



**Essays on Language, Leniency Laws, and Corporate Environmental and Financial
Decisions**

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Abstract

This thesis consists of three empirical studies that examine how informal institutions and regulatory enforcement shape corporate environmental and financial decisions. The first study investigates whether cross-country differences in linguistic time encoding explain variation in corporate carbon emissions. Drawing on the distinction between weak and strong future-time-reference (FTR) languages, the analysis tests whether firms operating in environments that emphasise future outcomes exhibit lower emissions.

Using a global sample of firms from 33 countries over the period 2001 to 2021, the findings show that firms in weak-FTR linguistic settings tend to produce lower carbon emissions. This relationship remains robust to alternative specifications and additional analyses, including within-country tests that help isolate the effect of language from broader institutional factors.

The second study examines how exposure to foreign antitrust leniency laws affects corporate investment behaviour among U.S. firms. Leniency programmes increase the expected detection risk of collusion by encouraging cartel members to self-report, thereby weakening collusive arrangements and intensifying product market competition. Using firm-level data from 1990 to 2021, I construct an import-weighted measure of foreign leniency exposure and estimate two-way fixed-effects models to assess its effect on investment outcomes.

The results show that firms exposed to stronger foreign leniency enforcement increase total investment and improve investment efficiency, primarily through a reduction in underinvestment. At the same time, the evidence also indicates higher levels of overinvestment under intensified competition. Overall, the investment findings are consistent with foreign leniency laws mitigating the managerial “quiet life” and encouraging firms to exert greater effort by pursuing investment opportunities and reducing underinvestment. These findings

remain robust across alternative specifications, measures, and additional robustness analyses, and highlight the role of competition policy in shaping investment behaviour and capital allocation.

The third study examines how foreign antitrust leniency laws influence the financing decisions of U.S. firms, with a particular focus on debt maturity structure. By increasing the expected detection risk of collusion and weakening collusive arrangements, leniency programmes intensify product market competition and increase the importance of financial flexibility. Using Compustat North America data from 1990 to 2021, I construct an import-weighted measure of foreign leniency exposure and estimate firm-level fixed-effects models to assess its impact.

The results show that greater exposure to foreign leniency laws is associated with shorter debt maturity and reduced reliance on long-term debt, consistent with firms adopting more flexible financing structures. Additional analysis indicates that this effect is stronger among financially constrained firms and weaker among firms with stronger profitability, greater liquidity, and more dynamic product market environments. I also find that foreign leniency exposure slows the speed at which firms adjust toward their target leverage. Overall, the findings highlight how foreign antitrust enforcement influences corporate financing through intensified competitive pressure.

Taken as a whole, the findings of the three studies demonstrate that both linguistic characteristics and antitrust enforcement play an important role in shaping corporate behaviour. Importantly, the investment and financing responses to foreign leniency exposure are complementary rather than contradictory. By intensifying competition and mitigating the managerial “quiet life,” foreign leniency laws induce firms to work harder, reflected in higher investment and reduced underinvestment, while at the same time encouraging more cautious and prudent financing choices. Together, these findings suggest that stronger competitive

discipline encourages firms to make more considered decisions across both their investment and financing policies. By linking language, competition policy, and firm-level decisions, this thesis provides new evidence on how institutional and competitive forces influence environmental outcomes, investment behaviour, and corporate financing decisions in an increasingly integrated global economy.

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Dedicated to my beloved family members.

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CHAPTER 1. INTRODUCTION

External institutional and regulatory environments play an important role in shaping firms' strategic, financial, and environmental decisions. Changes in competition policy, regulatory systems, and broader institutional conditions can influence managerial incentives, affect access to resources, and alter how firms respond to long-term opportunities and risks. As global markets become increasingly interconnected, developments in one jurisdiction may also generate spillover effects across borders through trade, competition, and financial linkages.

These issues have become increasingly important as firms face stronger regulatory scrutiny, intensified global competition, and growing expectations regarding environmental and corporate responsibility. At the same time, international integration has made corporate behaviour more sensitive to institutional and regulatory changes beyond national borders. Understanding how external institutional forces shape firms' long-term strategic and financial decisions has therefore become an important issue in accounting and finance research.

In this thesis, I examine how external institutional and regulatory environments influence firms' strategic, financial, and environmental behaviour. I focus on two broad themes. The first examines whether linguistic structures affect firms' environmental behaviour and corporate carbon emissions. The second investigates how foreign antitrust leniency laws affect firms' investment and financing decisions through changes in product market competition.

Although the empirical chapters examine different aspects of corporate behaviour, they share a common objective: to understand how external institutional conditions shape firms' long-term strategic decisions. Accordingly, this thesis considers both informal forces, such as language, and formal regulatory mechanisms, such as antitrust enforcement, to provide a broader view of how institutions affect corporate policies and managerial behaviour.

More broadly, I contribute to the growing literature on the real effects of institutional and regulatory environments. The thesis shows how formal and informal institutional forces

are reflected in firms' environmental strategies, capital allocation, and financing policies. To examine these issues, I use large international and U.S. firm-level panel datasets and fixed-effects empirical frameworks. This approach allows me to study how institutional and regulatory environments shape firm behaviour across different settings.

Chapter 2 investigates whether cross-country linguistic differences influence corporate carbon emissions. Building on the linguistic time-discounting framework developed by Chen (2013), I examine whether firms operating in weak future-time-reference (FTR) linguistic environments exhibit lower carbon emissions than firms operating in strong-FTR environments. The analysis argues that linguistic structures shape how firms and managers perceive future environmental consequences and, in turn, affect firms' incentives to adopt environmentally responsible strategies.

Chapter 3 examines whether exposure to foreign antitrust leniency laws affects corporate investment and investment efficiency among U.S. firms. Leniency programmes are designed to destabilise collusive arrangements by encouraging cartel members to disclose anti-competitive behaviour in exchange for reduced penalties (Miller, 2009). By intensifying competition and weakening collusive rents, these programmes may alter firms' investment incentives and affect the efficiency with which they allocate capital.

Chapter 4 investigates how foreign leniency laws influence firms' financing decisions, with particular emphasis on debt maturity and capital structure adjustment. Stronger competition may increase uncertainty, reduce profitability, and increase the importance of financial flexibility, thereby encouraging firms to adopt more precautionary financing policies. The chapter therefore examines whether exposure to foreign leniency laws affects firms' debt maturity decisions and the speed at which firms adjust toward target leverage.

Overall, this thesis argues that external institutional and regulatory environments have important implications for firms' strategic, financial, and environmental decisions. By

examining environmental performance, investment policy, and financing structure, it provides new evidence on how formal and informal institutions shape corporate behaviour across different areas of decision-making.

The remainder of this introductory chapter is organised as follows. Section 1.1 provides the background and motivation for the thesis. Section 1.2 presents the research questions. Section 1.3 summarises the main findings of the empirical chapters. Section 1.4 outlines the main contributions. Finally, Section 1.5 presents the overall structure of the thesis.

1.1 Background and Motivation

In recent decades, climate change and product market competition have become central issues in accounting and finance research. Firms operate under increasing regulatory scrutiny, stronger global competition, and growing pressure to improve both environmental and financial performance. At the same time, global integration has strengthened the transmission of economic and regulatory shocks across countries through trade, financial markets, and product market competition (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019).

This cross-border setting is particularly relevant because regulatory changes adopted abroad may affect domestic firms through trade linkages and changes in product market competition. These developments make it important to understand how external institutional conditions affect corporate behaviour and long-term decision-making. A growing literature suggests that both formal and informal institutions can shape managerial decisions (Chen, 2013; North, 1990). Formal institutions, such as antitrust regulation and competition policy, affect firms by changing competitive pressure, market discipline, and managerial incentives (Miller, 2009; Motta & Polo, 2003). Informal institutions, including language and cultural characteristics, may influence how individuals and firms perceive future outcomes and evaluate long-term risks (Chen, 2013; Liang et al., 2018). These institutional forces can therefore affect

a wide range of corporate policies, including environmental performance, investment behaviour, capital allocation, and financing decisions.

Recent studies further show that institutional and regulatory forces generate important real effects. In the environmental context, increasing attention has been given to how firms respond to climate-related risks and environmental responsibilities (Lewandowski, 2017; Matsumura et al., 2014). In the competition policy literature, stronger antitrust enforcement has been shown to affect financing decisions, disclosure practices, and strategic responses by intensifying product market competition (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019; Dong et al., 2019).

These studies highlight the importance of institutional settings in shaping firms' long-term decisions. These outcomes are important because they capture real corporate responses to institutional forces, including how firms manage environmental externalities, allocate capital, and structure financing under changing competitive conditions. Despite this progress, important gaps remain. Existing research often examines environmental behaviour, investment policy, and financing decisions separately, while less attention has been given to how broader institutional environments shape these outcomes across different settings. Limited evidence exists on whether linguistic structures influence firms' carbon emissions, or how international antitrust enforcement affects investment and financing choices through changes in competitive pressure.

Motivated by these gaps, I examine how external institutional and regulatory environments influence firms' environmental, investment, and financing decisions. I focus on two broad institutional mechanisms. The first is an informal mechanism: linguistic structures and their influence on corporate environmental behaviour and carbon emissions. The second is a formal regulatory mechanism: foreign antitrust leniency laws and their effects on investment and financing policies through intensified product market competition.

1.2 Research Questions

Building on the background and motivation discussed above, I organise the thesis around the following three broad research questions.

1.2.1 First Research Question

Climate change has become one of the most important challenges facing firms, regulators, and policymakers. Firms are increasingly expected to reduce their environmental impact and provide more transparent information about their climate-related activities. Prior research suggests that institutional and cultural factors may influence how firms respond to long-term environmental risks. Linguistic structures may shape how individuals perceive the future and evaluate the consequences of current decisions (Chen, 2013). If language affects future-oriented behaviour, it may also influence firms' environmental strategies and carbon emissions. On this basis, I ask the first broad research question:

Research Question 1: Do linguistic structures influence firms' environmental behaviour and corporate carbon emissions?

To address this question, Chapter 2 examines whether firms operating in weak future-time-reference linguistic environments exhibit lower carbon emissions than firms operating in strong future-time-reference environments. This chapter contributes by linking linguistic structures to corporate environmental behaviour and by examining whether language-based future orientation is reflected in firms' carbon emission outcomes.

1.2.2 Second Research Question

Product market competition plays an important role in shaping firms' investment behaviour and capital allocation. When firms operate in collusive environments, competitive pressure is weakened, managerial discipline may decline, and investment decisions may become less closely aligned with growth opportunities. Antitrust leniency laws are designed to destabilise collusive arrangements by encouraging cartel members to self-report in exchange for reduced

penalties. By increasing the expected detection risk of collusion and weakening coordinated market conduct, these laws intensify product market rivalry and may alter firms' incentives to invest. On this basis, I ask the second broad research question:

Research Question 2: Does exposure to foreign antitrust leniency laws affect firms' total investment and investment efficiency?

To answer this question, Chapter 3 examines whether exposure to foreign leniency laws affects total investment among U.S. firms and whether it improves the efficiency with which firms allocate capital. The chapter also investigates the mechanisms underlying investment efficiency by distinguishing between underinvestment, where firms fail to undertake profitable investment opportunities, and overinvestment, where firms invest beyond levels justified by firm fundamentals. This allows the analysis to assess whether leniency-induced competition affects both the level of corporate investment and the alignment of investment decisions with firms' growth opportunities.

1.2.3 Third Research Question

Competition policy may also influence firms' financing decisions by changing the competitive environment in which firms operate. Stronger product market competition can reduce profitability, increase uncertainty, and increase the value of financial flexibility, thereby affecting firms' debt maturity and broader capital structure choices. Debt maturity is an important dimension of corporate financial policy because it affects firms' exposure to refinancing risk, liquidity pressures, and their ability to maintain flexibility under changing competitive conditions. On this basis, I ask the third broad research question:

Research Question 3: Do foreign antitrust leniency laws influence firms' debt maturity decisions and the speed at which firms adjust toward target leverage?

To address this question, Chapter 4 examines whether greater exposure to foreign leniency laws leads U.S. firms to rely more heavily on shorter-term debt. The chapter also investigates the economic channels and firm characteristics through which these effects operate, including profitability, market share, financial constraints, liquidity, and product market competition. In addition, Chapter 4 examines whether exposure to foreign leniency laws affects the speed with which firms adjust toward their target capital structure. This chapter contributes by showing whether intensified competition encourages more precautionary financing policies and alters firms' debt maturity and capital structure dynamics.

1.3 Findings

1.3.1 First Research Question

In Chapter 2, I address the first research question by examining whether linguistic structures influence firms' environmental behaviour and corporate carbon emissions. Using an international sample of firms from 33 countries over the period 2001–2021, I find that firms operating in weak future-time-reference linguistic environments exhibit lower carbon emissions than firms operating in strong future-time-reference environments. This finding is consistent with the view that language shapes how individuals and organisations perceive the future. When the future is linguistically expressed as closer to the present, firms operating in these linguistic environments appear to place greater weight on the long-term consequences of current environmental decisions.

The findings remain stable across a range of additional tests, including alternative measures of carbon emissions, different specifications of the linguistic variable, sample restrictions, and alternative fixed-effects structures. I also find that the effect of weak future-time-reference language is weaker in more globalised and individualistic societies, suggesting that the influence of language on corporate environmental behaviour depends partly on the broader cultural and institutional setting in which firms operate. Further evidence from

multilingual countries supports this interpretation by showing that linguistic differences matter even within similar national environments. Overall, Chapter 2 shows that informal institutions, particularly language, can shape firms' environmental decisions and carbon emission outcomes.

1.3.2 Second Research Question

In Chapter 3, I examine whether exposure to foreign antitrust leniency laws affects corporate investment and investment efficiency among U.S. firms. Using a panel of publicly listed U.S. firms over the period 1990–2021 and an import-weighted measure of foreign leniency exposure, I find that firms with greater exposure to foreign leniency laws increase total investment. This effect is strongest for internally generated investment, particularly capital expenditures and research and development, while the effect on acquisitions is more moderate. This evidence suggests that when collusive arrangements are weakened and competition intensifies, firms exert greater effort by increasing investment activity to protect or strengthen their market position.

The chapter also shows that foreign leniency exposure improves investment efficiency. This improvement is mainly driven by a reduction in underinvestment, indicating that stronger competitive pressure encourages firms to undertake profitable projects that may previously have been delayed or overlooked. These findings are consistent with leniency-induced competition mitigating the managerial “quiet life” and strengthening investment discipline. At the same time, I find some evidence of higher overinvestment, indicating that intensified competition can also lead some firms to increase investment beyond expected levels. Taken together, the findings indicate that leniency-induced competition encourages firms to work harder and improves capital allocation primarily by reducing underinvestment, while also increasing investment intensity in some cases.

1.3.3 Third Research Question

Chapter 4 addresses the third research question by examining whether foreign leniency laws affect firms' financing policies, particularly debt maturity and capital structure adjustment. Using U.S. firm-level data over the period 1990–2021, I find that firms with greater exposure to foreign leniency laws rely less on long-term debt and adopt shorter debt maturity structures. This evidence suggests that intensified competition leads firms to preserve financial flexibility and reduce reliance on long-term financing commitments.

The results are consistent across a range of additional tests. The maturity-shortening effect remains evident when I use lagged specifications, alternative debt maturity measures, different fixed-effects structures, alternative clustering approaches, and trade-based definitions of foreign leniency exposure. This consistency reduces concerns that the findings are driven by a specific empirical design or measurement choice.

Further analysis shows that the financing response is not uniform across firms. The effect of foreign leniency exposure is stronger among financially constrained firms, including non-dividend-paying firms, less profitable firms, and firms with lower cash holdings. This pattern indicates that firms with weaker internal financial capacity respond more cautiously when competitive pressure increases. I also find that foreign leniency laws slow the speed at which firms adjust toward target leverage, suggesting that competition affects not only debt maturity choices but also broader capital structure dynamics. Overall, Chapter 4 shows that foreign antitrust enforcement shapes corporate financing policies by encouraging more precautionary debt choices under intensified product market competition.

1.4 Thesis Contributions

This thesis contributes to the accounting and finance literature by providing new evidence on how external institutional and regulatory environments shape firms' environmental, investment, and financing decisions. Although the three empirical chapters examine different

outcomes, they are connected by a common theme: firms do not make strategic decisions in isolation. Their behaviour is shaped by the formal rules, informal institutions, and competitive conditions in which they operate. By examining language and antitrust enforcement across carbon emissions, investment, debt maturity, and capital structure adjustment, this thesis shows how institutional forces influence firms' real decisions and long-term corporate policies.

First, Chapter 2 contributes to the literature on informal institutions and corporate environmental behaviour. Prior research shows that language can influence individual time preferences and future-oriented behaviour (Chen, 2013), and that linguistic structures may affect corporate policies such as corporate social responsibility, research and development, cash holdings, and investment decisions (S. Chen et al., 2017; Kim et al., 2017; Liang et al., 2018).

I extend this literature by examining whether linguistic structures are associated with firm-level carbon emissions. To the best of my knowledge, this chapter is among the first to provide international evidence that firms operating in weak future-time-reference linguistic environments have lower carbon emissions. This finding identifies language as an important informal institutional factor that shapes corporate environmental decisions and contributes to the broader literature on climate change, sustainability, and corporate behaviour.

Second, Chapter 3 contributes to the literature on the real effects of antitrust enforcement and product market competition. Prior studies show that leniency laws affect firms' disclosure behaviour, financing choices, merger activity, and information environments (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019; Dong et al., 2019; Wang et al., 2025). I extend this line of research by examining corporate investment, an important real outcome that has received relatively limited attention in this setting. Specifically, I show that exposure to foreign leniency laws is associated with higher total investment and improved investment efficiency among U.S. firms, primarily through a reduction in underinvestment, while also being associated with higher levels of overinvestment in some cases. These findings are

consistent with stronger competitive pressure reducing managerial complacency, encouraging firms to exert greater effort, and strengthening investment discipline.

This chapter therefore contributes to the literature on competition and capital allocation by showing that antitrust enforcement affects not only firms' disclosure, compliance, and strategic choices, but also how firms allocate resources to long-term investment opportunities.

Third, Chapter 4 contributes to the corporate finance literature by examining how foreign antitrust enforcement affects firms' financing policies, particularly debt maturity and capital structure adjustment. Prior studies show that competition influences leverage, financing costs, and broader corporate financial policy (Dasgupta & Žaldokas, 2019; Valta, 2012; Xu, 2012). However, less is known about whether enforcement-driven competition affects the maturity structure of corporate debt. I address this gap by showing that greater exposure to foreign leniency laws leads firms to shorten debt maturity, consistent with a precautionary response to intensified competition and greater uncertainty.

I also provide evidence that foreign leniency exposure slows the speed at which firms adjust toward target leverage. These findings identify debt maturity and capital structure adjustment as important channels through which competition policy shapes corporate financial behaviour. Taken together, the findings from Chapters 3 and 4 provide a broader contribution by showing how firms adjust both their investment and financing decisions in response to the same competitive pressure. Foreign leniency laws mitigate the managerial "quiet life," encouraging firms to work harder by increasing investment and reducing underinvestment, while at the same time inducing firms to make more prudent financing choices. These responses therefore reflect different but complementary dimensions of stronger competitive discipline.

More broadly, this thesis contributes to the literature on the real effects of institutional and regulatory environments. The evidence shows that both informal institutions and formal regulatory mechanisms influence firms across several important dimensions of corporate

behaviour. The thesis also highlights the importance of cross-border institutional spillovers. Chapters 3 and 4 show that foreign regulatory changes can affect U.S. firms through international trade linkages, suggesting that competition policy has economic consequences beyond the countries in which it is adopted. Overall, the thesis provides new evidence that institutional environments shape corporate decisions in ways that are relevant to accounting and finance researchers, regulators, investors, and policymakers.

1.5 Thesis Outline

The remainder of this thesis is organised as follows. Chapter 2 examines whether linguistic structures influence corporate carbon emissions. Chapter 3 investigates the effect of foreign antitrust leniency laws on corporate investment and investment efficiency. Chapter 4 examines how foreign leniency laws affect corporate financing decisions, with particular emphasis on debt maturity and capital structure adjustment. Chapter 5 concludes the thesis by summarising the main findings, discussing the overall contributions and policy implications, and outlining directions for future research.

CHAPTER 2. LINGUISTIC STRUCTURES AND CORPORATE CARBON EMISSIONS

2.1 Introduction

Carbon emissions are a major contributor to climate change and represent one of the most pressing environmental challenges facing the global economy. As economic activity continues to expand, concerns regarding the environmental consequences of carbon emissions have intensified among policymakers, researchers, and international organisations. Although countries differ substantially in their contribution to global emissions, these differences cannot be explained solely by variations in economic development or industrial structure. Cultural and institutional factors may also shape environmental outcomes.

Recent research suggests that language can influence economic behaviour by affecting how individuals and organisations perceive future outcomes. Prior studies show that cross-country variation in corporate future-oriented activities, including corporate social responsibility, research and development investment (Liang et al., 2018) and sustainability practices (Liang et al., 2014), may partly reflect linguistic characteristics within firms and societies.

Building on this literature, this study examines whether linguistic differences across countries help explain variation in corporate carbon emissions. Specifically, the study addresses the following research question: To what extent does linguistic structure influence corporate carbon emissions? Understanding this relationship may provide important insights into how informal institutions shape corporate responses to environmental challenges and may also assist policymakers and investors in evaluating environmental risk and designing effective climate-related policies.

Concerns regarding climate change and environmental risk have received growing attention in both academic research and policy discussions. As awareness of environmental

challenges continues to increase, firms face greater pressure to adopt environmentally responsible practices and provide more transparent disclosure regarding their environmental impact. In this context, Laufer (2003) argues that rising awareness of environmental challenges has strengthened expectations for corporate environmental responsibility. Similarly, Lewandowski (2017) notes that climate change has become an increasingly important strategic issue within corporate decision-making as investors and regulators place greater emphasis on environmental reporting and sustainability disclosure.

At the same time, scientific evidence continues to highlight the long-term environmental and economic consequences of climate change. According to the Intergovernmental Panel on Climate Change (IPCC), atmospheric carbon dioxide concentrations are expected to continue rising in the coming decades, with potentially significant implications for industries such as agriculture, energy, tourism, fisheries, and construction (Altunbas et al., 2022).

A major development in global climate policy was the adoption of the Paris Agreement in December 2015. Under this agreement, countries responsible for approximately 97 percent of global greenhouse gas emissions committed to limiting the increase in global temperatures to well below 2°C above pre-industrial levels. The agreement represents a coordinated international effort to reduce carbon emissions and strengthen long-term climate policies.

Participating countries are also encouraged to outline their climate strategies through Intended Nationally Determined Contributions (INDCs), which specify national targets and policy commitments aimed at mitigating climate change (Altunbas et al., 2022). Consequently, the Paris Agreement has increased pressure on governments to strengthen environmental regulation and pursue long-term climate objectives. Further progress in implementing the Paris framework was achieved during the 26th United Nations Climate Change Conference (COP26) held in November 2021.

During the conference, participating countries introduced additional measures aimed at improving transparency and accountability in climate policy, including enhanced reporting standards for greenhouse gas emissions and climate-related commitments. Financial mechanisms were also introduced to support developing countries in adapting to climate change and implementing emission-reduction initiatives.

Collectively, these developments highlight the growing importance of international cooperation in addressing climate-related challenges and have further increased attention toward firms' environmental performance and climate-related responsibilities. Busch and Hoffmann (2011) further argue that firms' environmental behaviour increasingly influences corporate legitimacy and reputation. Consequently, many firms have begun incorporating environmental considerations into their corporate strategies and decision-making processes.

Moreover, greenhouse gas emissions have become an important concern for both environmental sustainability and economic stability. As firms face increasing regulatory scrutiny and investor pressure, environmental performance increasingly affects corporate valuation and access to external financing. Matsumura et al. (2014) argue that carbon emissions can have important financial consequences, as firms with poor environmental performance may face higher regulatory and reputational costs, while firms that successfully reduce emissions may benefit from stronger investor confidence and improved market performance. Consequently, environmental responsibility has become an increasingly important component of corporate strategy and decision-making.

In addition to regulatory initiatives and international agreements, several organisations have contributed to improving corporate transparency regarding carbon emissions. Bolton and Kacperczyk (2020) note that non-governmental organisations began systematically monitoring corporate carbon emissions nearly two decades ago. Among these initiatives, the Carbon Disclosure Project (CDP) has emerged as one of the leading global platforms for collecting

information on firms' environmental performance and climate-related strategies. Consequently, carbon disclosure has become an important mechanism for enhancing corporate accountability and supporting informed decision-making among investors and policymakers. At the same time, international and national initiatives increasingly encourage firms to adopt environmentally responsible practices and reduce carbon emissions (Tanthanongsakkun et al., 2023), thereby increasing pressure on firms to incorporate environmental considerations into their strategic and operational decisions.

Importantly, the economic consequences of corporate carbon emissions have received growing attention in the academic literature. Matsumura et al. (2014) show that firms with higher emission levels are penalised by investors, indicating that carbon emissions are not only an environmental concern but also an important determinant of firm value. These findings highlight the importance of understanding the factors that influence corporate environmental behaviour. However, despite the expanding literature on the economic effects of carbon emissions, limited attention has been given to the role of informal institutions.

Existing studies primarily focus on regulation, market incentives, and corporate governance, while other contextual factors may also shape firms' environmental decisions. Linguistic structures may influence how firms and managers perceive future environmental risks and evaluate the long-term benefits of sustainability initiatives. Since language affects perceptions of time and future outcomes, cross-country linguistic differences may influence the extent to which firms prioritise long-term environmental responsibility over short-term economic objectives. Examining this relationship may therefore provide additional insights into the institutional factors shaping corporate responses to climate change and environmental sustainability challenges.

The central argument of this study is that linguistic structures shape how individuals and organisations perceive time, which in turn may influence how firms evaluate long-term

environmental costs and benefits. When future outcomes are perceived as more closely connected to the present, firms may place greater emphasis on the long-term consequences of carbon emissions rather than focusing primarily on short-term economic costs. Consequently, firms operating in weak future-time reference (FTR) linguistic environments may be more likely to adopt environmentally responsible strategies and reduce carbon emissions.

This study builds on the Sapir–Whorf hypothesis and the linguistic time-discounting framework developed by Chen (2013), which suggest that language influences perceptions of time and future consequences. In particular, Chen (2013) distinguishes between strong and weak FTR languages based on how future events are grammatically expressed. Strong FTR languages, such as English and French, require distinct grammatical forms when referring to the future, whereas weak FTR languages, including Chinese and German, allow future events to be expressed using present tense structures. These linguistic differences may affect how individuals perceive the distance between present and future outcomes. Speakers of weak FTR languages tend to perceive the future as more closely connected to the present, which may encourage greater attention to long-term outcomes. Consistent with this argument, prior studies show that linguistic structures are associated with more forward-looking behaviour, including higher savings rates, healthier lifestyles, and stronger environmental attitudes (Chen, 2013; Liang et al., 2014). Accordingly, firms operating in weak FTR environments may place greater weight on long-term environmental considerations and adopt more sustainable corporate strategies.

Extending this perspective to the corporate setting, linguistic characteristics may influence firms' environmental decisions and sustainability practices. Managers and stakeholders operating in weak future-time reference (FTR) linguistic environments may place greater emphasis on the long-term consequences of carbon emissions, thereby encouraging firms to adopt more environmentally responsible strategies. In contrast, firms operating in

strong FTR environments may perceive future environmental costs as more distant, potentially reducing incentives to address long-term environmental risks. Linguistic structures may therefore represent an important, yet largely unexplored, factor influencing corporate environmental behaviour.

Motivated by these considerations, this study examines whether firms operating in countries with weak future-time reference (FTR) languages exhibit lower carbon emissions than firms located in strong-FTR environments. To investigate this relationship, I construct an international dataset combining firm-level carbon emission data with cross-country linguistic characteristics for firms across 33 countries over the period 2001–2021. Using firm-level panel regressions with fixed effects, the analysis examines the relationship between linguistic structure and corporate carbon emissions while controlling for characteristics related to firms, industries, and countries.

The empirical findings indicate that firms operating in weak-FTR linguistic environments exhibit significantly lower carbon emissions. To assess the robustness of the results, the study employs a range of additional tests. The findings remain consistent across alternative measures of carbon emissions, different specifications of the linguistic variable, and various sample restrictions, including the exclusion of dominant countries and linguistically heterogeneous environments. The results also remain robust under alternative fixed-effects structures and forward-looking measures of carbon emissions.

Additional cross-sectional evidence supports the moderating hypotheses developed in this chapter. Specifically, the negative association between weak future-time reference (FTR) language and corporate carbon emissions becomes weaker in countries with higher levels of globalisation and individualism. These findings suggest that greater exposure to international environments and stronger emphasis on individual objectives reduce the influence of linguistic structure on corporate environmental decision-making. Furthermore, a within-country analysis

using multilingual settings such as Belgium and Switzerland provides additional support for the identification strategy, showing that the negative relationship persists even after holding country-level institutional and macroeconomic conditions constant. Overall, the findings highlight the importance of informal institutions in shaping firms' environmental decisions and provide new evidence on how linguistic structures influence corporate responses to environmental challenges.

This study contributes to the literature in several ways. To the best of my knowledge, it is the first study to examine the relationship between linguistic structure and firm-level carbon emissions using an international dataset. First, the study extends the literature on informal institutions by showing that linguistic characteristics can influence corporate environmental behaviour. While prior research demonstrates that language affects individual decision-making (Chen, 2013), limited evidence exists regarding its impact on firm-level environmental outcomes. Second, the study contributes to the literature on corporate environmental performance by identifying language as a previously unexplored determinant of firms' carbon emissions. In contrast to existing studies that primarily focus on regulation, governance, and economic incentives, this analysis highlights the role of linguistic structure in shaping how firms evaluate long-term environmental risks. Third, the study contributes to the broader literature on climate change and corporate behaviour by providing cross-country evidence on how cultural and institutional environments influence firms' responses to environmental challenges.

The remainder of this chapter is organised as follows. Section 2.2 reviews the relevant literature on language, informal institutions, and corporate environmental behaviour. Section 2.3 develops the study's hypotheses. Section 2.4 describes the sample, variables, and empirical methodology. Section 2.5 presents the main findings, while Section 2.6 reports the robustness tests. Section 2.7 examines cross-sectional variation in the relationship between linguistic

structure and carbon emissions, and Section 2.8 presents the within-country analysis. Finally, Section 2.9 concludes the chapter.

2.2 Literature Review

2.2.1 Language, Cognition, and the Sapir–Whorf Hypothesis

The idea that language influences how individuals think and behave has a long intellectual tradition in the fields of linguistics, philosophy, and psychology. As noted by Chen (2013), scholars have long debated whether linguistic structures shape the way individuals perceive and interpret the world around them. A central framework in this literature is the Sapir–Whorf Hypothesis (SWH), which proposes that linguistic features can influence how individuals perceive and interpret their environment. This perspective has been widely discussed in studies examining the relationship between language, cognition, and behavioural outcomes (Chen, 2013; Perlovsky, 2009). According to this view, language does not merely serve as a tool for communication; rather, it may also shape how individuals conceptualise time, events, and future outcomes.

Building on this perspective, Chen (2013) introduces a novel approach linking linguistic characteristics to economic decision-making. His framework focuses on how languages grammatically encode references to the future, a feature known as Future Time Reference (FTR). This linguistic distinction may influence how individuals perceive the temporal relationship between present actions and future outcomes. In languages that require explicit grammatical markers when referring to future outcomes, the future may be perceived as more distinct and psychologically distant from the present. Conversely, languages that allow speakers to describe future events using present tense structures may encourage a stronger perceived connection between present actions and future consequences.

In this context, the Sapir–Whorf Hypothesis suggests that linguistic features can shape beliefs and behavioural tendencies by influencing individuals' perceptions of time. When a

language grammatically separates the future from the present, speakers may perceive future outcomes as more distant. As a result, the perceived value of future benefits may decline, leading individuals to discount future rewards more heavily (Kong et al., 2022). By contrast, when linguistic structures blur the distinction between present and future, individuals may perceive future consequences as more immediate, potentially encouraging more forward-looking behaviour. These insights have stimulated growing interest in examining whether linguistic characteristics influence economic decisions and long-term behavioural outcomes.

Across the world, individuals communicate through a diverse range of languages that differ markedly in their grammatical structures and semantic systems. Although language is commonly viewed as a medium for communication, research in linguistics and cognitive psychology suggests that language may also influence how individuals organise information and interpret their environment (He & Zhang, 2022).

From this perspective, linguistic systems may shape cognitive processes by guiding how individuals categorise, store, and recall information. As a result, the structure of language can influence how individuals perceive everyday experiences and interpret external stimuli. These insights provide an important foundation for understanding how linguistic characteristics may influence economic behaviour and decision-making. In recent years, scholars have increasingly examined whether differences in future-time reference (FTR) across languages affect financial decisions and corporate policies.

Early empirical evidence supporting this perspective can be found in studies examining how language affects colour perception. For instance, d'Andrade (1995) argues that individuals tend to recognise and remember colours more easily when their native language provides distinct terms to describe them. In other words, the availability of specific vocabulary can affect how individuals organise visual information and distinguish between different categories of colour. Consistent with this argument, languages impose systematic semantic boundaries on

colour categories (Berlin & Kay, 1991), meaning that different linguistic systems classify colours in distinct ways. Consequently, speakers of different languages may develop varying cognitive associations and perceptual distinctions depending on how their language labels colour categories.

Empirical observations further illustrate how linguistic variation can shape perception. For example, speakers of the Zuni language often encounter difficulty distinguishing between yellow and orange because the language does not clearly differentiate between these colours. By contrast, Russian speakers tend to distinguish between shades of blue more accurately than English speakers, as the Russian language contains separate terms for light blue and dark blue (Kong et al., 2022).

These examples highlight how linguistic categories can influence perceptual sensitivity and the cognitive classification of information. Collectively, this evidence suggests that linguistic differences may shape cognitive processing by affecting how individuals interpret and organise information in their environment.

More broadly, language has been recognised as an important factor shaping human behaviour and decision-making across social and economic settings. A growing body of research suggests that linguistic systems are likely to influence how individuals interpret information, evaluate alternatives, and make decisions in both personal and economic contexts. In particular, Kim et al. (2017) argue that language may exert a stronger influence on behaviour than many other societal forces, including religion, cultural norms, or formal institutions.

This perspective implies that linguistic characteristics can affect how individuals process information and form expectations about future outcomes. Consequently, if language shapes how people perceive and interpret their environment, it may also influence the decisions they make in economic and organisational settings. Within this broader framework, scholars have increasingly examined how linguistic differences influence perceptions of time and future

consequences. In particular, Dahl (2000) identifies a group of languages described as “futureless,” meaning that they do not require speakers to use explicit grammatical markers when referring to future events.

This linguistic feature is closely related to the concept of future-time reference (FTR), which captures the extent to which a language grammatically distinguishes between present and future actions. Languages differ considerably in this respect, as some require clear grammatical separation between present and future events, whereas others allow speakers to refer to future consequences using present-tense constructions.

These linguistic variations have important implications for how individuals perceive the temporal relationship between present actions and future consequences. When a language requires explicit grammatical markers for future events, the future may be perceived as more distant from the present. By contrast, when a language allows speakers to describe future implications using present-tense structures, the future may appear more closely connected to current decisions. As a result, the concept of future-time reference provides a useful framework for understanding how linguistic structures may influence individuals’ perceptions of time and their orientation toward long-term outcomes.

2.2.2 Future-Time Reference and Intertemporal Behaviour

Building on the concept of future-time reference, Chen (2013) distinguishes between weak-FTR and strong-FTR languages. In this classification, languages that do not require speakers to explicitly mark future events are described as *weak-FTR* (often referred to as “futureless” languages), while languages that require a clear grammatical distinction between present and future events are classified as *strong-FTR*. This distinction highlights an important linguistic characteristic that may affect how individuals perceive the temporal distance between present actions and long-term outcomes.

The classification of languages based on future-time reference is closely related to grammatical rules governing how future events are expressed. As noted by Thieroff (2000), languages differ in whether they require speakers to explicitly mark future actions or allow future references to remain unmarked. In strong-FTR languages, such as English, speakers are typically required to use specific grammatical constructions when referring to future events.

For example, when describing an event that will occur in the future, an English speaker might say, “I will go to the hospital tomorrow,” using an auxiliary verb to indicate the future tense. In contrast, in several weak-FTR languages, including Chinese, Japanese, and German, the same statement can be expressed without a dedicated grammatical marker for the future (Chen, 2013; He & Zhang, 2022). For instance, in Chinese the sentence may simply translate as “Tomorrow I go to the hospital,” where the timing of the event is inferred from context rather than explicitly marked by grammatical structure.

These linguistic differences shape the way individuals interpret the relationship between present actions and future consequences. In this context, Liang et al. (2018) argue that the way individuals refer to future events can shape their tendency to engage in forward-looking behaviour. When the future is linguistically linked more closely to the present, individuals may consider long-term outcomes as more immediate, potentially encouraging decisions that prioritise long-term benefits.

Consistent with this argument, Chen (2013) provides empirical evidence showing that speakers of weak-FTR languages are more likely to engage in future-oriented behaviours than speakers of strong-FTR languages. His findings indicate that individuals speaking weak-FTR languages tend to save more, accumulate greater retirement wealth, and exhibit higher national savings rates. Similar patterns are observed in health-related behaviour, where speakers of weak-FTR languages are more likely to adopt healthier lifestyles, including lower smoking rates and greater use of preventative health measures. Chen (2013) argues that these

behavioural differences arise because strong-FTR languages require speakers to linguistically separate the future from the present, which may lead individuals to evaluate future implications as more distant. As a result, future benefits may be discounted more heavily when decisions are made.

Further evidence supporting the influence of linguistic structures on behaviour emerges from studies examining intertemporal decision-making. Speakers of weak-FTR languages may view the future as more closely connected to the present because their language does not require a clear grammatical separation between present and future events. As a result, future outcomes may appear less distant, potentially encouraging greater patience and long-term orientation in decision-making.

Empirical support for this argument is provided by Sutter et al. (2015), who conduct a controlled intertemporal choice experiment involving primary school children in a northern Italian city where both German and Italian are widely spoken. German, a weak-FTR language, contrasts with Italian, which is classified as a strong-FTR language. Their findings indicate that German-speaking children are approximately 46 percent more likely to delay gratification than Italian-speaking children.

Importantly, these behavioural differences remain significant even after controlling for individual characteristics and family background. This evidence provides further support for Chen's (2013) linguistic savings hypothesis, which links linguistic structures to forward-looking behaviour. These findings suggest that linguistic structures may influence individuals' time preferences and intertemporal choices. In turn, such behavioural tendencies may also affect economic decision-making in organisational settings.

Despite the growing evidence supporting the relationship between future-time reference and future-oriented behaviour, this hypothesis has also received methodological criticism. Roberts et al. (2015) argue that languages should not be treated as statistically

independent observations because they often share common historical origins and geographical proximity. Consequently, the observed association between future-time reference and economic behaviour may partly reflect broader cultural and institutional characteristics that are transmitted alongside language rather than linguistic structure alone. After accounting for historical and geographical relatedness using several alternative approaches, they find that the relationship between future-time reference and future-oriented behaviour generally becomes weaker, although it remains reasonably robust across a number of specifications. Based on these findings, they recommend that evidence from cross-country linguistic studies should be interpreted with caution and complemented by research designs that provide stronger evidence on the underlying causal mechanism.

The present study recognises this methodological concern and seeks to address it through a comprehensive empirical design. Specifically, the analysis incorporates an extensive set of country-level institutional, legal, economic, cultural, and religious control variables to account for cross-country differences that may influence firms' environmental behaviour. In addition, the study conducts within-country analyses in multilingual settings, allowing firms operating within the same institutional environment but exposed to different linguistic structures to be compared. Although these approaches cannot fully eliminate the possibility that linguistic characteristics are correlated with broader historical and institutional environments, they help mitigate this concern and provide stronger evidence that the documented relationship is consistent with the proposed linguistic mechanism. The empirical strategy adopted in this study is discussed in detail in Section 2.4.

2.2.3 Linguistic Structures and Corporate Decision-Making

Building on these insights, recent research has begun to examine whether linguistic characteristics influence corporate decision-making. Extending Chen's (2013) framework to organisational settings, several studies suggest that the linguistic environment in which firms

operate may shape managerial attitudes toward long-term outcomes. For instance, Liang et al. (2018) find that firms located in countries where weak-FTR languages are predominant tend to adopt more forward-looking corporate policies. Specifically, these firms exhibit higher levels of corporate social responsibility (CSR) engagement and invest more heavily in research and development (R&D), both of which reflect a stronger emphasis on long-term value creation.

Similarly, S. Chen et al. (2017) document that firms operating in weak-FTR linguistic environments tend to hold larger precautionary cash balances compared with firms located in countries dominated by strong-FTR languages. This pattern suggests that managers in weak-FTR environments assign greater weight to future uncertainty and therefore adopt more conservative financial policies. Additional evidence is provided by Kim et al. (2017), who report that both accrual-based and real earnings management are less prevalent in countries where weak-FTR languages are spoken. Their findings indicate that managers in such environments may be less inclined to manipulate short-term financial results, possibly because they are more attentive to the long-term consequences of these actions.

Overall, these studies suggest that linguistic structures may influence not only individual behaviour but also corporate policies and financial practices. Firms operating in linguistic environments that emphasise stronger connections between present actions and future outcomes appear more likely to adopt strategies that prioritise long-term value creation and sustainable performance. Further evidence on the economic implications of linguistic structures can be found in studies examining corporate financial policies and investment decisions.

For instance, Kim et al. (2021) analyse the relationship between linguistic time encoding and firms' investment efficiency. Their findings indicate that firms located in countries where weak-FTR languages are spoken are less likely to experience underinvestment. Specifically, the probability of underinvestment is approximately six percent lower for firms

operating in weak-FTR linguistic environments compared with those in strong-FTR language settings. These results suggest that when the future is seen as more closely connected to present decisions, managers may be more inclined to undertake investments that generate long-term value.

Similarly, He and Zhang (2022) investigate how linguistic characteristics influence corporate dividend policies across international markets. Using a large cross-country sample of firms from 19 economies, the authors find that companies operating in weak-FTR language environments tend to distribute lower dividends than firms located in strong-FTR language countries. This pattern is consistent with the idea that firms in weak-FTR linguistic settings may place greater emphasis on future growth opportunities. Thus, managers may prefer to retain earnings to support long-term investment and strategic development rather than distribute a larger share of profits to shareholders in the short term.

2.2.4 Linguistic Characteristics and Corporate Environmental Behaviour

Despite growing evidence that linguistic characteristics influence corporate financial policies and managerial behaviour, relatively little attention has been devoted to their potential impact on firms' environmental decisions and carbon emission outcomes. This perspective is consistent with the theoretical argument advanced by Chen (2013), which suggests that speakers of weak-FTR languages tend to perceive the future as more closely linked to the present. When the temporal distance between current actions and future implications are perceived as closer, individuals may place greater weight on long-term effects in their decision-making.

In corporate settings, this behavioural tendency may encourage managers to adopt policies that prioritise long-term investment, financial flexibility, and sustainable growth. Consequently, linguistic characteristics may represent an important yet often overlooked factor influencing corporate financial policies and strategic decision-making. Because environmental

policies inherently involve trade-offs between immediate costs and long-term benefits, linguistic features that shape perceptions of long-term outcomes may play an important role in firms' environmental decisions. The following section develops the hypotheses and formalises the empirical predictions of the study.

2.3 Hypothesis Development

2.3.1 Linguistic Future-Time Reference and Corporate Carbon Emissions

Building on the argument that weak future-time reference (FTR) languages are associated with stronger future-oriented behaviour, this study examines whether linguistic structures influence firms' environmental decisions, particularly their commitment to reducing carbon emissions. Prior research suggests that the way languages encode future events can influence how individuals view the relationship between present actions and future consequences (Chen, 2013). When the future is perceived as more closely connected to the present, individuals may place greater weight on long-term consequences when making economic and strategic decisions.

Extending this idea to the corporate context implies that firms operating in weak-FTR linguistic environments may exhibit a stronger commitment to reducing environmental emissions in their production and operational activities than firms operating in strong-FTR language environments. Chen's (2013) linguistic-savings theory provides an important explanation for how linguistic structures may influence forward-looking behaviour. According to this framework, the relationship between language and future-oriented behaviour arises from two related mechanisms. The first mechanism relates to how linguistic structures influence perceptions of time, while the second mechanism concerns the accuracy with which individuals evaluate the timing of future events. Through these mechanisms, linguistic differences can affect how individuals assess the present value of future rewards and costs.

The first mechanism operates through differences in time perception, which can be interpreted in economic terms through the concept of the discount rate. Languages influence how individuals consider distant future events, which in turn affects the extent to which future consequences are discounted relative to present outcomes. Consider a firm adopting a strategy aimed at reducing carbon emissions in its production and operational activities. Although such a strategy may involve immediate costs, it generates future benefits, including improved environmental performance, reduced regulatory risk, and enhanced long-term sustainability.

If speakers of weak-FTR languages see long-term outcomes as more closely connected to present decisions, the perceived temporal distance between current actions and future benefits may be reduced. In economic terms, this implies a lower discount rate, which increases the observed present value of long-term environmental benefits. Consequently, strategies aimed at reducing carbon emissions may appear more attractive when long-term benefits are valued more strongly relative to current costs. Under such conditions, managers and investors operating in weak-FTR linguistic environments may place greater importance on initiatives that reduce environmental emissions and support long-term environmental sustainability.

In addition to the time-discounting mechanism discussed above, linguistic structures may influence forward-looking behaviour through differences in how individuals evaluate the timing of future benefits. Prior research suggests that weak-FTR languages can affect economic decisions by improving the perceived accuracy with which individuals assess future rewards (Chen, 2013). When the future is linguistically connected to the present, individuals may develop clearer expectations regarding the timing of future consequences, which may encourage decisions that favour long-term benefits over short-term gains.

Consistent with this argument, Kim et al. (2021) show that speakers of weak-FTR languages are more likely to undertake investment projects for a given level of financing cost. Their findings suggest that linguistic structures can influence investment behaviour by

affecting how decision-makers evaluate the timing and magnitude of future returns. Similarly, Kong et al. (2022) argue that the relationship between language and economic behaviour operates partly through the accuracy of beliefs regarding future consequences. When future rewards are perceived more clearly, the expected benefits of long-term investments may appear more valuable in present terms. In contrast, speakers of strong-FTR languages may perceive the future as more temporally distant from the present. This separation can reduce the perceived present value of long-term investments because future benefits may appear less certain or more remote. As a result, strong-FTR linguistic environments may weaken incentives to undertake activities whose benefits materialise primarily in the future.

Consistent with this view, empirical evidence indicates that individuals operating in weak-FTR linguistic environments tend to display stronger future-oriented behaviour than those in strong-FTR settings (Chen, 2013; Sutter et al., 2015). The linguistic literature also suggests that weak-FTR languages reduce the psychological distance between present and future events (Dahl, 2000; Thieroff, 2000). When individuals perceive the future as more closely connected to current decisions, they may be more cautious about actions that generate undesirable long-term consequences. This behavioural tendency may be particularly relevant in the context of environmental decisions, where the benefits of current actions often materialise only in the distant future.

In recent years, awareness of climate-related risks has increased significantly among investors, regulators, and policymakers. Numerous international and national initiatives have been introduced to address climate change and encourage economic actors to support the transition toward a low-carbon economy (Tanthanongsakkun et al., 2023). As a result, firms are increasingly exposed to economic and regulatory pressures related to their environmental performance. Prior research shows that high levels of carbon emissions can impose substantial costs on firms. For example, companies may face carbon taxes or emissions trading obligations,

which increase operating costs and reduce firm value (Chapple et al., 2013; Clarkson et al., 2015; Griffin et al., 2017; Luo & Tang, 2014; Matsumura et al., 2014). In addition, carbon-intensive firms may experience higher energy and input costs, greater regulatory scrutiny, reputational risks, supply chain disruptions, and operational challenges.

Given these potential consequences, firms increasingly have incentives to reduce their environmental impact and adopt cleaner production technologies. However, decisions related to environmental investments often involve significant short-term costs while generating benefits that arise gradually over time. Consequently, managers' willingness to undertake emission-reduction strategies may depend on how strongly they value long-term benefits relative to present costs. If linguistic structures influence how decision-makers perceive the timing and importance of future consequences, language may also shape firms' environmental behaviour. Collectively, these arguments suggest that firms operating in weak-FTR linguistic environments may place greater emphasis on long-term environmental outcomes and therefore be more inclined to adopt strategies aimed at reducing carbon emissions.

In addition to influencing how decision-makers evaluate future rewards, linguistic structures may also shape attitudes toward the long-term risks associated with carbon-intensive activities. Climate-related risks have become increasingly relevant for firms as environmental concerns intensify worldwide. Physical climate hazards, such as extreme weather events, may damage infrastructure and production facilities, leading to significant repair and reconstruction costs. At the same time, firms with high carbon emissions may face additional financial pressures arising from stricter environmental regulations, potential legal liabilities, and reputational consequences associated with climate change (Jung et al., 2018; Luo & Tang, 2014). These factors indicate that carbon-intensive activities can impose substantial costs on firms and may negatively affect their financial performance.

Conversely, firms that successfully reduce their carbon emissions may experience a range of economic benefits. Improving environmental performance can enhance corporate reputation, facilitate compliance with environmental regulations, and improve access to markets that increasingly favour sustainable business practices. In addition, firms that adopt cleaner production technologies may benefit from greater operational efficiency and improved relationships with stakeholders, including investors, customers, and employees. As global attention to climate change continues to increase, businesses that align their strategies with environmental sustainability may also gain access to new market opportunities and consumer segments that value environmentally responsible products and services.

These considerations are particularly important for firms operating in industries characterised by high carbon intensity. As the global economy gradually transitions toward cleaner energy and more sustainable production systems, firms that fail to adapt to these changes may face declining competitiveness. In contrast, firms that proactively reduce emissions and invest in environmentally friendly technologies may strengthen their long-term growth prospects and maintain their relevance in evolving markets.

Linguistic structures may influence how managers and investors respond to these environmental challenges. As discussed earlier, speakers of weak-FTR languages tend to apply a lower discount rate when evaluating future outcomes. Consequently, the long-term benefits associated with environmental improvements may be valued more strongly relative to their short-term costs. This mechanism may encourage decision-makers operating in weak-FTR linguistic environments to support investments in cleaner technologies and emission-reduction strategies. In contrast, decision-makers in strong-FTR linguistic environments may perceive future environmental consequences as more distant, which may weaken incentives to undertake costly environmental initiatives in the present.

Combining these two mechanisms, the first operating through the discount rate channel and the second through attitudes toward the negative future consequences of carbon-intensive business decisions, linguistic structures may influence firms' incentives to undertake emission-reduction strategies. Firms operating in weak-FTR linguistic environments are therefore more likely to prioritise long-term environmental outcomes and adopt strategies aimed at reducing carbon emissions. Consequently, such firms are more inclined to invest in sustainable technologies and improve their environmental performance. Based on this reasoning, I propose the following hypothesis:

H1: Firms operating in countries with weak future-time reference (FTR) languages exhibit lower levels of carbon emissions than firms operating in countries with strong FTR languages.

2.3.2 The Moderating Role of Globalisation

Globalisation may influence the extent to which linguistic structure affects firms' environmental behaviour. Firms operating in highly globalised countries are exposed to international investors, customers, regulations, and sustainability standards. As noted by Kong et al. (2022), globalisation facilitates interactions among individuals from different linguistic and cultural backgrounds, encouraging adaptation to diverse cognitive and linguistic environments. Similarly, Liang et al. (2018) argue that firms operating in more globalised economies are more frequently exposed to international partners and multilingual interactions, reducing reliance on a single linguistic framework when making strategic decisions.

As firms become more internationally connected, external market pressures, international sustainability standards, and global environmental expectations may reduce the influence of domestic linguistic characteristics on managerial decision-making. Consequently, the effect of linguistic future-time reference on corporate carbon emissions is expected to become weaker in more globalised countries. Based on this reasoning, I propose the following hypothesis:

H2: The negative relationship between weak future-time reference (FTR) language and corporate carbon emissions is weaker in countries with higher levels of globalisation.

2.3.3 The Moderating Role of Individualism

Individualism may also moderate the relationship between linguistic structure and corporate carbon emissions. The distinction between individualism and collectivism represents one of the most important dimensions of national culture influencing economic and corporate behaviour (Guiso et al., 2006; Heine, 2010). As discussed by Liang et al. (2014), individualistic societies place greater emphasis on personal autonomy and independent decision-making, whereas collectivist societies place greater importance on shared values and collective welfare. These cultural differences may also influence firms' environmental decisions and the extent to which linguistic structures shape managerial behaviour.

Prior studies suggest that individuals in more individualistic societies exhibit lower concern for environmental issues and are less likely to engage in environmentally responsible behaviour (Kormos & Gifford, 2014; Schultz & Zelezny, 2003). Consequently, the future-oriented cognitive effects associated with weak-FTR languages may be less pronounced in highly individualistic countries, where managers place greater emphasis on firm-specific objectives than on broader collective outcomes. Based on this reasoning, I propose the following hypothesis:

H3: The negative relationship between weak future-time reference (FTR) language and corporate carbon emissions is weaker in countries with higher levels of individualism.

2.4 Sample, Variables, and Empirical Design

This section outlines the sample construction, variable definitions, and empirical strategy. It begins with the sample selection, followed by a discussion of the dependent and independent variables, control variables, and summary statistics, and concludes with the empirical model specification.

2.4.1 Sample

Table 2.1 reports the distribution of firm-year observations across countries, together with the dominant language in each country and its classification into strong or weak future-time reference (FTR) categories. The country-language assignment follows Chen's (2013) country-level classification, with each country assigned its dominant language for the empirical analysis. For multilingual countries, a single dominant language is therefore used consistently to construct the country-level FTR indicator, rather than languages used in particular settings such as corporate communication or financial reporting. The final sample comprises 14,301 firm-year observations drawn from 33 countries over the period 2001–2021. The panel is unbalanced, reflecting differences in data availability across firms and over time.

The distribution of observations indicates a predominance of firms from strong-FTR countries, which account for 9,431 observations (66% of the sample), while weak-FTR countries account for the remaining 4,870 observations (34%). This variation across linguistic environments offers a suitable empirical setting to identify the effect of linguistic structure on corporate carbon emissions. Despite this imbalance, both linguistic groups are well represented, providing sufficient variation for reliable empirical identification. Importantly, the empirical specification incorporates a comprehensive set of country-level controls, together with industry and year fixed effects, to account for relevant sources of heterogeneity, and the robustness analysis further examines subsamples to mitigate potential concerns regarding the dominance of strong-FTR countries.

At the country level, the United States accounts for the largest share of observations (3,493), followed by the United Kingdom (1,988) and Japan (1,424). In contrast, countries such as Ireland and Peru contribute relatively few observations. Overall, the sample provides broad coverage across different linguistic and institutional contexts, supporting the empirical analysis of the relationship between linguistic structure and corporate carbon emissions.

Firm-level financial data are obtained from the Refinitiv Worldscope database, which provides comprehensive coverage of accounting and market data for publicly listed firms across a wide range of countries. To ensure comparability, all financial variables are expressed in U.S. dollars. In addition, data on corporate carbon emissions are sourced from the Refinitiv Environmental, Social, and Governance (ESG) database, formerly known as Thomson Reuters Asset4.

This dataset provides detailed firm-level environmental indicators and is widely used in sustainability and corporate finance research. It reports greenhouse gas emissions in accordance with the Greenhouse Gas Protocol (GGP), an internationally recognised standard for measuring and reporting corporate emissions. Carbon emissions are measured as total greenhouse gas emissions in tonnes of carbon dioxide equivalent (MtCO₂e) on an annual basis. This measure reflects firms' overall environmental footprint.

2.4.2 Dependent Variable: Carbon Emissions

The dependent variable is the natural logarithm of firm-level carbon emissions scaled by revenue. In the main specification, emissions are measured as total Scope 1 and Scope 2 emissions divided by firm revenue. Scaling emissions by revenue facilitates meaningful comparisons across firms of different sizes by capturing carbon intensity rather than absolute emission levels. Consistent with prior studies (Altunbas et al., 2022; Benlemlih et al., 2023), the baseline analysis employs the natural logarithm of the CO₂/Revenue ratio because the emissions ratio is highly positively skewed. The logarithmic transformation reduces skewness, produces a more symmetric distribution, mitigates the influence of extreme observations, and better satisfies the assumptions underlying linear regression analysis. As an additional robustness check, the analysis is also re-estimated using the CO₂/Revenue ratio in levels.

Data on corporate carbon emissions are obtained from Refinitiv Eikon, which reports firm-level greenhouse gas emissions measured in tonnes of carbon dioxide equivalent. The

dataset follows the standards established by the Greenhouse Gas Protocol (GGP), an internationally recognised framework for measuring and reporting greenhouse gas emissions. The GGP classifies emissions into three categories according to their source and the extent of firms' operational control.

First, Scope 1 emissions refer to direct emissions generated from sources owned or controlled by the firm. These emissions primarily arise from production activities and the combustion of fossil fuels within company facilities. Second, Scope 2 emissions capture indirect emissions associated with the generation of purchased electricity, heat, or steam consumed by the firm. Finally, Scope 3 emissions represent indirect emissions generated along the firm's broader value chain. These include emissions produced during the manufacturing of purchased inputs, the use of sold products, waste disposal, and other outsourced activities that occur outside the firm's direct operational control (Bolton & Kacperczyk, 2021).

In this study, carbon emissions are examined over the period from 2001 to 2021. Consistent with prior research (Altunbas et al., 2022; Benlemlih & Yavaş, 2023), the analysis focuses on company-level emissions measured through Scope 1 and Scope 2 indicators. Using these two categories provides a more precise measure of firms' environmental impact, as they capture emissions directly generated or closely linked to operational activities.

Moreover, employing firm-level emission measures allows the analysis to exploit greater variation in carbon emissions across companies compared with aggregated environmental indices or broader carbon performance metrics used in earlier studies. In contrast, Scope 3 emissions are not included in the analysis. These emissions originate from activities across the supply chain and therefore fall outside the firm's direct control. As a result, they are often difficult to measure accurately, and their reporting quality may vary substantially across firms and countries.

Following previous studies (Benlemlih & Yavaş, 2023; Busch & Lewandowski, 2018; Matisoff et al., 2013), excluding Scope 3 emissions helps improve the reliability and comparability of the emission data used in the empirical analysis. Unlike prior studies that rely on country-level emissions or aggregate environmental indicators, this study employs firm-level emission data, allowing for a more granular analysis of corporate environmental behaviour. In accordance with the Greenhouse Gas Protocol, the emission measures used in this study incorporate several greenhouse gases expressed in carbon dioxide equivalent terms. These gases include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorinated compounds (PFCs), sulphur hexafluoride (SF₆), and nitrogen trifluoride (NF₃) (Benlemlih & Yavaş, 2023). Converting these gases into a common CO₂-equivalent metric ensures a consistent assessment of firms' total greenhouse gas emissions across the sample.

2.4.3 Independent Variable: Future-Time Reference (FTR)

The key explanatory variable, Weak-FTR, is a binary indicator equal to one if a firm operates in a country where a weak future-time reference (FTR) language is spoken, and zero otherwise (Chen, 2013). Information on linguistic time encoding is drawn from the European Science Foundation's Typology of Languages in Europe (EUROTYP) project. As noted by Chen (2013), EUROTYP represents one of the most comprehensive typological research programmes on cross-linguistic grammatical structures, including how languages encode references to future events.

The project involved approximately one hundred linguists over a five-year period between 1990 and 1994, and its detailed report on tense and aspect spans more than 800 pages. Drawing on the EUROTYP classification, Chen (2013) further extends the categorisation to include non-European languages not covered by the original project. Following Chen (2013), languages are classified according to their FTR into either weak-FTR or strong-FTR categories.

Weak-FTR languages do not require speakers to grammatically mark future events in prediction contexts, whereas strong-FTR languages typically require explicit grammatical markers when referring to future outcomes (Kim et al., 2021). This distinction reflects the extent to which languages grammatically separate present actions from future events.

Consistent with Chen (2013) and Liang et al. (2018), the linguistic classification is based on the dominant language of the country in which a firm's headquarters is located. The country-language assignment follows Chen's (2013) country-level coding, with each country assigned a single dominant language for constructing the FTR indicator. For multilingual countries, the dominant-language assignment is applied consistently rather than using languages employed in particular settings, such as corporate communication or financial reporting. This approach serves as a proxy for the broader linguistic environment in which firms operate and has been widely adopted in the literature examining the economic consequences of future-time reference. Although multinational firms may use English or other languages in corporate communication and financial reporting, the headquarters-country language provides a consistent proxy for the broader linguistic and institutional environment in which firms operate.

Nevertheless, this measure may not fully capture the language used by individual managers or in corporate disclosures. A CEO-native-language measure could not be constructed because reliable data on CEOs' ancestry and native linguistic backgrounds are not available for the international sample used in this study. Future research with access to such information could further strengthen the identification of the proposed linguistic mechanism by examining managers' native languages or the language used in corporate disclosures. In addition to this categorical classification, Chen (2013) proposes two quantitative measures of future-time reference based on a word-frequency analysis of weather forecasts collected from

online sources. The first measure, referred to as the sentence ratio, captures the proportion of sentences with explicit future-tense marking relative to all weather-related sentences.

The second measure, known as the verb ratio, captures the proportion of verbs that are grammatically marked for future tense relative to the total number of verbs in the sample. To ensure consistency with the interpretation of weak-FTR languages, both measures are multiplied by negative one so that higher values indicate weaker future-time reference. In this study, these two indicators are employed as alternative measures of linguistic future-time reference to assess the robustness of the main results.

2.4.4 Control Variables

To isolate the relationship between linguistic structures and corporate carbon emissions, I incorporate a comprehensive set of firm-level and country-level control variables. Consistent with prior literature on corporate environmental performance (Altunbas et al., 2022; Benlemlih & Yavaş, 2023), I include these controls to account for factors that may affect firms' emission levels.

At the firm level, I include several characteristics related to firms' financial condition and investment behaviour. Firm size is measured as the natural logarithm of total assets and reflects differences in organisational scale and resource availability. Larger firms often face greater regulatory scrutiny and public attention regarding their environmental impact, which may influence their carbon emission levels. Growth opportunities are proxied by the natural logarithm of Market to Book, which reflects market expectations regarding firms' future prospects. Financial leverage is measured as the ratio of total debt to total assets and represents firms' capital structure and associated financial risk.

I also control for firms' operating performance and financial condition. Profitability is measured using return on assets (ROA), while a loss indicator variable equals one if a firm reports negative earnings and zero otherwise. In addition, financial slack is measured as the

ratio of cash holdings to property, plant, and equipment and reflects the availability of internal resources that may support investment in environmental initiatives.

To account for firms' investment activity, I include capital expenditures scaled by total assets and research and development expenditures scaled by total assets. These variables represent firms' investment in physical capital and innovation, both of which may influence environmental performance and emission levels. In addition to firm-level characteristics, I include several country-level variables that account for macroeconomic, institutional, and cultural conditions that may influence corporate environmental behaviour. Macroeconomic conditions are proxied by GDP growth and financing conditions obtained from the World Bank.

Institutional quality is measured using several indicators drawn from Porta et al. (1998) and La Porta et al. (1999), including creditor rights, ownership concentration, legal enforcement, and legal origin variables such as a residualised measure of English common law (orthogonalized) alongside French legal origin. Following Liang et al. (2018), the English common-law indicator is first regressed on FTR, and the residual from this regression is included in the main specification. This residual captures the variation in legal origin that is not explained by linguistic structure, allowing the analysis to isolate its independent effect.

The inclusion of these institutional variables is particularly important because previous research has argued that linguistic characteristics may be correlated with broader historical and institutional environments. Roberts et al. (2015) demonstrate that languages often share common historical origins and geographical proximity, which may give rise to spurious correlations if such factors are not adequately considered. Therefore, controlling for legal origin and institutional quality helps mitigate the possibility that the estimated relationship between future-time reference and corporate carbon emissions merely reflects cross-country institutional differences rather than linguistic structure itself. These variables reflect cross-

country variation in legal frameworks and governance arrangements, which can shape corporate accountability and the effectiveness of regulatory enforcement.

In addition to legal institutions, the analysis incorporates a broad set of country-level economic, cultural, and religious characteristics to further reduce potential omitted variable bias. These variables reflect cross-country differences that may influence firms' environmental behaviour independently of linguistic structure. Although these controls cannot fully eliminate the possibility that language is correlated with deeper historical and cultural characteristics, they substantially reduce this concern by accounting for important institutional, economic, and cultural differences across countries. Together, these variables help isolate the relationship between linguistic future-time reference and corporate carbon emissions by accounting for other country-specific characteristics that may influence firms' environmental performance.

Cultural characteristics are measured using the dimensions developed by Hofstede and Hofstede (2001), including individualism, power distance, masculinity, uncertainty avoidance, and long-term orientation. These variables reflect societal values that may influence corporate attitudes toward environmental responsibility. I also include the linguistic diversity index provided by Rivière (2009) to account for differences in linguistic environments across countries. In addition, the KOF Globalisation Index developed by the Eidgenössische Technische Hochschule (ETH) Zürich (Gygli et al., 2018) is included to measure the degree of economic integration and global connectivity across countries.

Finally, I include the ESG score obtained from the Refinitiv ESG database to control for firms' overall environmental, social, and governance performance. Consistent with Tanthanongsakkun et al. (2023), this variable helps mitigate potential confounding effects, as it incorporates information related to carbon emissions. I also control for religious composition, measured by the proportions of Catholic and Muslim populations, following La Porta et al. (1999), as cultural and religious norms may influence environmental attitudes and corporate

behaviour. Together, these control variables provide a comprehensive framework for identifying the relationship between linguistic future-time reference and corporate carbon emissions, while helping to mitigate potential omitted variable bias.

2.4.5 Summary Statistics

Table 2.2 presents descriptive statistics for the variables employed in the regression analysis. The dependent variable, defined as the natural logarithm of carbon emissions scaled by revenue, exhibits a mean of -9.905 and a median of -10.080 , with a standard deviation of 1.990 . The interquartile range extends from -11.180 to -8.527 , indicating substantial variation in firms' carbon intensity. Importantly, the negative values reflect the logarithmic transformation rather than negative emission levels. As noted by Benlemlih and Yavaş (2023), such transformations are commonly used to reduce skewness and facilitate interpretation. In this context, the mean value implies that carbon emissions represent a relatively small proportion of firm revenue when expressed in levels.

Table 2.2 also reports descriptive statistics for the alternative carbon emissions measures used in the robustness analyses. $\text{Log}(\text{CO}_2)$, which captures firms' absolute carbon emissions, has a mean of 12.560 , a median of 12.470 , and a standard deviation of 2.533 , indicating considerable variation in absolute emissions across firms. $\text{Log}(\text{CO}_2/\text{Assets})$ has a mean of -10.540 and a standard deviation of 2.462 , while $\text{Log}(\text{CO}_2/\text{Market Cap})$ has a mean of -10.180 and a standard deviation of 2.373 . These measures capture carbon emissions relative to firms' asset base and market valuation, respectively. The Refinitiv Emissions Score has a mean of 38.560 , a median of 34.920 , and a relatively large standard deviation of 34.400 , indicating substantial variation in firms' environmental performance across the sample. Taken together, these alternative measures capture different dimensions of corporate carbon emissions and provide complementary measures for assessing the robustness of the baseline findings.

Turning to country-level characteristics, the indicator for weak future-time reference (Weak-FTR) has a mean of 0.341 and a median of zero, suggesting that the majority of observations are drawn from strong-FTR linguistic environments. This pattern is consistent with the percentile distribution, where the 25th percentile equals zero and the 75th percentile equals one. In addition, macroeconomic conditions, proxied by GDP growth, display moderate dispersion, with a mean of 1.961 and a standard deviation of 1.865. Similarly, the financing condition index shows considerable variation across countries, reflecting differences in financial development and access to capital. The creditor rights index has an average value of 1.994, indicating moderate levels of investor protection within the sample. These statistics highlight meaningful cross-country differences, which is important for identifying the impact of linguistic structure on corporate environmental outcomes.

With respect to national culture, the measures developed by Hofstede and Hofstede (2001) indicate substantial cross-country variation in cultural dimensions. The power distance index has a mean of 47.360, implying that firms in the sample operate across countries with differing degrees of hierarchical structure. Similarly, the masculinity index, which captures the extent to which societies emphasise achievement, competitiveness, and traditional gender roles (Hofstede & Hofstede, 2001), has a mean value of 58.420, which reflects that firms operate in environments characterised by moderate levels of masculinity.

In addition, uncertainty avoidance has a mean of 58.260, reflecting moderate variation in societies' tolerance for uncertainty and risk. In contrast, individualism displays a relatively high mean of 68.070, suggesting that a large proportion of firms operate in countries where individualistic values are prevalent. Long-term orientation, with an average value of 50.940, indicates a balanced tendency between short-term and long-term perspectives across the sample. Overall, these statistics highlight substantial differences in cultural environments,

consistent with the framework developed by Hofstede and Hofstede (2001), and underscore the relevance of cultural factors in shaping corporate behaviour.

Turning to broader institutional and macroeconomic characteristics, the globalisation index has a mean of 81.550, indicating that firms are predominantly located in highly integrated economies. At the same time, the linguistic diversity index, with a mean of 0.280, reflects variation in the degree of language fragmentation across countries. ESG performance exhibits a mean of 59.800, suggesting a moderate level of engagement in sustainable practices, with the associated dispersion indicating that firms differ considerably in their environmental and social performance. Ownership concentration averages 0.313, pointing to moderately concentrated ownership structures, while legal enforcement has a mean of 8.674, reflecting relatively strong institutional quality in many sample countries.

Regarding legal and religious characteristics, the residualised English common law variable is centred around zero, which is consistent with its orthogonalised construction. French legal origin has a mean of 0.201, indicating that a notable share of observations is drawn from civil law systems. In addition, the distribution of religious affiliation shows considerable variation, with Catholic representation averaging 31.030 and Muslim representation remaining relatively low on average.

At the firm level, the descriptive statistics reveal substantial heterogeneity in financial characteristics. Firm size, measured as the logarithm of total assets, has a mean of 23.230, indicating that the sample is composed primarily of relatively large firms. Leverage averages 0.263, while profitability, proxied by return on assets, has a mean of 0.048, suggesting modest but positive performance. Approximately 9.9% of firm-year observations report losses, which is consistent with prior evidence in the corporate finance literature. Measures of financial flexibility and investment also display notable dispersion, as reflected in the variation in slack, capital expenditure, and research and development intensity.

Overall, the descriptive statistics reveal considerable dispersion across cultural, institutional, and firm-level dimensions. This diversity provides a strong empirical setting for examining the relationship between linguistic structure and corporate carbon emissions and offers important preliminary insights for the subsequent analysis.

2.4.6 Empirical Design

To examine the relationship between linguistic structures and corporate carbon emissions, I estimate ordinary least squares (OLS) regressions with industry and year fixed effects using a firm-level panel dataset covering 33 countries over the period 2001–2021. Building on the variable definitions described above, the following model is estimated to assess this relationship. Industry fixed effects control for structural differences across industries, while year fixed effects capture macroeconomic conditions and regulatory developments that may affect firms' environmental outcomes over time.

Standard errors are clustered at the firm level to account for heteroskedasticity and potential serial correlation within firms over time. This specification enhances the reliability of the estimates by mitigating concerns related to omitted variable bias and ensuring robust statistical inference. All continuous variables are winsorised at the 1st and 99th percentiles, following standard practice in the literature, to reduce the influence of extreme observations. The empirical specification examines whether firms operating in weak-FTR linguistic environments exhibit different levels of carbon emissions compared with firms in strong-FTR environments. The unit of analysis is the firm-year observation, with linguistic variables assigned at the country level. Linguistic structure is largely predetermined and evolves slowly over time, making it unlikely to be influenced by firm-level environmental decisions.

The model relates firms' carbon emissions to the linguistic characteristics of the country in which they operate, while controlling for relevant firm- and country-level factors that may also shape environmental performance. A key identification assumption is that linguistic

structure, as captured by FTR, is largely predetermined and evolves slowly over time, rendering it plausibly exogenous to contemporaneous firm-level environmental decisions and mitigating concerns related to reverse causality.

The baseline empirical specification is defined as follows:

$$\text{LogCO}_{2i,t} = \alpha + \beta_1 \text{WeakFTR}_c + \sum \delta \cdot X_{i,t} + \mu_j + \lambda_t + \epsilon_{i,t}$$

where $\text{LogCO}_{2i,t}$ represents the natural logarithm of firm-level carbon emissions for firm i in year t . In the baseline specification, carbon emissions are measured as total Scope 1 and Scope 2 emissions scaled by firm revenue using data obtained from Refinitiv. Scope 1 emissions refer to direct greenhouse gas emissions generated from sources owned or controlled by the firm, typically arising from fossil fuel consumption during production processes.

Scope 2 emissions capture indirect emissions associated with the firm's consumption of purchased electricity, heat, or steam from external energy providers (Altunbas et al., 2022). The key explanatory variable, WeakFTR_c , is an indicator variable equal to one if the dominant language spoken in country c is classified as a weak future-time reference language and zero otherwise (Chen, 2013). Weak-FTR languages do not require speakers to grammatically distinguish between present and future events, which may guide how individuals and organisations perceive future outcomes. In a corporate context, this linguistic characteristic may shape managerial attitudes toward long-term environmental consequences.

To account for other factors that may affect firms' environmental behaviour, I include a comprehensive set of firm-level and country-level control variables. The vector $X_{i,t}$ denotes these control variables. At the firm level, I control for firm size measured as the natural logarithm of total assets, leverage defined as total debt divided by total assets, the logarithm of Market to Book capturing firms' growth opportunities, return on assets reflecting firm profitability, a loss indicator identifying firms reporting negative earnings, financial slack measured as the ratio of cash holdings to property, plant, and equipment, capital expenditures

scaled by total assets, and research and development intensity measured as research and development expenditures relative to total assets.

In addition, I include several country-level variables that capture macroeconomic conditions, institutional environments, and cultural characteristics that may affect corporate environmental behaviour. These variables include GDP growth, financing conditions, creditor rights, globalisation measured using the KOF Globalisation Index, linguistic diversity, ownership concentration, legal enforcement, legal origin indicators, religious composition, and cultural dimensions such as individualism, power distance, masculinity, uncertainty avoidance, and long-term orientation.

I also include the ESG score obtained from Refinitiv to control for firms' overall environmental, social, and governance performance and to mitigate potential confounding effects. The terms μ_j and λ_t denote industry and year fixed effects, respectively. Industry fixed effects control for structural differences across industries, while year fixed effects reflect macroeconomic conditions and regulatory developments that may influence firms' environmental performance over time. The error term $\varepsilon_{i,t}$ captures unobserved factors not explained by the model.

Consistent with the hypothesis that weak-FTR linguistic environments are associated with stronger future-oriented behaviour, the coefficient β_1 is expected to be negative. This prediction aligns with the theoretical argument that weak-FTR languages strengthen the perceived connection between present and future outcomes, encouraging firms to place greater weight on long-term environmental consequences. A negative coefficient would indicate that firms operating in countries where weak-FTR languages are spoken tend to exhibit lower levels of carbon emissions compared with firms located in strong-FTR linguistic environments.

2.5 Empirical Results

Table 2.3 reports the empirical results examining the relationship between linguistic structures and corporate carbon emissions. In this section, I evaluate both the statistical significance and economic implications of weak future-time reference (FTR) language for firms' environmental performance. I employ high-dimensional fixed-effects regressions that incorporate industry and year fixed effects, with standard errors clustered at the firm level to account for within-firm correlation over time.

In Column (1), I present the baseline specification including firm-level control variables. I find a negative and statistically significant relationship between Weak-FTR and firm carbon emissions (-0.131 , $p < 0.05$), indicating that firms operating in weak-FTR linguistic environments tend to generate lower levels of carbon emissions. This finding provides initial evidence that linguistic structures are associated with firms' environmental behaviour.

In Column (2), I extend the analysis by incorporating country-level characteristics. The coefficient on Weak-FTR remains negative and becomes larger in absolute magnitude (-0.528 , $p < 0.01$), indicating a stronger relationship after accounting for broader institutional and macroeconomic factors. Since Weak-FTR is a binary indicator and the dependent variable is expressed in natural logarithms, the economic effect is calculated as $100 \times [\exp(-0.528) - 1]$, which indicates that, holding other factors constant, firms operating in weak-FTR linguistic environments exhibit approximately 41.0% lower carbon emissions relative to revenue than comparable firms operating in strong-FTR environments.

For comparison, French Legal Origin, another country-level binary variable included in Column (2), has a coefficient of 0.049, corresponding to an approximate 5.0% difference [$100 \times (\exp(0.049) - 1)$], although this coefficient is not statistically significant. The magnitude of the Weak-FTR effect is therefore economically substantial relative to this comparable

country-level indicator. This finding is consistent with Kim et al. (2021), who argue that weak-FTR languages encourage more future-oriented corporate behaviour.

Overall, I find strong support for the hypothesis that linguistic structure influences corporate environmental performance. These findings are consistent with the view that weak-FTR languages encourage greater future-oriented behaviour, leading firms to place more emphasis on long-term environmental outcomes. This interpretation is aligned with Kim et al. (2021), who show that firms operating in weak-FTR linguistic environments exhibit more forward-looking investment behaviour and lower underinvestment. The model also exhibits strong explanatory power, with an R-squared of 0.566, indicating that the included variables explain a substantial proportion of the variation in firm-level carbon emissions.

I now turn to the control variables reported in Table 2.3, focusing on the full specification presented in Column (2). Overall, I find that the control variables are broadly consistent with prior expectations and provide additional insight into the determinants of firm-level carbon emissions. The results show that firm size is positive and statistically significant at the 1% level in both specifications, indicating that larger firms tend to generate higher levels of carbon emissions. This is consistent with the scale effect, whereby firms with greater operational capacity and production intensity produce more emissions (Haque, 2017; Liu et al., 2021).

Leverage is positive and statistically significant, indicating that firms with higher debt levels exhibit greater carbon intensity. This finding supports the view that financially constrained firms may face difficulties in adopting cleaner technologies or undertaking long-term investments, consistent with evidence that financial constraints influence firms' investment behaviour (Kim et al., 2021).

In contrast, I document a negative and statistically significant coefficient on Market to Book, implying that firms with stronger growth opportunities tend to exhibit lower emissions.

Profitability, measured by ROA, is negatively related to emissions and becomes statistically significant in Column (2). This suggests that more profitable firms are better positioned to undertake investments in environmentally sustainable production (De Villiers et al., 2011). I further find that the coefficient on the loss indicator is positive and statistically significant, implying that firms experiencing financial distress tend to generate higher emissions. This may reflect operational inefficiencies or the reduced ability to prioritise environmental initiatives under adverse conditions (Halldórsson & Kovács, 2010).

By contrast, I find that financial slack is negative and statistically significant, suggesting that firms with greater liquidity are better able to support environmentally friendly investments. This finding is consistent with the view that internal financial flexibility facilitates sustainability-related activities (Blanco, 2022). I also find that capital expenditure is positive and statistically significant, indicating that higher investment in physical assets is associated with increased carbon emissions, consistent with prior evidence (Benlemlih & Yavaş, 2023). However, I do not find a statistically significant relationship between R&D intensity and emissions.

At the country level, I find that financing condition is negative and statistically significant, indicating that improved access to finance may enable firms to reduce emissions through investment in cleaner technologies. I also find that Catholic religion is negatively associated with emissions, implying that social norms and cultural values may play an important role in shaping environmental behaviour.

I further document that several institutional and cultural variables exhibit meaningful relationships. Linguistic diversity and ESG score are both positive and statistically significant, which may reflect differences in disclosure intensity and reporting practices rather than lower underlying emissions. I also find that ownership concentration is positive and significant, indicating that more concentrated ownership structures are associated with higher carbon

intensity. In addition, legal enforcement and English common law (orthogonalized) origin display positive but weaker effects, suggesting that institutional frameworks may influence environmental outcomes, although the evidence is less pronounced.

With respect to cultural dimensions, individualism is negatively and significantly associated with emissions, whereas masculinity is positively related to carbon intensity. These findings suggest that cultural values shape firms' environmental behaviour in systematic ways. I also find that long-term orientation is negatively associated with emissions and marginally significant, consistent with the idea that more future-oriented societies place greater emphasis on environmental sustainability. Overall, the evidence strongly supports the role of linguistic structure, as an informal institutional factor, in shaping corporate environmental performance.

2.6 Robustness Checks

To further validate the baseline findings and ensure that the estimated relationship is not driven by sample composition, measurement choices, including alternative transformations of the dependent variable, or model specification, I conduct a comprehensive set of robustness tests. These tests address potential concerns related to cross-country heterogeneity, measurement error in the linguistic variable, and alternative definitions of environmental performance. The results, reported in Table 2.4, consistently support the baseline findings across a wide range of specifications and identification strategies.

2.6.1 Sample Composition: Excluding Dominant Countries

Panel A examines whether the baseline findings are driven by countries that account for a large share of the sample. As shown in Table 2.1, the United States and the United Kingdom together represent a substantial proportion of the observations, accounting for 5,481 firm-year observations (38.33% of the total sample). Since both countries are classified as strong-FTR environments, their dominance may influence the estimated relationship.

To address this concern, I re-estimate the empirical model after sequentially excluding these countries from the sample. Column (1) presents the results after removing U.S. firms, while Column (2) reports the estimates after excluding firms from both the United States and the United Kingdom. The estimates are consistent across both specifications. The coefficient on Weak-FTR continues to be negative and statistically significant at the 1% level, with a magnitude closely aligned with that obtained in the baseline analysis. This stability indicates that the estimated relationship is not sensitive to the inclusion of firms from these large economies.

In addition, as a further robustness check, I re-estimate the model after excluding Japan, which represents the largest weak-FTR country in the sample. The findings are qualitatively unchanged, with the coefficient on Weak-FTR continuing to be negative and statistically significant. For brevity, these additional estimates are not tabulated but are available upon request. The findings suggest that the negative association between weak-FTR linguistic environments and corporate carbon emissions reflects a general pattern in the data rather than being driven by a small number of dominant countries.

2.6.2 Linguistic Heterogeneity within Countries

Panel B of Table 2.4 presents the regression results after excluding firms from countries where both strong and weak FTR languages are spoken by a substantial share of the population. This test addresses a potential measurement concern arising from the construction of the FTR variable. Specifically, assigning a single linguistic classification at the country level may introduce noise when firms operate in environments characterised by linguistic heterogeneity, where both language types coexist.

While several countries in the sample are multilingual, in most cases the languages spoken within a country are relatively homogeneous in terms of their FTR structure. For example, South Africa predominantly uses strong-FTR languages, whereas Finland is

characterised by weak-FTR languages such as Finnish and Swedish, and Canada largely uses strong-FTR languages such as English and French. In these cases, the country-level classification is unlikely to introduce significant measurement error. However, a small number of countries exhibit substantial linguistic diversity in which both strong and weak FTR languages are spoken by a meaningful share of the population.

Following Kim et al. (2021), I identify six countries that meet this criterion, including Belgium, Hong Kong, Malaysia, the Philippines, Singapore, and Switzerland. These countries present a more complex linguistic environment that may obscure the relationship between language structure and economic behaviour. In Belgium, Dutch (a weak-FTR language) is spoken by approximately 55% of the population, while French (a strong-FTR language) accounts for around 36%, and German (weak-FTR) represents a small minority (Kim et al., 2021). Hong Kong recognises both Cantonese (weak-FTR) and English (strong-FTR) as official languages.

Similarly, Malaysia uses both Malay (weak-FTR) and English (strong-FTR). In the Philippines, Tagalog (strong-FTR) and Cebuano (weak-FTR) are widely spoken. Singapore represents a particularly diverse case, with Malay and Mandarin classified as weak-FTR languages, and Tamil and English classified as strong-FTR languages. Switzerland also exhibits a mixed linguistic structure, where German is a weak-FTR language, while French, Italian, and Romansh are classified as strong-FTR languages.

In these contexts, the coexistence of both language types makes it difficult to assign a clear linguistic classification at the country level, potentially attenuating the estimated effect of FTR on carbon emissions. To mitigate this concern, I exclude these countries from the sample and re-estimate the model. The results reported in Panel B show that the coefficient on Weak-FTR remains negative and statistically significant at the 5% level. This provides evidence that the baseline results are not driven by measurement error arising from within-

country linguistic heterogeneity and remain robust after excluding countries characterised by substantial linguistic diversity.

2.6.3 Alternative Measures of Carbon Emissions

To further assess the robustness of the baseline findings, I re-estimate the main specification using alternative measures of carbon emissions. The primary analysis employs the natural logarithm of total CO₂ emissions scaled by revenue, a measure commonly used in the literature (Altunbas et al., 2022; Nuber & Velte, 2021). Panels C and D of Table 2.4 examine whether the results are sensitive to alternative definitions of the dependent variable.

Panel C reports the results using three alternative measures that capture both absolute emissions and scaled emission intensity, following prior literature (Altunbas et al., 2022; Benlemlih & Yavaş, 2023; Bolton & Kacperczyk, 2021). In Column (1), I use the natural logarithm of total CO₂ and CO₂-equivalent emissions (Scope 1 and Scope 2), which reflects emissions in absolute terms. In Column (2), emissions are scaled by total assets to account for firm size from a balance sheet perspective. In Column (3), emissions are scaled by market capitalization, capturing emissions relative to market valuation. Across all three specifications, the coefficient on Weak-FTR remains negative and statistically significant at the 1% level. The estimated coefficients range from -0.423 to -0.476 , indicating a consistent relationship between weak-FTR languages and lower corporate carbon emissions across alternative emission measures.

Panel D further extends the analysis by using the Refinitiv Emissions Score as an alternative measure of environmental performance, following Tanthanongsakkun et al. (2023). Unlike the emission intensity measures, a higher emissions score reflects better corporate emissions performance. The results remain consistent with the baseline findings. The coefficient on Weak-FTR is positive and statistically significant at the 1% level ($\beta = 15.056$, $p < 0.001$), indicating that firms operating in weak-FTR linguistic environments receive

significantly higher emissions scores. This finding suggests that these firms exhibit superior carbon emissions performance relative to their industry peers.

Overall, the evidence from Panels C and D demonstrates that the main findings are robust to alternative measures of environmental performance. Whether carbon emissions are measured in absolute terms, scaled by firm size or market value, or captured using the Refinitiv Emissions Score, the results consistently indicate that firms operating in weak-FTR linguistic environments exhibit better environmental performance.

2.6.4 Alternative Measurement of FTR

The baseline analysis relies on a binary indicator of weak future-time reference (FTR) to capture linguistic differences across countries. To ensure that the results are not sensitive to this discrete classification, I employ alternative continuous measures of FTR based on the textual analysis developed by Chen (2013). These measures are constructed using word-frequency analysis of online weather forecasts, which provide a consistent and comparable linguistic context across languages.

Specifically, Chen (2013) develops two continuous proxies for FTR. The first measure, the sentence ratio, is defined as the proportion of grammatically future-marked sentences relative to the total number of weather-related sentences. The second measure, the verb ratio, is calculated as the proportion of future-marked verbs relative to the total number of verbs in the text. Following Kim et al. (2021), I multiply both measures by -1 so that higher values correspond to weaker future-time reference, ensuring consistency in interpretation with the main specification.

Panel E of Table 2.4 reports the results using these alternative measures. In Column (1), the coefficient on the sentence ratio is negative and statistically significant at the 1% level. In Column (2), the coefficient on the verb ratio is also negative and statistically significant at the 1% level. These findings indicate that languages with weaker future-time reference, as captured

by continuous text-based measures, are associated with lower levels of corporate carbon emissions. The evidence from Panel E is consistent with the baseline results obtained using the binary Weak-FTR indicator. The use of alternative, continuous measures of linguistic structure confirms that the documented relationship is robust and not driven by the specific construction of the main explanatory variable. This strengthens confidence in the interpretation that linguistic features systematically influence firms' environmental behaviour.

2.6.5 Controlling for Industry $\times$ Year Fixed Effects

Panel F of Table 2.4 reports the results from a more demanding specification that incorporates industry $\times$ year fixed effects. Consistent with Kong et al. (2022), I include industry-by-year fixed effects to control for time-varying industry characteristics. This specification captures unobserved factors that evolve within industries over time, such as changes in growth opportunities, technological developments, and sector-specific shocks that may influence firms' carbon emissions across countries.

By absorbing variation common to firms operating within the same industry-year, this approach reduces concerns that the baseline results are driven by differences in industry composition or time-varying industry dynamics. This specification is particularly important in a cross-country setting, where industry composition differs systematically across countries and over time, potentially affecting firms' environmental performance independently of linguistic structure.

Despite this more stringent control, the coefficient on Weak-FTR remains negative and statistically significant at the 1% level. The magnitude of the estimate is also comparable to that reported in the baseline specification. These findings confirm that the negative association between weak future-time reference language and corporate carbon emissions is robust to controlling for time-varying industry effects. This evidence strengthens the interpretation that the observed relationship is not attributable to unobserved industry-level factors but instead

reflects a systematic relationship between linguistic structure and firms' environmental behaviour. The economic magnitude of the estimated effect remains consistent with the baseline results, reinforcing the practical relevance of the findings.

2.6.6 Robustness Test Using Lead Carbon Emissions

Panel G of Table 2.4 reports a robustness test that evaluates whether the association between linguistic structure and corporate carbon emissions extends to future environmental outcomes as well. Following the empirical approach of Kong et al. (2022), I employ one-period-ahead measures of carbon emissions as the dependent variable to mitigate concerns related to reverse causality and simultaneity. The dependent variable is constructed as one-period-ahead carbon emissions using four alternative measures, including emissions scaled by revenue, total emissions, emissions scaled by total assets, and emissions scaled by market capitalization.

The results consistently indicate a negative and statistically significant relationship between Weak-FTR and future carbon emissions across all specifications. In Column (1), where emissions are scaled by revenue, the estimated coefficient is -0.434 and statistically significant at the 1% level. This pattern is maintained in columns (2) through (4), with coefficients of -0.373 , -0.316 , and -0.409 , respectively, each remaining statistically significant at conventional levels. These findings indicate that firms operating in weak-FTR linguistic environments are associated with lower levels of carbon emissions not only in the current period but also in subsequent periods.

The stability of the estimates across alternative measures of carbon emissions provides strong support for the robustness of the main results. All specifications incorporate firm-level and country-level controls, together with industry and year fixed effects, thereby accounting for observable firm characteristics as well as broader institutional and macroeconomic influences. The evidence presented in Panel G further strengthens the identification strategy by alleviating concerns related to reverse causality. The persistence of the negative effect in future

emissions is consistent with a forward-looking channel through which linguistic structure influences managerial decision-making, particularly with respect to long-term environmental outcomes.

2.6.7 Robustness Test Using the Post-2010 Sample

As an additional robustness test, I examine whether the baseline findings are sensitive to the lower level of corporate carbon disclosure during the early years of the sample. A potential concern is that a larger proportion of carbon emissions in the Refinitiv database may be estimated rather than directly reported when firms do not publicly disclose their emissions, particularly during the earlier years of the sample when corporate carbon reporting was less common. To address this concern, I re-estimate the baseline specification using only post-2010 firm-year observations, a period characterised by substantially higher levels of corporate carbon disclosure. The results are reported in Panel H of Table 2.4.

The results remain consistent with the baseline findings. The coefficient on Weak-FTR remains negative and statistically significant at the 1% level ($\beta = -0.488$, $p = 0.003$), with a magnitude very similar to that reported in the baseline specification ($\beta = -0.528$). This evidence indicates that the documented relationship between linguistic future-time reference and corporate carbon emissions is not driven by the greater use of estimated emissions during the earlier years of the sample. Instead, the findings remain robust when the analysis is restricted to the post-2010 period.

2.6.8 Robustness Test Using Country-Level Clustered Standard Errors

To further assess the robustness of the baseline findings, I re-estimate the baseline specification by clustering the standard errors at the country level. Since the key explanatory variable, Weak-FTR, is measured at the country level, clustering the standard errors by country accounts for potential within-country correlation in the error terms. The results are reported in Panel I of Table 2.4. The results remain consistent with the baseline findings. The coefficient on Weak-

FTR remains negative and statistically significant at the 5% level ($\beta = -0.528, p = 0.011$), and its magnitude is identical to that reported in the baseline specification. These findings indicate that the documented relationship is not sensitive to clustering the standard errors at the country level.

2.6.9 Robustness Test Using CO₂/Revenue in Levels

Finally, I re-estimate the baseline model using the CO₂/Revenue ratio in levels rather than its natural logarithm. As reported in Panel J of Table 2.4, the coefficient on Weak-FTR remains negative and marginally significant at the 10% level (coefficient = -0.00015 ; t-statistic = -1.67). This result provides additional evidence that the negative association between weak future-time reference language and corporate carbon emissions is not driven by the logarithmic transformation of the dependent variable.

Nevertheless, the baseline specification continues to employ the natural logarithm of CO₂/Revenue because the emissions ratio is highly positively skewed. The logarithmic transformation reduces skewness, produces a more symmetric distribution, and limits the influence of extreme observations, thereby improving the suitability of the dependent variable for linear regression analysis. This approach is consistent with prior studies, such as Benlemlih et al. (2023) and Altunbas et al. (2022), which also employ logarithmic transformations of carbon-emission measures. Accordingly, the logged specification remains the preferred baseline measure, while the level specification reported in Panel J serves as an additional robustness check.

Overall, the results across Panels A–J of Table 2.4 provide consistent evidence that the negative association between weak future-time reference language and corporate carbon emissions is robust to a wide range of alternative specifications, sample restrictions, and estimation approaches. The stability of the estimated coefficients across these tests enhances

confidence in the main findings and supports the conclusion that the documented relationship is not driven by a particular sample, measurement approach, or model specification.

2.7 Cross-Sectional Tests

2.7.1 Moderating Effect of Globalisation

This section examines whether the effect of linguistic structure on corporate carbon emissions varies across different country-level characteristics. While the baseline results indicate that linguistic structure plays a significant role in shaping firms' environmental behaviour, firms may not respond uniformly across institutional and economic environments. Exposure to globalisation may affect the extent to which language shapes managerial decision-making.

Globalization reflects the increasing integration of economies, institutions, and societies through cross-border flows of goods, capital, information, and people. As noted by Kong et al. (2022), globalisation facilitates interactions among individuals from diverse linguistic and cultural backgrounds, often requiring them to adapt both their language and cognitive frameworks. Consequently, globalisation reduces barriers across countries and promotes multicultural environments in which different linguistic systems coexist.

Building on this perspective, Liang et al. (2018) argue that firms operating in more globalised environments are more frequently exposed to international partners and multilingual interactions. Such exposure can shape managerial cognition by reducing reliance on a single linguistic structure and encouraging greater flexibility in interpreting information. Managers operating in multilingual environments may place greater emphasis on future-oriented considerations, as they become more accustomed to navigating diverse perspectives and decision-making frameworks.

Given these arguments, globalisation may moderate the relationship between linguistic structure and corporate carbon emissions. If exposure to global markets weakens the cognitive influence of language, the effect of weak future-time reference (FTR) languages on firms'

environmental behaviour is expected to be less pronounced in more globalised countries. To examine this moderating effect, I use the KOF Globalisation Index (KOFGI), obtained from the Swiss Federal Institute of Technology in Zurich. The KOF index is widely used in empirical research (Potrafke, 2015) and provides a comprehensive measure of globalisation by incorporating economic, social, and political dimensions (Liang et al., 2018).

To test this hypothesis, KOFGI is interacted with the Weak-FTR indicator. The regression results reported in Column (1) of Table 2.5 indicate that the coefficient on Weak-FTR is negative and statistically significant at the 1% level (-3.746). The interaction term between globalisation and Weak-FTR is positive and statistically significant at the 1% level (0.041). This result implies that the negative association between weak-FTR languages and carbon emissions becomes weaker as globalisation increases. In other words, greater exposure to globalisation reduces the extent to which linguistic structure influences firms' environmental outcomes.

Furthermore, the coefficient on globalisation is negative, indicating that firms located in more globally integrated countries tend to exhibit lower levels of carbon emissions. This result is consistent with the view that globalisation facilitates the diffusion of knowledge, technologies, and environmental practices across countries, thereby promoting more sustainable corporate behaviour. Overall, these findings highlight the importance of globalisation in shaping the relationship between linguistic structure and corporate carbon emissions. By fostering exposure to diverse linguistic and cultural environments, globalisation appears to weaken the influence of language-specific cognitive biases and encourage more forward-looking managerial decisions.

2.7.2 Moderating Effect of Individualism

The role of culture in shaping economic and corporate decision-making has been extensively documented in the financial and economic literature (Guiso et al., 2006). Among the various

cultural dimensions, the distinction between individualism and collectivism represents a central source of cross-country differences (Heine, 2010; Lu et al., 2021). Individualism reflects the extent to which members of a society emphasize personal autonomy and independence, whereas collectivism places greater weight on group cohesion and shared responsibilities. As discussed by Liang et al. (2014), this distinction also influences how individuals perceive themselves, either as independent agents (“I”) or as part of a broader social group (“We”). In individualistic societies, individuals are generally expected to prioritize their own interests and those of their immediate family, while collectivist societies tend to emphasize loyalty, mutual support, and the welfare of the group.

These cultural differences have important implications for corporate behaviour and environmental decision-making. In more individualistic environments, firms and managers are more likely to prioritize self-interest, personal achievement, and autonomy in decision-making (Ho et al., 2012). Such settings may encourage a stronger focus on firm-level objectives, potentially at the expense of broader societal concerns. By contrast, collectivist cultures tend to promote greater consideration of social welfare and collective outcomes. Prior research provides supporting evidence that individualistic tendencies are associated with weaker ethical standards and lower sensitivity to social and environmental issues.

For instance, Akaah (1990) finds that employees in individualistic organizations tend to exhibit lower ethical behaviour compared to those in collectivist settings. Similarly, individuals in highly individualistic societies are less likely to express concern about environmental challenges such as climate change (Schultz & Zelezny, 2003) and are less inclined to engage in environmentally responsible practices, including recycling (Kormos & Gifford, 2014). Collectively, these insights suggest that cultural orientation may influence how firms respond to environmental considerations. A stronger emphasis on individual interests

may reduce the weight placed on collective environmental outcomes, thereby weakening firms' incentives to adopt environmentally responsible behaviour.

In the context of this study, this implies that individualism may moderate the relationship between linguistic structure and corporate carbon emissions. If individualistic cultures place less emphasis on long-term collective outcomes, the influence of linguistic structures associated with future-oriented thinking may be diminished. Accordingly, I hypothesise that the negative association between weak future-time reference (FTR) languages and corporate carbon emissions is attenuated in more individualistic countries.

To capture cross-country variation in cultural orientation, I use the Hofstede Individualism Index (Hofstede, 2001), which measures the degree to which societies emphasize individual autonomy relative to collective values. The index ranges from 0 to 100, with higher values indicating stronger individualistic tendencies and lower values reflecting more collectivist cultures. This measure is widely used in empirical research and provides a consistent framework for examining how cultural differences shape corporate behaviour across countries. To investigate the moderating effect of individualism, I interact the Individualism Index with the Weak-FTR indicator.

The results, reported in Column (2) of Table 2.5, show that the interaction term between individualism and Weak-FTR is positive and statistically significant at the 5% level ($\beta = 0.016$). This evidence indicates that the negative association between weak-FTR languages and corporate carbon emissions is attenuated in more individualistic societies. This result suggests that the influence of linguistic structure on firms' environmental behaviour is moderated by cultural orientation. In more individualistic environments, decision-making tends to place greater emphasis on personal or firm-level objectives rather than collective outcomes. As a result, the future-oriented cognitive effects associated with weak-FTR languages are less likely to translate into stronger environmental responsibility.

This interpretation is consistent with prior research showing that individualistic tendencies are associated with lower concern for environmental issues and reduced engagement in environmentally friendly behaviour (Kormos & Gifford, 2014; Schultz & Zelezny, 2003). In such contexts, individuals may prioritize private benefits over broader societal considerations, thereby weakening the impact of language-driven future orientation on environmental outcomes. Overall, the cross-sectional evidence highlights that both globalisation and individualism play an important role in shaping the effect of linguistic structure on corporate carbon emissions. In particular, higher levels of individualism mitigate the negative impact of weak future-time reference languages, highlighting the role of cultural factors in shaping how linguistic structure affects corporate environmental performance.

2.8 Within-Country Analysis of Weak and Strong FTR Languages

A potential concern in the baseline analysis is that the estimated relationship between linguistic structure and corporate carbon emissions may be influenced by omitted country-level factors that are correlated with both language and environmental outcomes. Although the empirical specification incorporates a comprehensive set of firm-level and country-level controls, as well as industry and year fixed effects, unobserved time-invariant country characteristics may still affect the results. This concern is common in cross-country settings, where unobserved heterogeneity across countries may bias the estimated relationships. Consistent with Kim et al. (2021), who highlight the limitations of cross-country regressions in capturing unobserved institutional differences, this motivates the use of within-country variation to better isolate the effect of linguistic structure. In principle, this concern could be addressed by including country fixed effects.

However, this approach is not feasible in the present setting because the key explanatory variable, linguistic structure, is defined at the country level and would therefore be absorbed by the inclusion of country fixed effects, as noted by Kong et al. (2022). A related econometric

issue arises from multicollinearity, as the inclusion of country fixed effects would eliminate the variation required to identify the effect of linguistic structure. This limitation motivates the use of alternative identification strategies that exploit variation within countries.

To address this issue, I implement an identification strategy based on within-country variation in linguistic structure. This approach follows Liang et al. (2018), who exploit variation in future-time reference within multilingual countries to isolate the effect of language from broader country-level influences. Specifically, I focus on multilingual countries in which both weak and strong future-time reference (FTR) languages are spoken. This strategy enables a comparison of firms operating under different linguistic environments within the same country. By holding institutional, regulatory, and macroeconomic conditions constant, it provides a more precise assessment of whether linguistic differences are associated with variation in corporate carbon emissions.

I focus on Belgium and Switzerland, two countries in the sample that exhibit substantial linguistic diversity in terms of future-time reference (FTR). Belgium is characterised by variation in linguistic structure, where Dutch and German belong to the weak-FTR group, while French represents a strong-FTR language. Switzerland provides a comparable setting, with German associated with weak-FTR, whereas French, Italian, and Romansh are classified as strong-FTR languages. These countries therefore provide an ideal empirical setting in which different linguistic structures coexist within a common institutional framework. This setting closely mirrors the empirical design in Liang et al. (2018), where within-country linguistic variation is used to identify the effect of language.

This framework provides a stringent test of the language-based mechanism underlying the analysis. If differences in corporate carbon emissions persist across regions associated with different linguistic groups within the same country, it becomes less likely that the results are driven by country-specific factors. Instead, such patterns support the interpretation that

linguistic structure itself plays an independent role in shaping firms' environmental behaviour. Consistent within-country patterns therefore provide more compelling evidence of a language-based mechanism rather than reflecting country-level influences.

To implement this analysis, I construct a firm-level measure of linguistic structure based on the geographic location of each firm's headquarters at the city level, which allows for more granular identification of linguistic variation within countries. More specifically, I identify the dominant language spoken in the city where each firm is headquartered and assign the corresponding future-time reference classification. This classification is based on systematic verification of regional language usage, including official municipal sources and the language used in firms' financial disclosures.

By combining these sources, the classification closely captures the linguistic environment in which firms operate. The empirical specification is estimated using a two-way fixed effects model that includes industry and year fixed effects, with standard errors clustered at the city level to account for potential within-group dependence, following Kim et al. (2021).

In Belgium, firms located in Flanders, the Dutch-speaking region, are classified as operating in a weak-FTR linguistic environment, while firms headquartered in Wallonia, the French-speaking region, are classified as operating in a strong-FTR environment. A similar procedure is applied to Switzerland, where firms are assigned to linguistic groups based on the dominant language spoken in the canton or city of their headquarters. Firms located in German-speaking regions are classified as weak-FTR, whereas firms headquartered in French- or Italian-speaking regions are classified as strong-FTR. This regional classification allows for a more precise identification of linguistic effects within a single country.

Using this firm-level classification, I re-estimate the main regression within Belgium and Switzerland. By focusing on within-country variation, firms are compared within a common institutional, legal, and macroeconomic environment. As a result, this framework

allows for a more direct assessment of whether linguistic structure is associated with differences in corporate behaviour, rather than reflecting cross-country heterogeneity. In line with Liang et al. (2018), the persistence of this pattern within a single country provides evidence consistent with a pure language effect, rather than an explanation driven by broader country-level characteristics.

The results are reported in Table 2.6. In Column (1), the dependent variable is the logarithm of CO₂ emissions scaled by revenue. The coefficient on Weak-FTR is negative and statistically significant at the 10% level, indicating that firms operating in regions where weak-FTR languages are spoken tend to exhibit lower carbon emissions intensity than firms located in strong-FTR regions within the same country. The magnitude of the estimate is economically meaningful and consistent with the baseline results, suggesting that the relationship is not driven by cross-country differences.

Turning to Column (2), the dependent variable is the natural logarithm of total Scope 1 and Scope 2 greenhouse gas emissions. The coefficient on Weak-FTR remains negative and statistically significant at the 10% level, and its magnitude is larger in absolute terms. This pattern indicates that the effect is not limited to emissions intensity but also extends to total emissions. The results across both specifications reveal a clear pattern, indicating that firms in weak-FTR linguistic environments tend to exhibit lower carbon emissions.

Importantly, this within-country analysis offers a more demanding test of the underlying mechanism. By comparing firms operating within the same institutional and regulatory environment, the influence of omitted country-level factors is substantially reduced. The persistence of the negative association therefore strengthens the interpretation that linguistic structure plays an independent role in shaping firms' environmental decisions.

Although the statistical significance is somewhat weaker than in the baseline specification, this is expected given the smaller sample and the more restrictive identification

strategy. Nevertheless, the consistent negative relationship across both measures of emissions provides additional support for a language-based explanation. Overall, the within-country evidence strengthens the identification strategy and suggests that the observed relationship between language and corporate carbon emissions is not merely a reflection of country-level characteristics but is at least partly driven by linguistic differences.

2.9 Conclusion

This chapter examines the role of linguistic structure in shaping corporate environmental behaviour, with a particular focus on carbon emissions. While prior research has largely emphasised economic, regulatory, and institutional determinants of environmental performance, less attention has been given to the role of language as a fundamental cultural factor. In this study, I explore whether cross-country variation in future-time reference (FTR) is associated with systematic differences in firms' carbon emissions. To examine this relationship, I use a panel dataset covering firms across 33 countries over the period 2001–2021.

The empirical analysis provides consistent evidence that firms operating in weak-FTR linguistic environments exhibit lower levels of carbon emissions compared with firms in strong-FTR countries. This finding supports the central hypothesis that linguistic structure influences corporate environmental behaviour. When the future is less distinctly separated from the present, as in weak-FTR languages, firms appear to place greater weight on the long-term environmental consequences of their actions. As a result, firms in such environments are more likely to adopt strategies aimed at reducing carbon emissions.

A comprehensive set of robustness tests further reinforces the stability of the main findings. The results remain consistent when alternative measures of carbon emissions are employed, capturing both absolute emissions and different forms of emission intensity. The findings are unchanged when adjusting the sample to address potential concerns related to

sample composition, including the exclusion of dominant countries such as the United States and the United Kingdom, as well as the largest weak-FTR country, Japan. Moreover, the conclusions persist when excluding countries characterised by substantial linguistic heterogeneity, thereby mitigating concerns related to measurement error in the linguistic classification.

The results are also robust to alternative proxies for environmental performance based on emissions scores and to continuous measures of future-time reference derived from textual analysis. In addition, the findings remain stable under more demanding specifications, including the incorporation of industry-by-year fixed effects and the use of one-period-ahead carbon emissions, which helps alleviate concerns related to reverse causality. Collectively, these robustness checks provide strong support for the interpretation that the documented relationship reflects a systematic pattern rather than being driven by specific modelling choices or sample composition.

Additional evidence from the cross-sectional analyses offers further insight into how the effect of linguistic structure varies across different institutional and cultural environments. The analysis indicates that the effect of weak future-time reference is not uniform across countries but varies with broader economic and social conditions. In particular, the relationship between linguistic structure and corporate carbon emissions varies with factors such as globalisation and cultural orientation. For example, while firms operating in weak-FTR environments tend to exhibit lower carbon emissions, this effect becomes less pronounced in more globalised countries.

Greater exposure to international markets and multicultural environments appears to weaken the influence of language-specific cognitive frameworks, as firms and managers are more likely to adopt diverse perspectives in their decision-making processes. A similar pattern emerges for cultural orientation. In more individualistic societies, where decision-making

places greater emphasis on firm-level objectives, the impact of weak-FTR language on environmental behaviour is attenuated. By contrast, in less individualistic environments, where collective outcomes and long-term considerations are more strongly valued, the effect of linguistic structure is more pronounced.

In addition, the within-country analysis provides further support for the identification strategy. Focusing on multilingual countries such as Belgium and Switzerland, where weak and strong FTR languages coexist within a common institutional environment, the results show that firms in weak-FTR regions exhibit lower carbon emissions than those in strong-FTR regions within the same country. By holding country-level factors constant, this evidence reduces concerns that the baseline findings are driven by unobserved institutional or macroeconomic differences. The persistence of the effect within countries provides strong support for a language-based mechanism.

These findings are consistent with the theoretical mechanisms developed in this chapter. In particular, the results support the view that linguistic structure influences firms' environmental behaviour through its effect on intertemporal decision-making. When the future is perceived as more closely connected to the present, firms may apply a lower implicit discount rate when evaluating long-term environmental outcomes, increasing the perceived value of future benefits relative to short-term costs.

At the same time, weak-FTR environments may heighten firms' sensitivity to the long-term risks associated with carbon-intensive activities, including regulatory penalties, reputational damage, and operational disruptions. Together, these channels provide a coherent economic explanation for the observed relationship between linguistic structure and corporate carbon emissions.

This chapter also contributes to the literature by providing new evidence on the role of informal institutions in shaping corporate environmental outcomes. The findings indicate that

linguistic structure, as a core cultural characteristic, is systematically associated with cross-country differences in firms' carbon emissions. By highlighting language as an underlying factor shaping how firms evaluate long-term environmental consequences, the analysis offers a complementary perspective to existing studies that focus primarily on formal regulations, governance mechanisms, and economic incentives.

More broadly, the results provide international evidence on how cultural context shapes corporate responses to environmental challenges. These findings also carry important implications for policymakers and investors seeking to design effective climate policies and assess firm-level environmental risk. While this study provides robust evidence on the role of linguistic structure in shaping corporate environmental behaviour, future research could further explore additional mechanisms through which language affects firm decision-making, as well as examine the interaction between linguistic characteristics and firm-level managerial or governance factors. In conclusion, this chapter provides strong evidence that firms operating in weak-FTR linguistic environments tend to exhibit lower levels of carbon emissions.

Overall, the findings offer a novel perspective on the determinants of corporate environmental behaviour and underscore the importance of considering cultural and linguistic factors alongside conventional economic and regulatory explanations.

Tables of Chapter 2

Table 2.1. Sample Distribution by Country

This table presents the distribution of the 14,301 firm-year observations across countries. The sample covers countries with both weak and strong future-time reference (FTR) linguistic environments. The FTR classification and language coding follow Chen (2013), which extends the EUROTYP future-time reference classification to both European and non-European languages. The country-level assignment is based on the dominant language of each country. Each country is therefore assigned a single dominant language for the empirical analysis, and the corresponding FTR classification (weak or strong) is based on Chen (2013, Online Appendix Table 5). For multilingual countries, the dominant-language assignment follows Chen's (2013) country-level coding and is used consistently to construct the FTR indicator.

Country Name	Country Code	Observations	Dominant Language	FTR
Australia	AUS	643	English (UK)	Strong
Austria	AUT	99	German	Weak
Belgium	BEL	152	Dutch	Weak
Brazil	BRA	421	Portuguese (Brazil)	Weak
Canada	CAN	51	English (US)	Strong
Chile	CHL	111	Spanish	Strong
Colombia	COL	83	Spanish	Strong
Finland	FIN	256	Finnish	Weak
France	FRA	724	French	Strong
Germany	DEU	667	German	Weak
Greece	GRC	62	Greek	Strong
Hong Kong	HKG	213	Cantonese	Weak
India	IND	313	Hindi	Strong
Indonesia	IDN	48	Indonesian	Weak
Ireland	IRL	23	English (UK)	Strong
Italy	ITA	344	Italian	Strong
Japan	JPN	1,424	Japanese	Weak
Malaysia	MYS	194	Malaysian	Weak
Mexico	MEX	180	Spanish	Strong
Netherlands	NLD	233	Dutch	Weak
New Zealand	NZL	71	English (UK)	Strong
Norway	NOR	189	Norwegian	Weak
Peru	PER	23	Spanish	Strong
Philippines	PHL	85	Tagalog	Strong
Singapore	SGP	108	Mandarin	Weak
South Korea	KOR	586	Korean	Strong
Spain	ESP	402	Spanish	Strong
Sweden	SWE	457	Swedish	Weak
Switzerland	CHE	409	German	Weak
Thailand	THA	182	Thai	Strong
United Arab Emirates	ARE	67	Arabic	Strong
United Kingdom	GBR	1,988	English (UK)	Strong
United States	USA	3,493	English (U.S.)	Strong
Total		14,301		

Table 2.2. Summary Statistics

This table reports the descriptive statistics (Observations, Mean, Median, Standard Deviation, 25th percentile, and 75th percentile) for all variables used in the empirical analysis. The dependent variables include the baseline measure, Log(CO₂/Revenue), together with the alternative measures Log(CO₂), Log(CO₂/Assets), Log(CO₂/Market Cap), and Emissions Score used in the robustness tests. The remaining variables comprise the country-level and firm-level control variables employed in the regression analysis. Variable definitions are provided in Appendix 2-A.

VARIABLES	Observation	Mean	Median	STD	p25	p75
Dependent Variable						
Log(CO ₂ /Revenue)	14,301	-9.905	-10.080	1.990	-11.180	-8.527
Log(CO ₂)	14,335	12.560	12.470	2.533	10.930	14.260
Log(CO ₂ /Assets)	19,240	-10.540	-10.360	2.462	-11.750	-8.852
Log(CO ₂ /Market Cap)	14,335	-10.180	-10.270	2.373	-11.810	-8.575
Emissions Score	38,894	38.560	34.920	34.400	0.000	70.390
Country-Level Variables						
Weak-FTR	14,301	0.341	0.000	0.474	0.000	1.000
GDP Growth	14,301	1.961	2.130	1.865	1.380	2.710
Financing Condition	14,301	90.180	79.290	41.340	55.950	130.000
Creditor Rights Index	14,301	1.994	2.000	1.270	1.000	3.000
Power Distance	14,301	47.360	40.000	15.890	35.000	57.000
Masculinity	14,301	58.420	62.000	19.780	49.000	66.000
Uncertainty Avoidance	14,301	58.260	50.000	21.460	46.000	82.000
Individualism	14,301	68.070	71.000	24.320	46.000	90.000
Long Term Orientation	14,301	50.940	51.130	23.810	25.690	67.000
Globalization	14,301	81.550	82.170	7.142	78.450	87.680
Linguistic Diversity Index	14,301	0.280	0.190	0.223	0.140	0.350
ESG Score	14,301	59.800	61.330	16.580	48.580	72.210
Ownership Concentration	14,301	0.313	0.230	0.144	0.200	0.410
Legal Enforcement	14,301	8.674	9.220	1.485	8.680	9.540
English Common Law (orthogonalized)	14,301	0.113	-0.117	0.426	-0.117	0.488
French Legal Origin	14,301	0.201	0.000	0.400	0.000	0.000
Catholic Religion	14,301	31.030	30.000	29.700	3.900	35.000
Muslim Religion	14,301	1.933	0.800	6.516	0.020	1.400
Firm-Level Variables						
Size	14,301	23.230	23.100	1.671	22.090	24.250
Leverage	14,301	0.263	0.248	0.167	0.143	0.363
Market to Book	14,301	0.062	0.048	1.107	-0.526	0.677
ROA	14,301	0.048	0.041	0.067	0.014	0.075
Loss	14,301	0.099	0.000	0.299	0.000	0.000
Slack	14,301	3.827	0.343	19.830	0.111	1.266
CAPEX/Assets	14,301	0.046	0.037	0.041	0.018	0.062
R&D/Assets	14,301	0.011	0.000	0.028	0.000	0.004

Table 2.3. The Impact of Weak Future-Time Reference (FTR) on Firm Carbon Emissions

This table reports OLS regression results examining the association between linguistic structures and corporate carbon emissions. The dependent variable is the natural logarithm of CO₂ emissions scaled by revenue. Column (1) presents the baseline specification including firm-level control variables, while Column (2) extends the model by incorporating country-level characteristics. All specifications include industry and year fixed effects to control for unobserved industry heterogeneity and common time effects. Standard errors are clustered at the firm level and reported in parentheses beneath the coefficient estimates. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 2-A.

	(1)	(2)
VARIABLES	Log(CO ₂ /Revenue)	Log(CO ₂ /Revenue)
Weak-FTR	-0.131** (0.055)	-0.528*** (0.160)
Size	0.100*** (0.016)	0.079*** (0.024)
Leverage	0.572*** (0.152)	0.628*** (0.177)
Market to Book	-0.165*** (0.040)	-0.130*** (0.046)
ROA	-0.407 (0.332)	-0.818** (0.412)
Loss	0.254*** (0.053)	0.192*** (0.064)
Slack	-0.004*** (0.001)	-0.003*** (0.001)
CAPEX/Assets	8.509*** (0.638)	8.270*** (0.759)
R&D/Assets	-0.572 (0.823)	0.775 (1.008)
GDP Growth		0.017 (0.012)
Financing Condition		-0.002** (0.001)
Creditor Rights Index		0.016 (0.054)
Power Distance		0.007 (0.005)
Masculinity		0.008*** (0.002)
Uncertainty Avoidance		-0.000 (0.003)

	(1)	(2)
Individualism		-0.014*** (0.004)
Long Term Orientation		-0.006* (0.004)
Globalization		0.004 (0.010)
Linguistic Diversity Index		0.522*** (0.186)
ESG Score		0.004** (0.002)
Ownership Concentration		1.328*** (0.466)
Legal Enforcement		0.140* (0.073)
English Common Law (orthogonalized)		0.266* (0.160)
French Legal Origin		0.049 (0.216)
Catholic Religion		-0.008*** (0.002)
Muslim Religion		-0.008 (0.009)
Constant	-12.743*** (0.384)	-13.577*** (1.007)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	21,772	14,301
R-squared	0.508	0.566

Table 2.4. Linguistic Future-Time Reference and Corporate Carbon Emissions: Robustness Tests

This table reports a series of robustness tests examining the relationship between linguistic future-time reference and corporate carbon emissions. Weak-FTR is an indicator equal to one if the dominant language in the firm's headquarters country is classified as a weak future-time reference (FTR) language, and zero otherwise. Panel A excludes U.S. firms and, alternatively, both U.S. and U.K. firms. Panel B excludes multilingual countries. Panels C and D employ alternative measures of carbon emissions and environmental performance. Panel E uses alternative measures of Weak-FTR based on word-frequency analysis. Panel F includes industry-by-year fixed effects. Panel G uses one-period-ahead measures of carbon emissions. Panel H restricts the sample to observations after 2010. Panel I clusters standard errors at the country level. Panel J re-estimates the baseline specification using the CO₂/Revenue ratio in levels rather than its natural logarithm. All regressions include firm-level and country-level control variables and the fixed effects indicated in each panel. Standard errors are clustered at the firm level unless otherwise indicated and are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 2-A.

Panel A: Excluding U.S. and U.K. Firms			
	Excluding U.S. firms (1) Log(CO₂/Revenue)	Excluding U.S. and UK firms (2) Log(CO₂/Revenue)	
VARIABLES			
Weak-FTR	-0.491*** (0.168)	-0.494*** (0.184)	
Firm-Level Controls	Yes	Yes	
Country-Level Controls	Yes	Yes	
Industry FE	Yes	Yes	
Year FE	Yes	Yes	
Observations	10,808	8,820	
R-squared	0.568	0.573	
Panel B: Excluding Multilingual Countries			
	(1) Log(CO₂/Revenue)		
VARIABLES			
Weak-FTR	-0.603** (0.247)		
Firm-Level Controls	Yes		
Country-Level Controls	Yes		
Industry FE	Yes		
Year FE	Yes		
Observations	13,140		
R-squared	0.565		
Panel C: Alternative Measures of Carbon Emissions			
	(1) Log(CO₂)	(2) Log(CO₂/Assets)	(3) Log(CO₂/Market Cap)
VARIABLES			
Weak-FTR	-0.446*** (0.171)	-0.423*** (0.163)	-0.476*** (0.175)
Firm-Level Controls	Yes	Yes	Yes
Country-Level Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	14,335	19,240	14,335
R-squared	0.718	0.683	0.672

Table 2.4: (Continued)**Panel D: Alternative Measure of Environmental Performance (Emissions Score)**

(1)	
VARIABLES	Emissions Score
Weak-FTR	15.056*** (2.125)
Firm-level Controls	Yes
Country-Level Controls	Yes
Industry FE	Yes
Year FE	Yes
Observations	38,894
R-squared	0.434

Panel E: Alternative Measures of Weak-FTR Based on Word-Frequency Analysis

(1)		(2)
VARIABLES	Log(CO ₂ /Revenue)	Log(CO ₂ /Revenue)
Sentence Ratio	-1.008*** (0.271)	
Verb Ratio		-0.896*** (0.246)
Firm-level Controls	Yes	Yes
Country-Level Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	13,371	13,371
R-squared	0.570	0.569

Panel F: Industry × Year Fixed Effects

(1)	
VARIABLES	Log(CO ₂ /Revenue)
Weak-FTR	-0.539*** (0.161)
Firm-level Controls	Yes
Country-Level Controls	Yes
Industry×Year FE	Yes
Observations	14,291
R-squared	0.569

Table 2.4: (Continued)

Panel G: Lead Measures of Carbon Emissions

	(1)	(2)	(3)	(4)
VARIABLES	Log(CO ₂ /Revenue) t+1	Log(CO ₂) t+1	Log(CO ₂ /Assets) t+1	Log(CO ₂ /Market Cap) t+1
Weak-FTR	-0.434*** (0.153)	-0.373** (0.163)	-0.316** (0.159)	-0.409** (0.169)
Firm-level Controls	Yes	Yes	Yes	Yes
Country-Level Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	15,972	16,009	20,811	16,009
R-squared	0.568	0.721	0.678	0.658

Panel H: Robustness Test Using the Post-2010 Sample

	(1)
VARIABLES	Log(CO ₂ /Revenue)
Weak-FTR	-0.488*** (0.164)
Firm-Level Controls	Yes
Country-Level Controls	Yes
Industry FE	Yes
Year FE	Yes
Observations	12,177
R-squared	0.554

Table 2.4: (Continued)**Panel I: Robustness Test Using Country-Level Clustered Standard Errors**

	(1)
VARIABLES	Log(CO ₂ /Revenue)
Weak-FTR	-0.528** (0.197)
Firm-Level Controls	Yes
Country-Level Controls	Yes
Industry FE	Yes
Year FE	Yes
Observations	14,301
R-squared	0.566

Panel J: Robustness Using CO₂/Revenue in Levels

	(1)
VARIABLES	CO ₂ /Revenue
Weak-FTR	-0.00015* (0.00009)
Firm-Level Controls	Yes
Country-Level Controls	Yes
Industry FE	Yes
Year FE	Yes
Observations	14,315
R-squared	0.316

Table 2.5. Linguistic Structure and Corporate Carbon Emissions: Cross-Sectional Tests

This table reports regression results that examine whether the effect of linguistic structure on corporate carbon emissions varies across country-level characteristics. The dependent variable is the natural logarithm of carbon emissions scaled by revenue. Weak-FTR indicates whether the dominant language in a firm's headquarters country is classified as a weak future-time reference language. Globalisation is measured using the KOF Globalisation Index, and individualism is based on Hofstede's Individualism Index. Column (1) examines the moderating role of globalisation, while Column (2) examines the moderating role of individualism. All regressions include firm-level and country-level controls, as well as industry and year fixed effects. Standard errors clustered at the firm level are reported in parentheses beneath the coefficient estimates. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 2-A.

	(1)	(2)
VARIABLES	Log(CO ₂ /Revenue)	Log(CO ₂ /Revenue)
Weak-FTR	-3.746*** (1.138)	-1.526*** (0.481)
Globalization	-0.023* (0.013)	-0.009 (0.011)
Weak-FTR × Globalisation	0.041*** (0.014)	
Individualism	-0.011*** (0.004)	-0.018*** (0.005)
Weak-FTR × Individualism		0.016** (0.007)
Firm-level Controls	Yes	Yes
Country-Level Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	14,301	14,301
R-squared	0.567	0.567

Table 2.6. Within-Country Analysis of Language and Corporate Carbon Emissions

This table reports the results of the within-country analysis for Belgium and Switzerland, two multilingual countries in which both weak and strong future-time reference (FTR) languages are spoken. The dependent variable in Column (1) is the natural logarithm of CO₂ emissions scaled by revenue, while Column (2) uses the natural logarithm of total CO₂ emissions. Weak-FTR is an indicator equal to one if the dominant language in the firm's headquarters region is classified as a weak-FTR language, and zero otherwise. All regressions include industry and year fixed effects. Standard errors are clustered at the city level and reported in parentheses below the coefficient estimates. Statistical significance is indicated by ***, **, and * at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 2-A.

	(1)	(2)
VARIABLES	Log(CO₂/Revenue)	Log(CO₂)
Weak-FTR	-0.395* (0.230)	-0.534* (0.290)
Firm-level Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	789	789
R-squared	0.646	0.637

Appendix of Chapter 2

Appendix 2-A. Definition of Variables

This appendix provides detailed definitions of all variables used in the study, categorized into thematic groups for clarity. Each entry includes the variable name, definition, and data source.

1. Dependent Variables: Carbon Emission Measures

Variables	Definition	Source
Log(CO ₂ /Revenue)	Natural logarithm of total Scope 1 and Scope 2 greenhouse gas emissions (CO ₂ -equivalent) in tonnes divided by net sales (revenue).	Refinitiv Eikon
CO ₂ /Revenue	Total Scope 1 and Scope 2 greenhouse gas emissions (CO ₂ -equivalent) in tonnes divided by net sales (revenue). This variable is used in levels as an additional robustness measure.	Refinitiv Eikon
Log(CO ₂)	Natural logarithm of total Scope 1 and Scope 2 greenhouse gas emissions (CO ₂ -equivalent) in tonnes.	Refinitiv Eikon
Log(CO ₂ /Assets)	Natural logarithm of total Scope 1 and Scope 2 greenhouse gas emissions (CO ₂ -equivalent) in tonnes divided by total assets.	Refinitiv Eikon
Log(CO ₂ /Market Cap)	Natural logarithm of total Scope 1 and Scope 2 greenhouse gas emissions (CO ₂ -equivalent) in tonnes divided by market capitalisation.	Refinitiv Eikon
Emissions Score	Refinitiv percentile score measuring a firm's relative effectiveness in reducing environmental emissions across its operations. Higher scores indicate stronger emission reduction performance.	Refinitiv Eikon

2. Independent Variables: Linguistic Variables

Variables	Definition	Source
Weak-FTR	Indicator variable equal to 1 if the dominant language is classified as a weak future-time reference language, and 0 otherwise.	Chen (2013)
Sentence Ratio	Proportion of sentences referring to future events that contain a grammatical future marker, multiplied by -1 .	Chen (2013)
Verb Ratio	Proportion of verbs referring to future events that are grammatically marked for the future, multiplied by -1 .	Chen (2013)

3. Lead Variables (t+1)

Variables	Definition	Source
Log(CO ₂ /Revenue) t+1	One-period-ahead value of Log(CO ₂ /Revenue).	Refinitiv Eikon
Log(CO ₂) t+1	One-period-ahead value of Log(CO ₂).	Refinitiv Eikon
Log(CO ₂ /Assets) t+1	One-period-ahead value of Log(CO ₂ /Assets).	Refinitiv Eikon
Log(CO ₂ /Market Cap) t+1	One-period-ahead value of Log(CO ₂ /Market Cap).	Refinitiv Eikon

4. Interaction Variables

Variables	Definition	Source
Weak-FTR $\times$ Globalisation	Interaction term capturing how the effect of linguistic structure varies with the level of globalisation.	Chen (2013); ETH Zurich

Variables	Definition	Source
Weak-FTR × Individualism	Interaction term capturing how the effect of linguistic structure varies with cultural orientation.	Chen (2013); Hofstede (2001)
5. Country-Level Variables		
Variables	Definition	Source
GDP Growth	Growth rate of GDP per capita.	World Bank
Financing Condition	Average of equity market development (market capitalisation/GDP) and credit market development (domestic credit/GDP).	World Bank
Creditor Rights Index	Index capturing the strength of creditor rights.	La Porta et al. (1998)
Power Distance	Cultural index reflecting inequality in power distribution (scaled by 100).	Hofstede (2001)
Masculinity	Cultural index reflecting competitiveness and achievement orientation (scaled by 100).	Hofstede (2001)
Uncertainty Avoidance	Cultural index measuring tolerance for uncertainty and ambiguity.	Hofstede (2001)
Individualism	Cultural index reflecting the degree of individual versus collective orientation.	Hofstede (2001)
Long-Term Orientation	Cultural index reflecting long-term versus short-term orientation (scaled by 100).	Hofstede (2001)
Globalization	KOF Globalisation Index measuring economic, social, and political integration.	ETH Zurich
Linguistic Diversity Index	Measure of linguistic heterogeneity within a country (0–1 scale).	UNESCO World Report
ESG Score	A measure of a firm's overall environmental, social, and governance performance derived from Refinitiv data.	Refinitiv Eikon
Ownership Concentration	The average proportion of common shares held by the three largest shareholders in the ten largest non-financial, privately owned domestic firms.	La Porta et al. (1998)
Legal Enforcement	Average of judicial efficiency, rule of law, and corruption indices.	La Porta et al. (1999)
English Common Law (orthogonalized)	Residualised indicator of English common-law origin obtained by regressing the common-law dummy on future-time reference (FTR). The residual captures the component of legal origin that is independent of linguistic structure and is used to isolate the effect of legal systems.	La Porta et al. (1999) and Liang et al. (2018).
French Legal Origin	Indicator equal to 1 for countries with French legal origin, 0 otherwise.	La Porta et al. (1999)
Catholic Religion	Percentage of population adhering to Catholicism.	La Porta et al. (1999)
Muslim Religion	Percentage of population adhering to Islam.	La Porta et al. (1999)

6. Firm-Level Variables

Variables	Definition	Source
Size	Natural logarithm of total assets.	Refinitiv Eikon
Leverage	Total debt divided by total assets.	Refinitiv Eikon
Market to Book	Market value of assets divided by book value of assets, where the market value of assets is defined as the book value of assets minus the book value of equity plus the market value of equity.	Refinitiv Eikon
ROA	Return on assets, measured as net income divided by total assets.	Refinitiv Eikon
Loss	Indicator equal to 1 if net income is negative, 0 otherwise.	Refinitiv Eikon
Slack	Ratio of cash to property, plant, and equipment (PPE).	Refinitiv Eikon
CAPEX/Assets	Capital expenditures divided by total assets.	Refinitiv Eikon
R&D/Assets	Research and development expenses divided by total assets.	Refinitiv Eikon

CHAPTER 3. FOREIGN LENIENCY LAWS AND CORPORATE INVESTMENT

3.1 Introduction

Collusion among firms is one of the most persistent threats to competitive markets. By coordinating prices, restricting output, and dividing markets, cartels enable their members to earn monopoly rents at the expense of consumers and economic efficiency. Research estimates that global cartels generated approximately \$1.6 trillion in overcharges between 1990 and 2013 (Connor, 2020), with a median price overcharge of around 28 percent (Connor & Bolotova, 2006). Yet despite their illegality, cartels remain pervasive, and estimates suggest that only 10–30% are ever discovered, as reported by Connor and Helmers (2007).

Governments have responded by introducing leniency programs, which offer amnesty to the first cartel member that self-reports. The 1993 revision of the US program, which granted automatic immunity to the first applicant, proved highly effective, increasing cartel discoveries by approximately 60 percent before they fell roughly 40 percent below pre-lenieny levels (Miller, 2009), and inspired more than fifty other countries to adopt similar legislation.

A growing literature documents the corporate consequences of this global wave of anticollusion enforcement, including effects on disclosure (Bourveau et al., 2020), financing (Dasgupta & Žaldokas, 2019), mergers (Dong et al., 2019), and crash risk (Wang et al., 2025). Despite this progress, a fundamental question remains unexplored: does the competitive discipline generated by leniency laws alter how firms invest and allocate capital? Examining the investment effects of these policies is important because investment is one of the central channels through which product-market competition shapes long-run firm value, innovation, and economic growth (Stoughton et al., 2017).

This study addresses this question. Exploiting the staggered global adoption of leniency laws as a source of plausibly exogenous variation in competitive pressure, I examine whether

exposure to foreign leniency laws affects corporate investment efficiency among US firms. The answer is not straightforward, as the economic mechanisms underlying these reforms generate competing predictions. Accordingly, the first prediction is that foreign leniency laws influence the level of total corporate investment. By destabilising collusive arrangements and intensifying competitive pressure, leniency laws may mitigate the managerial “quiet life” and encourage firms to exert greater effort by pursuing investment opportunities that might otherwise be neglected. As collusive rents decline, firms may work harder to maintain and strengthen their competitive position, leading to higher investment activity. The analysis also examines several investment components, including capital expenditures, research and development, and acquisitions, to assess whether competitive pressure affects investment through different channels.

The second prediction is that foreign leniency laws also affect the efficiency with which firms allocate investment. By intensifying competition and weakening collusive arrangements, leniency laws may discipline managerial behaviour and encourage firms to align investment decisions more closely with growth opportunities. The analysis therefore examines whether intensified competition improves investment efficiency. In particular, the study distinguishes between underinvestment, where firms fail to undertake profitable investment opportunities, and overinvestment, where firms invest beyond levels justified by firm fundamentals due to agency conflicts or excessive expansion.

The channel through which investment efficiency improves depends on the dominant agency problem within the firm. Under the quiet life hypothesis (Bertrand & Mullainathan, 2003), limited competition may encourage managerial complacency and underinvestment, as managers avoid costly or effort-intensive projects. In this setting, stronger antitrust enforcement may improve efficiency by encouraging firms to pursue previously neglected investment opportunities. Alternatively, if overconfidence, empire building, or free cash flow

problems dominate (Jensen & Meckling, 1976; Richardson, 2006), collusion may support overinvestment by generating excess rents that finance inefficient expansion. In this case, leniency enforcement may improve efficiency by constraining such behaviour and reducing inefficient investment.

An alternative prediction is that leniency laws may have limited effects on investment efficiency. Rather than responding through greater investment activity, firms may respond to the breakdown of cartels by adopting alternative strategies that preserve market power. For example, Dong et al. (2019) show that firms may substitute explicit collusion with mergers, while Bourveau et al. (2020) find that greater disclosure transparency can facilitate tacit coordination. If these strategic responses dominate, the agency conflicts underlying investment inefficiency may persist despite stronger antitrust enforcement. Identifying which of these competing effects dominates is therefore a central objective of this study.

To examine these effects, I use a panel of approximately 26,700 firm-year observations for U.S. publicly listed firms over the period 1990–2021. Following Bourveau et al. (2020), I construct a measure of foreign leniency exposure based on the import-weighted average of leniency laws adopted by countries that trade significantly with each U.S. industry, using 1990 import weights to mitigate concerns related to subsequent changes in industry structure. The staggered adoption of leniency laws across foreign countries is largely driven by political and institutional developments outside the United States, including domestic political events, OECD recommendations, and bilateral trade negotiations, making the measure plausibly exogenous to individual firms' investment decisions. Because modern cartels often operate across borders, antitrust enforcement in one jurisdiction can alter competitive incentives in another (Choi & Gerlach, 2012), providing a useful setting to examine the effects of intensified competition on corporate investment behaviour.

The empirical findings indicate that firms with greater exposure to foreign leniency laws significantly increase total investment, with the strongest effects concentrated in internally generated investment, particularly capital expenditures and research and development activities. Acquisition activity also increases, although the effect is more moderate. In addition, firms exhibit higher investment efficiency, primarily driven by reductions in underinvestment, although intensified competition is also associated with higher levels of overinvestment.

Overall, the findings suggest that leniency-induced competition disciplines managerial decision-making and mitigates the managerial “quiet life,” encouraging firms to exert greater effort by increasing investment and reducing underinvestment. These responses are consistent with stronger competitive pressure encouraging firms to make more prudent corporate decisions. The results remain robust across alternative fixed-effects specifications, clustering approaches, and alternative measures of foreign leniency exposure based on major trading partners and export-weighted definitions.

Cross-sectional analyses reveal important heterogeneity in firms’ responses to leniency-induced competition. The investment-enhancing effect is strongest in concentrated industries, where collusive behaviour and monopoly rents are more likely to persist (Bourveau et al., 2020). Consistent with this interpretation, the effect is weaker in industries characterised by high product market fluidity, where rapidly changing competitive conditions reduce the sustainability of collusive arrangements. In addition, the effect is stronger among highly profitable firms, which possess greater internal resources to respond to intensified competition, but weaker among firms with high financial reporting quality, where investment decisions are already subject to stronger informational discipline.

This study contributes to three strands of literature. First, it extends the growing literature on the corporate effects of leniency laws. Prior research shows that anticollusion enforcement affects firms’ disclosure policies, financing decisions, mergers, and information

environments (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019; Dong et al., 2019; Wang et al., 2025). This study contributes to this literature by documenting a previously unexplored real effect of leniency enforcement on corporate investment and investment efficiency.

Second, the study contributes to the literature examining the effects of competition on corporate investment. Prior research finds that product market competition affects investment efficiency, investment composition, and labour investment decisions (Boubaker et al., 2022; Laksmana & Yang, 2015; Stoughton et al., 2017). However, much of this literature relies on cross-sectional competition measures that may be endogenous to firms' strategic choices. By using foreign leniency laws as a plausibly exogenous source of variation in competitive pressure, this study provides additional evidence on how competition shapes firms' investment behaviour and investment efficiency.

Third, the study contributes to the literature on the quiet life hypothesis by showing that collusive environments can weaken investment discipline, while stronger antitrust enforcement alters competitive incentives in ways that can improve capital allocation. In this regard, the findings complement Wang et al. (2025), who show that cartelization affects firms' information environments, by demonstrating that the same mechanism also influences real investment decisions. Overall, the study shows that leniency laws are not merely legal tools for detecting cartels, but also economically important shocks to the competitive environment with meaningful implications for firms' real policies. By linking the global expansion of antitrust enforcement to corporate investment outcomes, the analysis highlights an important channel through which competition policy affects capital allocation and long-run economic efficiency.

The remainder of this chapter is structured as follows. Section 3.2 reviews the relevant literature. Section 3.3 develops the hypotheses. Section 3.4 outlines the data, variables, and empirical strategy. Section 3.5 presents the main results. Section 3.6 reports the robustness

tests, while Section 3.7 examines cross-sectional variation in firms' responses. Finally, Section 3.8 concludes the chapter.

3.2 Literature Review

3.2.1 Collusion, Cartels, and the Case for Regulatory Intervention

Competition promotes productivity and innovation by encouraging firms to improve efficiency and by reallocating market share toward more productive firms (Carlin et al., 2001; Nelson & Winter, 1982). Collusion weakens these mechanisms by allowing firms to coordinate prices, restrict output, and sustain artificially high profit margins at the expense of consumers and economic efficiency.

Despite their illegality, cartels remain widespread and difficult to detect. Connor (2014) estimates that global cartels generated approximately \$1.6 trillion in overcharges between 1990 and 2013, while Connor and Helmers (2007) suggest that only 10–30% of cartels are ever discovered. In response, many jurisdictions introduced leniency programs as a central component of modern antitrust enforcement. These programs offer partial or full immunity to firms that voluntarily disclose their participation in cartels, thereby increasing incentives for cartel members to defect (Arce, 2010; Kreps et al., 1982; Motta & Polo, 2003). Although the United States introduced its leniency programme in 1978, its effectiveness increased substantially following the 1993 reforms, which granted automatic amnesty to the first qualifying applicant, conditional on full cooperation (Wang et al., 2025).

The success of the revised U.S. programme subsequently attracted international attention and contributed to the adoption of similar leniency frameworks in more than 50 countries (Hammond, 2005; Wang et al., 2025). Leniency programs operate by weakening the mutual trust necessary to sustain collusion and by creating strong first-mover incentives to self-report cartel activity (Harrington Jr, 2008; Motta & Polo, 2003). These effects are particularly important because many cartels operate across borders. Choi and Gerlach (2012) show that

antitrust enforcement in one jurisdiction can alter competitive incentives in another, highlighting the international transmission of competitive pressure.

Empirical evidence further suggests that leniency laws are effective in destabilising collusion. Miller (2009) finds that the 1993 US reforms increased cartel discoveries by approximately 60 percent and reduced cartel formation substantially, while Borrell et al. (2014) document improvements in perceived market competitiveness following the adoption of leniency programs across countries.

3.2.2 Corporate Consequences of Leniency Enforcement

A growing literature documents the broader corporate consequences of leniency enforcement. Prior research shows that stronger anticollusion enforcement intensifies competitive pressure and affects firms' financing, disclosure, and information environments. Dasgupta and Žaldokas (2019) show that the erosion of collusive rents alters firms' financing decisions, while Bourveau et al. (2020) find that leniency programs encourage firms to expand product market disclosure and are associated with declines in profit margins, equity returns, and product prices. Wang et al. (2025) further show that reduced cartelization increases expected crash risk, consistent with the view that collusive environments previously provided managers with a quiet life that facilitated bad news hoarding. More broadly, this evidence suggests that stronger competitive pressure can mitigate the managerial "quiet life" and encourage firms to make more disciplined corporate decisions.

However, stronger antitrust enforcement does not necessarily lead to more competitive outcomes in all settings. Dong et al. (2019) argue that firms may substitute explicit collusion with mergers to preserve market power through legal channels. Similarly, Bourveau et al. (2020) suggest that greater disclosure transparency may facilitate tacit coordination, whereby firms adjust behaviour using publicly available information without direct communication.

Collectively, these findings suggest that firms respond to leniency enforcement through both intensified competition and strategic substitution.

3.2.3 Leniency Enforcement and Investment

Despite the growing literature on leniency enforcement, limited attention has been given to its effect on corporate investment, a central channel through which competition influences long-run firm value and growth (Stoughton et al., 2017). Prior research shows that competitive conditions affect both the level and efficiency of investment (Boubaker et al., 2022; Laksmana & Yang, 2015; Stoughton et al., 2017), while information asymmetry contributes to investment inefficiency (Biddle & Hilary, 2006; Biddle et al., 2009). However, much of this literature relies on cross-sectional measures of competition that may be endogenous to firms' strategic choices. By exploiting the staggered global adoption of leniency laws as a source of plausibly exogenous variation in competitive pressure, this study examines whether stronger anticollusion enforcement alters firms' investment behaviour, a question that remains theoretically ambiguous.

3.3 Hypothesis Development

3.3.1 Leniency Enforcement and Total Investment

Competition is a key driver of productivity and innovation because it encourages firms to improve efficiency and adopt more effective technologies and organisational practices (Carlin et al., 2001). It also reallocates market share toward more productive firms, supporting the process of creative destruction described by Nelson and Winter (1982). However, these benefits may weaken when firms engage in anti-competitive behaviour. Bourveau et al. (2020) argue that weak regulatory environments can facilitate collusion, allowing firms to preserve market power and stable profits rather than compete through efficiency and innovation. By coordinating prices, restricting output, or dividing markets, cartels reduce competitive pressure and weaken incentives for firms to invest and innovate.

Leniency programs were introduced to destabilise collusion by encouraging firms to disclose cartel activity in exchange for partial or full immunity (Charistos & Papadopoulos, 2022). By increasing the risks associated with collusion, these programs weaken cartel stability and intensify competition. Motta and Polo (2003) argue that leniency rules raise the costs of maintaining collusive agreements by creating incentives for cartel members to defect. As collusive rents decline and competitive pressure increases, firms may respond by exerting greater effort and increasing investment to maintain and strengthen their market position. Greater competition may therefore encourage firms to allocate more resources toward investment, innovation, and operational efficiency.

Based on this reasoning, this study expects exposure to leniency enforcement to increase firms' total investment. The first hypothesis is therefore stated as follows:

H1. Greater exposure to leniency enforcement is associated with higher total firm investment.

3.3.2 Leniency Enforcement and Investment Efficiency

While leniency enforcement may increase overall investment, it may also affect the efficiency with which firms allocate capital. Investment efficiency refers to the extent to which firms' investment decisions align with underlying growth opportunities (Biddle et al., 2009). Inefficient investment can arise through underinvestment, where firms fail to undertake profitable projects, or overinvestment, where firms invest beyond levels justified by firm fundamentals. Collusive environments may contribute to both forms of inefficiency. By generating stable rents and weakening competitive discipline, cartelization can reduce managerial incentives to allocate resources efficiently.

Leniency programs, by destabilising collusive arrangements and intensifying competition, may therefore improve investment efficiency by strengthening managerial discipline and encouraging firms to align investment decisions more closely with growth opportunities. The channel through which investment efficiency improves depends on the

dominant agency conflict. Under the quiet life hypothesis (Bertrand & Mullainathan, 2003), limited competition may encourage managerial complacency and underinvestment, as managers avoid costly or effort-intensive projects. In this setting, stronger antitrust enforcement may improve efficiency by encouraging firms to undertake previously neglected investment opportunities. Accordingly, by mitigating the managerial “quiet life,” leniency-induced competition may encourage firms to work harder, reduce underinvestment, and make more disciplined investment decisions.

Alternatively, if managerial overconfidence, empire building, or free cash flow problems dominate (Jensen & Meckling, 1976; Richardson, 2006), collusion may facilitate overinvestment by generating excess rents that support inefficient expansion. In this case, leniency enforcement may improve efficiency by constraining inefficient investment and reducing overinvestment. In addition, intensified competition may encourage firms to allocate resources more effectively and invest in more productive projects. Prior research suggests that stronger competition associated with leniency enforcement improves resource allocation and promotes investment in innovation-oriented activities (Dasgupta & Žaldokas, 2019; Dong et al., 2019).

Based on this reasoning, leniency enforcement is expected to improve the alignment between firms’ investment decisions and their growth opportunities, thereby increasing investment efficiency. The second hypothesis is therefore stated as follows:

H2. Greater exposure to leniency enforcement is associated with higher investment efficiency.

3.3.3 Strategic Substitution and Alternative Mechanisms

The predictions developed in H1 and H2 assume that leniency enforcement strengthens product market competition and managerial discipline. However, firms may respond strategically in ways that weaken these effects. Prior research suggests that firms may substitute explicit collusion with alternative mechanisms that preserve market power. For example, mergers and

acquisitions may provide a legal channel through which firms consolidate market power and reduce competitive pressure. Dong et al. (2019) show that global leniency programs affect both profit margins and merger activity, suggesting that firms may respond to stronger antitrust enforcement by internalising competition through consolidation.

In addition, Bourveau et al. (2020) argue that greater transparency may facilitate tacit coordination by enabling firms to monitor competitors more effectively without direct communication. Consequently, some collusive outcomes may persist even under stronger antitrust enforcement. These mechanisms suggest that the competitive and disciplinary effects of leniency enforcement may be attenuated. As a result, the overall effect of leniency laws on corporate investment and investment efficiency remains an empirical question.

3.4 Sample, Variables, and Empirical Design

3.4.1 Sample

This study employs a comprehensive panel dataset obtained from the Compustat North America database to investigate the impact of leniency laws on corporate investment behaviour, covering the period from 1990 to 2021. Following established empirical approaches such as those of Dasgupta and Žaldokas (2019), Bourveau et al. (2020), and Biddle et al. (2009), a series of selection criteria are applied to ensure the consistency, accuracy, and robustness of the dataset.

The sample is restricted to firms headquartered in the United States and reporting financial data in U.S. dollars to maintain comparability in accounting and reporting standards. Firms operating in the financial sector, corresponding to Standard Industrial Classification (SIC) codes 6000 to 6999, and in the utilities sector, corresponding to SIC codes 4900 to 4999, are excluded.

These industries are subject to unique regulatory frameworks that can significantly affect financing and investment decisions, thereby introducing potential bias into the analysis.

In addition, firms with total assets below 0.5 million U.S. dollars are excluded to remove micro-firms that may exhibit atypical financial patterns and limited external financing, which could distort the results. Observations with missing or invalid data for key financial variables, such as total assets or fiscal year, are omitted. Duplicate entries, identified using firm identifiers and reporting dates, are removed to ensure the integrity of the panel structure and to maintain a one-to-one mapping between firms and years. Industry classification is conducted using two-digit SIC codes for aggregate industry-level analysis, while three-digit SIC codes are used for more detailed analyses to capture industry-specific heterogeneity.

3.4.2 Variables

3.4.2.1 Dependent Variables: Investment Metrics

3.4.2.1.1 Total Investment

The primary variables of interest are constructed using Compustat data. To measure total investment, this study follows the approach of Stoughton et al. (2017) and Chen et al. (2011). Total investment is defined as the sum of a firm's capital expenditures, research and development (R&D) expenditures, and acquisition costs, minus proceeds from the sale of property, plant, and equipment (PPE), scaled by lagged total assets.

This scaling controls for firm size and facilitates meaningful comparisons across firms operating in different industries and of varying scale. The resulting measure provides a consistent indicator of how intensively firms allocate resources toward expansion, innovation, and long-term growth initiatives. It captures a firm's overall commitment to value-enhancing activities and reflects the strategic dimensions of corporate investment behaviour in response to regulatory and competitive forces.

3.4.2.1.2 Investment Efficiency

I define investment efficiency as the extent to which a firm undertakes investments that are consistent with its underlying investment opportunities, following Biddle et al. (2009). Deviations from the expected level of investment reflect investment inefficiency and may arise in the form of either overinvestment or underinvestment. To estimate expected investment, I use a firm-level model that relates investment to growth opportunities, proxied by sales growth. This approach is grounded in the theoretical frameworks of Modigliani and Miller (1958) and Hubbard (1997), which emphasise the role of investment opportunities in shaping corporate investment decisions. Consistent with Biddle et al. (2009), the residual-based model captures deviations between actual and expected investment. The investment model is specified as follows:

$$Investment_{i,t+1} = \beta_0 + \beta_1 \cdot SalesGrowth_{i,t} + \epsilon_{i,t+1}$$

Where:

Investment_{i,t+1} represents total investment for firm *i* in year *t* + 1,

SalesGrowth_{i,t} is the percentage change in sales for firm *i* from year *t* – 1 to *t*,

β₀ and *β₁* are regression coefficients, and

ε_{i,t+1} is the residual term capturing deviations from predicted investment.

I estimate this model separately for each two-digit Standard Industrial Classification (SIC) industry-year group, requiring a minimum of twenty firm-year observations. The residual from the model captures the difference between a firm's actual and expected investment. A positive residual indicates that actual investment exceeds the predicted level and therefore represents overinvestment, whereas a negative residual indicates that actual investment falls below the predicted level and represents underinvestment.

To construct the investment efficiency measure used in the main analysis, I take the absolute value of the residual from the expected investment model. This transformation

captures the magnitude of the deviation from expected investment regardless of whether the deviation reflects overinvestment or underinvestment. Following Stoughton et al. (2017), larger absolute residuals indicate greater investment inefficiency. For ease of interpretation, I multiply the absolute residual by -1 so that higher values indicate greater investment efficiency. Accordingly, values closer to zero represent investment levels that are more closely aligned with expected investment, while increasingly negative values indicate larger deviations and therefore lower investment efficiency.

This measure provides a direction-neutral assessment of investment efficiency and allows me to examine whether exposure to foreign leniency laws is associated with investment decisions that are more closely aligned with firms' underlying investment opportunities.

3.4.2.1.3 Overinvestment

I define overinvestment as the extent to which a firm's actual investment exceeds the level predicted by its growth opportunities, indicating inefficient resource allocation. This occurs when firms allocate capital to projects that generate returns below the cost of capital.

To measure overinvestment, I isolate the positive residuals obtained from the investment efficiency model described above. Residuals that are zero or negative are set to zero, as they do not reflect excess investment. This approach follows Biddle et al. (2009) and Chen et al. (2011), who define overinvestment as the portion of investment that exceeds the level justified by a firm's growth opportunities. By focusing on positive deviations from expected investment, this measure captures instances where firms allocate capital beyond their optimal investment levels.

Overinvestment is particularly relevant for understanding how firms adjust their investment behaviour in response to regulatory reforms such as leniency laws. By intensifying competition and reducing the stability of collusive arrangements, these reforms may encourage firms to increase investment as they work harder to maintain or strengthen their competitive

position. In some cases, this response may lead firms to invest beyond levels justified by their growth opportunities, resulting in excessive capital spending. Accordingly, this measure provides a useful framework for examining how competitive and regulatory pressures influence corporate resource allocation decisions.

3.4.2.1.4 Underinvestment

I define underinvestment as the extent to which a firm's actual investment falls below the level predicted by its growth opportunities, indicating missed opportunities to undertake value-enhancing projects. To measure underinvestment, I focus on the negative residuals obtained from the investment efficiency model described above. Residuals that are zero or positive are set to zero, as they do not reflect insufficient investment. I then take the absolute value of the remaining residuals to capture the magnitude of the shortfall in investment relative to predicted levels.

This approach follows Chen et al. (2011) and Biddle et al. (2009), who conceptualise underinvestment as the extent to which firms fail to allocate sufficient resources to growth opportunities. By capturing negative deviations from expected investment, this measure highlights inefficiencies that arise when firms do not fully exploit profitable investment opportunities.

3.4.2.2 Treatment Variable: Foreign Leniency

To capture U.S. firms' exposure to international regulatory developments, a measure of foreign leniency is constructed using country-level import data from Schott's Data Library and cartel enforcement information obtained from *Cartel Regulation 2013*. Following Bourveau et al. (2020), the variable is computed as the weighted average of leniency laws adopted in foreign countries, where the weights correspond to the share of industry-level imports from each country relative to total imports within the industry.

This measure captures the extent to which U.S. industries are exposed to competitive pressure arising from foreign antitrust enforcement through international trade linkages. The adoption of leniency programs abroad increases the expected costs and detection risks associated with explicit collusion, thereby making collusive arrangements more difficult to sustain. Accordingly, the foreign leniency variable is constructed as a continuous measure capturing U.S. industries' exposure to leniency laws enacted outside the United States. The variable is defined as follows:

$$\text{Foreign Leniency}_{jt} = \sum_k w_{kj} L_{kt}$$

where:

- k represents a foreign country,
- j denotes a two-digit Standard Industrial Classification (SIC) industry,
- t denotes the year,
- w_{kj} is the proportion of industry j 's sales imported from country k

relative to the total sales of industry j in 1990, and

- L_{kt} is an indicator variable equal to 1 if country k has enacted a leniency law by year t , and 0 otherwise.

This formulation operationalizes industry-level exposure to foreign leniency enforcement. The use of fixed weights from 1990, consistent with Bourveau et al. (2020), ensures that the variable is not affected by subsequent changes in trade structures or industry classifications. Foreign leniency ranges from zero, indicating no exposure to foreign leniency laws, to one, indicating complete exposure, where all relevant foreign trading partners have adopted leniency programs.

It is important to note that the foreign leniency measure is constructed at the two-digit SIC industry-year level. Consequently, all firms within the same industry in a given year receive the same foreign leniency value. Although the outcome variables and firm-specific

controls are measured at the firm level, variation in foreign leniency exposure occurs across industries and over time rather than across firms within the same industry-year. A firm-specific measure would require detailed data on the import exposure of individual firms, which were not available for this study. Accordingly, the analysis examines firm-level investment responses to industry-level variation in foreign leniency exposure.

The foreign leniency variable captures the idea that as more countries adopt leniency laws, competitive pressure increases for U.S. industries exposed through international trade linkages, thereby raising the risks and costs associated with sustaining collusive behaviour. Importantly, this measure does not imply that U.S. firms collude directly with foreign suppliers. Rather, it reflects competitive interactions with foreign firms producing similar goods and operating in interconnected markets, thereby influencing domestic competitive dynamics (Bourveau et al., 2020).

To illustrate the transmission mechanism underlying foreign leniency exposure, consider automobile manufacturers operating in both the United States and European markets. Firms competing across multiple geographic regions frequently interact with the same rivals in parallel markets, creating strategic interdependence across jurisdictions. The industrial organization literature describes this setting as multimarket competition, where repeated interaction across markets can sustain coordinated behaviour under certain conditions (Bernheim & Whinston, 1990; Bourveau et al., 2020). When antitrust enforcement intensifies in one jurisdiction, these strategic relationships may be disrupted beyond the location of the regulatory change.

For example, the adoption of a leniency program within the European Union increases the likelihood of cartel detection and weakens incentives for coordination among firms operating there. Because many multinational firms participate simultaneously in U.S. and European product markets, the breakdown of collusion abroad can alter competitive dynamics

in the United States as well. Theoretical models show that enforcement actions in one market can destabilize collusive equilibria in interconnected markets through cross-market strategic linkages (Choi & Gerlach, 2013).

This mechanism implies that foreign regulatory reforms can reshape competitive conditions faced by U.S. firms even without domestic policy changes. As more trading partners implement leniency laws, competitive pressure transmitted through international market integration increases, encouraging firms to adjust investment decisions in response to heightened rivalry. The foreign leniency variable therefore captures these cross-border competitive spillovers, linking international antitrust enforcement to domestic corporate investment behaviour.

3.4.2.3 Control Variables

To enhance the robustness of the empirical analysis and mitigate potential endogeneity concerns, the model includes a set of control variables that capture firm characteristics known to influence corporate investment decisions. These controls account for differences in firm size, growth opportunities, and uncertainty surrounding firms' operating and investment environments. Firm size, measured as the natural logarithm of total assets, is included to capture differences in organizational scale and resource availability. Larger firms typically possess greater access to internal and external financing and are therefore better positioned to adjust investment policies in response to competitive pressures and regulatory changes (Brown et al., 2009; Le et al., 2021).

Growth opportunities are proxied by the market to book, defined as the ratio of the market value of assets to their book value. Firms with stronger growth prospects are generally expected to undertake higher levels of investment, making this variable an important determinant of investment behaviour (Aghion et al., 2005; Le et al., 2021).

To account for uncertainty affecting investment decisions, the study further controls for both cash flow volatility and investment volatility. Following Liu and Wysocki (2017), cash flow volatility is measured as the standard deviation of operating cash flows scaled by total assets over a rolling five-year window. This variable captures uncertainty in firms' internal funding capacity, which may constrain or delay investment activity. Investment volatility, consistent with Biddle et al. (2009), is measured as the rolling five-year standard deviation of total investment at the firm level. This measure controls for historical instability in investment patterns, ensuring that the estimated effects of leniency laws are not driven by pre-existing fluctuations in corporate investment decisions. Overall, these control variables help isolate the effect of leniency laws by accounting for firm-level heterogeneity and uncertainty, thereby strengthening the credibility of the empirical results.

To capture the role of financial conditions in shaping investment behaviour, the analysis includes the Zscore as a proxy for financial stability, following Le et al. (2021). The Zscore provides a composite measure of a firm's financial health by combining indicators related to liquidity, accumulated profitability, operating performance, and sales activity. Controlling for this measure ensures that the estimated effects of leniency laws are not driven by underlying financial distress or weak operating performance, thereby improving the reliability of the empirical results.

The model also controls for asset tangibility (TANG), defined as the ratio of property, plant, and equipment (PPENT) to total assets (AT) (Biddle & Hilary, 2006; Biddle et al., 2009). Tangibility captures the share of assets that can be pledged as collateral and is closely linked to firms' investment capacity and financing conditions, making it an important determinant of corporate investment decisions. In addition, K structure (Market Leverage) is included, measured as the ratio of long-term debt to the sum of long-term debt and the market value of equity. This variable reflects the firm's reliance on debt financing relative to equity and

captures financial leverage, which plays a central role in investment choices. Higher leverage may increase financial risk and limit firms' flexibility to undertake new investments, particularly during periods of heightened uncertainty (Biddle et al., 2009).

Following Biddle and Hilary (2006) and Biddle et al. (2009), the analysis incorporates two measures of financial slack to capture firms' internal liquidity and operational performance: CFO to Sales and Slack. *CFO to Sales*, defined as the ratio of cash flow from operations (CFO) to sales, serves as an indicator of operational efficiency and reflects a firm's capacity to generate internal funds from core business activities. Higher values indicate stronger operating performance and a greater ability to finance investment without reliance on external capital markets. *Slack* is measured as the ratio of cash holdings to property, plant, and equipment (PPE) and captures the availability of internal liquidity that can be deployed toward future investment opportunities. This measure reflects the extent to which firms possess readily accessible financial resources that enhance investment flexibility.

Collectively, these variables capture key dimensions of financial flexibility by accounting for both internally generated cash flows and accumulated liquidity reserves. Including these controls ensures that the estimated effects of leniency laws on investment behaviour are not driven by differences in firms' internal financing capacity, thereby strengthening the interpretation of the empirical results. In addition to firm-level financial and operational characteristics, the analysis incorporates several control variables to account for dividend policy, firm life-cycle considerations, and external competitive pressures, thereby ensuring a comprehensive examination of the relationship between leniency laws and corporate investment behaviour.

Dividend is measured using a dummy variable equal to one if a firm pays dividends in a given year and zero otherwise. Dividend-paying firms are typically associated with stronger financial positions, more stable cash flows, and more disciplined investment policies (Biddle

& Hilary, 2006). Including this variable helps control for differences in financial maturity and payout preferences that may influence firms' investment decisions independently of regulatory changes. By accounting for dividend behaviour, the analysis isolates the effect of leniency laws from firm-specific financial policies that could otherwise bias the estimated relationship between competition enforcement and investment activity.

To account for variation in firms' operating environments and life-cycle characteristics that may influence investment behaviour, the analysis includes three additional control variables: log firm age, operating cycle, and loss. Prior research shows that discretionary accruals and investment decisions vary systematically across business cycle stages and firm characteristics (Biddle et al., 2009; Dechow, 1994; Dechow & Dichev, 2002; Dechow et al., 1998). Log firm age is defined as the natural logarithm of one plus the number of years a firm has been listed in the Compustat database and serves as a proxy for firm maturity. Older firms are generally more established and tend to exhibit more stable and predictable investment patterns (Dechow et al., 1998).

The operating cycle is measured as the natural logarithm of 360 multiplied by the sum of receivables scaled by sales and inventory scaled by the cost of goods sold. This measure captures the length of time required for a firm to convert inventory into cash through sales (Biddle et al., 2009). Firms with longer operating cycles may face greater liquidity constraints, which can affect their ability to finance investment activities (Dechow & Dichev, 2002).

Finally, the loss indicator equals one if a firm reports negative earnings before extraordinary items and zero otherwise. Negative earnings are commonly associated with financial distress and reduced investment capacity (Dechow et al., 1998). In combination, these variables control for firm maturity, operational characteristics, and financial performance, confirming that the estimated effects of leniency laws on investment behaviour are not driven by underlying differences in firms' economic conditions.

To control for external market conditions that may influence firms' investment decisions, the analysis incorporates measures of import penetration and industry concentration. Import penetration, constructed at the industry level, captures the degree of exposure to international competition and trade-related pressures. Following Bourveau et al. (2020), it is defined as the ratio of imports to the sum of imports and domestic shipments minus exports. Including this variable helps ensure that the estimated effects of leniency laws are not driven by changes in trade exposure or shifts in global competitive conditions (Dasgupta & Žaldokas, 2019).

Moreover, industry concentration is measured using the Herfindahl–Hirschman Index (HHI), calculated at the two-digit SIC industry level. The HHI reflects the extent of market concentration, where higher values indicate more concentrated industries and lower competitive intensity. Consistent with Giroud and Mueller (2010), this measure captures how differences in market structure influence firms' investment incentives. Controlling for industry concentration allows the analysis to account for variation in competitive environments, providing a clearer assessment of how leniency laws interact with industry-level competition to shape corporate investment behaviour. Overall, these control variables ensure that the estimated effects of foreign leniency exposure reflect changes in competitive pressure rather than differences in firm characteristics, financial conditions, or industry environments.

3.4.2.4 Adoption of Leniency Programs Across Jurisdictions

The expansion of leniency programs across countries reflects the growing role of cartel enforcement in contemporary competition policy. Over the past three decades, competition authorities have increasingly relied on leniency provisions to detect and destabilise collusive agreements by encouraging cartel participants to disclose illegal conduct in exchange for reduced penalties.

Table 3.1 presents the adoption timeline of leniency programs across 54 jurisdictions, organised by region and year of implementation, illustrating how these policies gradually evolved from isolated national initiatives into a widely adopted global enforcement tool. Early adoption was concentrated among advanced economies with established legal systems and stronger regulatory capacity. The United States, which had operated a leniency programme since 1978, substantially revised its Corporate Leniency Policy in 1993, marking a turning point in cartel enforcement by formalising incentives for voluntary disclosure (Wang et al., 2025). Similar frameworks were subsequently introduced in other developed jurisdictions, including South Korea in 1997 and the United Kingdom in 1998. These early reforms contributed to the growing use of leniency mechanisms in cartel enforcement and provided a model that was subsequently adopted in other jurisdictions.

The diffusion of leniency programs accelerated during the early 2000s, particularly across Europe and Latin America, as countries modernised their competition regimes and aligned enforcement practices with emerging international standards. Brazil and Germany adopted leniency provisions in 2000, followed by France in 2001, reflecting broader institutional reforms aimed at strengthening antitrust enforcement. In subsequent years, adoption expanded to a wider group of emerging economies. Countries such as Lithuania (2008), Chile (2009), and India (2009) introduced leniency frameworks as part of broader regulatory development, while later adopters, including Thailand in 2016 and Argentina in 2018, further illustrate the continued global spread of these policies. Differences in adoption timing across jurisdictions reflect variation in domestic enforcement experience, institutional conditions, and the development of competition policy.

Advanced economies typically implemented leniency programs earlier due to established enforcement infrastructures, whereas emerging markets incorporated such mechanisms more gradually alongside broader legal and regulatory reforms. These staggered

adoption patterns are important for understanding how competition policy evolves internationally and how regulatory changes propagate across interconnected markets. From the perspective of this study, the global diffusion of leniency programs provides a meaningful institutional context for analysing firm behaviour.

As more trading partners introduce leniency laws, competitive conditions faced by U.S. firms may change even without domestic policy reforms. The variation in adoption timing therefore offers a useful setting for examining how foreign regulatory developments influence corporate investment decisions through international trade linkages. Recognising these global enforcement dynamics helps situate the empirical analysis within the broader evolution of competition policy and motivates the investigation of cross-border spillover effects on firm investment behaviour.

3.4.2.5 Institutional Background of Foreign Leniency Laws

Leniency programmes are designed to address a central difficulty in cartel enforcement because collusive agreements are often difficult for competition authorities to uncover. They encourage firms involved in cartels to come forward and provide information by offering full or partial immunity from penalties. By rewarding early cooperation, leniency programmes create uncertainty among cartel members about whether another participant may disclose the agreement, making collusion more difficult to maintain (Miller, 2009; Motta & Polo, 2003).

Countries have introduced these programmes under different institutional circumstances. Switzerland, for example, strengthened its competition framework in 2003 after experiencing difficulties in prosecuting firms involved in the international vitamin cartel. Mexico followed a different route, introducing a leniency programme in 2006 after an OECD review identified weaknesses in the investigative tools available for detecting secret cartels. These cases suggest that the adoption of leniency provisions has been shaped both by domestic

enforcement experience and by recommendations from international institutions (Dasgupta & Žaldokas, 2019; Lipsky, 2009).

A practical example of how leniency operates is provided by Dong et al. (2019) in their discussion of the European truck cartel. The truck manufacturers Daimler, Iveco, DAF, and Volvo were collectively fined approximately €2.93 billion for their involvement in a cartel that lasted for 14 years. MAN, a German truck manufacturer and another participant in the cartel, avoided a fine after revealing the cartel and receiving full immunity under the leniency programme. This case shows how the possibility of immunity gives cartel participants a direct incentive to disclose collusive conduct and cooperate with competition authorities.

Foreign leniency laws are particularly relevant to U.S. firms when they operate in markets connected through international trade. As trading partners adopt stronger cartel enforcement, cross-border collusive arrangements may become more difficult to maintain because the likelihood of detection and prosecution increases. Existing evidence indicates that the introduction of foreign leniency laws is associated with higher cartel conviction rates and weaker collusive activity involving U.S. firms (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019; Dong et al., 2019).

In this study, the Foreign Leniency measure captures U.S. firms' exposure to leniency laws adopted by their foreign trading partners. As discussed in Section 3.4.2.4, the staggered adoption of these laws provides variation across countries and over time. This variation is combined with international trade linkages to examine whether changes in foreign cartel enforcement are associated with the investment behaviour of U.S. firms.

3.4.3 Summary Statistics and Correlation Matrix

Table 3.2, Panel A presents summary statistics for all variables employed in the main analysis and provides an overview of their central tendencies and dispersion across the sample. Total Investment, the primary measure of firms' investment activity, reports a mean of 0.196 and a

median of 0.124, with a standard deviation of 0.277, indicating substantial cross-sectional variation in firms' investment levels and meaningful differences in investment intensity across firms. Investment Efficiency, measured as the negative absolute value of the residual from the expected investment model, has a mean of -0.134 and a median of -0.093 , with a standard deviation of 0.156. Because higher values (i.e., values closer to zero) indicate greater investment efficiency, these statistics capture the extent to which firms' actual investment deviates from expected investment.

Turning to the explanatory variables, Foreign Leniency, which measures firms' exposure to leniency laws implemented in foreign jurisdictions, has a mean of 0.086 and a median of 0.071, with a standard deviation of 0.076. These values are broadly consistent with those reported in prior studies, such as Bourveau et al. (2020), supporting the validity of the constructed measure. Firm characteristics display considerable heterogeneity across the sample. Firm size, measured as the natural logarithm of total assets, has a mean of 5.445 and a median of 5.275, reflecting variation in organizational scale. The market-to-book ratio, which proxies for growth opportunities, averages 2.382 with a median of 1.707, indicating substantial differences in growth opportunities across firms. Measures capturing uncertainty and operational volatility further highlight dispersion in firms' economic environments. Cash Flow Volatility and Investment Volatility exhibit mean values of 0.101 and 0.111, respectively, indicating notable variation in both operating performance and investment dynamics across firms.

Similarly, financial condition indicators reveal meaningful cross-sectional differences. The average Z-score of 4.611, with a median of 3.437, suggests that, on average, firms maintain relatively stable financial positions, although substantial variation remains across the sample. In addition, asset tangibility (TANG) has a mean of 0.192, reflecting heterogeneity in firms' asset structures. Likewise, the capital structure measure, K Structure, defined as long-term debt

scaled by financial capital, has a mean of 0.135, indicating differences in firms' reliance on long-term financing.

Turning to operating performance, the ratio of CFO to Sales records a mean of -1.373 and a standard deviation of 8.578, indicating considerable variation in firms' operating cash flow performance. Moreover, Slack, which captures financial flexibility, has a mean of 7.372 and a relatively large standard deviation of 27.290, highlighting substantial differences in firms' liquidity positions and internal financing capacity. Additional firm characteristics further describe the composition of the sample. Approximately 31.1 percent of firm-year observations distribute dividends, while the average log firm age of 2.450 reflects variation in firm maturity.

Furthermore, the operating cycle has a mean value of 5.010, reflecting differences in firms' production processes and cash conversion periods. Moreover, about 40.4 percent of firm-year observations report negative net income, as captured by the loss indicator, highlighting variation in firms' financial performance over time. Turning to industry- and market-level measures, these variables also exhibit meaningful dispersion across the sample. Import penetration records a mean of 0.028 and a median of 0.016, indicating heterogeneous exposure to international competitive pressures across industries. Similarly, the Herfindahl–Hirschman Index (HHI), which captures industry concentration, has a mean of 0.096 and a median of 0.065, suggesting substantial differences in the competitive environments faced by firms.

Overall, the descriptive statistics reveal pronounced cross-sectional variation in investment activity, investment efficiency, firm characteristics, and competitive exposure. These patterns are broadly consistent with prior evidence, including Bourveau et al. (2020), and support the suitability of the dataset for examining the effects of foreign leniency laws on

corporate investment behaviour. Detailed definitions of all variables are provided in Appendix 3-B to enhance transparency and facilitate replication.

Panel B of Table 3.2 reports the Pearson correlation matrix for the main variables used in the analysis, providing preliminary insights into their pairwise relationships and offering useful context for the subsequent empirical results. The reported coefficients reveal several systematic associations across the variables. * Indicates statistical significance at the 1 percent level. Focusing on the dependent variables, Total Investment and Investment Efficiency are strongly and positively correlated (0.967). Given that Investment Efficiency is measured as the negative absolute deviation of actual investment from expected investment, with higher values indicating greater efficiency, the strong positive correlation indicates a close association between firms' investment levels and the investment efficiency measure in the sample. Nevertheless, the two variables capture conceptually distinct dimensions of corporate investment behaviour and are examined separately as dependent variables in the subsequent regression analyses.

Turning to the key explanatory variable, Foreign Leniency is negatively correlated with Total Investment (-0.045), and this correlation is statistically significant at the 1 percent level. In contrast, its correlation with Investment Efficiency is -0.003 and is not statistically significant. These small pairwise correlations provide only preliminary evidence and do not account for firm characteristics, fixed effects, or other factors incorporated in the multivariate analysis. Foreign Leniency is also positively correlated with Import Penetration (0.253) and firm size (0.282), with both correlations statistically significant at the 1 percent level.

With respect to firm characteristics, the market-to-book ratio is positively correlated with both Total Investment (0.282) and Investment Efficiency (0.216). Similarly, financial Slack is positively correlated with Total Investment (0.167) and Investment Efficiency (0.087). Cash Flow Volatility is also positively correlated with both Total Investment (0.370) and

Investment Efficiency (0.291). These correlations indicate that firms with greater growth opportunities, financial slack, and cash flow volatility tend to exhibit higher investment levels and higher values of the investment efficiency measure, although these simple pairwise associations should not be interpreted as causal relationships.

Industry-level measures display negative associations with both investment outcomes. Import Penetration is negatively correlated with Total Investment (-0.116) and Investment Efficiency (-0.032). Similarly, the Herfindahl–Hirschman Index (HHI) is negatively correlated with Total Investment (-0.117) and Investment Efficiency (-0.010). Although statistically significant, particularly small coefficients should be interpreted cautiously in terms of their economic magnitude.

Overall, with the exception of the strong correlation between the two dependent variables, the pairwise correlations are generally moderate in magnitude. Importantly, Total Investment and Investment Efficiency are estimated separately as dependent variables and are not jointly included as explanatory variables in the regression specifications. Accordingly, their high correlation does not itself create a multicollinearity problem in the reported regressions. The correlations among the explanatory variables also do not indicate a substantial multicollinearity concern. Nevertheless, the reported correlations represent simple pairwise associations and should not be interpreted as causal relationships, as they do not account for unobserved firm heterogeneity, time-specific effects, or other determinants of corporate investment. These factors are addressed in the subsequent multivariate analysis.

As an additional diagnostic, Variance Inflation Factor (VIF) tests are conducted to assess potential multicollinearity among the explanatory variables. VIF measures the extent to which the variance of estimated coefficients is inflated due to correlations among predictors. Following the interpretation guidelines of Daoud (2017), VIF values below 5 indicate that multicollinearity is unlikely to pose a concern. In this study, all VIF values remain well below

this threshold, with a maximum value of 1.93, indicating that multicollinearity is unlikely to materially affect the regression estimates.

3.4.4 Empirical Design

I examine the effect of foreign leniency laws on corporate investment behaviour using a two-way fixed effects framework. The analysis is based on a panel dataset of United States firms obtained from the Compustat North America database over the period 1990 to 2021. The empirical design incorporates firm and year fixed effects to control for time-invariant firm characteristics and common shocks affecting all firms in a given year. Standard errors are clustered at the industry-year level to account for correlation in the error terms within industries over time as well as common shocks affecting firms within the same industry-year, following Jiang et al. (2025) and Dasgupta and Žaldokas (2019).

Controlling for these sources of unobserved heterogeneity helps mitigate potential endogeneity concerns arising from omitted variables that could bias the estimated relationship between foreign leniency exposure and corporate investment outcomes. The empirical specification is given by:

$$Y_{i,t} = \alpha + \beta_1 \text{Foreign leniency}_{i,t} + \sum \delta \cdot X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$$

where i indexes firms and t denotes fiscal years. All continuous variables are winsorized at the 1st and 99th percentiles to mitigate the influence of extreme observations. The variables in the model are defined as follows:

The dependent variable $Y_{i,t}$ captures firm i 's investment behaviour in year t . In the baseline specifications, this variable represents either total investment or investment efficiency. Total investment captures the overall level of firms' investment activity. Investment efficiency is measured as the negative absolute value of the residual from the expected investment model, such that higher values indicate smaller deviations from expected investment and therefore greater investment efficiency. Together, these measures capture both the quality and quantity

of firms' investment decisions in response to investment opportunities and competitive pressures. $X_{i,t}$ denotes a vector of firm-level control variables that capture firm characteristics, financial conditions, and industry-level factors affecting investment behaviour. Detailed definitions and motivations for these variables are provided in Section 3.4.2.3.

The terms μ_i and λ_t represent firm and year fixed effects, respectively. Firm fixed effects control for all time-invariant characteristics specific to each firm, while year fixed effects capture aggregate macroeconomic and regulatory shocks affecting all firms within a given year. The error term $\varepsilon_{i,t}$ captures unobserved influences not explained by the included covariates. Together, these fixed effects address unobserved heterogeneity across firms and over time. This specification allows the analysis to isolate the effect of foreign leniency laws while mitigating potential biases arising from unobserved firm-specific and time-related factors (Fang et al., 2014; Hashmi, 2013).

The empirical analysis proceeds in a structured manner. First, I estimate the baseline specification to examine the association between foreign leniency exposure and corporate investment outcomes. Second, I introduce firm-level control variables to account for observable heterogeneity in financial characteristics. Third, I incorporate industry-level controls to capture broader competitive pressures and market structure. This sequential approach provides a transparent assessment of how the estimated effect of foreign leniency laws evolves as additional determinants of investment behaviour are considered. Overall, this specification combines fixed effects with a comprehensive set of controls consistent with prior literature, thereby strengthening identification and reducing concerns related to omitted variable bias.

3.5 Empirical Results

The empirical results reported in Table 3.3 provide evidence on the effect of foreign leniency laws on corporate investment behaviour. This section evaluates both the statistical significance and the economic implications of foreign leniency exposure across the main dimensions of firms' investment decisions. All specifications follow the empirical framework described in Section 3.4.4.

Column (1) reports the results for total investment. The coefficient on Foreign Leniency is positive and statistically significant at the 1% level ($\beta = 0.224$). This indicates that greater exposure to foreign leniency laws is associated with a higher overall level of investment. The finding suggests that intensified competition resulting from leniency enforcement encourages firms to expand their investment activity. Firms may respond to increased competitive pressure by undertaking additional investment to strengthen their competitive position, consistent with the view that leniency enforcement influences real economic activity through heightened product market competition.

Column (2) presents the results for Investment Efficiency. The coefficient on Foreign Leniency is positive and statistically significant at the 1% level ($\beta = 0.494$). Investment Efficiency is measured as the negative absolute value of the residual from the expected investment model, such that higher values indicate smaller deviations from expected investment and therefore greater investment efficiency. Accordingly, the positive coefficient indicates that greater exposure to foreign leniency laws is associated with improved investment efficiency. This finding is consistent with the argument that stronger competitive pressure disciplines firms' investment decisions and encourages capital allocation that is more closely aligned with underlying investment opportunities.

The control variables also reveal several notable relationships with corporate investment. In Column (1), Size ($\beta = 0.050$), Market-to-Book ($\beta = 0.024$), and Cash Flow Volatility ($\beta = 0.556$) are positively and statistically significant at the 1% level, indicating that larger firms, firms with greater growth opportunities, and firms experiencing greater cash flow volatility tend to invest more. Investment Volatility is negatively associated with Total Investment ($\beta = -0.330$, significant at the 1% level), while K Structure is positively associated with Total Investment ($\beta = 0.074$, significant at the 1% level). Log Firm Age is negatively associated with Total Investment ($\beta = -0.136$, significant at the 1% level), whereas HHI is positively associated with Total Investment ($\beta = 0.130$, significant at the 1% level).

For Investment Efficiency in Column (2), Size ($\beta = 0.047$), Market-to-Book ($\beta = 0.024$), Cash Flow Volatility ($\beta = 0.555$), and K Structure ($\beta = 0.073$) are positively and statistically significant at the 1% level. By contrast, Investment Volatility ($\beta = -0.326$), Z-score ($\beta = -0.002$), and Log Firm Age ($\beta = -0.149$) are negatively and statistically significant at the 1% level. Loss ($\beta = 0.015$) and HHI ($\beta = 0.135$) are also positively and statistically significant at the 1% level. TANG, CFO to Sales, Dividend, Operating Cycle, and Import Penetration are not statistically significant.

To assess the economic magnitude of the results, I consider the effect of a one-standard-deviation increase in Foreign Leniency. As reported in Table 3.2, Foreign Leniency has a standard deviation of 0.076. In Column (1), multiplying this value by the estimated coefficient of 0.224 gives an increase of approximately 0.017 units in Total Investment. Relative to the sample mean of 0.196, this corresponds to approximately 8.7% of mean Total Investment.

For Investment Efficiency in Column (2), the coefficient on Foreign Leniency is 0.494. A one-standard-deviation increase in Foreign Leniency therefore corresponds to an increase of approximately 0.038 units in Investment Efficiency ($0.494 \times 0.076 = 0.0375$). Given that the

standard deviation of Investment Efficiency reported in Table 3.2 is 0.156, this effect corresponds to approximately 24.1% of one standard deviation of Investment Efficiency. Since higher values of the investment efficiency measure indicate smaller deviations from expected investment, the estimated effect suggests an economically meaningful improvement in investment efficiency associated with greater exposure to foreign leniency laws.

Overall, the results provide support for Hypotheses 1 and 2. Greater exposure to foreign leniency laws is associated with both higher total investment and greater investment efficiency. These findings are consistent with the view that stronger antitrust enforcement and the resulting competitive pressure influence not only the amount firms invest but also the efficiency with which capital is allocated.

3.6 Robustness Checks

3.6.1 Alternative Total Investment Measures

To further validate the baseline findings and ensure that the results are not driven by a specific definition of investment, the analysis employs alternative measures capturing different dimensions of corporate capital allocation. Firms invest through multiple channels, including tangible assets, innovation activities, and acquisitions. Examining these components separately provides a more comprehensive assessment of how foreign leniency exposure shapes firms' real investment behaviour.

Table 3.4, Panel A, reports the results and shows that the positive relationship between foreign leniency laws and corporate investment remains robust across alternative investment proxies. Column (1) presents the results for capital expenditures (CAPEX), measured as capital expenditures scaled by firm value. This measure is widely used as a proxy for firms' investment in productive capacity (Smith Jr & Watts, 1992; Vogt, 1997). The coefficient on Foreign Leniency is positive and statistically significant (0.075, $p < 0.05$), indicating that firms with

greater exposure to foreign leniency enforcement increase their investment in tangible assets. This suggests that stronger competitive pressure encourages firms to expand their operational capacity and reinforce their competitive position through higher capital expenditure.

Column (2) extends the analysis to R&D scaled by lagged total assets, capturing firms' investment in innovation relative to their existing asset base (Gaver & Gaver, 1993). The coefficient on Foreign Leniency is positive and statistically significant (0.177, $p < 0.01$), indicating that firms exposed to stronger leniency-induced competitive pressure allocate more resources to R&D activities. This finding suggests that the effects of leniency enforcement extend beyond physical investment to include innovation-oriented expenditure. Firms facing intensified competition appear to strengthen their technological capabilities and invest in activities that support future growth.

Column (3) examines acquisitions, measured as acquisition expenditures scaled by lagged total assets. This measure captures firms' reliance on external expansion strategies and reflects inorganic investment. The coefficient on Foreign Leniency is positive and statistically significant (0.093, $p < 0.05$), indicating that firms exposed to stronger competitive pressure modestly increase their acquisition activity. Although the magnitude is smaller than that observed for CAPEX and R&D, this result suggests that firms respond to intensified competition not only by strengthening internal investment but also by selectively pursuing external growth opportunities.

Column (4) reports results for organic investment, defined as the sum of CAPEX and R&D scaled by lagged total assets (R. Chen et al., 2017). This measure captures internally generated growth by combining firms' investment in both tangible and intangible assets. The coefficient on Foreign Leniency is positive and statistically significant (0.139, $p < 0.01$), indicating that firms exposed to stronger leniency-induced competitive pressure increase their

internally financed investment. This result is consistent with the evidence from the CAPEX and R&D specifications and suggests that firms adjust along multiple internal margins rather than relying on a single investment channel.

Overall, these findings indicate that foreign leniency laws influence multiple dimensions of corporate investment. Firms appear to adjust both internal and external investment strategies in response to heightened competitive pressure, highlighting the multifaceted nature of capital allocation under competition-enhancing regulatory reforms. The strongest responses are observed in internally generated investment, particularly capital expenditures and R&D, while acquisition activity exhibits a more moderate adjustment. This pattern suggests that foreign leniency laws primarily stimulate organic growth, while also contributing to a smaller yet positive increase in external expansion.

Importantly, the consistency of the estimates across all alternative investment measures strengthens confidence in the baseline results. The positive and statistically significant association between foreign leniency exposure and investment persists regardless of how investment is defined, indicating that the findings are not driven by any particular proxy. Taken together, the evidence supports the view that competition-enhancing regulatory reforms systematically influence firms' capital allocation decisions, encouraging sustained investment in both productive capacity and innovation. These robustness results provide additional support for Hypothesis 1 and reinforce the interpretation that foreign leniency laws act as an exogenous source of competitive pressure shaping firms' real investment behaviour.

To assess whether this effect extends beyond the firm level, I conduct additional analysis reported in Appendix Table 3-A2, which examines industry acquisition intensity (Hoberg et al., 2014). The results show a positive and statistically significant relationship between foreign leniency exposure and industry-level acquisition activity, suggesting that the

impact of leniency laws extends to broader industry dynamics. Additional robustness tests reported in Appendix 3-A confirm that the main findings remain consistent when using lagged foreign leniency exposure and alternative measures of product market competition.

3.6.2 Alternative Measures of Investment Efficiency

To further understand the mechanisms through which foreign leniency laws affect investment efficiency, I decompose investment inefficiency into underinvestment and overinvestment. Prior literature suggests that these two forms of inefficiency may arise from distinct agency conflicts. On the one hand, the quiet life hypothesis (Bertrand & Mullainathan, 2003) implies that reduced competitive pressure may weaken managerial incentives, leading firms to forgo profitable but effort-intensive projects (González et al., 2019; Stein, 2003).

Under this view, collusion is expected to be associated with underinvestment, and increased competition induced by leniency enforcement should reduce this distortion. On the other hand, agency conflicts such as managerial overconfidence, empire building, or the misallocation of free cash flow (Jensen & Meckling, 1976; Richardson, 2006) may lead to overinvestment, particularly when firms earn rents under weak competitive conditions. By eroding these rents and intensifying competitive pressure, leniency enforcement may also influence overinvestment behaviour. The relative importance of these channels is therefore an empirical question examined through the decomposition of investment inefficiency into its underinvestment and overinvestment components.

Panel B of Table 3.4 reports the results based on this decomposition. Column (1) presents the estimates for underinvestment. The coefficient on Foreign Leniency is negative and statistically significant (-0.266 , $p < 0.01$), indicating that greater exposure to foreign leniency laws is associated with a reduction in underinvestment. This finding is consistent with

stronger competitive pressure mitigating the managerial “quiet life” and encouraging firms to exert greater effort by undertaking projects that might otherwise be postponed or forgone. Column (2) examines overinvestment. The coefficient on Foreign Leniency is positive and statistically significant (0.229, $p < 0.01$), indicating that firms exposed to stronger leniency enforcement exhibit a higher tendency to invest beyond the benchmark level. This pattern suggests that while stronger competition encourages firms to increase investment activity, in some cases this response may result in investment exceeding levels justified by firms’ growth opportunities.

These findings reveal different effects across the two forms of investment inefficiency. The reduction in underinvestment is consistent with foreign leniency exposure encouraging firms to work harder and undertake investment opportunities that might otherwise have been forgone. However, the increase in overinvestment indicates that some firms respond to stronger competitive pressure by increasing investment beyond their expected levels. Thus, although the baseline results indicate an overall improvement in investment efficiency, the decomposition reveals that this effect is not uniform across the two forms of investment inefficiency.

The positive and statistically significant coefficient on Foreign Leniency in the baseline investment efficiency specification provides support for Hypothesis 2, indicating that greater foreign leniency exposure is associated with smaller absolute deviations from expected investment and therefore greater investment efficiency. The decomposition analysis provides additional insight into this overall effect. Foreign leniency exposure is associated with lower underinvestment but higher overinvestment, suggesting that stronger competitive pressure affects the two forms of investment inefficiency differently. Taken together, the results indicate an overall improvement in investment efficiency, alongside a reduction in underinvestment,

while also showing that some firms increase investment beyond expected levels in response to intensified competition.

3.6.3 Assessing Foreign Leniency Exposure: The Role of Major Trade Partners

The baseline measure of foreign leniency exposure is constructed using imports from all trading partners within each industry. To further assess the robustness of the results, I follow Callen and Fang (2021) and construct an alternative measure that focuses on the most economically important trade partners. Specifically, foreign leniency exposure is recalculated using only the top five U.S. import partners within each industry, denoted as FLL_TOP5. Focusing on the largest trading partners provides a more stringent test of the underlying mechanism, as U.S. imports are typically concentrated among a small number of countries that exert the greatest competitive pressure on domestic firms.

If the baseline findings reflect economically meaningful exposure to foreign leniency enforcement, they should persist when the measure is restricted to these dominant sources of trade. The regression results are reported in Table 3.5. Consistent with the baseline findings, the coefficient on FLL_TOP5 is positive and statistically significant in both the total investment and investment efficiency specifications. In Column (1), the coefficient on FLL_TOP5 is positive and statistically significant at the 1% level ($\beta = 0.101$), indicating that greater exposure to leniency enforcement through major trading partners is associated with higher total investment.

Similarly, Column (2) shows that FLL_TOP5 is positive and statistically significant at the 1% level ($\beta = 0.208$). Given that Investment Efficiency is measured such that higher values indicate greater investment efficiency, the positive coefficient indicates that greater exposure to foreign leniency laws through major trading partners is associated with improved investment efficiency. Collectively, these findings show that the positive associations between foreign

leniency exposure and both total investment and investment efficiency persist when attention is restricted to the most economically relevant trading partners.

While Callen and Fang (2021) examine the implications of leniency laws for stock price crash risk, the present analysis extends their framework to the context of corporate investment behaviour. Overall, the results provide additional support for the robustness of the main findings when foreign leniency exposure is measured using only the most influential trading partners. This evidence suggests that the documented relationships are not driven solely by smaller or less economically relevant trading partners but also arise from exposure through major international trade relationships.

3.6.4 Foreign Leniency Exposure through Export Markets

Following Bourveau et al. (2020), who highlight the importance of alternative treatment definitions in robustness analysis, I construct an export-based measure of foreign leniency exposure (FLL_EXP) to complement the baseline import-based specification. While the main measure captures competitive pressure arising from imports into the U.S. market, the export-based approach reflects the competitive environment faced by U.S. firms in international markets. This provides an additional perspective on how foreign leniency laws influence firm behaviour through global competition. Consistent with prior studies such as Callen and Fang (2021), examining this alternative channel allows for a more comprehensive assessment of the role of foreign regulatory enforcement.

The regression results are reported in Table 3.6. The estimates are consistent with the baseline findings, indicating that the relationship between foreign leniency exposure and corporate investment remains robust when exposure is measured through export markets. In Column (1), the coefficient on FLL_EXP is positive and statistically significant at the 1% level ($\beta = 0.271$), suggesting that firms facing greater foreign leniency exposure through export

markets increase their overall level of investment. In Column (2), FLL_EXP is also positive and statistically significant at the 1% level ($\beta = 0.597$). Given that Investment Efficiency is measured such that higher values indicate greater investment efficiency, the positive coefficient indicates that greater foreign leniency exposure through export markets is associated with improved investment efficiency.

This pattern suggests that firms not only expand investment in response to greater foreign leniency exposure but also exhibit investment levels that are more closely aligned with expected investment. Overall, these findings reinforce the robustness of the main results. By incorporating an export-based measure, the analysis captures an additional channel through which international competition affects corporate decisions. The consistency of the results across both import- and export-based specifications indicates that the relationship between foreign leniency exposure and corporate investment extends beyond competition arising through imports and is also evident through firms' exposure to international export markets.

3.7 Cross-Sectional Tests

In this section, I examine whether the impact of foreign leniency laws on corporate investment varies across firm and industry characteristics. Foreign leniency programs increase the expected costs of collusion and intensify product market competition, but firms are unlikely to respond uniformly to these changes. The strength of the effect is expected to depend on differences in market conditions, industry structure, firm performance, and information environments.

To capture this heterogeneity, I introduce a set of moderating variables that reflect product market competition, industry concentration, profitability, and financial reporting quality. In each specification, foreign leniency exposure is interacted with one of these factors to assess how its association with investment outcomes differs across firms facing different

economic conditions. Table 3.7 reports the results of these cross-sectional tests. To provide a comprehensive assessment, I examine both the level and the efficiency of investment decisions.

Accordingly, Panel A presents results for total investment, while Panel B reports results for investment efficiency. All regressions include firm and year fixed effects, together with the full set of control variables used in the baseline models. Standard errors are reported in parentheses and are clustered at the industry-year level to ensure robust inference.

3.7.1 Measurement of Moderating Variables

In addition to the main treatment variable, the empirical analysis incorporates several firm- and industry-level variables that capture differences in market structure, competitive dynamics, and firms' information environments. These variables are used in the cross-sectional tests to examine whether the effect of foreign leniency exposure varies across different economic conditions. First, product market fluidity (PM Fluidity), obtained from Hoberg and Phillips (2016), measures the extent to which firms' competitive environments evolve over time based on changes in product market descriptions. Higher levels of product market fluidity indicate more dynamic industries in which firms frequently face shifting competitive positions and evolving strategic interactions with rivals.

Second, industry concentration is measured using the text-based Herfindahl–Hirschman Index derived from the Textual Network Industry Classification framework (TNIC3HHI) developed by Hoberg and Phillips (2016). Unlike traditional concentration measures based on SIC codes, the TNIC approach captures product market competition using textual similarity in firms' product descriptions, thereby providing a more granular and firm-specific measure of industry concentration. Third, to capture firm-level performance and potential market power, profitability is measured using gross profit scaled by total assets (Gross

Profit to Assets). Higher values of this measure reflect stronger operating performance and may also indicate the presence of market power in less competitive environments.

Finally, financial reporting quality (FRQ) is included to capture differences in firms' information environments. Following the modified Dechow and Dichev (2002) framework, FRQ is calculated as the negative rolling standard deviation of residuals from the accrual quality model estimated over the previous five years. As a result, higher values of FRQ indicate better reporting quality and lower information asymmetry. In addition, to mitigate the influence of extreme observations, all continuous variables are winsorized at the 1st and 99th percentiles, following standard practice in empirical finance research. This procedure ensures that outliers do not exert disproportionate influence on the regression results, thereby improving the reliability and robustness of the empirical analysis.

3.7.2 Moderating Effect of Product Market Fluidity

The first cross-sectional test examines whether the effect of foreign leniency laws on corporate investment varies with the level of product market fluidity (PM Fluidity). Product market fluidity, developed by (Hoberg et al., 2014), captures the extent to which firms' competitive environments evolve over time based on similarities in product descriptions. Higher levels of fluidity reflect more dynamic markets, where firms face frequent changes in competitive positioning and greater uncertainty regarding future market conditions. In such environments, firms are likely to respond more actively to shifts in regulatory enforcement that alter the intensity of competition.

To examine this moderating effect, I interact PM Fluidity with the foreign leniency variable. The regression results reported in Column (1) of Table 3.7 indicate that product market fluidity is positively and statistically associated with firms' investment outcomes. In Panel A, where total investment is the dependent variable, PM Fluidity exhibits a positive and

significant coefficient ($\beta = 0.006$, $p < 0.01$), suggesting that firms operating in more dynamic markets increase their level of investment. A similar pattern is observed in Panel B, where investment efficiency is the dependent variable ($\beta = 0.007$, $p < 0.01$), indicating that firms in more fluid markets also allocate capital more effectively.

However, the interaction between PM Fluidity and foreign leniency is negative and statistically significant in both panels (Panel A: $\beta = -0.035$, $p < 0.01$; Panel B: $\beta = -0.041$, $p < 0.01$). This finding suggests that the positive effect of product market fluidity on investment outcomes is moderated when firms are exposed to stronger antitrust enforcement through foreign leniency laws. One possible explanation is that firms operating in highly fluid markets already face substantial competitive pressure and uncertainty. When additional regulatory discipline is introduced through stronger leniency enforcement, firms may adopt a more cautious and selective approach to investment decisions. Rather than expanding investment aggressively, firms may focus on prioritising projects with clearer returns and lower risk.

Overall, these findings highlight that the impact of foreign leniency laws depends not only on regulatory pressure but also on the competitive environment in which firms operate. In particular, the results suggest that while dynamic markets encourage investment and efficiency, the incremental effect of leniency enforcement becomes weaker in environments where competitive pressure is already high.

3.7.3 Moderating Effect of Industry Concentration

Industry structure plays an important role in shaping how firms respond to changes in competition policy. In the industrial organisation literature, higher market concentration is typically associated with weaker competitive pressure and a greater scope for coordinated behaviour among firms. Early studies such as Bain (1951) and Demsetz (1973) argue that firms operating in concentrated industries face limited rivalry and therefore have weaker incentives

to invest in innovation or expand capacity. In such environments, firms can sustain their market positions without undertaking substantial investment.

Regulatory interventions that increase the expected costs of collusion may alter these incentives. Leniency programs are designed to destabilise cartel arrangements by encouraging firms to report anti-competitive conduct in exchange for reduced penalties. As a result, the introduction of leniency laws can intensify competition, particularly in industries where concentration previously facilitated coordination. In these settings, stronger antitrust enforcement may prompt firms to adjust their investment behaviour to maintain or strengthen their competitive position.

To examine this moderating effect, I use the TNIC-based Herfindahl–Hirschman Index (TNIC3HHI) developed by Hoberg and Phillips (2016). Unlike traditional measures based on SIC classifications, the TNIC approach captures industry concentration using textual similarity in firms' product descriptions, providing a more precise measure of competitive proximity. Higher values of TNIC3HHI indicate more concentrated industries and lower levels of competition. I therefore interact TNIC3HHI with the foreign leniency variable to assess whether the effect of foreign leniency exposure varies across industries with different levels of concentration.

The regression results reported in Column (2) of Table 3.7 show that TNIC3HHI is negatively and statistically associated with investment outcomes in both panels. In Panel A, where total investment is the dependent variable, TNIC3HHI exhibits a negative and significant coefficient ($\beta = -0.035$, $p < 0.01$), indicating that firms in more concentrated industries invest less. A similar pattern is observed in Panel B, where higher concentration is associated with lower investment efficiency ($\beta = -0.034$, $p < 0.01$), suggesting weaker capital allocation in less competitive environments.

The interaction between TNIC3HHI and foreign leniency is positive and statistically significant in both panels (Panel A: $\beta = 0.303$, $p < 0.01$; Panel B: $\beta = 0.309$, $p < 0.01$). This finding indicates that foreign leniency laws mitigate the negative effect of industry concentration on investment outcomes. In more concentrated industries, stronger enforcement appears to increase competitive pressure, encouraging firms to expand investment and allocate resources more effectively.

A possible explanation is that leniency programs weaken collusive arrangements and increase competitive pressure in markets where coordination was previously easier to sustain. In response, firms may adjust by increasing investment in capacity, innovation, or product differentiation to maintain their competitive position. This interpretation is consistent with Dong et al. (2019), who show that leniency programs reduce collusion and strengthen product market competition.

Overall, these results highlight the interaction between regulatory enforcement and market structure in shaping corporate investment decisions. While higher concentration is generally associated with lower investment and weaker efficiency, the introduction of foreign leniency laws offsets this effect by intensifying competition and encouraging more active investment behaviour.

3.7.4 Moderating Effect of Profitability

The third cross-sectional test examines whether the effect of foreign leniency laws on corporate investment varies across firms with different levels of profitability. In this analysis, profitability is measured using gross profit scaled by total assets (Gross Profit to Assets), which captures a firm's ability to generate operating income from its asset base. Higher values of this measure reflect stronger operating performance and may also indicate the presence of market power. Firms operating in less competitive environments are often able to sustain higher margins, as competitive pressures are relatively limited.

This view is consistent with the industrial organisation literature, which suggests that highly profitable firms tend to possess greater market power and therefore face weaker competitive constraints (Bain, 1951; Demsetz, 1973). When firms benefit from such advantages, their performance is less reliant on continuous investment, as existing market positions can be maintained without substantial expansion or innovation. As a result, investment decisions in these settings are more likely to reflect the preservation of existing advantages rather than responses to competitive pressure. This suggests that the effect of foreign leniency laws may differ across firms depending on their level of profitability.

Regulatory interventions such as leniency programs can further reshape these competitive conditions. Dong et al. (2019) using a difference-in-differences framework, show that the global adoption of leniency laws significantly weakens collusive behaviour among firms. Leniency reforms are associated with higher conviction rates and a decline in firms' gross margins, reflecting stronger competitive pressure in markets that were previously conducive to coordination. These findings suggest that profitability is not only an indicator of operating performance but also reflects firms' exposure to changes in enforcement intensity. As leniency laws disrupt collusive arrangements and reduce the ability to sustain high margins, firms may need to adjust their investment strategies. This highlights the importance of examining how profitability interacts with foreign leniency exposure when analysing firms' investment responses.

The regression results reported in Column (3) of Table 3.7 show that Gross Profit to Assets is negatively and statistically associated with investment outcomes in both panels. In Panel A, where total investment is the dependent variable, the coefficient is negative and significant ($\beta = -0.166$, $p < 0.01$), indicating that more profitable firms tend to invest less. A similar pattern is observed in Panel B, where profitability is negatively related to investment

efficiency ($\beta = -0.172$, $p < 0.01$), suggesting weaker capital allocation among firms with greater market power.

These findings are consistent with the view that firms earning high rents face weaker incentives to expand investment when competitive pressures are limited (Porter, 1980).

However, the interaction between Gross Profit to Assets and foreign leniency is positive and statistically significant in both panels (Panel A: $\beta = 0.566$, $p < 0.01$; Panel B: $\beta = 0.589$, $p < 0.01$). This result indicates that foreign leniency laws mitigate the negative effect of profitability on investment outcomes. Firms that previously benefited from strong market positions appear to respond to increased competitive pressure by expanding investment and improving the efficiency of capital allocation.

These findings are consistent with the broader literature on regulatory interventions and firm behaviour. Increased competition can stimulate strategic investment as firms seek to defend or enhance their market position (Spence, 1975; Sutton, 1991). In this context, firms with high gross profits relative to their asset base are often characterised by substantial market power (Bain, 1951; Demsetz, 1973), where profitability may reflect limited competition rather than superior efficiency.

Evidence from Dong et al. (2019) shows that leniency laws raise the expected costs of collusion and weaken firms' ability to sustain anti-competitive practices. As these constraints become more binding, firms that previously relied on strong margins may adjust by increasing investment to remain competitive in a more transparent and contestable environment. Overall, the results indicate that leniency laws play a key role in reshaping the behaviour of firms with significant market power by encouraging more active investment and improved resource allocation.

3.7.5 Moderating Effect of Financial Reporting Quality

The fourth cross-sectional test examines whether the effect of foreign leniency laws on corporate investment varies with the quality of firms' financial reporting. Financial reporting quality (FRQ) plays an important role in shaping investment decisions by reducing information asymmetry and improving the quality of information available to managers and external stakeholders. Prior research, such as Chen et al. (2011), shows that higher FRQ enhances investment efficiency, particularly in settings where alternative sources of information are limited.

In this study, FRQ is measured as the negative rolling standard deviation of residuals from the modified Dechow and Dichev (2002) model over the previous five years, such that higher values indicate better reporting quality. Firms with higher FRQ are therefore expected to make more efficient investment decisions, as improved transparency facilitates more accurate evaluation of investment opportunities and mitigates agency frictions.

However, the role of FRQ may change in the presence of regulatory interventions such as leniency laws. By intensifying competition and altering the external environment in which firms operate, foreign leniency laws may affect the extent to which high-quality financial reporting provides an advantage in guiding investment decisions. To examine this moderating effect, I interact FRQ with the foreign leniency variable to assess whether the relationship between financial reporting quality and corporate investment varies with exposure to foreign antitrust enforcement.

The regression results reported in Column (4) of Table 3.7 show that financial reporting quality is positively associated with investment outcomes in both panels. In Panel A, where total investment is the dependent variable, FRQ exhibits a positive and statistically significant coefficient ($\beta = 0.002$, $p < 0.05$), indicating that firms with higher-quality financial reporting tend to invest more. A similar pattern is observed in Panel B, where FRQ is positively related

to investment efficiency ($\beta = 0.002$, $p < 0.10$), suggesting that improved reporting quality enhances firms' ability to allocate capital more effectively.

These findings are consistent with prior research showing that higher financial reporting quality reduces information asymmetry and supports more efficient investment decisions (Chen et al., 2011; Dechow & Dichev, 2002). However, the interaction between FRQ and foreign leniency is negative and statistically significant in both panels (Panel A: $\beta = -0.013$, $p < 0.01$; Panel B: $\beta = -0.011$, $p < 0.01$).

This result indicates that the positive effect of financial reporting quality on investment outcomes becomes weaker when firms are exposed to stronger competitive pressure induced by leniency laws. One possible explanation is that, as competition intensifies, the relative importance of internal information quality declines, as firms rely more on external market signals and strategic responses rather than on informational advantages derived from financial reporting.

These findings extend the insights of Chen et al. (2011) by showing that the role of financial reporting quality in shaping investment behaviour depends on the regulatory and competitive environment. Stronger antitrust enforcement may partially offset the benefits typically associated with higher reporting quality, as firms adjust their behaviour in response to increased competition. Overall, the results highlight the interaction between internal governance mechanisms and external regulatory forces. While financial reporting quality improves investment outcomes, its effectiveness is moderated by the competitive pressures introduced by foreign leniency laws, suggesting that both internal and external factors jointly influence firms' investment decisions.

In summary, the cross-sectional analyses provide strong evidence that the effect of foreign leniency laws on corporate investment varies systematically across firm and industry characteristics. The results show that foreign leniency exposure interacts with key economic

factors, including product market fluidity, industry concentration, firm profitability, and financial reporting quality, to shape firms' investment responses. In several cases, the introduction of leniency laws alters both the magnitude and, in some instances, the direction of these relationships, indicating that stronger antitrust enforcement reshapes the incentives underlying corporate investment decisions.

More specifically, the findings suggest that the impact of foreign leniency laws is more pronounced in environments characterised by higher industry concentration and among firms with greater profitability, where competitive pressures were previously weaker. In contrast, in more dynamic markets with higher product market fluidity, the effect of foreign leniency laws becomes weaker, suggesting that firms already facing substantial competitive pressure are less responsive to additional regulatory shocks.

In addition, although higher financial reporting quality generally facilitates investment by reducing information asymmetry, its influence diminishes under intensified competitive conditions induced by leniency laws. Overall, these results indicate that foreign leniency laws affect corporate investment not only directly but also indirectly by shaping the economic mechanisms that govern firms' investment behaviour. This highlights the importance of considering both firm-level characteristics and industry conditions when evaluating the broader effects of antitrust enforcement on corporate decision making.

3.8 Conclusion

This chapter examines how leniency laws influence corporate investment behaviour and the competitive environment in which firms operate. Leniency programmes have become an important tool of modern antitrust enforcement because they weaken cartel arrangements by encouraging participating firms to disclose collusive conduct in exchange for reduced penalties. Although prior research has mainly focused on their enforcement and legal implications, less attention has been given to their effects on firms' real economic decisions.

In this context, I investigate whether exposure to foreign leniency laws affects the investment behaviour and investment efficiency of U.S. firms. To address this question, I use a comprehensive panel of publicly listed firms from 1990 to 2021, which allows me to examine how changes in the global antitrust environment shape corporate investment decisions over time. The empirical analysis provides consistent evidence that exposure to foreign leniency laws is associated with higher levels of total investment and improved investment efficiency. The findings further show that the improvement in investment efficiency is primarily driven by a reduction in underinvestment, although intensified competition is also associated with higher levels of overinvestment.

Overall, the results suggest that stronger competitive pressure mitigates the managerial “quiet life” and encourages firms to work harder by undertaking investment opportunities that may previously have been delayed or overlooked. Although some firms also increase investment beyond expected levels, the overall evidence is consistent with stronger competitive discipline influencing firms’ investment decisions and capital allocation. These findings indicate that leniency programmes influence not only firms’ compliance behaviour, but also their strategic investment decisions and capital allocation policies. By weakening collusive arrangements and intensifying competition in product markets, leniency laws appear to encourage firms to respond more actively to growth opportunities.

I further show that these effects are not confined to domestic regulatory changes. By constructing a measure of foreign leniency exposure based on U.S. industries’ import linkages with countries that adopt leniency laws, I document economically meaningful cross-border effects on corporate investment decisions. This evidence suggests that regulatory developments abroad can influence firm behaviour in the United States through international trade connections, highlighting the increasingly global nature of competition policy.

I also conduct a broad range of robustness tests to ensure that the findings are not driven by specific modelling choices or variable definitions. The results remain consistent across alternative measures of investment, including capital expenditures, research and development, acquisitions, and their combined forms. The findings also remain robust across alternative specifications, measures of competition, clustering approaches, and fixed effects structures, reinforcing confidence in the stability of the results. Similar conclusions are also obtained when foreign leniency exposure is redefined using major trading partners and export-based measures, further supporting the stability of the estimates across different definitions of competitive exposure.

Taken together, these robustness checks reinforce the central conclusion of the chapter. The positive associations between foreign leniency exposure, total investment, and investment efficiency remain robust across a broad range of specifications. While the improvement in investment efficiency is primarily driven by lower underinvestment, the evidence also suggests that some firms respond to stronger competition by increasing investment beyond expected levels. Overall, these findings strengthen confidence in the empirical results and highlight the important role of leniency laws in shaping firms' investment decisions and capital allocation policies.

Further evidence from the cross-sectional analysis shows that the effect of foreign leniency laws varies across different firm and industry environments. In particular, the findings indicate that product market conditions, profitability, industry concentration, and financial reporting quality all influence firms' investment responses to intensified competition. The investment effect is weaker in highly fluid product markets, where competitive pressure is already strong, suggesting that additional regulatory discipline may encourage firms to adopt a more cautious approach to investment decisions.

By contrast, the effect of leniency laws is stronger in concentrated industries, where competition is typically weaker and firms tend to invest less. In these environments, stronger antitrust enforcement appears to encourage firms to increase investment as competitive pressure intensifies. A similar pattern is observed among highly profitable firms, where greater market power may have previously reduced incentives to invest more aggressively.

The results also highlight an important interaction between external competition and firms' internal information environments. Although higher financial reporting quality is generally associated with more efficient capital allocation, its influence becomes less pronounced under intensified competitive pressure. This finding suggests that stronger market discipline may partially substitute for internal informational advantages in shaping firms' investment decisions. Overall, the cross-sectional evidence indicates that the effects of foreign leniency laws operate through multiple economic channels and vary across different competitive and informational environments.

In sum, the findings indicate that foreign leniency laws influence corporate investment not only by intensifying competitive pressure, but also by altering the incentives that shape firms' capital allocation decisions. As competitive conditions evolve, firms appear to adjust their investment strategies in a more responsive manner under stronger antitrust enforcement.

The investment response documented in this chapter should also be considered alongside the financing response examined in Chapter 4. The two responses reflect different but complementary dimensions of firms' adjustment to stronger competitive pressure. By weakening collusive arrangements and mitigating the managerial "quiet life," foreign leniency laws encourage firms to work harder, as reflected in higher investment and reduced underinvestment. At the same time, stronger competitive pressure encourages firms to make more conscious and prudent financing choices in response to the associated uncertainty and financial risk. Thus, the investment and financing findings can be understood as part of a

common response to stronger competitive discipline, whereby firms pursue investment opportunities while exercising greater prudence in their financing decisions. Chapter 4 examines this financing response through firms' debt maturity and capital structure adjustment decisions.

These findings contribute to the growing literature on the real effects of competition policy by showing that leniency programmes extend beyond their traditional enforcement role. While prior research has focused mainly on cartel detection and legal outcomes, the evidence presented in this chapter demonstrates that leniency laws also influence firms' investment behaviour and capital allocation policies. By increasing the costs of collusion and strengthening market discipline, these policies influence firms' investment incentives and encourage more active responses to growth opportunities. From a policy perspective, the findings suggest that antitrust enforcement can generate broader economic benefits by improving resource allocation and fostering more competitive product markets.

Furthermore, the robustness of the findings across a wide range of specifications strengthens confidence in the broader economic relevance of leniency laws and provides useful insights for policymakers seeking to design antitrust frameworks that both deter anti-competitive behaviour and support long-term economic growth. Future research may extend this analysis by examining the long-term effects of leniency programmes on market structure, innovation, and economic development, as well as by exploring how competition policy interacts with other regulatory and institutional environments.

In conclusion, the evidence presented in this chapter highlights the important role of competition policy in shaping corporate investment decisions and provides new insights into how international antitrust enforcement influences firm behaviour. By demonstrating the real economic effects of leniency laws, this study contributes to a broader understanding of how

regulatory frameworks affect market outcomes in an increasingly interconnected global economy.

Tables of Chapter 3

Table 3.1. Adoption of Corporate Leniency Programs Worldwide

This table reports the year in which each country adopted a corporate leniency program. Leniency programs incentivise cartel participants to self-report and cooperate with antitrust authorities in exchange for reduced penalties or immunity. The information is primarily drawn from *Cartel Regulation (2013)*, published by Getting the Deal Through, as well as press releases and news articles, following Callen and Fang (2021), and is further extended using evidence from Dasgupta and Žaldokas (2019) and Duong et al. (2024).

Country	Year	Country	Year
Argentina	2018	Lithuania	2008
Australia	2003	Luxembourg	2004
Austria	2006	Malaysia	2010
Belgium	2004	Mexico	2006
Brazil	2000	Netherlands	2002
Canada	2000	New Zealand	2004
Chile	2009	Norway	2005
China	2008	Pakistan	2007
Colombia	2009	Peru	2005
Croatia	2010	Philippines	2009
Cyprus	2011	Poland	2004
Czech Republic	2001	Portugal	2006
Denmark	2007	Romania	2004
Ecuador	2011	Russia	2007
Estonia	2002	Singapore	2006
Egypt	2005	Slovakia	2001
Finland	2004	Slovenia	2010
France	2001	South Africa	2004
Germany	2000	South Korea	1997
Greece	2006	Spain	2008
Hong Kong	2015	Sweden	2002
Hungary	2003	Switzerland	2004
Iceland	2005	Taiwan	2012
India	2009	Thailand	2016
Ireland	2001	Turkey	2009
Italy	2007	United Kingdom	1998
Japan	2005	USA	1993

Table 3.2. Summary Statistics and Correlation Matrix

This table presents summary statistics and correlations for the key variables used in the main analysis over the period 1990 to 2021. Panel A reports summary statistics, including the mean, median, standard deviation, and selected percentiles. Panel B presents the Pearson correlation matrix among the variables. All continuous variables are winsorized at the 1st and 99th percentiles to mitigate the influence of extreme values. * Indicates statistical significance at the 1 percent level. Detailed variable definitions are provided in Appendix 3-B.

Panel A: Summary Statistics

VARIABLES	Observation	Mean	Median	SD	P25	P75
Dependent variables						
Total Investment	26,753	0.196	0.124	0.277	0.061	0.233
Investment Efficiency	26,747	-0.134	-0.093	0.156	-0.166	-0.045
Other variables						
Foreign Leniency	26,747	0.086	0.071	0.076	0.022	0.132
Size	26,747	5.445	5.275	2.156	3.822	6.893
Market to Book	26,747	2.382	1.707	2.004	1.196	2.743
Cash Flow Volatility	26,747	0.101	0.061	0.124	0.034	0.114
Investment Volatility	26,747	0.111	0.060	0.151	0.027	0.130
Zscore	26,747	4.611	3.437	9.419	1.785	6.058
TANG	26,747	0.192	0.153	0.153	0.076	0.270
K Structure	26,747	0.135	0.056	0.183	0.000	0.202
CFO to Sales	26,747	-1.373	0.059	8.578	-0.044	0.126
Slack	26,747	7.372	1.023	27.290	0.234	4.015
Dividend	26,747	0.311	0.000	0.463	0.000	1.000
Log Firm Age	26,747	2.450	2.485	0.545	2.079	2.890
Operating Cycle	26,747	5.010	5.057	0.686	4.690	5.395
Loss	26,747	0.404	0.000	0.491	0.000	1.000
Import Penetration	26,747	0.028	0.016	0.032	0.007	0.032
HHI	26,747	0.096	0.065	0.075	0.055	0.104

Panel B: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Total Investment	1.000																	
(2) Investment Efficiency	0.967*	1.000																
(3) Foreign Leniency	-0.045*	-0.003	1.000															
(4) Size	-0.133*	-0.084*	0.282*	1.000														
(5) Market to Book	0.282*	0.216*	-0.052*	-0.186*	1.000													
(6) Cash Flow Volatility	0.370*	0.291*	-0.077*	-0.417*	0.346*	1.000												
(7) Investment Volatility	0.208*	0.157*	-0.059*	-0.097*	0.155*	0.406*	1.000											
(8) Zscore	-0.019*	-0.026*	-0.071*	0.021*	0.387*	-0.173*	-0.104*	1.000										
(9) TANG	-0.117*	-0.044*	-0.185*	0.175*	-0.193*	-0.243*	-0.095*	-0.144*	1.000									
(10) K Structure	-0.116*	-0.057*	-0.033*	0.268*	-0.312*	-0.182*	0.051*	-0.253*	0.332*	1.000								
(11) CFO to Sales	-0.219*	-0.155*	0.022*	0.158*	-0.177*	-0.296*	-0.154*	0.011*	0.117*	0.096*	1.000							
(12) Slack	0.167*	0.087*	0.018*	-0.128*	0.128*	0.326*	0.141*	0.128*	-0.316*	-0.153*	-0.242*	1.000						
(13) Dividend	-0.137*	-0.076*	0.007	0.429*	-0.141*	-0.242*	-0.146*	-0.040*	0.242*	0.140*	0.116*	-0.141*	1.000					
(14) Log Firm Age	-0.078*	-0.067*	0.566*	0.358*	-0.058*	-0.087*	-0.034*	-0.134*	-0.058*	0.022*	0.054*	-0.050*	0.127*	1.000				
(15) Operating Cycle	-0.047*	-0.059*	0.031*	-0.058*	0.004	-0.073*	-0.050*	0.063*	-0.176*	-0.072*	-0.090*	-0.073*	-0.077*	-0.024*	1.000			
(16) Loss	0.203*	0.130*	0.001	-0.373*	0.177*	0.374*	0.207*	-0.100*	-0.188*	-0.032*	-0.245*	0.227*	-0.351*	-0.117*	-0.021*	1.000		
(17) Import Penetration	-0.116*	-0.032*	0.253*	0.213*	-0.161*	-0.162*	-0.098*	-0.065*	0.201*	0.200*	0.097*	-0.123*	0.167*	0.139*	-0.053*	-0.156*	1.000	
(18) HHI	-0.117*	-0.010*	0.157*	0.237*	-0.153*	-0.157*	-0.084*	-0.071*	0.264*	0.240*	0.086*	-0.105*	0.231*	0.131*	-0.159*	-0.155*	0.283*	1.000

Table 3.3. The Effect of Foreign Leniency Laws on Corporate Investment Behaviour

This table reports regression results examining the effect of foreign leniency laws on corporate investment behaviour. Column (1) presents results for total investment, while Column (2) reports results for investment efficiency. All specifications include firm and year fixed effects to control for unobserved firm-specific heterogeneity and common time effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 3-B. Variance Inflation Factor (VIF) diagnostics indicate that multicollinearity is not a concern, with all VIF values below the conventional threshold of 5 and a maximum value of 1.93.

	(1)	(2)
VARIABLES	Total Investment	Investment Efficiency
Foreign Leniency	0.224*** (0.067)	0.494*** (0.070)
Size	0.050*** (0.005)	0.047*** (0.005)
Market to Book	0.024*** (0.002)	0.024*** (0.002)
Cash Flow Volatility	0.556*** (0.048)	0.555*** (0.048)
Investment Volatility	-0.330*** (0.035)	-0.326*** (0.034)
Zscore	-0.002*** (0.001)	-0.002*** (0.001)
TANG	0.003 (0.027)	0.005 (0.027)
K Structure	0.074*** (0.018)	0.073*** (0.018)
CFO to Sales	-0.000 (0.000)	-0.000 (0.000)
Slack	-0.000*** (0.000)	-0.000*** (0.000)
Dividend	0.002 (0.006)	0.001 (0.006)
Log Firm Age	-0.136*** (0.026)	-0.149*** (0.026)
Operating Cycle	0.012 (0.008)	0.011 (0.008)
Loss	0.012** (0.005)	0.015*** (0.005)
Import Penetration	0.099 (0.220)	0.176 (0.218)
HHI	0.130*** (0.039)	0.135*** (0.038)
Constant	0.079 (0.075)	-0.099 (0.073)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,753	26,747
R-squared	0.421	0.367

Table 3.4. Foreign Leniency Exposure and Corporate Investment: Robustness Tests

This table reports regression estimates assessing the robustness of the relationship between foreign leniency exposure and corporate investment. Panel A uses alternative measures of corporate investment, including CAPEX, R&D, acquisitions, and organic investment. Panel B uses alternative measures of investment efficiency, distinguishing between underinvestment and overinvestment. All regressions include the full set of control variables used in the baseline specification and incorporate firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 3-B.

Panel A: Alternative Measures of Corporate Investment

	(1)	(2)	(3)	(4)
VARIABLES	CAPEX	R&D / Lagged Assets	ACQ / Lagged Assets	Organic Investment (CAPEX + R&D)
Foreign Leniency	0.075** (0.024)	0.177*** (0.041)	0.093** (0.039)	0.139*** (0.051)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	26,833	26,753	26,753	26,753
R-squared	0.622	0.601	0.200	0.561

Panel B: Alternative Measures of Investment Efficiency

	(1)	(2)
VARIABLES	Underinvestment	Overinvestment
Foreign Leniency	-0.266*** (0.040)	0.229*** (0.050)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,897	26,747
R-squared	0.602	0.304

Table 3.5. Robustness Check of Foreign Leniency Laws Using Alternative Trade Partner Measure

This table reports regression results using an alternative measure of foreign leniency exposure constructed based on the top five U.S. import partners (FLL_TOP5), following Callen and Fang (2021). This specification focuses on the most economically relevant sources of foreign competitive pressure within each industry. The dependent variables are total investment and investment efficiency. All regressions include the full set of control variables and firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 3-B.

	(1)	(2)
VARIABLES	Total Investment	Investment Efficiency
FLL_TOP5	0.101*** (0.028)	0.208*** (0.027)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,753	26,747
R-squared	0.422	0.367

Table 3.6. Foreign Leniency Exposure and Corporate Investment: Export-Based Measure

This table reports regression estimates using FLL_EXP, an export-based measure of foreign leniency exposure constructed from industry-level export shares. This specification captures firms' exposure to foreign leniency laws through competition in international export markets. The dependent variables are total investment and investment efficiency. All regressions include the full set of control variables and firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 3-B.

	(1)	(2)
VARIABLES	Total Investment	Investment Efficiency
FLL_EXP	0.271*** (0.094)	0.597*** (0.107)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,753	26,747
R-squared	0.421	0.366

Table 3.7. Foreign Leniency Laws, Investment Intensity, and Investment Efficiency: Cross-Sectional Evidence

This table reports regression results examining whether the effect of foreign leniency laws on corporate investment varies across firm and industry characteristics. Panel A presents results for total investment, while Panel B reports results for investment efficiency. The main independent variable is Foreign Leniency. Interaction terms are included with product market fluidity (Column 1), industry concentration measured by TNIC3HHI (Column 2), profitability proxied by gross profit to assets (Column 3), and financial reporting quality (FRQ, Column 4). All regressions include the full set of control variables and firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 3-B.

Panel A: Total Investment Results

VARIABLES	(1) Total Investment	(2) Total Investment	(3) Total Investment	(4) Total Investment
Foreign Leniency	0.427*** (0.095)	0.136* (0.078)	-0.023 (0.082)	0.027 (0.091)
PM Fluidity	0.006*** (0.001)			
PM Fluidity × Foreign Leniency	-0.035*** (0.013)			
TNIC3HHI		-0.035*** (0.009)		
TNIC3HHI × Foreign Leniency		0.303*** (0.071)		
Gross Profit to Assets			-0.166*** (0.019)	
Gross Profit to Assets × Foreign Leniency			0.566*** (0.151)	
FRQ				0.002** (0.001)
FRQ × Foreign Leniency				-0.013*** (0.004)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	26,753	26,749	26,753	25,985
R-squared	0.422	0.421	0.427	0.424

Table 3.7: (Continued)

Panel B: Investment Efficiency Results				
	(1)	(2)	(3)	(4)
VARIABLES	Investment Efficiency	Investment Efficiency	Investment Efficiency	Investment Efficiency
Foreign Leniency	0.723*** (0.100)	0.405*** (0.074)	0.238*** (0.081)	0.314*** (0.095)
PM Fluidity	0.007*** (0.001)			
PM Fluidity $\times$ Foreign Leniency	-0.041*** (0.013)			
TNIC3HHI		-0.034*** (0.009)		
TNIC3HHI $\times$ Foreign Leniency		0.309*** (0.070)		
Gross Profit to Assets			-0.172*** (0.019)	
Gross Profit to Assets $\times$ Foreign Leniency			0.589*** (0.151)	
FRQ				0.002* (0.001)
FRQ $\times$ Foreign Leniency				-0.011*** (0.004)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	26,747	26,743	26,747	25,978
R-squared	0.367	0.367	0.373	0.370

Appendices of Chapter 3

Appendix 3-A. Additional Robustness Test

Table 3-A1 reports additional robustness tests of the relationship between foreign leniency exposure and corporate investment. Panel A shows that lagged Foreign Leniency remains positive and statistically significant for both total investment and investment efficiency, indicating that the main findings are robust to timing concerns.

Panel B uses an alternative measure of product market competition based on the TNIC classification developed by Hoberg and Phillips (2016), and the results remain positive and significant. Panel C reports estimates using standard errors clustered at the industry level, following Bourveau et al. (2020), and the results remain unchanged. Panel D replaces firm fixed effects with industry and year fixed effects, following Dong et al. (2019), and the results continue to hold. Overall, these tests suggest that the findings are not driven by timing concerns, the choice of competition proxy, clustering level, or fixed-effects specification.

Appendix Table 3-A1. Additional Robustness Tests

This table reports robustness tests of the relationship between foreign leniency exposure and corporate investment. Panel A uses a lagged specification to address timing concerns. Panel B employs TNIC3HHI as an alternative measure of product market concentration. Panel C reports results with standard errors clustered at the industry level, while Panel D replaces the baseline firm and year fixed effects with industry and year fixed effects. All regressions include the full set of control variables and relevant fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level, except in Panel C, where they are clustered at the industry level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 3-B.

Panel A: Lagged Effect of Foreign Leniency on Corporate Investment

	(1)	(2)
VARIABLES	Total Investment	Investment Efficiency
Lag (Foreign Leniency)	0.255*** (0.069)	0.533*** (0.068)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,753	26,747
R-squared	0.422	0.367

Panel B: Foreign Leniency and Corporate Investment (Alternative Competition Measures)

	(1)	(2)
VARIABLES	Total Investment	Investment Efficiency
Foreign Leniency	0.252** (0.068)	0.524** (0.071)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,749	26,743
R-squared	0.421	0.366

Appendix Table 3-A1:(Continued)

Panel C: Clustered Standard Errors (Industry Level)

	(1)	(2)
VARIABLES	Total Investment	Investment Efficiency
Foreign Leniency	0.224** (0.104)	0.494*** (0.178)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,753	26,747
R-squared	0.421	0.367

Panel D: Industry and Year Fixed Effects Specification

	(1)	(2)
VARIABLES	Total Investment	Investment Efficiency
Foreign Leniency	0.128** (0.050)	0.421*** (0.061)
Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	27,105	27,099
R-squared	0.226	0.157

Appendix Table 3-A2. Foreign Leniency and Industry Acquisition Intensity

This table reports regression results examining the relationship between foreign leniency exposure and industry-level acquisition activity. Industry acquisition intensity is defined as the total number of acquisitions within an industry divided by the number of firms in that industry, following Hoberg et al., 2014. The coefficient on Foreign Leniency is positive and statistically significant, indicating that industries more exposed to foreign leniency laws experience higher acquisition intensity. The regression includes the full set of control variables and firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry and year levels. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

(1)	
VARIABLES	Industry Acquisition Intensity
Foreign Leniency	0.342*** (0.097)
Controls	Yes
Firm FE	Yes
Year FE	Yes
Observations	26,897
R-squared	0.813

Appendix 3-B. Definition of Variables

This appendix provides detailed definitions of all variables used in the study, categorized into thematic groups for clarity. Each entry includes the variable name, definition, and data source.

1. Dependent Variables: Investment Measures

Variables	Definition	Source
Total Investment	The scaled sum of a firm's capital expenditures, research and development (R&D) expenses, and acquisition costs, minus proceeds from the sale of property, plant, and equipment (PPE), scaled by lagged total assets.	Compustat
Investment Efficiency	Following Stoughton et al. (2017), investment inefficiency is measured as the absolute value of the residual from the expected investment model, capturing the magnitude of deviations from expected investment regardless of whether they reflect overinvestment or underinvestment. Larger absolute residuals indicate greater investment inefficiency. For ease of interpretation, the measure is multiplied by -1 so that higher values indicate greater investment efficiency.	Compustat
Underinvestment	The absolute value of negative residuals from the expected investment model, capturing the magnitude by which actual investment falls below expected investment.	Compustat
Overinvestment	Positive residuals from the expected investment model, capturing the magnitude by which actual investment exceeds expected investment.	Compustat
CAPEX	Capital expenditure scaled by firm value (Smith Jr & Watts, 1992; Vogt, 1997).	Compustat
Organic Investment (CAPEX + R&D)	Capital expenditure plus R&D, scaled by lagged total assets, as a measure of investment in tangibles and intangibles (Chen et al., 2014).	Compustat
R&D / Lagged Assets	Research and development (R&D) expenses scaled by lagged total assets, an innovation-based investment measure (Gaver & Gaver, 1993).	Compustat
ACQ / Lagged Assets	Acquisition expenditure scaled by lagged total assets	Compustat
Industry Acquisition Intensity	Total number of acquisitions within an industry divided by the number of firms operating in that industry (Hoberg & Phillips, 2016).	Compustat

2. Foreign Leniency Exposure and Interaction Variables

Variables	Definition	Source
Foreign Leniency	The weighted average of leniency laws adopted in foreign countries, where weights are based on the share of imports from each country relative to total industry imports. This measure captures U.S. firms' exposure to foreign antitrust enforcement.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020).
FLL_TOP5	Import-weighted foreign leniency exposure constructed using only the top five U.S. trading partner countries within each industry.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020).
FLL_EXP	Export-weighted measure of foreign leniency exposure, capturing competitive spillovers through U.S. export links.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020).
PM Fluidity	Measures how much a firm's product market language is being adopted or dropped by competitors, indicating market dynamism (Hoberg & Phillips, 2016).	Hoberg and Phillips (2016).
PM Fluidity x Foreign Leniency	Interaction between product market fluidity and foreign leniency laws, capturing the combined effect of competitive market shifts and antitrust enforcement.	Schott's Data Library, Bourveau et al. (2020), Hoberg & Phillips (2016).
TNIC3HHI	Textual Network Industry Classification (TNIC)-based Herfindahl-Hirschman Index (HHI), reflecting product-market concentration specific to firms.	Hoberg and Phillips (2016).
TNIC3HHI x Foreign Leniency	Interaction between TNIC-HHI and foreign leniency, highlighting how regulatory pressures and market concentration jointly influence investment behaviour.	Hoberg and Phillips (2016).
Gross Profit to Assets	Gross profit divided by total assets, capturing firm profitability and potential monopoly rents.	Compustat
Gross profit to assets x Foreign Leniency	Interaction between gross profit to assets and foreign leniency, capturing how the effect of foreign leniency laws varies with firms' profitability.	Cartel Regulation 2013, Schott's Data Library, Compustat.

Variables	Definition	Source
FRQ	Financial Reporting Quality (FRQ), calculated as the negative rolling standard deviation of residuals from the Dechow-Dichev model over five years. Reduces information asymmetry.	Compustat
FRQ × Foreign Leniency	Interaction between financial reporting quality and foreign leniency laws, showing how competitive pressures alter the role of FRQ in investment decisions.	Cartel Regulation 2013, Schott's Data Library, Compustat.

3. Firm-Specific Controls

Variables	Definition	Source
Size	The natural logarithm of total assets, used as a proxy for firm size.	Compustat
Market to Book	The ratio of the market value of assets to their book value, indicating growth opportunities.	Compustat
Cash Flow Volatility	Standard deviation of cash flows from operations, scaled by average total assets over five years, measuring cash flow volatility.	Compustat
Investment Volatility	Standard deviation of total investment over the past five years, capturing investment volatility.	Compustat
Zscore	Financial stability index calculated as: $\text{Zscore} = 1.2 \times WCA + 1.4 \times \frac{RE}{AT} + 3.3 \times \frac{EBIT}{AT} + 0.6 \times \frac{MEF}{LT} + 0.999 \times \frac{SALE}{AT},$ where $WCA = (ACT - LCT)/AT$.	Compustat
TANG	Ratio of property, plant, and equipment (PPE) to total assets, representing asset tangibility.	Compustat
K Structure	Ratio of long-term debt to total financial capital (long-term debt + market value of equity).	Compustat
CFO to Sales	Ratio of cash flows from operations to sales, reflecting operational efficiency.	Compustat
Slack	Ratio of cash holdings to PPE, capturing financial flexibility.	Compustat

Variables	Definition	Source
Dividend	Dummy variable equal to 1 if a firm pays dividends, 0 otherwise.	Compustat
Log Firm Age	Natural logarithm of a firm's age, based on years since the firm was first listed in Compustat.	Compustat
Operating Cycle	Natural logarithm of $360 \times (\text{Accounts Receivable} / \text{Sales} + \text{Inventory} / \text{Cost of Goods Sold})$, measuring the time required for a firm to convert inventory and receivables into cash through sales.	Compustat
Loss	Indicator variable equal to 1 if a firm reports negative net income, 0 otherwise.	Compustat

4. Industry and Market Measures

Variables	Definition	Source
Import Penetration	Ratio of imports to total industry shipments minus exports, reflecting exposure to international competition.	Schott's Data Library
HHI	Herfindahl-Hirschman Index (HHI) of two-digit SIC industries, capturing industry concentration.	Compustat

CHAPTER 4. LENIENCY LAWS AND CORPORATE FINANCING

4.1 Introduction

In recent years, scholars, policymakers, and regulators have expressed growing concern about the weakening of product market competition in the United States and across the world. This decline is often linked to rising industry consolidation and collusive practices that enable firms to maintain market power (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019; Dong et al., 2019). These developments have renewed interest in understanding how changes in competitive conditions influence firm behaviour, not only in product markets but also in corporate financial decisions (Callen & Fang, 2021; Jiang et al., 2025; Xu, 2012).

Cartels impose substantial costs on consumers and distort resource allocation. Between 1990 and 2017, detected cartels accounted for nearly \$900 billion in affected sales, with estimated overcharges ranging between \$64 and \$286 trillion (Connor, 2020; Duong et al., 2024). Despite these significant costs, collusive agreements remain difficult to detect because they are deliberately concealed (Duong et al., 2024). Understanding how antitrust enforcement shapes firms' financing behaviour is therefore important, as capital structure decisions influence firms' ability to respond to competitive shocks and maintain financial flexibility.

To address collusion, many jurisdictions have introduced leniency programs that encourage firms to disclose their involvement and cooperate with antitrust authorities. These programs typically offer immunity or reduced penalties to firms that voluntarily report their participation and assist in investigations, and in some countries they also provide exemptions from criminal prosecution (Dasgupta & Žaldokas, 2019).

The reform of the U.S. leniency program in 1993 was particularly influential, as it disrupted existing cartels, deterred new ones, and inspired the adoption of similar legislation abroad (Bourveau et al., 2020). Table 4.1 presents the timeline of leniency law adoptions across

countries, based on *Cartel Regulation 2013*, press releases, and news articles, following Callen and Fang (2021), and extended using evidence from Dong et al. (2019) and Duong et al. (2024).

A growing body of empirical evidence supports the role of leniency programs in strengthening market competition. Miller (2009) shows that the U.S. leniency program significantly improved cartel detection and deterrence, thereby fostering a more competitive environment. Similarly, Borrell et al. (2014) document that the adoption of leniency programs across Europe increased managerial perceptions of competitive pressure. In addition, Dong et al. (2019) provide cross-country evidence that these programs facilitate the detection of previously hidden cartels. Collectively, these findings indicate that leniency laws have reshaped global competitive dynamics and constitute a central component of modern antitrust enforcement.

Theoretical research provides complementary insights into how leniency programs affect cartel stability. Kofman and Lawarree (1996) show that leniency can deter collusion within hierarchical structures, while subsequent models emphasise its broader destabilising effects on cartels. By lowering the cost of defection for firms that self-report and increasing the expected penalties for those that remain silent, leniency programs weaken incentives to sustain collusive agreements (Aubert et al., 2003; Ellis & Wilson, 2003; Motta & Polo, 2003). As a result, collusion becomes less sustainable, leading to intensified product market competition.

While most existing studies focus on the domestic effects of antitrust enforcement (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019; Miller, 2009), an emerging literature examines whether international regulatory changes generate cross-border spillovers to firms in third countries, particularly the United States. Dong et al. (2019) show that foreign leniency laws increase cartel convictions and reduce the gross margins of U.S. firms, highlighting their role in undermining collusive behaviour and promoting more competitive markets. Consistent with the idea that the global diffusion of these programs has implications beyond the

jurisdictions in which they are implemented, Callen and Fang (2021) argue that foreign leniency laws impose competitive costs not only on firms in adopting countries but also on U.S. firms that may otherwise participate in collusion in international markets.

This chapter examines a relatively underexplored channel through which foreign antitrust enforcement affects firms, namely its influence on corporate financing decisions through intensified competition. Understanding how antitrust enforcement shapes financing behaviour is important because debt maturity choices affect firms' ability to respond to competitive shocks, preserve financial flexibility, and capitalise on future growth opportunities. While prior research has examined the effects of leniency-induced competition on corporate financing and leverage, less attention has been given to how such competitive pressure affects the maturity structure of corporate debt and the dynamics of capital structure adjustment.

Debt maturity is an important dimension of financial policy because it influences firms' exposure to refinancing pressures, liquidity risk, and changing economic conditions. Firms that rely more heavily on short-term debt must refinance more frequently and are therefore more vulnerable to disruptions in credit markets and adverse economic shocks. By focusing on debt maturity, this chapter provides new evidence on how foreign antitrust enforcement influences the financing choices of U.S. firms operating in increasingly competitive product markets.

The spread of leniency laws intensifies product market competition by weakening collusive arrangements and encouraging firms to adopt more competitive strategies. As competition increases, firms may experience lower profitability through declining price-cost margins and reduced market share, while also facing greater uncertainty in their operating environment. This heightened uncertainty can increase cash flow volatility and financial distress risk, both of which are important determinants of corporate financing decisions. In response, firms may adjust the structure of their liabilities by relying more heavily on shorter-

term debt to preserve financial flexibility and reduce exposure to long-term financial commitments.

Building on this intuition, the analysis examines whether exposure to foreign leniency laws influences the debt maturity choices of U.S. firms. Debt maturity represents an important dimension of corporate financial policy because it affects firms' exposure to refinancing risk, liquidity pressures, and their ability to maintain financial flexibility under changing competitive conditions. Specifically, I address three research questions. First, does greater exposure to foreign leniency programs lead U.S. firms to rely more heavily on shorter-term debt? Second, through which economic channels and firm characteristics, including changes in profitability, market share, financial constraints, liquidity, and product market competition, do these effects operate? Third, does exposure to foreign leniency laws influence the speed with which firms adjust toward their target capital structure?

To evaluate these conjectures, the study assembles a comprehensive panel of U.S. firms, covering 32,367 firm-year observations over the period from 1990 to 2021, and employs a two-way fixed-effects regression framework with firm and year fixed effects to control for unobserved heterogeneity and common macroeconomic shocks. The dataset combines firm-level information from Compustat North America with data on antitrust regulation and industry characteristics drawn from Cartel Regulation 2013, Schott's Data Library, and Hoberg and Phillips (2016). This integrated approach allows the analysis to assess how antitrust enforcement abroad influences firms' financial behaviour. The sample captures the global diffusion of leniency laws across 53 foreign jurisdictions, as reported in Table 4.1. This staggered adoption across countries provides variation in exposure to foreign antitrust enforcement over time and allows the analysis to examine how changes in the international enforcement environment spill over into U.S. product markets and affect firms' financing choices.

To capture the regulatory environment, the study employs two complementary measures of leniency laws. The first is a binary indicator equal to one if a foreign country has enacted a leniency program in a given year, capturing the timing of adoption at the country level. The second, following Bourveau et al. (2020), measures U.S. industry exposure to foreign leniency laws using an import-weighted index. This index is defined as the weighted average of foreign leniency adoptions, where weights reflect each country's share of imports within a two-digit SIC industry in 1990.

Using fixed trade weights ensures that the measure captures historical exposure rather than subsequent changes in trade flows or industry composition. This approach reflects the increased difficulty of sustaining international collusion and the strengthened coordination among antitrust authorities, both of which intensify competitive pressures on U.S. firms. Because the measure is based on foreign policy changes rather than domestic firm decisions, it is plausibly exogenous to firms' financing behaviour and supports a causal interpretation of the results. The empirical results show that greater exposure to foreign leniency laws is associated with a significant shortening of U.S. firms' debt maturity. Firms facing increased competitive pressure reduce their reliance on long-term debt and shift toward shorter-term financing, consistent with the adoption of more flexible and precautionary financial policies.

Cross-sectional analyses further indicate that these effects are stronger among firms facing intensified competition and declining profitability, suggesting that firms shorten debt maturity to preserve financial flexibility under heightened uncertainty. These results indicate that regulatory reforms introduced abroad generate substantial spillover effects on U.S. firms' financing choices. Foreign leniency laws reshape not only the competitive environment but also the financial strategies firms adopt to preserve flexibility and resilience in increasingly uncertain product markets.

More broadly, the findings extend existing research on competition and corporate finance by demonstrating that regulatory reforms in foreign jurisdictions can have important implications for firms' debt maturity structures and financial policy. The baseline findings are robust across a comprehensive set of sensitivity analyses. In particular, the results hold when using lagged specifications, confirming that the effect of foreign leniency laws on debt maturity persists over time and is not driven by contemporaneous shocks. The conclusions remain consistent when alternative measures of debt maturity are employed, including specifications based on the proportion of long-term debt, which capture different maturity horizons.

The findings are also robust to alternative fixed-effects structures, including models with industry and year fixed effects, indicating that the results are not driven by firm-specific unobserved heterogeneity. In addition, the results are stable when foreign leniency exposure is constructed using alternative trade-based measures. Consistent with Callen and Fang (2021), the findings remain unchanged when exposure is based on both import- and export-weighted measures, including specifications restricted to major trading partners.

Across all these specifications, greater exposure to foreign leniency laws is consistently associated with shorter debt maturity. Overall, these robustness checks confirm that the main findings are not sensitive to model specification, measurement choices, or sample construction, reinforcing the conclusion that foreign leniency laws lead firms to shorten the maturity of their debt in response to intensified competitive pressure.

Further analysis reveals substantial heterogeneity in firms' responses to competitive pressure. The maturity-shortening effect of foreign leniency laws is strongest among financially constrained firms, particularly those that do not pay dividends, exhibit lower profitability, and hold lower cash reserves, highlighting their greater sensitivity to heightened uncertainty. In contrast, firms with stronger financial capacity, including those with higher profitability and greater liquidity, exhibit a more muted adjustment in debt maturity. Similarly, firms operating

in more dynamic product markets show weaker responses, suggesting that their financing structures may already be better aligned with competitive conditions. Overall, these findings indicate that the financial effects of leniency laws vary systematically across firms depending on their financial strength and market environment.

This chapter contributes to three strands of literature. First, it extends the growing literature on the corporate effects of antitrust enforcement. Prior studies show that leniency programs intensify competition, reduce collusive behaviour, and influence a range of corporate policies, including disclosure, mergers, and financing decisions (Bourveau et al., 2020; Dasgupta & Žaldokas, 2019; Dong et al., 2019; Miller, 2009).

This study extends Dasgupta and Žaldokas (2019), who show that leniency-induced competition affects firms' external financing choices and leverage, by focusing on two distinct dimensions of financing policy that remain less explored. First, I examine debt maturity, which captures firms' exposure to refinancing risk, liquidity pressures, and the need for financial flexibility beyond the amount of debt they employ. Second, I examine the speed of adjustment toward target leverage, providing evidence on how foreign leniency exposure affects the dynamics of capital structure adjustment rather than leverage levels alone. Thus, the contribution of this chapter is to provide evidence that the financing consequences of leniency-induced competition extend beyond financing choices and leverage levels to the maturity and adjustment dynamics of corporate debt. By examining these additional dimensions of financing policy, the study provides a more complete picture of how leniency-induced competition affects corporate financial decisions.

Second, the chapter contributes to the corporate finance literature on competition and financing decisions. While prior research shows that competition influences firms' financing policies through channels such as import competition, product market fluidity, and industry structure (Hoberg & Phillips, 2016; Valta, 2012; Xu, 2012), I focus on an underexplored

dimension of competition arising from antitrust enforcement. By examining exposure to foreign leniency laws, I provide evidence that this regulatory-driven source of competition has a meaningful effect on firms' debt maturity choices. This contributes to a more comprehensive understanding of how different dimensions of competition shape firms' financing structures.

Third, the chapter contributes to the literature on international spillovers by showing how foreign regulatory changes affect domestic firms through trade linkages. While prior studies document that leniency programs strengthen competition and influence firm outcomes such as margins, detection, and strategic behaviour in adopting countries (Bourveau et al., 2020; Callen & Fang, 2021; Dong et al., 2019; Miller, 2009), less is known about their implications for firms' financing policies, particularly debt maturity decisions. By examining how exposure to foreign leniency laws influences the debt maturity choices of U.S. firms, this chapter provides new evidence on the financial consequences of competition policy operating across borders.

The remainder of this chapter is organized as follows. Section 4.2 provides the literature review. Section 4.3 develops the main hypotheses. Section 4.4 describes the sample, variable construction, and empirical design. Section 4.5 presents the main empirical results. Section 4.6 reports a range of robustness tests. Section 4.7 examines cross-sectional heterogeneity in the estimated effects. Section 4.8 investigates the impact of foreign leniency laws on the speed of leverage adjustment using Market Leverage. Finally, Section 4.9 concludes the chapter.

4.2 Literature Review

4.2.1 Real Effects of Competition and Leniency Programs

Concerns over the weakening of product market competition in the United States and globally have renewed interest in antitrust enforcement as a key policy instrument (Hammond, 2005; Miller, 2009). Among available tools, leniency programs have become central to cartel prosecution. By offering immunity or reduced penalties to the first firm that self-reports, these

programs raise the expected cost of collusion and create strong incentives for cartel members to defect (Chen & Rey, 2013; Motta & Polo, 2003).

The 1993 reform of the U.S. leniency program illustrates their effectiveness, leading to a substantial increase in cartel detection and deterrence and subsequently motivating widespread international adoption (Dong et al., 2019; Miller, 2009). From a theoretical perspective, leniency programs can have opposing effects. On the one hand, they destabilize collusion by increasing the incentives to report and by raising the expected penalties for firms that remain silent (Harrington Jr, 2008). On the other hand, they may induce strategic pre-emptive reporting, whereby firms anticipate rivals' actions and adjust their behaviour accordingly, potentially sustaining collusion under specific conditions (Chen & Rey, 2013; Spagnolo, 2000). Empirical evidence, however, largely supports the destabilisation view. Leniency programs reduce profit margins, increase detection rates, and alter firms' strategic behaviour (Dong et al., 2019; Miller, 2009).

A growing body of research shows that intensified competition has broader real effects on firms. Dasgupta and Žaldokas (2019) show that the transition from collusion to competition has important implications for firms' financing decisions, particularly their leverage and external financing choices. Similarly, Xu (2012) demonstrates that increased competition, proxied by import penetration, reduces profitability and leads firms to adopt lower leverage. Related evidence indicates that firms adjust their strategic responses by engaging in mergers to preserve market power (Dong et al., 2019) or by accessing public equity markets as competitive pressure expands growth opportunities (Duong et al., 2024). Taken together, these findings suggest that competition shocks, whether driven by trade exposure or regulatory enforcement, have far-reaching implications for firms' real and financial decisions.

The global diffusion of leniency programs provides an important institutional context for understanding competition effects. Over the past three decades, many jurisdictions have introduced formal leniency frameworks, although the timing and pace of adoption have varied substantially across countries. Following the introduction of the U.S. program in 1993, adoption gradually expanded across advanced and emerging economies, reflecting differences in institutional development and enforcement capacity (Dasgupta & Žaldokas, 2019; Dong et al., 2019; Miller, 2009). This staggered pattern of adoption is particularly valuable from an empirical perspective. Differences in the timing of leniency implementation across countries generate variation in U.S. firms' exposure to foreign enforcement, depending on their industry-level trade linkages (Bourveau et al., 2020; Callen & Fang, 2021). This variation underpins the construction of the foreign leniency measure used in this study and provides useful variation for examining how global antitrust enforcement shapes firms' financial behaviour (Dasgupta & Žaldokas, 2019; Duong et al., 2024).

4.2.2 Disclosure Responses

Beyond real outcomes, leniency programs also influence firms through informational channels. Bourveau et al. (2020) show that U.S. firms exposed to foreign leniency laws increase product-market disclosures, particularly in customer contracts and earnings calls. These disclosures can facilitate tacit coordination by reducing strategic uncertainty among competitors. While greater transparency can reduce information asymmetry (Biddle et al., 2009), it may also create focal points that facilitate coordinated behaviour among competitors. This dual role highlights the complex interaction between disclosure practices and competition policy.

4.2.3 Governance and Managerial Incentives

Leniency programs also affect corporate governance and managerial incentives. Callen and Fang (2021) find that stronger foreign antitrust enforcement reduces stock price crash risk by

limiting managers' ability to withhold negative information, thereby improving the overall information environment. In a related setting, Jiang et al. (2025) show that stricter enforcement reduces the use of option-based compensation, which in turn weakens incentives for excessive managerial risk-taking.

These effects are particularly pronounced in concentrated industries and among firms with prior exposure to cartel activity, indicating that increased enforcement risk alters managerial behaviour by raising the expected costs of collusion and encouraging more prudent decision-making. As a result, firms may adjust not only their governance structures but also their broader strategic choices, including investment, disclosure, and financing policies.

4.2.4 Debt Structure and the Remaining Gap

Theoretical research further highlights the role of financing structure in competitive environments. In collusive settings, debt can act as a strategic commitment device that sustains interaction among firms (Brander & Lewis, 1986; Maksimovic, 1988). However, as competition intensifies, this role diminishes. Greater competitive pressure increases firms' exposure to uncertainty and weakens profitability, making financial flexibility increasingly important.

Empirical studies further suggest that stronger competition increases financing pressures and reduces firms' reliance on leverage (Valta, 2012; Xu, 2012). In such environments, firms may adjust not only their leverage levels but also the maturity composition of their debt in order to manage refinancing risk and preserve liquidity under changing market conditions (Kovenock & Phillips, 1997; Rajan & Zingales, 1995).

Despite these advances, an important gap remains. Dasgupta and Žaldokas (2019) establish that leniency-induced competition affects firms' external financing choices and leverage. However, leverage captures the amount of debt firms employ rather than how that

debt is structured across maturities or how dynamically firms adjust toward their target leverage. These distinctions are important because debt maturity determines firms' exposure to refinancing risk, liquidity pressures, and their ability to preserve financial flexibility under heightened competitive uncertainty. This study therefore extends Dasgupta and Žaldokas (2019) by examining two distinct dimensions of financing policy: debt maturity and the speed of adjustment toward target leverage.

Building on this distinction, I examine whether exposure to foreign leniency laws influences the debt maturity structure of U.S. firms and the speed with which firms adjust toward their target capital structure. In doing so, the chapter extends prior research on competition and corporate finance (Callen & Fang, 2021; Jiang et al., 2025; Xu, 2012) by highlighting debt maturity and capital structure adjustment as important dimensions through which enforcement-driven competition shapes corporate financial policy. By examining these additional dimensions, the study provides a more complete picture of how leniency-induced competition affects corporate financial decisions. This framework motivates the empirical analysis presented in the subsequent sections.

4.3 Hypotheses Development

The corporate finance literature highlights that firms' financing choices are closely linked to their product market environment. Debt maturity is an important dimension of financial policy because it determines the timing of firms' repayment obligations and their exposure to refinancing risk. Debt maturity reflects a trade-off between financial flexibility and commitment. Short-term debt can reduce agency problems and preserve flexibility, but it also exposes firms to rollover risk, while long-term debt provides financing stability but creates longer-term commitments (Barclay & Smith Jr, 1995; Custódio et al., 2013; Myers, 1977).

Product market competition can affect this trade-off by changing firms' profitability, cash-flow stability, and financing risk. Prior studies show that intensified competition weakens

firms' market positions, reduces profitability, and increases financing costs (Ovtchinnikov, 2010; Valta, 2012; Xu, 2012). As financing conditions become tighter and uncertainty increases, firms face greater difficulty committing to long-term debt. Under these conditions, long-term debt becomes less attractive because it locks firms into fixed obligations over a longer horizon. Consequently, firms may prefer shorter debt maturity to preserve financial flexibility and respond more quickly to changes in the competitive environment.

Foreign leniency laws provide a useful setting to examine this mechanism. These laws increase the probability of cartel detection and raise the expected costs of collusion, thereby weakening coordinated behaviour and intensifying product market competition (Dong et al., 2019; Miller, 2009). Through trade linkages, the effects of foreign leniency laws can spill over into U.S. product markets, exposing U.S. firms to stronger competitive pressure. In this setting, firms are likely to face lower margins, weaker market positions, and greater uncertainty surrounding future cash flows. This is consistent with trade-off theory, which predicts that higher uncertainty and lower profitability increase financial distress risk, making long-term debt less attractive (Myers, 1984).

The debt maturity literature suggests that firms facing higher uncertainty, information asymmetry, or financing constraints tend to rely more heavily on short-term debt. Custódio et al. (2013) show that U.S. firms with greater information asymmetry and weaker financial conditions tend to use shorter debt maturity. Similarly, Diamond (1991) and Barclay and Smith Jr (1995) suggest that firms use debt maturity structure to manage agency costs, refinancing risk, and investment incentives. In the context of this chapter, foreign leniency laws are expected to create a similar environment by increasing competitive uncertainty and reducing firms' willingness to commit to long-term debt contracts.

Accordingly, I propose the following hypothesis:

H1: Foreign leniency laws are associated with shorter corporate debt maturity.

The effect of foreign leniency laws on debt maturity is unlikely to be uniform across firms. Firms differ in their ability to absorb competitive shocks depending on their financial strength, liquidity, and product market environment. These differences are expected to influence how strongly firms adjust their debt maturity in response to intensified competition.

Financially constrained firms are expected to respond more strongly. Non-dividend-paying firms, less profitable firms, and firms with lower cash holdings tend to have weaker internal resources and more limited access to external financing. Prior research shows that dividend-paying firms are generally more mature and financially stronger, whereas non-dividend-paying firms are more likely to face financing constraints (Custódio et al., 2013; Fama & French, 2001). Similarly, firms with lower profitability and limited liquidity are more exposed to uncertainty and refinancing risk. Consequently, when foreign leniency laws intensify competition, these firms are expected to exhibit a stronger reduction in debt maturity in order to preserve financial flexibility.

By contrast, firms with greater financial capacity are expected to exhibit a weaker response. Firms with higher profitability and larger cash holdings possess stronger internal resources and are better able to absorb shocks without substantially altering their financing structure. Cash reserves also provide a buffer against financial distress and reduce dependence on external financing (Almeida et al., 2012; Bates et al., 2009). As a result, these firms are less likely to shorten debt maturity in response to foreign leniency exposure.

The competitive environment may also moderate the effect. Firms operating in highly fluid product markets already face frequent competitive adjustments and may therefore maintain financing structures that are better aligned with such conditions (Hoberg & Phillips, 2016). Consequently, these firms may exhibit a more muted adjustment in debt maturity following increases in competitive pressure.

Taken together, these arguments suggest that the maturity-shortening effect of foreign leniency laws is stronger among financially weaker firms, but weaker among firms with greater financial strength, liquidity, and more dynamic product market environments. This motivates the cross-sectional analysis, which examines how the effect of foreign leniency laws varies across firms' financial conditions, liquidity positions, and competitive environments. This expectation is consistent with prior research showing that firms facing greater information asymmetry and uncertainty rely more heavily on short-term debt when long-term financing becomes more difficult to obtain (Custódio et al., 2013). It is also consistent with the view that firms balance the flexibility benefits of short-term debt against refinancing and rollover risks in uncertain environments (Chen et al., 2021). Based on these arguments, I develop the following hypothesis:

H2: The negative effect of foreign leniency laws on debt maturity is stronger for financially constrained firms and weaker for firms with greater financial strength, liquidity, and more dynamic product market environments.

4.4 Sample, Variables, and Empirical Design

4.4.1 Sample

This study employs a comprehensive panel dataset from Compustat North America to examine the impact of foreign leniency laws on corporate financial policy, with a particular focus on debt maturity structure. The initial sample includes all publicly listed U.S. firms over the period 1990–2021. Following established approaches in the literature (e.g. Dasgupta and Žaldokas (2019), Bourveau et al. (2020) and Biddle et al. (2009)), several filters are applied to ensure consistency and robustness.

First, the sample is restricted to firms headquartered in the United States and reporting in U.S. dollars to maintain comparability across accounting standards. Firms in the financial sector (SIC 6000–6999) and utilities sector (SIC 4900–4999) are excluded, as their financial

policies are heavily influenced by unique regulatory requirements. Second, to reduce noise, firms with total assets below \$0.5 million are excluded, since very small firms may exhibit financing patterns that differ systematically from larger corporations. Observations with missing or invalid values for key variables (e.g. total assets and fiscal year) are removed.

Duplicate firm-year records are also dropped based on unique firm identifiers and reporting dates to ensure data accuracy. Finally, industry classification is conducted using two-digit SIC codes to capture industry-specific variation in debt maturity decisions while maintaining consistency with prior studies.

4.4.2 Variables

4.4.2.1 Dependent Variable: Debt Maturity Measures

Debt maturity is measured using several alternative definitions to ensure robustness. The primary measure is Debt Maturity (Years), defined as the book-value weighted average maturity of debt. This measure is constructed using Compustat maturity buckets following Chen et al. (2012). Specifically, maturities of 0.5, 1.5, 2.5, 3.5, 4.5, and 13 years are assigned to the corresponding debt maturity categories.

To assess the robustness of the results, I also consider two alternative measures. First, Debt Maturity (>5 Years) is defined as the proportion of total debt maturing beyond five years, calculated as long-term debt after year five ($dltt - dd2 - dd5$) divided by total debt ($dltt + dlc$). Second, Debt Maturity (>1 Year) is defined as the proportion of total debt maturing beyond one year, calculated as long-term debt ($dltt$) divided by total debt ($dltt + dlc$). These measures capture firms' reliance on long-term financing (Custódio et al., 2013; Chen et al., 2021).

By employing these alternative definitions, the analysis ensures that the findings are not driven by a single measure of debt maturity but instead reflect consistent patterns across different dimensions of firms' debt structure. The baseline specification focuses on Debt Maturity (Years) as the main dependent variable. In the context of this study, examining debt

maturity allows for an assessment of how firms adjust the structure of their liabilities in response to changes in competitive pressure induced by foreign leniency laws.

4.4.2.2 Treatment Variable: Foreign Leniency

The primary explanatory variable, foreign leniency, is constructed by combining country-level import data from Schott's Data Library with cartel enforcement data from Cartel Regulation 2013. The list of leniency law adoptions is compiled based on this source, following Callen and Fang (2021), and extended using evidence from Dasgupta and Žaldokas (2019) and Duong et al. (2024).

This measure captures the degree of U.S. industry exposure to foreign leniency laws by calculating the weighted average of leniency adoptions across foreign jurisdictions, where the weights are based on each country's share of industry-level imports relative to total imports (Bourveau et al., 2020). This construction provides a nuanced measure of competitive pressure arising from global antitrust policy changes and enables an assessment of how these pressures affect U.S. firms' debt maturity decisions.

The implementation of foreign leniency laws is expected to increase the costs and risks of collusion for U.S. firms by making it more difficult to sustain anticompetitive agreements. To capture this effect, I construct a continuous measure, foreign leniency, which quantifies the exposure of U.S. industries to leniency laws enacted in other countries (excluding the United States). The variable is defined as:

$$\text{Foreign Leniency}_{jt} = \sum_k w_{kj} L_{kt}$$

where:

- k indexes foreign countries,
- j represents a two-digit Standard Industrial Classification (SIC) industry,
- t denotes the year,

- w_{kj} is the share of industry j 's imports from country k relative to the industry's total sales in 1990, and
- L_{kt} is an indicator equal to 1 if country k has enacted a leniency law by year t , and 0 otherwise.

This specification provides a weighted average of U.S. industries' exposure to foreign leniency laws. Following Bourveau et al. (2020), fixed weights from 1990 are used to avoid endogeneity concerns and ensure the measure is not affected by subsequent changes in industry structure. Foreign leniency ranges from 0 (no exposure) to 1 (full exposure, where all foreign trading partners relevant to an industry have adopted leniency laws). An important feature of this measure is that exposure varies at the two-digit SIC industry-year level rather than at the individual-firm level. Firms belonging to the same industry in a given year therefore share a common foreign leniency exposure.

The analysis examines how firm-level debt maturity decisions respond to variation in this industry-level exposure. Constructing a more granular measure based on individual firms' import relationships would require firm-specific import data, which were not available for this study. The estimated effects should therefore be interpreted as firm-level financing responses to variation in industry-level foreign leniency exposure. Importantly, this measure does not assume that U.S. firms collude directly with foreign suppliers. Instead, it reflects competitive spillovers that occur when foreign producers of similar goods adopt leniency regimes, thereby intensifying rivalry in U.S. industries. In this way, the measure captures how the staggered global diffusion of leniency laws reshapes the competitive environment for U.S. firms.

To illustrate the mechanism, consider U.S. and South Korean electronics producers operating across both markets with comparable sizes and market shares. When firms compete in multiple markets, their strategies often overlap, and collusion in one region may extend to

another through what the industrial organization literature refers to as multimarket contact (Bernheim & Whinston, 1990; Bourveau et al., 2020).

Multimarket contact arises when firms repeatedly encounter one another in different geographic or product markets, which under certain conditions can facilitate collusion. Regulatory shocks in one jurisdiction can disrupt this equilibrium. For instance, the introduction of a leniency program in South Korea may weaken collusion there and spill over into the U.S. market, destabilizing agreements among the same firms. Theoretical work confirms this dynamic, showing that antitrust interventions in one country can undermine collusion in interconnected markets (Choi & Gerlach, 2013). This example highlights how foreign enforcement measures can indirectly reshape U.S. competition.

By breaking collusive links abroad, leniency laws intensify rivalry at home, amplifying pressure on U.S. firms' profitability and financing choices. Accordingly, the foreign leniency variable provides a meaningful proxy for capturing these competitive spillovers, linking international regulatory change to domestic corporate behaviour and firms' debt maturity decisions. To further validate the foreign leniency measure, Appendix 4-A presents additional evidence examining its effects on profitability, market share, and corporate leverage. Consistent with prior literature, the results show that greater exposure to foreign leniency laws is associated with lower profitability, reduced market share, and lower leverage, supporting the interpretation that foreign leniency laws intensify competitive pressure and affect firms' financial policies.

4.4.2.3 Control Variables

To ensure robustness, the regression incorporates a comprehensive set of control variables grounded in prior research on capital structure and debt maturity. Following the prior literature, I include Size, Market Leverage, Market to Book, ROA, R&D, Asset Maturity, and HHI, which

have been consistently shown to shape firms' financing and debt maturity decisions (Bradley et al., 1984; Custódio et al., 2013; Harris & Raviv, 1991; Rajan & Zingales, 1995).

I begin by considering Size, proxied by the logarithm of total assets, which captures differences in diversification and information asymmetry. Larger firms typically have better access to capital markets and face lower refinancing risk, allowing them to obtain longer-term financing. At the same time, prior research suggests that the relation between Size and debt maturity may not be strictly linear, reflecting the trade-off between market access and financial flexibility (Barclay & Smith Jr, 1995; Diamond, 1991).

In addition, Market Leverage is included to account for firms' overall debt burden. Firms with higher Market Leverage may rely more on long-term debt to reduce rollover risk and stabilise their financing structure. Consistent with prior evidence, leverage is positively associated with debt maturity, as more leveraged firms tend to extend debt maturity to mitigate refinancing risk and avoid frequent rollover (Custódio et al., 2013; Danis et al., 2014; Xu, 2012).

Turning to firms' investment opportunities, Market to Book serves as a proxy for growth prospects. Firms with stronger growth opportunities tend to rely more on shorter-term debt to preserve flexibility and mitigate underinvestment problems. In particular, the use of shorter debt maturity can alleviate agency conflicts by reducing the underinvestment problem associated with growth options, consistent with agency-based explanations of debt maturity choice (Barclay & Smith Jr, 1995; Custódio et al., 2013; Myers, 1977).

ROA, measured as return on assets, captures firms' operating performance and internal financing capacity. Prior evidence suggests that profitability is closely related to debt maturity choices, with less profitable firms tending to rely more on short-term debt. Firms with lower ROA exhibit significantly shorter debt maturity compared with more profitable firms, reflecting greater financial constraints and higher uncertainty. By contrast, firms with higher

profitability show no significant tendency to shorten maturity, indicating better access to long-term financing (Custódio et al., 2013). Since profitability can also take negative values, this specification implicitly controls for the impact of losses on financing decisions.

Furthermore, R&D, defined as research and development expenditures scaled by total assets, captures firms' investment in intangible assets and exposure to information asymmetry. Firms with higher R&D are more likely to rely on short-term debt, as intangible assets are difficult to collateralise and increase uncertainty about future cash flows. This is consistent with the asymmetric information hypothesis and empirical evidence that R&D-intensive firms tend to use shorter debt maturity (Custódio et al., 2013).

In addition, Asset Maturity is included to capture the maturity-matching principle, whereby firms align the maturity of their liabilities with the life of their assets. Firms with longer-lived assets are therefore more likely to rely on longer-term debt (Custódio et al., 2013). Taken together, these firm-level controls ensure that the estimated effect of foreign leniency laws on debt maturity is not confounded by underlying financing fundamentals. Finally, to capture industry-level factors, I include industry concentration. This is measured using the Herfindahl–Hirschman Index (HHI) at the two-digit SIC level, which reflects the degree of product market competition. Financing decisions often vary systematically with competitive pressures, making this an important control (Giroud & Mueller, 2010).

Overall, by incorporating both firm- and industry-level variables, the analysis accounts for the key internal and external determinants of debt maturity, ensuring that the estimated relationship between foreign leniency laws and firms' financing behaviour is not driven by differences in firm characteristics or competitive conditions. In addition, to mitigate the impact of extreme observations, all continuous variables are winsorised at the 1st and 99th percentiles, consistent with standard practice in corporate finance research. This adjustment reduces the influence of outliers and ensures that the results are not driven by a small number of extreme

values. The final dataset combines firm-level financial information from Compustat, industry-level competition measures, and cross-country regulatory variables, creating a comprehensive empirical setting for examining how foreign leniency laws affect firms' debt maturity decisions. This integrated design allows for the assessment of both average effects and heterogeneous responses across different firm and industry conditions. Detailed variable definitions, along with their construction and data sources, are provided in Appendix 4-B to ensure clarity and replicability.

4.4.3 Summary Statistics and Correlation Matrix

Table 4.2 presents the summary statistics and correlation matrix for the key variables used in the main regression analysis. Panel A reports summary statistics for the variables included in the baseline model. The dependent variable, Debt Maturity (years), has a mean of 5.294 (median 4.161) and a standard deviation of 4.171, indicating substantial variation in firms' debt maturity structures.

The main explanatory variable, foreign leniency, has a mean of 0.067 and a median of 0.046. These values are broadly comparable to those reported in Bourveau et al. (2020) and Callen and Fang (2021), supporting the comparability of the dataset. The market-to-book ratio (Market to Book), used as a proxy for growth opportunities, averages 2.347 (median 1.673), while profitability (ROA) has a mean of -0.111 and a positive median of 0.0186, suggesting that although some firms report losses, a considerable proportion remain profitable.

Firm-level characteristics also exhibit substantial variation. Firm size (Size) averages 5.302, indicating that the sample includes both smaller and larger firms. Market Leverage has a mean of 0.154, suggesting moderate reliance on debt financing. R&D averages 0.106, with a median of 0.042, indicating that while most firms invest modestly in innovation, a subset allocates relatively higher resources to R&D activities. Asset Maturity has a mean of 7.734 years, reflecting differences in the structure and duration of firms' asset bases.

At the industry level, the Herfindahl–Hirschman Index (HHI) averages 0.097, indicating moderate levels of market concentration. Overall, the descriptive statistics highlight meaningful variation across firms and industries, providing an appropriate setting to examine the impact of foreign leniency laws on debt maturity decisions.

Panel B reports the Pearson correlation coefficients among the main variables. An asterisk (*) indicates statistical significance at the 1 percent level. Detailed variable definitions are provided in Appendix 4-B. Overall, the correlations are moderate in magnitude, suggesting that multicollinearity is unlikely to be a concern in the regression analysis. Focusing on the key relationship of interest, Debt Maturity (years) is positively correlated with Foreign Leniency, although the magnitude is relatively small (0.056). This represents an unconditional association and does not account for firm characteristics, industry factors, or fixed effects, which are incorporated in the subsequent regression analysis. Debt Maturity (years) is also positively correlated with firm size (Size) (0.351) and Market Leverage (0.160), consistent with prior evidence that larger and more leveraged firms tend to rely more on long-term debt (e.g., Custódio et al. (2013); Barclay and Smith Jr (1995)). In contrast, Debt Maturity (years) is negatively associated with growth opportunities, as proxied by Market to Book (−0.028), and with R&D (−0.093), in line with the view that firms with stronger growth prospects or higher information asymmetry prefer shorter maturities.

The correlation matrix also reveals patterns among control variables that are broadly consistent with the corporate finance literature. For example, profitability is positively related to firm size (Size) (0.428) and negatively related to both growth opportunities (−0.350) and R&D (−0.742), reflecting differences between mature and high-growth firms. In addition, Market Leverage is negatively associated with Market to Book (−0.340), supporting the notion that firms with stronger growth opportunities rely less on debt financing. Overall, the correlation structure is economically intuitive and aligns with established findings in the

literature, providing confidence in the data and offering a useful preliminary view of the relationships examined in the subsequent regression analysis.

4.4.4 Empirical Design

This study examines how exposure to foreign leniency laws influences corporate financial policy, with particular emphasis on firms' debt maturity decisions. To do so, I estimate a two-way fixed-effects model using firm-level panel data from Compustat North America over the period 1990–2021. To address unobserved heterogeneity, I include both firm and year fixed effects in the baseline regression. Firm fixed effects absorb time-invariant characteristics specific to each firm, while year fixed effects capture common shocks affecting all firms in a given year, such as macroeconomic fluctuations (Fang et al., 2014; Hashmi, 2013).

This approach ensures that the estimated effects are not confounded by persistent firm characteristics or broader temporal factors. Combined with a comprehensive set of control variables, the specification provides a robust framework for identifying the relationship between foreign leniency exposure and corporate debt maturity structure. The baseline regression model is specified as follows:

$$Debt\ Maturity\ (Years)_{i,t} = \alpha + \beta_1 \cdot Foreign\ leniency_{i,t} + \sum \delta \cdot X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$$

Where:

- $Debt\ Maturity\ (Years)_{i,t}$: The dependent variable, measured as the book-value weighted average maturity of debt in year t .
- $Foreign\ leniency_{i,t}$: The main explanatory variable, a continuous measure capturing the exposure of firm i 's industry to foreign leniency laws.
- $X_{i,t}$: A vector of firm- and industry-level control variables capturing key determinants of debt maturity decisions. Detailed definitions and theoretical motivations are provided in Section 4.4.2.3.
- μ_i and λ_t : Firm and year fixed effects, respectively.

- $\epsilon_{i,t}$: Error term, capturing other unobserved influences on debt maturity.

The empirical analysis proceeds in a stepwise manner. First, the baseline specification estimates the direct association between foreign leniency exposure and corporate debt maturity. Second, firm-level controls are introduced to account for heterogeneity in firm characteristics. Third, industry-level controls, including the Herfindahl–Hirschman Index (HHI), are incorporated to capture competitive pressures and market structure. This approach allows for a transparent assessment of how the estimated impact of foreign leniency laws on firms' debt maturity structure evolves as additional factors are considered.

4.5 Empirical Results

Table 4.3 presents the baseline estimates of the effect of foreign leniency laws on U.S. firms' debt maturity structure. Column (1) reports results from the baseline specification. The coefficient on foreign leniency is negative and statistically significant at the 1 percent level (-3.413), indicating that greater exposure to foreign leniency laws is associated with shorter debt maturity. This suggests that firms facing increased competitive pressure reduce their reliance on long-term debt and shift toward shorter-term financing.

To assess the economic magnitude of the results, I consider the effect of a one-standard-deviation increase in Foreign Leniency. As reported in Table 4.2, Foreign Leniency has a standard deviation of 0.074. Focusing on the full specification in Column (3), a one-standard-deviation increase in Foreign Leniency is associated with a reduction in debt maturity of approximately 0.175 years (-2.358×0.074), or approximately 2.1 months. Relative to the sample mean debt maturity of 5.294 years, this represents a reduction of approximately 3.3%. These rescaled estimates indicate that greater exposure to foreign leniency laws is associated with a shorter debt maturity structure, consistent with firms shifting towards shorter-term financing in response to increased competitive pressure.

Taken together, these findings provide consistent evidence that greater exposure to foreign leniency laws is associated with firms shortening their debt maturity. Rather than adjusting only the level of borrowing, firms respond to increased competition by altering the structure of their debt, reducing their exposure to long-term financial commitments. The estimated coefficients on the control variables are broadly consistent with the debt maturity literature. Firm size is positively associated with debt maturity, indicating that larger firms tend to issue longer-term debt, consistent with better access to capital markets.

Market Leverage is also positively related to maturity, suggesting that more leveraged firms rely more heavily on long-term debt to manage rollover risk. Growth opportunities, proxied by the market-to-book ratio, are positively associated with maturity, indicating that firms with stronger prospects may secure longer-term financing. Profitability (ROA) and R&D intensity are not statistically significant, suggesting a limited role in explaining maturity choices in this setting. Asset maturity exhibits a positive but insignificant coefficient, while industry concentration (HHI) is negative but not statistically significant.

Overall, the evidence supports the hypothesis that greater exposure to foreign leniency laws is associated with shorter debt maturity. This finding aligns with theoretical predictions that increased competition raises uncertainty and reduces firms' incentives to commit to long-term debt contracts. In line with prior studies (e.g., Diamond (1991); Barclay and Smith Jr (1995); Custódio et al. (2013)), firms facing higher risk and competitive pressure tend to rely more on shorter debt maturity to preserve financial flexibility and limit exposure to long-term obligations. This interpretation is also consistent with evidence showing that competitive shocks increase uncertainty and weaken firms' financial positions, thereby reducing their willingness to engage in long-term financial commitments (Valta, 2012; Xu, 2012).

The findings are consistent with Custódio et al. (2013), who document a pronounced shift toward shorter debt maturity among U.S. firms, particularly among those facing higher

information asymmetry and tighter financing conditions. In the context of this study, foreign leniency laws appear to generate a similar environment. By intensifying product market competition, these laws reduce profitability and increase uncertainty surrounding future cash flows. Under such conditions, firms adjust by shortening the maturity of their debt rather than committing to long-term financial obligations. This interpretation aligns with the broader literature on debt maturity choice, which emphasises the role of uncertainty and information frictions in shaping financing decisions. As firms become more exposed to competitive pressure, their financing policies increasingly favour shorter maturity structures. Overall, the evidence suggests that the observed shortening of debt maturity reflects a response to heightened competitive risk induced by foreign leniency regimes.

4.6 Robustness Tests

4.6.1 Alternative Debt Maturity Measures

To further assess the robustness of the baseline results, I examine whether the impact of foreign leniency laws persists under alternative definitions of debt maturity. While the main specification uses the weighted average maturity of debt in years, this section considers alternative measures based on the distribution of debt across maturity horizons, following Custódio et al. (2013) and Chen et al. (2021).

Table 4.4 presents the results. Column (1) uses Debt Maturity (>5 Years), defined as the proportion of total debt maturing beyond five years. The coefficient on foreign leniency is negative and statistically significant ($\beta = -0.160$, $p < 0.10$), indicating that greater exposure to foreign leniency laws is associated with a lower share of long-term debt. Column (2) uses a broader measure, Debt Maturity (>1 Year), defined as the proportion of total debt maturing beyond one year. The estimated coefficient remains negative and statistically significant ($\beta = -0.138$, $p < 0.10$), suggesting that the reduction in debt maturity extends beyond very long-term debt to the overall maturity structure.

These findings provide further support for the baseline evidence that foreign leniency laws are associated with shorter debt maturity. Firms facing increased competitive pressure reduce their reliance on longer-term financing across different maturity horizons. This evidence aligns with the debt maturity literature, which shows that firms exposed to higher uncertainty and information frictions tend to rely more on short-term debt (Chen et al., 2021; Custódio et al., 2013). The results also relate to recent evidence on the dynamics of debt maturity over the business cycle. Chen et al. (2021) show that corporate debt maturity is procyclical, with firms shortening maturity during economic downturns. They further demonstrate that shorter maturity structures increase firms' exposure to refinancing risk and amplify the sensitivity of credit spreads to aggregate shocks.

This highlights that debt maturity is not only a financing decision but also an important mechanism through which firms manage risk. In this context, the shortening of debt maturity observed in this study can be interpreted as a response to heightened competitive pressure. As foreign leniency laws intensify product market competition and increase uncertainty surrounding future cash flows, firms adjust their maturity structure toward shorter horizons to preserve financial flexibility, even at the cost of higher rollover risk. This trade-off between flexibility and refinancing risk is central to modern theories of debt maturity choice (Chen et al., 2021; Diamond, 1991).

4.6.2 Robustness Check: Major Trade Partners

The primary measure of foreign leniency exposure is constructed using imports from all trading partners within each industry. To assess whether the results are sensitive to the breadth of the trade network, I conduct an additional robustness test that focuses on the most economically important partners. Following Callen and Fang (2021), I construct an alternative measure based on the top five U.S. import partners (FLL_TOP5), which captures leniency exposure

concentrated among the largest sources of foreign competitive pressure faced by U.S. industries.

Table 4.5 reports the results. The specifications include firm and year fixed effects, with standard errors clustered at the industry-year level. Across all models, the coefficient on FLL_TOP5 remains negative and statistically significant. This indicates that industries more exposed to foreign leniency laws through their major trade partners tend to exhibit shorter debt maturity. The magnitude of the estimates is comparable to that obtained using the baseline measure, suggesting that the effect is not driven by smaller or less economically relevant trading relationships.

Although Callen and Fang (2021) examine leniency laws in the context of crash risk, this analysis extends their trade-partner sensitivity approach to firms' financing decisions. The results remain consistent when attention is restricted to the most important trading partners, reinforcing the interpretation that increased competitive pressure leads firms to shorten the maturity of their debt. Overall, this evidence strengthens the conclusion that foreign leniency exposure is robustly associated with shorter corporate debt maturity and is not sensitive to the construction of the trade-based measure.

4.6.3 Beyond Imports: Export-Based Foreign Leniency Exposure

In the baseline specification, foreign leniency exposure is constructed using import shares, capturing the competitive pressure faced by U.S. firms in domestic product markets. To examine whether the results depend on this channel, I construct an alternative measure based on export shares (FLL_EXP) and re-estimate the model using this specification. This approach follows Bourveau et al. (2020) and Callen and Fang (2021), who emphasise the importance of validating empirical findings using alternative definitions of the treatment variable.

Table 4.6 presents the results. The coefficient on FLL_EXP is negative and statistically significant ($\beta = -0.180$, $p < 0.05$), indicating that greater exposure to foreign leniency laws

through export markets is associated with shorter debt maturity. The magnitude of the effect is comparable to that obtained using the import-based measure, suggesting that the results are not sensitive to the construction of foreign exposure. These findings indicate that the impact of foreign leniency laws extends beyond domestic competition and operates through firms' participation in international markets.

These results reinforce the baseline evidence that foreign leniency exposure is associated with shorter debt maturity and confirm that this relationship extends to export-market competition. Firms facing increased competitive pressure reduce their reliance on longer-term financing across different maturity horizons. This evidence aligns with the broader debt maturity literature, which shows that firms exposed to higher uncertainty and information frictions tend to rely more on short-term debt (Chen et al., 2021; Custódio et al., 2013).

At the same time, both theoretical and empirical studies emphasise that debt maturity reflects a trade-off between rollover risk, financing flexibility, and investment considerations (Barclay & Smith Jr, 1995; Diamond, 1991; Stohs & Mauer, 1996). Firms adjust their maturity structure in response to refinancing needs and debt overhang, with shorter maturities providing flexibility but increasing exposure to refinancing risk (Johnson, 1967; Myers, 1977). In this context, foreign leniency laws appear to shift this trade-off. By intensifying product market competition and increasing uncertainty surrounding future cash flows, these laws reduce the attractiveness of long-term commitments. As a result, firms tilt their financing towards shorter maturities to retain flexibility, even at the cost of higher rollover risk.

Overall, the consistency of the results across both import- and export-based measures reinforces the robustness of the main findings and highlights the role of global competitive forces in shaping firms' debt maturity decisions. This interpretation is consistent with theoretical models of debt maturity choice (Barclay & Smith Jr, 1995; Diamond, 1991), which predict that firms facing greater uncertainty rely more on shorter-term debt. Additional

robustness analyses are reported in Appendix 4-C. These tests show that the main findings remain robust when using lagged explanatory variables and when replacing firm fixed effects with industry and year fixed effects. The results continue to show a negative and statistically significant association between foreign leniency exposure and debt maturity, suggesting that the findings are not driven by timing concerns or by the choice of fixed-effects structure.

4.7 Cross-Sectional Heterogeneity

In this section, I examine whether the effect of foreign leniency laws on debt maturity varies across firm characteristics. Specifically, I allow the impact of Foreign Leniency to differ across firms with varying financial conditions, liquidity positions, and competitive environments.

Column (1) examines dividend policy using a dividend dummy (Dividend). Column (2) considers profitability using ROA. Column (3) focuses on internal liquidity through Cash. Column (4) incorporates Product Market Fluidity (Hoberg & Phillips, 2016) to capture differences in competitive dynamics. Across all specifications, Foreign Leniency is measured using an import-weighted index. All regressions include firm and year fixed effects, a standard set of control variables, and standard errors clustered at the industry-year level.

4.7.1 Measurement of Moderating Variables

I construct a set of moderating variables to examine how firm characteristics influence responses to foreign leniency laws. These variables are introduced through interaction terms, allowing the effect of foreign leniency laws to vary systematically across firms. Dividend policy is captured using a dividend dummy (Dividend), which serves as a proxy for financial strength. Profitability is measured using return on assets (ROA), reflecting firms' operating performance and internal cash-generating ability. Internal liquidity is proxied by cash holdings (Cash), defined as the ratio of cash and cash equivalents to total assets.

To capture differences in the competitive environment, I include Product Market Fluidity, which measures the extent to which firms' product space evolves over time (Hoberg & Phillips, 2016). Taken together, these variables allow me to assess how the effect of foreign leniency laws on debt maturity varies across firms with different financial positions and competitive environments.

4.7.2 Dividend Policy and Debt Maturity

To examine whether the effect of foreign leniency laws varies across firms with different financial characteristics, I estimate a specification that interacts foreign leniency exposure with a dividend-paying indicator. Prior research suggests that dividend-paying firms are generally more mature, more profitable, and face lower financing constraints, whereas non-dividend-paying firms tend to be younger, riskier, and more financially constrained (Custódio et al., 2013; Fama & French, 2001). Column (1) of Table 4.7 reports the results. The coefficient on Foreign Leniency is negative and statistically significant ($\beta = -3.274$, $p < 0.01$), indicating that greater exposure to foreign leniency laws is associated with shorter debt maturity.

This finding is consistent with the view that increased competitive pressure and uncertainty lead firms to rely more heavily on shorter-term financing structures. The interaction term between Dividend and Foreign Leniency is positive and statistically significant ($\beta = 2.110$, $p < 0.01$), indicating that the maturity-shortening effect of foreign leniency laws is weaker among dividend-paying firms. Economically, this suggests that firms with stronger financial positions and more stable cash flows are better able to absorb competitive shocks without substantially adjusting their debt maturity structure. Overall, the results indicate that the effect of foreign leniency laws on debt maturity varies across firms according to their financial strength. Financially constrained firms respond more strongly to competitive pressure by shortening debt maturity, whereas financially stronger firms exhibit a more muted adjustment.

4.7.3 Leniency Laws, Profitability, and Debt Maturity

To further examine the mechanism underlying the relationship between foreign leniency exposure and debt maturity, I investigate whether this effect varies with firm profitability. Prior research shows that firms with lower profitability tend to rely more heavily on short-term debt and exhibit shorter debt maturity due to tighter financial constraints and greater uncertainty (Custódio et al., 2013). Column (2) of Table 4.7 reports the results. The coefficient on Foreign Leniency is negative and statistically significant ($\beta = -2.399$, $p < 0.05$), indicating that greater exposure to foreign leniency laws is associated with shorter debt maturity. The coefficient on ROA is not statistically significant, suggesting that profitability alone does not directly explain variation in debt maturity once firm fixed effects are accounted for. However, the interaction between ROA and Foreign Leniency is positive and statistically significant ($\beta = 3.449$, $p < 0.05$), indicating that the maturity-shortening effect of foreign leniency laws is weaker for more profitable firms.

These findings are consistent with Custódio et al. (2013), who show that less profitable firms rely more heavily on short-term debt and experience shorter debt maturity. In the context of this study, foreign leniency laws intensify product market competition and increase uncertainty, disproportionately affecting firms with weaker profitability. As a result, these firms appear to adjust their financing policies more aggressively by shortening debt maturity, likely reflecting greater refinancing risk and more limited access to long-term financing. By contrast, more profitable firms benefit from stronger internal cash flows and better access to external capital markets, allowing them to absorb competitive shocks with smaller adjustments to debt maturity. Overall, the results suggest that the effect of foreign leniency laws is more pronounced among firms with lower profitability, highlighting the role of financial strength in shaping firms' responses to competitive pressure.

4.7.4 Cash Holdings and Debt Maturity

To examine whether the effect of foreign leniency laws varies with firms' liquidity positions, I introduce an interaction term between foreign leniency and cash holdings (Cash $\times$ Foreign Leniency). This specification allows the sensitivity of debt maturity to competitive pressure to differ across firms with varying levels of internal liquidity. The results indicate that Foreign Leniency continues to exert a negative and statistically significant effect on debt maturity ($\beta = -4.057$, $p < 0.01$), confirming that increased exposure to foreign leniency laws is associated with shorter debt maturity.

The standalone coefficient on Cash is not statistically significant, suggesting that liquidity alone does not directly explain variation in debt maturity once firm fixed effects and other controls are considered. However, the interaction between Cash and Foreign Leniency is positive and highly significant ($\beta = 11.388$, $p < 0.01$), indicating that the negative effect of foreign leniency on debt maturity is substantially weaker for firms with higher cash holdings. Economically, this suggests that firms with greater internal liquidity are better able to absorb competitive shocks without substantially altering their financing structure.

These findings are consistent with the view that cash holdings provide a buffer against refinancing risk and financial distress (Diamond, 1991; Myers, 1977). Firms with limited liquidity are more exposed to uncertainty and financing constraints, making them more likely to shorten debt maturity in response to increased competitive pressure. By contrast, firms with stronger liquidity positions are less dependent on external financing and can maintain more stable financing policies (Almeida et al., 2012; Bates et al., 2009). Overall, the results highlight the importance of internal liquidity in shaping firms' responses to foreign leniency laws. While financially constrained firms respond more aggressively by shortening debt maturity, firms with greater cash holdings exhibit a more muted adjustment, reflecting the role of financial flexibility in corporate financing decisions.

4.7.5 Leniency Laws, Product Market Fluidity, and Debt Maturity

To further examine how competitive dynamics shape firms' financing decisions, I investigate whether the effect of foreign leniency laws varies with product market fluidity. Following Hoberg and Phillips (2016), product market fluidity captures the extent to which a firm's product space evolves over time through entry, exit, and repositioning by competitors, providing a dynamic measure of competitive pressure. Column (4) of Table 4.7 reports the results. The coefficient on Foreign Leniency is negative and statistically significant ($\beta = -4.695$, $p < 0.01$), indicating that increased exposure to foreign leniency laws leads firms to shorten debt maturity. The standalone coefficient on Product Market Fluidity is negative and marginally significant ($\beta = -0.025$, $p < 0.10$), suggesting that firms operating in more dynamic product markets tend to rely more on shorter-term debt.

More importantly, the interaction between Product Market Fluidity and Foreign Leniency is positive and highly significant ($\beta = 0.592$, $p < 0.01$), indicating that the maturity-shortening effect of foreign leniency laws is weaker for firms operating in highly fluid product markets. This suggests that firms in more dynamic competitive environments may already maintain financing structures that are better aligned with frequent competitive adjustments, reducing the need for further changes in debt maturity when additional competitive pressure arises. Overall, the findings indicate that the effect of foreign leniency laws on debt maturity depends not only on firm-level financial characteristics but also on the broader competitive environment. Firms operating in less fluid markets respond more strongly to leniency-induced competition by shortening debt maturity, whereas firms in highly dynamic markets exhibit a more muted adjustment.

Taken as a whole, the cross-sectional results provide support for Hypothesis 2. The evidence shows that the effect of foreign leniency laws on debt maturity is not uniform across firms but varies systematically with financial characteristics and competitive environments. In

particular, the maturity-shortening effect is more pronounced among financially constrained firms, including those that do not pay dividends, exhibit lower profitability, and hold lower cash reserves. These firms respond more strongly to increased competitive pressure by shortening debt maturity.

By contrast, firms with stronger financial positions, such as those with higher profitability and greater liquidity, exhibit a more muted adjustment. Similarly, firms operating in more dynamic product markets show weaker responses, suggesting that their financing structures may already be better aligned with competitive uncertainty and the need for financial flexibility. Overall, the findings highlight the importance of financial capacity and market conditions in shaping firms' responses to competitive shocks. Although the analysis is based on observational data, the consistency of the results across specifications supports a competition-based mechanism linking foreign leniency laws to corporate debt maturity decisions.

4.8 Foreign Leniency and the Speed of Leverage Adjustment Using Market Leverage

An important question that remains unanswered is how foreign leniency exposure affects the dynamics of capital structure adjustment. While prior research, particularly Dasgupta and Žaldokas (2019), shows that leniency-induced competition affects firms' financing choices and leverage, less is known about whether such competitive shocks influence the speed at which firms adjust towards their target leverage ratios. In this section, I examine how foreign leniency laws influence firms' capital structure dynamics, with particular attention to the speed of leverage adjustment. The speed of adjustment reflects the extent to which firms close the gap between observed leverage and target leverage over time.

In practice, firms may deviate from their desired capital structure because of adjustment costs, financing frictions, or changing economic conditions. As a result, leverage adjustments typically occur gradually rather than instantaneously (Fischer et al., 1989; Flannery & Rangan,

2006; Strebulaev, 2007). By examining this dynamic dimension of capital structure, the analysis complements existing evidence on financing choices and leverage and provides a more complete picture of how leniency-induced competition affects corporate financial decisions.

To extend the analysis, I examine whether foreign leniency laws affect firms' incentives or ability to move towards their target leverage ratios. The analysis focuses on market-based leverage measures because they incorporate forward-looking valuations and better reflect prevailing financing conditions. The empirical analysis proceeds in three stages. First, I estimate the baseline speed of adjustment model. Second, I examine whether the effect differs across firms with different leverage positions. Finally, I provide a formal test of asymmetry in leverage adjustment behaviour.

4.8.1 Estimation Strategy

To estimate the speed at which firms adjust their leverage, I adopt the two-step approach developed by Flannery and Rangan (2006). In the first step, target leverage is estimated by regressing observed leverage on standard determinants of capital structure, including firm size, asset tangibility, growth opportunities, profitability, depreciation, research and development intensity, and industry median leverage, while controlling for firm and year fixed effects.

The fitted values from this regression are used as the proxy for target leverage. In the second step, I estimate a partial adjustment model in which the change in leverage is regressed on the leverage gap, defined as the difference between target leverage and lagged observed leverage. The coefficient on the leverage gap captures the speed at which firms adjust towards their target capital structure. To examine the role of foreign leniency laws, I interact the leverage gap with lagged foreign leniency and include additional interaction terms with firm characteristics. This specification allows the speed of adjustment to vary systematically with exposure to foreign leniency and firm-specific conditions. All regressions include year and

industry fixed effects, and standard errors are clustered at the industry level to account for within-industry correlation over time.

4.8.2 Model Specification

The baseline speed of adjustment model is specified as follows:

$$\text{Change in Market Leverage}_{i,t} = a + b_1 \text{Leverage Gap (Market)}_{i,t} + m_i + l_t + E_{i,t}$$

where Change in Market Leverage is the dependent variable and Leverage Gap (Market) represents the deviation between target leverage and lagged Market Leverage. The coefficient on the leverage gap captures the speed at which firms adjust towards their target capital structure.

To examine the effect of foreign leniency laws on leverage adjustment dynamics, the model is extended as follows:

$$\begin{aligned} \text{Change in Market Leverage}_{i,t} &= a + b_1 \text{Leverage Gap (Market)}_{i,t} \\ &+ b_2 (\text{Leverage Gap (Market)}_{i,t} \times \text{Lagged Foreign Leniency}_{j,t-1}) \\ &+ b_3 \text{Lagged Foreign Leniency}_{j,t-1} + m_i + l_t + E_{i,t} \end{aligned}$$

where Lagged Foreign Leniency captures industry-level exposure to foreign leniency laws.

Additional specifications include interactions between the leverage gap and firm characteristics. Panel B estimates the model separately for over- and under-leveraged firms, while Panel C provides a robustness test using a pooled specification with a triple interaction between the leverage gap, foreign leniency, and an over-leveraged indicator. All specifications include year and industry fixed effects.

4.8.3 Foreign Leniency and the Speed of Leverage Adjustment

Panel A of Table 4.8 reports baseline estimates of the effect of foreign leniency exposure on the speed of leverage adjustment using market-based leverage measures. Market Leverage is

used because it reflects forward-looking firm valuation and prevailing financing conditions, making it more suitable for analysing firms' capital structure adjustments in response to changes in competitive pressure (Welch, 2004). The dependent variable is the change in Market Leverage, while the key explanatory variable is the leverage gap, defined as the deviation from target leverage. The coefficient on the leverage gap captures the speed at which firms adjust towards their target capital structure.

Across all specifications, the coefficient on the leverage gap is positive and highly statistically significant, confirming that firms actively rebalance towards target leverage. The estimated speed of adjustment ranges from 0.412 to 0.558, indicating that firms close a substantial proportion of the deviation from target leverage each year. These magnitudes are economically meaningful and consistent with prior capital structure research. Introducing foreign leniency exposure reveals a significant effect on leverage adjustment dynamics. The interaction between the leverage gap and foreign leniency is negative and statistically significant across specifications, indicating that greater exposure to foreign leniency laws slows the speed of adjustment towards target leverage. This effect remains stable after including additional controls, supporting the robustness of the findings.

Several mechanisms may explain this result. First, intensified competition may increase financing frictions and adjustment costs, making firms less willing to rebalance their capital structure rapidly (Fischer et al., 1989; Strebulaev, 2007). Second, firms facing heightened competitive pressure may adopt more precautionary financial policies in order to preserve financial flexibility (Bolton & Scharfstein, 1990; MacKay & Phillips, 2005). In this setting, firms appear to tolerate larger deviations from target leverage rather than adjusting rapidly. Overall, the results provide evidence that foreign leniency laws affect not only leverage levels but also the dynamics of capital structure adjustment. Increased competitive pressure is

associated with slower convergence towards target leverage, consistent with firms adopting more prudent financing policies under heightened uncertainty.

4.8.4 Foreign Leniency and the Speed of Leverage Adjustment for Over-Leveraged and Under-Leveraged Firms

Panel B of Table 4.8 presents a subsample analysis distinguishing between over-leveraged and under-leveraged firms based on their deviation from target Market Leverage. This analysis helps differentiate between competing explanations for the slowdown in leverage adjustment associated with foreign leniency exposure.

Under the predation or competition channel, over-leveraged firms are expected to reduce leverage more rapidly under intensified competition because their higher debt burden increases financial vulnerability (Bolton & Scharfstein, 1990). By contrast, if firms adopt a more prudent response to increased uncertainty, the slowdown in adjustment should be more pronounced among under-leveraged firms, reflecting precautionary behaviour and delayed debt issuance. The empirical results provide little support for the predation-based explanation. Although the leverage gap remains positive and highly significant in both subsamples, the interaction between the leverage gap and lagged foreign leniency differs substantially across groups. For over-leveraged firms, the interaction term is negative but statistically insignificant (-0.145), indicating no meaningful change in the speed of adjustment. In contrast, the interaction term for under-leveraged firms is negative and statistically significant (-0.793), suggesting that foreign leniency exposure substantially slows adjustment towards target leverage.

These findings indicate that the slowdown in leverage adjustment is concentrated primarily among under-leveraged firms. This pattern is more consistent with a precautionary behaviour mechanism, whereby firms respond to heightened competition and uncertainty by preserving financial flexibility and delaying debt issuance (Bolton & Scharfstein, 1990;

MacKay & Phillips, 2005). The results may also reflect increased financing frictions, as intensified competition can increase cash-flow volatility and the cost of external financing (Fischer et al., 1989; Flannery & Rangan, 2006; Strebulaev, 2007).

Panel C provides a robustness test using a pooled specification that incorporates a triple interaction between the leverage gap, lagged foreign leniency, and an indicator for over-leveraged firms. The interaction between the leverage gap and foreign leniency remains negative and statistically significant (-0.823), while the triple interaction term is positive and highly significant (0.700), indicating that the negative effect is substantially weaker for over-leveraged firms. Both the subsample analysis and the interaction-based specification indicate that the reduction in the speed of leverage adjustment associated with foreign leniency exposure is driven primarily by under-leveraged firms.

4.9 Conclusion

This study examines how foreign leniency laws influence corporate financing behaviour, with particular attention to firms' debt maturity decisions. By weakening collusive arrangements and intensifying product market competition, foreign leniency laws alter firms' financing incentives and increase the value of financial flexibility. As firms operate in more uncertain competitive environments, they may place greater reliance on shorter-term debt rather than committing to longer-term financing obligations.

Using a large sample of U.S. firms over the period 1990 to 2021 and an import-weighted measure of foreign leniency exposure, the analysis provides robust evidence that greater exposure to foreign leniency laws is significantly associated with shorter debt maturity. These findings highlight the financial spillovers of international antitrust enforcement transmitted through trade relationships. The results indicate that foreign regulatory shocks affect not only firms' competitive behaviour in product markets, but also the way firms structure their liabilities and manage financing decisions. The evidence suggests that preserving financial

flexibility becomes increasingly important when intensified competition disrupts collusive market conditions.

The main findings remain robust across a range of additional analyses and sensitivity tests. Similar results are obtained when using alternative measures of debt maturity and alternative definitions of foreign leniency exposure based on major trading partners and export shares. Additional robustness tests reported in the appendix further confirm that the documented relationship is not sensitive to model specification or variable construction. The analysis further reveals substantial heterogeneity in firms' responses to foreign leniency exposure. Firms with weaker financial positions, particularly those with lower profitability or lower cash holdings, exhibit a stronger reduction in debt maturity in response to heightened competitive pressure. In contrast, firms with stronger liquidity and profitability exhibit a more limited adjustment. Similarly, firms operating in more dynamic product markets show weaker responses, suggesting that their financing structures may already incorporate greater flexibility.

These findings are consistent with theories of debt maturity choice that emphasise the importance of uncertainty, information asymmetry, and financial constraints in shaping corporate financing decisions (Custódio et al., 2013; Diamond, 1991; Myers, 1977). The study also provides evidence that foreign leniency laws influence capital structure dynamics through their effect on the speed of leverage adjustment. Firms exposed to greater foreign leniency adjust more slowly towards their target leverage ratios, indicating that intensified competition increases financing frictions and encourages more prudent financing behaviour. Additional analysis shows that this effect is concentrated primarily among under-leveraged firms, which appear to delay debt issuance in response to heightened uncertainty and competitive pressure. These findings are more consistent with precautionary financial behaviour than with predation-based explanations.

Considered alongside the findings of Chapter 3, the financing response documented in this chapter provides a broader picture of how firms adjust to foreign leniency-induced competition. The investment and financing responses represent different but complementary dimensions of firms' adjustment to stronger competitive pressure. By weakening collusive arrangements and mitigating the managerial "quiet life," foreign leniency laws encourage firms to work harder, as reflected in higher investment and reduced underinvestment. At the same time, stronger competitive pressure encourages firms to make more conscious and prudent financing choices, as reflected in shorter debt maturity and slower adjustment towards target leverage. Thus, the findings across Chapters 3 and 4 are not contradictory but are consistent with stronger competitive discipline encouraging firms to pursue investment opportunities while exercising greater prudence in their financing decisions.

The implications of these findings extend to both policymakers and corporate managers. For policymakers, the results suggest that antitrust enforcement affects not only market competition but also firms' financing choices and capital structure decisions. Regulatory reforms that intensify competition may therefore generate broader financial consequences beyond product market outcomes alone. For managers, the findings highlight the importance of maintaining financial flexibility in periods of heightened competitive pressure. Firms with stronger internal resources are better positioned to absorb such shocks, whereas more financially constrained firms appear to rely more heavily on shorter-term financing arrangements.

Overall, this study contributes to a more integrated understanding of how competition policy and corporate finance interact. The findings show that foreign leniency laws are significantly associated with corporate debt maturity and leverage adjustment dynamics, suggesting that antitrust enforcement can shape firms' financing behaviour through its effects on uncertainty and competitive pressure. By linking insights from industrial organisation and

corporate finance, the study provides new evidence on the broader financial consequences of global antitrust enforcement. Since the analysis focuses on U.S. firms, future research could extend the analysis to other institutional settings to further explore the international financial implications of leniency laws.

Tables of Chapter 4

Table 4.1. Adoption of Corporate Leniency Programs Worldwide

This table reports the year in which each country adopted a corporate leniency program. Leniency programs incentivise cartel participants to self-report and cooperate with antitrust authorities in exchange for reduced penalties or immunity. The information is primarily drawn from *Cartel Regulation (2013)*, published by Getting the Deal Through, as well as press releases and news articles, following Callen and Fang (2021), and is further extended using evidence from Dasgupta and Žaldokas (2019) and Duong et al. (2024).

Country	Year	Country	Year
Argentina	2018	Lithuania	2008
Australia	2003	Luxembourg	2004
Austria	2006	Malaysia	2010
Belgium	2004	Mexico	2006
Brazil	2000	Netherlands	2002
Canada	2000	New Zealand	2004
Chile	2009	Norway	2005
China	2008	Pakistan	2007
Colombia	2009	Peru	2005
Croatia	2010	Philippines	2009
Cyprus	2011	Poland	2004
Czech Republic	2001	Portugal	2006
Denmark	2007	Romania	2004
Ecuador	2011	Russia	2007
Estonia	2002	Singapore	2006
Egypt	2005	Slovakia	2001
Finland	2004	Slovenia	2010
France	2001	South Africa	2004
Germany	2000	South Korea	1997
Greece	2006	Spain	2008
Hong Kong	2015	Sweden	2002
Hungary	2003	Switzerland	2004
Iceland	2005	Taiwan	2012
India	2009	Thailand	2016
Ireland	2001	Turkey	2009
Italy	2007	United Kingdom	1998
Japan	2005	USA	1993

Table 4.2. Summary Statistics and Correlation Matrix

This table presents summary statistics and correlations for the key variables used in the main analysis over the period 1990 to 2021. Panel A reports summary statistics, including the mean, median, standard deviation, and selected percentiles. Panel B presents the Pearson correlation matrix among the variables. All continuous variables are winsorized at the 1st and 99th percentiles to mitigate the influence of extreme values. * Indicates statistical significance at the 1 percent level. Detailed variable definitions are provided in Appendix 4-B.

Panel A: Summary Statistics

VARIABLES	Observation	Mean	Median	SD	P25	P75
Dependent variable						
Debt Maturity (Years)	32,367	5.294	4.161	4.171	1.479	8.829
Other variables						
Foreign Leniency	32,367	0.067	0.046	0.074	0.000	0.100
Size	32,367	5.302	5.097	2.193	3.665	6.815
Market Leverage	32,367	0.154	0.108	0.152	0.0317	0.231
Market to Book	32,367	2.347	1.673	2.002	1.177	2.690
ROA	32,367	-0.111	0.0186	0.360	-0.144	0.070
R&D	32,367	0.106	0.042	0.172	0.006	0.124
Asset Maturity	32,367	7.734	5.156	8.332	2.808	9.546
HHI	32,367	0.097	0.067	0.074	0.056	0.110

Panel B: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Debt Maturity (Years)	1.000								
(2) Foreign Leniency	0.056*	1.000							
(3) Size	0.351*	0.282*	1.000						
(4) Market Leverage	0.160*	-0.067*	0.194*	1.000					
(5) Market to Book	-0.028*	-0.052*	-0.186*	-0.340*	1.000				
(6) ROA	0.114*	0.026*	0.428*	0.074*	-0.350*	1.000			
(7) R&D	-0.093*	-0.016*	-0.333*	-0.247*	0.403*	-0.742*	1.000		
(8) Asset Maturity	0.063*	-0.017*	-0.005	0.070*	-0.029*	-0.022*	-0.035*	1.000	
(9) HHI	0.096*	0.157*	0.237*	0.219*	-0.153*	0.153*	-0.219*	0.153*	1.000

Table 4.3. Foreign Leniency Exposure and Corporate Debt Maturity

This table reports regression results examining the effect of foreign leniency laws on firms' debt maturity structure. The dependent variable in all specifications is Debt Maturity (Years), defined as the book-value weighted average maturity of debt constructed using Compustat maturity buckets. Column (1) presents the baseline specification including only foreign leniency alongside fixed effects. Column (2) introduces firm-level control variables, while Column (3) further includes industry-level competition measured by the Herfindahl–Hirschman Index (HHI). All specifications include firm and year fixed effects to control for unobserved firm heterogeneity and common time shocks. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 4-B.

VARIABLES	(1) Debt Maturity (Years)	(2) Debt Maturity (Years)	(3) Debt Maturity (Years)
Foreign Leniency	-3.413*** (0.940)	-2.409** (0.939)	-2.358** (0.940)
Size		0.714*** (0.043)	0.712*** (0.043)
Market leverage		3.254*** (0.239)	3.252*** (0.239)
Market to Book		0.117*** (0.017)	0.117*** (0.017)
ROA		0.099 (0.127)	0.100 (0.127)
R&D		0.282 (0.314)	0.284 (0.314)
Asset Maturity		0.004 (0.005)	0.004 (0.005)
HHI			-0.436 (0.687)
Constant	5.526*** (0.064)	0.842*** (0.271)	0.892*** (0.277)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	34,052	32,367	32,367
R-squared	0.439	0.453	0.453

Table 4.4. Foreign Leniency Exposure and Corporate Debt Maturity: Alternative Debt Maturity Measures

This table reports regression estimates examining the effect of foreign leniency laws on U.S. firms' debt maturity structure. The table presents robustness tests using alternative measures of debt maturity. Specifically, Column (1) uses Debt Maturity (>5 Years), while Column (2) uses Debt Maturity (>1 Year) as dependent variables. All specifications include firm and year fixed effects to control for unobserved firm heterogeneity and common time shocks. Standard errors are reported in parentheses and clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 4-B.

VARIABLES	(1)	(2)
	Debt Maturity (>5 Years)	Debt Maturity (>1 Year)
Foreign Leniency	-0.160* (0.084)	-0.138* (0.078)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	22,701	32,559
R-squared	0.492	0.476

Table 4.5. Robustness Check: Foreign Leniency Laws and Debt Maturity Using Major Trade Partners

This table reports regression results examining the effect of foreign leniency laws on firms' debt maturity structure using an alternative measure based on the top five U.S. import partners (FLL_TOP5), following Callen and Fang (2021). The dependent variable in all specifications is Debt Maturity (Years). Column (1) includes FLL_TOP5 with fixed effects, Column (2) adds firm-level controls, and Column (3) further includes industry-level competition (HHI). All specifications include firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. Variable definitions are provided in Appendix 4-B.

VARIABLES	(1) Debt Maturity (Years)	(2) Debt Maturity (Years)	(3) Debt Maturity (Years)
Foreign Leniency	-1.339*** (0.401)	-0.847** (0.394)	-0.827** (0.394)
Size		0.714*** (0.043)	0.712*** (0.043)
Market leverage		3.258*** (0.239)	3.255*** (0.239)
Market to Book		0.118*** (0.017)	0.118*** (0.017)
ROA		0.100 (0.127)	0.102 (0.127)
R&D		0.281 (0.314)	0.283 (0.314)
Asset Maturity		0.004 (0.005)	0.004 (0.005)
HHI			-0.474 (0.685)
Constant	5.444*** (0.046)	0.775*** (0.268)	0.830*** (0.274)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	34,079	32,367	32,367
R-squared	0.438	0.453	0.453

Table 4.6. Foreign Leniency Exposure and Corporate Debt Maturity: Export-Based Measure

This table reports regression estimates using FLL_EXP, an export-based measure of foreign leniency exposure constructed from industry-level export shares. This specification captures firms' exposure to foreign leniency laws through competition in international export markets. The dependent variable is Debt Maturity (Years), defined as the book-value weighted average maturity of debt. All regressions include the full set of control variables and firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 4-B.

VARIABLES	(1)
	Debt Maturity (Years)
FLL_EXP	-0.180** (0.088)
Controls	Yes
Firm FE	Yes
Year FE	Yes
Observations	32,367
R-squared	0.448

Table 4.7. Foreign Leniency Exposure and Debt Maturity: Cross-Sectional Heterogeneity

This table reports regression results examining the effect of foreign leniency laws on firms' debt maturity structure and how this relationship varies across firm characteristics. The dependent variable is Debt Maturity (Years), defined as the book-value weighted average maturity of debt. Column (1) examines the role of dividend policy by including Dividend and its interaction with foreign leniency (Dividend $\times$ Foreign Leniency). Column (2) considers firm profitability using ROA and its interaction (ROA $\times$ Foreign Leniency). Column (3) includes Cash (cash-to-assets ratio) and its interaction (Cash $\times$ Foreign Leniency). Column (4) examines Product Market Fluidity and its interaction (Product Market Fluidity $\times$ Foreign Leniency). All specifications include firm and year fixed effects, as well as a standard set of control variables. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 4-B.

VARIABLES	(1) Debt Maturity (Years)	(2) Debt Maturity (Years)	(3) Debt Maturity (Years)	(4) Debt Maturity (Years)	(5) Debt Maturity (Years)
Foreign Leniency	-3.274*** (0.961)	-2.399** (0.948)	-4.057*** (0.945)	-4.695*** (1.145)	-2.762*** (0.931)
Dividend	0.055 (0.098)				
Dividend $\times$ Foreign Leniency	2.110*** (0.715)				
ROA	0.106 (0.127)	-0.117 (0.140)	0.074 (0.125)	0.102 (0.126)	0.092 (0.128)
ROA $\times$ Foreign Leniency		3.449** (1.438)			
Cash			-0.104 (0.215)		
Cash $\times$ Foreign Leniency			11.388*** (2.349)		
Product Market Fluidity				-0.025* (0.013)	
Product Market Fluidity $\times$ Foreign Leniency				0.592*** (0.136)	
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	32,367	32,367	32,367	32,367	32,367
R-squared	0.453	0.453	0.454	0.453	0.453

Table 4.8. Foreign Leniency and the Speed of Leverage Adjustment Using Market Leverage

This table reports regression estimates examining the effect of foreign leniency exposure on the speed of leverage adjustment using Market Leverage measures. The dependent variable is the Change in Market Leverage. The leverage gap is defined as the deviation between Target Leverage and Lagged Market Leverage, where Target Leverage is estimated using a two-step partial adjustment approach. Panel A reports the baseline results. Panel B presents subsample estimates for over-leveraged and under-leveraged firms. Panel C provides a robustness test using a pooled specification with a triple interaction between the leverage gap, lagged foreign leniency, and an over-leveraged indicator. All regressions include year and industry fixed effects. Standard errors are reported in parentheses and clustered at the industry level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Baseline: Foreign Leniency and the Speed of Leverage Adjustment

Variables	(1) Change in Market Leverage	(2) Change in Market Leverage	(3) Change in Market Leverage
Leverage Gap (Market)	0.412*** (0.012)	0.437*** (0.015)	0.558*** (0.031)
Leverage Gap (Market)× Foreign Leniency		-0.404*** (0.092)	-0.379*** (0.106)
Lagged Foreign Leniency		-0.0552 (0.034)	-0.0574* (0.032)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Leverage Gap x Controls	No	No	Yes
Foreign Leniency Terms	No	Yes	Yes
Observations	37,773	37,773	37,773
R-squared	0.231	0.232	0.243

Table 4.8: (Continued)

Panel B: Foreign Leniency and the Speed of Leverage Adjustment: Over-Leveraged versus Under-Leveraged Firms

Variables	Dependent variable: Change in Market Leverage	
	(1) Over-Leveraged Firms	(2) Under-Leveraged Firms
Leverage Gap (Market)	0.637*** (0.046)	0.633*** (0.067)
Leverage Gap (Market)× Foreign Leniency	-0.145 (0.191)	-0.793** (0.216)
Lagged Foreign Leniency	-0.0271 (0.028)	-0.0252 (0.040)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Leverage Gap x Controls	Yes	Yes
Foreign Leniency Terms	Yes	Yes
Observations	16,079	21,694
R-squared	0.224	0.129

Table 4.8: (Continued)

Panel C: Robustness Test: Triple Interaction between Leverage Gap, Foreign Leniency, and the Over-Leveraged Indicator

Variables	(1) Change in Market Leverage
Leverage Gap (Market)	0.603*** (0.036)
Leverage Gap (Market) × Over-Leveraged	-0.037* (0.021)
Leverage Gap (Market) x Foreign Leniency	-0.823*** (0.200)
Leverage Gap (Market) × Lagged Foreign Leniency × Over-Leveraged	0.700*** (0.216)
Lagged Foreign Leniency	-0.017 (0.036)
Year FE	Yes
Industry FE	Yes
Leverage Gap x Controls	Yes
Foreign Leniency Terms	Yes
Observations	37,773
R-squared	0.244

Appendices of Chapter 4

Appendix 4-A. Validity Tests of Foreign Leniency Exposure

Following Xu (2012), I estimate the effect of foreign leniency laws on firm outcomes using the following specification:

$$Y_{i,t} = \alpha + \beta \cdot \text{Foreign Leniency}_{i,t} + \gamma X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

where:

- $Y_{i,t}$ denotes the dependent variable for firm i in year t . In Table 4-A1, this includes profitability, measured as operating income after depreciation scaled by lagged total assets, and Log Market Share, defined as the natural logarithm of a firm's sales relative to total industry sales. In Table 4-B1, the dependent variable is book leverage, defined as the ratio of interest-bearing debt to total assets.
- $\text{Foreign Leniency}_{i,t}$ measures firm i 's exposure to foreign jurisdictions with active leniency programs in the same year.
- $X_{i,t}$ represents a vector of firm-level controls. In Table 4-A1, the controls include size, leverage, cash holdings (Cash), R&D intensity (R&D), firm age (Log firm age), capital labour intensity, import penetration, and industry concentration (HHI). In Table 4-B1, the controls include firm size, market-to-book ratio, profitability (ROA), R&D intensity, asset maturity, and HHI.
- μ_i captures firm fixed effects, controlling for time-invariant unobserved heterogeneity.
- λ_t captures year fixed effects, accounting for macroeconomic and policy shocks common to all firms.
- $\varepsilon_{i,t}$ is the error term.

Standard errors are clustered at the firm level in Table 4-A1 and at the industry-year level in Table 4-B1. These validity tests examine whether foreign leniency laws intensify competitive pressure and generate effects consistent with prior literature on competition and corporate financial policy. The two-way fixed effects regression framework allows me to

isolate the impact of foreign leniency laws while controlling for firm fundamentals and broader industry conditions. Consistent with Xu (2012), the identifying assumption is that changes in foreign leniency regimes are plausibly exogenous to individual U.S. firms' financing and product-market strategies.

Table 4-A1 presents evidence that foreign leniency laws significantly reduce firms' profitability and market share. In Column (1), the coefficient on Foreign Leniency is -0.326 ($p < 0.01$), indicating that greater exposure to foreign jurisdictions with active leniency programs is associated with significantly lower firm profitability. In Column (2), the coefficient on Foreign Leniency is -2.691 ($p < 0.01$), suggesting that firms facing stronger competitive pressure from leniency-adopting countries experience substantial declines in relative industry sales. These findings provide direct empirical support for the competitive pressure mechanism underlying the main analysis and are consistent with evidence that intensified competition reduces firms' price-cost margins and market power.

Table 4-B1 examines whether foreign leniency exposure also affects firms' capital structure decisions. The results show that Foreign Leniency is negatively and significantly associated with book leverage across all specifications. In Column (1), the coefficient on Foreign Leniency is -0.330 ($p < 0.01$). After introducing firm-level financial controls in Column (2), the coefficient remains negative and highly significant (-0.341 , $p < 0.01$). Column (3) further incorporates HHI, and the coefficient on Foreign Leniency remains negative and statistically significant (-0.327 , $p < 0.01$). These findings indicate that intensified competitive pressure associated with foreign leniency laws reduces firms' reliance on debt financing.

Overall, the evidence in Tables 4-A1 and 4-B1 supports the interpretation that foreign leniency laws operate through economically meaningful increases in competitive pressure that weaken profitability, reduce market power, and lower firms' incentives to rely on debt

financing. These results provide supporting validity evidence for the foreign leniency measure used throughout the main empirical analysis.

Table 4-A1. The Impact of Foreign Leniency Laws on Profitability and Market Share

This table reports firm-level regression estimates examining the effect of foreign leniency law exposure on profitability (Column 1) and Log Market Share (Column 2). The key explanatory variable is foreign leniency, which captures U.S. firms' exposure to foreign jurisdictions with active leniency programs. Control variables include size, leverage, cash, R&D, Log firm age, capital labour intensity, import penetration, and HHI. All regressions include firm and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses below the coefficient estimates. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are reported in Appendix 4-B.

VARIABLES	(1) Profitability	(2) Log Market Share
Foreign Leniency	-0.326*** (0.096)	-2.691*** (0.327)
Size	0.059*** (0.005)	0.810*** (0.013)
Leverage	-0.159*** (0.013)	0.095*** (0.033)
Cash	-0.166*** (0.018)	-0.944*** (0.051)
R&D	-0.005*** (0.000)	-0.073*** (0.001)
Log firm age	0.052*** (0.017)	0.231*** (0.035)
Capital Labor Intensity	0.021*** (0.005)	-0.187*** (0.020)
Import Penetration	0.027 (0.148)	0.962*** (0.361)
HHI	-0.037 (0.054)	-0.366 (0.291)
Constant	-0.348*** (0.045)	-11.574*** (0.099)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	35,937	38,537
R-squared	0.747	0.977

Table 4-B1. Validity Test: The Effect of Foreign Leniency Exposure on Corporate Leverage

This table reports regression estimates examining the effect of foreign leniency laws on U.S. firms' capital structure. The dependent variable is book leverage, defined as the ratio of interest-bearing debt to total assets. The table presents baseline regression estimates of the relationship between foreign leniency exposure and corporate leverage. Column (1) includes foreign leniency as the sole explanatory variable. Column (2) adds firm-level financial controls, and Column (3) further incorporates industry-level controls, including the Herfindahl–Hirschman Index (HHI). All specifications include firm and year fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 4-B.

	(1)	(2)	(3)
VARIABLES	Book Leverage	Book Leverage	Book Leverage
Foreign Leniency	-0.330*** (0.061)	-0.341*** (0.059)	-0.327*** (0.059)
Size		0.026*** (0.002)	0.025*** (0.002)
Market to Book		-0.003*** (0.001)	-0.003*** (0.001)
ROA		-0.207*** (0.008)	-0.207*** (0.008)
R&D		-0.097*** (0.019)	-0.096*** (0.019)
Asset Maturity		0.000** (0.000)	0.000*** (0.000)
HHI			-0.092*** (0.028)
Constant	0.217*** (0.004)	0.079*** (0.012)	0.089*** (0.013)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	42,862	40,107	40,107
R-squared	0.539	0.583	0.583

Appendix 4-B. Definition of Variables

This appendix provides detailed definitions of all variables used in the study, categorized into thematic groups for clarity. Each entry includes the variable name, definition, and data source.

1. Dependent Variables: Leverage Measures

Variable	Definition	Source
Debt Maturity (Years)	Book-value weighted average maturity of debt, following Chen et al. (2012). Constructed using Compustat maturity categories: short-term debt (dlc), debt due in years two to five (dd2–dd5), and long-term debt beyond five years (dltt net of dd2–dd5), with assigned durations of 0.5, 1.5, 2.5, 3.5, 4.5, and 13 years.	Compustat
Debt Maturity (>5 Years)	Proportion of total debt maturing beyond five years, calculated as long-term debt after year five (dltt – dd2–dd5) scaled by total debt (dltt + dlc). Captures firms' reliance on long-term financing (Custódio et al., 2013; Chen et al., 2021).	Compustat
Debt Maturity (>1 Year)	Proportion of total debt maturing beyond one year, calculated as long-term debt (dltt) scaled by total debt (dltt + dlc). Captures firms' reliance on long-term financing (Custódio et al., 2013; Chen et al., 2021).	Compustat
Book Leverage	Ratio of interest-bearing debt (short-term debt plus long-term debt) to total assets (Danis et al., 2014; Xu, 2012).	Compustat
Market Leverage	Interest-bearing debt divided by the sum of total assets and market equity (share price × shares outstanding) minus book equity (Danis et al., 2014; Xu, 2012).	Compustat
Change in Market Leverage	The annual change in Market Leverage, defined as Market Leverage in year t minus Market Leverage in year $t - 1$.	Compustat

2. Independent Variables: Foreign Leniency Exposure and Interaction Term

Variable	Definition	Source
Foreign Leniency	The weighted average of leniency laws passed in foreign countries, weighted by the share of imports from each country relative to industry imports. Reflects exposure to international antitrust enforcement.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020).
FLL_TOP5	Import-weighted foreign leniency exposure constructed using only the top five U.S. trading partner countries within each industry.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020).

Variable	Definition	Source
FLL_EXP	Export-weighted measure of foreign leniency exposure, capturing competitive spillovers through U.S. export links.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020).
Dividend	Indicator variable equal to one if the firm pays dividends in a given year, and zero otherwise.	Compustat
Dividend $\times$ Foreign Leniency	Interaction term between the dividend dummy (Dividend) and foreign leniency exposure. This variable captures whether the effect of foreign leniency laws on debt maturity varies between dividend-paying and non-dividend-paying firms.	Compustat
Product Market Fluidity $\times$ Foreign Leniency	Interaction term between Product Market Fluidity and foreign leniency exposure. This variable captures whether the effect of foreign leniency laws on debt maturity varies across firms operating in product markets with different levels of competitive dynamism.	Hoberg and Phillips (2016).
Cash $\times$ Foreign Leniency	Interaction term between firm cash holdings (Cash) and foreign leniency exposure. This variable measures whether internal liquidity moderate's firms' leverage adjustments in response to competition induced by foreign leniency laws.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020) & Compustat
ROA $\times$ Foreign Leniency	Interaction term between firm profitability (ROA) and foreign leniency exposure. This variable captures whether the effect of foreign leniency laws on debt maturity varies with firms' profitability.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020) & Compustat
Leverage Gap (Market)	The difference between Target Market Leverage and Lagged Market Leverage. Target Market Leverage is estimated as the fitted value from a first-stage Market Leverage regression using firm characteristics commonly employed in the capital structure literature.	Compustat

Variable	Definition	Source
Lagged Foreign Leniency	The one-year lag of the foreign leniency measure, which captures industry-year exposure to foreign leniency laws.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020).
Leverage Gap (Market) $\times$ Lagged Foreign Leniency	The interaction between the Market Leverage Gap and Lagged Foreign leniency. It captures whether foreign leniency changes the speed of adjustment toward target leverage.	Cartel Regulation 2013, Schott's Data Library, Bourveau et al. (2020) & Compustat.
Over-Leveraged	A dummy variable equal to one if the firm's Lagged Market Leverage is above its Target Market Leverage. This corresponds to a negative Market Leverage Gap.	Compustat
Under-Leveraged	Firms whose Lagged Market Leverage is below Target Market Leverage. This corresponds to a positive Market Leverage Gap.	Compustat
Leverage Gap (Market) $\times$ Over-Leveraged	The interaction between the Market Leverage Gap and the Over-Leveraged indicator. It captures whether the baseline speed of adjustment differs between Over- and Under-Leveraged firms.	Compustat
Leverage Gap (Market) $\times$ Lagged Foreign Leniency $\times$ Over-Leveraged	The triple interaction between the Market Leverage Gap, Lagged Foreign Leniency, and the Over-Leveraged indicator. It tests whether the effect of foreign leniency on the speed of adjustment differs between over- and under-leveraged firms	Compustat

3. Firm-Specific Control Variables

Variable	Definition	Source
Size	Natural logarithm of total assets, used as a proxy for firm size.	Compustat
Market to Book	Ratio of the market value of assets to their book value, capturing firms' growth opportunities.	Compustat
Leverage	Book value of total liabilities scaled by total assets at the fiscal year-end.	Compustat
Cash	Ratio of cash and cash equivalents to total assets at the fiscal year-end, reflecting internal liquidity.	Compustat

Variable	Definition	Source
R&D	Research and development expenditures scaled by total assets, capturing firms' innovation intensity.	Compustat
Capital Labor Intensity	Ratio of total invested capital to the number of employees, reflecting capital intensity.	Compustat
ROA	Income before extraordinary items scaled by total assets, capturing operating profitability.	Compustat
Log Market Share	Natural logarithm of firm market share, where market share is firm sales relative to total sales in the same two-digit SIC industry.	Compustat
Profitability	Operating income after depreciation scaled by lagged total assets, reflecting efficiency in generating earnings from assets.	Compustat
Log Firm Age	Natural logarithm of firm age, based on the number of years since first appearance in Compustat.	Compustat
Asset Maturity	Weighted average duration of a firm's assets, calculated as property, plant, and equipment divided by depreciation and weighted by its share of total assets, plus current assets divided by cost of goods sold and weighted by their share of total assets.	Compustat

4. Industry and Market Measures

Variable	Definition	Source
Import Penetration	Ratio of imports to total industry shipments minus exports, capturing exposure to foreign competition.	Schott's Data Library
HHI	Herfindahl-Hirschman Index (HHI) of two-digit SIC industries, capturing industry concentration.	Compustat
Product Market Fluidity	Measures how much a firm's product market language is being adopted or dropped by competitors, indicating market dynamism (Hoberg & Phillips, 2016).	Hoberg and Phillips (2016).

Appendix 4-C. Additional Robustness Analyses: Lagged Specifications and Alternative Fixed Effects

To address potential simultaneity concerns, I re-estimate the baseline model using lagged explanatory variables, following Xu (2012). Panel A of Appendix Table 4-C reports the results. Across all specifications, the coefficient on lagged foreign leniency remains negative and statistically significant, indicating that the effect of foreign leniency laws on debt maturity persists over time and is not driven by contemporaneous shocks. The control variables generally behave in line with the debt maturity literature, with firm size, Market Leverage, and growth opportunities positively associated with debt maturity. Overall, the findings reinforce the conclusion that foreign leniency laws have a persistent negative effect on firms' debt maturity, suggesting that firms shorten debt maturity in response to increased competitive pressure and heightened uncertainty.

To further assess robustness, I re-estimate the model using industry fixed effects in place of firm fixed effects, while retaining year fixed effects. Panel B of Appendix Table 4-C reports the results. The coefficient on foreign leniency remains negative and statistically significant, indicating that the baseline findings are robust to this alternative fixed-effects specification. Overall, the results suggest that the relationship between foreign leniency laws and debt maturity is not driven by firm-specific unobserved characteristics and remains consistent after controlling for industry-level heterogeneity.

Appendix Table 4-C. Additional Robustness Analyses: Lagged Specifications and Alternative Fixed Effects

This table reports additional robustness analyses examining the relationship between foreign leniency exposure and corporate debt maturity. Panel A presents lagged specifications using lagged explanatory variables to address potential timing and simultaneity concerns. Panel B re-estimates the baseline model using industry fixed effects in place of firm fixed effects, while retaining year fixed effects. All regressions include the full set of control variables and relevant fixed effects. Standard errors are reported in parentheses and are clustered at the industry-year level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in Appendix 4-B.

Panel A. Lagged Specifications: Foreign Leniency and Debt Maturity

VARIABLES	(1) Debt Maturity (Years)	(2) Debt Maturity (Years)	(3) Debt Maturity (Years)
Lagged Foreign Leniency	-3.234*** (0.967)	-2.944*** (0.993)	-2.874*** (1.005)
Lagged Firm Controls	No	Yes	Yes
Lagged Industry Controls	No	No	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	30,329	28,841	28,841
R-squared	0.439	0.444	0.444

Panel B. Robustness Check: Foreign Leniency Laws and Debt Maturity (Industry Fixed Effects)

VARIABLES	(1) Debt Maturity (Years)
Foreign Leniency	-1.836** (0.762)
Controls	Yes
Industry FE	Yes
Year FE	Yes
Observations	32,842
R-squared	0.176

CHAPTER 5. SUMMARY AND CONCLUSION

This concluding chapter brings together the evidence from the three empirical studies. Sections 5.1, 5.2, and 5.3 summarise the findings of Chapters 2, 3, and 4, respectively, and discuss their implications for managers, investors, regulators, and policymakers. Each section also reflects on the main limitations of the corresponding study. Section 5.4 outlines possible avenues for future research, while Section 5.5 concludes the thesis.

5.1 Chapter 2: Linguistic Structures and Corporate Carbon Emissions

In Chapter 2, I examine whether linguistic structures help explain cross-country differences in corporate carbon emissions. Building on Chen's (2013) linguistic time-discounting framework, I investigate whether firms operating in weak future-time-reference linguistic environments produce lower emissions than those located in strong future-time-reference settings. The evidence shows that weak-FTR language is associated with significantly lower corporate carbon emissions. This result indicates that language, as an informal institution, may shape how managers evaluate future environmental consequences and respond to long-term climate-related risks.

The main evidence remains robust across alternative carbon emission measures, different specifications of the linguistic variable, sample restrictions, and alternative fixed-effects structures. I also show that the association between weak-FTR language and lower emissions is weaker in more globalised and individualistic societies. This suggests that the role of language depends partly on the broader cultural and institutional setting in which firms operate. Additional analysis from multilingual countries further supports the view that linguistic differences matter even within similar national environments. These results extend prior studies on language and future-oriented behaviour (Chen, 2013; Sutter et al., 2015) and contribute to research showing that linguistic structures influence corporate policies such as

corporate social responsibility, research and development, cash holdings, and investment decisions (S. Chen et al., 2017; Kim et al., 2017; Liang et al., 2018).

The chapter has implications for managers, investors, and policymakers. For managers, the evidence suggests that environmental choices may be shaped not only by regulation and financial incentives, but also by informal institutions that influence attitudes toward the future. For investors, the findings highlight the importance of considering cultural and linguistic contexts when assessing firms' environmental risk and long-term sustainability orientation, particularly because carbon emissions can affect firm value and investor perceptions (Bolton & Kacperczyk, 2021; Matsumura et al., 2014).

For policymakers, the results imply that climate-related policies may be more effective when they take account of the different institutional and cultural settings in which firms operate. However, the chapter is subject to some limitations. First, although I provide additional evidence from within-country analyses and multilingual settings, linguistic structures are still difficult to observe directly at the firm or managerial level. The country-level FTR classification may therefore not fully capture differences in language use within multinational firms or among managers working in multilingual environments.

Nevertheless, the consistency of the results across alternative FTR measures, sample restrictions, and within-country tests helps reduce this concern. Second, the sample is limited to publicly listed firms with available carbon emissions data, which may restrict the extent to which the findings apply to private firms or firms with weaker environmental disclosure practices. Finally, although language is relatively stable and unlikely to be shaped by firm-level emissions, the empirical design cannot fully eliminate the possibility that other unobserved cultural or institutional factors influence corporate environmental behaviour.

5.2 Chapter 3: Foreign Leniency Laws and Corporate Investment

In Chapter 3, I examine whether exposure to foreign antitrust leniency laws affects corporate investment behaviour and investment efficiency among U.S. firms. Consistent with the view that leniency laws weaken collusive arrangements and intensify product market rivalry, I find that firms more exposed to foreign leniency enforcement increase total investment. Using a panel of publicly listed U.S. firms from 1990 to 2021 and an import-weighted measure of foreign leniency exposure, the evidence shows that this response is strongest for capital expenditures and research and development, while the effect on acquisitions is more moderate. This pattern suggests that firms mainly respond to heightened competitive pressure by expanding internal investment rather than relying primarily on external growth through acquisitions.

With respect to investment efficiency, the results show that foreign leniency exposure improves capital allocation. This improvement is driven mainly by a reduction in underinvestment, indicating that stronger competitive pressure encourages firms to undertake profitable projects that may otherwise have been delayed or avoided. This finding is consistent with foreign leniency laws mitigating the managerial “quiet life” and encouraging firms to work harder by pursuing investment opportunities that might otherwise have been forgone. At the same time, the evidence also points to some increase in overinvestment, suggesting that certain firms respond to heightened rivalry by increasing investment beyond expected levels. Overall, the chapter shows that foreign leniency laws affect both the scale of investment and the efficiency with which firms allocate resources.

These results have important implications for the literature on antitrust enforcement, competition, and corporate investment. They suggest that leniency programmes are not only legal tools for detecting and destabilising cartels but also have real effects on firms’ strategic decisions. By increasing competitive pressure through international trade linkages, foreign

leniency laws can influence the investment behaviour of U.S. firms even when the regulatory change occurs outside the domestic market. This highlights the importance of cross-border regulatory spillovers and shows that competition policy can shape corporate resource allocation beyond the country in which it is adopted.

The chapter should also be interpreted in light of several limitations. The analysis is based on publicly listed U.S. firms, and therefore the results may not necessarily extend to private firms or to firms operating in different institutional and financial environments. Nevertheless, this setting is well suited to the research question because U.S. listed firms provide detailed and comparable investment data and are exposed to competitive spillovers through international trade. A further limitation concerns the level at which foreign leniency exposure is measured. The foreign leniency variable is constructed at the two-digit SIC industry-year level, meaning that firms within the same industry-year receive the same exposure value. Firm-specific exposure would require detailed data on individual firms' import relationships, which were not available for this study. Future research with access to such data could construct more granular measures and examine variation in foreign leniency exposure across firms within the same industry.

In addition, while the empirical strategy exploits variation in industry-level foreign leniency exposure across industries and over time, other unobserved developments may still occur around the same time as changes in foreign competition policy. I address this concern by using firm and year fixed effects, a broad set of control variables, alternative foreign leniency measures, and a range of robustness tests. Taken together, the evidence suggests that foreign antitrust enforcement has meaningful real effects on corporate investment behaviour and capital allocation among U.S. firms.

5.3 Chapter 4: Foreign Leniency Laws and Corporate Financing

In Chapter 4, I examine how foreign antitrust leniency laws affect corporate financing decisions, with particular emphasis on debt maturity and capital structure adjustment. The chapter builds on the idea that leniency programmes increase the expected costs and detection risk of collusion, weaken coordinated market conduct, and intensify product market competition. Through international trade linkages, these enforcement changes can affect U.S. firms by increasing competitive pressure and making financial flexibility more valuable.

Using Compustat North America data for U.S. firms over the period 1990 to 2021, I construct an import-weighted measure of foreign leniency exposure and estimate firm-level fixed-effects models. The main results show that greater exposure to foreign leniency laws is associated with significantly shorter debt maturity, indicating that firms reduce their reliance on long-term debt when competitive pressure increases. These findings are consistent with the view that firms adjust their financing structures in response to heightened uncertainty and weaker competitive positions. Prior research shows that product market competition can affect leverage, financing costs, and broader corporate financial policy (Dasgupta & Žaldokas, 2019; Valta, 2012; Xu, 2012). I extend this literature by showing that competition induced by foreign antitrust enforcement affects not only leverage levels, but also the maturity composition of corporate debt.

The evidence is also consistent with theories of debt maturity choice, which suggest that firms facing greater uncertainty, information asymmetry, or financing constraints may rely more heavily on shorter-term debt to preserve flexibility, even though this can increase refinancing risk (Barclay & Smith Jr, 1995; Chen et al., 2021; Custódio et al., 2013; Diamond, 1991; Myers, 1977). The chapter also provides evidence on the channels through which foreign leniency laws affect debt maturity. The maturity-shortening effect is stronger among financially constrained firms, particularly non-dividend-paying firms, low-profitability firms, and firms

with lower cash holdings. This pattern suggests that firms with weaker internal resources respond more cautiously to intensified competition by shortening debt maturity and preserving financial flexibility. By contrast, firms with stronger profitability and greater liquidity show a weaker response, consistent with their greater ability to absorb competitive shocks.

The effect is also weaker among firms operating in more dynamic product markets, suggesting that these firms may already maintain financing structures suited to competitive uncertainty. These results are consistent with the broader corporate finance literature showing that financial constraints, liquidity, and market conditions shape firms' financing choices (Almeida et al., 2012; Bates et al., 2009; Fama & French, 2001; Hoberg & Phillips, 2016). In addition to debt maturity, Chapter 4 examines whether foreign leniency exposure affects capital structure dynamics. The results show that foreign leniency laws slow the speed at which firms adjust toward their target leverage. This effect is concentrated mainly among under-leveraged firms, suggesting that firms delay debt issuance when competition increases and uncertainty becomes more pronounced.

The evidence is more consistent with a precautionary financing explanation than with a predation-based channel. Rather than moving quickly toward target leverage, firms appear to tolerate larger deviations to preserve flexibility under heightened competitive pressure. This interpretation is consistent with dynamic capital structure models in which adjustment costs, financing frictions, and uncertainty prevent firms from immediately reaching their target leverage ratios (Fischer et al., 1989; Flannery & Rangan, 2006; Strebulaev, 2007). The findings have implications for managers, investors, creditors, and policymakers. For managers, the results highlight the importance of maintaining financial flexibility when firms face stronger product market competition. Firms with limited liquidity or weaker profitability appear more exposed to competitive shocks and therefore adjust their debt maturity more strongly.

For investors and creditors, the findings suggest that changes in foreign competition policy can affect firms' financing risk, maturity structure, and leverage adjustment behaviour. For policymakers, the chapter shows that antitrust enforcement has consequences beyond cartel detection and product market outcomes. By intensifying competition, foreign leniency laws can also influence corporate financing decisions in firms located outside the adopting countries. As with any empirical study, this chapter has some limitations. The analysis focuses on publicly listed U.S. firms, which may limit the extent to which the findings apply to private firms or firms operating in different institutional environments. However, this setting is appropriate for examining corporate financing responses because listed firms provide detailed debt structure information and are likely to be exposed to international product market competition.

Another limitation is that foreign leniency exposure is measured at the two-digit SIC industry-year level rather than for individual firms. As a result, the measure does not capture differences in exposure among firms operating within the same industry-year. More detailed firm-specific import data would allow future research to develop a finer measure of foreign regulatory exposure and examine whether financing responses vary with firms' individual trade linkages. In addition, although the empirical design uses staggered foreign leniency adoptions and trade-based exposure to capture cross-border regulatory spillovers, it cannot fully rule out all unobserved factors that may coincide with changes in foreign enforcement environments.

To reduce this concern, the chapter uses firm and year fixed effects, a broad set of control variables, alternative debt maturity measures, different fixed-effects structures, alternative trade-based leniency measures, and several robustness tests. Overall, Chapter 4 shows that foreign antitrust enforcement shapes corporate financing behaviour by encouraging firms to shorten debt maturity and adjust more cautiously toward target leverage under intensified competition.

5.4 Future Research Suggestions

The findings presented in this thesis open several avenues for further research on how institutional and regulatory environments shape corporate behaviour. One promising direction is to extend the analysis of linguistic structures and corporate environmental outcomes beyond carbon emissions. Given the difficulty of observing linguistic characteristics directly at the firm or managerial level, future research could use more granular measures based on managers' native languages, corporate disclosures, or other firm-level indicators of language use. Such an analysis could not be undertaken in the present study because reliable data on CEOs' ancestry and native linguistic backgrounds are not available for the international sample. Future studies with access to such managerial-level information could provide a more direct test of the proposed linguistic mechanism.

Future work could examine whether weak future-time-reference languages influence environmental innovation, climate-related disclosure, green investment, or the adoption of emission-reduction technologies. It would also be useful to explore whether the effect of language varies with managerial characteristics, board composition, ownership structure, or the strength of national environmental regulation. Such an analysis would provide a deeper understanding of the channels through which informal institutions influence corporate environmental decisions.

A second avenue relates to the real effects of foreign antitrust leniency laws. This thesis shows that exposure to foreign leniency laws increases total investment and improves investment efficiency, primarily by reducing underinvestment, while also leading some firms to increase investment beyond expected levels under intensified competition. Future research could use firm-specific trade relationships, where available, to construct more granular measures of foreign leniency exposure and examine heterogeneity among firms within the same industry. Further research could examine whether these investment responses translate

into higher productivity, stronger innovation output, market share growth, or long-term firm value. Additional work could also investigate whether firms change the composition of investment following leniency-induced competition, for example by reallocating resources between capital expenditure, research and development, acquisitions, and intangible investment. This would help clarify whether stronger competition encourages value-enhancing investment or results in investment exceeding levels justified by firms' growth opportunities.

A third direction is to build on the financing results by examining other dimensions of corporate financial policy. While this thesis focuses on debt maturity and capital structure adjustment, further work could consider whether foreign leniency exposure affects debt covenant design, credit ratings, loan spreads, bond issuance, cash holdings, payout policy, or access to external finance. It would also be valuable to examine whether banks and bondholders adjust lending terms when firms become more exposed to foreign antitrust enforcement. This would provide a broader view of how competition policy affects financing constraints, creditor behaviour, and financial flexibility. More granular firm-level measures of foreign regulatory exposure could also help identify how differences in individual trade linkages shape firms' financing responses.

Finally, future research could examine how formal and informal institutions interact. This thesis studies language and antitrust enforcement in separate empirical settings, but an important next step would be to investigate whether cultural and linguistic environments shape firms' responses to regulatory shocks. For example, firms operating in more future-oriented institutional environments may respond differently to competition, climate regulation, or financial market shocks. Given that Chapters 3 and 4 focus on publicly listed U.S. firms, further research could extend the analysis to private firms and non-U.S. settings to assess whether the documented investment and financing responses generalise across different institutional and financial environments. Comparative analysis across countries with different legal systems,

governance quality, and capital market development could provide further insight into these relationships.

5.5 Concluding Remarks

Overall, this thesis shows that external institutional and regulatory environments play an important role in corporate behaviour. Firms do not make environmental, investment, and financing decisions in isolation. Rather, their choices are shaped by the informal institutions, formal regulations, and competitive conditions in which they operate.

In Chapter 2, I show that firms located in weak future-time-reference linguistic environments have lower carbon emissions, suggesting that language can affect how managers perceive future environmental consequences and respond to long-term climate risks. In Chapter 3, I find that exposure to foreign antitrust leniency laws increases total investment and improves investment efficiency among U.S. firms, primarily through a reduction in underinvestment, although some firms also increase investment beyond expected levels. In Chapter 4, I show that foreign leniency exposure affects corporate financing decisions by shortening debt maturity and slowing the speed of adjustment toward target leverage.

The findings of Chapters 3 and 4 provide a complementary picture of how firms respond to intensified competition. By weakening collusive arrangements and mitigating the managerial “quiet life,” foreign leniency laws encourage firms to work harder, as reflected in higher investment and reduced underinvestment. At the same time, stronger competitive pressure encourages firms to make more conscious and prudent financing choices, including shortening debt maturity and adjusting more cautiously toward target leverage. Thus, the investment and financing responses are not contradictory but represent different dimensions of firms’ adjustment to stronger competitive discipline. Firms respond to greater competition by pursuing investment opportunities while simultaneously exercising greater prudence in their financing decisions.

Overall, the evidence supports the view that institutional forces have meaningful real effects on firms. Informal institutions, such as language, influence corporate environmental behaviour by shaping future-oriented decision-making. Formal regulatory mechanisms, such as antitrust leniency laws, affect firms through intensified product market competition. In particular, the findings from Chapters 3 and 4 suggest that stronger competitive discipline mitigates managerial complacency and encourages firms to make more considered corporate decisions across both investment and financing policies. The thesis also highlights the importance of cross-border regulatory spillovers, as foreign antitrust enforcement can affect U.S. firms through international trade linkages.

Finally, this thesis contributes to the accounting and finance literature by showing that institutional and regulatory environments influence firms' environmental outcomes, investment decisions, and financing policies. The results have important implications for managers, investors, creditors, regulators, and policymakers. For managers, the evidence highlights the need to consider institutional and competitive conditions when making long-term corporate decisions. For investors and creditors, the findings suggest that external institutional forces can affect firms' environmental risk, investment behaviour, and financing risk. For policymakers, the thesis shows that both informal institutions and formal regulatory mechanisms can shape corporate outcomes in ways that are relevant to sustainability, competition policy, and financial stability.

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