generate negative externalities over students.

I also estimate the magnitude of peer effects among users, considering the number of items they borrow from the library. In particular, I test the hypothesis of complementarities among library users, in terms of the number of items they borrow when they go to the library. In this case, I want to answer the following question: how does the behavior of peer groups affects individual users? I uncover two main results. First, I report a “crowding-out” effect in the library: for an additional unity in professors and employees’ counts, there is an approximate decrease of one-to-one in students’ counts, *ceteris paribus*. Second, when estimating peer effects among users, I find that, for every 100 books borrowed by a user’s peer group, there is an approximate increase of three books per user.

Chapter 4 - “What happens when transaction costs go down? Evidence from return boxes”.

Finally, in chapter 4, I evaluate the impacts of lower transaction costs in an information commons. In this case, I want to answer the question in this chapter’s title: what happens when transaction costs go down in a field setting? I hypothesize that the introduction of return boxes, by reducing transaction costs, would enhance user performance measures in the libraries that decide to adopt them. For instance, users’ delays and effective durations would be lower in libraries that adopt return boxes.

To answer the above question, I exploit variation in the introduction of return boxes in distinct libraries: after 2012, one library introduced a return box in the university campus where it operated, while another library did the same one year later, in 2013. This unique feature of the data allows me to employ a difference-in-differences research design to evaluate the effects of the policy implemented in each library. Contrarily to traditional arguments based on transaction costs, I find that the instauration of return boxes either increases some performance measures, such as borrowings’ effective duration and users’ delays, at the same time that it does not exert any significant effect over item counts.

2. EFFECTS OF MONETARY SANCTIONS ON BEHAVIOR: EVIDENCE FROM LIBRARY FINES

“Laws die, Books never.”
– Edward Bulwer-Lytton, *Richelieu*, 1839

2.1. Introduction

An important discussion in the field of law and economics relates to the merits of alternative ways to deter illicit behavior. The classical economic model of crime predicts that, either monetary sanctions – such as fines – or imprisonment, can work as a deterrence factor for illicit activities (G. S. Becker, 1968; Stigler, 1974)⁸. While most contributions in the economics literature focused on the deterrent effects of imprisonment (Di Tella & Schargrodsky, 2004; Kline, 2012; Levitt, 1997), the tradeoff among distinct types of punishment has received far less attention (Langan, 1994; Piehl & Williams, 2011). In fact, discussions comparing fines to imprisonment suggest that, under certain conditions, the former may be preferred over the latter, especially in terms of economic efficiency, since they correspond to mere transfers of money across society (Polinsky & Shavell, 2000)⁹.

This paper presents novel evidence related to the effects of fines in a field setting. I evaluate the behavior of users in a library during a ten-year period (2005-2015), covering more than 800,000 daily transactions. In doing so, I want to answer the following question: how does the introduction of a monetary sanction affect behavior in this specific setting? I exploit variation in the introduction of a monetary sanction (fine) in the library in a specific year to uncover a causal effect of such a sanction over user behavior. Before 2006, the library here studied had a sanctioning system based on nonmonetary sanctions

⁸ When reviewing the literature related to criminal deterrence, Chalfin and McCrary (2017) conclude that the evidence in favor of deterrence effects presents mixed results, at best. See Chalfin and McCrary (2017), and Levitt and Miles (2006) for surveys on the economics of crime and deterrence.

⁹ According to Piehl and Williams (2011, p. 98): “Monetary sanctions are generally considered effective and appropriate for minor infractions.” The authors recognize that, although the imposition of fines corresponds to a minority of cases, the obligation derived from them may be quite substantial. Estimates for 2006 correspond to nearly US\$ 5,000,000. See Piehl and Williams (2011) for a critical perspective of fines as a criminal sanction in the United States. Chalfin (2013) discusses the economic costs of crime.

(daily suspensions) for all of its users. After this period, the library started charging monetary sanctions for students with late items, while maintaining a nonmonetary sanction for professors and university employees.

One particular advantage of this setting is that the change in the type of sanction was not the same for all library users. Specifically, the present situation corresponds to a natural experiment, since the institutional change in the workings of the library generated a treatment group (subject to monetary sanctions) and a control group (subject to nonmonetary sanctions) for the periods before (pre-policy) and after (post-policy) the fine's instauration. This unique feature of the data allows me to employ a difference-in-differences research design to evaluate the effects of the policy implemented by the library. In this case, the identification condition is that, in the absence of treatment, both groups – control and treatment – would display similar trends over time (the “parallel trends” hypothesis).

I uncover two main results. First, in aggregate terms, the instauration of a monetary sanction in the library reduces users' delays, as predicted by standard models of law enforcement. Second, since the nominal value of the fine remained the same (R\$ 2.00) during a ten-year period (2006-2015), this specific type of sanction loses efficacy over time. I report estimates of the dynamic effects of fines, which suggest that the fine deters illicit behavior in the short run, only. While these results corroborate some of the main predictions derived from standard economic models, I explore other alternative mechanisms, which could explain the behavioral responses of library users over time.

The remainder of the paper proceeds as follows. Section 2 presents a brief discussion of the related literature, as well as the paper's main contributions in this context. Section 3 describes the data and research design employed in the empirical analysis below. Section 4 reports the main empirical results, while section 5 contains the results of sensitivity analysis' tests. Finally, section 6 concludes.

2.2. Related literature

There is not a clear consensus among economists, legal scholars and psychologists in terms of the superiority of monetary sanctions over other forms of punishment. For

example, previous results from laboratory experiments suggesting that different types of punishment can affect behavior through distinct channels (Fehr & Gächter, 2000; Masclet, Noussair, Tucker, & Villeval, 2003)¹⁰. In terms of field settings, however, the available evidence presents mixed results. In a famous study, Gneezy and Rustichini (2000a) uncovered a result in which the instauration of fines at daycare centers in Israel actually increases the number of late-incoming parents, instead of decreasing it. According to the authors, this result is a consequence of contracts' incompleteness. When reporting the results of a study analyzing the impacts of personal experience with fines faced by video-rental store customers during a two-year period, Haselhuhn, Pope, Schweitzer, and Fishman (2012) conclude that monetary fees boost users' compliance. Bar-Ilan and Sacerdote (2004) report the results of a series of field experiments in the United States and Israel where traffic violations decrease in response to higher fines and the probability of capture. Taken together, these latter results suggest that fines can deter illicit behavior, as predicted by standard models of law enforcement (Becker, 1968).

This paper dialogues with distinct literatures. First, the results here presented correspond to an empirical analysis related to the public enforcement of law, a situation in which victims may not know who is injuring them. In such situations, the imposition of monetary fines may be a preferred option when compared to incapacitation (Polinsky & Shavell, 2000)¹¹. In this sense, the present paper contributes to a growing literature discussing the desirability of fines as an efficient means to punish illicit behavior (Gneezy & Rustichini, 2000a; Piehl & Williams, 2011). In particular, the results here reported complement previous empirical analyses focused on the impacts of fines, such as Agarwal et al. (2013), Bar-Ilan and Sacerdote (2004), Fisman and Miguel (2007), and Haselhuhn et al. (2012). However, contrarily to these papers, the present setting allows me to study the causal effects of the instauration of a monetary sanction. By exploiting variation in the imposition of fines over time for distinct groups of users, I am able to uncover a causal effect of fines over illicit behavior. Additionally, the focus on the dynamic effects of the

¹⁰ Gneezy, Meier, and Rey-Biel (2011) and Kamenica (2012) discuss the importance of monetary and non-monetary sanctions on behavior, as well as the related evidence.

¹¹ At least since Becker's (1968) influential contribution to the study of the economic aspects of crime, several authors – including Becker himself – have discussed the importance of the instauration of optimal fines as a deterrence factor (Polinsky & Shavell, 1991, 2000). See Shavell (1987) for a model of optimal incapacitation.

fine represents an innovation when compared to previous studies, which concentrate on shorter periods of time (Bar-Ilan & Sacerdote, 2004; Donna & Espín-Sánchez, 2015).

Second, this paper's results also relate to contexts in which agents may value nonmonetary factors, such as customs or social norms, making the instauration of monetary sanctions a less effective instrument to deter certain behaviors (Acemoglu & Jackson, 2017; Bénabou & Tirole, 2006, 2011; Ellingsen & Johannesson, 2007). In fact, there are situations in which, due to contracts' incompleteness, agents may interpret monetary sanctions as a price to pay for additional goods and services. In such situations, monetary sanctions can backfire (Bowles, 2009; Gneezy & Rustichini, 2000a). The present paper contributes to this literature, by comparing the behavioral responses of agents subject to distinct types of sanctions in a field setting.

Finally, the paper's findings relate to a well-established literature in social dilemmas, such as common-pool resources' management, and public goods provision. While most previous contributions in the literature related to common-pool resources emphasize examples related to environmental themes such as forests, fisheries, and wildlife in general, I present an example related to an information commons (libraries) (Hess & Ostrom, 2007a). To the best of my knowledge, this is probably the first attempt to study the effects of monetary sanctions in a specific type of common-pool resource, an information commons. In this sense, the present paper contributes to understanding the impacts of distinct sanctions over behavior, with an emphasis on social dilemmas involving collective action¹².

2.3. Data and method

2.3.1. Institutional Background

In this paper, I study the behavior of library users covering more than 800,000 transactions during a 10-year period (2005-2015). I have access to confidential daily data related to

¹² See Buchanan (1965), Hardin (1968), Olson (1965), Ostrom (1990), and Samuelson (1954) for pioneering analyses on public goods and common-pool resources. In the case of examples of common-pool resources' studies related to environmental themes, see Cárdenas and Ostrom (2004), Cárdenas (2003), Dietz, Ostrom, and Stern (2003), Rustagi Engel, and Kosfeld (2010), Volland and Ostrom (2010), and Zylbersztajn (2010).

library users of a private university, for the 2005-2015 period. This rich dataset corresponds to the transactions of a university library located in São Paulo, Brazil (Fundação Escola de Comércio Álvares Penteado, FECAP). The data contain detailed information on 17,498 individual users, covering more than 800,000 daily transactions. This corresponds to an unbalanced panel, since each library user may borrow different numbers of specific library items at distinct moments. For instance, one user may borrow two books on March 1st, and then borrow one more book on March 3rd, before returning previous items. The data is available in electronic format through a system named *Pergamum* (<https://www.pergamum.pucpr.br>), which provides technology services for several libraries in Brazil¹³.

The main advantage of studying the 2005-2015 period is that I am able to investigate the dynamic effects of the instauration of a monetary sanction over time. Since I am interested in the immediate effects of the monetary sanction, I concentrate the analysis on the 2005-2006 period¹⁴. The data contain information on users' socioeconomic characteristics – such as gender, date of birth, and address – as well as library's confidential information, with each user's identification number, university category (high school, undergraduate, master's, MBA, former student, professor, and employee) and area of study (management, accounting, economics, international relations, advertising, and secretariat). For each user in the data, I am able to identify her department and category. The data also contain the dates when each user borrowed specific items from the library, as well as each item's code, and title. Based on each title, I am able to build a measure of area of expertise for each book in the sample, such as management, accounting, economics, and law.

I also have access to the library's official yearly reports. These reports contain institutional information related to the library's internal workings over the 2005-2015 period (Choi, 2016). Based on this information, I am able to estimate the predicted devolution date for each user in the sample. In this specific case, the library's electronic

¹³ The data in *Pergamum* starts in 2005. Since this is a highly unbalanced panel, I am not able to estimate fixed-effects regressions with the data.

¹⁴ I obtained formal permissions from FECAP's Dean and library manager to have access to detailed and confidential information from all library users in the period. Appendix A contains data consent statements from the university.

system imposes a rule of 15 days for professors and masters' students, and seven days, for all other users. Each user can renew books after the predicted devolution date expires, conditional on a waiting list managed by library staff. Although I do not have access to the information in such lists, I can observe when users renew library items by comparing the dates of borrowings of the same item over time. There are also differences in terms of the number of items that each user can borrow from the library: while professors and masters' students can borrow a maximum limit of seven items, students can borrow a maximum of five, while university employees can borrow three items, only. This information allows me to build additional performance measures for each user in the sample, such as the number of items that she borrows every time she goes to the library, as well as measures of delays over time (equal to the difference between the predicted and effective devolution dates for each item borrowed). I also build measures of early returns (in the case of users who return books before the predicted date), and books' usage (equal to the number of times that users pick a specific book). I complement the data with academic calendar information related to exam weeks occurred in the university over time. Table 2.1 contains the descriptive statistics of the main data used in the paper:

Table 2.1 – Descriptive statistics – 2005-2006

VARIABLE	Mean	Std. Deviation	Minimum	Maximum
Female	0.53	--	0	1
First Year	0.27	--	0	1
Scholarship	0.28	--	0	1
0 to 4 years in College	0.83	--	0	1
High School	0.02	--	0	1
Undergraduate	0.66	--	0	1
Graduate	0.17	--	0	1
Former Student	0.08	--	0	1
Management	0.40	--	0	1
Accounting	0.30	--	0	1
Economics	0.16	--	0	1
International Relations	0.03	--	0	1
Advertising	0.03	--	0	1
Secretariat	0.02	--	0	1
Business Book	0.34	--	0	1
Accounting Book	0.14	--	0	1
Economics Book	0.16	--	0	1
Law Book	0.06	--	0	1
Early Returns	0.40	--	0	1
Age	25.16	6.74	14	65
Predicted Duration	7.59	2.10	7	15
Effective Duration	7.81	21.92	0	2,971
Delays	1.94	21.63	0	2,964
Book Usage	1,070.39	1,758.67	1	7,288
Penalty Days	11.55	49.53	0	954
Fines	0.61	26.04	0	3,606
Fine Count	0.08	0.48	0	8
Item Count	2.52	1.41	1	10
Observations	128,156			

Source: author's calculations, based on library data.

Notes: (a) Observations correspond to the 2005-2006 period, covering 128,156 transactions by 3,232 library users.

The table's second and third columns report mean values and standard deviations for each variable, respectively. The fourth and fifth columns contain minimum and maximum values. In the table, I follow Stevens (1946), by reporting standard deviation values for metric variables, only (Fávero & Belfiore, 2017). For the main period of analysis in this paper (2005-2006), I observe 128,156 library transactions by more than 3,000 users¹⁵.

¹⁵ Specifically, when considering the 2005-2006 period, I observe 128,156 transactions by 3,232 library users. When evaluating the dynamic effects of the fine, I augment the analysis for the 2005-2015 period, corresponding to 830,813 transactions, done by 17,397 users. In Appendix B, I present descriptive statistics for the total sample period.

These users are, on average, 25 years old, with similar proportions in terms of gender. Among these users, 27% is in the first year of college and holds a scholarship. In terms of categories, most library users are either undergraduate (66%) or graduate students (17%). In terms of areas of study, the vast majority of users enroll in either management (40%), accounting (30%), or economics (16%). This is an intuitive result, given the fact that the university in which the library is located corresponds to a business school. Similarly, when looking at the library's books, the same pattern reappears: more than one-third of these books correspond to business books, with accounting and economics books jointly responding for more than 30%, in approximate terms.

In terms of user performance measures, one notes the occurrence of very similar values in terms of predicted and effective durations for library borrowings, located in the 7-8 day range. However, a closer look at these two measures reveal strikingly different patterns: while there is little variance in predicted durations (around two days), the same does not happen in the case of effective durations, which display a much higher variance (more than 21 days), as well as a high maximum value (2,971 days or eight years, approximately). Similar patterns occur in the case of other related measures, such as delays, fines, and penalty days.

2.3.2. Empirical strategy

An ideal situation for my research purposes would be one in which I could observe the behavior of an individual who were, at the same time, charged and not charged with a monetary fee, as well as her subsequent behavior. One way to capture such a possibility, in a field setting, would be to randomly charge different types of fees from distinct library users and observe their behavior. An advantage of the library studied in this paper is the fact that it instituted a monetary fee for delays in 2006, only. This observational setting allows me to compare the behavioral effects of a monetary sanction *vis-à-vis* a non-monetary sanction. By controlling for users' observed characteristics, I am able to compare the behavior of fined users, who were subject to a monetary fee after 2006 (treatment group), to the behavior of users who were not fined during the same period (control group). This institutional feature allows me to employ a difference-in-differences research design to answer the main question I pose in the paper. In doing so, I run different versions of the following econometric specification:

$$(2.1) \quad Y_{ist} = \alpha + \gamma(\text{Treatment}) + \lambda(\text{Post-Policy}) + \beta(\text{Treatment} \times \text{Post-Policy}) + \Sigma_t(\psi_t) + \varepsilon_{ist}$$

Here, Y_{ist} represents potential outcomes for individual i (equal to 0 or 1), in state s (treatment or control), at time t . In most specifications below, Y_{ist} corresponds to the proportion of delays above average by user i and period t , after the introduction of the monetary sanction, while Y_{0st} corresponds to the same proportion before such an introduction. The term “*Treatment*” corresponds to an indicator variable, which assumes unity value in the case of users who were fined, and 0, otherwise. The term “*Post-Policy*” corresponds to an indicator variable that assumes unity value for the period posterior to 1/1/2006, and 0, otherwise. I also include academic year, book, and user fixed-effects as controls in the regressions below (captured by the term α), as well as time effects (ψ_t). In the case of the term ε_{ist} , it has a conditional mean of zero ($E(\varepsilon_{ist} | s, t) = 0$). The parameter of interest, representing a causal estimate in this context, is β , given by the following expression:

$$\begin{aligned} \beta = & [E(Y_{ist} | s = \text{Control}, t = \text{Post-Policy}) - E(Y_{ist} | s = \text{Control}, t = \text{Pre-Policy})] \\ & - [E(Y_{ist} | s = \text{Treatment}, t = \text{Post-Policy}) - E(Y_{ist} | s = \text{Treatment}, t = \text{Pre-Policy})] \end{aligned}$$

That is, β corresponds to a difference-in-differences estimate.

2.4. Results

2.4.1. Main estimates

The main empirical challenge in the present setting is to find an appropriate counterfactual, that is, a control group that would present behaviors consistent with the behavior of the treatment group, given the absence of the institutional change in the library. I try to circumvent this difficulty by considering as the treatment group users who suffered any kind of sanction (nonmonetary or monetary) during the entire sample period. For instance, users who present delays over time suffer either a nonmonetary sanction (daily suspension) in the pre-policy period or a monetary sanction (fine), afterwards. On the other hand, the control group corresponds to users who did not suffer any sanction.

Initially, I exclude professors and employees from the treatment and control groups, since these categories were not subject to monetary sanctions in either period. It is worth noting that the latter categories present specific characteristics that make difficult comparisons to groups containing students. I return to these groups below, when presenting placebo tests for the identification condition used in the paper. Table 2.2 presents summary statistics for selected variables for both groups in the pre-policy period (the 2005 year):

Table 2.2 – Descriptive statistics – pre-policy period (2005)			
VARIABLE	Control Group	Treatment Group	Total Sample
Age	25.56 (7.11)	24.40 (5.82)	25.13 (6.68)
Female	0.55 (--)	0.56 (--)	0.55 (--)
First Year	0.29 (--)	0.31 (--)	0.29 (--)
Predicted Duration	8.02 (2.67)	7.05 (0.62)	7.66 (2.20)
Business Book	0.35 (--)	0.34 (--)	0.34 (--)
Accounting Book	0.12 (--)	0.12 (--)	0.12 (--)
Economics Book	0.16 (--)	0.17 (--)	0.16 (--)
Observations	39,522	23,271	62,793

Source: author's calculations, based on library data.

Notes: (a) Standard deviations reported in parentheses.

The table's first and second columns display results for the control and treatment groups, respectively. The third column contains results for the total sample (treatment + control) during the pre-policy period. A visual inspection of the results in the table suggests that both groups (treatment and control) present very similar characteristics in the period before the instauration of a monetary sanction in the library. The only exception is for each group's predicted duration. At first, this result may reflect compositional differences between the groups, since distinct user categories face different limits in terms of predicted duration.

Figure 2.1 presents the average number of delays (measured in days) in the years of 2005 and 2006 for the total sample. The graph displays an interesting pattern: a reduction in delays in 2006, when compared to 2005. Specifically, delays reduce from 2.38 to 1.50 days in aggregate terms (a -37% reduction):

Figure 2.1 – Average number of delays, for the years 2005 and 2006

Source: author's calculations, based on library data.

I present the results of difference-in-differences estimations in table 2.3. In this case, the dependent variable corresponds to the proportion of delays above average in the period (named “Prob.(Late)”) ¹⁶. I progressively add covariates to the specifications in the table to control for fixed-effects that may bias the resulting estimates, a common practice in studies of this kind.

¹⁶ I initially choose this variable to verify if the introduction of the fine has any effect over delays' extensive margin. Apesteguia, Funk, and Iriberrí (2013) follow a similar approach when evaluating the results of a field experiment in the public libraries of Barcelona.

Table 2.3 – Effects of fines over probability of delays

VARIABLES	(1) Prob.(Late)	(2) Prob.(Late)	(3) Prob.(Late)	(4) Prob.(Late)	(5) Prob.(Late)
DiD Coefficient	-0.01 (0.023)	-0.03 (0.022)	-0.03 (0.022)	-0.04** (0.017)	-0.04** (0.017)
Acad. Year Dummies	No	Yes	Yes	Yes	Yes
Book Dummies	No	No	Yes	Yes	Yes
User Dummies	No	No	No	Yes	Yes
Time Trends	No	No	No	No	Yes
Mean Dep. Variable	0.233	0.233	0.233	0.233	0.233
Observations	128,156	128,156	128,156	128,156	128,156
Adj. R-squared	0.467	0.511	0.511	0.515	0.516

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of higher than average delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) "Time Trends" correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

There is one important, but untestable hypothesis, in a difference-in-differences research design. In this specific case, users' non-observable characteristics should follow similar time trends, either in the control or treatment groups. Although I am not able to test this hypothesis in the present setting, I try to address such a possibility by including specific time trends in my estimations, following the suggestions contained in Besley and Burgess (2004). I also present related evidence in the robustness section below. Given the possibility of severe serial correlation among users and library borrowings over time, as originally suggested by Bertrand, Duflo, and Mullainathan (2004), I cluster standard errors by the number of courses offered at the university¹⁷.

The table's first column corresponds to an econometric specification for equation (2.1) with no controls. In the table's second column, I add dummies for each week in the year, to capture seasonal effects over borrowings. I also add dummies for days of the week, month, and year. In the third column, I add book and library dummies to capture

¹⁷ There are 58 courses in the university during the 2005-2006 period (and 219 courses during the 2005-2015 period). These courses are different from the areas of study (management, economics, accounting, international relations, advertising, and secretariat) that a student may choose when she enrolls in the university. I am able to track the courses that each library user attends, either as a student or as a professor.

differences in terms of items borrowed. In the fourth column, I add a rich set of user-related covariates to capture users' fixed effects: their gender, age group, area of study, category, and time at school. Finally, in the fifth column, I add specific time trends for both the control and the treatment groups. I do this inclusion to allow distinct trends for each group over time, which corresponds to an alternative test of the parallel trends hypothesis in a difference-in-differences' research setting (Besley & Burgess, 2004).

The first column in the table finds no statistically significant correlation between the introduction of a monetary sanction and the proportion of delays. This result may be a consequence of a lack of inclusion of other variables, which can bias the reported estimates. Even after adding dummies for seasonal effects (second column), as well as books' and libraries' fixed effects (third column), I do not find a statistically significant effect of fines over the probability of delays. However, once I include users' fixed effects (fourth column), and specific time trends (fifth column), the estimated coefficients become statistically and economically significant at a 5% level of significance (with a magnitude of -.04). This result suggests that, if the difference-in-differences identification hypothesis is valid in the present context, there is a negative impact of monetary sanctions over delays. Specifically, the introduction of fines reduces the probability of higher than average delays by 17% ($= -0.04/0.23$).

In table 2.4, I present difference-in-differences estimates in which I substitute the dependent variable with alternative measures for user performance in the library. These variables are the following: borrowings' effective duration, borrowings' delays, the proportion of early devolutions ("Early"), the proportion of item renewals ("Renew Rates"), and the number of items that each user borrows every time she goes to the library ("Item Count"). In doing so, I want to verify how the introduction of the fine in 2006 affects other performance measures for users in the library. In each case, I include a full set of covariates to capture distinct types of fixed effects, as well as specific time trends.

Table 2.4 – Effects of fines over distinct library performance measures

VARIABLES	(1) Effective Duration	(2) Delays	(3) Early	(4) Renew Rates	(5) Item Count
DiD Coefficient	-3.37*** (0.405)	-3.11*** (0.389)	0.02* (0.012)	0.00 (0.004)	0.07 (0.064)
Acad. Year Dummies	Yes	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes	Yes
Mean Dep. Variable	7.81	1.94	0.40	0.10	2.52
Observations	128,156	128,156	128,156	128,156	128,156
Adj. R-squared	0.0310	0.0157	0.462	0.0270	0.118

Source: author's calculations, based on library data.

Notes: (a) The dependent variables in the specifications corresponds to borrowings' effective duration (first column), borrowings' delays (second column), the proportion of early devolutions (third column), renew rates (fourth column), and the number of items borrowed by each user (fifth column). (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) "Time Trends" correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Three main results emerge in the case of these alternative specifications. First, the instauration of a fine in the library affects borrowings' effective duration and delays in the predicted direction: in both cases, there is a decrease of three days in each variable, approximately. This corresponds to a reduction of -43% in the case of borrowings' effective durations ($= -3.37/7.81$). In the case of borrowings' delays, the introduction of the fine leads to a decrease that is 1.6 times larger than the variable's average value ($= -3.11/1.94$). Second, there is a marginally significant effect in the proportion of early devolutions (0.02), which corresponds to a 5% increase ($= 0.02/0.40$). This result suggests that the fine not only affects delays' measures, but it also affects the proportion of books returned in advance. Third, there are no significant effects over renew rates or the number of items that each user borrows in the period. When compared to the results reported above, the estimates involving other dependent variables preserve the previous qualitative patterns, although most of these specifications do not present the same predictive power (measured by lower values of the adjusted coefficient of determination, R^2), except for the proportion of early devolutions.

2.4.2. Dynamic effects

One unique feature of the data used in this paper relates to its longitudinal dimension. I am able to observe 830,813 transactions by 17,397 library users, covering more than 10 years (2005-2015). In this section, I explore the data's longitudinal dimension in more detail. In doing so, I hope to gain a better understanding of the long-term impacts of the fine over behavior. I exploit the fact that the fine, once it began, remained with the same nominal value (R\$ 2.00) for the entire period after the 2006 year. In this case, there are two related possibilities. First, if library users perceive the fine's constancy over time, they would probably respond to it by raising delays, since the fine's real value declines as time goes by (given a positive rate of inflation, in aggregate terms). Second, even with a fine with constant nominal value, there is the possibility that users' delays reduce over time, due to the symbolic effects of a sanction of this kind¹⁸.

I report estimates of dynamic difference-in-differences specifications in table 2.5 for distinct library performance measures. I include an additional library performance measure in the table: the number of fines received per user ("Fine Count"). In this case, I take advantage of the longitudinal nature of the library data I use and estimate specific difference-in-differences coefficients of the following form:

$$(2.2) \quad Y_{ist} = \alpha + \gamma(\text{Treatment}) + \lambda(\text{Post-Policy}) + \beta(\text{Treatment} \times \text{Post-Policy} \times \text{Year}) + \sum_t(\psi_t) + \varepsilon_{ist}$$

In the above specification, I estimate the parameter of interest (β) for each year in the sample. I consider the same controls as before, but I also add each of the years available in the sample, as well as specific time trends for the control and treatment groups. Figure 2.2 displays the dynamic effects of the introduction of the fine over the probability of higher than average delays for the 2006-2015 period. Figure 2.3 contains the dynamic effects for users' alternative measures of performance¹⁹.

¹⁸ See Funk (2007) for an empirical study on the effects of symbolic fines in Switzerland. When evaluating the impacts of economic incentives over blood donations, Lacetera, Macis, and Slonim (2013) suggest that such incentives can have spatial and short-lived effects on behavior. This is the reason why I study the dynamic effects of fines over distinct measures of library performance.

¹⁹ Kline (2012) employs a similar strategy when evaluating the impacts of curfew laws over crime in the United States.

Table 2.5 – Dynamic effects of fines over library performance measures

VARIABLES	(1) Prob.(Late)	(2) Effective Duration	(3) Delays	(4) Early	(5) Renew	(6) Item Count	(7) Fine Count
DiD Coefficient (2006)	-0.04** (0.018)	-3.53*** (0.399)	-3.06*** (0.407)	0.04*** (0.016)	0.00 (0.004)	0.09 (0.086)	0.33*** (0.017)
DiD Coefficient (2007)	0.01 (0.015)	-3.35*** (0.480)	-3.07*** (0.420)	0.01 (0.024)	-0.00 (0.005)	-0.07 (0.069)	0.34*** (0.020)
DiD Coefficient (2008)	-0.04** (0.016)	-3.46*** (0.462)	-3.28*** (0.336)	0.00 (0.027)	0.00 (0.005)	-0.05 (0.059)	0.42*** (0.020)
DiD Coefficient (2009)	-0.04* (0.020)	-3.79*** (0.485)	-3.51*** (0.336)	0.01 (0.030)	-0.00 (0.004)	-0.00 (0.064)	0.44*** (0.021)
DiD Coefficient (2010)	-0.02 (0.020)	-3.84*** (0.529)	-3.32*** (0.374)	0.04 (0.031)	0.00 (0.004)	0.05 (0.062)	0.44*** (0.023)
DiD Coefficient (2011)	-0.05** (0.021)	-4.04*** (0.528)	-3.35*** (0.359)	0.07** (0.031)	-0.00 (0.004)	0.09 (0.066)	0.53*** (0.017)
DiD Coefficient (2012)	0.14*** (0.027)	-2.71*** (0.624)	-2.52*** (0.420)	-0.02 (0.035)	-0.00 (0.005)	0.19*** (0.064)	0.44*** (0.023)
DiD Coefficient (2013)	0.03 (0.021)	-3.48*** (0.568)	-2.95*** (0.393)	0.03 (0.029)	-0.00 (0.004)	0.14** (0.063)	0.55*** (0.027)
DiD Coefficient (2014)	-0.13*** (0.018)	-4.23*** (0.526)	-3.56*** (0.429)	0.04 (0.027)	-0.00 (0.005)	0.17** (0.072)	0.61*** (0.035)
DiD Coefficient (2015)	-0.14*** (0.018)	-4.26*** (0.458)	-3.61*** (0.361)	0.03 (0.030)	0.00 (0.005)	0.04 (0.070)	0.59*** (0.042)
Acad. Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	830,813	830,813	830,813	830,813	830,813	830,813	830,813
Adj. R-squared	0.513	0.0856	0.0326	0.438	0.0261	0.0796	0.109

Source: author's calculations, based on library data.

Notes: (a) The dependent variables in the above specifications correspond to the probability of higher than average delays in the library (first column), borrowings' effective duration (second column), borrowings' delays (third column), the proportion of early returns (fourth column), renew rates (fifth column), item counts (sixth column), and fine counts (seventh column). (b) Standard errors clustered by course (reported in parentheses). (c) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 2.2 – Dynamic effects of a fine, 2005-2015

Source: author's calculations, based on library data.

Figure 2.3 – Dynamic effects for distinct performance measures, 2005-2015

Source: author's calculations, based on library data.

When looking at the dynamic effects of the fine over other variables, I uncover two distinct sets of results. First, according to the patterns in the graph, the fine has an initial negative impact of -0.04 percentage points (p.p.) over the probability of delays, in the year following its introduction (2006). However, after that period, there is not a statistically significant impact in the following five years (2007-2011). There is a positive impact in 2012, no impact in 2013, and negative impacts for the 2014-2015 period. While it seems unlikely the occurrence of fine impacts five years past its instauration, this dynamic evidence suggests that the deterrent effects of the fine are short-lived, at best. This is probably a direct consequence of the fine's constant nominal value.

Second, while the fine has a clear contractionary effect over borrowings' effective durations and delays, it does not present a robust pattern in the case of early returns, renew rates, and the number of items each user borrows. Interestingly, when looking at the number of fines per user, I uncover a result in which the number of fines increases over time, contrarily to standard arguments concerning the efficacy of fines as a deterrence factor for illicit behavior. I investigate such a pattern in detail in the next section of the paper²⁰.

2.4.3. Heterogeneous effects

One interesting question in the present setting is the following: how do different types of users respond to a monetary sanction? Since there is ample variation in library users, in terms of their characteristics, one could expect resulting differences in terms of behavior. For instance, differences in wealth could significantly affect individual responses to monetary sanctions: richer users would not be as affected by the fine as poorer users (Polinsky & Shavell, 1991). In order to answer such a question, I present in table 2.6, estimates considering the effects of fines over distinct category of library users, such as high school students, undergraduates, graduate students, and former students. I also

²⁰ In such a situation, one may argue that the value of the fine is small enough to make individuals not care about the consequences of delayed items. However, as argued by Bénabou and Tirole (2006), in real-world situations, in which time has an opportunity cost, this type of "small rewards" correspond to substantial values of an incentive rate.

consider additional users' characteristics, such as their gender, and area of study. All estimates cover the 2005-2006 period:

Table 2.6 – Heterogeneous effects of fines, 2005-2006

VARIABLES		Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)
DiD Coefficient	-0.05*** (0.017)	-0.04** (0.018)	-0.01 (0.025)	-0.04** (0.019)	-0.03* (0.019)	-0.01 (0.019)	-0.02 (0.017)	-0.02** (0.010)	-0.02 (0.015)	-0.02 (0.014)	-0.02 (0.014)
DiD Coefficient x Female	0.02 (0.015)										
DiD Coefficient x Highschool		-0.13*** (0.037)									
DiD Coefficient x Undergraduate			-0.03 (0.026)								
DiD Coefficient x Graduate				0.04** (0.015)							
DiD Coefficient x Former Student					0.05*** (0.020)						
DiD Coefficient x Management						-0.05** (0.024)					
DiD Coefficient x Economics							0.05*** (0.019)				
DiD Coefficient x Accounting								0.06* (0.033)			
DiD Coefficient x Advertising									-0.00 (0.021)		
DiD Coefficient x Int. Relations										0.04 (0.037)	
DiD Coefficient x Secretariat											0.03 (0.019)
Acad. Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	128,156	128,156	128,156	128,156	128,156	128,156	128,156	128,156	128,156	128,156	128,156
Adj. R-squared	0.516	0.517	0.517	0.516	0.516	0.517	0.517	0.517	0.516	0.516	0.516

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of higher than average delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) "Time Trends" correspond to variable time trends for the control and treatment groups. Statistical significance: * p < 0.10, ** p < 0.05, *** p < 0.01.

An initial test for heterogeneous effects of fines relates to behavioral differences in terms of gender. Building on previous work related to the importance of gender and identity in socioeconomic contexts, I run difference-in-difference specifications that allow for users' gender differences. In this case, I cannot find significant differences in terms of behavior between male and female users²¹.

The remaining results in the table confirm the previous intuition: monetary sanctions, such as fines, exert heterogeneous effects on users, depending on the specific category to which they belong. In this case, the effect of fines over the probability of higher than average delays is negative and stronger for undergraduates, while it is positive for graduate and former students. For most specifications in the table, the average treatment effect remains negative and statistically significant (around -0.04). In the specific case of high school students, the fine presents a negative effect more than three times larger than the average effect ($= -0.13/0.04$). Since high school students present, on average, lower wealth levels than other user categories in the sample, this result suggests that the effects of the fine depend on the wealth of users. Given the constant nominal value of the fine over the sample period under analysis, one can expect that the fine would have a larger effect over users with less wealth (Polinsky & Shavell, 1991).

Another interesting possibility relates to area of study. Previous contributions reported behavioral differences resulting from undergraduate major choices, either in the laboratory or the field (Cadsby & Maynes, 1998; Fosgaard, Fosgaard, & Foss, 2017; Frey & Meier, 2005). In a similar fashion, building on contributions related to the importance of culture for economic outcomes (Alesina & Giuliano, 2015; Henrich et al., 2001), there could be behavioral differences due to specific cultural biases for each area of study. Based on these contributions, I investigate if users coming from distinct university departments present different responses to fines. It is important to note that, contrarily to previous contributions, I deal not only with students, but also with professors, in this case. A clear picture emerges from the results in the table: there is considerable heterogeneity, in terms of the effects of fines over delays, across areas of study. The negative impact of the fine occurs in the case of the area of management, only (-0.05), being positive and of

²¹ Antonovics, Arcidiacono, and Walsh (2005), Niederle and Vesterlund (2007), and Sarsons (2017) correspond to discussions related to gender in economic settings. See Akerlof and Kranton (2000, 2005), Benjamin, Choi, and Fisher (2016), Benjamin, Choi, and Strickland (2010), and Kranton, Pease, Sanders, and Huettel (2012) (Benjamin et al., 2016) for discussions related to the importance of identity in economics.

similar magnitude in the case of the areas of economics and accounting (in the 0.05-0.06 range). Once I allow for heterogeneous effects across areas of study, the average treatment effect remains significant for the area of accounting only, although with a smaller magnitude. The fine does not seem to affect users from other areas of study, such as advertising, international relations, and secretariat.

2.5. Sensitivity analysis

In the previous section, I reported a result in which the instauration of a monetary sanction reduces illicit behavior in a statistical and economic meaningful way. Although this is an intuitive result, it may present different types of bias for several reasons. In this section, I present results from distinct tests to validate the main results reported before. I divide the section in three parts: a first section containing placebo tests, a second section containing robustness checks, and a third section, in which I explore alternative mechanisms.

2.5.1. Placebo tests

In the case of the present setting, fines make delays more expensive on average, and this affects users' behavior, lowering delays. If this basic mechanism applies to the library I study, then it should not affect variables that would not correlate with monetary sanctions, at first. Given this reasoning, I present, in table 2.7, estimates of difference-in-differences regressions, in which the dependent variables correspond to variables that the fine should not affect. Specifically, I consider specifications in which the dependent variable is either users' gender (first column) or borrowings' predicted duration (second column). Additionally, I consider specifications in which I substitute the treatment group with professors (third column) or university employees (fourth column), given that none of these categories were subject to monetary sanctions during the entire sample period. Once again, I employ complete specifications, controlling for the same fixed-effects as before, as well as specific time trends.

Table 2.7 – Placebo tests

VARIABLES	(1) Female	(2) Predicted Duration	(3) Professors	(4) Employees
DiD Coefficient	0.01 (0.009)	0.65* (0.384)	-0.06 (0.056)	0.04 (0.161)
Acad. Year Dummies	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes
Observations	128,156	126,352	128,156	128,156
Adj. R-squared	0.0745	0.286	0.458	0.456

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to users' gender (first column), and borrowings' predicted duration (second column). In the case of the table's third and fourth columns, I substitute the treatment group either by professors (third column) or by university employees (fourth columns). (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) "Time Trends" correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results reported above confirm that monetary sanctions do not affect the dependent variables considered in the table. When looking at users' gender, I cannot reject the null hypothesis of no significance for the estimated difference-in-differences coefficient. Similarly, when considering either professors or employees as the treatment group, I cannot find a significant difference-in-differences effect. The only exception to such a pattern is borrowings' predicted duration, which is marginally significant, in this case. Overall, the placebo tests reported in this section suggest that there is a meaningful effect of monetary sanctions over behavior in the present context.

2.5.2. Robustness checks

In table 2.8, I present difference-in-differences estimates based on different samples. I do this to verify if the previous results are sensitive to alternative sample definitions.

Table 2.8 – Robustness: alternative samples

VARIABLES	(1) Legal Counts	(2) No Vacations	(3) No Holydays	(4) No Exams
DiD Coefficient	-0.04** (0.016)	-0.03** (0.015)	-0.04** (0.017)	-0.04** (0.018)
Acad. Year Dummies	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes
Observations	122,676	112,663	127,544	110,940
Adj. R-squared	0.517	0.526	0.516	0.512

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of higher than average delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) In each column, I exclude a specific part of the sample: no book counts outside the library's legal rules (first column), no vacations (second column), no holydays (third column), and no exam weeks (fourth column). (d) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (d) "User Dummies" correspond to a set of dummies for users' group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (d) "Time Trends" correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In the first column of the table, I exclude from the sample users whose item counts surpass the library's legal limits. Although the library has clear rules concerning item limits for each user category, it is possible that some users have special permission from librarians to take more items during specific times of the academic year. For instance, some professors may be able to take more than seven books in the beginning of the semester to organize courses²². In the second column, I exclude vacation periods. I do this because one could speculate that the main results concerning the effects of fines over delays may present biases due to longer delays during periods when classes are over. Similarly, in the third and fourth columns, I exclude holidays and exam weeks from the sample, to avoid contamination of the results by specific times of the academic year. In the latter case, one possible concern would be that users exhibit a different behavior during exam weeks. For instance, some users could hold books for longer time during exam weeks, given the library's rivalry property. Note that the exclusion of these specific periods (vacations, holydays, and exam weeks) correspond to indirect tests of the importance of users' behavioral biases, such as inattention during holydays, or opportunistic behaviors during exam weeks. I return to these points below, when I discuss in detail possible mechanisms

²² I confirm this empirical pattern by looking at the data. In certain occasions, some users took more items than allowed by the library. However, the vast majority of the sample (99.96%) conforms to the library's legal rules concerning maximum item limits per user.

affecting the main results. In all cases reported in the table, the previous results remain robust to minor modifications in the sample.

2.5.3. Alternative mechanisms

Up to this point, I uncovered a result in which the instauration of a monetary sanction (fine) in the library under study affects illicit behavior in the way predicted by standard models of law enforcement. However, when examining the dynamic effects of the fine, I notice that, although the fine affects effective durations and delays permanently, it does not do so with other variables, such as item counts and renew rates. More importantly, when looking at the number of fines per user, there is a consistent increasing pattern over the entire period after the instauration of the fine. In this section, I explore possible mechanisms underlying the last result, related to the lack of long-term effects of this sanction. Specifically, I explore three possibilities, based on different driving forces, that I call “opportunism”, “inattention”, and “learning”. I discuss each of these mechanisms in detail below.

2.5.3.1. Opportunism

As mentioned above, one potential source of bias in the present context relates to the possibility of opportunistic behaviors by library users. Given the library’s rivalry property, some users may retain books during exam weeks, to harm other users, for instance. In fact, there is a well-established literature related to testing opportunistic behaviors – such as free-riding – either in the laboratory or the field (Andreoni, 1988; Andreoni & Croson, 2008; Croson, 2008; Fehr & Gächter, 2000; Fehr & Leibbrandt, 2011). If opportunistic behaviors play a significant role in explaining the effects of the fine in this context, then one would expect that delays are higher in exam weeks, or in dates near them. I test such a prediction in table 2.9, by considering the interaction of difference-in-differences coefficients with specific periods of the academic year. Since I have access to official university information, I build specific dates for exams, as well as nearby dates (one day, three days, and seven days before exam weeks).

Table 2.9 – Mechanisms: opportunism

VARIABLES	(1) Prob.(Late)	(2) Prob.(Late)	(3) Prob.(Late)	(4) Prob.(Late)
DiD Coefficient	-0.01 (0.014)	-0.02 (0.015)	-0.02 (0.014)	-0.02 (0.014)
DiD Coefficient x Exams	-0.06*** (0.011)			
DiD Coefficient x Exams (1day before)		-0.02 (0.015)		
DiD Coefficient x Exams (3days before)			-0.01 (0.012)	
DiD Coefficient x Exams (7days before)				0.01 (0.014)
Acad. Year Dummies	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes
Observations	830,813	830,812	830,810	830,806
Adj. R-squared	0.508	0.507	0.507	0.507

Notes: (a) The dependent variable in the specifications corresponds to the probability of higher than average delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) “Acad. Year Dummies” correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) “Book Dummies” correspond to a set of dummies for books’ area of study (business, accounting, economics, and law). (e) “User Dummies” correspond to a set of dummies for users’ group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) “Time Trends” correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As the table’s results suggest, there are no significant effects of dates near exam weeks over delays. Actually, as reported in the table’s first column, the probability of delays is lower during exam weeks, not otherwise. This result suggests that opportunistic behaviors are not affecting the main results reported above.

2.5.3.2. Inattention

Another potential source of bias in the present setting relates to users’ behavioral biases. Library users may present cognitive limitations in the sense suggested by Simon (1955), which could affect borrowings’ delays²³. One related example in the present context is that users could lack attention in terms of predicted devolution dates. When surveying part of the evidence related to behavioral economics, DellaVigna (2009) states that pre-weekend dates could proxy for inattention. I build on this insight to test if the probability of delays is higher in specific days of the week, such as Fridays, for instance. If users’

²³ Simon (1976) presents alternative definitions of rationality in economics. See Jones (1999) for a survey on the theme of bounded rationality.

inattention plays an important role in explaining the previous results, then one should expect to see higher delays in days before weekends. I test this hypothesis in table 2.10, by presenting results of difference-in-differences specifications where I consider the effects of the fine for each day of the week:

Table 2.10 – Mechanisms: inattention

VARIABLES	(1) Prob.(Late)	(2) Prob.(Late)	(3) Prob.(Late)	(4) Prob.(Late)	(5) Prob.(Late)	(6) Prob.(Late)
DiD Coefficient	-0.03* (0.013)	-0.02 (0.014)	-0.03* (0.014)	-0.01 (0.013)	-0.01 (0.015)	-0.02 (0.016)
DiD Coefficient x Monday	0.02* (0.014)					
DiD Coefficient x Tuesday		0.01 (0.014)				
DiD Coefficient x Wednesday			0.03** (0.013)			
DiD Coefficient x Thursday				-0.07*** (0.014)		
DiD Coefficient x Friday					-0.06*** (0.016)	
DiD Coefficient x Saturday						0.06*** (0.018)
Acad. Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes	Yes	Yes
Observations	830,813	830,813	830,813	830,813	830,813	830,813
Adj. R-squared	0.495	0.494	0.492	0.490	0.509	0.503

Notes: (a) The dependent variable in the specifications corresponds to the probability of higher than average delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) “Acad. Year Dummies” correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) “Book Dummies” correspond to a set of dummies for books’ area of study (business, accounting, economics, and law). (e) “User Dummies” correspond to a set of dummies for users’ group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) “Time Trends” correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Contrarily to the previous intuition, I cannot find a “Friday-effect” for library’s delays. For most specifications in the table, there is not a robust effect of fines over behavior for specific days of the week. The probability of delays is higher on Saturdays, but it presents a similar magnitude and opposite sign for Fridays, which seems hard to reconcile with arguments considering inattention as the main driver of the reported results. This is an

intuitive result, since the library's electronic system (*Pergamum*) sends reminders to late users, with such reminders even sent in advance, in some occasions²⁴.

2.5.3.3. Learning

When evaluating the dynamic effects of fines in the library setting studied in this paper, I uncover a result in which the number of fines faced by users raises over time. In this section, I test the possible occurrence of learning effects among users. Specifically, I try to verify the occurrence of social learning in this context. When analyzing learning and peer effects in a sample of movie releases during the 1982-2000 period, Moretti (2011) defines social learning as “. . . a situation where consumers in week t update their prior based on feedback from others who have seen the movie in previous weeks” (p. 357). While I am not able to observe how library users personally interact, I can employ a similar empirical strategy to Moretti's (2011) to evaluate the relative importance of learning effects²⁵.

To test the occurrence of learning in this context, I employ two alternative strategies. First, I present in table 2.11 differences-in-differences estimations, where I allow for heterogeneous effects based on book usage, previous delays, and the number of fines per user. If learning effects are relevant in this setting, than one could expect that interactions involving either one of these variables would present a negative sign. For instance, users who borrow specific books more often would learn the importance of monetary sanctions faster than users who do otherwise. Similarly, users who faced monetary sanctions in the past – either in the form of previous delays or positive fines – would learn not to delay in future occasions.

²⁴ In personal meetings with the library manager, she informed me that *Pergamum* automatically sends electronic reminders to users before the borrowings' due date is over. Appendix B contains a graphical example of such reminders. Apesteguia et al. (2013) and Chetty, Saez, and Sándor (2014) correspond to examples of field experiments focusing on the importance of reminders in distinct settings. See Wiederholt (2010) for a brief survey of inattention theories.

²⁵ Agarwal, Driscoll, Gabaix, and Laibson (2013) report a result in which monetary fee payments can induce learning in a large sample of credit card statements.

Table 2.11 – Mechanisms: learning (library use)

	(1)	(2)	(3)
VARIABLES	Prob.(Late)	Prob.(Late)	Prob.(Late)
DiD Coefficient	-0.01 (0.019)	-0.02* (0.014)	-0.01 (0.020)
DiD Coefficient x Book Usage	-0.00 (0.000)		
DiD Coefficient x Late Before		-0.00 (0.014)	
DiD Coefficient x Fine Count			0.04** (0.014)
Acad. Year Dummies	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes
Observations	830,813	830,813	830,813
Adj. R-squared	0.507	0.508	0.561

Notes: (a) The dependent variable in the specifications corresponds to the probability of higher than average delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) “Acad. Year Dummies” correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) “Book Dummies” correspond to a set of dummies for books’ area of study (business, accounting, economics, and law). (e) “User Dummies” correspond to a set of dummies for users’ group ages (14-17, 18-23, 24-30, 31-40, 41-50, 51-60, 60+), category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) “Time Trends” correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results presented in the table do not confirm the hypothesis that library users learn from monetary sanctions. There are no effects in terms of book usage or previous delays, suggesting that library users do not learn about the deterrent effects of fines, as time goes by. In the case of the number of fines each user faces, the estimated coefficient is significant at a 5% significance level, but it has the opposite sign to that predicted by explanations based on learning effects.

In terms of the second empirical strategy used to test the importance of learning, I follow Moretti (2011) by using age as a *proxy* for social networks. Specifically, one could expect that younger users would have larger social networks, which could induce faster learning by them. I do this to test the hypothesis that social learning should be stronger for those users who have larger social networks. In fact, there is a well-established literature describing the benefits of social networks for information dissemination, thus allowing

for significant gains in terms of learning²⁶. In table 2.12, I present difference-in-differences estimates allowing for heterogeneous effects based on users' age groups.

²⁶ See Granovetter (1973, 1985) for pioneering contributions in social networks, with an emphasis on the importance of social ties for information diffusion. Granovetter (2005), Jackson (2008, 2014), and Munshi (2014) correspond to surveys on the growing importance of networks for economic outcomes. Allcott, Karlan, Möbius, Rosenblat, and Szeidl (2007), Barr, Dekker, and Fafchamps (2014), Costa and Kahn (2007), Glaeser, Laibson, Scheinkman, and Soutter (2000), Goeree, McConnell, and Mitchell (2010), Karlan (2005), Leider, Möbius, Rosenblat, and Do (2009), Marmaros and Sacerdote (2006), and Uzzi (1997) correspond to empirical and experimental analyses related to the importance of social networks in distinct contexts.

Table 2.12 – Mechanisms: learning (social networks)

VARIABLES	(1) Prob.(Late)	(2) Prob.(Late)	(3) Prob.(Late)	(4) Prob.(Late)	(5) Prob.(Late)	(6) Prob.(Late)	(7) Prob.(Late)
DiD Coefficient	-0.02 (0.014)	-0.02 (0.022)	-0.01 (0.017)	-0.02** (0.011)	-0.02 (0.012)	-0.02 (0.014)	-0.02 (0.014)
DiD Coefficient x Age (14-17)	-0.05* (0.030)						
DiD Coefficient x Age (18-23)		-0.00 (0.022)					
DiD Coefficient x Age (24-30)			-0.02* (0.012)				
DiD Coefficient x Age (31-40)				0.06* (0.037)			
DiD Coefficient x Age (41-50)					0.08** (0.036)		
DiD Coefficient x Age (51-60)						-0.18 (0.113)	
DiD Coefficient x Age (60+)							-0.31*** (0.079)
Acad. Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	830,813	830,813	830,813	830,813	830,813	830,813	830,813
Adj. R-squared	0.507	0.507	0.507	0.507	0.507	0.507	0.507

Notes: (a) The dependent variable in the specifications corresponds to the probability of higher than average delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) “Acad. Year Dummies” correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2006-year. (d) “Book Dummies” correspond to a set of dummies for books’ area of study (business, accounting, economics, and law). (e) “User Dummies” correspond to a set of dummies for users’ category (high school student, undergraduate, graduate, and former student), area of study (business, accounting, and economics), and time at school (0 to 4 years). (f) “Time Trends” correspond to variable time trends for the control and treatment groups. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The evidence presented in the table does not support the existence of learning effects. Although the estimated coefficient presents the expected sign and magnitude for the youngest cohort in the sample (users in the 14-17 age group), the same does not occur in the case of the following two cohorts (18-23 and 24-30 age groups), which would be expected to have larger than average social networks. More than that, it is worth noting that, while older cohorts present higher values for the probability of delays, the oldest cohort in the sample (60+ age group) presents the strongest negative effect among age groups. The latter result seems implausible in the present context: if stronger social networks relate inversely to age, than one would expect that older users present higher values for the probability of delays, not otherwise. These results could be reflecting the wealth status of such age groups (14-17 and 60+ age groups), since both may present higher wealth elasticities to the effects of a monetary fine. To sum up, I cannot find convincing evidence regarding the importance of social learning in the present context. If anything, learning effects happen in the opposite direction: library users, by noticing the constancy of the fine's nominal value over time, raise delays, instead of diminishing them.

2.6. Conclusion

Different types of sanctions can affect behavior in varied (and unexpected) ways. In this paper, I try to answer the following question: how does the introduction of a monetary sanction affect behavior? Based on a unique field setting and a longitudinal dataset covering more than 800,000 daily transactions from a university library during a 10-year period (2005-2015), I evaluate how the introduction of a monetary sanction (fine) affects users' delays.

By exploiting the fact that the library instituted, in a given year, a fine for students only, I estimate the effects of the introduction of a monetary sanction over behavior. Two main results emerge. First, in aggregate terms, the introduction of the monetary sanction reduces delays, as predicted by standard models of law enforcement. It is worth noting that there is considerable heterogeneity in terms of the effects of the fine over distinct groups of library users. Second, when considering the dynamic effects of this type of sanction, I uncover a result in which the fine loses efficacy over time, since its nominal value remains the same after instauration. These results are robust to several specification

issues, such as variations in sample definitions and periods, as well as the use of distinct library performance measures, for instance. They also do not seem to be a result of alternative mechanisms that could affect users' behavior, such as opportunism, inattention, or learning.

Overall, the results reported in this paper suggest that monetary sanctions can influence behavior in the desired direction. The uniqueness of the library setting studied call attention for two important points related to the impacts of fines over time. These results suggest the importance of adjusting fines' values to users' wealth, as predicted by previous contributions. According to some authors, one important aspect related to the instauration of fines is adjusting its value to users' wealth (Polinsky & Shavell, 1991). By not adjusting fines in this manner, the library under study ended up punishing poorer users harder. On the other hand, the results related to dynamic effects emphasize the symbolic effects of fines, since the fine's nominal value remained constant for a 10-year period. Given that library users observe these values, as well as the enforcement done by the library (imperfectly), they can adapt their decisions to such an environment.

These results have important implications, both in practical and theoretical grounds. In terms of practice, the results provide valuable insight for organizational issues, such as agency and teamwork issues, for example. For instance, firms interested in aligning incentives may use a combination of distinct types of sanction as an effective means to influence behavior. In terms of theory, the results in this paper not only provide a better understanding of the impacts of fines over illicit behavior, but they also shed light on related issues, such as economic incentives, social norms, and corruption in real-world settings. In particular, one promising route of future research would be to empirically explore some of the results predicted by models emphasizing the interaction between social norms and laws (Acemoglu & Jackson, 2017; Bénabou & Tirole, 2011).

3. MEASURING EXTERNALITIES IN AN INFORMATION COMMONS: THE CASE OF LIBRARIES

“Books are the best things, well used: abused, among the worst.”
 – Ralph Waldo Emerson, *American Scholar*, 1837

3.1. Introduction

Common-pool resources correspond to goods with unique characteristics: they are non-exclusive, but rival. The first property states that it is hard to exclude individuals from consuming the good, while the second property states that one individual’s consumption may reduce other individuals’ consumption. One important question related to this class of goods asks if their characteristics may lead to overexploitation. In a seminal contribution, Hardin (1968) predicted that such a situation would inevitably happen, given that individualistic attitudes may prevail in both the short and long run. For example, forest degradation would be a natural result in a setting where individuals and firms try to maximize their own private gains, the so-called “Tragedy of the Commons” (Hardin, 1968).

The present paper measures externalities in a specific type of common-pool resource, an information commons. Employing a novel dataset related to more than 700,000 transactions in distinct libraries during a 10-year period (2006-2015), I estimate the magnitude of external effects derived from the actions of library users who were subject to a non-monetary sanction over users who were subject to a monetary sanction. Additionally, I estimate the magnitude of peer effects among users, considering the number of items they borrow from the library. In both occasions, I exploit the fact that libraries are an example of a common-pool resource, with an emphasis over their basic properties. I also exploit differences among library users in terms of the incentives they face: while some users (professors and employees) are subject to non-monetary sanctions, in the form of daily suspensions, others (students) face monetary sanctions, in the form of fines.

Libraries constitute an ideal setting for studying externalities. The existence of a limited supply of books in a library may generate competition among users, as well as congestion of library services. Given common-pool resources' rivalry property, one can imagine that, the higher the number of books that a particular user borrows, the lower will be the number of available books for remaining users. In a library setting, students from the same class, facing exam weeks, could compete for the same books. Following the same reasoning, professors from similar areas, preparing course materials before the semester begins, could face competition for library services from their peers. Moreover, the constant interaction among users with similar needs, such as students from the same class, may generate peer effects in such a context. These features of the data allow me to study externalities in this setting by: (i) estimating the magnitude of external effects of users' actions, considering that they face distinct types of sanctions, and (ii) estimating peer effects among users with similar characteristics.

I anticipate two main results. First, when investigating the external effects of professors and employees' actions over students, I uncover a "crowding-out" effect: for an additional unity in non-students' book counts, there is an approximate decrease of one-to-one in students' counts, *ceteris paribus*. Although these estimates do not have a causal interpretation in the present setting, they correspond to an empirical measure of the magnitude of libraries' rivalry property. Second, when estimating peer effects among users with similar characteristics, I find a positive influence of group behavior over individuals: for every 100 books borrowed by a user's peer group, there is a rise of three books per user, on average. Taken together, these results stress the importance of behavioral complementarities in a field setting, having important implications for theories based on common-pool resource management, as well as public goods provision.

The remainder of the paper proceeds as follows. Section 2 contains a selective description of the literatures on externalities and peer effects measurement, as well as their relation to the contributions in this paper. Section 3 describes the data and research design employed in the empirical analysis below. Section 4 contains the analysis' main empirical results, while section 5 reports sensitivity analysis tests. Finally, section 6 concludes.

3.2. Related literature

This paper brings three main contributions to distinct literatures. First, the results here presented dialogue with a well-established literature in social dilemmas, with a special emphasis over common-pool resources' management (Demsetz, 1967; Hardin, 1968; Olson, 1965; Ostrom, 1990, 1999, 2010). Although there exists a large volume of evidence related to social dilemmas in artificial settings – such as laboratory experiments (Andreoni, 1988; Andreoni, Harbaugh, & Vesterlund, 2008; Dawes & Thaler, 1988) – the present paper reports results related to social dilemmas in a field setting, along the lines of recent studies (Fehr & Leibbrandt, 2011; Gneezy, Leibbrandt, & List, 2016). Most previous contributions in the literature emphasized examples related to themes such as forests, fisheries, and wildlife in general (Cárdenas, 2003; Dietz et al., 2003; Fehr & Leibbrandt, 2011; Ostrom, 2007; Rustagi et al., 2010). Here, I present an example of application related to an information commons. The present paper differs from previous contributions by expanding the scope of analysis and focusing on the internal dynamics of an information commons (Hess & Ostrom, 2007a, 2007b). To the best of my knowledge, this is probably one of the first attempts to measure externalities in an information commons²⁷.

Second, these results contribute to an ever-growing literature related to the empirical measurement of externalities. While previous contributions focused on specific settings, such as traffic accidents (Edlin & Karaca-Mandic, 2006), crime (Ayres & Levitt, 1998), or natural resources (Fehr & Leibbrandt, 2011), I exploit the main properties of common-pool resources to estimate the magnitude of external effects in a novel setting. A related literature emphasizes the importance of peer effects in distinct situations (Breza, 2012; Marmaros & Sacerdote, 2006; Moretti, 2011), with a focus on the effects of group behavior over individuals. In the case of these contributions, although there were differences in terms of results obtained, most authors agree that peer effects measurement

²⁷ Today, there is an extensive experimental literature related to public goods' provision. See, for instance, Andreoni (1988), Andreoni and Croson (2008), Andreoni et al. (2007), Fehr and Gächter (2000), and Gneezy et al. (2013). Chaudhuri (2011), Ledyard (1995), and Zelmer (2003) correspond to surveys on the theme. In the case of distinct studies related to common-pool resources' management, see Cárdenas (2003), Cárdenas and Ostrom (2004), Dietz et al. (2003), Libecap (2016), Ostrom (1990, 1999, 2000, 2005), Rustagi, Engel, and Kosfeld (2010), Volland and Ostrom (2010), Wilson et al. (2013), and Zylbersztajn (2010).

is fraught with difficulties. As mentioned above, the present paper adds to this literature by exploiting the fact that the existence of a limited supply of books in a library at a given moment may generate competition between users, as well as congestion of services. In particular, the constant interaction among users with similar needs, such as students from the same class, allows me to estimate peer effects in this setting.

Third, by comparing the behavior of users subject to different kinds of sanctions (monetary and non-monetary), the present paper adds to a multidisciplinary literature on the importance of distinct types of incentives. In fact, there is not a clear consensus among social scientists in terms of the superiority of monetary sanctions over other forms of punishment (Gneezy, Meier, & Rey-Biel, 2011; Kamenica, 2012). Although there exists some evidence from laboratory experiments suggesting that different types of sanctions can affect behavior through distinct channels (Fehr & Gächter, 2000; Masclet, Noussair, Tucker, & Villeval, 2003), the available evidence presents mixed results, either in terms of natural or field experiments (Bar-Ilan & Sacerdote, 2004; Gneezy & Rustichini, 2000a; Haselhuhn et al., 2012; Squazzoni, Bravo, & Takács, 2013). In this sense, the present paper brings new results to an open debate, by evaluating the behavior of users responding to distinct types of incentives in a field setting²⁸.

3.3. Data and method

3.3.1. Institutional Background

I study the behavior of library users covering more than 700,000 transactions during a 10-year period. I have access to confidential daily data related to library users of a private university in São Paulo, Brazil, for the 2006-2015 period. The data contain detailed information on 16,232 individual users, covering 723,798 daily transactions. This corresponds to an unbalanced panel, since each library user may borrow different numbers of specific library items at distinct moments. For instance, one user may borrow two books on March 1st, and then borrow one more book on March 3rd, before returning previous items. The data is available in electronic format through a system named

²⁸ Ellingsen and Johannesson (2007), Gneezy, Meier, and Rey-Biel (2011) and Kamenica (2012) correspond to discussions related to the importance of distinct types of incentives in economic settings.

Pergamum (<https://www.pergamum.pucpr.br>), which provides technology services for several libraries in Brazil²⁹.

The data contain information on users' socioeconomic characteristics – such as gender, date of birth, and address – as well as library's confidential information, with each user's identification number, university category (high school, undergraduate, master's, MBA, former student, professor, and employee) and area of study (management, accounting, economics, international relations, advertising, and secretariat). For each user in the data, I am able to identify her department and category. The data also contain the dates when each user borrowed specific items from the library, as well as each item's code, and title. Based on each title, I build a measure of area of expertise for each book in the sample, such as management, accounting, economics, and law.

One important information regarding the libraries studied in this paper relates to their location and size. The libraries here studied belong to different *campi* of the same university, two located in central neighborhoods of São Paulo (Liberdade and Largo do São Francisco), and one located in an upper-class neighborhood (Pinheiros). The Liberdade unit is the oldest and largest library of the three: founded in 1902, it contained 31,193 books in the 2015 year. In the case of the Largo do São Francisco unit, it dates from 2006, containing 2,883 books, in 2015. Finally, the Pinheiros unit dates back to 2011, having 883 books. Although the different locations may affect user behavior in each library, it is worth noting that two of these libraries (Largo do São Francisco and Pinheiros) serve the same type of user, MBA students, mainly. On the other hand, the oldest library (Liberdade) serves a diversified group of users, which includes high school, undergraduate, graduate, and MBA students, as well as professors, former students, and university employees. I discuss these differences in detail in the robustness section below.

²⁹ Originally, I had access to data for the 2005-2015 period. Before 2006, the libraries studied in this paper had a sanctioning system based on nonmonetary sanctions (daily suspensions), only. After that year, the library started charging monetary sanctions (fines) for students with late items, while maintaining a nonmonetary sanction for professors and university employees. I decide to focus the analysis on the 2006-2015 period, since I want to compare two distinct groups of users: one subject to non-monetary sanctions (professors and employees) and another subject to monetary sanctions (students). See Appendix B for descriptive statistics related to the total sample period (2005-2015).

I also have access to the library's official yearly reports. These reports contain rich institutional information related to the library's internal workings, for the 2005-2015 period. Based on this information, I am able to estimate the predicted devolution date for each user in the sample. In this specific case, the library's electronic system (*Pergamum*) imposes a rule of 15 days for professors and masters' students, and seven days, for all other users. Each user can renew books after the predicted devolution date expires, conditional on a waiting list managed by library staff. Although I do not have access to information on such lists' content, I can observe when users renew library items by comparing the dates of borrowings of the same item over time. There are also differences in terms of the number of items that each user can borrow from the library: while professors and masters' students can borrow a maximum limit of seven items, students can borrow a maximum of five, and university employees can borrow three items, only.

Table 3.1 presents information related to the workings of the libraries studied in this paper. The table's first column contains information on the number of library items that each user can borrow, based on the category that she belongs (named "Item Counts"). The table's second and third columns contain the number of borrowing days per user category ("Borrowing Days"), as well as the distinct types of sanctions they face in the case of delays ("Sanction Type"), respectively:

Table 3.1 – Library rules by user category, 2006-2015

USER CATEGORY	Item Counts	Borrowing Days	Sanction Type
High School Student	5	7	Fine
Undergraduate Student	5	7	Fine
Masters Student	7	15	Fine
MBA Student	5	7	Fine
Former Student	2	7	Fine
University Employee	3	7	Daily Suspension
Professor	7	15	Daily Suspension

Source: author's calculations, based on library data.

Notes: (a) Observations correspond to the 2006-2015 period, covering 723,798 transactions by 16,232 library users.

Table 3.2 presents descriptive statistics for the main variables used in the paper. The table's first column displays mean values for each variable and, in the case of metric variables, its standard-deviation values (reported in parenthesis). The second and third columns contain minimum and maximum values, respectively:

Table 3.2 - Main variables' descriptive statistics, 2006-2015

VARIABLE	Mean	Std.Dev.	Minimum	Maximum
Age	26.28	7.55	13	79
Book Count	2.65	1.42	1	7
Female	0.53	--	0	1
First Year	0.22	--	0	1
Scholarship	0.37	--	0	1
0 to 4 years in College	0.89	--	0	1
High School	0.02	--	0	1
Undergraduate	0.66	--	0	1
MBA	0.21	--	0	1
Graduate	0.04	--	0	1
Former Student	0.04	--	0	1
University Employee	0.01	--	0	1
Professor	0.02	--	0	1
Management	0.33	--	0	1
Accounting	0.36	--	0	1
Economics	0.14	--	0	1
International Relations	0.05	--	0	1
Advertising	0.04	--	0	1
Secretariat	0.02	--	0	1
Business Book	0.32	--	0	1
Accounting Book	0.16	--	0	1
Economics Book	0.15	--	0	1
Law Book	0.08	--	0	1
Observations	723,798			

Source: author's calculations, based on library data.

Notes: (a) Observations correspond to the 2006-2015 period, covering 723,798 transactions by 16,232 library users. (b) Standard deviations reported in the case of metric variables, only.

For the main period of analysis in this paper (2006-2015), I observe 723,798 library transactions, made by more than 16,000 users. These users are, on average, 26 years old, with similar proportions in terms of gender. Among these users, 22% are in their first year in college, while 37% holds a scholarship. In terms of categories, most library users are either undergraduates (66%) or MBA students (21%). In terms of areas of study, the vast majority of users enroll in either accounting (36%), management (33%), or economics (14%). This is an intuitive result, given the fact that the university in which the libraries are located corresponds to a business school. When looking at the library's books, a similar pattern reappears: one-third of these books correspond to business books, with accounting and economics books jointly responding for more than 30% of the total.

3.3.2. Empirical strategy

In this section, I describe the empirical strategy employed in the paper. In order to estimate externalities in the present setting, I proceed in two steps. First, I employ count

models to correlate the number of items among users facing distinct types of sanctions (monetary and non-monetary). In doing so, I aggregate library users in two distinct groups: one composed by students, only (named “student”), and another composed by professors and university employees (“non-student”). The first hypothesis I want to test is the following:

H_{3.1} (Externalities): Being subject to non-monetary sanctions, non-student users generate negative externalities over student users. Specifically, the higher the number of items borrowed from non-students, the lower should be the number of items borrowed by students.

I test this first hypothesis by running econometric specifications of the following form:

$$(3.1) \ln(\text{Counts by Student})_{it} = \alpha_i + \gamma \ln(\text{Counts by Non-student})_{it} + \mathbf{X}\beta_{it} + \Sigma_t(\psi_t) + \varepsilon_{it}$$

The dependent variable in the above specification corresponds to the number of item counts (number of books) that each user facing a monetary sanction borrows every time that she goes to the library. I regress this variable on the number of item counts that users facing a non-monetary sanction borrows, and on a set of controls ($\mathbf{X}$), which include users’ age, gender, and area of study, as well as book characteristics. I also include time dummies in most specifications, to reflect days of the week, weeks in the year, and specific years, in some specifications (ψ_t). In the case of the term ε_{it} , it has a conditional mean of zero ($E(\varepsilon_{it} | t) = 0$). The parameter of interest, in this case, corresponds to γ , measuring the response of students’ counts to variations in non-students’ counts. By estimating correlations between item counts of different types of users, I try to measure the magnitude of external effects in this context. Specifically, I measure the magnitude of an information commons’ rivalry property.

When estimating the above specification, I employ two alternative methods: ordinary least squares (OLS), as well as count-based regressions (Poisson). I employ the latter methods, given the nature of the dependent variable, which is discrete and non-negative ($Y_i = 0, 1, 2 \dots$). In the case of the Poisson distribution, the probability of occurrence of a count (m) for a given exposition is the following:

$$p(Y_i = m) = \frac{e^{-\lambda_i} \lambda_i^m}{m!},$$

with $E(Y) = \text{Var}(Y) = \lambda$. In this context, λ_{it} measures the expected number of occurrences of a rare event for a given exposition or, alternatively, the estimated average rate of incidence³⁰.

As a second step, when estimating peer effects among library users, I want to test the following hypothesis:

H_{3.2} (Peer Effects): The library's rivalry property may generate competition among users with similar needs. Specifically, the higher the counts of books from a peer group, the lower should be an individual user's count.

To test the last hypothesis, I run the following specification:

$$(3.2) \ln(\text{Counts by Student})_{it} = \alpha_i + \gamma \ln(\text{Counts by Peer Group})_{-it} + \mathbf{X}\beta_{it} + \Sigma_t(\psi_t) + \varepsilon_{it}$$

In the above specification, I regress an individual user's counts on the counts of a group that she belongs. Although I do not have official information related to class size and its composition for library users, I create peer groups based on user categories, area of knowledge and time at the university. For instance, in the case of a first-year student majoring in management, I regress her number of book counts on the number of book counts of her classmates. In this case, there is the implicit assumption that library users from the same category, area, and university time, share common characteristics. Again, I employ OLS methods to estimate peer effects. However, given the possibility of endogeneity problems in this setting, I also employ instrumental variables estimations (Angrist & Krueger, 2001; Baum, 2007). For instance, peer effects could be the result of omitted variable bias, or measurement error, as suggested by previous contributions on the theme (Breza, 2012). I try to circumvent these potential problems by instrumenting peers' delays with their own lagged values (one and two lags). In order to test these

³⁰ See Blevins et al. (2015) for a survey on count-based models. Marmaros and Sacerdote (2006) present an application of count-based models involving peer effects among college students. On the other hand, Fisman and Miguel (2007) study corruption practices among United Nations' diplomats.

instruments' adequacy, I report the results of Sargan-Hansen tests below (which tests the validity of over-identifying restrictions) (Baum, 2007).

3.4. Results

In this section, I present the main results of the empirical analysis performed in the paper. I divide the section in two parts: a first part, reporting estimates of externalities derived from the actions of non-students over students; and a second part, reporting estimates of peer effects among users.

3.4.1. Externalities

I present, in table 3.3, the results of OLS estimations for equation (3.1). In the table, the dependent variable corresponds to the average number of items that users in the student group borrow from the library (named "Counts by Student"). The table's first column reports the results of a simple bivariate regression relating item counts by students to item counts by non-students. I measure both variables in natural logarithmic scale. I do this to obtain an initial estimate of the sensitivity (elasticity) of the first variable to the second variable, as well as to evaluate the sign of the estimated correlation³¹. In the table's second to fourth columns, I progressively add covariates to the specifications to control for fixed-effects that may affect the resulting estimates. I do this to evaluate the robustness of the main results in the table. In all cases, I cluster standard errors by the number of courses offered at the university in the period³².

³¹ I transform variables according to the following formula: $\log(X) = 1 + \ln(X)$, where X represents the variable in its original scale.

³² There are 193 courses in the university during the 2006-2015 period. These courses differ from the areas of study (management, economics, accounting, international relations, advertising, and secretariat) that a student may choose when she enrolls in the university. When clustering standard errors by the number of courses, I follow Moretti (2011).

Table 3.3 – External Effects – OLS estimates, 2006-2015

VARIABLES	(1) Counts by Student	(2) Counts by Student	(3) Counts by Student	(4) Counts by Student
Counts by Non-student	-0.79*** (0.032)	-0.79*** (0.034)	-0.79*** (0.034)	-0.80*** (0.048)
Acad. Year Dummies	No	Yes	Yes	Yes
Book Dummies	No	No	Yes	Yes
User Dummies	No	No	No	Yes
Observations	723,798	723,798	723,798	723,798
Adj. R-squared	0.204	0.214	0.215	0.234

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the number of items borrowed by students in the library. (b) Standard errors clustered by course (reported in parentheses). (c) The group "Student" corresponds to high school, undergraduate, graduate, and MBA students. The group "Non-student" corresponds to professors and university employees. (d) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2007-2015 years. (e) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (f) "User Dummies" correspond to a set of dummies for users' group ages (18-23, 24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (management, accounting, and economics), and time at school (0 to 4 years). (g) Sample Period: 2006-2015. (h) Item counts expressed as natural logarithms. (i) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In all cases, there is a robust negative correlation between item counts among students and non-students, with an estimated coefficient of -0.80, on average. This result suggests that, for a 10% increase in the number of items borrowed by non-students, there is a -8% decrease in the number of items borrowed by students. At first, this evidence suggests that, on average, there is a negative correlation between items borrowed by users facing distinct types of sanctions, which confirms the library's rivalry property.

I investigate this result in detail in table 3.4, by presenting estimates of (3.1) based on a Poisson count model. Once again, I regress the number of items borrowed by students on the number of items borrowed by non-students. I also progressively add controls in the table's second to fourth columns, in order to control for distinct types of fixed effects in the data.

Table 3.4 – External Effects – Poisson estimates, 2006-2015

VARIABLES	(1) Counts by Student	(2) Counts by Student	(3) Counts by Student	(4) Counts by Student
Counts by Non-student	-22.70*** (0.448)	-21.95*** (0.448)	-21.44*** (0.447)	-21.73*** (0.459)
Acad. Year Dummies	No	Yes	Yes	Yes
Book Dummies	No	No	Yes	Yes
User Dummies	No	No	No	Yes
Observations	723,798	723,798	723,798	723,798
Log Pseudo-likelihood	-1.221e+06	-1.217e+06	-1.217e+06	-1.209e+06

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the number of items borrowed by students in the library. (b) Standard errors clustered by course (reported in parentheses). (c) The group "Student" corresponds to high school, undergraduate, graduate, and MBA students. The group "Non-student" corresponds to professors and university employees. (d) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2007-2015 years. (e) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (f) "User Dummies" correspond to a set of dummies for users' group ages (18-23, 24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (management, accounting, and economics), and time at school (0 to 4 years). (g) Sample Period: 2006-2015. (h) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results in the table point to a negative estimate among students' and non-students' counts, with coefficients around -22.00. Given the non-linear nature of count-based models, it is worth discussing these estimates in detail. As stated above, the parameter of interest in this setting corresponds to λ , which measures the expected number of cases of a rare event, for a given exposition. Based on the estimates presented in the table, one can calculate the incidence rate ratio (IRR), which gives, as the name suggests, the average incidence rate of item counts for a given variation in the parameter of interest (λ). For instance, in the case of the estimate in the table's fourth column, $\hat{\lambda} = -21.73$, it leads to an IRR value of $3.65e-10$ ($= e^{-21.73}$). This result corresponds to the multiplication of the incidence rate of students' counts by a factor of $3.65e-10$, *ceteris paribus*. Alternatively, this means that students' counts are -99.99% lower, on average. A similar result holds for the other estimates reported in the table. That is, an additional count by a non-student tends, on average, to generate a one-to-one displacement effect ("crowding-out") on students' counts.

3.4.2. Peer Effects

In table 3.5, I report estimates of equation (3.2), based on two alternative methods: OLS and instrumental variables (IV) estimations. In the case of all columns in the table, I employ variables in natural logarithmic scale, which provides an interpretation of

estimated coefficients as elasticities. I consider full specifications, controlling for academic year, book and User Dummies. I also report the results of Sargan-Hansen tests, in the case of instrumental variables' estimations (under the label "Hansen J Statistic", in the table). This statistic tests the validity of over-identifying restrictions, or alternatively, the validity of the instruments employed in the estimations.

Table 3.5 – Peer Effects – OLS and IV estimates, 2006-2015

VARIABLES	(1) Counts by Student OLS	(5) Counts by Student IV
Counts by Peers	0.03*** (0.008)	0.04*** (0.010)
Acad. Year Dummies	Yes	Yes
Book Dummies	Yes	Yes
User Dummies	Yes	Yes
Observations	723,798	723,796
Adj. R-squared	0.052	0.052
Hansen J Statistic		0.92 (0.34)

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the number of items borrowed by library users. (b) Standard errors clustered by course (reported in parentheses). (c) In instrumental variables (IV) estimations, I instrument the regressor of interest ("Counts by Peers") with its own lagged values for t-1 and t-2. (d) I include academic year, book, and User Dummies in all regressions. (e) Sample Period: 2006-2015. (f) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

One interesting result emerges from the table: in the case of estimations involving the entire sample during the 2006-2015 period, there is evidence of positive peer effects, regardless of the estimation method employed. In particular, a 1% increase in peers' counts correlate to individual users' counts, by an average of +0.03%. That is, for every 100 books borrowed by a user's peer group, there is a rise of three books per user. At first, these results suggest the existence of positive complementarities among users in the libraries investigated in this paper. It is also worth noting that they contradict the theoretical hypothesis tested here, which postulates a negative association between library users' book counts and their respective peers.

3.5. Conclusion

In this paper, I present estimates of externalities in a specific type of common-pool resource, an information commons. I estimate the magnitude of external effects of the

actions of library users who were subject to a non-monetary sanction (daily suspension) over users who were subject to a monetary sanction (fine). I also estimate peer effects among users, considering the number of items they borrow from the library. I report two main results. First, I uncover a “crowding-out” effect: for an additional unity in non-students’ counts, there is an approximate decrease of one-to-one in students’ counts, *ceteris paribus*. Second, when estimating peer effects among users, I find that, for every 100 books borrowed by a user’s peer group, there is a rise of three books per user.

In terms of limitations, it is important to emphasize that the estimates here presented do not have a causal meaning. Although I try to avoid some problems derived from omitted variables bias, by presenting instrumental variables estimates, I am not able to uncover a causal effect among count items of distinct library users. I recognize that a desirable research goal would be to employ instruments based on institutional or economic factors, as previous contributions did in distinct settings (Breza, 2012; Levitt, 1997).

In terms of strengths, this paper is probably one of the first attempts to evaluate individual behavior in an information commons. While most previous contributions on the theme focused on determining precise definitions of related terms, and tried to evaluate some of its main implications for relevant situations – such as the diffusion of the internet and the new role of libraries in the digital age – there were few efforts aimed at empirically testing its main insights (Hess & Ostrom, 2007a). By providing results for the hypotheses tested above, I hope to stimulate more research on empirical topics related to an information commons.

4. WHAT HAPPENS WHEN TRANSACTION COSTS GO DOWN? EVIDENCE FROM RETURN BOXES

“Some books are to be tasted, others to be swallowed,
and some few to be chewed and digested.”
– Francis Bacon, *Of Studies*, 1625

4.1. Introduction

At least since Coase's (1937) seminal contribution, academics and policy makers incorporated transaction costs as an important ingredient in their analyses. These costs, defined as the “. . . cost of using the price mechanism” (Coase, 1937, p. 390) or “. . . the costs of running the economic system” (Arrow, 1969, p. 59), have played a fundamental role in several areas of knowledge, such as accounting, business strategy, economics, marketing, and law, just to cite a few (Macher & Richman, 2008). In theoretical terms, transaction costs constitute a major element in explanations related to vertical integration (Klein, Crawford, & Alchian, 1978; Williamson, 1985, 1996). In empirical terms, the literature on transaction costs' measurement is currently recognized as a “success story”, since many studies attested the importance of such costs by employing alternative methods and proxies to a variety of settings and time periods (Macher & Richman, 2008; Masten, 1996; Ruester, 2010; Williamson, 2000)³³.

Despite all the progress made over the last decades, few studies evaluated the impacts of transaction costs over common-pool resources in a field setting. The present paper takes an alternative route to understand the effects of transaction costs in this kind of setting. In particular, I try to answer the following question: what happens when transaction costs go down in a common-pool resource? I investigate the importance of transaction costs in a specific type of common-pool resource, by exploiting variation in the timing of introduction of a cost-saving technology (library return boxes). I consider such an introduction a *proxy* for lower transaction costs, since return boxes correspond to a

³³ Anderson and Schmittlein (1984), Gooroochurn and Hanley (2007), Joskow (1987), Lyons (1994), Muris, Scheffman, and Spiller (1992), Parmigiani (2007), Poppo and Zenger (1998, 2002), and Zylbersztajn and Lazzarini (2005) correspond to examples of empirical studies related to transaction-cost theories. See Foss and Klein (2006), Hart (1989), and Milgrom and Roberts (2011) for surveys related to theories of the firm.

practical and faster way for returning items in libraries, saving time for both library users and staff.

According to Huck and Rasul (2010, p. 1), transactions costs may “. . . be related to the time costs of decision making”. I follow a similar approach in this paper and propose that the introduction of return boxes may reduce transaction costs by lowering users’ time costs when returning specific items to the library. Users could save time by directly returning items through the boxes, instead of going to the library’s front desk. On the other hand, users could save time by not going to the library, which can be located, several floors above university entrance, for instance. Given these possibilities, I hypothesize that return boxes, by reducing transaction costs, would enhance performance measures in the libraries that decide to adopt them. For example, one could expect that the number of delayed items would reduce after the introduction of a return box. Alternatively, one could expect a rise in the number of early devolutions, since users would have more opportunities to return items they borrowed from the library.

As stated above, I exploit variation in the introduction of a cost-saving technology (return boxes) in different libraries, located at distinct *campi* of the same university. Before 2012, users had to return books in person in each library. After that year, one library introduced a return box in the university campus where it operated, while another library did the same one year later, in 2013. This unique feature of the data allows me to employ a difference-in-differences research design to evaluate the effects of the policy implemented in each library. If lower transaction costs were relevant in this setting, then one would expect to find a significant effect of such costs over library users’ performance measures, as predicted by standard theories of vertical integration, for instance. Contrarily to the previous rationale, I uncover a result in which the instauration of return boxes either increases some measures, such as borrowings’ effective duration and users’ delays, at the same time that it does not exert any significant effect over item counts. These results have important implications for theories based on transaction costs, with an emphasis over common-pool resources.

The remainder of the paper proceeds as follows. Section 2 contains a selective description of the related literature, as well as its relation to the present paper. Section 3 describes the data and research design employed in the empirical analysis below. Section 4 contains

the analysis' main results, while section 5 reports sensitivity analysis tests. Finally, section 6 concludes.

4.2. Related literature

This paper dialogues with distinct literatures. First, the results reported in the paper represent a new way to watch the importance of transaction costs in a field setting, when compared to a long tradition in the literature focused on vertical integration issues, only (Klein, 1990; Klein et al., 1978; Williamson, 1985, 1991)³⁴. For example, in the case of previous contributions related to vertical integration, it may be hard to disentangle firms' decisions based either on transaction costs or on other features of the data, such as contracts' incompleteness. One advantage of the present setting is that I am able to isolate the effects of lower transaction costs over behavior in a field setting. A related point is that, while most of the empirical literature focused on the consequences of such costs for vertical integration processes in firms (Joskow, 1987; Parmigiani, 2007; Poppo & Zenger, 1998, 2002), I present an analysis based on their effects over users' behavior in an information commons, a library. To the best of my knowledge, this is one of the first papers to relate transaction costs to an information commons in a field setting³⁵.

Second, and related to the latter point, the results in this paper add to a well-established literature in social dilemmas, with a special emphasis over common-pool resources' management (Demsetz, 1967; Hardin, 1968; Olson, 1965; Ostrom, 1990, 1999, 2010). While there exists a large volume of evidence related to social dilemmas in artificial settings – such as laboratory experiments (Andreoni, 1988; Fehr & Gächter, 2000; J. J. Murphy & Cárdenas, 2004) – the present paper reports results related to a social dilemma in a unique field setting, an information commons. This setting has the advantage of not needing external interventions from the researcher, as well as not being subject to “demand effects”, a common problem reported in the experimental literature (Al-Ubaydli,

³⁴ This tradition is still present in modern discussions of the theme, such as standard textbooks in the areas of organizational economics and strategy (Besanko, Dranove, Shanley, & Schaefer, 2013).

³⁵ It is important to note that there is a well-established theoretical literature relating transaction costs to common-pool resources (North, 1990; Ostrom, 2005). The present paper distinguishes itself from these contributions by empirically measuring the impacts of lower transaction costs over behavior in a specific type of common-pool resource, an information commons.

List, & Suskind, 2017; Fréchette, 2015; J. H. Kagel, 2009). Although there were previous research efforts related to common-pool resources' management in field settings, most of them focus on studying environmental themes such as forests, fisheries, and wildlife, in general (Cárdenas & Ostrom, 2004; Fehr & Leibbrandt, 2011; Rustagi et al., 2010). This paper differs from previous contributions by expanding the scope of analysis and focusing on a specific type of common-pool resource, an information commons (Hess & Ostrom, 2007a).

Third, this paper dialogues with other papers presenting the results of field experiments involving transaction costs. I specifically refer to the contributions by Funk (2007, 2010) and Huck and Rasul (2010), in which the authors test the importance of lower transaction costs in distinct field settings. In the first paper, when evaluating the effects of the instauration of a cost-saving technology (postal voting) over voter turnout, the author cannot find significant effects of such an instauration. On the other hand, in the second paper, the authors find significant effects of lower transaction costs over fundraising campaigns in Germany. The present paper differs from these contributions by empirically exploring the impacts of transaction costs in a common-pool resource. Similarly to Funk (2010), this paper contributes to a new body of evidence which questions the importance of transaction costs in specific settings³⁶.

Finally, the results described here also add to the growing evidence related to processes of institutional change in distinct settings. I see the introduction of a cost-saving technology as a change in the “rules of the game”, as originally proposed by North (1990, 1991)³⁷. In this sense, the present paper contributes to the understanding of institutional change in a very specific setting (Ostrom, 2007). As a consequence, the results here

³⁶ Aragón (2015) also tests the effects of lower transaction costs in a field setting. However, the author focus his analysis on the impacts of property rights' improvements over local communities in Canada. See also Alston and Mueller (2011), who study the importance of insecure property rights in Brazil. Foss and Foss (2005) discuss the importance of property rights for strategy theories, emphasizing that these theories “... paid little attention to transaction cost-reducing practices” (p. 542). DellaVigna and Malmendier (2006) report a result in which health club members delay cancelling contracts, despite the presence of small transaction costs.

³⁷ Although I adopt North's (1990, 1991) definition, I am aware that this is a very specific definition of institutions. See Eggertsson (1990) and Hodgson (2006) for alternative definitions and related discussions on the theme. Joskow (1995) and Williamson (2000) describe some of the main concepts related to the New Institutional Economics. Commons (1931) corresponds to a seminal contribution related to Institutional Economics.

reported dialogue with the literature related to the impacts of institutional change at distinct levels of aggregation, both in the short and long run (Aoki, 2007; Greif, 1998; Greif & Laitin, 2004; North, 1990, 1994)³⁸.

4.3. Data and method

4.3.1. Institutional Background

I have access to confidential daily data related to library users of a private university in São Paulo, Brazil, for the 2011-2015 period. This rich dataset corresponds to the detailed transactions of distinct libraries located in different *campi* of the same university. The data contain detailed information on 1,950 individual users, covering more than 20,000 daily transactions for the entire sample period. This corresponds to an unbalanced panel, since each library user may borrow different numbers of specific library items at distinct moments.

The data contain information on users' socioeconomic characteristics – such as gender, date of birth, and address – as well as library's confidential information, with each user's identification number, university category (high school, undergraduate, master's, MBA, former student, professor, and employee) and area of study (management, accounting, economics, international relations, advertising, and secretariat). For each user in the data, I am able to identify her department and category. The data also contain the dates when each user borrows specific items from the library, as well as each item's code, and title. Based on each title, I am able to build a measure of area of expertise for each book in the sample, such as management, accounting, economics, and law.

³⁸ There is also an established literature related to the long-term effects of specific events. Acemoglu et al. (2001), Acemoglu and Robinson (2006), Alston and Mueller (2011), Aragón (2015), Baumol (1990), Becker and Woessmann (2009), La Porta, Lopez-de-Sillanes, and Shleifer (2008), Murphy, Shleifer, and Vishny (1991), North, Wallis, and Weingast (2006), Nunn (2008), Nunn and Qian (2010), Nunn and Wantchekon (2011), and Sokoloff and Engerman (2000) correspond to examples of studies of this kind. Nunn (2009) summarizes part of this literature, with an emphasis on the importance of historical effects. See also North, Wallis, and Weingast (2006), who emphasize the importance of political economy arrangements for long-run outcomes. Jones and Romer (2010), Nelson and Sampat (2001), and Pande and Udry (2006) correspond to examples of discussions which regard institutions as an important ingredient for growth models.

One important information regarding the libraries studied in this paper relates to their location and size. As stated above, these libraries belong to different *campi* of the same university, two located in central neighborhoods in São Paulo (Liberdade and Largo do São Francisco), and one located in an upper-class neighborhood (Pinheiros). The Liberdade unit is the oldest and largest library of the three: founded in 1902, it contained 31,193 books in the 2015 year. In the case of the Largo do São Francisco (San Fran) unit, it dates from 2006, containing 2,883 books, in 2015. Finally, the Pinheiros unit dates back to 2011, having 883 books. Although these different locations may affect user behavior in each library, it is worth noting that two of these libraries (Largo do São Francisco and Pinheiros) serve the same type of user, MBA students, mainly. Because of this feature, I only consider MBA students in the estimations below. In doing so, I want to make both treatment and control groups more comparable, and to respect the identification condition of a difference-in-differences research design, namely parallel trends³⁹.

Libraries also differ in terms of dates of instauration of the cost-saving technology studied in this paper. In the beginning of the 2012 academic year, two libraries (Liberdade and Largo do São Francisco) introduced return boxes in their facilities. At first, the Liberdade unit introduced two return boxes, while the Largo do São Francisco unit introduced one return box, only. One year later, the university decided to relocate the box from Liberdade to the Pinheiros unit. This institutional setting provides me with the opportunity to compare distinct situations involving reduced transaction costs: first, by comparing similar libraries (Largo do São Francisco and Pinheiros), which received treatment at different points in time; second, by comparing distinct libraries (Liberdade and Largo do São Francisco), which differ in their treatment intensities (two return boxes *versus* one box). I follow this strategy in the robustness section by comparing distinct pairs of libraries over time, after the instauration of their respective return boxes⁴⁰.

³⁹ It is worth noting that there are considerable differences, in terms of sample size, between the treatment and control groups in the pre-treatment period. In the first case, I have a sample containing 4,268 observations, while I have only 192 observations, in the second case (both for the 2011 year). I try to circumvent this problem by implementing alternative estimation strategies. More details in the robustness section below.

⁴⁰ Appendix B contains pictures of the libraries studied in this paper, as well as their respective return boxes.

I also have access to the library's official yearly reports. These reports contain rich institutional information related to the library's internal workings over the 2005-2015 period. Based on this information, I am able to build predicted devolution dates for each user in the sample. Each user can renew books after the predicted devolution date expires, conditional on a waiting list managed by library staff. Although I do not have access to information on such lists' content, I can observe when users renew library items by comparing the dates of borrowings of the same item over time. This information allows me to build additional performance measures for each user in the sample, such as renew rates, the number of items that each user borrows every time she goes to the library, as well as measures of delays over time (equal to the difference between predicted and effective devolution dates for each item borrowed). Finally, I build measures of early returns (in the case of users who return books before the predicted date), and books' usage (equal to the number of times that users pick a specific book). I complement the data with academic calendar information related to exam weeks occurred in the university over time, as well as holydays, vacations, and weekends.

4.3.2. Empirical Strategy

A unique feature of the libraries studied in this paper is the fact that one of them introduced a return box in its daily operations in the beginning of 2012 (Largo do São Francisco), while the other did the same one year later (Pinheiros). By estimating econometric specifications in which I control for users' observed characteristics, I am able to compare the behavioral responses of library users who had access to the boxes (treatment group) to users who did not (control group). This institutional feature allows me to employ a difference-in-differences research design to test the main hypothesis I pose in the paper. This hypothesis is the following:

H_{4.1}: the introduction of a return box in a library, by lowering transaction costs, would improve user performance measures. Specifically, such an introduction would lower delays, and borrowings' effective durations, at the same time that it would raise early returns and item counts.

To test such a hypothesis, I run different versions of the following econometric specification:

$$(4.1) \quad Y_{ist} = \alpha + \gamma(\text{Treatment}) + \lambda(\text{Post-Policy}) + \beta(\text{Treatment} \times \text{Post-Policy}) + \sum_t(\psi_t) + \varepsilon_{ist}$$

Here, Y_{ist} represents potential outcomes for individual i (equal to 0 or 1), in library s (treatment or control), at time t . In most specifications below, Y_{Ist} corresponds to the proportion of delays by user i and period t , after the introduction of a box in the library, while Y_{Ost} corresponds to the same proportion before such an introduction. The term “*Treatment*” corresponds to an indicator variable, which assumes unity value in the case of the library that received a box, and 0, otherwise. The term “*Post-Policy*” corresponds to an indicator variable that assumes unity value for the period posterior to 1/1/2012, and 0, otherwise. I also include academic year, book, and user fixed-effects as controls in the regressions below (captured by the term α), as well as time effects, such as days of the week, weeks in the year, and specific years, in some specifications (ψ_t). In the case of the term ε_{ist} , it has a conditional mean of zero ($E(\varepsilon_{ist} | s, t) = 0$). The parameter of interest, representing a causal estimate in this context, is β , which corresponds to a difference-in-differences estimate.

4.4. Results

The main empirical challenge in the present setting is to find an appropriate counterfactual, that is, a control group that would present behaviors consistent with the behavior of the treatment group, given the absence of the treatment. Specifically, one important but untestable hypothesis in a difference-in-differences research design is that both control and treatment groups follow parallel trends over time. Figure 4.1 presents time trends for distinct library performance measures during the pre-treatment period:

Figure 4.1 – Time trends for the pre-policy period, 2011

Source: author's calculations, based on library data.

In the figure, I plot the means of each library performance measure, for the period between the months of September and December 2011⁴¹. For both groups (treatment and control), I only consider the behavior of MBA students, by excluding other user categories from the sample. In terms of library performance measures, I consider borrowings' delays (upper left graph), borrowings' effective duration (upper right), early returns (lower left), and item counts (lower right). Since I employ these measures as dependent variables in the difference-in-differences specifications below, I check the visual adequacy of each of them, in terms of the parallel trends assumption. A first look at the graphs suggest that all variables conform to such a condition. Table 4.1 presents summary statistics for selected variables for both groups (treatment and control) in the pre-policy period:

⁴¹ I choose the period between September and December 2011 because it corresponds to a pre-treatment period in which I observe parallel trends for both groups. I do not observe the same result in the case of periods containing more months of the same year.

Table 4.1 – Descriptive statistics – pre-policy period (2011)

VARIABLE	Control Group	Treatment Group	Total Sample
Age	32.70 (7.29)	32.70 (7.35)	32.70 (7.35)
Female	0.72 (--)	0.60 (--)	0.60 (--)
Scholarship	0.18 (--)	0.29 (--)	0.29 (--)
Business Book	0.55 (--)	0.39 (--)	0.40 (--)
Accounting Book	0.24 (--)	0.25 (--)	0.25 (--)
Economics Book	0.08 (--)	0.04 (--)	0.04 (--)
Law Book	0.01 (--)	0.08 (--)	0.08 (--)
Management	0.45 (--)	0.27 (--)	0.27 (--)
Accounting	0.54 (--)	0.73 (--)	0.72 (--)
Observations	192	4,268	4,460

Source: author's calculations, based on library data.

Notes: (a) Standard deviations reported in parentheses.

One important feature of the data in the table relates to the imbalance between treatment and control groups, in this case. Specifically, when looking at the control group (Pineiros), one notices that it contains far less observations (192) than the treatment group (Largo do São Francisco, with 4,268 observations). This imbalance between both groups translates in a total sample that directly reflects characteristics from the treatment group. I try to circumvent this problem in two different ways: first, I employ matching estimators to obtain a better balance between the two groups; second, I consider variation in the control and treatment groups to evaluate the robustness of main results. I discuss these alternative procedures in the robustness section below.

In table 4.2, I present the results of difference-in-differences estimations for the 2011-2012 period. In the table, the dependent variable corresponds to the proportion of delays in the period, that is, to the number of times that each user in the sample delays returning items to the library, given her total number of borrowings (named “Prob.(Late)”). This variable corresponds to a dummy variable that assumes unity value every time a user presents a positive value for her delays. I run this first specification to evaluate “extensive margin” effects of the introduction of return boxes over user behavior in the libraries, following Apesteguia, Funk, and Iriberry (2013). In the table's second to fifth columns, I progressively add covariates to the specifications to control for fixed-effects that may bias the resulting estimates, a common practice in difference-in-differences studies. I also

consider alternative ways to control for the existence of distinct trends in the treatment and control groups: in the table's fifth column, I follow Besley and Burgess (2004) by including library specific time trends, while in the sixth column, I consider distinct weekly time trends for each group. Finally, I follow Bertrand, Duflo, and Mullainathan (2004), and cluster standard errors by the number of courses offered at the university⁴².

Table 4.2 – Effects of return boxes over probability of delays

VARIABLES	(1) Prob.(Late)	(2) Prob.(Late)	(3) Prob.(Late)	(4) Prob.(Late)	(5) Prob.(Late)	(6) Prob.(Late)
DiD Coefficient	0.33*** (0.057)	0.33*** (0.055)	0.32*** (0.054)	0.33*** (0.051)	0.36*** (0.048)	0.36*** (0.059)
Acad. Year Dummies	No	Yes	Yes	Yes	Yes	Yes
Book Dummies	No	No	Yes	Yes	Yes	Yes
User Dummies	No	No	No	Yes	Yes	Yes
Time Trends	No	No	No	No	Yes	Yes
Mean Dep. Variable	0.53	0.53	0.53	0.53	0.53	0.53
Observations	12,993	12,993	12,993	12,993	12,993	12,993
Adj. R-squared	0.059	0.095	0.095	0.098	0.098	0.100

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) Sample Period: 2011-2012. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The table's first column corresponds to an econometric specification for equation (4.1) with no controls. In the table's second column, I add dummies for each week in the year, days of the week, and year. I do this to capture academic year fixed effects. In the third column, I add book dummies (accounting, management, economics, and law books) to capture differences in terms of specific items borrowed by library users. In the fourth column, I add a rich set of user-related covariates to capture users' fixed effects: their gender, age group, area of study, and time at school. In the fifth and sixth columns, I repeat the specification in the fourth column, but I consider distinct types of time trends.

One main result emerges from the table: the introduction of return boxes tends, on average, to raise the probability of delays among library users. Although there are differences in terms of the adequacy of each specification (given by the values of the coefficient of determination, R^2), I find a positive effect of the introduction of return

⁴² There are 47 courses in the university during the 2011-2015 period. These courses differ from the areas of study (management, economics, accounting, international relations, advertising, and secretariat) that a student may choose when she enrolls in the university.

boxes over delays. Specifically, such an introduction rises the probability of delays by 62%, approximately ($= 0.33/0.53$). This result contradicts the previous rationale based on the main hypothesis that I want to test in the present setting, i.e., that return boxes, by lowering transaction costs, would improve library performance measures. If anything, boxes tend to raise delays in the period after its instauration.

In table 4.3, I present difference-in-differences estimates in which I substitute the dependent variable with alternative measures of library users' performance. These variables are the following: borrowings' effective duration, borrowings' delays, the proportion of early devolutions (named "Early Returns"), and the number of items that each user borrows every time she goes to the library ("Item Counts"). In the case of each specification, I include a full set of covariates to capture distinct types of fixed effects, as well as variable time trends, in the spirit of Besley and Burgess (2004):

Table 4.3 – Effects of return boxes over library performance measures

VARIABLES	(1) Effective Duration	(2) Delays	(3) Early Returns	(4) Item Counts
DiD Coefficient	3.48*** (0.381)	3.21*** (0.243)	-0.16*** (0.059)	-0.58 (0.359)
Acad. Year Dummies	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes
Mean Dep. Variable	8.50	2.27	0.24	2.97
Observations	12,993	12,993	12,993	12,993
Adj. R-squared	0.072	0.081	0.039	0.056

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to borrowings' effective duration (first column), borrowings' delays (second column), early returns (third column), and item count (fourth column). (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) Sample Period: 2011-2012. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In the case of the alternative performance measures considered in the table, the results confirm the previous empirical pattern related to the probability of delays. In particular, the introduction of return boxes in one of the libraries tends, on average, to raise borrowings' effective durations and delays by a similar magnitude, in both cases (around three days). On the other hand, there is a negative correlation between boxes and early returns, suggesting that users delay returning books ahead of time, in this case. Finally, it

is worth noting that the boxes do not affect the number of items that users borrow when they go to the library.

4.5. Sensitivity analysis

In the previous section, I reported a strong counterintuitive result: the introduction of a return box in a library tends, on average, to affect library performance measures in the opposite direction as predicted by standard transaction-cost theories. In the present section, I discuss the results of tests aimed at checking the robustness of the empirical patterns reported above. I divide the section in two parts: a first section containing robustness checks, and a second section containing placebo tests.

4.5.1. Robustness checks

A potential source of concern in the present setting relates to the periods compared in the above difference-in-differences analysis. In this case, the choice of post-treatment years may affect the results. For instance, if there were adverse aggregate factors affecting library performance measures in the post-treatment period, then delays could rise in response to such shocks. Given the fact that the university to which the libraries belong went through a corruption scandal in mid-2012, one could argue that such a phenomenon affected the results⁴³.

I investigate such a possibility in table 4.4, by considering alternative years as the post-treatment period. Specifically, I run difference-in-differences specifications in which the pre-treatment period remains the same (09/2011 to 12/2011), while the post-treatment period varies. In each column of the table, I present estimates considering distinct post-treatment years (2013, 2014, and 2015). In doing so, I drop intermediate years from the sample, and compare the final year to the initial year. For instance, in the case of the table's first column, I compare the years 2011 (pre-treatment) and 2013 (post-treatment), only (without the 2012 year). In all cases, the dependent variable is the probability of

⁴³ In 2012, there was a corruption scandal involving the control of FECAP, with national media coverage. See, for instance, the following link: <https://www.cartacapital.com.br/politica/berlinck-neto-e-afastado-da-presidencia-da-fecap-5890.html>.

delays (“Prob.(Late)”). The results of this initial experiment suggest that the previous empirical patterns remain virtually the same.

Table 4.4 – Robustness: distinct post-treatment years

VARIABLES	(1) 2011/2013	(2) 2011/2014	(3) 2011/2015
DiD Coefficient	0.32*** (0.071)	0.33*** (0.070)	0.40*** (0.059)
Acad. Year Dummies	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes
Observations	26,249	19,538	12,522
Adj. R-squared	0.0629	0.0424	0.0470

Source: author’s calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) “Acad. Year Dummies” correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) “Book Dummies” correspond to a set of dummies for books’ area of study (business, accounting, economics, and law). (e) “User Dummies” correspond to a set of dummies for users’ group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) In each column of the table, I report estimates comparing pairs of specific pre-treatment and post-treatment periods. Sample Periods: 2011-2013 (first column), 2011-2014 (second column), and 2011-2015 (third column). (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

I present, in table 4.5, difference-in-differences estimates based on distinct samples. I do this to verify if the previous results are sensitive to alternative sample definitions. In the first three columns of the table, I exclude weekends, holidays, and vacations. In the fourth column, I exclude exam weeks from the sample, while in the fifth column, I exclude users who present delays higher than two standard deviations from average delays. I run this robustness check to avoid contamination of results by specific times of the academic year (columns 1-4) or unusual behavior (column 5). Once again, results remain qualitatively the same.

Table 4.5 – Robustness: alternative samples

VARIABLES	(1) No Weekends	(2) No Holydays	(3) No Vacations	(4) No Exams	(5) No Outliers
DiD Coefficient	0.34*** (0.056)	0.33*** (0.061)	0.35*** (0.055)	0.32*** (0.058)	0.30*** (0.069)
Acad. Year Dummies	Yes	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes	Yes
Observations	31,731	35,065	34,166	32,806	33,133
Adj. R-squared	0.0742	0.0700	0.0667	0.0709	0.0654

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) In each column of the table, I report estimates based on different samples. "No Weekends" refer to samples in which I exclude weekends. "No Holydays" refer to samples in which I exclude holydays (second column). "No Vacations" refer to samples in which I exclude vacations (third column). "No Exams" refer to samples in which I exclude exam weeks (fourth column). "No Outliers" refer to samples in which I exclude users who present delays corresponding to two standard deviations above average. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As mentioned earlier, one problem related to the previous estimations concerns the imbalance between treatment and control groups. I try to circumvent this problem in two different ways: first, I employ matching estimators to obtain a better balance between the two groups; second, I consider variation in the control and treatment groups to evaluate the robustness of main results. In table 4.6, I present descriptive statistics for the main variables used in the analysis, before and after implementing matching methods. In doing so, I try to achieve greater balance between the two groups:

Table 4.6 – Robustness: descriptive statistics (before and after matching)

VARIABLE	Before matching		After matching	
	Control Group	Treatment Group	Control Group	Treatment Group
Age	32.43	32.13	32.43	32.82
Female	.61	.78	.61	.62
Scholarship	.31	.27	.31	.43
Business Book	.41	.54	.41	.42
Accounting Book	.26	.21	.26	.20
Economics Book	.03	.14	.03	.06
Law Book	.08	.03	.08	.06
Management	.29	.51	.29	.30
Accounting	.70	.49	.70	.69

Source: author's calculations, based on library data.

In table 4.7, I present the results of difference-in-differences estimations based on matched samples. In all cases, estimations correspond to weighted regressions in which I use the weights derived from matching methods. This weight assumes unity values for observations in the treatment group (Largo do São Francisco), while it corresponds to the number of observations from the treated group for which the observation is a match in the control group (Pinheiros). This procedure raises the number of observations in the estimations below. I do this inclusion with the goal of reducing eventual imbalances between the samples representing treatment and control groups. In the table, the dependent variable corresponds to the proportion of delays in the period (“Prob.(Late)”). Again, I progressively add covariates to the specifications in the table to control for fixed-effects that may bias the resulting estimates, and I cluster standard errors by the number of courses offered at the university⁴⁴.

Table 4.7 – Robustness: effects of return boxes on Prob.(Late)

	(1)	(2)	(3)	(4)
VARIABLES	Prob.(Late)	Prob.(Late)	Prob.(Late)	Prob.(Late)
DiD Coefficient	0.25*** (0.059)	0.30*** (0.050)	0.32*** (0.053)	0.33*** (0.055)
Acad. Year Dummies	No	Yes	Yes	Yes
Book Dummies	No	No	Yes	Yes
User Dummies	No	No	No	Yes
Mean Dep. Variable	0.48	0.48	0.48	0.48
Observations	67,471	67,471	67,471	67,471
Adj. R-squared	0.038	0.230	0.238	0.251

Source: author’s calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) “Acad. Year Dummies” correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) “Book Dummies” correspond to a set of dummies for books’ area of study (business, accounting, economics, and law). (e) “User Dummies” correspond to a set of dummies for users’ group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) Sample Period: 2011-2012. (g) The results in the table correspond to weighted regressions, in which I use the weights derived from matching methods. This weight assumes unity values for observations in the treatment group, while it corresponds to the number of observations from the treated group for which the observation is a match in the control group. (h) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results in the table confirm the previous finding that the introduction of return boxes tend, on average, to increase the probability of delays in the library. Specifically, the estimates derived from matched samples lie in the 0.25-0.33 range, suggesting a 52%

⁴⁴ When using matching methods to obtain comparable treatment and control groups, I follow Aragón (2015). Specifically, I employ the propensity score matching (PSM) method in the estimations below.

increase in delays ($= 0.25/0.48$), a similar magnitude to the non-matched estimations above. Additionally, it is worth noting that the regressions' fit increase in this case, which suggests that the treatment and control groups are more comparable. In table 4.8, I present estimates based on alternative library performance measures, but derived from matched samples.

Table 4.8 – Robustness: effects of return boxes on performance measures

VARIABLES	(1) Effective Duration	(2) Delays	(3) Early Returns	(4) Item Count
DiD Coefficient	2.95*** (0.596)	2.80*** (0.507)	-0.11* (0.056)	-0.10 (0.256)
Acad. Year Dummies	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes
Mean Dep. Variable	7.94	1.73	0.26	3.16
Observations	67,471	67,471	67,471	67,471
Adj. R-squared	0.223	0.224	0.244	0.385

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to borrowings' effective duration (first column), borrowings' delays (second column), early returns (third column), and item count (fourth column). (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) Sample Period: 2011-2012. (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results in the table confirm the previous finding that the introduction of return boxes affect alternative library performance measures in the opposite way in which I formulate the main hypothesis tested in this paper. Once again, such an introduction raises borrowings' effective durations and delays, at the same time that it reduces early returns, while not affecting item counts. One interesting point to note in the case of this table is the better fit of all estimations (R^2 coefficients in the 0.22-0.39 range). This result lends confidence to the importance of using matched samples in the present setting, given the existence of considerable imbalances between treatment and control groups.

Another potential source of concern in the present setting relates to the specific choice of treatment and control groups. Given the existing imbalance between the two libraries that I use to compare the impacts of lower transaction costs in a field setting, one could argue that such a choice may affect the main results. I try to address this concern by considering distinct combinations of treatment and control groups. In this case, I take advantage of

the fact that, besides the two libraries used in the previous analyses, there is also an additional university library in my sample. This library, located in the main university campus (Liberdade), is responsible for attending the entire university community, including high school, undergraduate and graduate students, MBA candidates, university employees, and professors.

I exploit the fact that the libraries in the sample introduced return boxes at distinct points of time. Specifically, while the libraries located at the Liberdade and Largo do São Francisco *campi* introduced boxes in 2012, the Pinheiros library did the same in 2013, only. As stated above, Liberdade firstly introduced two boxes at the time, while Largo do São Francisco introduced one box, in 2012. This unique feature of the data allows me to compare these different libraries in pairs. If transaction costs are relevant in this setting, then one should expect to find significant differences between performance measures when comparing these libraries, either in terms of extensive or intensive margins. In the first case, a comparison between a library that introduced a box and one that did not represents an empirical test of the extensive margin hypothesis. In the second case, a comparison between libraries involving different numbers of boxes represents a test of the intensive margin.

In table 4.9, I present the results of difference-in-differences specifications involving distinct combinations of treatment and control groups. I consider the following combinations of libraries in the table: (i) Liberdade (Treatment) *versus* Pinheiros (Control); (ii) Liberdade (Treatment) *versus* Largo do São Francisco (Control); (iii) Liberdade and Largo do São Francisco, combined (Treatment) *versus* Pinheiros (Control). In all cases, I estimate specifications involving distinct library performance measures, as well as a complete set of covariates and time trends.

Table 4.9 – Robustness: distinct treatment and control groups

Treatment x Control	(1)	(2)	(3)	(4)	(5)
<i>Liberdade x Pinheiros</i>	Prob.(Late)	Effective Duration	Delays	Early Returns	Item Count
DiD Coefficient	0.27*** (0.059)	2.81*** (0.456)	2.46*** (0.344)	-0.13*** (0.045)	-0.61** (0.266)
Observations	25,225	25,225	25,225	25,225	25,225
Adj. R-squared	0.0667	0.0588	0.0557	0.0404	0.104
<i>Liberdade x SanFran</i>	Prob.(Late)	Effective Duration	Delays	Early Returns	Item Count
DiD Coefficient	-0.04 (0.027)	0.04 (0.195)	-0.04 (0.150)	0.00 (0.017)	0.23 (0.176)
Observations	48,561	48,561	48,561	48,561	48,561
Adj. R-squared	0.0639	0.0406	0.0409	0.0275	0.0741
<i>(Liberdade + SanFran) x Pinheiros</i>	Prob.(Late)	Effective Duration	Delays	Early Returns	Item Count
DiD Coefficient	0.30*** (0.060)	2.91*** (0.478)	2.54*** (0.372)	-0.15*** (0.042)	-0.80*** (0.224)
Observations	54,728	54,728	54,728	54,728	54,728
Adj. R-squared	0.0638	0.0378	0.0393	0.0240	0.0507
Acad. Year Dummies	Yes	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes	Yes

Source: author's calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of delays in the library (first column), borrowings' effective duration (second column), borrowings' delays (third column), early returns (fourth column), and item count (fifth column). (b) Standard errors clustered by course (reported in parentheses). (c) "Acad. Year Dummies" correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) "Book Dummies" correspond to a set of dummies for books' area of study (business, accounting, economics, and law). (e) "User Dummies" correspond to a set of dummies for users' group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) Sample Period: 2011-2012. (g) In the table's first panel, I employ the Liberdade and Pinheiros units as treatment and control, respectively. In the table's second panel, I employ the Liberdade and Largo do São Francisco (denoted "San Fran") units as treatment and control, respectively. Finally, in the third panel, I employ the Liberdade and Largo do São Francisco units as treatment, and the Pinheiros unit as control. (h) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results in the table suggest that the previous empirical patterns remain the same, when considering distinct combinations of treatment and control groups. In general, the present section suggests that the previous results are robust to modifications in the sample, as well as different treatment and control groups.

4.5.2. Placebo tests

In the present setting, I report a result in which the introduction of return boxes in libraries affect library performance measures in the opposite direction of standard transaction-cost theories. In table 4.10, I present the results of an alternative placebo test, in which I vary the pre-treatment period. In this case, if I correctly identify the mechanism by which return boxes translate into reduced transaction costs, affecting library performance measures, then these boxes should not have significant effects during pre-treatment

periods. In order to test such a possibility, I consider distinct pre-treatment periods in each column of the table. In all cases, the dependent variable corresponds to the probability of delays (“Prob.(Late)”), with full specifications:

Table 4.10 – Placebo tests: alternative pre-treatment periods

VARIABLES	(1) 2008	(2) 2009	(3) 2010	(4) 2011
DiD Coefficient	-0.02 (0.031)	-0.02 (0.021)	-0.01 (0.018)	0.00 (0.018)
Acad. Year Dummies	Yes	Yes	Yes	Yes
Book Dummies	Yes	Yes	Yes	Yes
User Dummies	Yes	Yes	Yes	Yes
Time Trends	Yes	Yes	Yes	Yes
Observations	107,685	107,685	107,685	107,685
Adj. R-squared	0.0572	0.0569	0.0568	0.0568

Source: author’s calculations, based on library data.

Notes: (a) The dependent variable in the specifications corresponds to the probability of delays in the library. (b) Standard errors clustered by course (reported in parentheses). (c) “Acad. Year Dummies” correspond to a set of dummies for 6 days of the week, 51 weeks for each year, and the 2012-year. (d) “Book Dummies” correspond to a set of dummies for books’ area of study (business, accounting, economics, and law). (e) “User Dummies” correspond to a set of dummies for users’ group ages (24-30, 31-40, 41-50, 51-60, 60+), gender (female), area of study (business and accounting), and time at school (0 to 4 years). (f) Sample Period: 2011-2012. (g) Alternative pre-treatment periods: 2008 (first column), 2009 (second column), 2010 (third column), and 2011 (fourth column). (g) Statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results reported in the table lend confidence to the mechanism mentioned above. When looking at ‘false’ pre-treatment periods, I cannot reject the null hypothesis of no significance of the estimated difference-in-differences coefficient. Overall, the placebo tests reported in this section suggest that there is a meaningful effect of return boxes over library performance measures in the present context.

I also evaluate the dynamic impacts of the policy in its first year of implementation. I consider econometric specifications with time dummies (months) for the period between September 2011 and August 2012, as well as their interactions with the treatment dummy. In doing so, I want to evaluate the possible existence of anticipatory effects of the policy. If I am able to correctly identify the effects of the instauration of return boxes, than one would expect that such a policy exert no effect during the pre-treatment period. Figure 4.2 contains the results of this exercise:

Figure 4.2 – Dynamic impacts of the policy, first year of implementation.

Source: author's calculations, based on library data.

The graphical patterns suggest that the policy exerts no significant effects over the first eight months reported in the figure (10/2011 to 06/2012). In fact, the first policy effects occur in July 2012, six months after the instauration of return boxes in selected libraries. This result lends confidence to the identification of the main policy effects in the present setting.

4.6. Conclusion

Transaction-cost theory constitutes one of the most important contributions in social sciences today (Coase, 1992; Williamson, 2010). Previous research brought new insight to the mechanisms through which transaction costs affect important decisions in distinct areas, such as accounting, economics, management, and law (Macher & Richman, 2008). However, despite all the progresses made, few studies were able to evaluate the impacts of transaction costs over an information commons in the field. The present paper tries to fill this gap by studying the impacts of lower transaction costs in a specific type of information commons, a university library.

By exploiting variation in the introduction of a cost-saving technology (return boxes) in distinct libraries over time, I evaluate the impacts of lower transaction costs in a field setting. The main advantage of the present context is the fact that I am able to isolate the influence of transaction costs over behavior, as opposed to most previous contributions in the literature. Contrarily to standard arguments based on transaction costs, I find a

result in which the instauration of return boxes tends, on average, to raise the probability of delays, and borrowings' effective durations, at the same time that it lowers early returns and does not affect item counts.

In terms of limitations, the results here presented may lack external validity, since I study user behavior in different libraries of the same university. Although there seems to be considerable diversity among library users and university *campi*, one may argue that these results could reflect a very specific institutional setting. One way to circumvent this argument would be to evaluate the behavior of users in distinct types of libraries or departments, for instance. Although I do not pursue such a strategy here, I suspect that the main qualitative results would remain unchanged, in this case.

Another caveat in the present setting refers to the details of the introduction of return boxes in the libraries. Having had several personal reunions with the libraries' staff, I learned that each library had, in most cases, introduced one box at a time, in specific locations of each campus (such as its entrance). A possible extension of this paper would be to run an experiment to verify if the boxes' locations could influence library performance measures over different time spans. In the end, one important question that remains unanswered is whether the empirical relevance of transaction costs depends on the specific context in which they are embedded or not.

5. CONCLUSION

“A good book is a good friend. It will talk to you when you want it to talk, and it will keep still when you want it to keep still.”

– Ernest Hamlin Abbott, Lyman Abbott, and Francis Rufus Bellamy, *The Outlook*, 1901

The present dissertation evaluates the internal dynamics of a specific type of common-pool resource, an information commons. Employing a novel dataset related to more than 800,000 library transactions during a 10-year period (2005-2015), I address distinct questions in the fields of organizational economics, law and economics, and the economics of the public sector, by considering libraries an ideal field setting for the study of social dilemmas.

In chapter 2, I present novel evidence related to the effects of fines in a field setting. By exploiting variation in the introduction of a monetary sanction in a library after a specific year, I uncover a causal effect of such a sanction over user behavior. In aggregate terms, the instauration of a fine reduces users’ delays in the library, as predicted by standard models of law enforcement. However, since the nominal value of the fine remains the same for 10 years, this specific type of sanction loses efficacy over time. In fact, estimates of the dynamic effects of fines suggest that they deter illicit behavior in the short run, only. These results are robust to several specification issues, such as variations in sample definitions and periods, as well as the use of distinct library performance measures. They also do not seem to be a result of alternative mechanisms, which could affect users’ behavior, such as opportunism, inattention, or learning.

In chapter 3, I present estimates of externalities and peer effects in an information commons. Specifically, I measure the magnitude of external effects of the actions of library users who were subject to non-monetary sanctions (professors and university employees) over users who were subject to monetary sanctions (students). I also measure peer effects among users, considering the number of items they borrow from the library. In the case of this chapter, I report two results. First, there is a “crowding-out” effect among library users: for an additional unity in non-students’ counts, I uncover an approximate decrease of one-to-one in students’ counts, *ceteris paribus*. Second, when

estimating peer effects among users, I find that, for every 100 books borrowed by a user's peer group, there is an approximate rise of three books per user. Taken together, these results suggest the importance of behavioral complementarities in a field setting.

Finally, in chapter 4, I evaluate the impacts of lower transaction costs in an information commons. In this case, I exploit variation in the introduction of a cost-saving technology (return boxes) in distinct libraries. I hypothesize that return boxes, by reducing transaction costs, would enhance performance measures in the libraries that decide to adopt them. If lower transaction costs were relevant in this setting, then one would expect to find a significant effect of such costs over library users' performance measures, as predicted by standard theories of vertical integration, for instance. Contrarily to the previous rationale, I uncover a result in which the instauration of return boxes either increases some measures, such as borrowings' effective duration and users' delays, at the same time that it does not exert any significant effect over item counts.

5.1. Theoretical implications

The results reported in this dissertation have important implications, both in theoretical and practical grounds. In terms of theory, the results reported in chapter 2 not only provide a better understanding of the impacts of fines over illicit behavior, but they also shed light on related issues, such as economic incentives (Gneezy et al., 2011; Gneezy & Rustichini, 2000a), social norms (Acemoglu & Jackson, 2017; Posner, 1997), and corruption (Fisman & Miguel, 2007; Svensson, 2005) in real-world settings. An interesting route of future research in the case of this chapter would be to empirically explore some of the predictions derived from models emphasizing the interaction between social norms and laws (Acemoglu & Jackson, 2017; Bénabou & Tirole, 2011)⁴⁵.

The results in chapter 3 not only dialogue with the literatures on incentives and social norms, but they also contribute to the literature on peer effect measurement (Breza, 2012; Moretti, 2011). More than that, these results relate to a sparse set of contributions focused

⁴⁵ Over the last years, there has been an increasing literature related to the economic impacts of corruption. Mauro (1995) corresponds to the seminal contribution on the theme, with a focus on growth issues. See also Brollo, Nannicini, Perotti, and Tabellini (2013), Caselli and Michaels (2013), Duggan and Levitt (2002), Ferraz and Finan (2011), Fisman and Miguel (2007), and Glaeser and Goldin (2006), for examples of applications in distinct settings.

on the behavior of economists in laboratory and field settings (Carter & Irons, 1991; Frank, Gilovich, & Regan, 1993; Marwell & Ames, 1981; Yezer, Goldfarb, & Poppen, 1996). While the latter contributions focus on the sole behavior of economists, the chapters in this dissertation evaluate the interactions of library users from distinct areas of knowledge, such as management, accounting, and advertising. These results contribute to the literature by contextualizing economists' behavior, when compared to other areas (Cadsby & Maynes, 1998; Fosgaard et al., 2017; Frey & Meier, 2005; Rubinstein, 2006). At a broader level, by emphasizing differences in behavior based on area of expertise, the results in this dissertation contribute to a better understanding of the effects of specific social factors – such as identity and culture – over economic outcomes (Akerlof & Kranton, 2000, 2005; Alesina & Giuliano, 2015; Henrich et al., 2001)⁴⁶.

In the case of the results reported in chapter 4, they add to an ever-growing body of empirical evidence related to the importance of transaction costs in distinct settings (Funk, 2010; Huck & Rasul, 2010). While previous contributions emphasized the role of such costs for vertical integration issues (Joskow, 1987; Parmigiani, 2007; Poppo & Zenger, 1998), the results in that chapter correspond to one of the first contributions to relate transaction costs to observed behavior in a unique field setting, an information commons. In this case, theoretical contributions exploring the mechanisms by which transaction costs affect the workings of common-pool resources could bring important insights, as well as new testable hypotheses. While most experiments related to common-pool resources focus on cooperation and collective action issues involving environmental themes (Cárdenas & Ostrom, 2004; Fehr & Leibbrandt, 2011), new experimental work in distinct settings could bring light to pending questions in the field, such as the impacts of transaction costs over individual behavior, instead of firm behavior.

⁴⁶ Colander (2007), Colander and Klammer (1987), and Leijonhufvud (1973) correspond to examples of studies focused on the specific behavior of economists. In the case of examples of a growing set of experimental and empirical evidence regarding the importance of identity and personal traits for economic outcomes, see Benjamin, Choi, and Fisher (2016), Benjamin, Choi, and Strickland (2010), Kagel and McGee (2014), Kaplan, Klebanov, and Sorensen (2012), Kranton, Pease, Sanders, and Huettel (2012), McLeish and Oxoby (2011), and Morita and Servátka (2013).

5.2. Management implications

In terms of practice, the results reported in this dissertation provide valuable insight for important organizational issues, such as incentives, and teamwork issues. In the case of incentives, the results reported in all chapters suggest the occurrence of heterogeneous behavioral responses among library users. In particular, these results call attention to the importance of incentives in organizations, by suggesting possible complementarities between different types of sanctions in social dilemmas. For example, when dealing with situations similar to common-pool resources' management, decision makers could think about using gradual monetary sanctions as a means to induce behaviors that would benefit the organization as a whole.

In the case of teamwork, the results here reported provide valuable insights for policies that take place inside organizations, given their increasing importance over the last decades (Hu & Liden, 2015; B. F. Jones, 2009; B. F. Jones, Wuchty, & Uzzi, 2008; Wuchty, Jones, & Uzzi, 2007). In particular, a traditional question in organization studies relates to the impossibility of measuring distinct members' contributions to teamwork, given the possibility of free-riding behavior (Alchian & Demsetz, 1972). Since some organizations have similar characteristics to common-pool resources – such as non-exclusion and rivalry – the results in the present dissertation may help distinguishing which incentives affect employees' cooperation at different points in time (Mills & Rudnicki, 2015)⁴⁷.

In the specific case of chapter 4, one promising avenue of research would be to verify the impacts of transaction costs in distinct organizational settings, with similar characteristics to a common-pool resource. For instance, one possibility would be to explore the impacts of such costs in the setting previously explored by Gneezy, Leibbrandt, and List (2013) to study the impacts of social norms over the behavior of Brazilian fishermen. Similarly, running field experiments inside firms, as originally proposed by Bandiera, Barankay,

⁴⁷ Croson (2008) reports the results of a laboratory experiment related to the theoretical predictions derived from Alchian and Demsetz (1972). Holt and Laury (1997), Holt and McDaniel (1998), Leuthold (1993), and Nelson and Beil (1994) correspond to examples of classroom experiments related to public goods provision. Cárdenas and Ramos (2006) present several examples related to common-pool resources' management.

and Rasul (2011) and Huck and Rasul (2010) could bring new insights related to the importance of transaction costs for academics, policy makers and managers.

5.3. Future research

This dissertation has limitations. A first limitation refers to the external validity of the results here presented. In the case of chapter 2, related to the effects of monetary sanctions on behavior, it is not clear if one can extrapolate these results to situations involving higher costs, such as those faced by criminal justice courts, for instance. While the results in that chapter refer to a very specific setting (a university library), it is important to recognize that they add to the growing empirical literature exploring the interplay between monetary sanctions and behavior in distinct contexts (Bar-Ilan & Sacerdote, 2004; Gneezy & Rustichini, 2000a; Haselhuhn et al., 2012)⁴⁸.

A similar point relates to the findings reported in chapter 4, in which I evaluate the impacts of the introduction of return boxes in distinct libraries. Again, the results there presented may lack external validity, since I study user behavior in different libraries of the same university. Although there seems to be considerable diversity among library users and university *campi* studied in the chapter, one may argue that these results reflect a very specific institutional setting. A possible way to circumvent such an argument would be to evaluate the behavior of users in distinct types of libraries or university departments, as Apesteguia et al. (2013) do when evaluating rule compliance in the public libraries of Barcelona⁴⁹.

When estimating peer effects, in chapter 3, I emphasize that the estimates there presented do not have a causal meaning, since I do not build instruments based on natural experiments. In that case, I recognize that a desirable empirical strategy to estimate peer effects would be to employ instruments based on institutional or economic changes, as previous contributions did in distinct settings (Acemoglu et al., 2001; Breza, 2012; Levitt,

⁴⁸ The results in chapter 2 also dialogue to a sparse set of contributions related to white-collar criminal activities (Fisman & Miguel, 2007; Levitt, 2006; Posner, 1980).

⁴⁹ See also Butcher et al. (2014), Carter and Irons (1991), Estevan et al. (2016), Frank et al. (1993), Rubinstein (2006), and Yezer et al. (1996) for examples of studies based on distinct university departments.

1997). However, it is worth noting that contributions based on non-causal estimates of peer effects can also bring important insights and policy implications related to the theme (Moretti, 2011). Similarly, employing novel instruments derived from natural experiments does not necessarily guarantee the appropriate identification of causal effects, as originally suggested by Rosenzweig and Wolpin (2000).

In terms of strengths, the present dissertation is probably one of the first attempts to evaluate individual behavior in an information commons. As stated above, most previous contributions on the theme focus on determining precise definitions of related terms, or evaluating its main implications for relevant situations (Hess & Ostrom, 2007a, 2007b). Additionally, the literature presents an excessive emphasis on environmental themes, in the case of other types of common-pool resources (Cárdenas & Ostrom, 2004; Fehr & Leibbrandt, 2011; Rustagi et al., 2010). While these contributions represent a natural extension to some of the main insights related to common-pool resources, given Hardin's (1968) original contribution, it is not clear why there are still few studies related to other settings.

It is important to stress that the repeated-measure nature of the phenomenon here studied constitutes an additional strength of this dissertation (since users borrow different library items over time), given that most collective-action situations reported in laboratory and field experiments involve repeated interaction (Andreoni, 1988; Andreoni & Croson, 2008; Cárdenas & Ostrom, 2004; Ostrom, 2000). In fact, contrarily to most research related to laboratory experiments, where there is the possibility that part of the subject pool start gaming the experimenter – generating “experimenter demand effects” – the data used in this dissertation allow me to observe individual behavior in a real-world setting during distinct moments of time.

Similarly, there is a well-known criticism related to laboratory experiments, stating that their exclusive reliance on students' behavior may compromise external validity (Fréchette, 2015; Kagel, 2009; List, 2011). In this case, one advantage of the present findings is that they focus on the behavior of distinct users, such as professors, graduate students, and university employees. This feature of the data lends confidence against such criticisms, at the same time that presents some of the advantages related to behavior

observed in field settings (Apesteguia et al., 2013; Cárdenas & Ostrom, 2004; Fehr & Leibbrandt, 2011)⁵⁰.

Additionally, it is worth noting that, while some contributions stress the importance of property rights in common-pool resources settings (Aragón, 2015; Ostrom, 2009), few relate common-pool resources to other important theoretical concepts originated in the areas of organizational economics and law and economics, such as transaction costs (Coase, 1937; Williamson, 1985), externalities (Coase, 1960) or measurement costs (Barzel, 1982, 1997). At the present moment, the empirical impacts of transaction costs over behavior in different types of common-pool resource setting are still not clear, both in theoretical and empirical grounds. For example, most contributions in the transaction-cost tradition focus on vertical integration issues (Klein et al., 1978; Williamson, 1985, 1991), with very few contributions related to alternative settings (Funk, 2010; Huck & Rasul, 2010). Similarly, difficulties in measuring externalities, as well as goods' main attributes in real-world settings could affect the dynamics of exploration of collective goods.

In terms of opportunities, future research could benefit from an increasing focus on behavior in distinct settings. Although there were significant contributions in this direction coming from the work of Elinor Ostrom and coauthors (Dietz et al., 2003; Ostrom, 1990, 1999, 2005, 2010; Volland & Ostrom, 2010), there is still room for improvement, either in terms of field or natural experiments. In this case, it is worth citing two novel contributions. Fehr and Leibbrandt (2011) present results of laboratory and field experiments focused on the behavior of Brazilian anglers in a lake, a typical example of a common-pool resource. In a similar spirit, Gneezy, Leibbrandt, and List (2013) study the evolution of social norms among anglers, conditional on their working routines. In both cases, the authors stress the importance of psychological traits predicting observed behavior in the field, as well as the importance of jointly considering the results of laboratory and field experiments, when evaluating social dilemmas. While there is an ever-growing literature on experiments in several areas, such as economics and business (Falk & Heckman, 2009; Kagel, 2009; Smith, 1989), it is clear that the current research

⁵⁰ Bandiera, Barankay, and Rasul (2011), DellaVigna (2009), Harrison and List (2004), Levitt and List (2008, 2009), List (2011), and Reiley and List (2010) correspond to contributions emphasizing the use of field experiments in distinct settings.

on common-pool resources could benefit from a tendency to blend the results of laboratory and field experiments.

Finally, one promising route for future research relates to Big Data applications. While there is not a definitive consensus on the meaning of such a term (Stephens-Davidowitz, 2017), it seems clear that it provides social scientists with an increasing set of tools to evaluate distinct situations involving massive volumes of data (Stephens-Davidowitz & Varian, 2014; Varian, 2014; Varian & Choi, 2009). In this sense, contributions exploring larger sets of data related to common-pool resources could provide valuable insights for social dilemma situations.

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⁵¹ According to the style guide from the American Psychological Association (APA) (SIBiUSP, 2016).

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APPENDIX A: DATA PERMISSION STATEMENTS

DATA CONSENT STATEMENT

I, EDISON SIMONI DA SILVA, Dean of Fundação Escola de Comércio Álvares Penteado (FECAP), authorize the use of data and information from the libraries of all units of FECAP, as well as the disclosure of the name of FECAP, in the PhD dissertation of MATHEUS ALBERGARIA DE MAGALHÃES, PhD candidate at Programa de Pós-Graduação em Administração da Universidade de São Paulo (PPGA-USP).

The PhD student commits not to disclose any personal information from the libraries' users, as well as to use the research results for academic purposes only, such as publishing papers in academic journals and presenting results in academic seminars.

São Paulo, May 4th 2017.

EDISON SIMONI DA SILVA

MATHEUS ALBERGARIA DE MAGALHÃES

DATA CONSENT STATEMENT

I, VANIA PIKANÇO CHOI, Chief Librarian of Biblioteca Paulo Ernesto Tolle, located at the Fundação Escola de Comércio Álvares Penteado (FECAP), authorize the use of data and information from the libraries of all units of FECAP, as well as the disclosure of the name of FECAP, in the PhD dissertation of MATHEUS ALBERGARIA DE MAGALHÃES, PhD candidate at Programa de Pós-Graduação em Administração da Universidade de São Paulo (PPGA-USP).

The PhD student commits not to disclose any personal information from the libraries' users, as well as to use the research results for academic purposes only, such as publishing papers in academic journals and presenting results in academic seminars.

São Paulo, May 4th 2017.

VANIA PIKANÇO CHOI

MATHEUS ALBERGARIA DE MAGALHÃES

APPENDIX B: LIBRARY DATA

In this appendix, I present details related to the library data used in this dissertation. Table B.1 presents descriptive statistics for the total sample period (2005-2015):

Table B.1 – Descriptive statistics – Total Sample, 2005-2015

VARIABLE	Mean	Std. Deviation	Minimum	Maximum
Female	0.53	--	0	1
First Year	0.22	--	0	1
Scholarship	0.36	--	0	1
0 to 4 years in College	0.88	--	0	1
High School	0.02	--	0	1
Undergraduate	0.66	--	0	1
Graduate Student	0.21	--	0	1
Masters Student	0.05	--	0	1
Professor	0.02	--	0	1
Former Student	0.04	--	0	1
Management	0.33	--	0	1
Accounting	0.36	--	0	1
Economics	0.14	--	0	1
International Relations	0.04	--	0	1
Advertising	0.04	--	0	1
Secretariat	0.02	--	0	1
Business Book	0.33	--	0	1
Accounting Book	0.16	--	0	1
Economics Book	0.15	--	0	1
Law Book	0.07	--	0	1
Early Returns	0.40	--	0	1
Age	26.20	7.50	13	79
Predicted Duration	7.55	2.03	7	15
Effective Duration	7.47	11.42	0	2,971
Delays	1.50	10.86	0	2,964
Book Usage	938.44	1,485.96	1	7,054
Penalty Days	69.74	216.30	0	968
Fines	0.69	14.17	0	5,048
Fine Count	0.18	0.74	0	7
Item Count	2.64	1.42	1	7
Observations	785,550			

Source: author's calculations, based on library data.

Notes: (a) Observations correspond to the 2005-2015 period, covering 785,550 transactions by 17,236 library users.

In figures B.1-B.3, I present pictures from the three libraries studied in this dissertation, divided by their location. The library manager of FECAP, Vania Choi, provided me these pictures as a courtesy. All the pictures correspond to the 2017 year⁵².

a) Liberdade

Figure B.1 – Liberdade unit

Source: Fundação Escola de Comércio Álvares Penteado (FECAP).

⁵² There is a manual containing the working rules for these libraries, available at the following link: <http://biblioteca.fecap.br/wp-content/uploads/2017/08/Regulamento-Biblioteca-2017.pdf>.

b) Largo do São Francisco

Figure B.2 – Largo do São Francisco unit

Source: Fundação Escola de Comércio Álvares Penteado (FECAP).

c) Pinheiros

Figure B.3 – Pinheiros unit

Source: Fundação Escola de Comércio Álvares Penteado (FECAP).

I also include below pictures of the return boxes studied in chapter 4. From left to right, these pictures correspond to the boxes in the Liberdade, Largo do São Francisco, and Pinheiros units, respectively:

Figure B.4 – Return boxes in distinct library units.

Source: Fundação Escola de Comércio Álvares Penteado (FECAP).

Figure B.5 contains a picture of the libraries' electronic system (*Pergamum*) for their users. This picture also corresponds to the 2017 year⁵³

⁵³ In the case of this figure, it is worth noting that the fine's value is R\$ 3.00 (instead of the constant value of R\$ 2.00, which was in force during the 2005-2015 period). In a personal conversation with FECAP's Chief-Librarian, Vania Choi, she informed me that FECAP decided to change the value of the fine for late items in 2017.

Figure B.5 – Libraries' electronic system (*Pergamum*).

Meu Pergamum | Comentários Gerais | Sugestões Gerais | Alto contraste | Login

Pesquisa Geral

Selecione outras pesquisas ▼

Opções de consulta

☒ Palavra | ☐ Índice | Ordenação: | Unidade de Informação:

Busca por: | Ano de publicação: | Tipo de obra:

Registros por página:

O e-mail é um a forma de lembrá-lo da data de devolução do material, que é uma responsabilidade sua; o não envio da mensagem, independente do motivo, não o isenta do pagamento da multa.

ATENÇÃO! A cobrança de multa por atraso na devolução será cobrada por DIAS CORRIDOS, R\$3,00 por dia e por obra.

Horários de funcionamento:

Biblioteca Central - Campus Liberdade: de segunda a sexta-feira, das 7h30 às 21h50; sábado, das 8h às 16h50.

Biblioteca Setorial - Campus Largo São Francisco: de segunda a quinta-feira, das 17h às 21h50; sábado, das 8h às 14h.

Biblioteca Setorial - Campus Pinheiros: de segunda a quinta-feira, das 17h às 21h50.

Meu Pergamum | ICAP

Idiomas: [Català](#) | [English](#) | [Español](#) | [Français](#) | [Italiano](#) | [Português](#)

» Pergamum Mobile

Utilize em desses navegadores: