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Strategic Corporate Purpose under Competition

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# Abstract

Diese Arbeit untersucht den Einfluss von Strategic Corporate Purpose auf die Einführung sauberer Technologien, deren Kosten von der gemeinsamen Implementierung der adoptierenden Unternehmen abhängen. Unter Verwendung eines formalen zweistufigen spieltheoretischen Modells vergleicht die Analyse das Unternehmensverhalten und die Gleichgewichtsausgänge in Monopol- und Duopol-Marktstrukturen. Im Monopolszenario zeigt das Modell, dass rein gewinnmaximierende Unternehmen die Einführung aufgrund erwarteter Gewinnverluste rational ablehnen, was einen quantifizierbaren Schwellenwert für das interne Engagement für Corporate Purpose erfordert, um den Übergang zu grüner Technologie zu rechtfertigen. Im Duopolszenario identifiziert die Analyse ein Koordinationsproblem, bei dem das ineffiziente Nicht-Adoptions-Gleichgewicht trotz vorhandener Kostensynergien neben dem effizienten gegenseitigen Adoptionsgleichgewicht bestehen bleibt und in Abwesenheit eines Koordinationsmechanismus selektiert werden kann. Die Ergebnisse belegen, dass Strategic Corporate Purpose als glaubwürdiges Commitmentinstrument fungiert. Eine hinreichend starke Purpose-Orientierung eliminiert das ineffiziente Nicht-Adoptions-Gleichgewicht, während schwächere Commitments das Koordinationsproblem zwar in Richtung Adoption verschieben, die zugrunde liegende Multiplizität aber nicht vollständig auflösen. Darüber hinaus zeigt das Modell, dass unter asymmetrischen Bedingungen ein zweckorientiertes Unternehmen einseitig adoptieren kann, während sein gewinnorientierter Konkurrent auf der Alttechnologie verbleibt. Eine vergleichende Analyse zeigt, dass das Duopol-Setting niedrigere Schwellenwerte für die erforderliche Purpose-Orientierung zur Folge hat als das Monopol. Das liegt teils an der angenommenen Kostenkomplementarität, teils aber auch an einem davon unabhängigen Effekt der Cournot-Gewinnstruktur, da die Schwelle für einseitige Adoption auf denselben erwarteten Kosten beruht wie die des Monopolisten, aber dennoch unter dem Monopolschwellenwert liegt. Wettbewerb verändert also, wie

ein gegebenes Commitment in Adoption übersetzt wird, und macht Corporate Purpose nicht pauschal wirksamer.

This thesis investigates the strategic influence of corporate purpose on the adoption of clean technologies whose cost outcomes depend on the joint implementation of adopting firms. Using a formal two-stage game-theoretic model, the analysis compares firm behavior and equilibrium outcomes across monopoly and duopoly market structures. In the monopoly setting, the model demonstrates that purely profit-maximizing firms rationally reject adoption due to expected profit losses, requiring a quantifiable threshold of internal purpose commitment to justify the transition to green technology. In the duopoly setting, the analysis identifies a coordination problem. Despite the presence of cost synergies, the inefficient non-adoption equilibrium coexists with the efficient mutual-adoption equilibrium and may be selected in the absence of a coordination device. The findings establish that strategic corporate purpose functions as a credible commitment device. A sufficiently strong purpose orientation eliminates the inefficient non-adoption equilibrium, while weaker commitments shift the coordination problem toward adoption without fully resolving the underlying multiplicity. Furthermore, the model shows that, under asymmetric conditions, a purpose-driven firm can unilaterally adopt while its profit-driven rival remains with the legacy technology. Comparative analysis shows that, relative to the monopoly benchmark, the duopoly lowers the purpose level required for adoption. This is partly due to an assumed cost complementarity, and partly due to an effect of the Cournot profit structure that is independent of it, since the unilateral-adoption threshold rests on the same expected cost as the monopolist's yet lies below the monopoly threshold. Competition thus reshapes how a given commitment translates into adoption rather than making purpose uniformly more powerful.

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# List of abbreviations

**CSR** Corporate Social Responsibility  
**ESG** Environmental Social Governance  
**FOC** First-Order Condition  
**SPNE** Subgame Perfect Nash Equilibrium

# 1. Introduction

**Relevance of the topic** For decades, the dominant neoclassical economic paradigm asserted that the sole social responsibility of business was to maximize shareholder profits (Friedman, 1970). However, the role of the firm is currently undergoing a fundamental transformation (Ocasio et al., 2023). In an environment characterized by increasingly complex societal and environmental challenges, corporations are moving beyond the narrow pursuit of shareholder value maximization toward a stakeholder-oriented paradigm (Blocker et al., 2025b; Ocasio et al., 2023). This shift reflects an evolving understanding of business impact, marking a highly debated transition from traditional shareholder capitalism towards "sustainable capitalism" (Ocasio et al., 2023). The latter is an ideal based on achieving sustainable prosperity for society and its population (Ocasio et al., 2023). Within this context, corporate purpose has emerged as a mechanism for firms to navigate these external expectations and align their internal decision-making. Purpose is defined as a concrete goal or objective that extends beyond the pursuit of profit maximisation (Henderson & Van den Steen, 2015). It functions as a unifying principle, offering an explanation for the fundamental moral or social reason behind an organisation's existence (Jones, 2016). Crucially, strategic corporate purpose represents the evolution of this concept from isolated philanthropic initiatives into the core of a firm's business model. It acts as a powerful strategic commitment device that can alter the competitive landscape (Albuquerque & Cabral, 2025). Strategic corporate purpose is a mechanism through which firms can align their internal decision-making with external expectations (Fitzsimmons et al., 2022). As demonstrated in the relevant literature, this has been shown to enhance legitimacy, stakeholder trust, and long-term resilience (Kauppi, 2022; Porter & Kramer, 2011). However, the practical implementation of such a purpose faces a critical hurdle in the context of clean technology adoption. Transitioning to green production methods is characterized by high upfront capital ex-

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penditures, long development cycles, and significant uncertainty regarding future returns (Acemoglu et al., 2016; Ma et al., 2019). While joint adoption of green technologies could lead to industry-wide benefits and legitimacy (Porter & Kramer, 2011), individual profit-maximizing firms face a strategic coordination problem: unilateral adoption is unattractive because the expected production costs of the new technology, when adopted alone, exceed those of the incumbent legacy technology, whereas joint adoption can lower expected costs through complementarities (Albuquerque & Cabral, 2025). As a result firms may remain trapped in the inefficient non-adoption outcome even though mutual adoption of green technology would leave both better off. Without a credible commitment device that aligns expectations across firms, pure financial metrics fail to account for the strategic value of long-term sustainability (Albuquerque & Cabral, 2025; Constantatos & Herrmann, 2011). This research identifies a pressing need to understand how purpose orientation can modify these incentives and enable firms to overcome the barriers to sustainable innovation.

**Objective and research question** The primary objective of this thesis is to formally analyze how a commitment to a corporate purpose influences a firm's decision to adopt clean technologies. Specifically, this research aims to determine if a purpose-oriented utility function can provide the necessary strategic incentives to overcome the financial risks and coordination failures identified in the previous section.

While the normative importance of corporate purpose has been widely acknowledged over the past years, its strategic implications remain underexplored. The central question the research seeks to address is as follows:

**How does a firm's commitment to a strategic corporate purpose  
affect its incentive to adopt green technologies under  
monopoly and duopoly market structures?**

In order to provide a comprehensive answer, the thesis adopts a formal, game-theoretic model. This model incorporates firm-level decisions regarding purpose orientation (ranging from either being purely profit-maximizing, or being purpose-driven) and the subsequent choices concerning clean technology adoption (or not adopting). The model

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differentiates between profit-maximizing firms (often referred to as "Friedman firms", which prioritize shareholder wealth exclusively (Friedman, 1970)), and purpose-driven firms (which integrate broader societal or environmental objectives into their utility functions (Albuquerque & Cabral, 2025; Henderson & Van den Steen, 2015)). This allows for a nuanced examination of how these distinct orientations affect equilibrium behavior in different market structures.

**Contribution to literature and methodology** The thesis contributes to the academic discourse by modeling how strategic corporate purpose shapes green technology adoption, and equilibrium outcomes in monopolistic and duopolistic markets. A comparison of these two market structures illuminates how purpose-driven firms navigate competitive pressures while pursuing a broader corporate purpose.

The thesis develops a formal game-theoretic model that extends the framework of Albuquerque and Cabral (2025) by adding a monopoly benchmark and by replacing deterministic adoption costs with a stochastic cost structure. The central approach involves the development of a two-stage game for the analysis of firms' strategic decisions. In the initial phase, firms select their corporate purpose orientation, determining whether to operate as purely profit-maximizing entities or as purpose-driven firms. Stage 2 involves market competition (Cournot competition in the duopoly case) and decisions regarding the adoption of new, green production technology, which is characterized by uncertain cost outcomes. The model is solved using the method of backward induction, whereby firms' optimal responses in stage 2 are analyzed for given choices in stage 1. In order to complement the analytical derivations, the thesis also uses numerical illustrations and graphical representations in order to visually demonstrate the equilibrium outcomes under varying parameters, such as legacy technology costs and the strength of corporate purpose orientation.

The model allows for a comparison across two fundamental market structures. A monopolistic setting, which serves as a benchmark to examine how internal purpose-driven incentives function in isolation, without the influence of direct competition. As well as a duopolistic setting, which introduces strategic interactions and allows for an examination of how corporate purpose acts as a credible commitment device. Within the duopoly, the analysis also covers the asymmetric case in which a single purpose-driven

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firm faces a profit-maximizing rival.

**Structure of the thesis** Chapter 2 initiates a thorough literature review, which investigates existing academic discourse on strategic corporate purpose, clean technology adoption, and commitment under competition. This serves to establish the theoretical foundation for the subsequent analysis. The central argument of the thesis is set out in Chapter 3 of the model, where the formal framework is developed. This chapter examines both monopoly and duopoly market structures, including detailed analyses of adoption decisions, corporate purpose choices, and equilibrium concept across various scenarios. Chapter 4 then presents the analytical and numerical findings derived from the model, comparing outcomes between monopoly and duopoly settings, and including numerical examples. The thesis ends with a conclusion (Chapter 5), which summarizes the key insights and implications developed across the preceding chapters.

## 2. Literature review

This chapter provides a review of the relevant academic literature on strategic corporate purpose, clean technology adoption, and commitment under competition, thereby establishing the theoretical foundation for the model in Chapter 3. The review is based on a literature search conducted in Scopus, Google Scholar, and u:search. The quality of the research was ensured by including primarily peer-reviewed journal articles that were ranked in Quartile 1 (Q1) of the SCImago Journal Rank. Where justified, publications in Quartile 2 (Q2) were also considered. In order to ensure the literature under review is current, the set of publications examined focus on works published from 2015 onward, with a particular emphasis on contributions from 2020 to the present. A smaller number of publications predating 2015 were included to provide essential theoretical context. The search process involved applying combinations of up to three targeted keywords to capture different conceptual linkages. Examples of keyword combinations include 'corporate purpose' and 'firm performance', or 'technology adoption' and 'strategic decision' in the market structure of a 'duopoly'. These combinations were organized differently for the three subsections of Chapter 2, according to their respective emphasis of the section. In addition to these keyword combinations, the search strategy sought to identify foundational articles repeatedly cited across multiple relevant studies, ensuring coverage of the most influential contributions in the field. Studies were excluded if they failed to meet the quality and topical criteria, were not published in English, or lacked a connection to the thesis.

## **2.1. Strategic corporate purpose**

### **2.1.1. Definition of corporate purpose**

A review of economic history rests on an established principle: the capacity of businesses to expand and thrive is contingent upon the generation of profits (Friedman, 1970). But over the past years, the merely profit-maximizing view (Friedman, 1970), has given way to a growing recognition of other business factors, like sustainability, working conditions, and the influence a firm has on society (Fink, 2018; van Tuin et al., 2020). Current discussions among practitioners and scholars reveal significant divergence regarding the actionable dimensions of the term corporate purpose (Besharov & Mitzineck, 2023). For example, it can be defined as a firm's goal not only to maximize profits, but also to pursue a broader objective by articulating the specific value or impact it aims to create for society or stakeholders (Henderson & Van den Steen, 2015).

From a strategic management perspective, purpose can be used as a commitment device that influences competitive behavior and internal organizational dynamics (Albuquerque & Cabral, 2025). Henisz (2023) posits that by expanding a firm's objectives to encompass salient stakeholder concerns, corporate purpose can foster relational contracting, reduce transaction costs, and align the incentives of powerful stakeholders with long-term shareholder value. This conceptual framework positions purpose as a powerful factor in the firm's decision-making process, capable of altering the perceived returns of strategic actions (Albuquerque & Cabral, 2025).

This thesis defines the corporate purpose as a deliberate and credible commitment to integrate non-financial objectives into core decision-making in ways that can influence competitive strategy. This commitment is assumed to be beneficial to rivals and stakeholders, and sufficiently durable to alter the firm's incentives in subsequent strategic interactions. The model presented in this thesis treats corporate purpose as a choice variable, thus allowing an analysis of how varying the strength of purpose affects adoption of clean technologies under different market structures.

### 2.1.2. Distinction from related concepts

Corporate purpose must be clearly distinguished from related terms that also address a firm's societal role. Environmental Social Governance (ESG) refers to a framework for evaluating a company's performance across sustainability and governance criteria (Liang & Renneboog, 2020). Unlike ESG, which is primarily an assessment tool (Liang & Renneboog, 2020), corporate purpose serves as a proactive guiding principle that defines the firm's long-term direction (Jones-Khosla & Gomes, 2023).

Mission and vision statements also differ from the term corporate purpose. Fitzsimmons et al. (2022) point out that, while corporate purpose defines a corporation's reasons for existence beyond profit, mission and vision statements serve complementary roles in conveying corporate goals and operational foundations. While vision may incorporate elements of purpose, it extends further to describe strategic aspirations for the future of the company (Fitzsimmons et al., 2022). Purpose and mission often overlap in expressing current values and commitments, but vision is typically more forward-looking and internally focused (Fitzsimmons et al., 2022).

The concept of CSR describes initiatives aimed at managing a company's impact on society. Carroll (1991) classifies CSR into four dimensions: economic, legal, ethical, and philanthropic responsibilities. Fulfillment of these responsibilities indicates that a firm has met its CSR obligations (Carroll, 1991).

Figure 2.1 provides a structured overview of purpose-related concepts by distinguishing between intent, strategy and action, and measurement. The concept of vision, mission, and corporate purpose constitutes the intent layer, encompassing aspirational, operational, and normative orientations that do not directly impact competitive outcomes. The model developed in this thesis (see Chapter 3) is situated within the strategy and action layer. In this layer, corporate purpose becomes strategic by entering firms' objective functions and shaping technology adoption decisions and equilibrium behavior. Figure 2.1 also includes ESG metrics as a separate layer, reflecting their role in assessing environmental, social, and governance outcomes.

## 2. Literature review

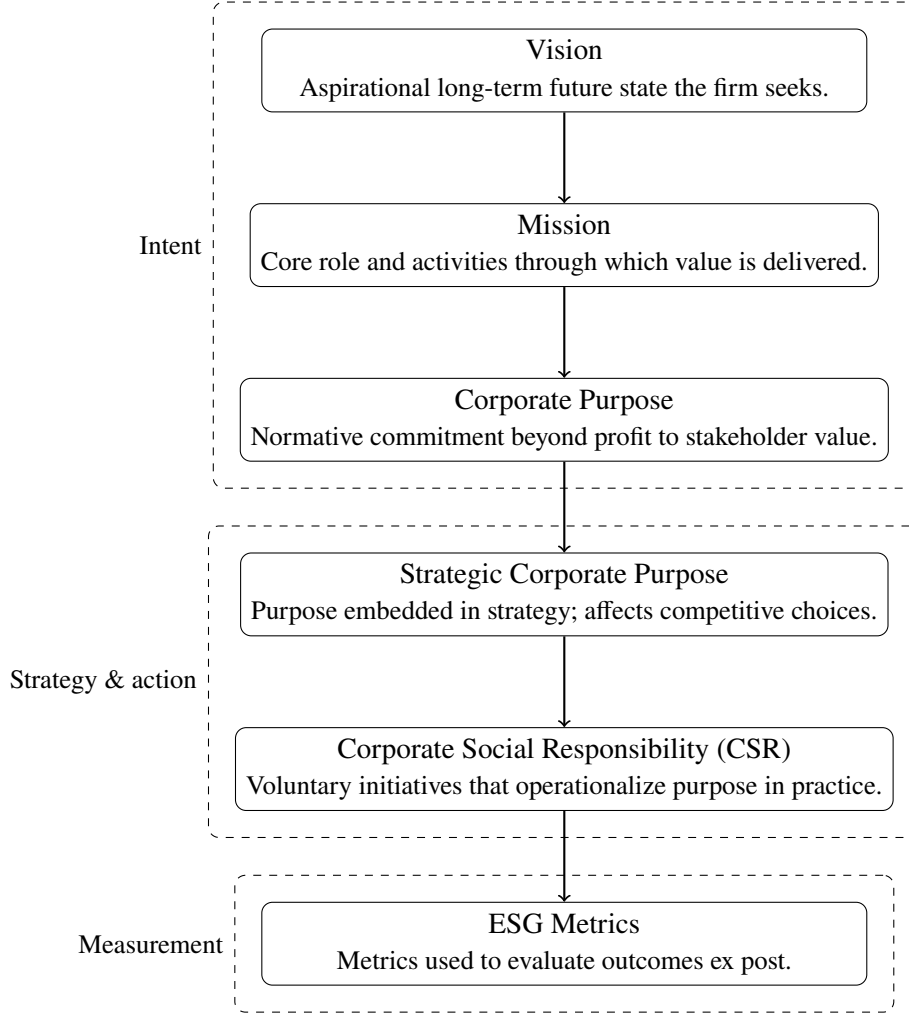


Figure 2.1.: Conceptual distinction between vision, mission, corporate purpose, strategic corporate purpose, CSR and ESG.

In this thesis, the adoption of clean technology serves as a central CSR activity, representing the concrete actions taken to meet its corporate purpose. Two quantities introduced formally in Chapter 3 are useful already at this point. The first, denoted  $t$ , captures whether a firm adopts the clean technology and thus serves as a proxy for fulfilling its CSR obligations. The second, denoted  $\theta$ , captures the strength of a firm's commitment to corporate purpose, with a higher value reflecting greater weight on non-financial, purpose-related objectives. The relationship between corporate purpose and CSR is intertwined in this framework, because  $\theta$  measures the value a firm derives from the

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adoption action  $t$ , linking the internal commitment to a broader purpose with the external execution of social responsibility.

### 2.1.3. Strategic role of corporate purpose

Strategic purpose necessitates the incorporation of societal considerations into the core of the business model, rather than treating them as marginal, isolated initiatives (Blocker et al., 2025a). The need for this integrated approach becomes clearer as the challenges of sustainability mount and organizations that maintain cultural behaviors, which are out of step with evolving societal values, face accelerating irrelevance (Hurth & Vrettos, 2021).

Blocker et al. (2025a) elaborate how a purpose-driven organization achieves "purpose orientation" by harmonizing three foundational components: Purpose Logic, Purpose Identity, and Purpose Strategy. Purpose Strategy, in particular, is the operational element that translates the enduring ideology (Logic) and authentic persona (Identity) into concrete, actionable plans (Blocker et al., 2025a). However, successful execution and the prevention of merely symbolic adoption require management clarity, guaranteeing that the abstract ideology is transformed into specific, unambiguous expectations and directions (Gartenberg et al., 2019).

Empirical evidence from Gartenberg et al. (2019) shows that purpose alone does not systematically predict financial performance, but purpose combined with clarity is associated with superior future stock market outcomes. As Gartenberg et al. (2019) have demonstrated, this positive relationship is driven chiefly by perceptions among middle management and professional staff, as opposed to senior executives or other personnel.

By enhancing managerial clarity, firms mitigate implementation frictions by translating corporate purpose from an abstract statement into actionable guidance throughout the organization (Gartenberg et al., 2019). When such purpose is embedded in the firm's objective function as a credible commitment, it can also reshape strategic interactions in oligopolistic settings: Albuquerque and Cabral (2025) show that adding a mission-statement stage, where shareholders choose whether to commit to a stakeholder-oriented objective, can generate a pure coordination game at the commitment stage and thereby

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internalize externalities that would otherwise sustain an inefficient equilibrium. In their clean-technology application, this mechanism can shift equilibrium selection in the one-shot adoption subgame from the inefficient non-adoption outcome toward joint adoption.

From a comparative governance perspective, Aguilera (2023) demonstrates that the strategic effects of purpose depend on institutional context, as governance structures and societal expectations shape how purpose commitments are interpreted and enforced. The legal system and the nature of share ownership are two of the institutions that have the greatest influence on a firm's corporate policy, shaping the incentives and penalties (Aguilera, 2023).

Overall, the literature suggests that corporate purpose and CSR, when credibly embedded and communicated, can reshape strategic incentives in competitive environments (Albuquerque & Cabral, 2025). In the extended framework of Albuquerque and Cabral (2025), this is reflected in  $\theta$  acting as a commitment parameter that shifts the payoff matrix toward equilibria in which clean technology adoption is jointly sustained.

## 2.2. Clean technology adoption

### 2.2.1. Drivers of clean technology adoption

Clean technology adoption denotes a firm's strategic decision to implement production processes or products that lower negative environmental externalities and increase resource efficiency compared to incumbent technologies (Chi et al., 2026; Del Río González, 2005). Environmental improvements, once seen purely as cost drivers, are now increasingly recognized as opportunities to achieve cost savings, enhance process efficiency, and improve resource utilization through the implementation of advanced technology (Del Río González, 2005; Porter & Kramer, 2011). This shift in perspective entails a repositioning of clean technology adoption, no longer regarded as a mere compliance obligation, but rather as a deliberate strategic choice congruent with the firm's long-term objectives (Del Río González, 2005).

The adoption of clean technology in competitive markets is influenced by a set of strategic

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and contextual drivers that alter the payoff structure in firms' adoption strategies (Del Río González, 2005; Du et al., 2024). Most of these drivers are not represented explicitly in the model developed in Chapter 3, which deliberately abstracts to a small set of cost and purpose parameters. They are reviewed here because they establish adoption as an economically meaningful decision and motivate the conditions the model considers.

**Knowledge externalities and demand spillovers** – As shown by Horii (2012), firms may invest in clean technology even when they cannot fully appropriate the resulting knowledge, driven by consumer demand for innovation. In our model, such demand spillovers increase the payoff to adoption in both unilateral and mutual adoption profiles, potentially reducing the  $\theta$  threshold required for adoption to occur.

**Environmental efficiency gains** – Del Río González (2005) highlights that clean technologies can decouple economic growth from environmental impact by improving input–output efficiency. Such efficiency gains increase the payoff from adoption, irrespective of the rival's action, making adoption more attractive for low to moderate  $\theta$  values.

**Regulatory design** – Building on this, the design of environmental regulation itself plays a decisive role in shaping firms' investment behavior (Mohammadi et al., 2024). Mohammadi et al. (2024) highlights that the introduction of penalty-based levers, such as emission-based taxes or performance-based fines, is a significant development in the regulation of clean technology.

While incentives (e.g. subsidies) directly motivate firms to invest in innovation, penalties raise the cost of harmful activities directly and generate public funds that can be used for subsidy programs indirectly (Mohammadi et al., 2024). Empirical work by Zhang et al. (2021) shows that consistent and well-designed environmental regulations have stronger, positive effects on green technology adoption than inconsistent or uncertain policies.

Taken together, these drivers differ in how central they are to the argument developed in this thesis. Inter-firm spillovers stand apart, because the idea that one firm's successful adoption can lower costs for its competitor as well creates a genuine interdependence between firms, and this interdependence is the mechanism the model in Chapter 3 is built around. Efficiency gains and the design of environmental regulation matter as well, but in a different way. Rather than creating interdependence between firms, they

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make adoption more attractive for a firm on its own, either by raising its returns or by strengthening the non-financial value it attaches to going green. These drivers are not modeled explicitly, but instead form the broader context that explains why adoption is worth considering in the first place, while inter-firm complementarity is the force the thesis analyzes directly.

### 2.2.2. Barriers of clean technology adoption

The high costs associated with adopting clean technology represent a significant barrier for firms (Luthra et al., 2015), influencing their strategic decisions and long-term competitive positioning. In the framework of this thesis, such barriers directly affect the expected payoff from adoption, thereby altering the conditions under which a positive corporate purpose parameter ( $\theta$ ) can shift the equilibrium toward clean technology adoption. Furthermore, in the model, the probability of successful implementation  $\delta$  interacts with these barriers, since higher costs and risks amplify the adverse impact of a low  $\delta$  on adoption incentives. One of the most prominent barriers to clean technology adoption is the high upfront capital expense required for new technologies (Del Río González, 2005; Luthra et al., 2015).

Businesses typically face substantial costs associated with the purchase, installation, and maintenance of clean technologies (Dzurov Vargová & Matušíková, 2025). For instance, transitioning from conventional machinery to clean energy systems, such as solar panels or electric vehicles, often necessitates significant capital outlay (Ma et al., 2019). It is important to note that the high initial cost is likely to be especially problematic for small and medium-sized enterprises, who may have less financial resources and stability than their larger competitors (Agrawal et al., 2025). In the model context, high fixed adoption costs raise the profitability threshold that must be exceeded for adoption to be optimal, especially when the success probability is low and the risk of costlier-than-expected outcomes increases.

Another barrier is technological uncertainty. Firms may hesitate to adopt when a technology is inefficient or carries the risk of becoming obsolete too soon, a challenge documented by Luthra et al. (2015) in their study of renewable energy adoption barriers in India. Their analysis shows that uncertainty about the technical performance or

## 2. Literature review

longevity of clean technologies deters adoption. In the context of the present model, this effect can be represented as a reduction in the probability of successful implementation  $\delta$ , which lowers the expected net benefit from adoption and, in a simultaneous-move game, increases the likelihood of non-adoption equilibria.

Beyond the initial investment, firms also may encounter ongoing operational costs that can deter clean technology adoption. These include costs related to maintenance and repairs, as well as higher operational expenses if the new technology is not as efficient as anticipated (Dzurov Vargová & Matušíková, 2025). For instance, certain clean technologies may require specialized training for staff to operate effectively, which incurs additional costs (Dzurov Vargová & Matušíková, 2025). Macroeconomic conditions also shape adoption incentives. Tan et al. (2025) show that in Belt and Road economies, economic uncertainty reduces green technology imports, primarily due to investor caution, market volatility, and policy unpredictability. In model terms, economic instability effectively lowers  $\delta$ , as firms discount the likelihood of successfully realizing adoption benefits in volatile environments. Tan et al. (2025) also find that larger economic size and rapid population growth can negatively correlate with adoption rates, reflecting structural dependence on incumbent technologies, resource strain, and competing policy priorities, which increase the  $\theta$  required for adoption to occur in equilibrium.

Finally, insufficient financial development indirectly acts as a barrier by constraining the access to capital for clean technology investments. While Tan et al. (2025) demonstrate that greater financial development benefits green technology adoption, its absence limits the ability to fund the fixed and operational costs of adoption.

Overall, these barriers are not merely practical constraints, but strategic determinants of equilibrium outcomes. In the game-theoretic framework uncertain technological outcomes, lower the expected return from adoption, increasing reliance on either high  $\delta$  or substantial  $\theta$  values to achieve mutual adoption in equilibrium. Recognizing these interactions is essential for understanding how corporate purpose commitments can tip the strategic balance toward sustainable technology adoption, despite the aforementioned barriers.

### 2.2.3. Relationship between corporate purpose and clean technology

The adoption of clean technology in our model can be understood as a strategic choice, influenced by a firm's corporate purpose, particularly when purpose reflects a credible commitment to long-term environmental and stakeholder goals. Adopting clean technology can also be viewed through the lens of Stakeholder Theory, as Henriques and Sadorsky (2007) articulates. External stakeholders, including regulators and community groups, put pressure on companies to implement clean technologies that transform production processes rather than relying on traditional end-of-pipe solutions (Henriques & Sadorsky, 2007). In the model framework, such stakeholder pressures can be used as an increase in the corporate purpose parameter  $\theta$ , raising the non-financial value associated with adoption and potentially shifting the equilibrium toward mutual adoption. Analytically, Albuquerque and Cabral (2025) show that when firms incorporate stakeholder-oriented objectives into their payoff functions, the strategic interaction in adoption games can shift toward an equilibrium in which joint adoption is sustained, as the stakeholder-oriented payoff component selects the Pareto-superior coordination outcome over the inefficient one.

The role of purpose is also context-dependent. Henisz (2023) conceptualizes corporate purpose as a governance mechanism that strengthens relational contracts with stakeholders, reducing transaction costs and uncertainty. In the model, this effect can be represented as an indirect increase in the probability of successful implementation, since stronger stakeholder alignment reduces the risk of project failure or opposition.

Similarly, Aguilera (2023) highlights that governance systems and societal norms influence how purpose commitments are interpreted and enforced. This suggests that the impact of a given corporate purpose value on adoption incentives may vary across institutional environments. Additionally, Acemoglu et al. (2016) emphasize the complexity inherent in transitioning to clean technology. Their microeconomic model highlights, that when dirty technologies begin with an advantage, clean technologies face significant hurdles in both innovation and adoption. Policymaking plays a pivotal role, as demonstrated through their quantitative analysis, which illustrates that carbon taxes and research subsidies can accelerate this transition, thus reducing carbon emissions and

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mitigating climate change (Acemoglu et al., 2016).

### **2.3. Commitment under competition**

#### **2.3.1. Competitive foundations**

The concept that firms use voluntary strategies, such as corporate purpose or CSR, as strategic devices to gain long-term competitive advantages and shift market equilibria is well supported (Albuquerque & Cabral, 2025; Planer-Friedrich & Sahm, 2020; Roe, 2021). In quantity competition with homogeneous goods (Cournot), firms' outputs are strategic substitutes: increasing output reduces rivals' best responses, and owners may find it profitable to commit managers to more aggressive production strategies (Sklivas, 1987; Vickers, 1985). In such scenarios, profit-maximizing owners may offer managers behavioral contracts (or incentives) that differ from pure profit maximization in order to gain a strategic advantage through commitment (Sklivas, 1987; Vickers, 1985). This delegation literature derives its results in a sequential setting, in which an owner binds a manager to a modified objective before competition unfolds, and the rival observes this commitment and adjusts its best response accordingly. The model developed in this thesis departs from this in that firms choose adoption simultaneously in the second stage. The commitment logic nonetheless carries over, because the relevant sequencing lies not within the adoption stage but between the two stages: the purpose orientation is chosen first and is fixed and observable before any adoption decision is made. It is this prior, observable choice of objective, rather than any move order within the adoption stage itself, that gives purpose its strategic role in the sense of Shapiro (1989).

The present model adopts a Cournot framework to capture competitive interactions in which firms' strategic choices affect rivals through quantity adjustments rather than price-setting. In price competition (Bertrand), actions are strategic complements, and the same aggressive delegation can intensify price cutting and lower profits (Sklivas, 1987). The conclusion regarding the role of CSR in the context of Bertrand competition is noteworthy. When confronted with Bertrand competition, firms typically do not engage in CSR initiatives, as committing to increased output leads to reduced prices,

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thereby rendering CSR a strategically unattractive option (Planer-Friedrich & Sahn, 2020). This contrast underscores that the strategic value of corporate purpose as a commitment device is not universal but contingent on the mode of competition. The present analysis is therefore confined to Cournot competition, where committing to a modified objective shifts rivals' best responses in a way that can support adoption. The results of this study establish a general principle: altering the firm's objective function changes rivals' best responses. However, the direction and profitability of that change depend on the competitive environment (Sklivas, 1987; Vickers, 1985).

In the present model, the objective function is expanded by a stakeholder-oriented term ( $\theta$ ) reflecting a firm's commitment to corporate purpose. The logic of strategic delegation applies: changing  $\theta$  modifies the firm's effective payoff from adoption and thus its position on the rival's best-response function. As shown by Albuquerque and Cabral (2025), when adoption decisions exhibit strategic complementarities, the game already takes the form of a coordination problem with multiple equilibria, and a sufficiently high  $\theta$  shifts equilibrium selection toward mutual adoption in a simultaneous-move setting.

### 2.3.2. Commitment

Shapiro (1989) emphasizes the importance of distinguishing between strategic decisions, which involve durable and often irreversible commitments, and tactical decisions, which are short-term reactions to the current environment. These strategic choices shape the state variables of the competitive game and thereby influence the set of tactical moves available to firms over time (Shapiro, 1989).

One of the most illustrative examples Shapiro (1989) offers is investment in physical capital, which he characterizes as a classic strategic variable because it changes a firm's future incentives and capabilities. For instance, when a firm invests in assets that reduce its marginal costs, it may signal a credible intention to compete more aggressively in subsequent periods (Shapiro, 1989).

However, Shapiro (1989) underlines two necessary conditions for such investments to qualify as strategic commitments:

- The action must be observable to rivals, so that its signaling function is effective,

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and

- they must be irreversible or not costlessly reversible, since “costlessly reversible actions never constitute commitments and have no strategic role” (Shapiro, 1989, p. 127).

This insight is crucial in understanding which types of corporate behavior can genuinely influence market dynamics through commitment mechanisms. In the context of corporate purpose, Shapiro’s framework suggests that long-term environmental or social initiatives can only function as strategic commitments if they meet certain criteria (Shapiro, 1989). The process of establishing a strategic corporate purpose entails the maximization of shareholder value, wherein the selection of the weight  $\theta$  the firm gives its corporate purpose serves as a commitment device, thereby influencing future decision-making (Albuquerque & Cabral, 2025).

This commitment is necessary because green technology adoption, as we have established in Subsection 2.2.2, typically entails higher upfront investment costs and uncertain long-term payoffs (Buccella et al., 2021; Del Río González, 2005; Du et al., 2024). The commitment mechanism is credible because it involves an opportunity cost relative to short-term profit maximization, thereby reducing the likelihood that it will be dismissed as mere cheap talk (Henderson & Van den Steen, 2015).

Investments in sustainable technologies, renewable energy infrastructure, or resilient supply chains can change a company’s costs and how it competes (Shapiro, 1989). If these changes are visible to stakeholders and competitors and cannot easily be reversed, they can demonstrate a firm’s commitment to sustainability and encourage innovation across the industry (Shapiro, 1989).

The impact of commitments on equilibrium outcomes can already be observed in simple, two-firm settings. Buccella et al. (2021) analyze a Cournot duopoly with emission abatement and demonstrate that the game admits two distinct Nash equilibria: one in which both firms abate, and one in which neither does. The inefficient “no-abatement” outcome persists even though both firms would be better off in the cooperative equilibrium, since each fears unilateral commitment would lower its profit if the rival defected (Buccella et al., 2021).

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This result shows that commitment problems are intrinsic to duopolistic competition, because even with only two players, equilibrium selection depends on whether rivals view commitments as credible. Sim and Kim (2019) develop a formal model to examine how sustainability-related commitments play out in a duopolistic market. Their analysis suggests that, when only a single firm commits to sustainability investment, it may trigger the highest overall level of investment in the industry, driven by that firm's strong strategic signal. In contrast, when all competing firms commit simultaneously, the result may be lower investment levels and reduced environmental outcomes, as firms soften competition by limiting costly sustainability efforts (Sim & Kim, 2019). This highlights that while commitment can support competitive advantage and align with individual firms' economic incentives, it may also create unintended effects such as raising competitor profits or diminishing social welfare (Sim & Kim, 2019). Although the present model assumes simultaneous choice and no sequential moves, the result highlights that commitment by both firms does not automatically intensify rivalry. Motivated by the role of commitment under competition, the next chapter introduces a formal, game-theoretic model that analyzes firms' strategic choices regarding corporate purpose and clean technology adoption.

## 3. The Model

In the following chapter, the theoretical framework used to analyze firms' strategic decisions on corporate purpose and green technology adoption are described. Building on the baseline model by Albuquerque and Cabral (2025), we extend it by introducing a monopoly market structure, while comparing this market structure to the duopoly.

We begin by analyzing the monopoly setting, which serves as a benchmark in the absence of strategic interaction. We then introduce the duopoly model, where two firms interact in a Cournot framework. This market comparison allows us to explore how strategic interaction influences the effectiveness of corporate purpose commitments and the decision to adopt clean technologies. Finally, we define the equilibrium concept used to solve the model and describe the solution approach applied in the next chapter.

### 3.1. Monopoly

The monopoly setting serves as an analytical benchmark rather than a substantive strategic analysis. In the absence of a rival, the parameter  $\theta_M$  cannot function as a strategic commitment device in the sense of Albuquerque and Cabral (2025), since there is no rival's behavior to influence. Instead, the monopoly case isolates the internal dimension of corporate purpose: the role of  $\theta_M$  as a private, non-financial utility component that may justify adoption decisions which pure profit maximization would reject. This decomposition is deliberate: by demonstrating that purpose without strategic interaction reduces to an internal utility shift, the monopoly analysis clarifies that the commitment-theoretic content of corporate purpose emerges only under strategic interaction, which we examine in the duopoly setting that follows.

### 3. The Model

The monopolist must make two key decisions in this model, which we analyze in a two-stage decision framework. In stage 1, the monopolist may choose to align itself with a broader corporate purpose, understood as a commitment to objectives beyond profit maximization and mandatory regulations, such as sustainability or social responsibility. In stage 2, the monopolist decides whether to adopt a green technology that has the potential to reduce emissions.

We begin by describing the monopoly setting in stage 2 and how it is modeled. The monopolist produces a homogeneous output and faces a typical linear inverse demand function

$$p = a - bq_M, \quad (3.1)$$

where  $p$  represents the market price,  $q_M$  is the production quantity of the monopolist, and  $a > 0$ ,  $b > 0$ , are the demand parameters influencing the price of the monopolist output. The monopolist chooses its output to maximize an objective function, which we will define formally later on.

To analyze the incentives for adopting a more sustainable, green technology, we assume that the marginal production costs under adoption are uncertain. While the firm can continue to produce using a legacy technology at a constant marginal cost  $c$ , the adoption of the new technology leads to a stochastic cost outcome. With a probability of  $\delta \in (0, 1)$ , the technology succeeds, resulting in a lower marginal cost  $\underline{c}$ . With probability  $1 - \delta$ , the implementation fails to be productive, and the firm incurs a higher marginal cost  $\bar{c}$ . The new cost structure assumed is arranged as follows:  $\underline{c} < c < \bar{c}$ .

This results in expected costs, under adoption of the clean technology, for the monopolist of

$$E_M[c] = \delta \cdot \underline{c} + (1 - \delta) \cdot \bar{c}. \quad (3.2)$$

Within this framework, the monopolist determines its orientation toward corporate purpose in stage 1 by choosing the parameter  $\theta_M \in \{0, \bar{\theta}\}$ . The monopolist can choose  $\theta_M = 0$ , where the firm acts as a purely profit-maximizing entity and has no corporate

### 3. The Model

purpose ambitions. In contrast, when the monopolist chooses to commit to a corporate purpose, the parameter is set to  $\theta_M = \bar{\theta}$ , which reflects the firm's commitment to a corporate purpose beyond the mandatory regulations. We treat the choice of  $\theta_M = \bar{\theta}$  as entailing a small but unmodeled fixed commitment cost  $\epsilon > 0$  capturing, for instance, governance adjustments, internal communication, and the establishment of credible reporting structures required to make a purpose orientation observable to stakeholders. This cost is assumed negligible relative to the utility magnitudes considered in the analysis, so that it does not affect the comparative statics or threshold conditions derived below. Its sole role is to ensure that  $\theta_M = 0$  remains a non-dominated choice for purely profit-maximizing shareholders, consistent with the commitment-theoretic interpretation of corporate purpose in Albuquerque and Cabral (2025). Following the logic of backward induction, the following sections first analyze the optimal behavior in stage 2 (the adoption and production choice) before moving back to the strategic decision in stage 1.

#### 3.1.1. Stage 2: production and adoption decisions

In the second stage of the game, the monopolist decides whether to adopt the green technology ( $t_M = 1$ ) or to maintain the legacy technology ( $t_M = 0$ ). The firm then determines its optimal production quantity  $q_M$  based on the realized cost structure. For the sake of readability a comprehensive, step-by-step documentation of all First-Order Condition (FOC) and algebraic derivations throughout this monopoly analysis is provided in Appendix A.

##### No adoption case

If the monopolist decides against adopting the new technology, it continues to produce using the legacy technology at a constant marginal cost  $c$ . In this scenario, there is no cost uncertainty. Using the previously defined price function  $p = a - bq_M$ , the monopolist's profit function is given by

$$\pi_M^{NA} = q_M(p - c) = q_M(a - bq_M - c). \quad (3.3)$$

### 3. The Model

We now derive the FOC with respect to the monopolist's production quantity  $q_M$ , which gives us the optimal output level

$$q_M^{NA} = \frac{a - c}{2b}. \quad (3.4)$$

Given this output quantity, the monopolist's corresponding profit is

$$\pi_M^{NA} = \frac{(a - c)^2}{4b}, \quad (3.5)$$

where "NA" refers to the non-adoption scenario.

#### Adoption case

In the next step of our model, we now consider the case where the monopolist decides to adopt the new technology ( $t_M = 1$ ), letting the initial marginal production cost of the legacy technology  $c$  be replaced by the uncertain cost structure (3.2). Therefore, the monopolist's payoff function, when adopting the new technology is

$$\pi_M^A = E[q_M(p - c)] = q_M (a - bq_M - \delta \cdot \underline{c} - (1 - \delta) \cdot \bar{c}). \quad (3.6)$$

By deriving the FOC of the monopolist's profit function, we obtain the optimal quantity and profit function

$$q_M^A = \frac{a - \delta \cdot \underline{c} - (1 - \delta) \cdot \bar{c}}{2b} \quad \text{and} \quad \pi_M^A = \frac{(a - \delta \cdot \underline{c} - (1 - \delta) \cdot \bar{c})^2}{4b}. \quad (3.7)$$

"A" denotes the adoption scenario chosen by the monopolist. For later comparisons, we assume that adoption is less profitable than remaining with the legacy technology. This condition simplifies to a threshold on the success probability  $\delta$

$$\delta < \frac{\bar{c} - c}{\bar{c} - \underline{c}}. \quad (3.8)$$

### 3. The Model

This implies that the monopolist's profits would decrease when adopting the new technology, due to the expected cost of technology adoption being higher than the legacy marginal cost.

#### 3.1.2. Stage 1: choice of corporate purpose

Having determined the optimal production levels and profits for both technology scenarios in Stage 2, we now analyze the first stage of the model. In stage 1, the monopolist chooses its corporate purpose orientation ( $\theta_M \in \{0, \bar{\theta}\}$ ) to maximize its objective function, given by

$$v_M = \pi_M + \theta_M t_M \quad (3.9)$$

and either sets  $\theta_M = 0$ , or  $\theta_M = \bar{\theta}$ . Since the monopolist operates in isolation and faces no competitive pressure, the choice of corporate purpose has no strategic effect. Moreover, since  $\bar{\theta}$  enters the utility function only multiplicatively with the adoption decision  $t_M$ , and given that the commitment cost  $\epsilon$  is negligible, the choice between  $\theta_M = 0$  and  $\theta_M = \bar{\theta}$  becomes consequential only when the firm intends to adopt the green technology in stage 2. The relevant comparison is therefore between not adopting at all and adopting while committing to corporate purpose

$$\begin{aligned} t_M = 0 : \quad v_M &= \pi_M^{NA} \quad \text{or} \\ t_M = 1 : \quad v_M &= \pi_M^A + \bar{\theta} \cdot 1. \end{aligned} \quad (3.10)$$

The monopolist therefore commits to  $\theta_M = \bar{\theta}$  and adopts the new technology if and only if the resulting utility exceeds the non-adoption profit, i.e. if the following inequality is satisfied

$$\pi_M^A + \bar{\theta} > \pi_M^{NA} \quad \Leftrightarrow \quad \bar{\theta} > \frac{(a-c)^2}{4b} - \frac{(a-E_M[c])^2}{4b}. \quad (3.11)$$

### 3. The Model

**Monopoly outcome** To summarize the results for the monopoly derived above: a profit-oriented monopolist gains no additional utility from adoption and thus will not adopt (earning  $\pi_M^{NA}$ ), whereas a purpose-driven monopolist will either not adopt (also earning  $\pi_M^{NA}$ , if  $\bar{\theta}$  is below the threshold) or will adopt and obtain  $\pi_M^A + \bar{\theta}$  (if  $\bar{\theta}$  is high enough to satisfy the threshold in (3.11)). The purpose orientation is therefore consequential only when adoption is desirable. Where it is, the firm commits to  $\theta_M = \bar{\theta}$  and realizes the additional utility  $\bar{\theta}$ , where it is not, the firm sets  $\theta_M = 0$  to avoid the commitment cost  $\epsilon$ , leaving profit unchanged. The equilibrium outcome is thus that, in any Subgame Perfect Nash Equilibrium (SPNE) of the single-firm game, the monopolist adopts the clean technology in stage 2 and commits to  $\theta_M = \bar{\theta}$  in stage 1 if and only if  $\bar{\theta}$  exceeds the required threshold, and otherwise sets  $\theta_M = 0$  and remains with the legacy technology.

### 3.2. Duopoly

While the previous monopoly section served as a benchmark for decisions in isolation, the duopoly framework allows us to examine the strategic interactions between two firms. This main model builds upon the framework of Albuquerque and Cabral (2025), who propose a theory of strategic CSR where firms use their objective functions to influence industry-wide decisions. In the baseline model of Albuquerque and Cabral (2025), technology adoption by a single firm leads to definite high marginal costs  $\bar{c}$ , while joint adoption results in lower costs  $\underline{c}$  and a cost structure of  $\underline{c} < c < \bar{c}$ . This assumption creates a coordination problem: while both firms would be better off jointly adopting the new technology, neither firm finds it profitable to adopt unilaterally, so legacy production constitutes a Nash equilibrium alongside mutual adoption, leaving the outcome dependent on which equilibrium firms coordinate on.

We adopt their two-stage game structure, where in stage 1 the firms choose the extent of their corporate purpose commitment, represented by  $\theta_i \in \{0, \bar{\theta}\}$ . Here they either act as a purely profit-maximizing firm  $\theta_i = 0$  or deviate from this and choose to set  $\theta_i = \bar{\theta}$ . Let the firms be indexed by  $i \in \{1, 2\}$ . Although firms choose simultaneously within each stage, the two stages are sequential. Both firms first commit to an objective function

### 3. The Model

in stage 1, and these purpose choices are fixed and observable before the adoption and output decisions of stage 2 are made. It is this commitment to a payoff function before competition unfolds that gives  $\theta$  its strategic role in the sense of Shapiro (1989), since each firm's stage 2 behavior is shaped by the purpose orientations both firms have already fixed.

In stage 2, we depart from the original model's assumption of deterministic costs and introduce technological uncertainty. Upon choosing to adopt the green technology ( $t_i = 1$ ), a firm's marginal cost is no longer fixed at  $\bar{c}$  but becomes stochastic just as in our benchmark model: with probability  $\delta$ , the technology succeeds, resulting in a low cost  $\underline{c}$ , and with probability  $1 - \delta$ , it fails, resulting in the high cost  $\bar{c}$ .

In this model, both firms choose their production output simultaneously and independently. The market is characterized by a linear, inverse demand function, similar to the monopoly setting

$$p = a - bQ = a - b(q_1 + q_2), \quad (3.12)$$

where  $Q$  represents the total output of firms 1 and 2 ( $Q = q_1 + q_2$ ),  $a > 0$  is the market size (intercept), and  $b > 0$  measures how strongly total output lowers the market price, i.e. the slope of inverse demand. In the baseline case, both firms behave symmetrically in their choices. In later analyses, we then introduce asymmetric corporate purpose choices and technology adoption decisions.

#### 3.2.1. Stage 2: production and adoption decisions

To maintain focus on the economic implications of the duopoly structure, the subsequent analysis highlights the equilibrium outcomes. The complete, step-by-step mathematical derivations of all FOC, response functions, and corresponding profits are compiled in Appendix B.

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#### Duopoly without adoption

As we solve the game by backward induction, we begin with stage 2 of Cournot competition. If both firms 1 and 2 decide against adopting the new technology, stage 2 reduces to a standard Cournot game, with profits given by:

$$\pi_i^{NA} = q_i(a - b(q_1 + q_2) - c), \quad (3.13)$$

where  $q_i$  denotes the quantity produced by firm  $i \in \{1, 2\}$  in the duopoly, and  $c$  represents the legacy cost incurred by the firm when producing output. In this case, since neither firm adopts the new technology, the costs remain at the legacy level, with no uncertainty of higher or lower costs.

Each firm chooses its output level  $q_i$  to maximize profit, taking the output of the other firm as given. Solving the FOC and assuming a symmetric equilibrium yields the optimal output level

$$q_i^{NA} = \frac{a - c}{3b}. \quad (3.14)$$

Substituting this equilibrium quantity back into the profit function results in

$$\pi_i^{NA} = \frac{(a - c)^2}{9b}. \quad (3.15)$$

#### Duopoly with adoption

A key assumption in this thesis is that there exists a positive complementarity between firms with respect to adopting green technology (Albuquerque & Cabral, 2025). This means that we assume both firms benefit from each other's efforts to adopt green technology rather than sticking with the legacy technology, as formalized in the probability structure (3.16) below, in which a successful implementation by either firm makes the low-cost outcome  $\underline{c}$  available to both. This assumption reflects the role of inter-firm spillovers in green-technology adoption. Chi et al. (2026) model green-technology acquisition in a duopoly and show that spillover effects between competing firms are a central determinant of strategic R&D and adoption choices, with their strength interacting with the intensity of competition. In a related mechanism, Horii (2012) argues

### 3. The Model

that firms adopt novel technologies even when they cannot fully appropriate the resulting knowledge, implying that part of the benefit of a successful implementation accrues to other firms rather than to the original adopter. In the present setting, this non-appropriability is modeled in its strongest form: the cost reduction achieved by a successful adopter is assumed to be fully available to the rival. This is a deliberate simplification that captures the qualitative idea of inter-firm complementarity arising, for instance, through knowledge diffusion or technological standardization. In contrast, if only one firm adopts, it does not benefit from this shared market risk reduction, which becomes evident when comparing the utility functions later on. Specifically, the probability structure in the symmetric duopoly is

$$\begin{aligned} \underline{c} \quad & \text{with probability} \quad \overbrace{\delta \cdot \delta}^{\text{both succeed}} + \overbrace{\delta(1 - \delta)}^{\text{firm 1 succeeds}} + \overbrace{(1 - \delta)\delta}^{\text{firm 2 succeeds}} = 2\delta - \delta^2, \text{ and} \\ \bar{c} \quad & \text{with probability} \quad \overbrace{(1 - \delta)^2}^{\text{both fail}}. \end{aligned} \tag{3.16}$$

This probability structure reflects the uncertainty associated with green technology adoption in the duopoly setting. Specifically,  $\delta \in (0, 1)$  denotes the probability that a firm adopting the green technology succeeds in achieving the low-cost outcome  $\underline{c}$ . In this setup, conditional on both firms adopting, the success of at least one of them suffices for both to access the low marginal cost  $\underline{c}$ .

If both firms succeed, which occurs with probability  $\delta \cdot \delta$ , the marginal cost for each becomes  $\underline{c}$ . Additionally, a firm may individually succeed even if the other fails, which occurs with probability  $\delta(1 - \delta)$  or  $(1 - \delta)\delta$ , depending on whether firm 1 or firm 2 succeeds. Since, when both firms adopt, one firm's success is sufficient for both to use the technology, the total probability of at least one firm achieving  $\underline{c}$  is  $2\delta - \delta^2$ . If neither firm succeeds, an outcome with probability  $(1 - \delta)^2$  both firms will face the high-cost outcome  $\bar{c}$ , representing a failed innovation attempt.

This setup highlights the strong strategic relationship in our duopoly case. In contrast to the monopoly case, where adoption outcomes are internal to the firm due to a lack of competitors, the duopoly allows for complementarity. Specifically, the success of

### 3. The Model

one firm can lower the expected cost for both, making joint adoption more attractive despite the risk of failure. This principle of strategic complementarity is also discussed in Albuquerque and Cabral (2025), who model CSR adoption as a coordination game with positive externalities between firms.

Given this cost and probability structure, the expected cost under adoption in the duopoly setup becomes

$$E_D[c] = (2\delta - \delta^2) \underline{c} + (1 - \delta)^2 \bar{c}. \quad (3.17)$$

Taking all parameters into account, we derive the profit function for firms 1 and 2 by substituting the legacy cost with the expected cost

$$\pi_i = q_i (a - b(q_i + q_j) - E_D[c]) = q_i \left( a - b(q_i + q_j) - [(2\delta - \delta^2) \underline{c} + (1 - \delta)^2 \bar{c}] \right). \quad (3.18)$$

Substituting the expected cost  $E_D[c]$  into the profit function and solving for the symmetric Nash equilibrium yields the optimal production quantity and the resulting profit

$$q_i^A = \frac{a - E_D[c]}{3b} \quad \text{and} \quad \pi_i^A = \frac{(a - E_D[c])^2}{9b}. \quad (3.19)$$

A key assumption here, unlike in the monopoly case, is that  $\pi_i^A > \pi_i^{NA}$  if and only if  $E_D[c] < c$ . This implies that both firms' profits are higher if their expected costs under adoption are lower than the legacy cost.

This condition is a key distinction between monopoly and duopoly behavior. In the monopoly case, we assumed  $\pi_M^A < \pi_M^{NA}$ , thus, unlike in the duopoly, a monopolist would not adopt the new technology based solely on profit.

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#### 3.2.2. Stage 1: choice of corporate purpose

In this section, we describe stage 1 of the duopoly setting, where both firms 1 and 2 simultaneously choose the extent of their commitment in the form of the parameter  $\theta_i \in \{0, \bar{\theta}\}$ , where  $\theta_i = 0$  reflects a purely profit-maximizing firm, while  $\theta_i = \bar{\theta}$  represents a firm that incorporates corporate purpose into its company identity. As in the monopoly setting, we treat the commitment  $\theta_i = \bar{\theta}$  as entailing a negligible fixed cost  $\epsilon > 0$  capturing, for instance, governance adjustments, internal communication, and the establishment of credible reporting structures required to make the purpose orientation observable to stakeholders and competitors. This cost is assumed small relative to the utility magnitudes considered in the analysis, so that it does not affect the comparative statics or threshold conditions derived below. Its sole role is to ensure that  $\theta_i = 0$  remains a non-dominated choice for purely profit-maximizing shareholders, consistent with the commitment-theoretic interpretation of corporate purpose in Albuquerque and Cabral (2025). We incorporate CSR into our model by assuming that each firm's utility function consists of both its profit function and an additional component that reflects the firm's choice of corporate purpose commitment

$$v_i = \pi_i + \theta_i t_i, \quad (3.20)$$

where  $\pi_i$  is the firm's profit,  $\theta_i$  represents the corporate purpose weight, and  $t_i \in \{0, 1\}$  denotes whether the firm adopts the green technology ( $t_i = 1$ ) or not ( $t_i = 0$ ). If the firms do not adopt the green technology ( $t_1 = t_2 = 0$ ), the utility function simplifies to

$$v_i^{NA} = \pi_i^{NA}, \quad (3.21)$$

since the utility extension  $\theta_i t_i = 0$ , regardless of whether the firms commit to a corporate purpose or not. If the firms adopt the green technology ( $t_1 = t_2 = 1$ ), the utility function becomes

$$v_i^A = \pi_i^A + \theta_i. \quad (3.22)$$

Thus, firms with stronger corporate purpose (higher  $\theta_i$ ) may be willing to adopt green technologies, even when the profit benefit is marginal or uncertain, as long as the benefit

### 3. The Model

offsets the cost-risk trade-off. Here, the corporate purpose commitment directly adds to the firm's utility, as it reflects the firm's contribution to CSR goals beyond pure profit maximization and mandatory regulations.

This structure enables a more detailed analysis of adoption incentives under different market structures, unlike Albuquerque and Cabral (2025), who examine only the duopoly market structure. In particular, it allows us to analyze how strategic commitment influences firm decisions in monopoly versus duopoly settings, and how the interaction between firms results in complementarity.

### 3.3. Equilibrium concept and analysis

In this section, we analyze the equilibrium outcomes of the duopoly market structure following the framework of Albuquerque and Cabral (2025), in which firms first choose their objective functions and then make strategic technology adoption decisions.

In **stage 1**, each firm  $i \in \{1, 2\}$  simultaneously selects whether to act as a purely profit-maximizing firm ( $\theta_i = 0$ ) or as a purpose-driven firm ( $\theta_i = \bar{\theta} > 0$ ), thereby committing to an objective function that will guide its subsequent decisions.

In **stage 2**, given these objective functions, firms choose whether to adopt the new technology ( $t_i = 1$ ) or to stick with the legacy technology ( $t_i = 0$ ). Profits in this stage depend on the adoption profile and realized production costs, with firms competing à la Cournot. We solve the game by backward induction:

- first, we analyze the adoption and competition stage for each fixed pair of  $(\theta_1, \theta_2)$ ,
- then, we determine whether either firm has an incentive to deviate from its initial objective function.

A strategy profile constitutes a SPNE if no firm has an incentive to unilaterally deviate given the other firm's choice.

In the stage 2 analysis, we use the following notation for clarity: let  $(t_1, t_2) \in \{0, 1\}^2$  denote a pair of adoption decisions. We write  $(t_1, t_2)_i$  to denote the expected utility of firm  $i$  when the adoption profile  $(t_1, t_2)$  is played. For example,  $(1, 0)_1$  refers to firm 1's

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utility if it adopts and firm 2 does not, and  $(0, 1)_1$  denotes firm 1's utility if it does not adopt while firm 2 does.

We say that firm  $i$  prefers outcome  $(t_1, t_2)$  over  $(t'_1, t'_2)$  (holding the other firm's decision fixed) if  $(t_1, t_2)_i > (t'_1, t'_2)_i$ . In particular, given the rival's action  $t_j$ , firm  $i$  will choose  $t_i = 1$  over  $t_i = 0$  if and only if  $(1, t_j)_i \geq (0, t_j)_i$ . At a Nash equilibrium of the adoption subgame, neither firm can improve its utility by unilaterally changing its own  $t_i$ . Formally, for each  $i = 1, 2$  we must have

$$(t_1, t_2)_i \geq (t'_i, t_j)_i \quad \text{for both } t'_i \in \{0, 1\}. \quad (3.23)$$

This condition simply means that, given the equilibrium decisions  $(t_1^*, t_2^*)$ , no single firm can obtain a higher  $v_i$  by deviating to the opposite adoption decision. We set up the following key assumption regarding cost expectations under the green technology:

**Assumption 1.**

$$E_D[c] < c < E_M[c] \quad (3.24)$$

This inequality means that a single firm adopting the new technology ( $E_M[c]$ ) faces a higher expected marginal cost than sticking to the old technology ( $c$ ), but if both firms adopt, the expected marginal cost for each firm falls below the legacy cost  $c$ . In other words, unilateral adoption is unprofitable, whereas joint adoption can be profitable (in expectation) due to complementary cost-reduction effects (Albuquerque & Cabral, 2025; Dhimi & Zeppini, 2025).

Under Assumption 1, neither firm would adopt for profit reasons alone if it expects to be the only adopter, but if both adopt, they may achieve a lower expected cost and higher joint profits than sticking with the old technology. This assumption is critical for generating strategic effects and multiple potential equilibria in the adoption game. We additionally assume throughout that market size  $a$  is large enough to ensure interior Cournot solutions for all adoption profiles, in particular  $a > 2E_M[c] - c$ , so that all quantities are strictly positive and the signs in the comparative-statics derivations are unambiguous. We now proceed with the backward-induction analysis. We analyze the duopoly adoption subgames for the three relevant cases:

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- both firms are profit-driven ( $\theta_1 = \theta_2 = 0$ ),
- both firms are purpose-driven ( $\theta_1 = \theta_2 = \bar{\theta}$ ),
- or one firm is profit-driven while the other is purpose-driven (an asymmetric profile:  $\theta_1 = \bar{\theta}, \theta_2 = 0$  or  $\theta_1 = 0, \theta_2 = \bar{\theta}$ ).

In solving for SPNE for the duopoly market structure, we evaluate each possible adoption profile by calculating all parameter thresholds and check whether either firm would have a profitable deviation. The complete documentation of all stability checks, difference-of-squares factorizations, and market size threshold proofs across the three cases is provided in Appendix C.

#### 3.3.1. Duopoly case 1: both firms are profit-driven ( $\theta_1 = \theta_2 = 0$ )

Both firms are pure profit-maximizers with no intrinsic motive for corporate purpose. In this scenario, each firm  $i$ 's utility matches with its profit  $\pi_i$ , and each firm will adopt the technology only if it increases its expected profit. We compare the profits from adopting vs. not adopting, given each possible action of the rival:

**Both adopt (1,1):** If both firms adopt the technology, each faces the (lower) expected marginal cost  $E_D[c] < c$ . Symmetrically, let  $\pi_i(1, 1)$  denote firm  $i$ 's expected Cournot profit when both firms adopt. First, we must check unilateral deviations from (1, 1).

Suppose the profile is (1, 1) and consider whether a firm would want to drop adoption to increase profit. Given firm  $j$  continues to adopt ( $t_j = 1$ ), a deviating firm  $i$  (switching to  $t_i = 0$ ) would then become the sole non-adopter in a one-sided adoption scenario (0, 1).

In that scenario, firm  $j$  has expected cost  $E_M[c]$  (since it would be the only adopter), which by Assumption 1, exceeds  $c$ . Firm  $i$ , as the lone non-adopter, incurs cost  $c$  and thus also has higher costs under Assumption 1. In order for joint adoption (1, 1) to be sustainable, each firm must prefer adopting when the other firm also adopts. This condition can be expressed as

$$(1, 1)_1 \succ (0, 1)_1 \quad \wedge \quad (1, 1)_2 \succ (1, 0)_2. \quad (3.25)$$

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This preference relation is equivalent to the following stability condition

$$2c > E_M[c] + E_D[c]. \quad (3.26)$$

Thus, joint adoption  $(1, 1)$  is a Nash equilibrium if and only if (3.26) is satisfied. Under this condition, neither firm has an incentive to unilaterally deviate, since the profit from mutual adoption exceeds that from exploiting the rival's adoption while saving on costs. Although the adoption game exhibits a coordination problem—both firms must be confident that the other will adopt—the  $(1, 1)$  outcome is stable whenever the mutual cost reduction is large enough.

In the absence of condition (3.26), however, each firm would prefer to deviate, and the only equilibrium would be  $(0, 0)$ . Therefore, joint adoption is a Nash equilibrium under profit-maximizing behavior, but only when cost parameters satisfy the above threshold condition.

**No adoption by either  $(0,0)$ :** If neither firm adopts the new technology, the equilibrium output and profit for each firm are those of the standard Cournot duopoly with marginal cost  $c$ . In particular, each firm produces  $q_i^{NA} = \frac{a-c}{3b}$  and earns profit  $\pi_i(0, 0) = \frac{(a-c)^2}{9b}$ . Consider a deviation by one firm to adopt unilaterally.

Given the rival remains with  $t_j = 0$ , a deviator  $i$  would face the expected marginal cost  $E_M[c] > c$  by adopting, whereas the non-adopting rival maintains cost  $c$ . Assumption 1 implies that the adopter's expected profit  $\pi_i(1, 0)$  would be lower than  $\pi_i(0, 0)$ . In other words, if firm  $j$  sticks with 0, firm  $i$  prefers  $(0, 0)_i$  over  $(1, 0)_i$ , fulfilling the equations

$$(0, 0)_1 \succ (1, 0)_1 \quad \wedge \quad (0, 0)_2 \succ (0, 1)_2. \quad (3.27)$$

Substituting the profits into the preference relation yields the following expression

$$\frac{(a-c)^2}{9b} > \frac{(a+c-2E_M[c])^2}{9b} \implies E_M[c] > c. \quad (3.28)$$

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This strategy always holds by Assumption 1. Therefore, neither firm has an incentive to deviate to adoption when the other is not adopting and  $(t_1^*, t_2^*) = (0, 0)$  always constitutes an equilibrium if  $\theta_1 = \theta_2 = 0$ .

**One firm adopts, the other does not (1,0) or (0,1):** Consider (1, 0), where firm 1 adopts and firm 2 stays with the old technology. For the profile (1, 0) to be an equilibrium, firm 1 must prefer adoption over no adoption, while firm 2 must prefer remaining with the legacy technology rather than switching when its rival adopts. This can be expressed as

$$(1, 0)_1 \succ (0, 0)_1 \quad \wedge \quad (1, 0)_2 \succ (1, 1)_2. \quad (3.29)$$

The inequalities in (3.29) are equivalent to the following profit comparison

$$\frac{(a + c - 2E_M[c])^2}{9b} > \frac{(a - c)^2}{9b} \quad \text{and} \quad \frac{(a + E_M[c] - 2c)^2}{9b} > \frac{(a - E_D[c])^2}{9b}. \quad (3.30)$$

The first inequality results in  $c > E_M[c]$  which violates Assumption 1, so it never holds under  $E_M[c] > c$ . The adopter strictly prefers (0, 0) to (1, 0) and (1, 0) and (0, 1) are never equilibria.

In summary, for case 1, where both firms are purely profit-driven and choose  $\bar{\theta}_i = 0$ , the stage 2 subgame typically admits two pure-strategy Nash equilibria: either both firms adopt the technology (1, 1) or neither adopts (0, 0). The outcome (0, 0) is always constitutes an equilibrium under the assumption  $c < E_M[c]$ , since unilateral adoption is not profitable when the other firm sticks with the legacy technology. The joint adoption outcome (1, 1), by contrast, is a Nash equilibrium only if the condition  $2c > E_M[c] + E_D[c]$  holds. Under this inequality, each firm's profit from adopting together exceeds the profit it would obtain by deviating unilaterally.

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#### 3.3.2. Duopoly case 2: both firms are purpose-driven

$$(\theta_1 = \theta_2 = \bar{\theta})$$

Now each firm receives not only profit  $\pi_i$  but also a non-monetary payoff from adopting (e.g., due to environmental or social purpose), captured by the common weight  $\bar{\theta} > 0$ . In other words, firm  $i$ 's utility function is  $v_i = \pi_i + \bar{\theta} \cdot t_i$ .

**Both adopt (1,1):** Given that the rival is adopting, each firm  $i$  compares the utility of adopting versus deviating to no adoption. The no-deviation condition is:

$$(1, 1)_1 \succ (0, 1)_1 \quad \wedge \quad (1, 1)_2 \succ (1, 0)_2, \quad (3.31)$$

which requires that each firm's utility is higher in the joint-adoption profile than in the free-riding scenario. Under symmetry, both inequalities in (3.31) are equivalent, yielding the condition

$$\pi_i(1, 1) + \bar{\theta} > \pi_i(0, 1) \quad \text{for } i = 1, 2. \quad (3.32)$$

Substituting the respective profits into (3.32), gives us

$$\frac{(a - E_D[c])^2}{9b} + \bar{\theta} > \frac{(a + E_M[c] - 2c)^2}{9b}, \quad (3.33)$$

which simplifies to

$$\bar{\theta} > \frac{(a + E_M[c] - 2c)^2 - (a - E_D[c])^2}{9b}. \quad (3.34)$$

If  $\bar{\theta}$  is large enough to satisfy inequality (3.34), then no firm has an incentive to deviate from joint adoption, making (1, 1) a stable outcome. In that case, (1, 1) constitutes a SPNE.

Thanks to the additional utility benefit, firms are more inclined to adopt: even if the pure-profit condition  $2c > E_M[c] + E_D[c]$  fails, a sufficiently high value of  $\bar{\theta}$  can restore

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incentives and ensure that joint adoption becomes individually rational. Large values of  $\bar{\theta}$  ensure that each firm prefers to adopt as long as the other does so as well.

**No adoption by either (0,0):** Here, each firm must prefer staying with the legacy technology over unilaterally adopting on its own. The inequality condition is

$$(0,0)_1 \succ (1,0)_1 \quad \wedge \quad (0,0)_2 \succ (0,1)_2, \quad (3.35)$$

which reduces (by symmetry) to

$$\pi_i(0,0) > \pi_i(1,0) + \bar{\theta}. \quad (3.36)$$

In terms of payoffs, no single firm will deviate to adopt if

$$\frac{(a-c)^2}{9b} > \frac{(a+c-2E_M[c])^2}{9b} + \bar{\theta}, \quad (3.37)$$

so, (3.37) ensures that the profit loss from being the sole adopter cannot be compensated by the purpose-driven benefit  $\bar{\theta}$ . Thus, the no-adoption outcome (0,0) is an equilibrium only if  $\bar{\theta}$  is sufficiently small. As  $\bar{\theta}$  increases, the right-hand side of (3.37) rises, making the inequality harder to satisfy.

**One firm adopts, the other does not (1,0):** Suppose firm 1 adopts while firm 2 does not. With identical purpose weights  $\bar{\theta}_1 = \bar{\theta}_2 = \bar{\theta} > 0$ , (1,0) is an equilibrium only if

$$(1,0)_1 \succ (0,0)_1 \quad \text{and} \quad (1,0)_2 \succ (1,1)_2. \quad (3.38)$$

Substituting the utility functions and solving for  $\bar{\theta}$  yields a lower and an upper bound for the corporate purpose weight of

$$\bar{\theta} > \frac{4(a-E_M[c])(E_M[c]-c)}{9b} \quad (3.39)$$

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and

$$\bar{\theta} < \frac{(E_M[c] + E_D[c] - 2c)(2a + E_M[c] - E_D[c] - 2c)}{9b}. \quad (3.40)$$

The upper bound (3.40) is positive only if the joint expected cost is low enough relative to the legacy cost ( $2c < E_M[c] + E_D[c]$ ). Furthermore, an interval for  $\bar{\theta}$  exists only if the upper bound (3.40) is at least as large as the lower bound. Comparing these bounds leads to a market size threshold

$$a < c + \frac{5(E_M[c] - c)^2 - (c - E_D[c])^2}{2(E_M[c] - E_D[c])}. \quad (3.41)$$

In summary, the asymmetric outcome  $(1, 0)$  is an equilibrium if and only if market size  $a$  is sufficiently small and  $\bar{\theta}$  lies in the interval defined by (3.39) and (3.40).

In case 2, where both firms value purpose with weight  $\bar{\theta}$ , the equilibrium outcomes are determined by the magnitude of  $\bar{\theta}$  relative to the profit differentials. If  $\bar{\theta}$  is sufficiently low, neither firm finds it profitable to adopt unilaterally, making  $(0, 0)$  the unique equilibrium. Conversely, if  $\bar{\theta}$  is high enough to satisfy inequality (3.34), the non-monetary utility leads  $(1, 1)$  to be a stable SPNE. However, unlike the purely profit-driven case, asymmetric equilibria  $(1, 0)$  or  $(0, 1)$  are also possible. Specifically, if the cost condition  $2c < E_M[c] + E_D[c]$  holds and market size  $a$  is below the threshold in (3.41), an intermediate range of  $\bar{\theta}$  defined by inequalities (3.39) and (3.40) exists where exactly one firm adopts the technology while the other does not.

#### 3.3.3. Duopoly case 3: one purpose-driven firm, one profit-driven firm ( $\theta_1 = \bar{\theta}$ , $\theta_2 = 0$ )

Now consider an asymmetric setting: let firm 1 have a purpose motive  $\bar{\theta}$  and let firm 2 be profit-maximizing. This case captures a situation where only one firm values the benefits of adoption.

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**Both adopt (1,1):** Firm 1 has not only the profit incentive but also the  $\theta$  incentive to adopt the green technology, whereas firm 2 has only the profit incentive. For this profile to be an equilibrium, the requirements are

$$(1, 1)_1 \succ (0, 1)_1 \quad \wedge \quad (1, 1)_2 \succ (1, 0)_2. \quad (3.42)$$

These conditions expand to the following utility comparisons

$$\frac{(a - E_D[c])^2}{9b} + \bar{\theta} > \frac{(a + E_M[c] - 2c)^2}{9b} \quad \text{and} \quad \frac{(a - E_D[c])^2}{9b} > \frac{(a + E_M[c] - 2c)^2}{9b}. \quad (3.43)$$

Under Assumption 1 ( $E_D[c] < c < E_M[c]$ ),  $E_M[c] < a$  and  $b > 0$ , the second inequality in (3.43) simplifies to

$$2c > E_M[c] + E_D[c]. \quad (3.44)$$

Given (3.44), the first inequality reduces to a lower bound

$$\bar{\theta} > \frac{(a + E_M[c] - 2c)^2 - (a - E_D[c])^2}{9b}. \quad (3.45)$$

The right-hand side of (3.45) is negative under condition (3.44). Because  $\bar{\theta} > 0$ , this inequality is automatically satisfied. Both-adopt (1, 1) is a strict Nash equilibrium if and only if (3.44) holds. Under this condition, firm 2 strictly prefers (1, 1) to (1, 0), and since the implied lower bound on  $\bar{\theta}$  is negative any  $\bar{\theta} > 0$  ensures firm 1 strictly prefers (1, 1) to (0, 1).

**No adoption (0,0):** We now assess whether the no-adoption outcome  $(t_1, t_2) = (0, 0)$  constitutes a SPNE in the asymmetric setting where firm 1 has a purpose motive  $\theta_1 = \bar{\theta} > 0$  and firm 2 is purely profit-driven ( $\theta_2 = 0$ ). In this profile, neither firm adopts the green technology. For (0, 0) to be an equilibrium, neither firm must have a profitable

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unilateral deviation. The equilibrium condition is

$$(0, 0)_1 \succ (1, 0)_1 \quad \wedge \quad (0, 0)_2 \succ (0, 1)_2 . \quad (3.46)$$

Firm 2 has no incentive to adopt as a profit-maximizing firm without a purpose motive, unilateral adoption is strictly unprofitable under the model's cost assumptions. This follows from

$$\pi_2(0, 0) > \pi_2(0, 1) \quad \Leftrightarrow \quad c < E_M[c], \quad (3.47)$$

which always holds under Assumption 1.

Next we must analyze whether firm 1 might have an incentive to deviate which expands to the following utility comparisons

$$\frac{(a - c)^2}{9b} > \frac{(a + c - 2E_M[c])^2}{9b} + \bar{\theta}. \quad (3.48)$$

Accordingly, the no-adoption outcome  $(0, 0)$  can only be sustained as a SPNE if  $\bar{\theta}$  is sufficiently small, specifically

$$\bar{\theta} < \frac{4(a - E_M[c])(E_M[c] - c)}{9b}. \quad (3.49)$$

Therefore,  $(0, 0)$  is a strict Nash equilibrium if and only if (3.49) holds.

The profit-only firm never adopts alone, while the purpose-driven firm would do so only if its purpose benefit exceeds the unilateral profit loss from the higher expected cost  $E_M[c]$  when adopting by itself. Keeping  $\bar{\theta}$  below the threshold (3.49) prevents that deviation and stabilizes  $(0, 0)$ .

**One firm adopts, the other does not (1,0):** We now examine whether the asymmetric profile  $(t_1, t_2) = (1, 0)$ , in which firm 1 (the purpose-driven firm) adopts the green technology while firm 2 (the profit-driven firm) does not, constitutes a SPNE in the asymmetric purpose setting.

For this outcome to be an equilibrium, both firms must have no incentive to deviate: firm

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1 must prefer to adopt unilaterally rather than refrain from adoption, and firm 2 must prefer to stay out rather than join and co-adopt. Formally, the equilibrium condition is

$$(1, 0)_1 \succ (0, 0)_1 \quad \wedge \quad (1, 0)_2 \succ (1, 1)_2 . \quad (3.50)$$

Replacing the inequalities with the respective utilities (3.50) and solving for firm 1's threshold yields

$$\frac{(a + c - 2E_M[c])^2}{9b} + \bar{\theta} > \frac{(a - c)^2}{9b} . \quad (3.51)$$

So firm 1 prefers to adopt if

$$\bar{\theta} > \frac{4(a - E_M[c])(E_M[c] - c)}{9b} . \quad (3.52)$$

This inequality defines a threshold: firm 1 will adopt alone only if its purpose motive  $\bar{\theta}$  is strong enough to outweigh the profit loss from adopting without coordination.

Since firm 2 has no purpose motive, it compares pure profits and will remain with the legacy technology rather than co-adopt if

$$\frac{(a + E_M[c] - 2c)^2}{9b} > \frac{(a - E_D[c])^2}{9b} . \quad (3.53)$$

Rearranging yields the second equilibrium condition

$$2c < E_M[c] + E_D[c] . \quad (3.54)$$

As shown in (3.54), firm 2's best response to firm 1's adoption is to stay out and if (3.54) fails, firm 2 strictly prefers to co-adopt. Firm 1's unilateral adoption decision is governed by the threshold in (3.52). So the asymmetric profile  $(1, 0)$  is a strict Nash equilibrium precisely when both (3.54) and (3.52) hold. If (3.54) is violated, the outcome shifts to  $(1, 1)$ , but if the inequality in (3.52) is reversed, the outcome is  $(0, 0)$ .

In case 3, the three equilibria are determined by the derived conditions. Joint adoption

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(1,1) is sustained when the profit comparison (3.44) holds and given this condition, the companion bound (3.45) is automatically satisfied for any  $\bar{\theta} > 0$ . The no-adoption outcome (0,0) is a strict Nash equilibrium precisely when the purpose weight lies below the unilateral-adoption threshold in (3.49). The profit-only firm's comparison reduces to  $c < E_M[c]$ , which holds by Assumption 1 and adds no further restriction. The asymmetric outcome (1,0) obtains only if the profit-maximizing firm strictly prefers to stay out, (3.54), while the purpose-driven firm is willing to adopt alone, (3.52). To provide a comprehensive overview of the analysis across all scenarios, table 3.1 shows these insights by systematically categorizing the SPNE, their underlying conditions, and economic explanations.

Table 3.1.: Equilibrium classification under different  $\bar{\theta}$  and technology adoption strategies

| Case | Config.                                     | Strat. | SPNE Condition(s)                                          | SPNE? | Explanation                                                                                                    |
|------|---------------------------------------------|--------|------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------|
| 1.1  | $\theta_i = 0$                              | (1, 1) | $2c > E_M[c] + E_D[c]$                                     | Yes   | Joint adoption only if marginal cost synergy is large enough                                                   |
| 1.2  | $\theta_i = 0$                              | (0, 0) | $c < E_M[c]$                                               | Yes   | No firm benefits from adopting alone                                                                           |
| 1.3  | $\theta_i = 0$                              | (1, 0) | — (violates Assumption 1)                                  | No    | Unilateral adoption increases expected costs; not sustainable                                                  |
| 2.1  | $\theta_i = \bar{\theta}$                   | (1, 1) | $\bar{\theta} > [(a + E_M[c] - 2c)^2 - (a - E_D[c])^2]/9b$ | Yes   | Purpose utility incentivizes both to adopt even with moderate cost gains                                       |
| 2.2  | $\theta_i = \bar{\theta}$                   | (0, 0) | $(a - c)^2 > (a + c - 2E_M[c])^2 + 9b\bar{\theta}$         | Yes   | No adoption only if $\bar{\theta}$ is small and cost advantage is weak                                         |
| 2.3  | $\theta_i = \bar{\theta}$                   | (1, 0) | Bounds on $\bar{\theta}$ must hold (3.39) and (3.40)       | Yes   | One-sided adoption only in a narrow parameter region.                                                          |
| 3.1  | $\theta_1 = \bar{\theta}$<br>$\theta_2 = 0$ | (1, 1) | Co-adoption test (3.44) and purpose threshold (3.45)       | Yes   | Firm 1 adopts for purpose; firm 2 joins for profit.                                                            |
| 3.2  | $\theta_1 = \bar{\theta}$<br>$\theta_2 = 0$ | (0, 0) | Small-purpose bound (3.49)                                 | Yes   | Only if firm 1's purpose is too weak to offset its solo loss.                                                  |
| 3.3  | $\theta_1 = \bar{\theta}$<br>$\theta_2 = 0$ | (1, 0) | One-sided tests (3.52), (3.54)                             | Yes   | Purpose firm adopts when its utility gain exceeds the solo profit loss; profit-only rival prefers to stay out. |

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#### 3.3.4. Numerical illustration of the equilibrium

This section provides numerical illustrations of the adoption decision, depicting how firms' choices vary with the cost of the legacy technology  $c$  (horizontal axis) and the corporate purpose parameter  $\theta$  (vertical axis). The parameter values used in the figures below are chosen to render the equilibrium regions visually distinguishable for each of the three cases analyzed in Section 3.3. Since the relative size of the equilibrium regions depends on the joint configuration of demand parameters  $(a, b)$ , the success probability  $(\delta)$ , and the cost structure  $(\underline{c}, c, \bar{c})$ , no single parameter set displays all relevant equilibrium configurations simultaneously. The values reported in each subfigure should therefore be read as illustrative benchmarks.

**Monopoly setting** In the monopoly setting, the numerical illustration highlights how the analytical adoption threshold partitions the  $(c, \theta)$ -space into regions in which adoption is optimal and regions in which the monopolist continues to rely on the legacy technology. The green technology takes a low cost of  $\underline{c} = 0.4$  with probability  $\delta = 0.45$ , and a high cost of  $\bar{c} = 1.6$  with probability  $1 - \delta = 0.55$ . The expected cost of adopting the green technology is therefore a weighted average of these two outcomes. In contrast, the legacy technology features a known cost  $c$ , which is not fixed in this illustration but varied continuously along the x-axis of the simulation over a range consistent with the model's core Assumption 1. Here the legacy cost can take on values between  $E_D[c] = 0.763 < c < E_M[c] = 1.06$ .

The second key parameter in this decision is the firm's orientation towards putting weight on a corporate purpose  $\theta$ , which is plotted along the y-axis. The region plot 3.1, generated via Mathematica, depicts two distinct areas in the  $(c, \theta)$  space: the blue region indicates the combinations of  $c$  and  $\theta$  where adoption of the green technology is optimal for the monopolist, while the orange region reflects parameter combinations under which the firm prefers to remain with the legacy technology. The parameter settings are  $a = 5$ ,  $b = 1$  and  $\delta = 0.45$ .

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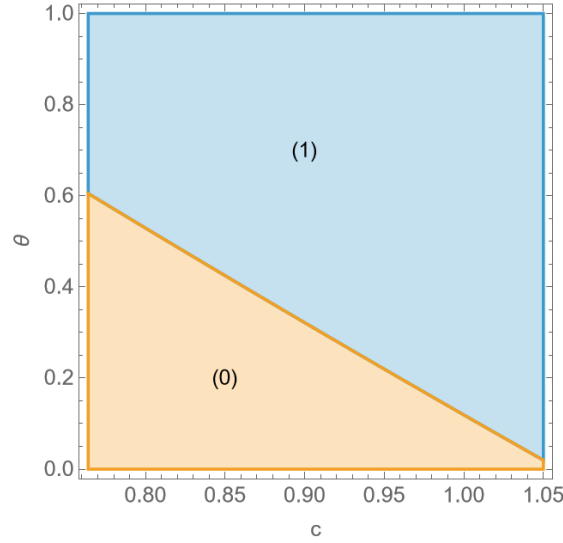


Figure 3.1.: Monopoly equilibria

The threshold boundary between these two regions reflects the trade-off between cost competitiveness and corporate purpose. The graphic clearly shows that when the legacy technology is relatively cheap (the left side of the plot), a very strong corporate purpose orientation (a high  $\theta$ ) is required to justify an adoption decision. As the legacy cost  $c$  increases, the required  $\theta$  that is needed for an adoption outcome (1) decreases.

This illustration confirms the central insight of the monopoly model: adoption depends on both the relative cost position of the technologies and the internal value of corporate purpose to the firm. By representing a riskier technology, these parameters visually emphasize the significant role that a strong corporate purpose must play in overcoming the financial obstacles to green innovation.

**Duopoly setting** To further explore the equilibrium behavior in the duopoly setting, Figures 3.2, 3.3, and 3.4 present a set of region plots, also generated via Mathematica which visualize the equilibrium outcomes. These region plots illustrate, which symmetric/asymmetric equilibrium either joint adoption (1, 1), mutual non-adoption (0, 0) or one-sided adoption (1, 0)/(0, 1), is supported for given combinations of  $\theta$  and  $c$ . Across all figures, the color coding remains uniform: orange areas illustrate mutual non-adoption (0, 0), blue areas denote joint adoption (1, 1), and green areas represent

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one-sided adoption (1, 0) or (0, 1).

Figure 3.2 corresponds to case 1 (see 3.3.1), in which both firms are fully profit-oriented and place no intrinsic value on corporate purpose, i.e., symmetric  $\theta_1 = \theta_2 = 0$ . The parameter settings are  $a = 3$ ,  $b = 1$ ,  $\underline{c} = 0.4$ ,  $\bar{c} = 1.6$ , and  $\delta = 0.35$ , chosen so that the legacy cost ( $c$ ) varies across an interval in which both the symmetric (0, 0) and (1, 1) equilibria can be sustained under purely profit-driven behavior. Over the plotted range the legacy cost satisfies, as for all cases shown,  $c \in [E_D[c], E_M[c]]$  which calculated for case 1 results in the expected technology costs  $E_D[c] = 0.907$  and  $E_M[c] = 1.180$ .

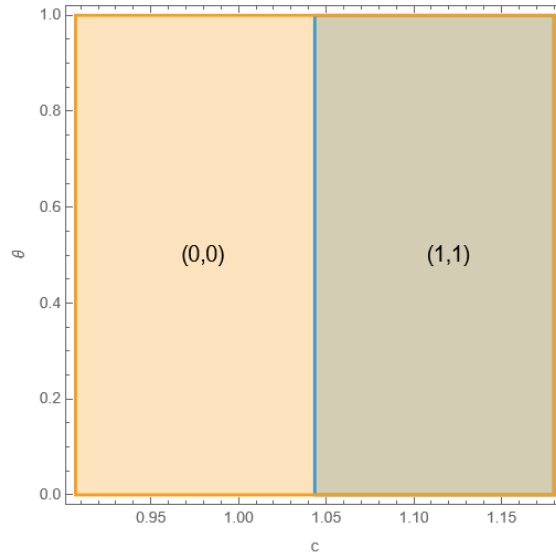


Figure 3.2.: SPNE for case 1

The SPNE structure under this setting visualizes our calculated threshold pattern. Note first that, since both firms are profit-driven ( $\theta_1 = \theta_2 = 0$ ), the purpose weight  $\theta$  does not enter any payoff in this case. It is retained on the vertical axis solely to keep the axes consistent with the purpose-driven cases (Figures 3.3 and 3.4), so that the regions here appear as vertical bands in  $c$ . For lower values of  $c$ , the unique equilibrium involves both firms refraining from adoption, as indicated by the orange region. As the legacy cost  $c$  increases, firms are increasingly incentivized to adopt the clean technology.

The figure shows that the blue region (1, 1) is entirely overlaid by the orange region (0, 0). This visual overlap indicates that in the high  $c$  range, both (0, 0) and (1, 1) are

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simultaneously symmetric Nash equilibria. In other words, the game supports multiple SPNE in that region. This multiplicity of equilibria arises because both strategies yield acceptable payoffs in the absence of strategic pressure or corporate purpose. When multiple stable Nash equilibria occur, firms may fail to converge on the socially preferable equilibrium  $(1, 1)$ .

Figure 3.3 (see 3.3.2) presents the equilibrium outcomes for case 2, where both firms are purpose-driven, i.e.,  $\theta_1 = \theta_2 = \bar{\theta}$  and the parameter settings are changed to  $a = 1.1$ ,  $b = 0.08$ ,  $\underline{c} = 0.4$ ,  $\bar{c} = 1.6$ , which results in  $E_D[c] = 0.7$  and  $E_M[c] = 1.0$  with  $\delta = 0.5$ . The relatively small market size and shallow demand slope are chosen to render the three equilibrium regions  $((0, 0), (1, 0), (1, 1))$  jointly visible within the plotted range. For larger parameters of  $a$  or  $b$  the asymmetric region collapses to a thin wedge and becomes graphically indistinguishable.

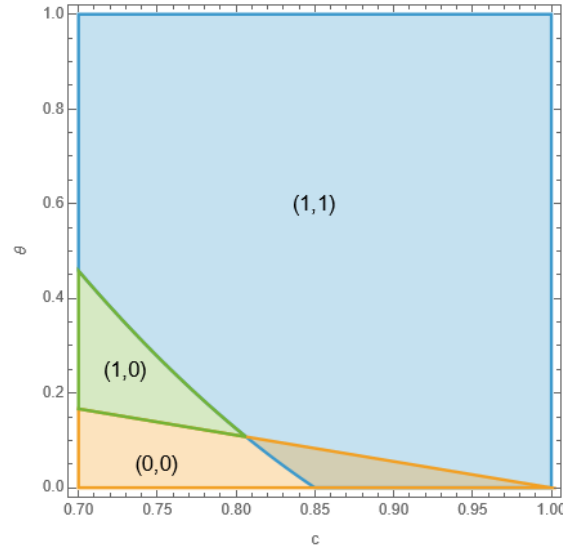


Figure 3.3.: SPNE for case 2

The figure shows three equilibrium regions. For low purpose weights and comparatively attractive legacy costs, the unique outcome is mutual non-adoption  $(0, 0)$  (orange). For higher purpose weights, or when legacy becomes sufficiently unattractive, the unique outcome is mutual adoption  $(1, 1)$  (blue). Between these areas a clearly visible wedge emerges (green) in which asymmetric outcomes occur: one firm adopts while the other does not, so  $(1, 0)$  satisfies the equilibrium conditions. The boundaries between regions

### 3. The Model

slope downward, indicating that lower legacy costs require higher purpose weights to sustain adoption, whereas higher legacy costs permit adoption even at lower purpose weights. In the lower-right portion of Figure 3.3, the blue (1, 1) and orange (0, 0) regions overlap. In this overlap, multiple equilibria exist simultaneously, with both symmetric outcomes being supported.

Figure 3.4 shows the equilibrium outcomes for case 3 (see 3.3.3), where one firm is fully purpose-oriented ( $\theta_1 = \bar{\theta}$ ) and the other is purely profit-driven ( $\theta_2 = 0$ ). The parameter settings are  $a = 5$ ,  $b = 1$ ,  $\underline{c} = 0.4$ ,  $\bar{c} = 1.6$ ,  $\delta = 0.45$ , which results in  $E_D[c] = 0.763$  and  $E_M[c] = 1.06$ . These parameters reproduce a standard duopoly market size and demand slope while keeping the cost structure consistent with cases 1 and 2.

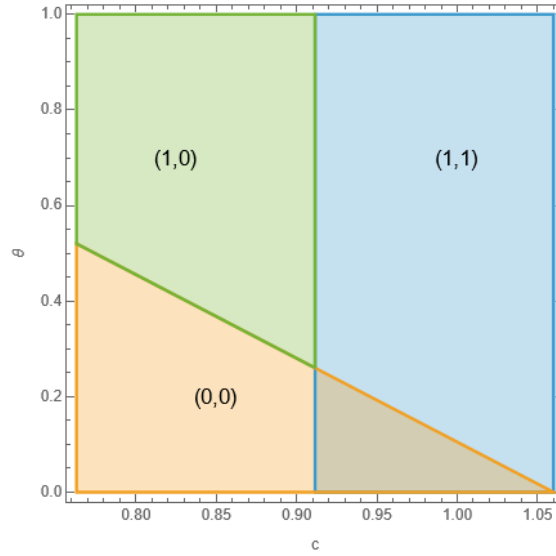


Figure 3.4.: SPNE for case 3

The plot again displays three regions. For comparatively favorable legacy costs and low values of the common purpose weight  $\theta$ , the equilibrium is mutual non-adoption (0, 0) (orange). To the left of a vertical cutoff in  $c$ , higher  $\theta$  yields an asymmetric outcome (1, 0) (green). To the right of the vertical cutoff, the outcome is mutual adoption (1, 1) (blue), with a downward-sloping lower boundary indicating that increasing legacy costs support adoption at progressively lower  $\theta$ .

Two narrow overlap regions are visible in the plot. The overlaps arise where the no-

### 3. The Model

deviation thresholds for the competing outcomes intersect. With one firm valuing purpose and the other purely profits,  $\theta$  shifts only the purpose-oriented firm's incentives while  $c$  shifts both firms' payoffs.

For certain  $(c, \theta)$  pairs this produces boundary points at which two profiles satisfy the equilibrium conditions at the same time yielding the green–orange overlap  $(1, 0)$  vs.  $(1, 1)$  around the vertical cutoff, and the blue–orange overlap  $(0, 0)$  vs.  $(1, 1)$  in the lower-right corner. Small changes in  $c$  or  $\theta$  eliminate the multiplicity so within the overlap, both outcomes are consistent with best responses. Having illustrated the stage 2 equilibrium regions numerically, we now turn back to stage 1 and ask whether firms have an incentive to choose  $\theta_i = \bar{\theta}$  in the first place.

#### 3.3.5. The commitment game

The preceding subsections solved the adoption subgame for each fixed purpose configuration. We now close the model by treating the stage 1 choice  $\theta_i \in \{0, \bar{\theta}\}$  as a simultaneous-move game between the two firms, whose payoffs are the stage 2 equilibrium utilities derived above. The four configurations map onto the cases already analyzed:  $(0, 0)$  corresponds to case 1,  $(\bar{\theta}, \bar{\theta})$  to case 2, and  $(\bar{\theta}, 0)$  or  $(0, \bar{\theta})$  to case 3.

Because the adoption subgame admits multiple equilibria in the overlap regions, the stage 1 payoffs are well defined only under an explicit selection rule. Following Albuquerque and Cabral (2025), we assume that, whenever several stage 2 equilibria coexist, firms coordinate on the payoff-dominant (Pareto-superior) one. Where neither outcome is clearly better for both firms, we say so explicitly below. The resulting stage 1 game can then be written as

|        |                           | Firm 2         |                           |
|--------|---------------------------|----------------|---------------------------|
|        |                           | $\theta_2 = 0$ | $\theta_2 = \bar{\theta}$ |
| Firm 1 | $\theta_1 = 0$            | case 1 outcome | case 3 (mirrored)         |
|        | $\theta_1 = \bar{\theta}$ | case 3 outcome | case 2 outcome            |

Table 3.2.: Stage 1 commitment game: each cell is evaluated at the selected stage 2 equilibrium utility.

### 3. The Model

Up to this point, corporate purpose was treated as a commitment device by assumption. The stage 1 game shows that it actually behaves like one. Consider a parameter region in which, absent any purpose commitment, the inefficient non-adoption profile  $(0, 0)$  would be selected under case 1. Suppose firm 1 deviates unilaterally to  $\theta_1 = \bar{\theta}$ . If the synergy condition  $2c > E_M[c] + E_D[c]$  (see (3.44)) holds, case 3 already establishes that joint adoption  $(1, 1)$  is the unique stage 2 equilibrium, so firm 1 can anticipate this outcome when choosing  $\theta_1$ . The payoff rises from  $\frac{(a-c)^2}{9b}$  (see (3.15)) to  $\frac{(a-E_D[c])^2}{9b} + \bar{\theta}$ . For any  $\bar{\theta} > 0$  this deviation is profitable, so  $(0, 0)$  is no longer a stage 1 equilibrium in this region, and firm 1 chooses the purpose commitment on its own. Where  $\bar{\theta}$  lies below the unilateral-adoption threshold (3.52), by contrast, no firm has an incentive to deviate from  $(\theta_1, \theta_2) = (0, 0)$ , and the non-adoption outcome persists at both stages. The commitment works precisely because it changes how the rival reacts in stage 2, moving the selected outcome from the trap to mutual adoption.

When the synergy is weak ( $2c < E_M[c] + E_D[c]$ ), the same deviation instead induces the asymmetric outcome  $(1, 0)$ , which is profitable for firm 1 whenever its purpose weight clears the unilateral-adoption threshold (3.52). In this case commitment does not eliminate the rival's non-adoption but still moves the deviating firm out of the trap on its own. Under conditions (3.52) and (3.54), the asymmetric profile  $(1, 0)$  is the selected stage 2 outcome following firm 1's unilateral commitment, as established in case 3.

Two observations follow. First, the elimination of the inefficient outcome is unconditional only when  $\bar{\theta}$  exceeds the no-adoption stability bound ( (3.49) in the asymmetric case). Below this bound, both  $(0, 0)$  and  $(1, 1)$  survive as stage 2 equilibria, and the stage 1 ranking depends on the selection rule, consistent with the focal-point interpretation discussed in Section 4.2. Second, the threshold governing firm 1's deviation, (3.52), lies strictly below the monopoly threshold (3.11) for all admissible parameters, so the commitment incentive is stronger under competition than in isolation.

## 4. Results

This chapter presents the main results derived from the model introduced in Chapter 3 and summarizes the key findings of the monopoly and duopoly market structure and compares these to one another. The objective of the results is to underline the influence of corporate purpose on the firms (parameter  $\theta$ ), the role of strategic interaction and complementarity in the duopoly setting.

### 4.1. Monopoly: adoption decision and corporate purpose incentives

The monopoly analysis serves to isolate the internal utility dimension of corporate purpose, abstracting from the strategic interaction that gives  $\theta$  its commitment-theoretic content. The results below should therefore be read as characterizing the private trade-off facing a purpose-oriented decision-maker, not as a strategic-commitment result. Under the monopoly setting, the decision to adopt a green technology hinges on the firm's cost structure and its orientation toward corporate purpose. As noted previously (see equation (3.2)), adopting the green technology yields uncertain expected production costs, and under the baseline parameters this uncertainty makes adoption as a monopolist unprofitable.

In the initial phase of the game, the monopolist chooses between  $\theta_M = 0$  and  $\theta_M = \bar{\theta}$ , with the latter entailing the small fixed commitment cost  $\epsilon > 0$  introduced in Section 3.1. Since  $\bar{\theta}$  enters the utility function only multiplicatively with the adoption decision  $t_M$ , the stage 1 choice becomes consequential only when the firm intends to adopt the green technology in stage 2.

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Equation (3.11) reveals the precise threshold of corporate purpose. The right-hand side of the inequality represents the requisite magnitude of commitment needed to trigger adoption. If the firm's internal weight of corporate purpose  $\bar{\theta}$  falls below this value, the force of the legacy profits is too strong, and the firm behaves identically to a Friedman firm, rejecting the technology.

This threshold is determined by the interaction of three structural factors:

- The green premium ( $E_M[c] - c$ ): the threshold rises with the cost disadvantage, increasing approximately linearly for small premia. As the green technology becomes more expensive relative to the legacy technology, the required purpose commitment rises. This suggests that for radical, early-stage innovations where the green premium is high, only firms with exceptionally strong purpose orientations (high  $\bar{\theta}$ ) will adopt.
- The market capacity ( $a$ ): the threshold increases with the demand intercept  $a$ , i.e., with market size. The reason is a scale effect: in a larger market the monopolist produces a higher baseline quantity, so an expected marginal-cost increase from adoption (the wedge  $E_M[c] - c$ ) is applied to a larger output level. Consequently, the absolute profit loss from adopting the green technology grows with  $a$ , and a stronger purpose motive is required to offset this larger opportunity cost. Formally,  $\bar{\theta}(a) = \pi_M^{NA} - \pi_M^A$  is increasing in  $a$  under  $E_M[c] > c$ .
- The slope of demand ( $b$ ): the threshold is inversely proportional to  $b$ . A flatter demand curve (lower  $b$ ) implies a larger quantity response to price changes, potentially amplifying the profit losses from a cost increase.

The threshold  $\pi_M^{NA} - \pi_M^A$  is higher when the profit penalty of adoption is larger. For instance, if the new technology is very risky (low  $\delta$ ) or the cost reduction in case of success is modest, the expected cost  $E_M[c]$  will be much higher than the legacy costs  $c$ . This yields a large profit difference  $\pi_M^{NA} - \pi_M^A$ , meaning the firm would need a very strong corporate purpose weight (high  $\theta_M$ ) to justify adoption. By contrast, if for example technological improvements make the green technology nearly cost-competitive (reducing  $E_M[c]$  closer to  $c$ ), the profit gap narrows and the required  $\theta$  threshold drops.

In the extreme case where adoption would not reduce profit at all (i.e.  $\pi_M^A \approx \pi_M^{NA}$ ), the

#### 4. Results

threshold  $\theta_M$  would approach zero, then even a minimal corporate purpose weight could tip the balance in favor of adoption. This threshold result highlights why a corporate purpose value of  $\theta_M = \bar{\theta} > 0$  is necessary to induce green technology adoption in the monopoly scenario. Under the given cost parameters, the innovation entails an expected profit sacrifice (the new technology's higher expected costs make  $\pi_M^A < \pi_M^{NA}$ ). A firm that cares only about profits simply will not adopt a technology that risks a profit loss.

The objective function provides an additional incentive by assigning an intrinsic utility value to the adoption of green technology. In conclusion, the firm's model is based on the premise that it will derive a benefit from its investment in green technology. This enables the monopolist to rationalize adoption, provided that the additional benefit is sufficiently substantial.

Indeed, an alternative interpretation of  $\theta$  is that it represents the monetary equivalent of the firm's conscience or social commitment. That is to say, it may be viewed as a measurement of the amount of profit the firm is willing to forego (due to  $c < E_M[c]$ ) in order to achieve environmental improvement. In the event that  $\theta_M$  is below the cost of doing so, the firm will not sacrifice profit. However, if  $\theta_M$  is high, the firm is willing to trade off some profit for its corporate purpose. This reasoning reflects the view of CSR as "sacrificing profits in the social interest" to meet stakeholders' values and ethical expectations (Bénabou & Tirole, 2010, p.2).

### 4.2. Duopoly: strategic corporate purpose commitment and adoption

In a duopoly setting, the decision of whether to commit to a corporate purpose and adopt new green technology becomes a strategic interaction between two firms. The equilibrium outcomes derived in Section 3.3 (summarized in table 3.1) indicate that a firm's commitment (or lack thereof) alters the adoption incentives for both players.

**Profit-driven duopoly:** Case 1 ( $\theta_1 = \theta_2 = 0$ ), models firms as purely profit-driven entities whose decision to adopt clean technology is entirely dependent on its expected

#### 4. Results

profitability and is not influenced by any internal, non-financial commitment. The equilibrium analysis of Subsection 3.3.1 reveals that a fundamental coordination problem is inherent to this competitive environment.

Without a purpose commitment, non-adoption (0, 0) persists as the dominant outcome even when joint adoption would be mutually beneficial, as each firm rationally fears unilateral exploitation by its rival (Albuquerque & Cabral, 2025). This coordination failure, visualized in Figure 3.2 where the regions of (0, 0) and (1, 1) overlap, underscores the necessity of an internal commitment mechanism such as corporate purpose ( $\theta > 0$ ) to shift the industry toward the efficient adoption equilibrium.

**Both firms commit to a corporate purpose:** The strategic landscape undergoes a shift when both firms commit to corporate purpose in stage 1. This dual commitment results in a modification of the firms' payoffs from technology adoption, with the addition of an additional purpose utility to the clean technology outcome. Consequently, adoption incentives are no longer governed solely by cost considerations but instead, each firm's optimal response becomes more sensitive to the expected utility gain from adoption, which now includes the purpose component.

The game admits three equilibrium configurations depending on parameter values. For sufficiently high purpose intensity, both firms adopt, as the added purpose utility makes joint adoption individually optimal. For low purpose intensity, neither firm adopts and the outcome mirrors the profit-driven case because the purpose benefit is too small to justify adoption. On an intermediate range, an asymmetric equilibrium can arise in which one firm adopts while the other stays with the legacy technology, even though both firms share the same  $\theta$ .

The key strategic implication of this research is that joint commitment can enable industry-wide technology adoption. By cooperatively embracing a broader objective, firms can avoid the under-investment trap and achieve a higher-payoff equilibrium that benefits both the firm and society. This finding is consistent with the concept that the integration of social purpose into business strategy can generate shared value (Porter & Kramer, 2011). In this case, the strategic alignment of competitors toward sustainability leads to enhanced outcomes.

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**One firm commits, the other does not:** In the context of an asymmetric duopoly, one firm exhibits a purpose-driven behavior, characterized by a positive value of  $\theta$  ( $\theta = \bar{\theta} > 0$ ), while the other maintains a profit-focused approach ( $\theta = 0$ ). When the technology offers sufficient efficiency gains to satisfy the condition  $2c > E_M[c] + E_D[c]$ , the presence of a purpose-driven firm facilitates mutual adoption  $(1, 1)$ . Unlike the purely profit-driven case where coordination failure is a risk, the purpose-driven firm's commitment, ensured by  $\bar{\theta} > 0$  (see (3.45)), acts as a strategic anchor.

When the corporate purpose is weak and falls below the critical threshold derived in equation (3.49), the outcome is mutual non-adoption  $(0, 0)$ . Here, the purpose-driven firm behaves indistinguishably from its profit-maximizing rival because the internal utility from adoption is insufficient to justify the financial loss of acting alone, leaving the market trapped in the legacy technology.

A unique asymmetric equilibrium  $(1, 0)$  emerges if the purpose weight is strong enough to satisfy equation (3.52) while the cost synergy remains low ( $2c < E_M[c] + E_D[c]$ ). Driven by its commitment, the purpose-oriented firm adopts the green technology unilaterally despite the high expected costs  $E_M[c]$ .

A clarification is warranted regarding the sense in which corporate purpose acts on the set of equilibria, since two mechanisms are at work, as formalized in Section 3.3.5. Where the purpose weight  $\bar{\theta}$  exceeds the no-adoption stability bound, condition (3.37) in the symmetric case and threshold (3.49) in the asymmetric case, non-adoption is no longer a Nash equilibrium, so the unique SPNE involves adoption by at least one firm. Here the model delivers genuine equilibrium elimination: the inefficient outcome is removed, not merely outranked. Below this threshold, however, both  $(0, 0)$  and  $(1, 1)$  remain equilibria simultaneously, as the overlap regions in Figures 3.3 and 3.4 show. In these regions the simultaneous-move framework does not by itself pin down a unique outcome. The interpretation of purpose as selecting adoption rests on the focal-point and credible-commitment argument of Albuquerque and Cabral (2025), not on a formal refinement derived here. The contribution is therefore strongest in the elimination region, where the result is unconditional, and remains conditional on an equilibrium-selection assumption in the overlap region.

### 4.3. Comparison of monopoly and duopoly outcomes

Both models build on the formal equilibrium framework of Chapter 3, in which firms maximize an objective that includes profits and a corporate purpose component. In each case, the firm's corporate purpose parameter ( $\theta$ ) can augment its utility if it adopts the green technology. In this setting, we will compare the behavior of a monopolist and a duopoly under different values of  $\theta$ , and how competition (or its absence) shapes strategic outcomes. Several important differences emerge between the monopoly and duopoly outcomes, reflecting how competition alters the incentives and innovation.

**Adoption thresholds:** In a monopoly, the adoption condition reduces to a simple profit trade-off in which  $\bar{\theta}$  must cover the firm's profit loss from adopting (see (3.11)). In a duopoly the relevant threshold depends on the adoption profile. For unilateral adoption the deviating firm faces the same expected cost  $E_M[c]$  as the monopolist, yet the required purpose weight (see (3.52)) is strictly lower than the monopoly threshold for all admissible parameters ( $a > E_M[c] > c$ ). Comparing the two expressions,  $\theta_{i,\text{uni}} > \theta_M$  would hold if and only if  $2a < 9c - 7E_M[c]$ . But  $a > E_M[c]$  and  $c < E_M[c]$  imply  $9c - 7E_M[c] < 2E_M[c] < 2a$ , so this inequality can never be satisfied, and hence  $\theta_{i,\text{uni}} < \theta_M$  throughout (see Appendix C.4 for the full derivation). The difference stems not from expected costs but from the curvature of the profit function: under Cournot competition each firm produces a smaller equilibrium quantity, and a unilateral cost increase is partly absorbed by the rival's output expansion, so the absolute profit sacrifice from adopting alone, and hence the purpose weight needed to offset it, is smaller than under monopoly. For joint adoption the threshold falls further still: the cost complementarity between adopting firms (Assumption 1) can render mutual adoption profitable even without any purpose motive, since under the synergy condition  $2c > E_M[c] + E_D[c]$  the required  $\bar{\theta}$  in (3.45) becomes non-positive. The within-duopoly contrast is therefore that unilateral adoption requires a strictly positive purpose weight, whereas joint adoption can be sustained at  $\bar{\theta} \rightarrow 0$ . Both channels point in the same direction: relative to the monopoly benchmark, the duopoly lowers the purpose level required for adoption, with equilibrium selection between the resulting multiple equilibria then governed by firms' expectations about the rival's behavior.

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**Role of corporate purpose:** The introduction of a corporate purpose parameter ( $\theta$ ), reflecting a firm's commitment to social or environmental objectives, alters the strategic landscape especially in duopoly. In a monopoly,  $\theta$  is purely an internal parameter and is only a commitment device in the sense that the firm voluntarily expands its objectives. Essentially,  $\theta$  shifts the firm's internal calculus by adding a non-monetary benefit to going green. This can lower the monopolist's adoption threshold, for example, a monopolist might invest in clean technology as a long-term mission even if it slightly reduces short-run profit. Whether or not this leads to adoption ultimately depends on the magnitude of  $\theta$ , as discussed, but there is no scenario in which a positive value of  $\theta$  harms the monopolist's position.

In conclusion, a comparison of the monopoly and duopoly settings indicates that both the presence of strategic interaction and the underlying cost complementarity between adopting firms shape the incentives for corporate purpose and technology adoption. The duopoly outcome cannot be attributed to competition alone: the shift in expected costs from  $E_M[c]$  to  $E_D[c]$  under joint adoption already reduces the required purpose threshold relative to the monopoly benchmark, while the additional layer of strategic interaction governs equilibrium selection between the resulting multiple equilibria. The numerical examples in Section 4.4 below isolate the role of the demand slope directly, by varying  $b$  within the duopoly setting at constant cost structure. This insight reinforces the idea that CSR strategies can create 'shared value' (Porter & Kramer, 2011) by aligning expectations across competing firms toward outcomes that benefit both shareholders and society. Our findings are consistent with real-world observations of contagious CSR behavior within industries (Cao et al., 2019), and suggest that fostering a strong sense of purpose within firms could unlock innovation under competitive interaction.

**Numerical illustration of monopoly vs. duopoly** To further illustrate this divergence in incentive structures, Figure 4.1 plots the expected utility from adoption and non-adoption as a function of  $\delta$ , the probability that the green technology yields the low-cost outcome, for both market structures. The four utility functions are depicted: the orange and red curves represent the expected utility from adoption in the monopoly ( $v_M^A$ ) and duopoly ( $v_D^A$ ) settings respectively, while the blue and green horizontal lines indicate the utility from non-adoption in the monopoly ( $v_M^{NA}$ ) and duopoly ( $v_D^{NA}$ ) case.

#### 4. Results

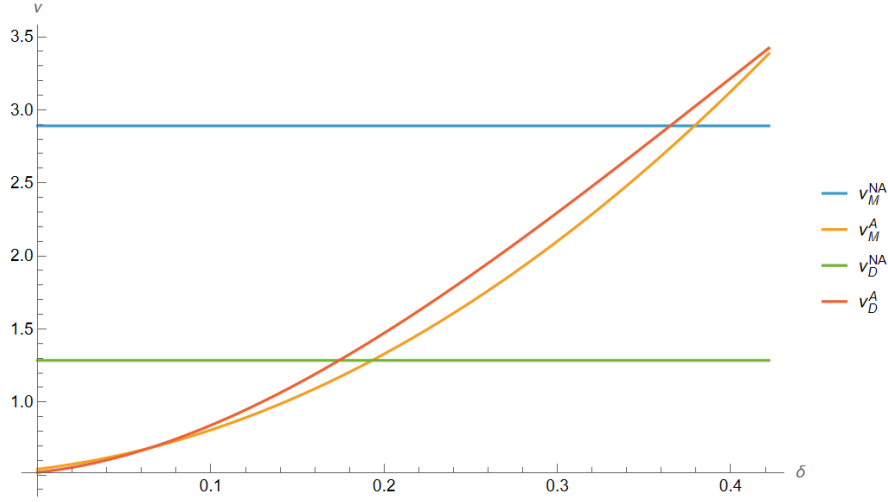


Figure 4.1.: Expected utility: monopoly vs. duopoly

The figure makes the theoretical contrast concrete: while the monopolist requires a relatively high success probability before adoption utility exceeds the non-adoption benchmark, the duopolist crosses this threshold at a substantially lower  $\delta$ . The duopoly adoption curve  $v_D^A$  here depicts utility under joint adoption, where the relevant expected cost is  $E_D[c]$  rather than  $E_M[c]$ . Because joint adoption lowers the expected cost, the duopolist reaches the point where adoption becomes profitable at a lower success probability than the monopolist. This gap reflects the cost complementarity between adopting firms. In the duopoly under joint adoption, the expected cost is  $E_D[c]$  rather than  $E_M[c]$ , so the duopolist reaches the profitability threshold at a lower success probability. The figure isolates this complementarity channel, since the Cournot scaling enters both adoption and non-adoption utilities symmetrically and therefore shifts levels but not crossing points. The effect comes from how Cournot competition shapes the profit function, not from expected costs. It is shown separately in the threshold comparison of Section 4.4 below. The figure thus visualizes the central comparative result: that market structure, through the joint action of cost complementarity and strategic interaction, shapes how much technological risk a firm is willing to absorb at a given purpose intensity.

## 4.4. Numerical examples

**Analysis of  $\delta$**  To assess how technological uncertainty affects the equilibrium structure in the asymmetric duopoly (case 3), this section varies the success probability of the green technology,  $\delta$ , while holding the remaining parameters fixed. In both Figures 4.2 and 4.3, the horizontal axis reports the legacy-technology cost  $c$ , and the vertical axis reports the purpose parameter  $\theta$  of firm 1 (with firm 2 remaining purely profit-maximizing,  $\theta_2 = 0$ ). Shaded areas indicate the set of  $(c, \theta)$  combinations for which a given adoption profile constitutes a SPNE, and overlaps represent parameter constellations with multiple equilibria.

Unless stated otherwise, the numerical illustrations use the parameter set  $a = 5$ ,  $\underline{c} = 0.4$ ,  $\bar{c} = 1.6$ ,  $b = 1$ , and vary only  $\delta$ . Figures 4.2 and 4.3 therefore isolate how changes in success probability translate into changes in expected adoption costs and, in turn, shift the equilibrium regions.

Figure 4.2 depicts a higher-risk environment with a low success probability,  $\delta = 0.40$ . In this case, joint adoption  $(1, 1)$  occurs only for sufficiently high legacy costs  $c$ , reflecting that the profit-driven firm is willing to co-adopt only when remaining with the legacy technology is relatively expensive. At the same time, the diagram explicitly features the asymmetric equilibrium  $(1, 0)$ , in which the purpose-driven firm adopts while the profit-driven rival does not. This outcome is feasible only when  $\theta$  is large enough to compensate the purpose-driven firm for the unilateral profit loss induced by the low expected success of the innovation. For lower values of  $\theta$ , the non-adoption equilibrium  $((0, 0))$  dominates, as technological risk raises the expected cost of adoption and thereby weakens the purpose-driven firm's incentive to adopt unilaterally.

#### 4. Results

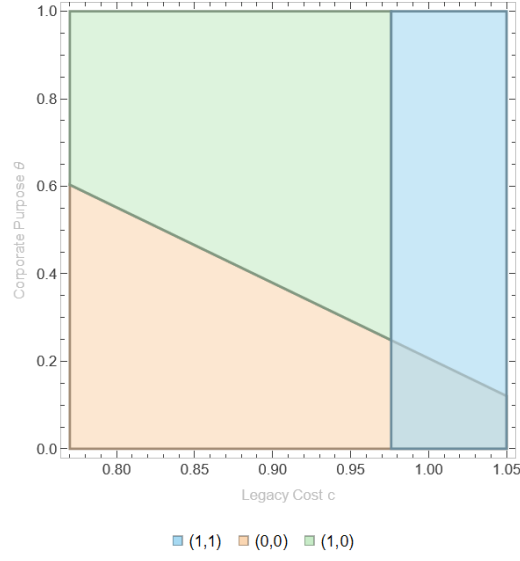


Figure 4.2.: SPNE for case 3 with lower success probability ( $\delta$ )

An important feature of Figure 4.2 is the presence of an overlapping region between the (1, 1) and (0, 0) equilibrium sets at the lower right corner of the region plot. This overlap indicates equilibrium multiplicity: for these parameter combinations, both joint adoption and non-adoption satisfy the respective unilateral-deviation constraints and therefore constitute SPNE. Economically, the adoption subgame takes the form of a coordination problem. Although sufficiently high legacy costs  $c$  make co-adoption optimal for the profit-driven firm conditional on the rival adopting, a relatively low purpose weight  $\theta$  prevents the purpose-driven firm from adopting unilaterally starting from (0, 0), thereby sustaining non-adoption as an additional equilibrium. Hence, in this region the realized outcome depends on equilibrium selection, rather than on incentives uniquely pinning down a single adoption profile.

In contrast, Figure 4.3 considers a lower-risk environment in which the success probability increases to  $\delta = 0.55$ . Relative to the low- $\delta$  benchmark, the joint-adoption region (1, 1) expands markedly, reflecting that higher technological reliability reduces expected adoption costs and makes co-adoption attractive for the profit-driven firm already at substantially lower legacy costs  $c$ . As a consequence, the scope for unilateral adoption by the purpose-driven firm in profile (1, 0) becomes more limited: as the profit-driven firm's incentive to co-adopt increases, parameter constellations in which firm 1 adopts while

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firm 2 stays out are largely confined to a narrow range where adoption is attractive for the purpose-driven firm but not yet profitable for its rival. This leads to a sharp contraction of the non-adoption region  $(0, 0)$ , which is subsequently confined to a negligible area where both legacy costs and corporate purpose are minimal.

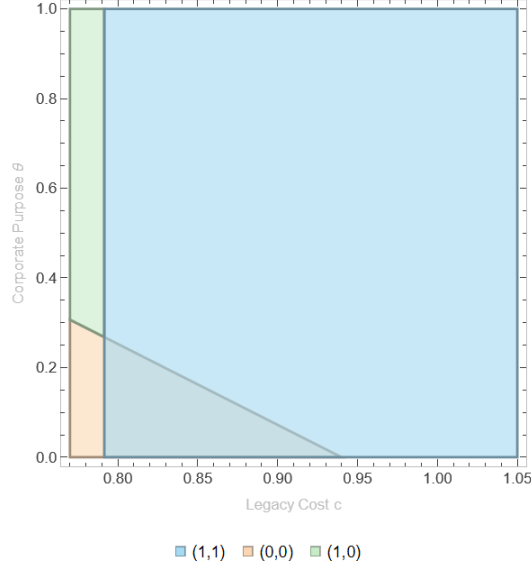


Figure 4.3.: SPNE in case 3 with high success probability ( $\delta$ )

The comparison clearly demonstrates that technological reliability is a critical determinant of the market equilibrium, as it improves the business case for the profit-driven firm, which in turn creates the conditions under which the purpose-driven firm's unilateral adoption can shift the industry toward sustainable innovation.

**Analysis of  $b$**  This subsection examines how the slope of inverse demand, captured by  $b$ , reshapes the equilibrium regions in the asymmetric duopoly (case 3). It should be stressed at the outset that  $b$  is not competitive intensity in the conventional sense (the number of firms or the degree of product substitutability), but the price-responsiveness of demand: how strongly total output depresses the market price. Because  $b$  enters all duopoly thresholds through the common  $1/(9b)$  scaling, a higher  $b$  compresses both equilibrium profits and the profit differences between adoption profiles, thereby lowering the absolute profit loss from adopting alone and, with it, the purpose weight required

#### 4. Results

for unilateral adoption (see (3.52)). The exercise below should be read accordingly. As in the previous sensitivity exercise, the horizontal axis reports the legacy cost  $c$  and the vertical axis reports the purpose parameter  $\theta$ . Throughout Figures 4.4 and 4.5, the remaining parameters are held fixed at  $a = 5$ ,  $\underline{c} = 0.4$ ,  $\bar{c} = 1.6$ ,  $\delta = 0.45$ , and only  $b$  is varied to isolate this effect.

Figure 4.4 shows the equilibrium region plot for a flat-demand environment ( $b = 0.5$ ). In this setting, the non-adoption outcome  $(0, 0)$  occupies a relatively large portion of the parameter space, indicating that when demand is weakly price-responsive the profit loss from adopting alone is large, so both firms tend to remain with the legacy technology unless the purpose motive is sufficiently strong. Joint adoption  $(1, 1)$  nonetheless emerges once legacy costs  $c$  are high enough to make co-adoption privately attractive for the profit-driven firm. Between these regions, the asymmetric profile  $(1, 0)$  appears for intermediate combinations of  $(c, \theta)$ , the purpose-driven firm adopts, while the profit-driven rival still prefers to stay out.

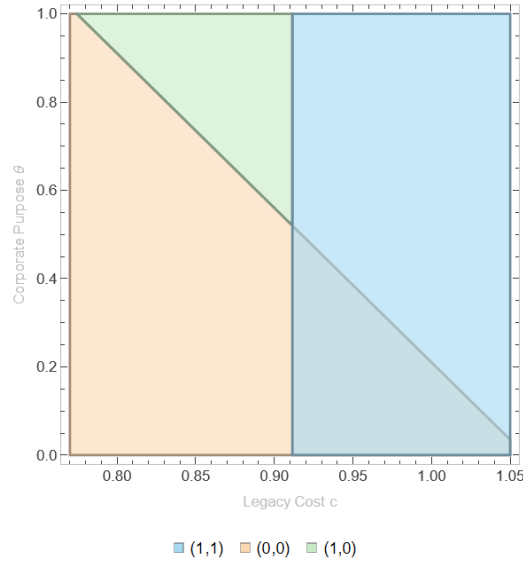


Figure 4.4.: SPNE in case 3 with flat demand (low  $b$ )

Figure 4.5 depicts the steep-demand case ( $b = 2.0$ ). Relative to the flat-demand benchmark, the non-adoption region  $(0, 0)$  becomes markedly smaller and is largely confined to very low values of  $\theta$ . The reason is the  $1/(9b)$  scaling: a steeper demand curve ties the

#### 4. Results

firms' payoffs together more closely and shrinks the absolute profit sacrifice from adopting alone, which lowers the threshold and thereby raises the strategic value of adopting for the purpose-driven firm. As a result, unilateral adoption  $(1, 0)$  can be sustained for a broader range of  $(c, \theta)$ . At the same time, once legacy costs  $c$  are sufficiently high, the profit-driven firm's incentive to co-adopt strengthens and the equilibrium shifts toward joint adoption  $(1, 1)$  over most of the remaining parameter space.

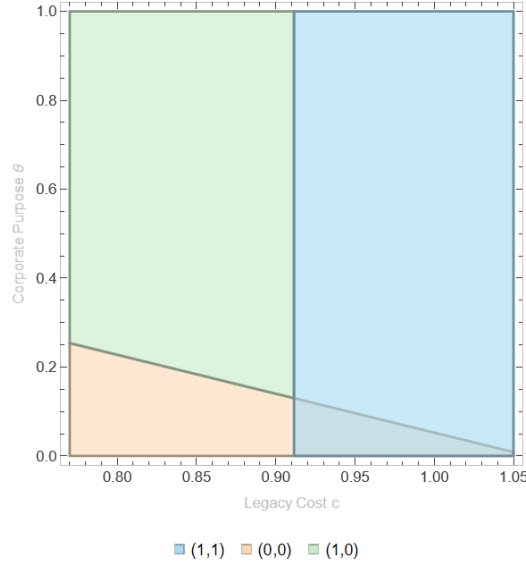


Figure 4.5.: SPNE in case 3 with steep demand (high  $b$ )

The analysis therefore points to a clear mechanism: a steeper, more price-responsive demand curve lowers the strategic risk for the purpose-driven firm of unilaterally adopting and thereby moves the market away from the non-adoption equilibrium. This effect operates through the price-responsiveness of demand via the  $1/(9b)$  scaling, rather than through the number of competitors or product substitutability.

## **4.5. Critical discussion of model results and implications**

### **4.5.1. Simplification of innovation, profitability and cost uncertainty**

The thesis assumes that clean technology adoption is generally unprofitable for a monopolist due to cost uncertainty, and only becomes viable in a duopoly through cost synergies and coordination. Rexhäuser and Rammer (2014) suggest that the profitability of green innovation depends heavily on the type of innovation. Their research distinguishes between "resource efficiency-improving" innovations (which increase profitability regardless of regulation) and other environmental innovations (which often reduce profitability) (Rexhäuser & Rammer, 2014). By modeling adoption as a singular, binary choice with uncertain costs, the thesis overlooks that firms may adopt clean technology simply to reduce material or energy consumption, a move that is inherently profit-seeking and does not require a purpose  $\theta$  to justify it.

The model focuses on adoption as a cost-synergy problem. However, André et al. (2009) argue that the move to green variants often succeeds through vertical differentiation, where consumers' willingness to pay for high quality allows firms to benefit from higher prices. The thesis treats  $\theta$  as an internal utility gain but could further explore how  $\theta$  interacts with market demand signals, as seen in models where firms benefit from charging price premiums for "green" goods (André et al., 2009; Flammer, 2015)

Relatedly, the framework models uncertainty primarily on the cost side, but an additional and consequential source of uncertainty concerns whether consumers perceive and reward the environmental attribute of the innovation (Constantatos & Herrmann, 2011). Constantatos and Herrmann (2011) demonstrate that when consumers assess the environmental quality of a new product with a delay, adopting it unilaterally can be disadvantageous in the short term. This can lead to "market inertia," which resists the introduction of a cost-efficient green product without regulation. This mechanism implies that uncertainty is not only about production costs, but also about whether (and when) consumers will reward adoption, which can sustain non-adoption even under favorable

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long-run fundamentals.

A further qualification concerns the treatment of cost uncertainty itself. Because both firms maximize expected profits, only the mean cost enters their objective function, and the model could in principle be restated in terms of two deterministic cost levels. The stochastic formulation is nonetheless deliberate rather than cosmetic: it derives the single-adopter and joint-adoption costs from one underlying success probability instead of imposing them as two independent parameters, and it is precisely this common parameter whose variation the numerical examples in Section 4.4 exploit. What matters for the complementarity is therefore not risk attitudes but the correlation of the firms' success realizations. The complementarity mechanism arises only because a single firm's success suffices to deliver the low-cost outcome  $\underline{c}$  to both, which is what generates the wedge  $E_D[c] < c < E_M[c]$  underlying Assumption 1. The model's reliance on uncertainty is thus genuine, but it works through the aggregation of independent successes rather than through risk preferences. One might conjecture that introducing risk aversion would reinforce the central finding, since a risk-averse firm would dislike bearing the full downside of unilateral adoption alone. Establishing this formally, however, lies beyond the present scope and is left for future work.

These limitations do not invalidate the core finding that corporate purpose can shift equilibrium selection toward adoption. Rather, they suggest that the model captures a necessary but not sufficient condition: purpose orientation matters most precisely in those adoption decisions where profit motives alone are insufficient.

### 4.5.2. Competitive pressure

In their seminal work, Aghion et al. (2005) advanced a theoretical model illustrating an inverted-U relationship between competition and innovation. While competition can be a catalyst for innovation on the part of firms that are performing at a similar level, extreme competition can also have a discouraging effect on those that are lagging behind (Aghion et al., 2005). The thesis's symmetric duopoly model does not account for these different industry structures, potentially missing the point where competition becomes so intense that it destroys the rents needed to sustain a purpose-driven strategy (Aghion et al., 2005).

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Flammer (2015) provides empirical evidence that supports the thesis's argument that competition, specifically from trade liberalisation, fosters CSR as a differentiation strategy. However, Flammer (2015) posits that domestic firms leverage CSR to establish 'soft' trade barriers against foreign rivals who lack local stakeholder trust. The thesis could be strengthened by incorporating these comparative advantages in stakeholder relations rather than treating  $\theta$  as a purely non-financial utility component.

Taken together, these points show that the model captures competition in a deliberately narrow way. By reducing it to the strategic interaction of two Cournot firms, the framework leaves out the richer effects that this literature emphasises, such as firm heterogeneity, the number of competitors, and CSR as a source of competitive advantage. This keeps the analysis manageable, but it also limits what it can say about how the intensity of competition shapes a purpose-driven strategy.

### 4.5.3. Strategic commitment vs. decoupling

The model rests on a tacit coupling assumption. A firm that chooses a purpose orientation ( $\theta > 0$ ) is assumed to act on it by adopting the clean technology. Since clean-technology adoption is defined as the central CSR activity in this thesis,  $t$  proxies the fulfilment of CSR obligations and  $\theta$  measures the non-financial value the firm derives from that action. A positive  $\theta$  is therefore treated as a sincere internal weight that the firm follows through on, and the model leaves no room for a firm that claims purpose without implementing it. This coupling is what gives the commitment its force, because  $\theta$  only shifts the rival's expectations if it is credibly turned into adoption.

The decoupling literature questions this link. Bothello et al. (2023) document CSR decoupling, which they define as symbolic CSR communication without real action, and show that it can persist without being fully penalised by the market. Similarly Kaplan (2023) warns that corporate purpose pronouncements are often decoupled from real action. She argues that many firms use purpose as a power grab to forestall government regulation or maintain legitimacy without making expensive changes to organizational practice (Kaplan, 2023). The thesis assumes that if a firm chooses  $\theta > 0$ , it is a sincere internal weight. It neglects the risk that a firm might strategically choose a purpose orientation but fail to adopt the technology, or only pursue it when the "business case"

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aligns perfectly (Kaplan, 2023).

This decoupling risk does not refute the commitment mechanism modeled here, but it does highlight an important boundary condition: the model's predictions hold only insofar as the chosen  $\theta > 0$  reflects genuine internal commitment rather than strategic signaling. Where decoupling is prevalent, the equilibrium-shifting role of corporate purpose identified in this thesis would be correspondingly weakened.

## 5. Conclusion

This thesis investigates the transformative role of strategic corporate purpose in shaping green technology adoption across different market structures. By integrating a non-financial utility parameter into a formal game-theoretic model, this research demonstrates that purpose orientation alters firm behavior. It transitions from a purely internal rationalization in monopolies to a strategic commitment device in duopolistic competition.

The analysis reveals that in a monopoly, corporate purpose functions as an internal mechanism to justify the expected profit sacrifice inherent in early-stage green innovation. A profit-maximizing monopolist ( $\theta = 0$ ) will naturally reject green technology because the unilateral expected costs exceed legacy costs. However, a purpose-driven firm uses  $\bar{\theta}$  to expand its utility function, rationalizing adoption when the intrinsic social value exceeds the financial loss.

In contrast, the duopoly setting highlights the power of purpose to resolve market failures. Under pure profit maximization, competition often results in an inefficient non-adoption equilibrium, where firms avoid adoption due to the risk of being exploited by a rival. Strategic corporate purpose destabilizes this inefficient equilibrium by acting as a credible signal. By committing to a stakeholder-oriented objective, firms can move the industry toward joint adoption. Where the purpose orientation is strong enough to remove non-adoption from the set of equilibria, this shift is unconditional. Where the two outcomes coexist, it depends on equilibrium selection. Either way, it can pave the way for mutual adoption that yields Pareto-superior outcomes for both shareholders and society. Furthermore, numerical examples show that the price-responsiveness of demand ( $b$ ) and technological reliability ( $\delta$ ) are catalysts for this change, as a steeper demand curve lowers the threshold of uncertainty required for a firm to act on its purpose.

## 5. Conclusion

Despite these “win-win” possibilities, the research underscores significant strategic risks. The principal qualification concerns the risk of CSR decoupling or “purpose-washing”, where firms strategically claim a purpose orientation to gain legitimacy while failing to implement substantive technological changes (Bothello et al., 2023). The equilibrium-shifting role identified here holds only insofar as a chosen  $\bar{\theta} > 0$  reflects genuine internal commitment rather than symbolic signaling.

In essence, corporate purpose serves as the coordinating mechanism that enables firms to achieve collectively what they cannot achieve through isolated self-interest. In the monopoly benchmark, purpose operates purely as an internal valuation that may rationalize adoption when profit motives alone are insufficient. In the duopoly, purpose acquires an additional, distinctly strategic role: it coordinates expectations across firms and shifts equilibrium selection toward mutually adoptive outcomes.

# Bibliography

- Acemoglu, D., Akcigit, U., Hanley, D., & Kerr, W. (2016). Transition to Clean Technology. *Journal of Political Economy*, 124(1), 52–104. <https://doi.org/10.1086/684511>
- Aghion, P., Bloom, N., Blundell, R., Griffith, R., & Howitt, P. (2005). Competition and Innovation: an Inverted-U Relationship. *The Quarterly Journal of Economics*, 120(2), 701–728. <https://doi.org/10.1093/qje/120.2.701>
- Agrawal, S. S., Boddeda, O., Palisetty, R., Pb, N. K., Jada, K., & Naidu, A. T. (2025). Determinants of Adoption of Green Technology in a Corporate Sustainability Setting: A Quantitative Analysis. *Business Strategy and the Environment*, 34(7), 9397–9420. <https://doi.org/10.1002/bse.70066>
- Aguilera, R. V. (2023). Corporate Purpose in Comparative Perspective: The Role of Governance. *Strategy Science*, 8(2), 193–201. <https://doi.org/10.1287/stsc.2023.0198>
- Albuquerque, R., & Cabral, L. (2025). Strategic Corporate Purpose. *Journal of Economics & Management Strategy*, 34(3), 743–758. <https://doi.org/10.1111/jems.12619>
- André, F. J., González, P., & Porteiro, N. (2009). Strategic quality competition and the Porter hypothesis. *Journal of Environmental Economics and Management*, 57(2), 182–194. <https://doi.org/10.1016/j.jeem.2008.07.002>
- Bénabou, R., & Tirole, J. (2010). Individual and Corporate Social Responsibility. *Economica*, 77(305), 1–19. <https://doi.org/10.1111/j.1468-0335.2009.00843.x>
- Besharov, M., & Mitzinneck, B. (2023). The Multiple Facets of Corporate Purpose: An Analytical Typology. *Strategy Science*, 8(2), 233–244. <https://doi.org/10.1287/stsc.2023.0186>

## Bibliography

- Blocker, C. P., Cannon, J. P., & Zhang, J. (2025a). *Purpose-driven transformation: A roadmap for leaders to enhance social impact and business performance* [Insight]. Retrieved July 24, 2025, from <https://cmr.berkeley.edu/2025/05/purpose-driven-transformation-a-roadmap-for-leaders-to-enhance-social-impact-and-business-performance/>
- Blocker, C. P., Cannon, J. P., & Zhang, J. Z. (2025b). Purpose orientation: An emerging theory transforming business for a better world. *Journal of the Academy of Marketing Science*, 53(2), 367–393. <https://doi.org/10.1007/s11747-023-00989-5>
- Bothello, J., Ioannou, I., Porumb, V.-A., & Zengin-Karaibrahimoglu, Y. (2023). CSR decoupling within business groups and the risk of perceived greenwashing. *Strategic Management Journal*, 44(13), 3217–3251. <https://doi.org/10.1002/smj.3532>
- Buccella, D., Fanti, L., & Gori, L. (2021). To abate, or not to abate? A strategic approach on green production in Cournot and Bertrand duopolies. *Energy Economics*, 96, 105164. <https://doi.org/10.1016/j.eneco.2021.105164>
- Cao, J., Liang, H., & Zhan, X. (2019). Peer Effects of Corporate Social Responsibility. *Management Science*, 65(12), 5487–5503. <https://doi.org/10.1287/mnsc.2018.3100>
- Carroll, A. B. (1991). The pyramid of corporate social responsibility: Toward the moral management of organizational stakeholders. *Business Horizons*, 34(4), 39–48. [https://doi.org/10.1016/0007-6813\(91\)90005-g](https://doi.org/10.1016/0007-6813(91)90005-g)
- Chi, Y., Chen, L., Hu, Y., Zu, Y., Peng, X., & Liu, J. (2026). Green technology acquisition strategies for chemical enterprises considering competition effects and spillover effects. *Kybernetes*, 55(1), 506–531. <https://doi.org/10.1108/K-05-2024-1308>
- Constantatos, C., & Herrmann, M. (2011). Market Inertia and the Introduction of Green Products: Can Strategic Effects Justify the Porter Hypothesis? *Environmental and Resource Economics*, 50(2), 267–284. <https://doi.org/10.1007/s10640-011-9471-0>
- Del Río González, P. (2005). Analysing the factors influencing clean technology adoption: a study of the Spanish pulp and paper industry. *Business Strategy and the Environment*, 14(1), 20–37. <https://doi.org/10.1002/bse.426>

## Bibliography

- Dhami, S., & Zeppini, P. (2025). Green technology adoption under uncertainty, increasing returns, and complex adaptive dynamics. *Journal of Economic Behavior & Organization*, 233, 106953. <https://doi.org/10.1016/j.jebo.2025.106953>
- Du, S., Huang, C., Yan, X., & Tang, W. (2024). Voluntary green technology adoption: The effects of regulatory uncertainty and competition. *European Journal of Operational Research*, 315(2), 528–540. <https://doi.org/10.1016/j.ejor.2023.11.042>
- Dzurov Vargová, T., & Matušíková, D. (2025). Perception of the Importance of Applying Environmental Innovations to Tourism Businesses in Slovakia. *Sustainability*, 17(6), 2549. <https://doi.org/10.3390/su17062549>
- Fink, L. (2018). *Larry Fink's 2018 letter to CEOs: A sense of purpose* [Accessed: 2025-07-24]. <https://www.blackrock.com/corporate/investor-relations/2018-larry-fink-ceo-letter>
- Fitzsimmons, A. B., Qin, Y. S., & Heffron, E. R. (2022). Purpose vs mission vs vision: Persuasive appeals and components in corporate statements. *Journal of Communication Management*, 26(2), 207–219. <https://doi.org/10.1108/JCOM-09-2021-0108>
- Flammer, C. (2015). Does product market competition foster corporate social responsibility? Evidence from trade liberalization. *Strategic Management Journal*, 36(10), 1469–1485. <https://doi.org/10.1002/smj.2307>
- Friedman, M. (1970). The social responsibility of business is to increase its profits. *The New York Times Magazine*, 32–33, 122–124.
- Gartenberg, C., Prat, A., & Serafeim, G. (2019). Corporate Purpose and Financial Performance. *Organization Science*, 30(1), 1–18. <https://doi.org/10.1287/orsc.2018.1230>
- Henderson, R., & Van den Steen, E. (2015). Why Do Firms Have “Purpose”? The Firm’s Role as a Carrier of Identity and Reputation. *American Economic Review*, 105(5), 326–330. <https://doi.org/10.1257/aer.p20151072>
- Henisz, W. J. (2023). The Value of Organizational Purpose. *Strategy Science*, 8(2), 159–169. <https://doi.org/10.1287/stsc.2023.0195>
- Henriques, I., & Sadorsky, P. (2007). Environmental technical and administrative innovations in the Canadian manufacturing industry. *Business Strategy and the Environment*, 16(2), 119–132. <https://doi.org/10.1002/bse.475>

## Bibliography

- Horii, R. (2012). Wants and past knowledge: Growth cycles with emerging industries. *Journal of Economic Dynamics and Control*, 36(2), 220–238. <https://doi.org/10.1016/j.jedc.2011.08.001>
- Hurth, V., & Vrettos, A. (2021). Unleashing the sustainable business: How purposeful organisations can break free of business-as-usual. *Cambridge: University of Cambridge Institute for Sustainability Leadership*.
- Jones, B. (2016). The Difference Between Purpose and Mission [Accessed: 2026-05-05]. <https://hbr.org/sponsored/2016/02/the-difference-between-purpose-and-mission>
- Jones-Khosla, L., & Gomes, J. (2023). Purpose: From theory to practice. *Global Business and Organizational Excellence*, 43(1), 90–103. <https://doi.org/10.1002/joe.22203>
- Kaplan, S. (2023). The Promises and Perils of Corporate Purpose. *Strategy Science*, 8(2), 288–301. <https://doi.org/10.1287/stsc.2023.0187>
- Kauppi, K. (2022). Institutional theory. In *Handbook of theories for purchasing, supply chain and management research* (pp. 320–334). Edward Elgar Publishing.
- Liang, H., & Renneboog, L. (2020). Corporate Social Responsibility and Sustainable Finance: A Review of the Literature. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3698631>
- Luthra, S., Kumar, S., Garg, D., & Haleem, A. (2015). Barriers to renewable/sustainable energy technologies adoption: Indian perspective. *Renewable and Sustainable Energy Reviews*, 41, 762–776. <https://doi.org/10.1016/j.rser.2014.08.077>
- Ma, G., Lim, M. K., Mak, H.-Y., & Wan, Z. (2019). Promoting Clean Technology Adoption: To Subsidize Products or Service Infrastructure? *Service Science*, 11(2), 75–95. <https://doi.org/10.1287/serv.2019.0238>
- Mohammadi, M., Heese, H. S., & Kraft, T. (2024). Environmental Regulation Design: Motivating Firms' Clean Technology Investments With Penalties and Subsidies. *Production and Operations Management*, 33(1), 32–47. <https://doi.org/10.1177/10591478231224911>
- Ocasio, W., Kraatz, M., & Chandler, D. (2023). Making Sense of Corporate Purpose. *Strategy Science*, 8(2), 123–138. <https://doi.org/10.1287/stsc.2023.0054>

## Bibliography

- Planer-Friedrich, L., & Sahm, M. (2020). Strategic corporate social responsibility, imperfect competition, and market concentration. *Journal of Economics*, 129(1), 79–101. <https://doi.org/10.1007/s00712-019-00663-x>
- Porter, M. E., & Kramer, M. R. (2011). Creating Shared Value. *Harvard business review*, 89(1), 1–17.
- Rexhäuser, S., & Rammer, C. (2014). Environmental innovations and firm profitability: unmasking the Porter hypothesis. *Environmental and Resource Economics*, 57(1), 145–167. <https://doi.org/10.1007/s10640-013-9671-x>
- Roe, M. J. (2021, July). *Corporate Purpose and Corporate Competition* (Law Working Paper No. 601/2021). European Corporate Governance Institute. <https://doi.org/10.2139/ssrn.3817788>
- Shapiro, C. (1989). The theory of business strategy. *The RAND Journal of Economics*, 20(1), 125. <https://doi.org/10.2307/2555656>
- Sim, J. E., & Kim, B. (2019). Commitment to Environmental and Climate Change Sustainability under Competition. *Sustainability*, 11(7), 2089. <https://doi.org/10.3390/su11072089>
- Skliwas, S. D. (1987). The Strategic Choice of Managerial Incentives. *The RAND Journal of Economics*, 452–458. <https://doi.org/10.2307/2555609>
- Tan, D., Xiao, Z., & Hong, X. (2025). Modeling green technological imports in the Belt and Road economies. *Humanities and Social Sciences Communications*, 12(1), 1–8. <https://doi.org/10.1057/s41599-025-05080-8>
- van Tuin, L., Schaufeli, W. B., van den Broeck, A., & van Rhenen, W. (2020). A Corporate Purpose as an Antecedent to Employee Motivation and Work Engagement. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.572343>
- Vickers, J. (1985). Delegation and the Theory of the Firm. *The Economic Journal*, 95(Supplement), 138–147. <https://doi.org/10.2307/2232877>
- Zhang, J., Ouyang, Y., Ballesteros-Pérez, P., Li, H., Philbin, S. P., Li, Z., & Skitmore, M. (2021). Understanding the impact of environmental regulations on green technology innovation efficiency in the construction industry. *Sustainable Cities and Society*, 65, 102647. <https://doi.org/10.1016/j.scs.2020.102647>

## Appendix

### A. Derivations for the monopoly case

#### A.1. Optimal production and profit in the no adoption case

##### 1. Profit function and FOC

Starting from the profit definition in (3.3), we expand the expression

$$\pi_M = q_M(a - bq_M - c) = aq_M - bq_M^2 - cq_M.$$

To find the optimal output level, we derive the FOC by differentiating the profit function with respect to  $q_M$  and setting the result to zero

$$\frac{\partial \pi_M}{\partial q_M} = a - 2bq_M - c = 0.$$

##### 2. Derivation of the optimal quantity ( $q_M^{NA}$ )

Solving the FOC for  $q_M^{NA}$  yields the optimal production quantity

$$\begin{aligned} a - c &= 2bq_M \\ q_M^{NA} &= \frac{a - c}{2b}. \end{aligned} \tag{A.1}$$

##### 3. Derivation of the optimal profit ( $\pi_M^{NA}$ )

To obtain the equilibrium profit, we substitute the optimal quantity  $q_M^{NA}$  back into the original profit function  $\pi_M = (a - c - bq_M)q_M$

$$\pi_M^{NA} = \left( a - c - b \left[ \frac{a - c}{2b} \right] \right) \left( \frac{a - c}{2b} \right).$$

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Simplifying the expression within the first set of parentheses

$$\begin{aligned}\pi_M^{NA} &= \left( (a - c) - \frac{a - c}{2} \right) \left( \frac{a - c}{2b} \right) \\ \pi_M^{NA} &= \left( \frac{2(a - c) - (a - c)}{2} \right) \left( \frac{a - c}{2b} \right) \\ \pi_M^{NA} &= \left( \frac{a - c}{2} \right) \left( \frac{a - c}{2b} \right).\end{aligned}$$

This results in the final expression for the non-adoption profit

$$\pi_M^{NA} = \frac{(a - c)^2}{4b}. \quad (\text{A.2})$$

## A.2. Optimal production and profit in the adoption case

### 1. Profit function and FOC

The firm maximizes the expected profit

$$\pi_M^A = (a - bq_M - E_M[c])q_M.$$

The FOC is given by

$$\frac{\partial \pi_M^A}{\partial q_M} = a - 2bq_M - (\delta \underline{c} + (1 - \delta)\bar{c}) = 0.$$

Solving for  $q_M^A$  yields the optimal quantity in the adoption scenario

$$q_M^A = \frac{a - \delta \underline{c} - (1 - \delta)\bar{c}}{2b}.$$

Substituting  $q_M^A$  back into the expected profit function (analogous to the derivation in A.1) results in the equilibrium profit

$$\pi_M^A = \frac{(a - \delta \underline{c} - (1 - \delta)\bar{c})^2}{4b}. \quad (\text{A.3})$$

### 2. Derivation of the profit comparison threshold

## Bibliography

$$\pi_M^A < \pi_M^{NA} \iff \frac{(a - E_M[c])^2}{4b} < \frac{(a - c)^2}{4b}$$

Since  $a > \bar{c} > c$ , we can simplify this by focusing on the costs

$$\begin{aligned} a - E_M[c] &< a - c \\ c &< E_M[c] \\ c &< \delta \underline{c} + (1 - \delta)\bar{c} \\ c &< \delta \underline{c} + \bar{c} - \delta \bar{c}. \end{aligned}$$

Rearranging to solve for  $\delta$

$$\begin{aligned} \delta \bar{c} - \delta \underline{c} &< \bar{c} - c \\ \delta(\bar{c} - \underline{c}) &< \bar{c} - c \\ \delta &< \frac{\bar{c} - c}{\bar{c} - \underline{c}}. \end{aligned} \tag{A.4}$$

This derivation confirms the threshold condition presented in equation (3.8).

## B. Derivations for the duopoly case

### B.1. Optimal production and profit in the no adoption case

#### 1. FOC and optimal production quantity ( $q_i^{NA}$ )

Firm  $i$ 's profit function is

$$\pi_i^{NA} = q_i(a - b(q_i + q_j) - c) = aq_i - bq_i^2 - bq_iq_j - cq_i.$$

The FOC for firm  $i$  is obtained by differentiating with respect to  $q_i$

$$\frac{\partial \pi_i^{NA}}{\partial q_i} = a - 2bq_i - bq_j - c = 0.$$

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This leads to firm  $i$ 's reaction function

$$q_i(q_j) = \frac{a - c - bq_j}{2b}.$$

Assuming symmetry in equilibrium ( $q_i = q_j = q^{NA}$ ), we substitute  $q_j$  with  $q_i$  in the FOC

$$\begin{aligned} a - c &= 2bq_i + bq_i \\ a - c &= 3bq_i \\ q_i^{NA} &= \frac{a - c}{3b}. \end{aligned} \tag{B.1}$$

This confirms the optimal output level presented in equation (3.14).

### 2. Derivation of the optimal profit ( $\pi_i^{NA}$ )

To find the equilibrium profit, we substitute  $q_i^{NA}$  and the total quantity  $Q = 2q_i^{NA}$  back into the profit function

$$\begin{aligned} \pi_i^{NA} &= q_i^{NA} (a - b(2q_i^{NA}) - c) \\ \pi_i^{NA} &= \left(\frac{a - c}{3b}\right) \left(a - c - \frac{2(a - c)}{3}\right) \\ \pi_i^{NA} &= \left(\frac{a - c}{3b}\right) \left(\frac{3(a - c) - 2(a - c)}{3}\right) \\ \pi_i^{NA} &= \left(\frac{a - c}{3b}\right) \left(\frac{a - c}{3}\right). \end{aligned}$$

The resulting equilibrium profit for the non-adoption duopoly is

$$\pi_i^{NA} = \frac{(a - c)^2}{9b}. \tag{B.2}$$

## B.2. Optimal production and profit in the adoption case

### 1. FOC and optimal production quantity ( $q_i^A$ )

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The expected profit for firm  $i$  is defined as

$$\pi_i^A = q_i(a - b(q_i + q_j) - E_D[c])$$

Differentiating with respect to  $q_i$  yields the FOC

$$\frac{\partial \pi_i^A}{\partial q_i} = a - 2bq_i - bq_j - E_D[c] = 0.$$

Under the assumption of a symmetric equilibrium ( $q_i = q_j = q_i^A$ ), the condition simplifies to

$$\begin{aligned} a - E_D[c] &= 3bq_i^A \\ q_i^A &= \frac{a - E_D[c]}{3b}. \end{aligned} \tag{B.3}$$

## 2. Derivation of the optimal profit ( $\pi_i^A$ )

Substituting  $q_i^A$  back into the expected profit function  $\pi_i^A = q_i^A(a - b(2q_i) - E_D[c])$

$$\begin{aligned} \pi_i^A &= \left( \frac{a - E_D[c]}{3b} \right) \left( a - \frac{2(a - E_D[c])}{3} - E_D[c] \right) \\ \pi_i^A &= \left( \frac{a - E_D[c]}{3b} \right) \left( \frac{3(a - E_D[c]) - 2(a - E_D[c])}{3} \right) \\ \pi_i^A &= \left( \frac{a - E_D[c]}{3b} \right) \left( \frac{a - E_D[c]}{3} \right). \end{aligned}$$

This results in the final profit expression for the adoption scenario

$$\pi_i^A = \frac{(a - E_D[c])^2}{9b}. \tag{B.4}$$

## C. Duopoly equilibrium analysis

### C.1. Case 1: both firms are profit-driven ( $\theta_1 = \theta_2 = 0$ )

#### Stability of joint adoption (1, 1)

To derive the stability condition in (3.26), we start with the profit comparison  $\pi_i(1, 1) > \pi_i(0, 1)$ . Substituting the Cournot profits

$$\frac{(a - E_D[c])^2}{9b} > \frac{(a + E_M[c] - 2c)^2}{9b}.$$

Since  $9b > 0$ , we multiply both sides by  $9b$  and take the square root, assuming  $a$  is sufficiently large

$$\begin{aligned} \sqrt{(a - E_D[c])^2} &> \sqrt{(a + E_M[c] - 2c)^2} \\ a - E_D[c] &> a + E_M[c] - 2c. \end{aligned}$$

Subtracting  $a$  from both sides and rearranging to isolate  $2c$

$$2c > E_M[c] + E_D[c]. \quad (\text{C.1})$$

#### Stability of no adoption (0, 0)

To verify the stability of the no-adoption profile (0, 0) we analyze the incentive for firm  $i$  to unilaterally deviate to adoption. The stability condition  $\pi_i(0, 0) > \pi_i(1, 0)$  is given by

$$\frac{(a - c)^2}{9b} > \frac{(a + c - 2E_M[c])^2}{9b}.$$

Multiplying both sides by  $9b$  and taking the square root

$$\begin{aligned} \sqrt{(a - c)^2} &> \sqrt{(a + c - 2E_M[c])^2} \\ a - c &> a + c - 2E_M[c]. \end{aligned}$$

### *Bibliography*

Subtracting  $a$  from both sides and simplifying the cost terms gives us

$$\begin{aligned} -c &> c - 2E_M[c] \\ 2E_M[c] &> 2c \\ E_M[c] &> c. \end{aligned}$$

#### **Non-existence of asymmetric equilibria $(1, 0)$ or $(0, 1)$**

For the profile  $(1, 0)$  to be a Nash equilibrium in case 1, two conditions must hold

1. Firm 1 prefers adoption:  $\pi_1(1, 0) > \pi_1(0, 0)$
2. Firm 2 prefers legacy:  $\pi_2(1, 0) > \pi_2(1, 1)$

As derived in C.1, but with the inequality reversed, the first condition implies

$$a + c - 2E_M[c] > a - c \implies c > E_M[c]$$

which contradicts Assumption 1.

The second condition is

$$\frac{(a + E_M[c] - 2c)^2}{9b} > \frac{(a - E_D[c])^2}{9b}.$$

Taking the square root and simplifying simplifies to

$$\begin{aligned} a + E_M[c] - 2c &> a - E_D[c] \\ E_M[c] + E_D[c] &> 2c. \end{aligned} \tag{C.2}$$

## C.2. Case 2: both firms are purpose-driven ( $\theta_1 = \theta_2 = \bar{\theta}$ )

### Stability of asymmetric adoption (1, 0)

**1. Lower bound (stability for firm 1):** Firm 1 (the adopter) prefers (1, 0) over (0, 0) if its utility with adoption exceeds the utility from the legacy technology

$$\pi_1(1, 0) + \bar{\theta} > \pi_1(0, 0)$$

$$\frac{(a - 2E_M[c] + c)^2}{9b} + \bar{\theta} > \frac{(a - c)^2}{9b}.$$

Isolating  $\bar{\theta}$  gives us

$$\bar{\theta} > \frac{(a - c)^2 - (a + c - 2E_M[c])^2}{9b}.$$

Expanding the squares in the numerator results in

$$(a - c)^2 = a^2 - 2ac + c^2$$

$$(a + c - 2E_M[c])^2 = a^2 + c^2 + 4E_M[c]^2 + 2ac - 4aE_M[c] - 4cE_M[c].$$

Subtracting these terms results in

$$(a^2 - 2ac + c^2) - (a^2 + c^2 + 4E_M[c]^2 + 2ac - 4aE_M[c] - 4cE_M[c])$$

$$= -4ac + 4aE_M[c] - 4E_M[c]^2 + 4cE_M[c].$$

Factoring out  $4(E_M[c] - c)$  through multiplication

$$4(aE_M[c] - ac - E_M[c]^2 + cE_M[c]) = 4[a(E_M[c] - c) - E_M[c](E_M[c] - c)]$$

$$= 4(a - E_M[c])(E_M[c] - c).$$

This confirms the lower bound

$$\bar{\theta} > \frac{4(a - E_M[c])(E_M[c] - c)}{9b}. \quad (\text{C.3})$$

**2. Upper bound (stability for firm 2):** Firm 2 (the non-adopter) prefers the asymmetric

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profile  $(1, 0)$  if its profit is greater than the utility from shifting to co-adoption:

$$\pi_2(1, 0) > \pi_2(1, 1) + \bar{\theta}$$

$$\frac{(a + E_M[c] - 2c)^2}{9b} > \frac{(a - E_D[c])^2}{9b} + \bar{\theta}.$$

Isolating  $\bar{\theta}$  gives us

$$\bar{\theta} < \frac{(a + E_M[c] - 2c)^2 - (a - E_D[c])^2}{9b}.$$

Expanding the squares in the numerator results in

$$(a + E_M[c] - 2c)^2 = a^2 + E_M[c]^2 + 4c^2 + 2aE_M[c] - 4ac - 4cE_M[c]$$

$$(a - E_D[c])^2 = a^2 - 2aE_D[c] + E_D[c]^2.$$

Subtracting these terms results in

$$\begin{aligned} & \left( a^2 + E_M[c]^2 + 4c^2 + 2aE_M[c] - 4ac - 4cE_M[c] \right) - \left( a^2 - 2aE_D[c] + E_D[c]^2 \right) \\ &= 2aE_M[c] + 2aE_D[c] - 4ac - 4cE_M[c] + E_M[c]^2 - E_D[c]^2 + 4c^2 \\ &= 2a(E_M[c] + E_D[c] - 2c) + E_M[c]^2 - E_D[c]^2 - 4cE_M[c] + 4c^2 \\ &= (E_M[c] + E_D[c] - 2c)(2a + E_M[c] - E_D[c] - 2c). \end{aligned}$$

Substituting this simplified expression back into the inequality confirms the upper bound

$$\bar{\theta} < \frac{(E_M[c] + E_D[c] - 2c)(2a + E_M[c] - E_D[c] - 2c)}{9b}. \quad (\text{C.4})$$

### 3. Derivation of the market threshold $a$

An intermediate range for  $\bar{\theta}$  exists only if the upper bound (C.4) exceeds the lower bound (C.3). Setting the numerators against each other results in

$$(a + E_M[c] - 2c)^2 - (a - E_D[c])^2 > (a - c)^2 - (a + c - 2E_M[c])^2.$$

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Expanding all quadratic terms using the identity  $(x+y+z)^2 = x^2+y^2+z^2+2xy+2xz+2yz$  gives us

$$\begin{aligned} & [a^2 + E_M[c]^2 + 4c^2 + 2aE_M[c] - 4ac - 4cE_M[c]] - [a^2 - 2aE_D[c] + E_D[c]^2] \\ & > (a^2 - 2ac + c^2) - [a^2 + c^2 + 4E_M[c]^2 + 2ac - 4aE_M[c] - 4cE_M[c]]. \end{aligned}$$

Simplifying by canceling the  $a^2$  and  $c^2$  terms on both sides, as well as the  $-4ac$  and  $-4cE_M[c]$  terms, the inequality reduces to

$$\begin{aligned} E_M[c]^2 + 4c^2 + 2aE_M[c] + 2aE_D[c] - E_D[c]^2 &> -4E_M[c]^2 + 4aE_M[c] \\ 2a(E_D[c] - E_M[c]) &> -5E_M[c]^2 + 8cE_M[c] - 4c^2 + E_D[c]^2. \end{aligned}$$

Multiplying both sides by  $-1$  reverses the inequality and collects the positive coefficient  $(E_M[c] - E_D[c])$  on the left

$$2a(E_M[c] - E_D[c]) < 5E_M[c]^2 - 8cE_M[c] + 4c^2 - E_D[c]^2. \quad (\text{C.5})$$

The right-hand side does not yet factor into squared differences directly. Using the identity

$$5E_M[c]^2 - 8cE_M[c] + 4c^2 - E_D[c]^2 = 5(E_M[c] - c)^2 - (c - E_D[c])^2 + 2c(E_M[c] - E_D[c]), \quad (\text{C.6})$$

the residual term  $2c(E_M[c] - E_D[c])$  can be moved to the left-hand side and combined with  $2a(E_M[c] - E_D[c])$ , which is what produces the common factor  $(a - c)$

$$\begin{aligned} 2a(E_M[c] - E_D[c]) - 2c(E_M[c] - E_D[c]) &< 5(E_M[c] - c)^2 - (c - E_D[c])^2 \\ 2(a - c)(E_M[c] - E_D[c]) &< 5(E_M[c] - c)^2 - (c - E_D[c])^2. \end{aligned} \quad (\text{C.7})$$

Solving equation (C.7) for  $a$  confirms the threshold presented in (3.41)

$$a < c + \frac{5(E_M[c] - c)^2 - (c - E_D[c])^2}{2(E_M[c] - E_D[c])}. \quad (\text{C.8})$$

### C.3. Case 3: one purpose-driven firm, one profit-driven firm

$$(\theta_1 = \bar{\theta}, \theta_2 = 0)$$

#### C.3.1 Stability of joint adoption (1, 1)

To derive the simplified stability condition (3.44) for the profit-driven firm (firm 2), we analyze the second inequality in (3.43)

$$\frac{(a - E_D[c])^2}{9b} > \frac{(a + E_M[c] - 2c)^2}{9b}.$$

Using the difference-of-squares identity  $x^2 - y^2 = (x - y)(x + y) > 0$

$$[(a - E_D[c]) - (a + E_M[c] - 2c)][(a - E_D[c]) + (a + E_M[c] - 2c)] > 0.$$

Simplifying the terms within the brackets yields

$$(2c - E_M[c] - E_D[c])(2a + E_M[c] - E_D[c] - 2c) > 0.$$

The second factor is strictly positive for sufficiently large  $a$ . Thus, the inequality holds if and only if

$$2c - E_M[c] - E_D[c] > 0 \implies 2c > E_M[c] + E_D[c]. \quad (\text{C.9})$$

This confirms equation (3.44). Furthermore, the lower bound for  $\bar{\theta}$  in (3.45) is expanded using the same identity

$$\bar{\theta} > \frac{(E_M[c] + E_D[c] - 2c)(2a + E_M[c] - E_D[c] - 2c)}{9b}.$$

Under condition (3.44), the first factor  $(E_M[c] + E_D[c] - 2c)$  is negative, which implies that any  $\bar{\theta} > 0$  satisfies the condition for the purpose-driven firm.

### C.3.2 Stability of no adoption (0, 0)

For the profit-driven firm (firm 2), the condition  $\pi_2(0, 0) > \pi_2(0, 1)$  expands to

$$\frac{(a - c)^2}{9b} > \frac{(a + c - 2E_M[c])^2}{9b}.$$

Taking the square root and simplifying results in

$$\begin{aligned} a - c &> a + c - 2E_M[c] \\ -c &> c - 2E_M[c] \\ 2E_M[c] &> 2c \\ E_M[c] &> c. \end{aligned} \tag{C.10}$$

This confirms equation (3.47) under Assumption 1.

For the purpose-driven firm (firm 1), the threshold for  $\bar{\theta}$  in (3.49) is derived from the utility comparison in (3.48)

$$\bar{\theta} < \frac{(a - c)^2 - (a + c - 2E_M[c])^2}{9b}.$$

Applying the difference-of-squares identity  $x^2 - y^2 = (x - y)(x + y)$  with  $x = (a - c)$  and  $y = (a + c - 2E_M[c])$  gives us the factors

$$\begin{aligned} (x - y) &= (a - c) - (a + c - 2E_M[c]) = 2(E_M[c] - c) \\ (x + y) &= (a - c) + (a + c - 2E_M[c]) = 2a - 2E_M[c] = 2(a - E_M[c]). \end{aligned}$$

Multiplying these factors yields

$$\bar{\theta} < \frac{2(E_M[c] - c) \cdot 2(a - E_M[c])}{9b} = \frac{4(a - E_M[c])(E_M[c] - c)}{9b}. \tag{C.11}$$

This confirms the threshold stated in (3.49).

### C.3.3 Stability of asymmetric adoption (1, 0)

Starting from the utility comparison of firm 1 ( $\pi_1(1, 0) + \bar{\theta} > \pi_1(0, 0)$ ), we isolate  $\bar{\theta}$

$$\bar{\theta} > \frac{(a - c)^2 - (a + c - 2E_M[c])^2}{9b}.$$

Again using the difference-of-squares identity  $x^2 - y^2 = (x - y)(x + y)$  with  $x = (a - c)$  and  $y = (a + c - 2E_M[c])$  yields

$$(x - y) = (a - c) - (a + c - 2E_M[c]) = 2(E_M[c] - c)$$

$$(x + y) = (a - c) + (a + c - 2E_M[c]) = 2a - 2E_M[c] = 2(a - E_M[c]).$$

The product of these terms confirms the threshold in (3.52) giving us

$$\bar{\theta} > \frac{4(a - E_M[c])(E_M[c] - c)}{9b}. \quad (\text{C.12})$$

This threshold has the same value as the upper bound on  $\bar{\theta}$  for the stability of (0, 0) derived in (C.11), with the inequality reversed: below it non-adoption is stable, while above it the purpose-driven firm adopts alone. The two conditions thus pin down a single boundary in the  $(c, \bar{\theta})$ -plane rather than two independent ones.

Firm 2 prefers remaining a non-adopter if  $(1, 0)_2 > (1, 1)_2$ . Substituting the profits from (3.53) results in

$$\frac{(a + E_M[c] - 2c)^2}{9b} > \frac{(a - E_D[c])^2}{9b}.$$

Multiplying by  $9b$  and taking the square root (given  $a$  is sufficiently large) gives us the condition

$$a + E_M[c] - 2c > a - E_D[c].$$

Subtracting  $a$  and rearranging the cost terms to isolate  $2c$  yields

$$2c < E_M[c] + E_D[c]. \quad (\text{C.13})$$

This confirms the second equilibrium condition in (3.54).

#### C.4. Comparison of the monopoly and unilateral-adoption thresholds

The thresholds from (3.11) and (3.52) are

$$\theta_M = \frac{(a - c)^2 - (a - E_M[c])^2}{4b} = \frac{(E_M[c] - c)(2a - c - E_M[c])}{4b},$$

$$\theta_{i,\text{uni}} = \frac{4(a - E_M[c])(E_M[c] - c)}{9b}.$$

Suppose  $\theta_{i,\text{uni}} > \theta_M$ . Dividing by the common positive factor  $(E_M[c] - c)/b$  (positive since  $b > 0$  and  $E_M[c] - c > 0$  by Assumption 1),

$$\frac{4(a - E_M[c])}{9} > \frac{2a - c - E_M[c]}{4} \implies 16(a - E_M[c]) > 9(2a - c - E_M[c]),$$

which expands to

$$16a - 16E_M[c] > 18a - 9c - 9E_M[c].$$

Collecting terms in  $a$ ,

$$-2a > -9c + 7E_M[c] \iff 2a < 9c - 7E_M[c].$$

By Assumption 1,  $c < E_M[c]$ , so  $9c - 7E_M[c] < 9E_M[c] - 7E_M[c] = 2E_M[c]$ ; and  $a > E_M[c]$  gives  $2a > 2E_M[c]$ . Hence

$$9c - 7E_M[c] < 2E_M[c] < 2a,$$

contradicting  $2a < 9c - 7E_M[c]$ . The condition never holds, so  $\theta_{i,\text{uni}} < \theta_M$  for all admissible parameters.