

**Platform Governance: A Study of Governance Mechanisms
and Their Impact on Ecosystem Outcomes**

Nudrat Mahmood

A Dissertation Submitted to
the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of
Doctor of Philosophy

Graduate Program in Business Administration
Schulich School of Business, York University
Toronto, Ontario

June 2024

© Nudrat Mahmood, 2024

ABSTRACT

While governance has long been fundamental to strategic management research, its nature has shifted in today's digital economy. In this dissertation I study governance in the context of digital platforms, drawing together both theory and practice in three distinct and interrelated essays. In essay 1, I conduct a systematic literature review of platform governance to synthesize extant scholarship. In doing so, I uncover the conceptual structure of the literature, clarify the conceptual contours of the construct, develop an organizing framework, and identify areas for future research. In the next two essays, I conduct empirical investigations using the e-commerce landscape to address some of the salient gaps identified in the review. Specifically, in essay 2, I examine the effectiveness of revenue-sharing, a prominent pecuniary mechanism used by platform firms to govern ecosystem activity. In essay 3, I develop a better understanding of how governance mechanisms combine to shape platform participation. Specifically, I undertake a configurational examination of both user- and complementor- oriented governance mechanisms and study their impact on platform adoption. Together, the essays offer insight into how platform firms manage their ecosystems and as such advance a more nuanced understanding of platform governance, the development of which is increasingly important as digital platforms continue to integrate further into the economic fabric.

ACKNOWLEDGEMENTS

This dissertation was made possible through the continued support and generosity of several individuals. I extend my sincere gratitude to them all.

It has been an honor working with an outstanding and supportive committee. I would like to express my deepest gratitude to my advisor, **Professor Anoop Madhok** for his invaluable guidance, unwavering support, and insightful feedback, all of which have significantly enhanced the quality of this dissertation. His expertise and encouragement have been instrumental in shaping not only this work but also my growth as a researcher. I am deeply appreciative of the countless hours he has dedicated to reviewing drafts, providing thoughtful suggestions, and offering support at every stage of this endeavor. I am truly honored to have had the privilege of working with him, and I am grateful for his dedication towards fostering my intellectual growth.

I am also thankful to **Professor Eileen Fischer** for her guidance and insightful comments which have played a pivotal role in shaping the direction of this research. I deeply appreciate the time she invested in providing comprehensive feedback on my work. I am especially thankful to her for taking a keen interest in my overall development as a scholar. Her unwavering support and belief in me have been a constant source of motivation.

I am also indebted to **Professor Majid Majzoubi** for his invaluable contributions to this research endeavour. I am especially grateful for his support with topic modelling and his guidance throughout the process of learning and applying the method. I am also deeply appreciative of his constant support which helped me better navigate the challenges of my academic journey. His mentorship has not only contributed to the scholarly rigour of this dissertation but has also inspired me to pursue academic excellence with passion and perseverance.

Outside of the dissertation committee, I would like to extend my sincere gratitude to **Professor Moshe Farjoun** with whom I had the honor of co-authoring my first publication. I deeply appreciate the time and effort he invested in providing insightful feedback, engaging in stimulating discussions and offering invaluable advice throughout my academic journey. His treasured support has been an immense source of strength and inspiration.

I am also thankful to **Professor Yuval Deutsch** and **Professor Robert Phillips** for their ongoing support and guidance. I also extend my gratitude to Schulich School of Business staff, notably **Stephanie Allen** who provided the utmost care in supporting all administrative matters.

I would like to extend a heartfelt thanks to my colleagues and friends at Schulich for the cherished time spent together. I am especially grateful for their encouragement and moral support during challenging times. A special thanks to **Ramya, Diya, Jueun, Henry, Mohammad, Pouyan, Qasim, Mehran** and **Sonia**. I am also grateful to my dear friends **Latisha, Tushna** and **Ann-Marie** for encouraging me to start this journey and for cheering me on every step of the way.

Last, and certainly not the least, I am deeply thankful to my family for their unconditional love, patience, and encouragement. To my parents, **Mama** and **Abu ji**, thank you for your countless sacrifices and unfaltering support which enabled me to pursue this path. Your belief in my dreams and your willingness to celebrate my successes, no matter how small, have been a constant source of motivation. To my brothers, **Aaqib, Saqib & Haris**, thank you for believing in me when I could not. Your unwavering support and belief in my potential have been a source of strength during this journey. To my daughter, **Ayra**, thank you for being a constant source of inspiration. Your love and patience made this all possible. I am forever indebted to you all.

TABLE OF CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGEMENTS.....	iii
TABLE OF CONTENTS.....	iv
LIST OF TABLES.....	v
LIST OF FIGURES.....	vi
CHAPTER 1 - INTRODUCTION.....	1
CHAPTER 2 - ESSAY 1.....	13
CHAPTER 3 - ESSAY 2.....	78
CHAPTER 4 - ESSAY 3.....	110
APPENDIX A.....	154
APPENDIX B.....	167
APPENDIX C.....	169
APPENDIX D.....	174
APPENDIX E.....	174
REFERENCES.....	194

LIST OF TABLES

Table 1.1. Summary of Essays in Dissertation	6
Table 2.1. Top 10 Terms (First 10 Topics).....	22
Table 2.2. Topic 19	24
Table 2.3. All Labelled Topics (30).....	24
Table 2.4. Definitions of Platform Governance.....	38
Table 2.5. Purposes of Platform Governance	39
Table 3.1. Tests for Parallel Trends	99
Table 3.2. Effect of Revenue-Sharing Change	101
Table 4.1. Calibration Criteria (User-oriented Model).....	133
Table 4.2. Calibration Criteria (Complementor-oriented Model).....	138
Table 4.3. Configurations for the Presence of High Platform Adoption (User).....	140
Table 4.4. Configurations for the Absence of High Platform Adoption (User)	143
Table 4.5. Configurations for the Presence of High Platform Adoption	144
Table 4.6. Configurations for the Absence of High Platform Adoption (Complementor)	146
Table A 1. LDA Analysis Parameters.....	154
Table A 2. Top 10 Terms (All 30 Topics)	155
Table A 3. Complete List of Topics, Terms & Labels.....	156
Table B 1. Effect of Revenue-Share Change	168
Table C 1. Shopify Topics (70).....	171
Table C 2. WooCommerce Topics (50).....	172
Table E 1. Calibration (User-oriented Model).....	174
Table E 2. Calibration (Complementor-Oriented Model).....	185

LIST OF FIGURES

Figure 1.1. Dissertation Overview	4
Figure 1.2. E-commerce Landscape: Essays 2 & 3	5
Figure 2.1. Three Stage Review Process	18
Figure 2.2. Perplexity Analysis.....	22
Figure 2.3. Topic Probabilities for Wareham et al. (2014).....	23
Figure 2.4. Publications Per Year: 2003 - 2023.....	27
Figure 2.5. Top 10 Journals	28
Figure 2.6. Three-Field Plot (An Overview)	28
Figure 2.7. Co-citation Network	30
Figure 2.8. Historiograph.....	32
Figure 2.9. Keyword Co-occurrence Network.....	33
Figure 2.10. Thematic Evolution	34
Figure 2.11. Data Structure (Partial).....	36
Figure 2.12. Clarifying the Construct	42
Figure 2.13. Platform Governance Research: An Organizing Framework.....	46
Figure B 1. Parallel Trends: Quantity	167
Figure C 1: Results of Perplexity Analysis.....	170
Figure D 1. Parallel Trends: Variety	174
Figure D 2. Parallel Trends: Quality.....	174

CHAPTER 1 - INTRODUCTION

Digital platforms have revolutionized economic activity, reshaping the way in which actors interact and transact in the modern world. Enabled by advances in technology and the widespread adoption of the internet, digital platforms facilitate peer-to-peer transactions, foster innovation, and provide access to a vast array of products and services with unprecedented convenience. Encompassing a wide range of services, from ridesharing (e.g., Uber) and on-demand streaming (e.g., Netflix), to social media networks (e.g., TikTok) and operating systems (e.g., Android), digital platforms have become the emblematic organizational form of the digital age (Gawer, 2022). As digital platforms continue to proliferate and evolve, their impact on the economy is becoming increasingly profound, fundamentally altering the way we interact, work, and live in the digital age.

Based on foundational technologies upon which a range of actors converge to co-create value (Gawer, 2009), digital platforms are associated with *ecosystems* that constitute the platform firm and the set of actors that participate on the platform (Gawer, 2014; Kapoor, 2018; Jacobides, Cennamo & Gawer, 2018). These actors include (1) end users, (2) providers (e.g., sellers on marketplace platforms, drivers on ride-sharing platforms, or restaurants on food delivery platforms), and/or (3) complementors who leverage the platform to develop innovative complements that extend the platform's core functionality (e.g., app developers). Such ecosystems are characterized by multilateral interdependencies between actors – i.e., “a set of relationships that are not decomposable to an aggregation of bilateral interactions” (Adner, 2017: 42)¹. They are much like biological ecosystems in that the actors are “intertwined in mutually dependent relationships outside of which they have little meaning” (Iansiti & Levien, 2004:76).

¹ Note that while all actors in the ecosystem are interdependent, they need not be equally essential to one another.

As value systems constituting independent yet interdependent actors that interact to realize a value proposition (Jacobides, Cennamo & Gawer, 2018; Adner 2017), ecosystems are a type of meta-organization where legally autonomous actors are bound together by a common goal to co-create value (Kretschmer, Leiponen, Schilling & Vasudeva, 2022; Gulati, Puranam & Tushman, 2012). A key challenge for platform firms within such ecosystems is to effectively govern the activities of the large set of ecosystem actors. Platform firms must sustain the external actors' participation and motivate them to contribute their resources towards the ecosystem's value proposition in a platform-enhancing manner (Gawer, 2014). They must also create alignment between the multilateral set of actors, as their interactions collectively enable the focal value proposition to materialize (Adner, 2017). This requires appropriate *platform governance*, which refers to the design, deployment and enforcement of mechanisms through which a platform firm exerts influence on ecosystem actors to guide their activity (Tiwana et al. 2010; Wareham et al., 2014; Gawer, 2014).

Governance has long been fundamental to strategic management research, with scholars devoting much attention to understanding how interorganizational exchanges are governed. The vast scholarship suggests that firms utilize two main types of governance: (1) contractual governance that involves formal contracts to safeguard against exchange hazards such as opportunism and conflict (Williamson, 1985; Mesquita & Brush, 2008; Ryall and Sampson, 2009), and (2) relational governance, primarily embodied in trust, which emerges from informal norms and values found in social relationships, and attenuates exchange hazards associated with uncertainty and transaction-specific investments (Zaheer & Venkatraman, 1995; Dyer & Singh, 1998; Poppo & Zenger, 2002).

Since ecosystem participants are autonomous actors, and are free to enter and exist, no direct authority relations exist between them and the platform firm. As such, platform firms cannot resort to traditional formal contracting (Gawer, 2014), and cannot ‘force’ specific behaviors or actions as in the case of employees or partners. Similarly, given the vast number of ecosystem participants, most of whom are unknown to the platform firm (and one another), relations between the actors are more market-like, making relational governance impractical.

Platform firms must instead rely on a distinct set of governance mechanisms to create conditions that are conducive to attracting, incentivizing and enabling the sustained participation of ecosystem actors (Tiwana et al., 2010; Wareham et al., 2014; Gawer, 2014; Jacobides et al., 2018). Here, the idea is to shape the ecosystem, not fully direct it (Williamson & De Meyer, 2012). Platform governance mechanisms include, but are not limited to, rules, standards and guidelines with which actors must comply (Boudreau & Hagiu, 2009), and entail both hard regulations and soft nudges (Zhang, Li & Tong, 2022) pertaining to matters such as decision rights, incentive structures and control mechanisms (Tiwana, 2013). Collectively, through these decisions, platform firms shape ecosystem activity.

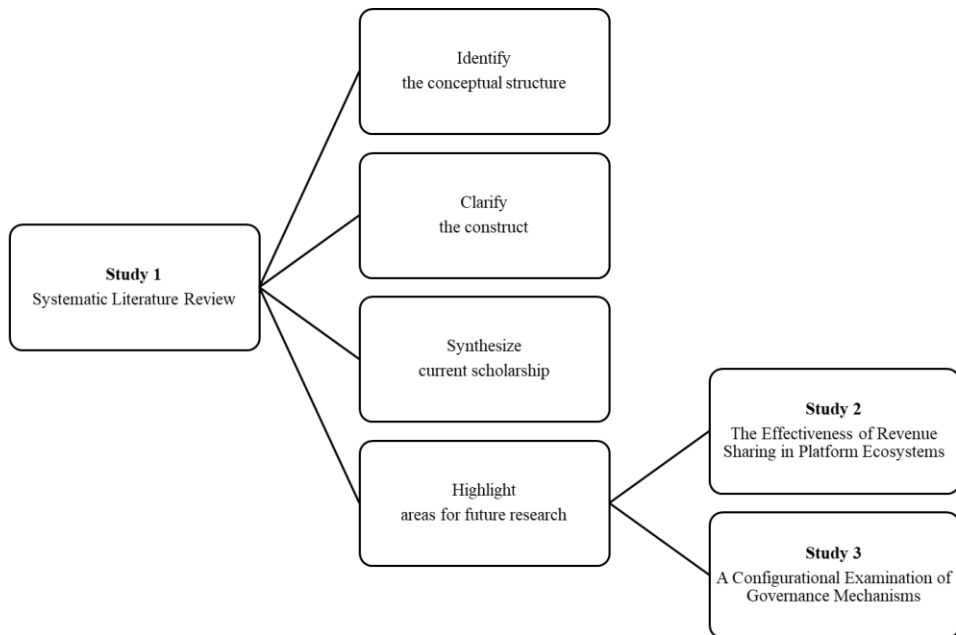
With scholarly interest in digital platforms on the rise, many studies have contributed towards developing a better understanding of how platform firms govern their ecosystems. In this dissertation, I advance this line of work by undertaking a comprehensive examination of platform governance in three distinct, interrelated essays (See Figure 1.1).

In essay 1, I conduct a systematic literature review on platform governance to synthesize extant scholarship and identify areas for future research. In the next two essays, I conduct empirical investigations to address some of the salient gaps identified in the review. Specifically, in essay 2, I examine the effectiveness of revenue-sharing, a prominent governance mechanism, to quantify

its impact on complementor activity. While extant scholarship has identified various governance mechanisms used by platform firms to shape value co-creation, this essay is the among the first to study a mechanism that is more oriented towards value capture.

In essay 3, I develop a better understanding of how governance mechanisms combine to shape participation in platform ecosystems. Although platform firms use a variety of governance mechanisms, extant studies tend to examine the impact of individual mechanisms (e.g., Ghazwaneh & Henfridsson, 2013; Rietveld, Schilling & Bellavitis, 2019; Zhang, Li & Tong, 2022; Koo & Eesley, 2021). While these studies have produced valuable insights, as yet very little is known about how platform firms *combine* different mechanisms to influence ecosystem outcomes. In this essay, I take a step in this direction by exploring how various combinations of governance mechanisms impact platform adoption.

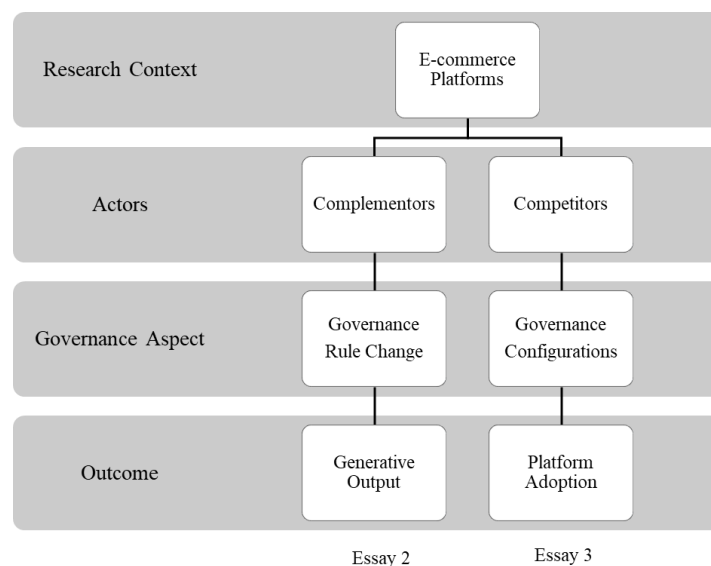
Figure 1.1. Dissertation Overview



The empirical setting for my studies is the e-commerce landscape, which constitutes digital platforms like Shopify and WooCommerce. These e-commerce platforms are distinct from marketplace platforms such as Amazon and Alibaba, in that instead of simply facilitating exchange between platform sides, they provide users (i.e., merchants) the ability to create and customize online stores for their businesses. They also help users manage orders, process payments, and create, execute and analyze marketing campaigns to better sell their products. While the platforms provide the core functionalities, they often have an ecosystem of third-party developers that create apps (also referred to as add-ons, extensions or plug-ins) that extend the functionality of the core platform. These apps offer additional features that make the platform more attractive.

Although I use the same context in both empirical studies, I conduct the studies at different levels of analysis, allowing me to explore platform governance in relation to two different sets of actors – i.e., complementors in essay 2 and competitors in essay 3 (Figure 1.2). Additionally, in each of the studies I shed light on different outcomes, namely innovative output in essay 2 (a complementor-level outcome) and platform adoption in essay 3 (an ecosystem-level outcome).

Figure 1.2. E-commerce Landscape: Essays 2 & 3



In the following sections, I provide brief summaries of the three essays (See Table 1.1).

Table 1.1. Summary of Essays in Dissertation

	Essay 1	Essay 2	Essay 3
Purpose	Integrate the fragmented research on platform governance and offer insights on its conceptual structure and future directions.	Examine the effectiveness of revenue-sharing on complementor activity by exploiting a quasi-experiment wherein Shopify lowers its revenue-sharing regime from 20% to 0%.	Conduct a configurational examination of ecosystem governance mechanisms to better understand how they combine to shape participation in platform ecosystems.
Methods	(1) Topic Modelling (2) Bibliometrics (3) Qualitative Content Analysis	(1) Difference-in-Differences (2) Topic Modelling	Fuzzy-set Comparative Qualitative Analysis (fsQCA)
Key Findings	(1) Uncovers the conceptual structure of the literature by mapping the evolutionary trajectory of the scholarship (2) Clarifies the conceptual contours of the construct by offering a more comprehensive definition and highlighting the unique characteristics of platform governance	(1) A reduction in revenue-sharing has a positive effect on the quantity and variety of complements, as well as a positive spillover effect on the quality of complements (2) A reduction in revenue-sharing is an effective incentive mechanism that motivates complementors to participate and engage in innovative activity	(1) Enhanced platform adoption can be achieved through distinctly different governance mechanism combinations (2) Incentive mechanisms are more important than control mechanisms when seeking high platform adoption (3) Complementor and user analyses are interconnected
Contributions	(3) Synthesizes knowledge in an organizing framework, highlighting the antecedents, mechanisms, consequences and moderators of platform governance (4) Identifies areas for future research	(1) Quantifies the impact of governance on complementor activity (2) Extends the work on the dynamics and evolution of governance design (3) Adds to a more nuanced understanding of the quantity-quality trade-off	(1) Shifts focus from a particular governance mechanism to combinations of governance mechanisms (2) Shifts empirical focus from one (or a few) ecosystems to a competitive landscape (3) Highlights the importance of user-oriented governance

ESSAY 1. Platform Governance: A Systematic Review and Organizing Framework

Purpose. In Essay 1, I conduct a systematic literature review to (1) identify the conceptual structure of the literature, (2) clarify the conceptual contours of platform governance, (3) synthesize extant knowledge in an organizing framework and (4) highlight future directions for research.

Method. I conduct the review using a hybrid methodology, combining three different approaches. I start with an *exploratory analysis* using topic modelling to identify topics in the literature, group together similar articles and evaluate where more time and focus should be spent (Asmussen & Møller, 2019). Next, I conduct a *bibliometric analysis* to present the ‘big picture’ of the literature and develop an understanding of its conceptual structure (Aria & Cuccurullo, 2017). In the final stage of the review process, I perform an in-depth qualitative *content analysis*. Through a comprehensive examination of the articles, I identify important themes and connections that allow me to clarify the conceptual contours of platform governance, synthesize the literature, and identify areas for future research.

Key Findings & Contributions. This essay makes several contributions. First, it uncovers the conceptual structure of platform governance research. In doing so it maps the evolutionary trajectory of the scholarship, drawing attention to seminal works (e.g. Rochet and Tirole, 2003), as well as more recent influences, such as Tiwana et al. (2010) and Wareham et al. (2014). Second, it clarifies the conceptual contours of the construct by offering a more comprehensive definition of platform governance – one which highlights the two primary functions of platform governance – that of *coordination* and *regulation*. The paper also sheds light on the unique characteristics of platform governance, highlighting its *constitutional*, *algorithmic*, *multi-layered*, and *polycentric* nature. Third, this essay synthesizes extant knowledge in an organizing framework. Specifically, it organizes the content in terms of the antecedents, mechanisms, consequences and moderators of

platform governance. Finally, the paper identifies areas for future research, which form the basis for the following two essays.

ESSAY 2. The Effectiveness of Revenue-Sharing in Platform Ecosystems

Purpose. Extant work has examined the impact of different governance mechanisms used by platform firms, such as rewarding high quality complements (Claussen, Kretschmer & Mayrhofer, 2013), providing boundary resources (Ghazwaneh & Henfridsson, 2013), gatekeeping (Zhang, Li & Tong, 2022), selectively promoting complements (Rietveld, Schilling & Bellavitis, 2019), and altering algorithms (Koo & Eesley, 2021). While these studies have produced valuable insights on how platform firms govern complementor activity, these mechanisms relate primarily to value co-creation. In this essay, I complement this line of work by examining the effectiveness of revenue-sharing which is a pecuniary mechanism that is more oriented towards value capture.

While it is recognized that different types of revenue-sharing schemes can have a strong impact on complementors' incentives to participate and innovate in the ecosystem (Tiwana, 2013), as yet very little is known about how the choice of revenue-sharing schemes affects complementor activity. More specifically, there is a lack of work exploring the impact of revenue-sharing on the nature of generative output within an ecosystem. Accordingly, in this essay I examine the affect of revenue-sharing on the nature of generative output, specifically in terms of its impact on the variety and quality of complements.

Method. To conduct the study, I exploit a quasi-experiment wherein Shopify implements a distinct rule change to its revenue-sharing scheme, lowering it from 20% to 0%. This natural experiment-like change allows for similar identification as field experiments (Harrison & List, 2004), and therefore I use it to analyze the impact of revenue-sharing on the nature of generative

output produced by complementors. I do this by using a difference-in-differences approach that studies the differential effect of a specific intervention (i.e., revenue-share change) on an outcome (e.g., variety of apps) by comparing the changes in outcome over time between a ‘treatment group’ (i.e., Shopify’s ecosystem) and a ‘control group’ (i.e., WooCommerce’s ecosystem).

Key Findings. The analyses reveal that a reduction in the revenue-sharing scheme has a positive effect on the variety of complements, as well as a positive spillover effect on the quality of complements. Together, the results demonstrate that a reduction in revenue-sharing is an effective incentive mechanism that motivates complementors to engage in innovative activity.

Contributions. By empirically demonstrating the effectiveness of revenue sharing, this essay takes steps to quantify the impact of governance on complementor activity. In doing so, it contributes to the line of work examining *changes* to governance mechanisms and their effects on ecosystem activity (e.g., Chung et al., 2024; Koo & Eesley, 2021; Wessel et al., 2017; Claussen et al., 2013), extending our understanding of the dynamics and evolution of governance design. Moreover, it contributes towards a better understanding of how generative output is shaped through governance.

It also adds to a more nuanced understanding of the quantity-quality trade-off, which suggests that an increased level of innovative output often comes at the expense of lower quality, especially in more mature ecosystems like Shopify’s (Wareham et al., 2014; McIntyre et al., 2020). The findings in this essay challenge this common understanding by demonstrating that this need not always be the case – and that increased quantity can at times be accompanied by improved quality.

ESSAY 3. A Configurational Examination of Ecosystem Governance Mechanisms

Purpose. Whereas essay 2 examines the impact of one particular governance mechanism, in this essay, I develop a better understanding of how governance mechanisms *combine* to shape ecosystem participation. Since platform firms utilize a variety of governance mechanisms to collectively shape ecosystem activity (Wareham et al., 2014), it is important to understand how these different combinations of mechanisms influence ecosystem outcomes. For instance, various governance mechanisms impact actors' decisions to participate in the ecosystem differently, and therefore, differences in combinations of mechanisms may have implications for outcomes such as platform adoption. Research has yet to quantify such differences (Bogers, Sims & West, 2019), leaving us with relatively little knowledge in this regard. Therefore, in this essay I address the following question: *What configurations of ecosystem governance mechanisms (pathways) lead to enhanced platform adoption in both users and complementors?*

Method. Since platforms utilize a combination of governance mechanisms, this study requires a configurational approach. Accordingly, I apply fuzzy-set Comparative Qualitative Analysis (fsQCA), which is a case-based configurational approach (Ragin, 2008). The main objective of fsQCA is to identify different configurations (or 'causal recipes') that enable or disable specific empirical outcomes (e.g., high platform adoption). It is designed to handle small and large numbers of cases equally well (Greckhamer, Misangyi & Fiss, 2013), therefore making it suitable to analyse the e-commerce landscape, where I have identified a total of 30 digital platforms that directly compete with one another. Since e-commerce platforms govern the actions of both users and complementors, I conduct two separate analyses. In the first, I examine the configurations of *user-oriented* governance mechanisms that contribute towards enhanced platform adoption, and in the second I examine the configurations of *complementor-oriented* governance mechanisms that contribute towards enhanced platform adoption.

Key Findings. The results indicate that (1) enhanced platform adoption can be achieved through distinctly different governance mechanism combinations; (2) incentive mechanisms are more salient than control mechanisms when it comes to high platform adoption; and (3) complementor and user analyses are interconnected, such that complementor-oriented governance can inform not only complementors' platform adoption, but also inform a better understanding of users' platform adoption. As such, assessing ecosystem-level outcomes requires a comprehensive examination of both user- and complementor-specific governance mechanisms and outcomes, because relying on only one analysis can leave out important details in understanding ecosystem performance.

Contributions. This essay contributes to the literature on platform governance by (1) shifting focus from a particular governance mechanism and its impact, to highlighting the various ways in which governance mechanisms combine to shape ecosystem participation; (2) shifting empirical focus from one (or a few) ecosystems to competing ecosystems by studying governance in a competitive landscape; and (3) highlighting the importance of user-oriented governance in ecosystems where users also generate output.

Overall Contributions

Together, the essays in this dissertation advance a more nuanced understanding of platform governance, which is increasingly important as digital platforms continue to integrate further into the economic fabric. First, by examining the various facets of ecosystem governance, this dissertation offers insight into how platform firms manage their ecosystems, contributing to an ecosystem perspective that reflects platform firms' agency, as opposed to ecosystems' structural features (McIntyre & Srinivasan, 2017). Since ecosystem actors' value creation activities are critical to the success of such platforms (Jacobides et al., 2018), developing a better understanding

of how platform firms govern these activities is essential. By quantifying the effect of platform governance on complementor activity and studying it in a competitive landscape (in essays 2 and 3), this dissertation contributes towards such an understanding.

Second, by studying governance at different levels of analysis within the same e-commerce context, this dissertation uncovers underlying connections and offers more integrative insights (as compared to the standalone contributions). While essay 3 suggests that incentive mechanisms play an important role in driving platform adoption, essay 2 offers some insight on why this may be – by showing that incentive mechanisms have the potential to enhance complementor activity, resulting in higher quality and variety of complements (which then in turn play a role in attracting more users). In other words, the two studies show that incentive mechanisms have the potential to enhance complementor activity (essay 2), and that such outcomes have a positive effect on ecosystem-level outcomes such platform adoption (essay 3).

Third, by synthesizing extant scholarship and integrating the various findings (essay 1), this dissertation adds structure to the growing (and fragmented) literature. Not only does it fill important gaps, but it also identifies other areas for research that merit further attention. Among other aspects, it suggests that governance-oriented studies have the potential to highlight key strategic decisions made by platform firms, along with critical capabilities developed over time to nurture ecosystem vitality. Taken together, this dissertation serves as a ‘platform’ off which future research can develop.

CHAPTER 2 - ESSAY 1

PLATFORM GOVERNANCE: A SYSTEMATIC REVIEW AND ORGANIZING FRAMEWORK

INTRODUCTION

Digital platforms are the emblematic organizational form of the digital age (Gawer, 2022). They have transformed the way in which actors interact and transact in the modern world. Encompassing a diverse range, from ride-sharing services and e-commerce marketplaces to operating systems and social media networks, these platforms facilitate transactions, enable peer-to-peer interactions, and provide access to a vast array of products and services with unprecedented convenience. They also foster innovation and empower individuals and businesses to create, share, and monetize content on a global scale.

The rise of digital platforms has garnered significant interest from scholars across diverse disciplines. In recent years, there has been a particular interest in *platform governance*, which broadly refers to the means through which platform firms exert influence over actors that participate in its ecosystem² (Wareham et al., 2014). These actors include end users, providers (e.g., sellers on marketplace platforms, drivers on ride-sharing platforms, or restaurants on food delivery platforms), and complementors who leverage the platform to develop innovative complements that extend the platform's core functionality (e.g., app developers). Since they are autonomous actors over whom platform firms do not have direct authority, platform firms cannot resort to traditional forms of governance such as formal contracting (Gawer, 2014). Instead, they

² Platform governance refers to both the governance *of* and governance *by* platforms. The first aspect refers to the rules that platforms have enforced on them by regulatory bodies to alleviate concerns related to market concentration, data privacy and labor rights, while the second aspect refers to the platforms' role in governing the actors within its ecosystem (Gillespie, 2017; Shafiei Gol et al., 2019). In this paper, we focus on the latter, i.e., governance *by* platforms.

rely on a different set of mechanisms to create conditions that are conducive to attracting, incentivizing and enabling the sustained participation of ecosystem actors (Wareham et al., 2014; Tiwana et al., 2010; Jacobides et al., 2018). Here, the idea is to *shape* actors' activity, not fully direct it (Williamson & De Meyer, 2012).

A burgeoning stream of literature has enhanced our understanding of platform governance, with scholars studying the concept from different perspectives and in different contexts. However, although the diversity adds richness to the study of platform governance, there is a risk of theoretical fragmentation, especially since the scholarship is not yet synthesized and distilled into sharp distinctions (Suddaby, 2010). Thus, it is important to integrate findings by drawing together the diverse perspectives and clarifying the conceptual contours of the construct. Systematic literature reviews are an effective means of synthesizing voluminous and fragmented research findings and advancing a line of research through evidence-based insights (Aria & Cuccurullo, 2017). Accordingly, in this study I undertake a systematic literature review of platform governance scholarship to integrate the research and add structure to the growing body of work.

I conduct the review using a hybrid methodology, combining three different approaches to increase the reliability of my findings. I start with an *exploratory analysis* using topic modelling to identify topics in the literature, group together similar articles and evaluate where more time and focus should be spent (Asmussen & Møller, 2019). Next, I conduct a *bibliometric analysis* to present the 'big picture' of the literature and develop an understanding of its conceptual structure (Aria & Cuccurullo, 2017). This is followed by an in-depth qualitative *content analysis* through which I identify important themes and connections in the literature to develop an organizing framework and identify gaps in the literature.

This review study makes several contributions. First, it uncovers the conceptual structure of platform governance research. In doing so it maps the evolutionary trajectory of the scholarship, drawing attention to the seminal work in the field, as well as more recent influences. Second, it clarifies the conceptual contours of platform governance. It offers a clearer, more comprehensive definition of platform governance – i.e., *the design, deployment and enforcement of mechanisms through which a platform firm exerts influence on ecosystems actors in an effort to coordinate and regulate ecosystem activity*. This definition highlights the two primary functions of platform governance – that of *coordination* and *regulation*. The paper also sheds light on the unique characteristics of platform governance, highlighting its *constitutional, algorithmic, multi-layered, and polycentric* nature.

Third, the paper synthesizes extant knowledge in an organizing framework. It highlights *platform architecture* and a variety of *platform attributes* as key influences on platform governance; *ecosystem growth, trust* and *justice* as ecosystem-level outcomes; *innovation, knowledge-sharing/learning, complementor decisions and performance* as complementor-level outcomes; and the *external environment* and *platform capabilities* as important moderators. The framework also adds structure to the work on governance mechanisms by categorizing them in terms of the purpose they serve. It presents pricing, decision rights, standardization, resource provision, information provision and digital orienting as key *coordinating mechanisms*, and access control, output control, recognition and conflict management and key *regulatory mechanisms*.

Finally, the paper highlights areas for future research that are currently underexplored. Although the study of platform governance is rapidly diffusing, there are many opportunities to examine it more rigorously. For example, there is scope to further examine the role of *competitors, legitimacy, and platform identity/culture* when exploring the effectiveness of governance. There

are also opportunities to further add to the scholarship on *platform capabilities, learning* and the interplay between *justice and trust*. Most importantly there is a need to explore the *evolution* of platform governance by focusing on changes to governance over time.

In summary, this paper contributes by (1) identifying the conceptual structure of the literature, (2) clarifying the conceptual contours of platform governance, (3) synthesizing extant knowledge in an organizing framework and (4) highlighting future directions for research³. In essence, it gives structure to the literature and provides reliable, evidence-based findings that together offer a ‘platform’ off which future research can build.

REVIEW METHOD

In this section, I outline the search process and the data analysis methods used to conduct the systematic literature review.

Data

To ensure the reliability of the review, I employed reproducible steps in the search process. I started with a search for all articles from 2023 or earlier in the Web of Science Social Sciences Index⁴ that included the terms “govern*” and “platform*” in their titles, abstracts or keywords⁵

³ There currently exists one other review on platform governance, but its objective is different to that of this study. In their review, Chen, Tong, Tan & Han (2022) connect platform governance to platform design, drawing on classic organizational theory. Their review focuses specifically on governance mechanisms and relies on content analysis alone. In this review, I focus on all aspects of governance, including antecedents, consequences and moderators (in addition to mechanisms), and I utilize a hybrid methodology that provides insights that go beyond those found in the previous review.

⁴ The Social Sciences Index on Web of Science is generally considered a comprehensive database for scholarly works and covers thousands of journals (Thomas & Tee, 2022).

⁵ Web of Science also utilizes Keywords Plus, which are additional keywords (not from the authors) to better label the articles. This search includes these extra keywords.

(n= 2,309)^{6,7}. To ensure that only management articles were included, I applied a filter using Web of Science's categories, and retained only those articles categorized under 'management', 'business' or 'economics' (n=619). I ensured that only those journals listed in the *Academic Journal Guide 2021* (Association of Business Schools, 2021) were included⁸. Next, I read the abstracts of the articles to determine their relevance. Many of the articles did not use the term 'platform' in the same context as this study. For instance, some of the papers referred to election platforms or regulatory platforms, and therefore, such papers were removed. Similarly, papers that did not utilize the term governance in a relevant manner were also removed. After this manual filtering, a total of 201 articles remained. Together they formed the dataset used in the review.

Data Analysis (An Overview)

I used a hybrid methodology to conduct the systematic literature review. I combined three distinct approaches that served different – yet complementary – objectives, thus increasing the reliability of my findings (See Figure 2.1).

First, I carried out an *exploratory analysis* using Latent Dirichlet Allocation (LDA), a topic modelling method (Blei, Ng, & Jordan, 2003). This step enabled the identification of topics in the literature and allowed me to group together similar articles for further analysis (Asmussen & Møller, 2019). It also helped me evaluate where to direct my focus in the subsequent steps (Asmussen & Møller, 2019).

Next, I conducted a *bibliometric analysis* using the *bibliometrix* package in R (Aria &

⁶ The * is used for truncation, such that govern* can be governance, governing, governs etc. Since it could also include government, I made sure to add another filter which ensured that the 'government' was not included in search.

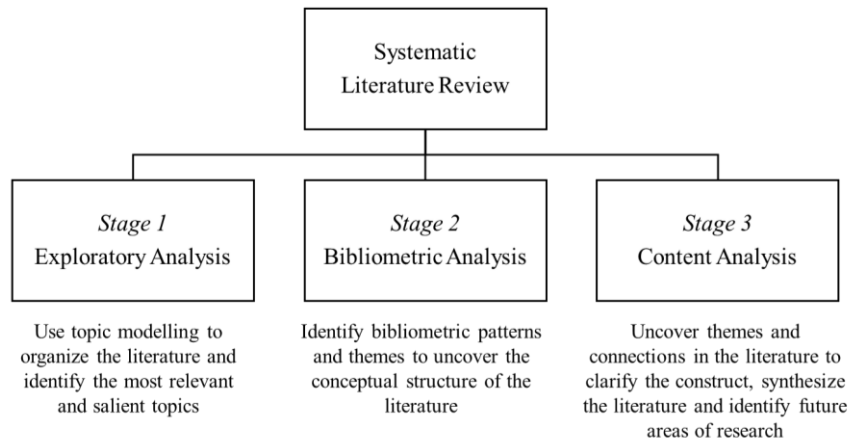
⁷ I used the 'topic' filter in the Web of Science database which by default searches for the given words (i.e., govern* and platform) in the title, abstract and keywords.

⁸ This guide includes details on the range, subject and quality of the journals in which business and management academics publish. Other reviews, such as the one by Thomas & Tee (2022) also rely on this guide.

Cuccurullo, 2017). This involved using bibliometric data to perform descriptive analyses, as well as co-citation and keyword co-occurrence analyses. I also used the *biblioshiny* functionality to generate unique maps, such as a ‘historiograph’ that charts the chronological map of the most relevant citations, as well as a thematic map that demonstrates the evolution of the main topics in the literature over time. Together, the analyses present an overview of literature and uncover its conceptual structure.

In the final stage of the review process, I performed an in-depth qualitative *content analysis*. Through a comprehensive examination of the articles, I identified important themes and connections to develop an organizing framework. Specifically, I organized the content in terms of the antecedents, mechanisms, consequences and moderators of platform governance. I also identified gaps in the literature that merit further study.

Figure 2.1. Three Stage Review Process



In the following three sections I provide details on each method, along with the respective findings.

PART I: EXPLORATORY ANALYSIS USING TOPIC MODELLING

I started the review process by conducting an exploratory analysis of the literature using topic modelling. Asmussen & Møller (2019) offer a compelling case for utilizing Latent Dirichlet Allocation (LDA) to conduct exploratory analysis when doing literature reviews, as it enables scholars to analyse a greater, almost unlimited number of papers, faster and with greater reliability. It helps identify various topics in the literature, allowing scholars to group together similar articles and evaluate where their time and focus should be spent. In essence, it provides information on a large number of papers before time-intensive manual work is conducted. Another advantage of this method is reproducibility, since all the steps in the exploratory process can be replicated. It also enables a higher degree of transparency than competing methods, as the entire review process can be evaluated by other researchers (Asmussen & Møller, 2019).

Latent Dirichlet Allocation (LDA)

LDA is a generative probabilistic topic modelling method (Blei, Ng, & Jordan, 2003). It is one of the most popular topic modelling techniques used to classify texts to a particular topic. It is an unsupervised method, which means we do not know the relationship between the papers prior to the model being executed. A key benefit of LDA is that it does not require classification by humans. Instead, it has structure emerge from the text data. The method uses a ‘Bag of Words’ approach where the semantics and meaning of sentences are not evaluated. Rather, the method evaluates the frequency of words. It is therefore assumed that the most frequent words within a topic will present an aboutness of the topic (Asmussen & Møller, 2019). (See Blei (2012) for a detailed description of LDA).

One crucial human choice when using LDA is the number of topics to be estimated by the algorithm. The appropriate number of topics can differ greatly, depending on the purpose of the

analysis. Usually, a low number of topics is used for a general overview and a higher number of topics is used for a more detailed view⁹. Given the nature of an exploratory analysis in a literature review, a lower number of topics is preferred (Asmussen & Møller, 2019).

The outcome of an LDA analysis is a list of topics, as well as a matrix containing topic probabilities for each paper¹⁰. The topic probabilities can be used to assign papers to a particular topic (i.e., the topic for which they have the highest topic probability). The topics need to be labelled by the researcher, based on how the LDA model groups together the words that make up a topic. After the topics have been labelled, the exploratory search ends. These topics essentially guide the content analysis, as they direct the researcher towards the most relevant papers for a more complete literature review (Asmussen & Møller, 2019).

In the following section, I describe the steps and results of the LDA analysis.

Latent Dirichlet Allocation (LDA) Analysis

Data Cleaning. I started the process by loading all 201 articles into the R environment. Then, I cleaned the data by converting all the words to lowercase and removed all punctuation, numbers and whitespaces. I then removed non-value adding words including email addresses, URLs and special characters as they do not contribute to the identification of topics. I also removed stop words – which are terms like “can”, “this”, “the” that do not add value to the aboutness of a topic¹¹. Next, I stemmed all the words to their root forms to avoid repetition and facilitate easier

⁹ At the extremes, choosing one topic would indicate one topic covering all papers, which will provide a very coarse view of the papers. On the other hand, if the number of topics is equal to the number of papers, then a very precise topic description will be achieved, although the topics will lose practical use as the overview of topics will be too complex (Asmussen & Møller, 2019).

¹⁰ This matrix has size of ‘number of topics’ x ‘number of papers’.

¹¹ As is often the case, this was an iterative process, as it is difficult to identify all misread and non-value adding words a priori. As part of the iterative process, I investigated several papers by displaying the text to manually evaluate the cleaning progress. I also ran several preliminary LDA analyses to check for the terms per topic. These steps revealed several special characters and terms like “university” and “paper” that had to be removed.

comparison. As a final step in the data cleaning process, I removed words that did not have sparsity or likelihood of 99%¹². After these steps, 20,416 unique words remained in the paper corpus.

Number of Topics. Next, I identified the optimal number of topics. As previously mentioned, LDA requires the researcher to select an appropriate number of topics to be estimated by the algorithm. Since I was conducting an exploratory analysis to gain a general overview of the literature, a low number of topics was preferred. While there is no concrete way to select the most optimal number of topics, Asmussen and Møller (2019) suggest that visualizing the perplexity can provide an aid for the decision.

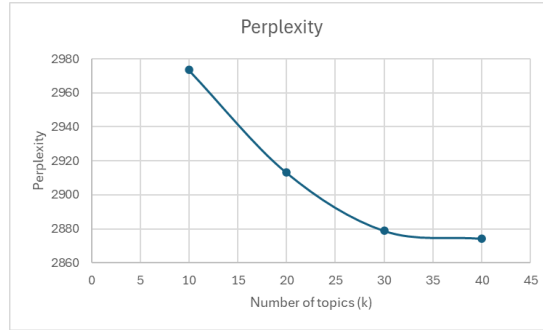
Perplexity is a measure used in information theory to evaluate language models, where a low score indicates a better generalisation model (see Blei & Lafferty, 2007; Xu and Raschid, 2016; Zhao et al., 2015). In other words, lower perplexity indicates better predictive performance of the model. The criterion for selecting the right number of topics is to find the balance between a useable number of topics and, at the same time, to keep the perplexity as low as possible.

To calculate perplexity, I followed Asmussen & Møller (2019) and divided the data into training and test sets, such that 75% of the papers were used for training the model, and the remaining 25% were used for testing. The LDA algorithm was run on the training set, and the test set was used to validate the results. I selected 10, 20, 30, 40 and 50 as the number of ‘candidate’ topics to be evaluated and calculated the perplexity for each. The goal was to find the lowest number of topics, which at the same time had a low perplexity. As seen in Figure 2.2, the slope of the fitted line started to gradually decline at 30 topics. Therefore, I selected 30 as the number of topics to be estimated.

¹² This step removes sparse terms – i.e., words that occur only in a few documents.

Figure 2.2. Perplexity Analysis

Topics (k)	Perplexity
10	2973.534
20	2913.13
30	2878.843
40	2874.209



LDA Analysis. After selecting the number of topics, I ran the LDA analysis on the entire set of papers, using the *lda* function in the ‘topicmodels’ R package (Grün & Hornik, 2011). I used the Gibbs sampling algorithm and used recommended default values for the other parameters (See Appendix A for details).

Results

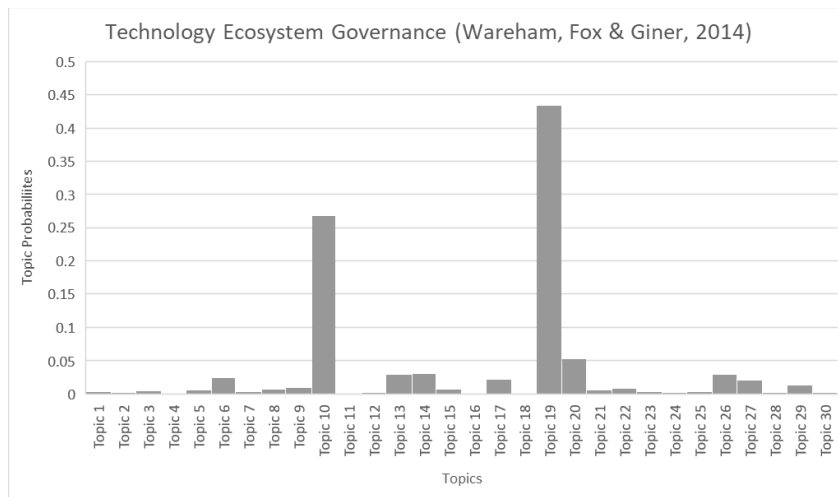
The outcome of the LDA analysis was a list of 30 topics, with the most prevalent words for each topic grouped together. I generated a list of the top 10 most frequent words for each topic. Table 2.1 provides a list of the 10 most frequent words for the first 10 topics. For a complete list of the 30 topics, see Appendix A.

Table 2.1. Top 10 Terms (First 10 Topics)

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10
actor	case	develop	platform	knowledg	servic	platform	seller	standard	inform
platform	vote	system	worker	communiti	manag	seller	platform	platform	provid
valu	juror	technolog	work	share	custom	trust	equilibrium	organ	studi
side	bias	standard	gig	vol	suppli	market	price	collabor	one
activ	experi	platform	labor	social	firm	mechan	profit	manag	system
coordin	tabl	patent	manag	effect	busi	effect	model	project	govern
new	seller	mobil	employ	studi	chain	buyer	commiss	architectur	new
digit	ingroup	industri	crowdwork	govern	vol	review	fee	share	differ
manag	level	applic	job	behavior	product	transact	optim	oper	make
metaorgan	estim	product	algorithm	manag	industri	relationship	product	develop	relat

Another outcome of the LDA analysis was a 201 by 30 matrix containing topic probabilities for each paper. These probabilities enabled me to allocate papers to each topic. I assigned papers to the topics with the highest probabilities, thus grouping together similar papers. For example, Wareham, Fox & Giner’s (2014) paper, titled *Technology Ecosystem Governance*, had the highest probability for topic 19 (See Figure 2.3). Accordingly, this paper was assigned to topic 19, along with the other papers that also had the greatest probability for this topic.

Figure 2.3. Topic Probabilities for Wareham et al. (2014)



After all the papers were distributed into their respective topics, I used the list of grouped papers, along with the list of top 10 terms for each topic (as seen in Table 1) for sensemaking and labelling of the topics. For example, topic 19 was associated with terms like ‘complementor’, ‘partner’ and ‘rule’, and was associated with 4 papers that concerned the governance of complementors. Accordingly, I labelled the topic “Complementor Governance” (See Table 2.2).

Table 2.2. Topic 19

Top 10 Terms	Papers	Topic Name
partner	Haki et al. - 2024 - Dynamic capabilities for transitioning from product platform ecosystem to innovation platform ecosystem	Complementor Governance
complementor	Huber et al. - 2017 - Governance practices in platform ecosystems: navigating tensions between cocreated value and governance costs	
rule	Hurni et al. - 2021 - Complementor dedication in platform ecosystems: rule adequacy and the moderating rule of flexible and benevolent practices	
govern	Wareham et al. - 2014 - Technology ecosystem governance	
partnership		
valu		
platform		
practic		
ecosystem		
manag		

I performed a similar analysis for each topic. Table 2.3 includes all the topics with their respective labels. While some topics were very easy to label, such as topic 7, where all papers clearly concerned trust in platform ecosystems, other topics, such as topic 10, were more difficult to label given the diversity of papers in that group. In such cases, a broader label was used to accurately capture the essence of all papers in that group (i.e., topic). (See Appendix A for a complete list of labels, papers and terms associated with each topic.)

Table 2.3. All Labelled Topics (30)

Topic 1 Coordination	Topic 2 Consensus Governance	Topic 3 Mobile Industry	Topic 4 Gig Economy	Topic 5 Communities	Topic 6 Servitization
Topic 7 Trust	Topic 8 Mathematical Models	Topic 9 Collaborative Platforms	Topic 10 Ecosystem Governance	Topic 11 Blockchain	Topic 12 Incentives
Topic 13 App Developers	Topic 14 Platform Design	Topic 15 Generativity	Topic 16 Complementor Dynamics	Topic 17 Open Innovation Platforms	Topic 18 Platform Participation

Topic 19 Complementor Governance	Topic 20 Innovation Ecosystems	Topic 21 Crowdsourcing	Topic 22 Misc.	Topic 23 Sharing Economy	Topic 24 Platform Regulation
Topic 25 Data Governance	Topic 26 Boundary Resources	Topic 27 Collective Governance	Topic 28 Power	Topic 29 Organizing	Topic 30 Crowdfunding

Once the topics were labelled, the exploratory analysis was complete. This analysis served three main purposes. *First*, the exploratory analysis provided a general overview of the literature on platform governance. It highlighted the diverse set of platforms that have been studied in the literature, including digital labor platforms in the gig economy (topic 4), collaborative platforms (topic 9), blockchain platforms (topic 11), open innovation platforms (topic 17), innovation platforms (topic 20), crowdsourcing platforms (topic 21), and crowdfunding platforms (topic 30). It also drew attention to the various aspects of platform governance, such coordination (topic 1), data governance (topic 25), and consensus governance (topic 2). It also helped identify key topics that are important to understanding platform governance, such as incentives (topic 12), boundary resources (topic 26), communities (topic 5) and trust (topic 7).

Second, by grouping together similar papers, the exploratory analysis helped guide the next steps of the literature review, especially the content analysis. The groupings made it easier to refer to a collection of papers when coding for a particular topic and it also helped keep the papers organized.

Finally, the exploratory analysis aided in further refining the list of papers for the review. Although I had manually filtered out papers in the preliminary data collection stage, the exploratory analysis helped me further identify papers that were not quite relevant to my review. For instance, although papers grouped under topic 6 involved some mention of platforms and governance, most of them were primarily about servitization in manufacturing, and in some cases,

supply chains. As such, they did not directly speak to platform governance, and therefore, I removed most of the papers in this group from my dataset. Similarly, several papers under topic 24 were more concerned with the regulation of platforms, which (as identified earlier), is not within the scope of this review. Accordingly, these papers were removed. Topics 5 also had a couple of papers that were irrelevant and were therefore also removed. (See Appendix A for the complete list). Together, a total of 13 papers were removed, with 188 papers remaining which were used in the next steps of the literature review.

PART II: BIBLIOMETRIC ANALYSIS

Following the exploratory analysis, I conducted a bibliometric analysis of the 188 articles in the dataset. Bibliometrics is a statistical method that analyzes large volumes of bibliographic data to identify patterns and themes (Aria & Cuccurullo, 2017). It offers a systematic, transparent and reproducible analysis based on the statistical measurement of research activity (Broadus, 1987; Diodato, 1994; Pritchard, 1969). It is a useful approach to conduct structured analysis to infer trends over time, identify themes and shifts in the literature, and to evaluate the ‘big picture’ of extant research (Aria & Cuccurullo, 2017; Crane, 1972). It helps with the difficult task of accumulating and synthesizing knowledge, especially when the research is fragmented.

To begin the analysis, I gathered the bibliometric data of the articles from the Web of Science database. I imported this data in R and used the *bibliometrix* package (Aria & Cuccurullo, 2017) to carry out the analysis. I used various functions to perform descriptive analyses, as well as co-citation and keyword co-occurrence analyses. I also generated informative maps, such as a ‘historiograph’ and a thematic evolution map. Together, the analyses help uncover the conceptual structure of the literature on platform governance. I provide the bibliometric findings below.

Descriptive Analysis

Figure 2.4 illustrates the growth of peer-reviewed articles that substantively consider platform governance. As the figure indicates, there is a growing interest in platform governance research, with the number of articles having grown exponentially in recent years. These 188 articles have been published in a wide variety of journals that cater to different disciplines. Figure 2.5 lists the top 10 journals with the most articles published in this research area. The high impact factor of these journals indicates that this research is highly relevant and that it will only draw more attention in the future.

Figure 2.4. Publications Per Year: 2003 - 2023

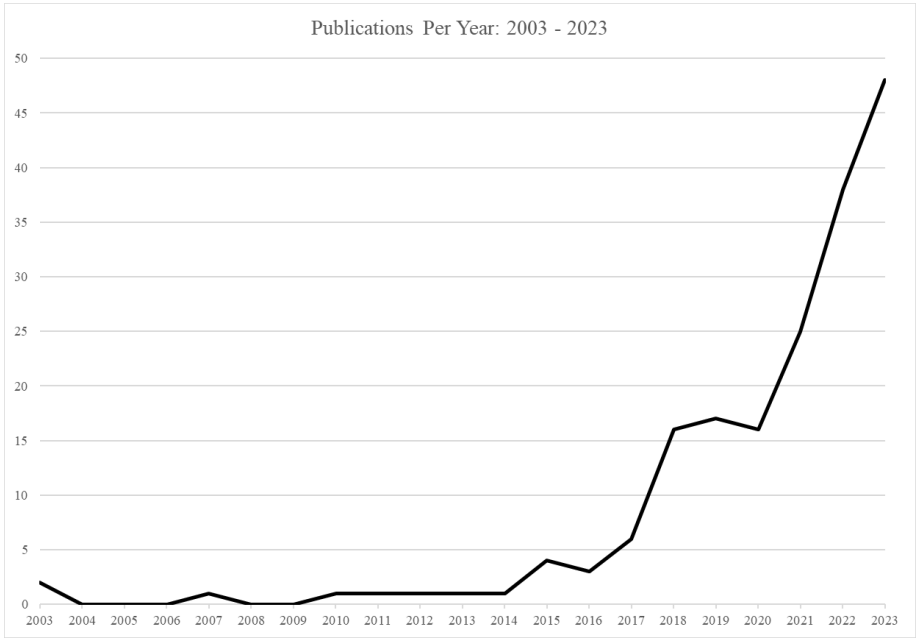


Figure 2.5. Top 10 Journals

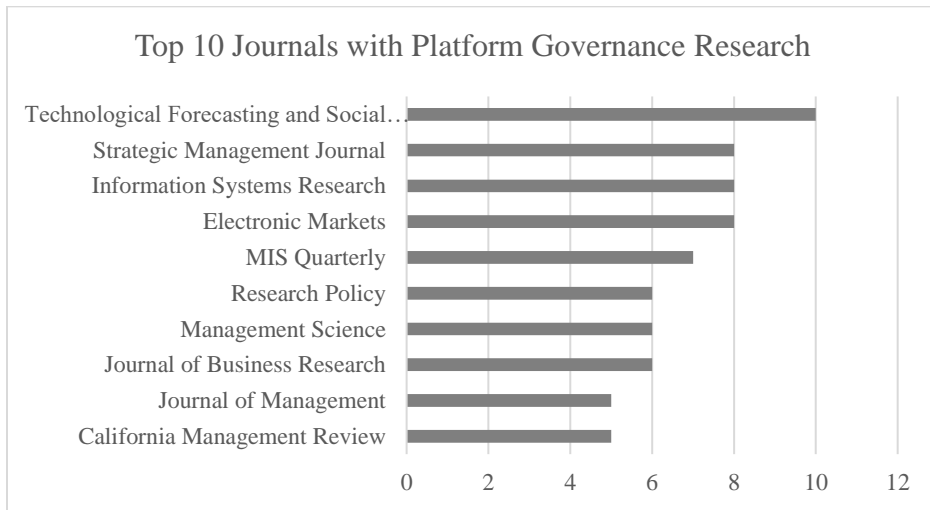


Figure 2.6. Three-Field Plot (An Overview)

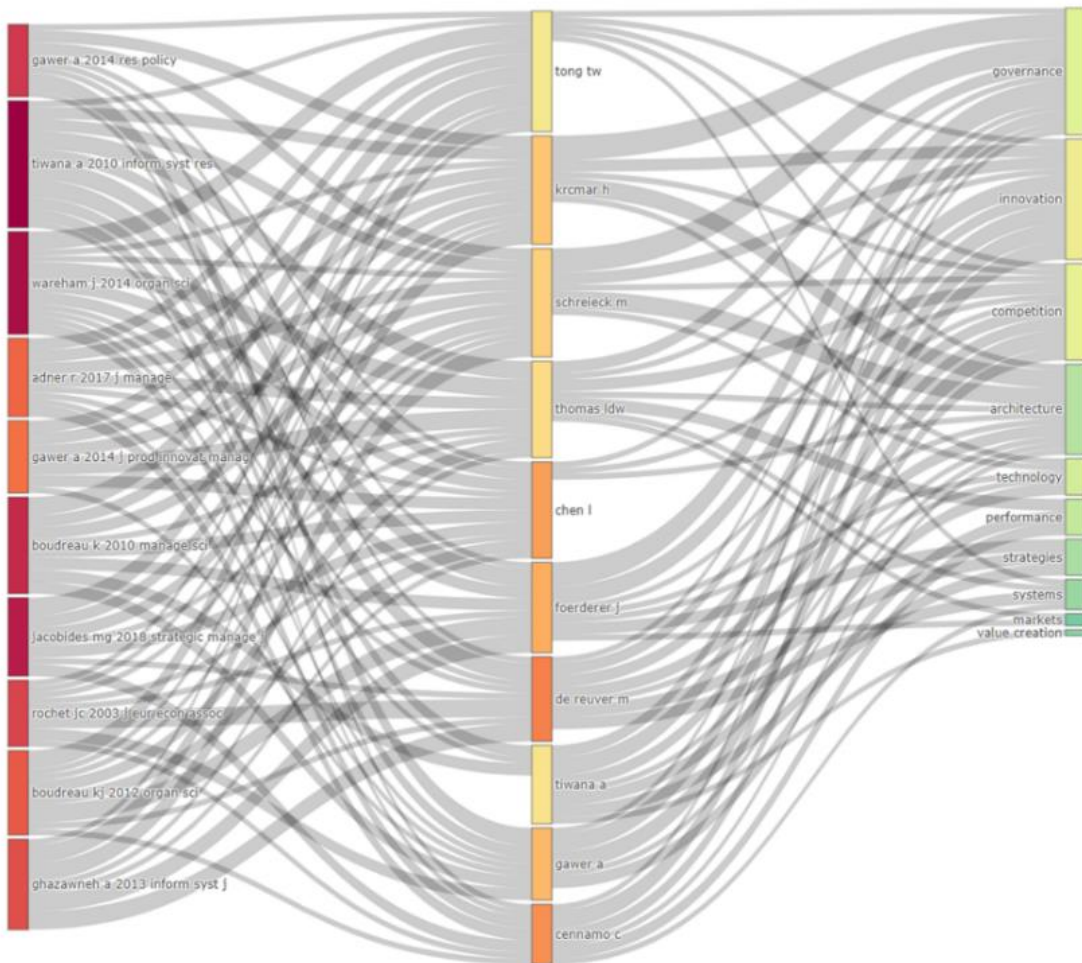


Figure 2.6 additionally offers a visual overview of the literature in the form of a three-field plot which lists (1) the most cited references on the left; (2) the most active/productive contributors in the middle; and the (3) the most studied topics on the right. The plot is rather insightful in that it illustrates the relationships between each aspect (in terms of inflows and outflows) and also highlights the relative importance of each aspect in terms of color, with the deeper tones reflecting greater numbers. For example, it shows that de Reuver M, Cennamo C, Chen L, Foerderer J, Gawer A, and Krestchmer H are among the most active authors in this space, and that together they have contributed towards an understanding of platform governance and related topics such as innovation, competition, architecture, performance, and value creation. The plot also indicates that they draw heavily on the works of Tiwana et al. (2010) and Wareham et al. (2014) among others (more on this in the following sections).

Co-citation Analysis

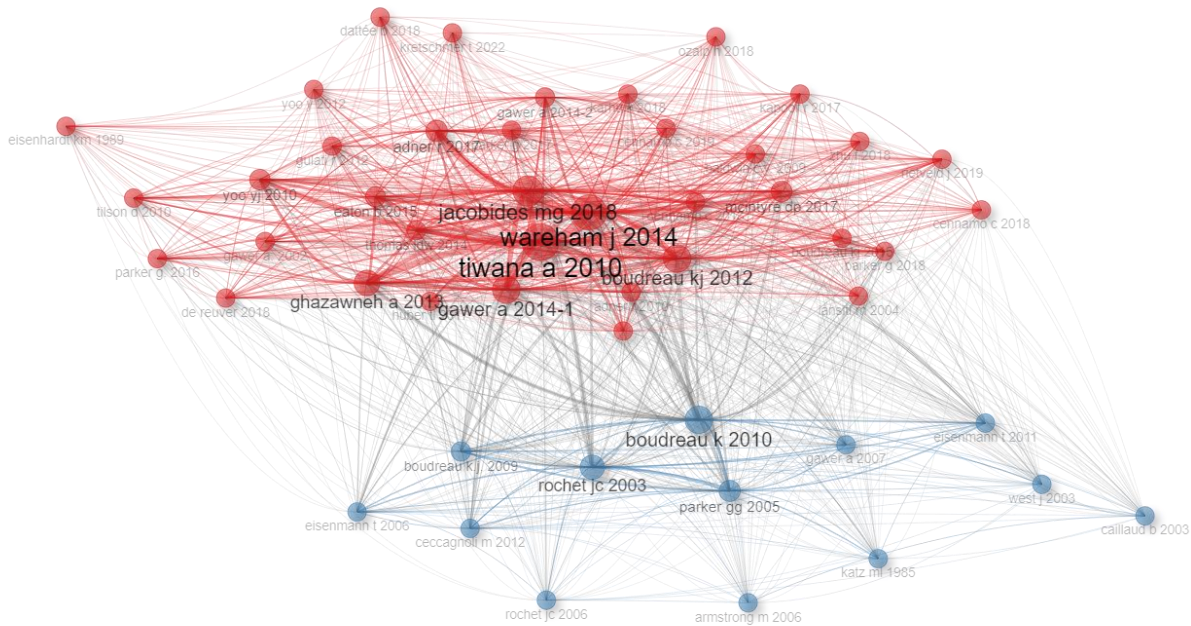
Following the descriptive analysis, I conducted a co-citation analysis using the *biblioNetwork* function (Aria & Cuccurullo, 2017). This analysis helps identify relationships between articles based on the frequency with which they are cited together by others (Batagelj and Cerinšek, 2013). It explores the notion that articles that are cited together are likely to be related in some manner. In essence, co-citation analysis enables the mapping of intellectual structures within a field (Small, 1973).

The co-citation network map (Figure 2.7) reveals two distinct, but related, clusters. The blue cluster reveals that scholarship in the economics domain (e.g., Rochet & Tirole, 2003; Caillaud & Jullien, 2003; Armstrong, 2006; Katz & Shapiro, 1985) forms the foundation on which the platform governance literature is based. Much of this work relates to platform competition and the related concept of network effects, whereby platform value for one side depends on the number

of users on the same side (direct network effects), as well as the users on the other side (indirect network effects) (Rochet & Tirole, 2003). This cluster also reveals foundational works in the management field, such as the work by Parker & Van Alstyne (2005), Eisenmann et al. (2006), Boudreau & Hagiu (2009) and Ceccagnoli et al. (2012). This scholarship is within the same cluster as the economics articles due their similar focus on network effects within two-sided platforms.

As can be seen in the network map, Boudreau’s (2010) work on openness in platforms is perhaps the most important work in this cluster, as it forms one of the strongest direct links to the red cluster. The red cluster indicates that Tiwana et al. (2010) and Wareham et al. (2014) are central within the co-citation map, demonstrating their significant influence in the research domain. Ghazawneh & Henfridsson (2013), Jacobides et al. (2018) and Gawer (2014) similarly stand out as some of the highly cited articles.

Figure 2.7. Co-citation Network

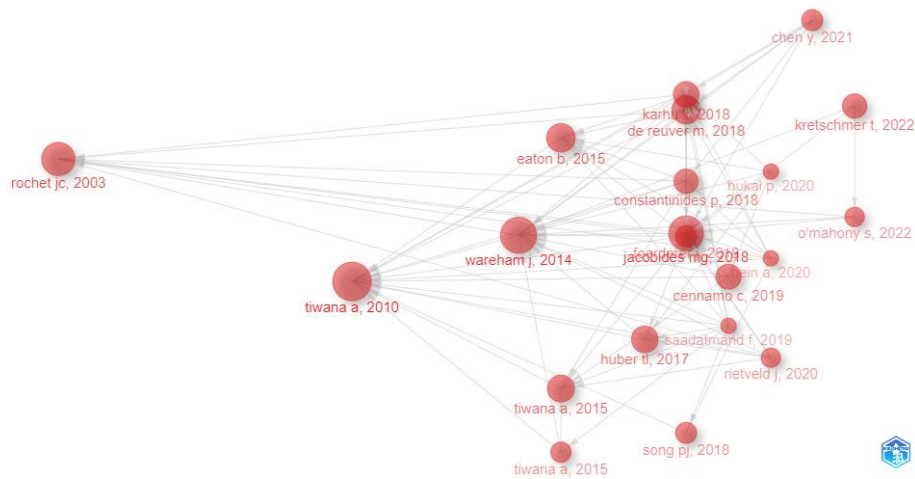


Historiograph

To complement the co-citation analysis, I also performed a historiographic analysis (Garfield, 2004), as seen in Figure 2.8. I used the *histNetwork* and *histPlot* functions to plot a chronological citation network, referred to as a historiograph, which represents a chronological map of the most relevant citations (Aria & Cuccurullo, 2017).

This analysis reveals that the work on platform governance originates from the economics domain, primarily through the work of Rochet & Tirole (2003). Later, the information systems (IS) literature formally introduced the concept through the work of Tiwana, Konsynski & Bush (2010) and Wareham, Fox & Giner (2014) who were the first to define the concept and recognize it as a distinct aspect of platform organizing. Several IS scholars, including Eaton, Elaluf-Calderwood, Sørensen & Yoo (2015), along with Huber, Kude & Dibbern (2017) followed with notable contributions. This resulted in a growing body of work, with platform governance eventually making its way into the strategic management field. Here, Jacobides, Cennamo & Gawer (2018) were among some of the first scholars to contribute in this direction. It is interesting to note that while management scholars cite Rochet & Tirole (2003), the IS scholarship does not cite this seminal work, further reinforcing insights from the co-citation analysis, where the work of IS scholars did not form part of the blue cluster, despite being among the first to formally introduce and define platform governance as a construct.

Figure 2.8. Historiograph



Keyword co-occurrence analysis

Next, to get a sense of the topics in the platform governance literature, I conducted a co-word network analysis using the articles' keywords. The purpose of this analysis is to develop a conceptual structure using a word co-occurrence network to map and cluster keywords (Aria & Cuccurullo, 2017). This analysis captures relationships between relevant concepts based on their co-occurrence in a set of articles. The results are interpreted based on the relative position of the nodes and their distribution, such that the more similar the words in distribution, the closer they are represented on the map (Cuccurullo, Aria, & Sarto, 2016). Likewise, the size of the nodes represent the frequency of the keyword, such that the greater the node, the higher the frequency.

The network map in Figure 2.9 reveals two distinct clusters. The first cluster (in green) reveals the centrality of innovation to the work on platform governance. It is associated with concepts like coordination, cooperation, value creation, performance, and capabilities. The centrality of innovation suggests that although the research on platform governance includes a wide variety of platforms¹³ (as illustrated in the exploratory analysis), there is a much greater focus

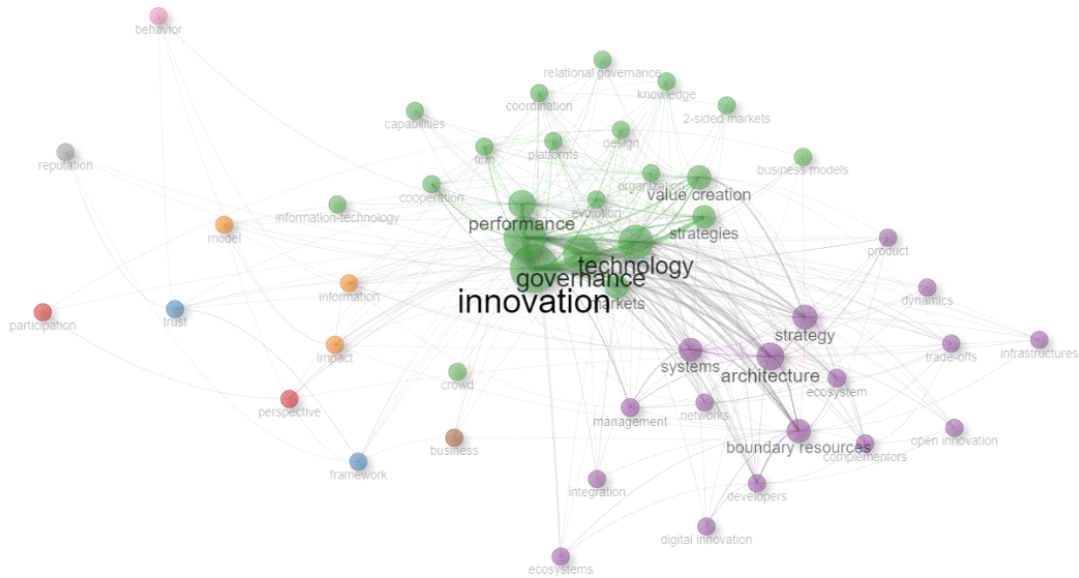
¹³ Many of which do not concern innovation, such as digital labor platforms in the gig economy.

on innovation within the scholarship. This work concerns the governance of complementors in particular (and therefore, there is less focus on the governance of other actors such as users).

The second cluster (in purple) relates to platform architecture. This is not surprising as most of the initial work on platforms in the information systems domain emphasizes the importance of *both* architecture and governance (e.g., Tiwana et al., 2010). Closely tied to this scholarship is the work on boundary resources, which refer to interfaces that connect actors with platforms (Ghazawneh and Henfridsson, 2013).

The map also reveals some topics such as trust and reputation that share weak links with the two main clusters. Although connected (and therefore relevant), they are not as closely tied. As such, they reveal areas for potential future research. Efforts can be undertaken to bridge these gaps and therefore better integrate them with the main topics (more on this later).

Figure 2.9. Keyword Co-occurrence Network

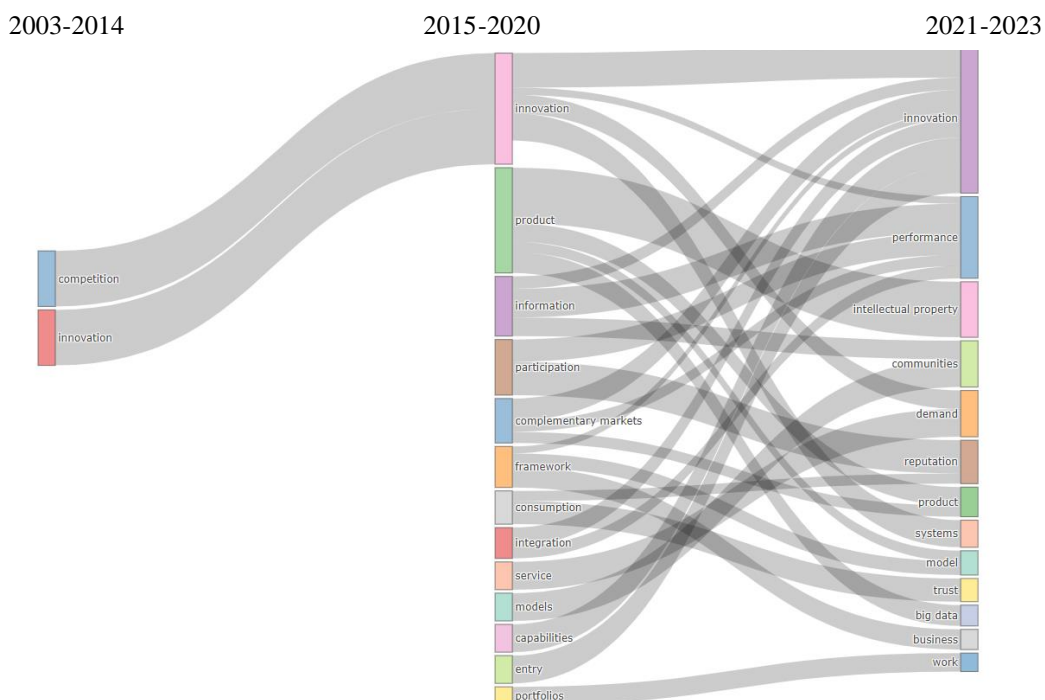


Thematic Evolution

As the final step in the bibliometric analysis, I generated a conceptual thematic map, as seen in Figure 2.10. Such maps illustrate the evolution of the different topics (or themes) in the dataset. They help identify how different topics in the literature either converge into specific themes, or how they diverge into multiple themes over time (Carst & Hu, 2023).

To generate this map, I first separated the period (2003-2023) into three separate intervals: 2003-2014, 2015-2020 and 2021-2023 (based on the trends highlighted in Figure 2.4). As Figure 10 illustrates, innovation has been a central theme across the three intervals, with its importance only growing throughout the literature's evolution. It also reveals that the limited work on platform governance until 2014 was largely focused on innovation and competition; and that after 2015 it grew in several directions, with scholars studying a variety of relevant topics such as complementary markets and capabilities. As the scholarship grew further between 2021-2023, more concrete topics were studied such as performance, intellectual property and communities, all of which helped develop a deeper understanding of platform governance.

Figure 2.10. Thematic Evolution



Taken together, the bibliometric findings demonstrate that interest in platform governance has garnered interest from scholars across several disciplines and this interest is rapidly growing. They also offer insight on the conceptual structure of the literature, indicating that platform governance involves the study of a large variety of topics, of which innovation is the most central.

PART III: CONTENT ANALYSIS

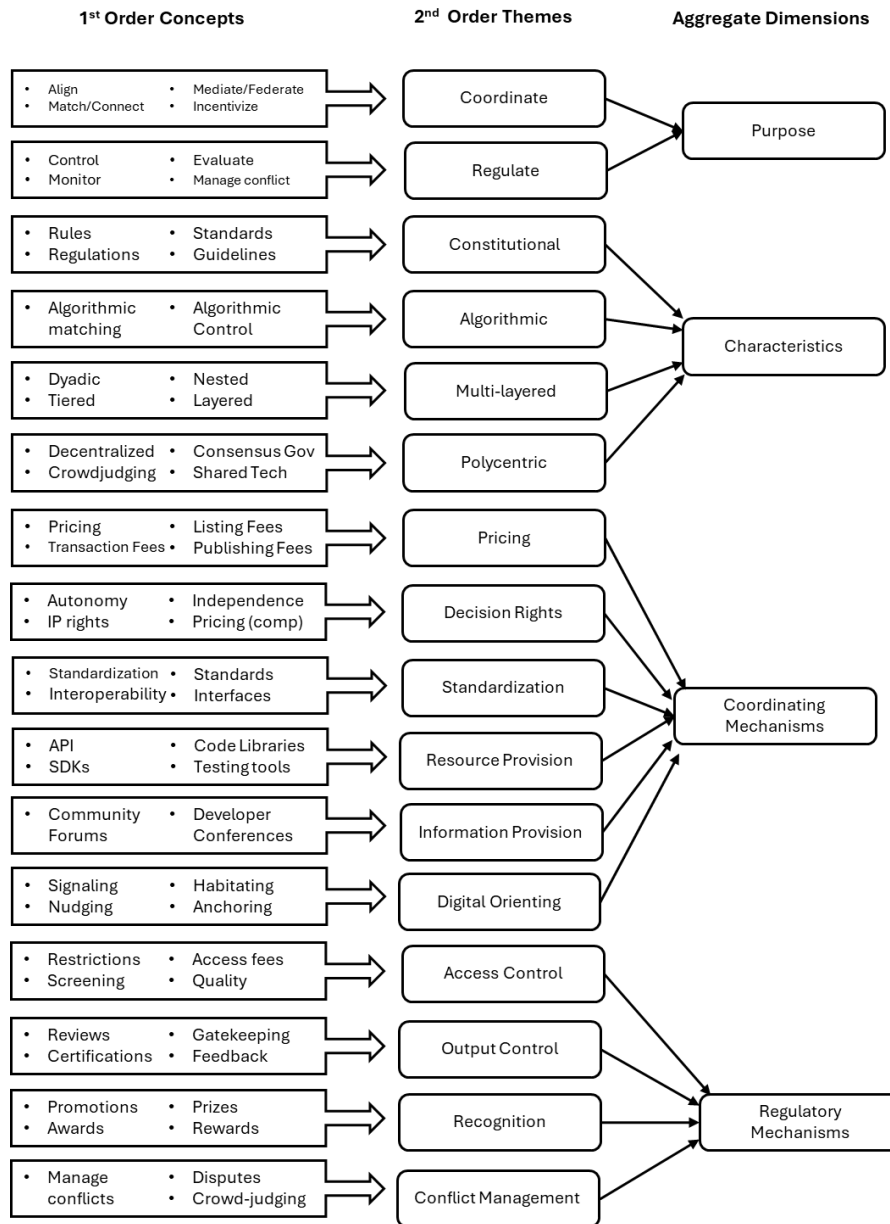
In the final stage of the literature review, I carried out an in-depth qualitative content analysis. I started the content analysis by reading the 188 articles, and carefully constructing a coding scheme in NVivo, a qualitative data analysis software. I followed an iterative approach by moving back and forth between the data (articles) and relevant theoretical frameworks, focusing on conceptually relevant items (Duriau, Reger, & Pfarrer, 2007; Schilke et al., 2018). Based on a random sample of 20 articles, I developed initial coding sheets for classifying extant literature into relevant concepts and themes. As I analyzed additional articles, I continued to hone the coding schemes by collapsing, dropping and adding categories.

While coding, I paid attention to both the current state of knowledge, as well as recommendations for future research. For the latter, I followed Schilke et al. (2018) and coded the limitations identified by authors in extant literature. This allowed me to offer a bottom-up insight into what the field as a whole considers to be opportunities for future research (Brutus, Aguinis, & Wassmer, 2013; de Jong, Kroon, & Schilke, 2017). I further augmented the coding with my own assessment of the literature, both while synthesizing the current state of knowledge and identifying areas for future research.

After coding the 188 articles, several themes emerged, revealing that platform governance literature has covered a variety of areas, including: the *purpose* of platform governance; the

characteristics of platform governance; the *antecedents* that influence platform governance; the large number of *mechanisms* through which platform governance is enacted; the *consequences* (or outcomes) of platform governance; as well as the *moderators* of the relationship between governance mechanisms and outcomes (See Figure 2.11 for part of the Data Structure).

Figure 2.11. Data Structure (Partial)



Informed by the content analysis (and previous insights from the exploratory and bibliometric analyses), I present the findings in three parts. I start by clarifying the conceptual contours of platform governance by elucidating its purpose and characteristics, as well as offering a clearer definition. Next, I introduce an organizing framework that encompasses the antecedents, mechanisms, consequences and moderators identified in extant platform governance scholarship. I conclude by highlighting gaps in the literature that merit further study to improve our understanding of platform governance.

Platform Governance: Clarifying The Construct

The content analysis reveals that although there is a growing body of research on platform governance, there is yet to be convergence on a *definition*. As Table 2.4 highlights, platform governance has been defined in a plethora of ways. For example, Tiwana et al. (2010) describe it as “who makes what decisions about a platform” (p.679), Song et al. (2018) define it as “the policies and mechanisms through which a [platform firm] exerts influence over participants” (p.125), while Chen et al. (2022) refer to it as “how platform owners utilize rules, constraints, and inducements to address market failures and enable interactions” (p.631).

Moreover, scholars use a variety of terms to describe platform governance, such as “orchestrating”, “shepherding”, “managing”, “shaping”, “federating”, “mediating” and “guiding”. Many of these terms evoke a sense of influence that is indirect and distinct from more traditional governance, emphasizing the fact that platform firms do not have direct authority over ecosystem participants, unlike more traditional contractual relationships (such as employee-employer), where the firm can utilize more direct means to govern actors. While many of these terms are used to describe the uniqueness of platform governance, at times, they are used interchangeably with the term “governing”, causing confusion and a lack of consistency in terminology.

Table 2.4. Definitions of Platform Governance

Article	Definitions of Platform Governance
Tiwana et al. (2010)	We define platform governance as who makes what decisions about a platform.
Wareham et al. (2014)	Cultivating an ecosystem of complementors for generativity through purposefully designed governance mechanisms that promote contributions of autonomous actors.
Song et al. (2018)	Platform governance in software platforms refers to all policies and mechanisms through which a software platform operator exerts influence over participants on both sides and coordinates operations in the ecosystem (Tiwana et al., 2010).
Zhang et al. (2020)	Platform governance broadly concerns the design and deployment of governance choices , including decision rights, incentive structures, and control mechanisms (Tiwana, 2013).
Chen et al (2022)	...platform governance, that is, how platform owners utilize rules, constraints, and inducements to address market failures and enable interactions (Boudreau & Hagiu, 2009; Zhang, Li, & Tong, 2020).
Islam et al. (2023)	Platform governance consists of a set of overarching rules, constraints, and inducements that platform owners develop and utilize to address information asymmetries and market dynamics in coordinating and deploying co-specialized capabilities that they share with participants of the platform (Boudreau and Hagiu, 2009; Zhang et al., 2022).
Kang & Suarez (2023)	Platform governance refers to the extent to which a platform cedes decision rights to complementors or other stakeholders, regarding platform attributes and arrangements (Boudreau, 2010; Chen et al., 2022...)
Karhu et al. (2018)	Platform governance refers to the mechanisms through which a platform owner exerts influence over other actors in the ecosystem, such as app developers (Tiwana 2013).
Reiter et al. (2024)	Ecosystem governance is the collective set of decisions that affects the relationships among firms participating in an ecosystem (Rietveld et al., 2020; Wareham et al., 2014).
Wagener et al. (2021)	Governance pertains to the strategic management of control and coordination mechanisms (Gol et al. 2019b), including systems for data-driven match-making services, managing requirements, tasks, incentives, contracts, periodical evaluation, quality assessment, conflict resolution, worker reputation, and accountability of clients (Du and Mao 2018; Gol et al. 2019b).

Given the diversity of platforms, scholars also offer different perspectives on the *purpose* of platform governance (Table 2.5). For instance, Kang & Suarez (2023) suggest that “the goal of platform governance is to orchestrate and nurture the ecosystem of complementors and other stakeholders” (p.1770), Chen et al. (2021) state that platform governance is required to “align incentives, coordinate actions, mitigate conflicts and foster a common identity” (p.1313), while Gol et al (2019) suggest that the purpose of platform governance is “to mediate between sides, moderate content, coordinate and control the workflow” (p.176). Furthermore, while some scholars identify the importance of governing both sides of a platform (e.g., Song et al., 2018; Jia

et al., 2021), particularly when discussing transaction platforms (such as digital labor platforms), others focus exclusively on governance in relation to complementors (e.g., Tiwana et al., 2010; Jacobides et al., 2018), largely highlighting its role in fostering innovation.

Table 2.5. Purposes of Platform Governance

Article	Purposes of Platform Governance
Kang & Suarez (2023)	The goal of platform governance is to orchestrate and nurture the ecosystem of complementors and other stakeholders for the platform’s value creation and appropriation (Karhu et al., 2018; Wareham et al., 2014).
Chen et al (2022)	...to address market failures and enable interactions (Boudreau & Hagiu, 2009; Zhang et al., 2020).
Islam et al. (2023)	... to address information asymmetries and market dynamics in coordinating and deploying co-specialized capabilities (Boudreau and Hagiu, 2009; Zhang et al., 2022). ... platform governance is a critical factor that can reduce opportunistic behavior, develop trust, and reduce conflict among platform partners.
Karhu et al. (2018)	The goal of platform governance should be to orchestrate , rather than direct (Williamson and Meyer 2012), and cultivate an ecosystem of complementors for innovation (Wareham et al. 2014).
Gol et al. (2019)	... mediate between sides, moderate content, coordinate and control the workflow (Gillespie, 2017).
Chen et al (2021)	... align incentives, coordinate actions, mitigate conflicts, and foster a common identity and thus can be critical to platform performance (Di Tullio & Staples, 2013; Gawer & Phillips, 2013; Kyprianou, 2018; Reischauer & Mair, 2018; Tiwana et al., 2010; Wareham et al., 2014).
O’Mahony & Karp (2022)	... orchestrate the participation of external complementors dependent on the platform (Parker & Van Alstyne, 2017).
Ma et al. (2020)	... to resolve conflict between exchange parties (Eisenmann et al. 2006).

While the diversity of perspectives adds richness (and some variance is to be expected), too much diversity risks theoretical fragmentation. Therefore, it is important to appropriately define platform governance and its purpose, especially because a construct needs to “distill phenomena into sharp distinctions that are comprehensible to a community of researchers” (Suddaby, 2010, p. 346). As such, in this section I undertake efforts to clarify the conceptual contours of platform governance and work towards a clearer definition in order to synthesize and add structure to the literature.

Clarifying Purpose. Drawing on my findings, I suggest that platform governance serves two primary functions: (1) coordination and (2) regulation.

(1) Coordination. The coordination function of platform governance subsumes a variety of purposes highlighted in the literature, including incentivizing, aligning, mediating and federating. In simplest terms, coordination involves the bringing together of actors' contributions effectively (Gulati, Wohlgezogen, & Zhelyazkov, 2012). It is broadly understood in the social sciences as the linking, meshing, synchronization, or alignment of actions (Aiken, Dewar, DiTomaso, Hage, & Zeitz, 1975; Okhuysen & Bechky, 2009). In an inter-organizational context, coordination can be defined as the “deliberate and orderly alignment or adjustment of actors’ actions to achieve jointly determined goals” (Gulati et al., 2012, p. 537) through “mutually consistent decisions” (Simon, 1997, p. 190). It can also be defined as the “the act of working together harmoniously” (Malone and Crowston, 1990, p. 5)

In platform ecosystems, coordination is vital to align the interest of all the autonomous actors participating in the ecosystem. In the literature, coordination is consistently referred to as a key function of platform governance that is enacted through a variety of mechanisms. As Jacobides, Cennamo and Gawer (2018) highlight, it is the significant need for coordination across a heterogenous set of independent yet interdependent actors that cannot be dealt with in markets, and at the same time does not require traditional hierarchical control, which drives ecosystem emergence in the first place.

Platform coordination is uniquely challenging because the platform firm does not have formal authority over the platform sides, in contrast to managing employees in a traditional organization, subsidiaries in a business group, or partners in a supply chain, where actors are bound

by legal employments, ownership structures and contractual relationships, respectively (Leong et al., 2023).

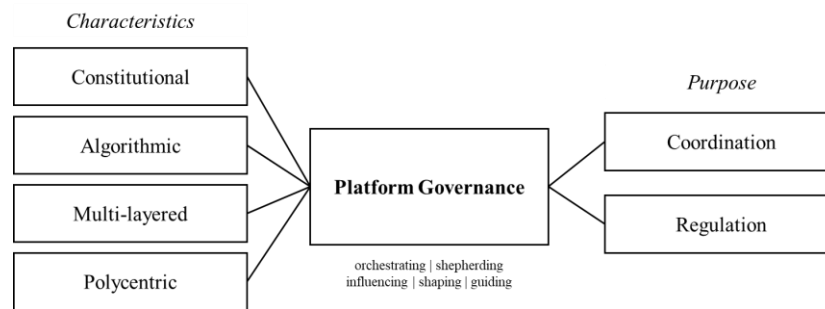
(2) **Regulation.** The regulatory function of platform governance subsumes a variety of purposes highlighted in the literature, including monitoring, evaluating, rewarding, punishing, and managing conflicts. Much like a government regulator that runs an economy, a platform firm regulates the behavior of platform users through setting rules (Teh, 2022). Platform firms are in a unique position to be “focal, private regulators by virtue of the one-to-many asymmetric relationship between them and the other [actors]” (Boudreau & Hagiu, 2009, p.4). In a sense, they have “bouncer’s rights” (Strahilovetz, 2005) such that they have the power to set the terms of access. They “impose rules and constraints, create inducements and otherwise shape behaviors” (Boudreau & Hagiu, 2009, p.3), thus acting like licensing authorities (Rochet & Tirole, 2004) that regulate interactions among ecosystem members to increase productivity (Iansiti & Levien, 2004).

As private regulators, platform firms set and enforce rules of engagement in order to regulate the conduct of ecosystem actors and reduce negative externalities created by them (Boudreau & Hagiu, 2009; Cutolo & Kenney, 2021). Platform firms seek to “regulate uncivilized behaviors” (Jia et al., 2018, p.9) by imposing restrictions such as denying entry or punishments like loss of reputation if platform rules are violated (Blackburn et al., 2023). In addition to monitoring and punishing deviant behavior, regulation also involves ‘engagement behavior recognition’ which rewards participants for actively engaging with the platform (Yin et al., 2023). In a nutshell, the regulatory function of platform governance serves to punish bad behavior, reward desirable behavior, and promulgate standards of behavior among ecosystem actors (Tiwana, 2013; Evans & Schmalensee, 2007).

A Comprehensive Definition. Based on the two distinct purposes identified, I suggest the following comprehensive definition: *Platform governance refers to the design, deployment and enforcement of mechanisms through which a platform firm exerts influence on ecosystems actors in an effort to coordinate and regulate ecosystem activity.* This definition includes all ecosystem actors and applies to all contexts covered in the content analysis.

Platform Governance Characteristics. Platform governance has several unique characteristics that set it apart from more traditional forms of governance. In synthesizing the literature, I have distilled them into four key characteristics: Platform governance is (1) constitutional, (2) algorithmic, (3) multi-layered and (4) polycentric (Figure 2.12).

Figure 2.12. Clarifying the Construct



(1) Constitutional. Platform governance is constitutional in nature, such that instead of detailing specifications of behaviors and outcomes (as in traditional contractual governance), it utilizes rules and clearly agreed upon decision rights to preserve high-powered incentives, while providing room for innovation and discovery. Through a form of community governance, platform firms seek to “maintain the commons” by devising rules which members are willing to voluntarily commit to, and by ensuring compliance to these rules (Ostrom, 1990; Bridoux & Stoelhorst, 2020). These rules and regulations function as a charter, the adherence to which guarantees participation and rewards, and the non-compliance of which results in punitive action/consequences.

(2) *Algorithmic*. Enabled by the unprecedented speed, scale and prevalence of technologies involving data processing and machine learning, platform governance involves the use of algorithms to shape behavior and relationships between actors (Orlikowski & Scott, 2015; Kellogg et al., 2020; Basukie et al., 2020; Curchod et al., 2020; Bucher et al., 2021). These algorithms can come in the form of location monitoring and game-like inducing tools such as those used by ride-hailing platforms like Uber (Jeronimo et al., 2022), or algorithms that helps match buyers with sellers, as well as search-ranking algorithms (Koo & Eesley, 2021).

These algorithms facilitate a form of control that is distinct from the bureaucratic control used by employers of the past century (Kellogg et al., 2020; Bucher et al., 2021). Here “action is controlled ...by shaping an environment in which there are only programmed alternatives to performing the work” (Aneesh 2009, p.356). As governance mechanisms become increasingly embedded in algorithms (Kallinikos et al., 2013; Reuber & Fischer, 2022), the literature on algorithmic management encompasses both discussions of flexibility and autonomy as well as more critical debates on control and surveillance, especially since these algorithms are characterized by an inherent opaqueness driven by a lack of disclosure (Bucher et al., 2021; Burrell, 2016; Orlikowski and Scott, 2014).

(3) *Multi-layered*. Although much of the initial scholarship on platform governance examines ecosystem-wide rules, there is increasing recognition that platform firms enact governance differently under certain scenarios. For example, Huber et al. (2017) emphasize the importance of dyadic, complementor-specific governance as a supplement to the more arms-length governance approach, especially when responding to local needs. They highlight the use of ‘partner levels’, where complementors are governed differently depending on the level they self-select into. For instance, some levels may have access to more valuable resources, or have more

demanding entry requirements than other levels (Huber et al., 2017). Similarly, Reiter et al. (2024) demonstrate how platform firms create “distinctly governed tiers of complementors based on the domains of uncertainty underlying their ecosystem blueprint” (p.1) and in doing so show how governance tiers blend elements of ecosystem-wide and complementor-specific governance.

Constantinides et al. (2018) aptly describe such governance as multi-layered, in that different sets of interactions are governed differently by the platform firm. For instance, multi-layered governance can involve governing consumer-consumer interactions, complementor-complementor interactions, consumer-complementor interactions, as well as platform-complementor interactions. Here, governance is nested into a series of layers, in line with the layered, modular architecture; with each layer of interactions is governed independently from others (Constantinides et al., 2018).

(4) Polycentric. A key aspect of platform governance is the degree of decentralization, which refers to the extent to which decision rights and control are shared between the platform firm and platform participants (Bardhan, 2002; Faguet, 2014; Chen et al., 2021). Although most platform ecosystems adopt a more centralized governance structure where the central actor (i.e., the platform firm) retains control over the ecosystem, many of these platforms share decision-rights with platform participants, reflecting some degree of decentralization.

Such governance is said to be polycentric in that it is characterized by many centers of decision-making that are formally independent of each other (Ostrom, 1990). Polycentric governance highlights the importance of systems that are governed by resource users themselves, often as a means to manage cooperative collectives that involve common-pool resources (Ostrom, 1990; Bridoux and Stoelhorst, 2022; Klein et al., 2019). Polycentricism is essentially viewed as an

alternative to both a completely centralized approach, as well as a fully decentralized approach (Bridoux and Stoelhorst, 2022; Klein et al., 2019).

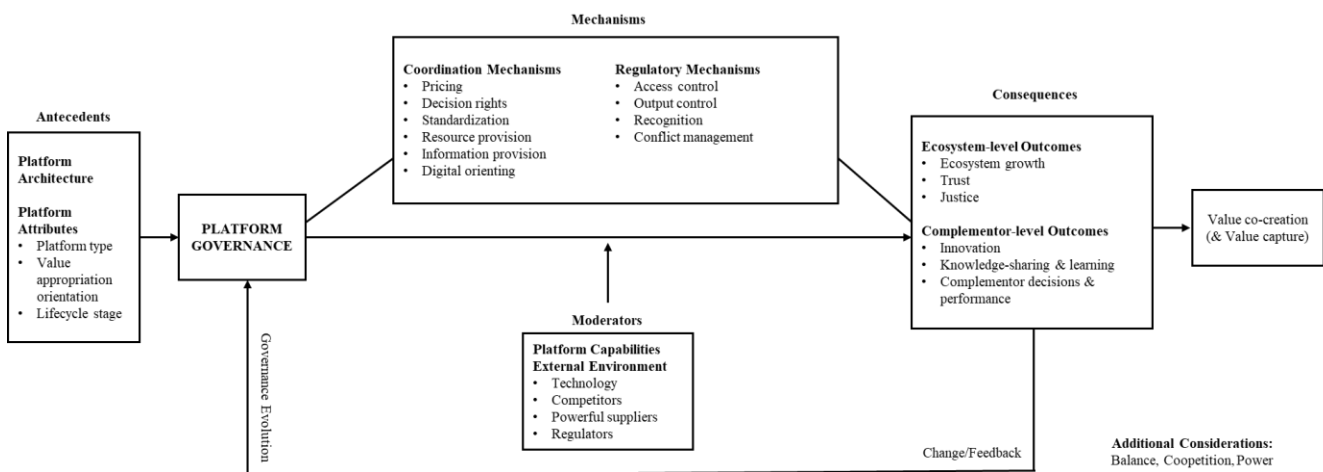
Platforms are increasingly making use of more consensus-based governance to carry out different governance tasks such as conflict management, reflecting a greater degree of polycentricism. Consider for example the use of crowd-judging, whereby disputes are adjudicated by a panel of volunteers. Instead of more traditional centralized approaches of dealing with dispute resolution, platforms like eBay and Taobao are experimenting by using ecosystem participants to settle disputes (Kwan et al., 2024; Papanastasiou et al., 2023).

Over the past decade, the rise of blockchain technology – also known as distributed ledger technology (Sunyaev, 2020) – has also led to the emergence of a growing number of increasingly decentralized platforms that are governed less by platform firms and more through community efforts (Chen et al., 2021). Blockchains essentially enable the decentralization of transaction validation (Catalini & Gans, 2016; Trabucchi et al., 2020), which enhances transparency and reduces the need to trust remote parties, thus facilitating shared governance of information resources (as it is very difficult for a single party to corrupt the resources without others noticing) (Leiponen et al., 2022). In such platforms, ecosystem participants collectively enjoy full governance control (Chen et al., 2021; Ostrom, 1990). By removing decision-making bottlenecks, decentralized polycentric governance improves efficiency and allows of smoother coordination of workflows (Gol et al., 2019).

The Current State of Platform Governance Research: An Organizing Framework

A multitude of studies have contributed to our understanding of platform governance. In this section I integrate the various findings by formulating an organizing framework that encompasses the antecedents, mechanisms, moderators and consequences of platform governance, as identified in current scholarship (Figure 2.13).

Figure 2.13. Platform Governance Research: An Organizing Framework



Antecedents. Extant scholarship has identified several antecedents that influence platform governance decisions. These include (1) platform architecture and (2) a variety of platform attributes.

(1) Platform Architecture. First and foremost, scholars recognize that platform governance is inseparable from platform architecture, which refers to the technological foundation of the platform. Typically, platforms have modular architectures that enable autonomous actors to work independently on separate components of the ecosystem’s value proposition (Baldwin & Woodard, 2009; Jacobides et al., 2018). Modularity acts as a mechanism to break down complex interdependencies to a more simplified form that reduces coordination frictions.

Scholars emphasize that a platform's architecture shapes the choice of governance mechanisms used, and that an alignment between them is necessary for the ecosystem to function properly (Tiwana et al., 2010). The design and improvements to a platform's architecture shapes the general environment in which interactions takes place, and therefore, the architectural development of the platform cannot be completely separate from platform governance (Song et al., 2018; Tiwana et al., 2010; Tiwana, 2013).

(2) *Platform Attributes*. A variety of platform attributes play a role in influencing governance decisions made by platform firms. First, the *type* of platform determines the kind of governance mechanisms utilized. For instance, transaction platforms such as eBay and Taobao require more mechanisms oriented towards dispute resolution (between buyers and sellers) in cases where sellers act opportunistically and engage in dishonest behaviors (Kwan et al., 2024). In contrast, innovation platforms like Apple's iOS platform do not require the adjudication of disputes in the same manner. Here, poorly performing complementors eventually exit the ecosystem themselves. Such platforms rely more heavily on mechanisms that encourage innovation, given the goal of the ecosystem.

Similarly, a platform's *value-appropriation orientation* can shape its governance decisions (Rietveld et al., 2020). For instance, Apple and Valve are fully focused on maximizing shareholder value, while Kickstarter (public benefit corporation) and Kiva (non-profit) also contribute to public welfare. Rietveld et al. (2020) show that the implementation of governance changes is more pronounced when the platform firm has a stronger orientation toward creating value for shareholders rather than public welfare. As another example, community-led open-source e-commerce platforms like OpenCart do not utilize transaction fees and revenue-sharing schemes,

while software-as-a-service e-commerce platforms like Shopify rely on such mechanisms for value appropriation.

The *stage of a platform's lifecycle* also influences governance. At the early stage, the emphasis of governance is on creating favorable conditions to attract diverse actors for value creation. During this phase, governance may be more oriented towards providing incentives, with looser control since building a critical mass of complementors is of primary importance at this stage (Wareham et al., 2014). In later stages, as participation grows, platform firms may take more steps towards curbing undesirable behavior, such as by introducing stricter screening and monitoring processes (Wareham et al., 2014). They may also devise more intrusive mechanisms to better manage the ecosystem, such as controlled search or selective promotion of complementors' products to influence ecosystem value (Rietveld et al., 2019).

Mechanisms. Most of the work on platform governance involves the identification and study of particular mechanisms through which platform governance is enacted. Scholars have attempted to categorize these mechanisms in a variety of ways. For example, Tiwana et al. (2010) categorize them as (1) decision rights, (2) control and (3) propriety versus shared ownership; Chen et al (2022) categorize them as (1) incentives and (2) control; and Song et al. (2018) group them under three broad categories of (1) pricing, (2) coordination and control mechanisms and (3) platform self-development.

Scholars also differ in their emphasis and categorizations based on the type of platforms being studied. For example, in their study of crowdwork platforms, Gol et al. (2019) suggest that platform governance rests on (1) control and (2) coordination mechanisms; while in their study of social media platforms, Reuber & Fischer (2022) identify four types of governance mechanisms,

namely (1) those that regulate user behaviour, (2) those related to user identification and stature, (2) those that structure relationships among users and (3) those that direct user attention.

To bring structure to the literature, I propose organizing the mechanisms in terms of the purpose they fulfil. Accordingly, I categorize mechanisms based on whether they help coordinate or regulate ecosystem activity.

Coordination Mechanisms. A large subset of governance mechanisms enable coordination within platform ecosystems. These mechanisms help align the interests of ecosystem participants and help bring together their contributions effectively. These mechanisms involve (1) pricing, (2) granting of decision-rights, (3) standardization, (4) resource provision, (5) information provision and (6) digital orienting.

(1) Pricing. Pricing is a prominent mechanism and is one of the first mechanisms to be studied in the platform governance literature (Leong et al., 2023). Scholars in the economics tradition have largely focused on the role of pricing as a coordination mechanism (Rochet and Tirole 2003; Rysman, 2009). Much of this work examines how pricing can be subsidized on one side of the platform, in order to attract participation on the other side, thereby triggering the self-reinforcing network effects critical for launching platform ecosystems (Eisenmann et al., 2011; Islam et al., 2023).

(2) Decision-rights. Platform firms often grant participants decision rights, whereby they devolve some rights of decision-making to ecosystem actors (Tiwana, 2013; Hagiwara & Wright, 2009; Bauner, 2015). For example, decision rights may involve the right to set prices of items in a transaction platform like Amazon, or the right to set prices of complements developed in an innovation ecosystem such as Apple's App Store. In platforms where the right to decide prices has been delegated to complementors (i.e., more decentralized decision rights), complementors have

the choice to offer their complements for free, use a freemium model (that involves in-app purchases), or charge users a one-time fee or an ongoing subscription fee. In platforms where complementors do not have this right (the decision rights are more central), complement prices are set by the platform firm, thus constraining the level of flexibility granted to complementors. The degree of flexibility and discretion afforded to complementors shapes their incentives and willingness to contribute. Overall, granting such decision rights allows greater autonomy in product development, transactions and interactions with customers (Boudreau, 2010; Chen et al., 2021). It creates a stronger sense of ownership and higher degree of freedom, motivating participants to join the platform (Ye & Kankanhalli, 2018).

(3) **Standardization.** Platform governance also involves standardization as a coordination mechanism. Platform firms utilize standardized interfaces which allow knowledge to be encapsulated in modules (Zhong & Sun, 2020), providing embedded coordination for the coupling of modules (Sanchez & Mahoney, 1996). With increasing interface standardization, platform firms can involve less of their own architectural knowledge in joint value co-creation with complementors. As such, interface standardization can effectively prevent knowledge leakage (Zhong & Sun, 2020).

Additionally, when offering development tools, platform firms ensure that they are standardized. Complementors have a choice between either using these tools or creating the functionality themselves (Miric et al., 2023). By providing standardized tools, platform firms essentially simplify the product development process and help coordinate complementors' efforts. In their study of the video game market, Miric et al. (2023) show that the use of such standardized tools (i.e., game engines in this case) leads to the creation of products that are less novel, but that have higher sales on average (signalling better quality).

Developing standards is also important in collaborative platform ecosystems where independent companies in a business sector come together to develop a platform as a joint effort for mutual benefit (Costabile et al., 2022). Here, the development and enforcement of standards, in the absence of a clear platform leader, is essential for the ecosystem to succeed (Costabile et al., 2022).

(4) Resource Provision. Platform firms provide resources to ecosystem actors, to assist them in their value creating activities. The purpose is to help them achieve their goals more effectively and in alignment with the overall value proposition of the ecosystem. Boundary resources – i.e., tools that serve as the interface between the platform firm and complementors (Ghazawneh and Henfridsson, 2013), are the most studied resources in the literature. These boundary resources often come in the form of application programming interfaces (APIs), software development kits (SDKs), code libraries (Chen et al., 2022), as well as automated testing tools and integration support (Tiwana, 2013; Huber et al., 2017). They serve a coordination function by assisting actors with developing complements that are well integrated with the platform (von Hippel & Katz, 2002; Ghazawneh and Henfridsson, 2013).

Other forms of resources include marketing resources like market reports, sales templates and joint marketing campaigns (Huber et al., 2017), technical/customer support, creator tools (e.g., logo makers, name generators, video makers), advanced business resources that help with strategy and planning, as well as advanced data analytic functions.

(5) Information Provision. Platform firms also provide useful information to guide ecosystem actors and prompt desired behaviors. This information can be offered in the form of API documentation, tutorials, webinars and guides, along with platform-facilitated community forums where users can connect and interact with one another to exchange information. In their

study of mobile platforms, Choi et al (2020) demonstrate that developer communities serve as excellent sources of information for developers. Some platforms also provide opportunities for knowledge exchange through developer conferences. In his study of Apple's 2014 Developers Conference, Foerderer (2020) demonstrates that such conferences have a positive effect on stimulating innovation. He argues that such opportunities promote innovation through learning and through enabling collaborations.

(6) Digital Orienting. Another key coordinating mechanism is digital orienting. Introduced by Leong et al (2023), digital orienting refers to the mechanism by which platform firms “induce the platform sides to pursue certain actions within the space of enabled possibilities” (p.20). Here, platform firms *orient* actors towards some possibilities rather than towards others, leveraging various digital means (Leong et al., 2023).

Signalling is one means of digital orienting. It refers to the process by which a platform owner makes its strategic interests explicit and known to the platform sides, signalling its intentions about the direction of the platform (Hukal et al., 2020; Leong et al., 2023). Platform firms can use *opportunity signals*, which aim to stimulate new activity in new areas of the platform, as well as *endorsement signals*, which aim to increase activity in existing areas of the platform (Hukal et al. 2020). The selective promotion of complements is a prominent form of signalling. Here, platform firms highlight specific complements under categories like “Best New Apps” (Rietveld et al., 2019). In doing so, platform firms essentially signal that complementor activity of a certain kind is desirable (Hukal et al, 2020), thus orienting complementor activity in that direction. In a way, complementors make inferences on where to dedicate their resources by relying on the platform firms' actions. Van Angeren and Karunakaran (2023) refer to this as anchored inferential learning. Through an empirical study, they demonstrate how complementors

take a platform firm's occasional venture capital investments in (other) complementors as an indicator of the platform's future focus, and consequently direct their focus in that direction.

Leong et al. (2023) also describe habitating and anchoring as other forms of digital orienting. Here, habitating involves exposing ecosystem actors to repeated stimulus in a way that shapes their idea of the platform, naturally affecting their behavior, while anchoring refers to a process by which a platform firm deepens the actors' dependencies on the digital infrastructure "such that they can use the platform as a primary base in their entrepreneurial undertaking [even] outside the platform" (Leong et al., 2023, p. 22).

Nudging can also be viewed as a form of digital orienting. It refers to the use of subtle differences in the choice and information architecture to alter actors' behaviors without changing the option space or economic incentives (Thaler and Sunstein, 2008). In their study of Uber's use of nudges, Uzunca & Kas (2023) emphasize that Uber designs nudges to keep drivers on the road and towards areas where they are needed. They show that Uber utilizes both 'good' nudges that are transparent and easy to opt-out of, and 'evil' nudges that are obscure and misleading. They show that while drivers were more satisfied with 'good' nudges, they did not make them more productive. At the same time, the 'evil' nudges did not have any effect on driver productivity.

Regulatory Mechanisms. The other group of governance mechanisms enable the regulatory function of platform governance. These mechanisms help regulate ecosystem activity and relate to enforcing rules, monitoring activity, rewarding positive behavior, punishing undesirable behavior and managing conflicts. Specifically, these mechanisms involve (1) access control, (2) output control, (3) recognition, and (4) conflict management.

(1) Access control. Access control is a prominent mechanism that regulates the level of access to a platform (Boudreau, 2010; Halaburda et al., 2018; O'Mahony and Karp, 2022; Parker

and Van Alstyne 2018; Chung et al., 2024). It includes all the rules and regulations that stipulate who is allowed to use the platform and in what ways (Tiwana, 2013; Huber et al. 2017; Ghazawneh & Henfridsson, 2013).

Access control involves the use of access fees whereby actors incur a cost (either one-time or recurring) to use the platform. It also involves screening criteria based on which actors are either denied or granted access and entry (Tiwana, 2015; Casadesus-Masanell and Campbell, 2019). The screening processes essentially dictate who and what is allowed into an ecosystem. Charging access fees and using screening mechanisms serve as filters to weed out low-quality contributors at the early stage (Song et al., 2021).

By relaxing or tightening access, platform firms can moderate complementor activities. Existing studies suggest that increased access control results in restricted complementors exiting the ecosystem and switching to competing platforms (Eisenmann et al., 2009). Chung et al. (2024) further demonstrate that in some cases, increased access control on one platform can have spillover effects such that complementors exit *both* the restricted and (unrestricted) competing platform(s). At the same time, access control can be beneficial in encouraging complementors to improve the quality of their products (e.g., Casadesus-Masanell and Halaburda, 2014), as well as retaining higher quality complementors. For example, during the late 1980s Nintendo used licensing policies to restrict the number of game developers on its platform (Brandenburger, 1995), enabling it to retain a group of high-quality game developers (while other developers were forced to switch to Sega, a competing platform that did not enforce strict access control) (Schilling, 2003).

(2) Output control. In addition to input (or access) control, ecosystem governance involves output control, which refers to the measures that the platform firm uses to monitor, evaluate and validate output in the ecosystem (Tiwana, 2013). This is necessary for quality assurance and

reliability, and to maintain coherence in the ecosystem. Allowing all types of output in an ecosystem can jeopardize a platform's reputation and negatively impact the ecosystem's overall value proposition.

Ecosystem actors are often bound by rules and standards with which they must comply. Failure to comply with the rules can often result in restrictions being placed on use, or removal of the actor. For example, users who violate Instagram's policies and community guidelines may have their accounts temporarily or permanently suspended. Sometimes feedback systems are also used to evaluate user performance or behavior.

Output control is also important for integration purposes in innovation ecosystems (Tiwana, 2013). In these settings, platform firms use various measures to assess whether the complements adhere to specific inclusion criteria. Based on screening and review processes, the complement is either allowed or rejected on a platform's marketplace. This practice is often referred to as gatekeeping. Although some scholars view gatekeeping as a form of access control (e.g., Tiwana, 2013; Zhang et al. 2018), careful consideration makes it apparent that it is a form of output control because it evaluates fully developed complements and assesses whether they are up to the standard to be made officially available to users¹⁴. These criteria do not prevent complementors from accessing the boundary resources and trying to develop complements – instead these criteria determine whether the complements are up to the standard for being listed or not. Gatekeeping is useful to weed out complements that are potentially damaging to the ecosystem (Tiwana, 2013), and to limit competitive crowding (Boudreau & Jeppesen, 2015). This type of assessment and evaluation is used extensively by platforms like Apple that have a strict review

¹⁴ Gatekeeping is often viewed as access control because it *limits access to the complement marketplace*. Here, I highlight that it does *not* limit access to the *boundary resources* and does not affect complementors' ability to develop applications. By making assessments around the standards and requirements of the app (and making a decision based on this evaluation), gatekeeping essentially functions as an output control mechanism.

process and certification requirements that determine whether an app meets all the guidelines and standards before being made available to users (Zhang et al., 2022, Tiwana, 2013).

Platform firms also rely on feedback from users as a means to evaluate output. For instance, users may provide ratings and reviews (Choi et al., 2019), as well as reputation scores (Fan et al., 2016; Li et al., 2018) to share their personal experience and opinions regarding the quality and usefulness of complements (Chen et al., 2022). These feedback systems allow platform firms to evaluate complementor performance (Lin et al., 2019; Yi et al., 2019), and they also enable complementors to take corrective actions to further improve their output (Huang et al., 2017). This self-correction by complementors constitutes a secondary mechanism by which platform firms utilize output control to improve complement quality, and by extension, value creation (Chen et al., 2022).

(3) Recognition. The regulatory function of platform governance also includes the recognition of desirable behavior (Yin et al., 2023), which is often carried out through the granting of rewards. Rewards may be in the form of discounts or points that can be used towards future purchases. They may also include features on a platform’s promotional page (such as “Success Stories”) or badges that signify high performance.

Platform firms may offer financial incentives for high-quality contributions. They may also offer promotional rewards as continued inducements for enacting value-creating activities (Li and Agarwal, 2017). These promotional rewards come in the form of recommendations, certifications and featuring, which help selected complementors enhance their reputation, draw customers’ attention and improve sales growth (Chen et al., 2018; Huang et al., 2014). Such rewards may have spillover effects such that they incentivize other complementors to make similar high-quality contributions. In essence, offering pecuniary and non-pecuniary rewards can encourage platform

adoption and boost the performance of ecosystem actors (Ceccagnoli et al., 2012; Rietveld et al., 2019; Wen et al., 2013).

(4) Conflict Management. Managing conflict is yet another important function of platform governance. Conflicts can arise directly between ecosystem participants and the platform firm, at times resulting in disruptive behavior. For example, drivers' conflicts with Uber have resulted in periodic service disruptions¹⁵, and artisans' conflicts with Etsy over its increase in the commission resulted in an Etsy Strike¹⁶. Islam et al. (2023) highlight the importance of utilizing appropriate rules that reduce information asymmetry and build trust, as a means of reducing such conflict.

Conflicts can also arise between ecosystem participants on different sides of the platform, for instance, between consumers and sellers on transaction platforms. Adjudicating disputes between such actors is a difficult function for platform firms to manage because “on one hand, buyers and sellers expect their complaints and disputes to be resolved in a timely and efficient manner; on the other, the sheer volume of interactions occurring inside the platform often means that allocating the necessary resources to do so is prohibitively costly.” (Papanastasiou et al., 2023, p.6021). Additionally, platform firms can be criticized depending on the decision they make, since “pro-consumer outcomes come at the expense of sellers, while pro-seller outcomes disfavor consumers” (Kwan et al., 2024, p.2459). Platform firms' inability to deal with disputes appropriately can lead to loss of goodwill and cause ecosystem actors to question the platform's legitimacy, resulting in decreased participation (Papanastasiou et al., 2023; Kwan et al., 2024), and in extreme cases, failure of platforms (Islam et al., 2023).

Given the challenges associated with adjudicating disputes, several platform firms have experimented by delegating some of their conflict management function to ecosystem actors. One

¹⁵ <https://www.theguardian.com/us-news/2019/mar/22/uber-lyft-ipo-drivers-unionize-low-pay-expenses>

¹⁶ <https://www.cbc.ca/arts/the-etsy-strike-what-s-next-for-artists-and-shoppers-who-leave-the-platform-1.6420187>

such innovation is “crowd-judging” whereby platform firms crowd-source their own users to adjudicate disputes arising within the ecosystem (Kwan et al., 2024). eBay’s community court and Alibaba’s Taobao Public Jury serve this function.

Some conflicts do not require adjudication, but rather, the institution of new governance mechanisms when challenges arise. For example, Airbnb introduced an anti-discriminatory policy only after concerns were raised in the media around racial discrimination by Airbnb hosts (Farmaki & Kladou, 2020). The new policy enabled hosts to ask guests for a photo only after they had accepted the booking request (Fulwood, 2018), thus limiting hosts’ ability to be selective in who stayed in their home (Farmaki & Kladou, 2020).

Consequences. Platform governance studies examine a wide variety of outcomes, some which are at the ecosystem-level, while others are more at the complementor level.

Ecosystem-level Consequences. Outcomes of interest at the ecosystem level include (1) ecosystem growth, (2) trust, and (3) justice¹⁷.

(1) Ecosystem Growth. The most prominent outcome studied is ecosystem growth, which examines the increase in ecosystem adoption/participation. Much of the earlier work in the economics tradition has focused on network effects (Eisenmann et al., 2011; Rysman, 2009), whereby platform value for any given side depends on the number of users on the same side (direct network effects), as well as the platform’s other side (indirect network effects). As Rochet & Tirole (2003) first highlighted: “Buyers of video game consoles want games to play on; game developers pick platforms that are or will be popular among gamers. Cardholders value credit or debit cards only to the extent that these are accepted by the merchants they patronize; affiliated merchants benefit from a widespread diffusion of cards among consumers” (p.990). Network effects

¹⁷ There is work on other outcomes such as ecosystem value, but it is comparatively less than the three outcomes identified.

essentially trigger a self-reinforcing virtuous circle, which is why a key question of platform governance is “how to bring multiple sides on board” (Evans 2003, Rochet and Tirole 2006).

(2) *Trust*. Trust, which refers to a confidence in an actor’s integrity, credibility, and benevolence in an exchange relationship (Moorman et al., 1992; Barney and Hansen, 1994; Das and Teng, 1998) is vital to the functioning of platform ecosystems. Trust has been widely acknowledged in the literature as an essential element, especially in online transactions (Bart et al., 2005; Fang et al., 2014; Pavlou, 2002; Pavlou & Gefen, 2004). Trust can greatly reduce perceived uncertainty and ultimately increase commitment—i.e., the willingness to engage in long-term relationships (Guo et al., 2021; Kumar et al. 1995; Yuan et al. 2018).

In a platform setting, ecosystem participants need to trust the platform, as well as trust each other – for example, on a microsourcing platform, the microsourcer and microsourcee must trust each other, in addition to trusting the platform they participate on (Guo et al., 2021); and similarly, a buyer on a B2B platform must trust the sellers, as well as the platform itself (Liu & Gao, 2023). In their study of fakery on review platforms, Beck et al. (2023) identify five practices as essential to building trust in a platform ecosystem, namely, monitoring, exposure, community building, status endowment and identity disclosure.

Building trust has been viewed as a necessary condition in reaching critical mass, especially in the sharing economy (Rong et al., 2021). In their study of B2B platforms, Liu & Gao (2023) draw attention to the importance of building trust by limiting opportunism among sellers. They suggest that due to information asymmetry, buyers are always at an information disadvantage, because of which sellers can at times behave opportunistically by providing false product descriptions, posting deceptive advertisements and concealing critical information, among other dishonest behaviors (Liu & Gao, 2023). These behaviors can result in buyers not trusting the

platform, and therefore platform firms need to “employ effective governance mechanisms that limit opportunism among sellers and promote buyers’ trust in the platform” (Liu & Gao, 2023, p.117)

Without sufficient trust, actors do not initiate exchanges with other actors (Pavlou & Gefen, 2004; Poppo et al., 2016). In fact, the lack of trust can at times lead to platform failure. For example, Yoffie et al (2019) highlight how sellers’ lack of trust in eBay’s payment system – which was different from the payment system offered by Alibaba with Alipay – was a critical factor that led to its failure in China.

(3) **Justice.** In addition to system-level trust, platform governance also involves the enactment of justice (or perceived fairness). Several scholars have explored the importance of perceptions of fairness (or lack thereof) in platform ecosystems (e.g., Deng et al., 2016; Kwan et al., 2024; Sen et al., 2023 and Yang et al., 2019), finding that is important for ecosystem actors to feel that they are treated fairly compared to others. The perception of fairness is associated with actors’ confidence in the platform, pushing them to participate fully by sharing information, investing resources and cooperating (Liu et al., 2012).

Literatures in social psychology, organization behavior, and behavioral economics (Lind and Van den Bos, 2002) depict fairness as a key “lubricant” for reducing friction in both social and organizational relationships. In platform ecosystems, procedural justice, which refers to the perceived fairness of the process by which outcomes are reached (Greenberg, 1993; Kumar et al., 1995; Luo, 2007), is particularly important (Sen et al., 2023; Kwan et al., 2024). Procedural justice is reflected in procedures and criteria that are “(1) transparent, adjustable, and correctable, (2) unbiased, representative and non-discriminatory to each party, and (3) in accordance with contractual specification” (Luo, 2007, p. 647).

In platform ecosystems, enacting procedural justice involves ensuring that actors with similar types of interdependencies face the same set of rules and guidelines (Jacobides et al., 2018) and face similar consequences when rules are broken. For instance, all app developers have to meet the same certification requirements before Apple allows the apps to be sold (and run) on its iOS platform. It is also suggested that individuals view procedures as fair when they perceive control over the process (Thibaut and Walker, 1975). As we observe in most platform ecosystems, actors are often given the freedom to set their own prices for their complements (and design them how they want).

In transaction platforms, procedural fairness is particularly important *ex post*, when platform firms resolve disputes that arise in transactions among the platform participants (Sen et al., 2023). To the buyers, these procedural fairness mechanisms offer a grievance redressal arrangement, which affirms the platform's commitment to the former's well-being (Sen et al., 2023). These mechanisms also serve as a signal to the sellers to desist from opportunism. Absent procedural fairness, the informal restraint on seller opportunism disappears, which can result in poor seller performance towards buyers (Sen et al., 2023).

Complementor-level Consequences. Outcomes of interest at the complementor level include (1) innovation (2) knowledge-sharing & learning, and (3) complementor decisions and performance.

(1) Innovation. In platform governance scholarship, a key outcome of interest is the level of innovation within an ecosystem. Many governance mechanisms are utilised to encourage complementors to undertake innovative activities. Much of this work considers innovation in terms of variety – where an increase in the diversity of complements reflects greater innovation (Inoue, 2021; Panico & Cennamo, 2022; Cennamo and Santaló, 2019). A greater variety of complements

is desired because it increases a platform's value by enhancing its appeal to a wider audience of users. It also enables users to derive a range of benefits, as opposed to similar benefits (as in the case where there are more of the same type of complements).

Relatedly, studies have also examined complement quality as an outcome of interest in innovation ecosystems. From a user-demand perspective, quality captures how much benefit the customer derives from using the product (e.g., Binken & Stremersch, 2009; Xu et al., 2010). The presence of high-quality complements increases platform value by enhancing the consumption benefits from using the platform. Indeed, it has been shown that high-quality complements, generally referred to as "hits" (Corts & Lederman, 2009) or "superstars" (Binken & Stremersch, 2009), can critically affect users' platform adoption. At the same time, an influx of low-quality complements can lead to a platform's failure (Wareham et al., 2014). Therefore, platform firms utilize mechanisms specifically targeted towards promoting higher quality of output, such as rewarding high quality complements through increased user engagement opportunities (Claussen et al., 2013).

(2) ***Knowledge-sharing & Learning.*** Through platform governance, platform firms seek to facilitate interactions between participants in an effort to encourage knowledge-sharing, especially in innovation ecosystems. Platform-mediated community forums often help achieve this by facilitating information exchange between complementors, allowing them to share new ideas and enhance their expertise (Choi et al., 2020). A survey by Stackoverflow (2018) shows that 93.3% of mobile developers acquire and learn new knowledge from such communities (Stackoverflow, 2018; Choi et al., 2020). Such knowledge-sharing is a key to stimulate subsequent complement development and innovation (Foerderer, 2020; Zhang et al., 2022). This is because knowledge sharing can uncover new interdependencies, triggering novel knowledge

recombination and empowering complementors' innovation attempts (Boudreau, 2010; Zhang et al., 2022). Governance mechanisms like gatekeeping (Zhang et al., 2022), and the provision of information (Foerderer, 2020; Choi et al., 2020) often facilitate this outcome.

Closely tied to the concept of knowledge-sharing is that of learning. Foerderer (2020) shows that interfirm exchange (through developer conferences) promotes innovation through learning – such that complementors learn from one another and from the platform firm. To complement this work, Weiss et al (2022) shed light on how platform firms can learn and benefit from interacting with complementors. They do so by elucidating the learning process of an inexperienced platform firm and show how such firms can improve their platforms through such learning processes.

(3) Complementor Decisions & Performance. Since platform governance seeks to shape complementor activity, many studies examine the effect of governance on specific complementor decisions. One such decision is that of multihoming, whereby complementors make the choice of offering their complements on multiple platforms (instead of just one). While platform firms prefer complementors not to multihome (in order to preserve the benefits they receive from the complements), complementors often have incentives to multihome due to cross-platform scale economies (Landsman & Stremersch, 2011), and also because it allows them to counter the risk of hold-up and expropriation by platform firms (Huang et al., 2013).

Other complementor decisions and actions studied in the literature include participation decisions (Kathuria et al., 2020), continuance intentions (Goldbach et al., 2018), complementor dedication (Hurni et al., 2021), as well as withdrawal decisions (Angeren & Karunkaran, 2023) and platform desertion (Tiwana, 2015).

Relatedly, some studies examine the impact of governance on complementors' performance. For example, Rietveld et al. (2020) discover that complementor performance is negatively affected as a platform becomes increasingly dominant. This is because the platform firm's governance strategies shift from being largely supportive of the wider complement population to becoming more selective and geared toward end users, and therefore, the average demand for individual complements decreases and becomes progressively concentrated. Moreover, prices for complements tend to decline while the costs incurred by complementors increase.

Moderators. Platform governance scholarship also includes a study of factors that can be best understood as moderators that affect the strength of the relationship between platform governance and the outcomes of interest. These moderators are (1) platform capabilities and (2) the external environment.

(1) Platform Capabilities. Platform governance scholarship has illuminated the capabilities required by platform firms to effectively govern their ecosystems (e.g., Foss et al., 2023). Capabilities refer to the capacity that reliably allows an organization to achieve particular ends (Winter, 2000). Organizational capabilities are critical to understanding the success of firms (Peteraf, 1993; Teece et al., 1997; Barney, 1999), and are likewise important to understanding effective platform governance.

Altman et al. (2022) highlight four key capabilities used by managed ecosystems: (1) “shepherding communities without exploiting them” – i.e., guiding a community of independent actors and reaping the benefits of the activities without taking advantage of the community members; (2) “managing data and intellectual property”, which involves executing processes consistent with more open, interconnected, and interdependent approaches; (3) “ecosystem-driven

open adaptation” – i.e., the capabilities, activities and processes that organizations employ as they transition from hierarchical closed governance to more open ecosystem structure; and (4) “ambidextrous governance” – i.e., the ability of an organization to successfully manage the tensions associated with embracing more than one governance structure at the same time.

Foss et al. (2023) also emphasize ecosystem leadership as an important dynamic capability which they further relate to three externally-oriented dynamic capabilities: (1) sensing – i.e., facilitating the formation of a shared vision; (2) seizing – i.e., inducing others to make ecosystem-specific investments; and (3) reconfiguring/transforming – i.e., engaging in ad hoc problem solving to create and maintain stability. Haki et al (2024) add to this line of work by highlighting the dynamic capabilities required by incumbent firms as they transition from a product platform to an innovation platform – namely (1) resource curation, (2) ecosystem preservation, (3) resource configuration and (4) ecosystem diversification.

Together, these works highlight the importance of developing capabilities to address the various challenges that arise in governing ecosystem activity¹⁸. It is plausible that a platform firm’s capabilities can influence the effectiveness of its governance practices. For instance, if a platform firm lacks adaptation capability, it may become more prone to ‘governance rigidity’ (Uzunca et al., 2022), affecting its ability to make the appropriate changes in governance.

(2) *External environment*. There are several environmental factors exogenous to the platform that can influence the effectiveness of platform governance. First, technological advancements play a crucial role in enabling platform functionalities and features, and therefore,

¹⁸ There is also some work exploring the capabilities required by complementors – for example, Yoo et al (2022) shed light on the need for complementors to develop a cocompetition capability – or “the ability to think paradoxically and to initiate processes that help firms attain and maintain a moderate level of tension, irrespective of the strength of the paradox” (Bengtsson, Raza-Ullah, & Vanyushyn, 2016, p. 19; Yoo et al., 2022).

a platform firm's access to appropriate technology can influence the effectiveness of its governance policies and practices. Second, the relative power and influence of providers can shape the effectiveness of platform governance, especially when they provide services to more than one platform (Tiwana et al., 2010). For example, service suppliers such as AT&T that supply network bandwidth to Apple's iPhone, as well as film production studios like Warner Brothers that supply content to Netflix and other streaming platforms (Tiwana et al., 2010) have the power to dampen or enhance the effectiveness of a platform firm's governance practices. Third, regulatory agencies such as the Federal Trade Commission can shape the effectiveness of platform governance by imposing restrictions and regulating platform firms' activities. These actions can also have trickle down effects such that a sanction or lawsuit against one platform can trigger others to modify their policies.

Finally, the presence of competitors can shape the outcomes of certain governance mechanisms. For instance, governance changes implemented by a platform firm may yield different results in the presence of competing platforms to which users can switch over, versus cases where they do not have other choices (or when competing platforms are of lower quality). As Chung, Zhou & Ethiraj (2024) demonstrate, Lyft's access restriction not only affected drivers on its platform, but also those on Uber. Interestingly, in this particular case, although one would expect Lyft's drivers to switch over to Uber, the study finds that restricting access on one platform prevented drivers from achieving economics of scope from multi-homing, and therefore abandon both the restricted and (unrestricted) competing platforms (Chung et al., 2024). This finding reinforces the idea that multihoming costs (Armstrong and Wright, 2007), which reflect the total adoption, operating, and opportunity costs incurred by complementors to maintain affiliation with multiple platforms, can affect complementors' decisions (Tiwana et al., 2010). When competing

platforms lower such costs, they can create what Katz and Shapiro (1994) describe as "tipping," wherein competing platforms can pull complementors away from the focal platform.

Additional Considerations. In addition to the antecedents, mechanisms, moderators and consequences, the literature elaborates on several additional aspects that provide a more complete understanding of the nature of platform governance. These aspects relate to (1) balance, (2) coopetition and (3) power.

(1) Balance. Much of the literature on platform governance relates to addressing tensions that are inherent in platform organizing. Wareham et al. (2014) highlight three salient tensions that characterize platform ecosystems: standard-variety at the output level, control-autonomy at the actor level, and collective-individual at the identification level. They argue that platform governance mechanisms are designed to manage these tensions effectively, such that while some mechanisms foster output variety, others enforce standardized output; similarly, while some enforce control to reduce undesirable variance, others confer autonomy to promote desirable variance; furthermore, while some mechanisms direct actions towards a collective purpose, others promote the advancement of individual motives (Wareham et al., 2014). Taken together, "the challenge is to establish governance mechanisms that appropriately bound participant behavior without excessively constraining the desired level of generativity" (Wareham et al., 2014, p.1195)¹⁹.

Other scholars have also emphasized similar tensions. For example, Eaton et al. (2015) highlight the "paradoxical tension between the logic of generative and democratic innovations and the logic of infrastructural control" (p.217). This has also been referred to as the flexibility-control tension (Hukal et al., 2020), as well as the autonomy-control tension (Lin et al, 2022). Kang and

¹⁹ Here, generativity refers to innovation that is "driven by large, varied and uncoordinated audiences" (Zittrain, 2006, p. 180).

Suarez (2023) frame it as a “tension between a decentralized, “open and laissez-faire” approach that devolves decision rights to platform stakeholders on the one hand and, on the other hand, a centralized, “closed and reigning” approach that reserves most rights for the platform owner” (p.1768).

All these scholars emphasize the importance of balance when utilizing governance mechanisms, since an imbalance can result in negative consequences. Accordingly, Tiwana (2013) refers to this as the “goldilocks” principle, whereby platform firms have to get the balance “just right”. Too much control can stifle the autonomy and flexibility of ecosystem actors, thus dampening incentives to participate (Tiwana, 2013). Similarly, too much openness can compromise the ecosystem (Boudreau, 2010). As Karhu et al. (2018) illustrate, too much openness can result in extreme forms of exploitation, such that hostile firms (or forkers) can exploit a platform firm’s shared resources to create competing platform businesses.

(2) *Coopetition.* A subset of platform governance scholarship examines coopetition within platform ecosystems, which results from platform firms’ decisions to enter complementor markets. The paradoxical coexistence of cooperation and competition has potential for both greater value creation and for negative impacts on complementor-platform firm relationships (Yoo et al., 2022).

Platform firms have strong incentives to enter complementor markets (Farrell and Katz 2000), as they can benefit from appropriating complementors’ rents (Huang et al. 2013), increasing customer experience through integration (Eisenmann et al. 2011; Li and Agarwal, 2017), and retaining control over platform evolution (Eaton et al., 2015; Gawer and Henderson, 2007). At the same time, their entry may hurt complementors’ revenues as they compete with the platform firm (Foerderer et al., 2018). Since a disproportionately large number of complementors are small in size and suffer from insufficient resources, the platform firm’s unfair competition can pose

existential threats to them (Yoo et al., 2022). Essentially, as Kang & Suarez (2023) highlight, there is a key tradeoff when considering a platform firm’s entry in complementors’ markets – that of value capture versus platform growth.

Extant scholarship has empirically examined several instances where platform firms entered complementor markets, with the studies yielding mixed results (Kang & Suarez, 2023). For example, Zhu and Liu (2018) find that after Amazon entered sellers’ markets, the affected third-party sellers experienced a significant drop in sales, leading to a decrease of 57% in their sales ranking positions. At the same time, other studies find a positive effect of such entry. For instance, when investigating Google’s introduction of a competing Photos app for managing photographs on the Android platform, Foerderer et al. (2018) find that Google’s entry in this market had a positive effect on complementary innovation, which they attribute to an “attention spillover” effect whereby the platform firm’s entry increased consumer demand and feedback, thus providing complementors with new ideas and opportunities to innovate (Foerderer et al., 2018).

(3) Power. Some of the more recent work explores the dark side of platform governance, highlighting the role of power asymmetries inherent in the one-to-many relationship between the platform firm and ecosystem actors²⁰. Since the platform firm can unilaterally enforce changes, ecosystem actors experience a great power imbalance, often facing only two choices – to accept the conditions or to stop using the platform (Cutolo & Kenney, 2021). Without effective checks and balances, platform firms can sometimes direct ecosystem activity to pursue their own benefit

²⁰ There is another line of work that additionally examines the “unprecedented levels of economic power” amassed by dominant platform firms, and the implications thereof (Gawer, 2022). The issues related to such extreme levels of power include anti-competitive practices, mass-harvesting of data and the failure to tackle illegal or harmful digital content (Gawer, 2022). Such platform power also relates to the ability to shape markets, in that it involves “making the rules of the game itself, coding them in legal terms and directing how the games evolves, in an agenda-setting way” (Andreoni & Roberts, 2022: p. 1440). Together, these issues have started to generate societal concern. Much of this research relates to the regulation of platforms, which is outside the scope of this review, which is why we touch on it only briefly in this footnote.

at the expense of ecosystem actors (Chen et al, 2021). In extreme cases, platform firms can exploit ecosystem actors' cognitive biases by creating false expectations in the form of various prompts and rewards, without the actors realizing that they are being manipulated (Uzunca & Kas, 2023). Harracá et al (2023) highlight the role that some platforms play in fostering organized immaturity – i.e., the erosion of individuals' capacity for public use of reason.

FUTURE DIRECTIONS FOR PLATFORM GOVERNANCE RESEARCH

In this section I identify meaningful gaps in the literature, which call for additional research. I also offer ideas on how these gaps may be filled to develop a more complete and nuanced understanding of platform governance. These research directions pertain to (1) platform governance evolution, (2) competitors, (3) platform legitimacy, (4) platform identity & culture, (5) justice & trust, (6) platform capabilities and (7) learning.

(1) Platform Governance Evolution. In terms of the dynamics and evolution of platform governance, some scholars have offered insights on how changes to specific governance mechanisms affect ecosystem activity. For example, Chung et al. (2024) examine the impact of Lyft and Uber's restriction of driver access, while Wessel et al. (2017) investigate the effect of a relaxing the screening process on Kickstarter. Similarly, Koo & Eesley (2021) study the effect of a change in ranking algorithms used by a leading e-commerce platform, while Claussen et al. (2013) examine the effectiveness of a rule change by Facebook which enabled apps with higher user engagement to send out more notifications. There is also work exploring how a platform's competitive moves – such as Uber (New York) and GoJEK's decisions to partner with local taxi drivers – can change roles and interactions, affecting the alignment of actors within the ecosystem (Leong et al., 2023; Li et al., 2022).

While this growing body of work has contributed to an understanding of platform governance dynamics, there remains a lack of work exploring how platform governance *evolves* over time. Just as governance can shape an ecosystem's evolution, governance itself also evolves over an ecosystem's life cycle. As Wareham et al. (2014) state, "if evolvability is considered a focal property of the ecosystem, then governance mechanisms also need to embrace the changing maturity levels of the ecosystem through time" (p.1212). Although extant scholarship recognizes that governance evolves, as yet there has not been a systematic investigation of ecosystem governance from an evolutionary perspective. As Chen et al. (2021) highlight, "there is little research [exploring a] platform's successive renewal over its lifecycle through governance" (p.27). To deepen our knowledge of the dynamics and evolution of governance, they suggest that future research can begin "by focusing on longitudinal changes in digital platforms' governance mechanisms and illustrating the motivations and implications of such changes" (Chen et al., 2021, p.27).

Among other factors, there is potential to examine the role of the external environment in shaping ecosystem governance over time. Although Tiwana et al. (2010) highlighted the importance of the environment in shaping platform governance (and architecture), there has not yet been a systematic exploration of how external factors, such as technological advancements or economic conditions, shape the trajectory of platform governance over time. There is also scope to explore whether the mechanisms governing the ecosystem change as a function of the shifting nature of platform goals and/or identities. As yet, only Eaton et al. (2015) have contributed to this direction by studying tuning – i.e., the process by which boundary resources come into being and evolve over time through the interaction of heterogeneous actors and the platform firm. Similar

studies are required to contribute towards a more complete understanding of platform governance evolution.

(2) *Competitors*. In extant scholarship, there is a lack of research exploring platform governance in a competitive context, with most empirical studies examining activity within one platform, or two at most. As Jacobides et al. (2018) suggest, the literature requires “a shift in empirical focus from within-ecosystem to across-ecosystem dynamics” (p.2268). Accordingly, there is space to contribute to this area by conducting empirical studies that compare across platforms within a particular landscape. Here, configurational approaches, such as fuzzy-set Qualitative Comparative Analysis (Ragin, 2008) can be useful to analyze differences between the choice of mechanisms utilized by platform firms, and the impact of these choices on ecosystem outcomes. As yet, only one study has undertaken such efforts: Islam et al. (2023) use fsQCA analysis to identify multiple configurations of governance rules that lead to different levels of platform-seller conflicts in the online auction and mail-order industry. Additional studies examining differences across platforms have the potential to add more nuance to our understanding of platform governance in a competitive context.

Comparing across competing platforms also offers opportunities to uncover how different governance approaches may impact platform survival – or failure. Naturally, much of the research on platform governance examines platforms that are successful. While this helps develop a better understanding of useful governance mechanisms and practices, it is also important to understand why platforms may fail. As Jacobides et al. (2018) emphasize: “Looking past the shiny success stories of strong hubs such as Apple, we should also ask what we can learn from firms that tried to become hubs but failed” (p.2270). Examining paths to failure is especially important as it is becoming increasingly evident that failure rates of platforms are rather high (Yoffie et al., 2019).

Among other factors, there is potential to examine how a platform's initial conditions (Uzunca et al., 2022) may constrain or enable its governance decisions over time. There is a possibility that differences in platforms' architectures limits certain governance directions and may therefore negatively affect a platform's performance in the face of competition. Understanding such differences can contribute towards a deeper understanding of governance in a competitive context.

(3) Platform Legitimacy. Platform legitimacy is another outcome of interest that requires further study. Legitimacy refers to “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (Suchman, 1995, p. 574). The literature on legitimacy has largely shown that actors who perceive an organization as legitimate will tend to voluntarily comply with the rules set up by it (Chung et al., 2016; Finch et al., 2015). As such, the legitimacy of a platform plays a role in how effective its governance rules and regulations are, as well as its overall success.

Currently, there is only one study that examines platform legitimacy: Elambert (2023) shows that the legitimacy of microtasking platforms, as perceived by workers, is related to the strength of their incentive systems. Further work is required to develop a better understanding of how platform firms imbue their platforms with legitimacy. There are opportunities to explore the connection between justice and legitimacy, especially because negative perceptions of justice can call into question the legitimacy of a platform's decision-making, harming the relationship between ecosystem actors and the platform firm (Kwan et al., 2024; Van Loo, 2016)

(4) Platform Identity & Culture. Although Chen et al. (2021) suggest that effective platform governance can help “foster a common identity”, there is a lack of research exploring the relationship between platform identity and governance. Here, platform identity refers to a platform's unique attributes that distinguish it from others, either through its distinctive

technological capabilities and/or its unique market scope (Cennamo, 2021). A platform firm can develop its platform identity by building a unique, distinctive positioning based on quality or consumption experience (Cennamo & Santaló, 2013). These notions are directly tied to platform governance, and therefore, there is a need to better understand how governance mechanisms play a role in fostering platform identity, as well as how distinct platform identities may shape the choice of governance policies over time.

This line of work can also shed light on platform culture, a concept that has similarly been overlooked in the literature. Platform culture refers to the norms, values and capabilities shared among ecosystem actors (Sundararajan, 2014). In most cases, the platform firm sets the tone for platform culture, with differences in treatment of ecosystem participants (though governance policies) giving rise to different types of culture. For example, Airbnb has a community culture, while Uber has more of a control culture (Sundararajan, 2014). At the same time, values may emerge over a longer term through platform use, such that ecosystem actors develop their own ways of interacting on the platform, shaping a particular culture (Alt, 2022). Studying the interplay between governance and platform culture has the potential to generate interesting insights and add more depth to our understanding of platform governance.

(5) *Justice & Trust.* While there is some work on justice in the platform governance literature, it tends to focus primarily on procedural justice, leaving a lot more to be desired. Justice consists of three other dimensions (in addition to procedural justice), all of which can be studied in relation to platform governance. For example, distributive justice refers to the fair distribution of outcomes, where fairness is perceived as the degree to which a party's gains are in accordance with its resource contribution, commitment and risk bearing (Colquitt, 2001; Luo, 2007). Research on this dimension can examine the impact of breakdowns in distributive justice, as illustrated in

the legal tussle between Epic Games and Apple, as well as the Etsy Strike involving artisans and Etsy. In these cases, the complementor/providers challenged the unfair distribution policies in the form of high commission rates used by platform firms. In such cases, failure to develop perceptions of justice can result in complementors/providers reducing their commitment, multi-homing, or exiting the ecosystem entirely, thus negatively affecting the platform ecosystem.

Similarly, interactional justice, which refers to the perceived fairness of interpersonal treatment (Bies and Moag, 1986; Tyler & Bies, 1990), and informational justice which refers to the perceived fairness of open communication of information (Greenberg, 1993) are other important dimensions of justice worthy of examination in a platform context. These are more social dimensions and their associated aspects such as openness, honesty and feedback (Luo, 2007) are highly relevant. Through open channels of communication platform firms can offer clarity and relevant information as needed. At the same time, the lack of such communication can negatively affect actors' perceptions of fairness and transparency.

Studies have shown that perceptions of justice have positive effects on higher-order attitudes like trust (Kim and Mauborgne, 1998; Kale et al., 2000). As such, there are opportunities to further explore how justice relates to trust in a platform context. It can be argued that when outcome sharing, decision-making procedures and interactions are conducted justly (Luo, 2007), ecosystems are able to foster trust in the ecosystem. The implications of building such trust – or the lack of it – merits further study in the platform governance literature, especially when considering various stages of an ecosystem's lifecycle. It is possible that the consequences of building (or failing to build) trust may affect the survival or progress of the ecosystem differently. Additionally, since “the quality of relationships that platform firms establish with complementors can, in part, determine the extent to which a platform continues to thrive” (McIntyre et al., 2021,

p.575; Yoffie & Kwak, 2006), it can be worthwhile to explore how enhanced trust in an ecosystem may play a role in fostering better quality of relationships. Furthermore, just as some scholars in adjacent fields have identified various types of trust, such as competence-based trust and goodwill-based trust (Malhotra & Lumineau, 2011), platform governance scholarship can similarly identify different forms of trust and examine what forms of justice they may be linked to, in addition to examining their implications on ecosystem outcomes.

(6) Capabilities. Although there is a growing body of work on capabilities within the platform governance literature, there is space to further contribute in this area. There is promise in drawing on Teece's (2007) work on 'orchestration skills', referring to an "enterprise's capacity to shape the ecosystem it occupies" (p.1320) as well as his work on 'asset orchestration processes' that constitute coordinating/integrating, learning and reconfiguring. Whereas that work was focused on orchestration within the firm, it can potentially be extended to the ecosystem domain. There is also an opportunity to examine how governance capabilities differ across various types of ecosystems. For instance, the capabilities required to govern an exchange platform may differ from those required to effectively govern an innovation platform.

(7) Learning. Similarly, although there is some work on learning in relation to knowledge-sharing, there is scope for contributing to a better understanding of learning in platform ecosystems. Researchers have opportunities to explore how platform firms learn over time, and how this learning allows them to make adjustments to their governance mechanisms. Platform firms' access to user data enables them to learn and improve their platform through data analytics. This has implications for the nature of learning, the speed of learning, as well as ethical considerations, such as the ones that arise when examining search algorithms (See Tsamados et

al., 2021). There are also opportunities to examine how learning shapes ecosystem evolution and how platforms firms may better cultivate learning within their ecosystems.

CONCLUSION

In this study I conducted a systematic literature review of the platform governance scholarship, to (1) identify the conceptual structure of the literature, (2) clarify the conceptual contours of platform governance, (3) synthesize extant knowledge in an organizing framework and (4) highlight areas for future research that are currently underexplored. By using a hybrid methodology combining topic modelling driven exploratory analysis, a bibliometric analysis and an in-depth qualitative content analysis, this paper provides reliable, comprehensive and evidence-based findings that offer directions for ongoing efforts investigating this important construct.

CHAPTER 3 - ESSAY 2

THE EFFECTIVENESS OF REVENUE-SHARING IN PLATFORM ECOSYSTEMS

INTRODUCTION

Digital platforms have transformed the nature of business and economic activity by enhancing the ability to deliver increasingly complex solutions to consumers (Williamson & De Meyer, 2012). Many of these platforms rely on an ecosystem of complementors – i.e., a set of heterogeneous and autonomous actors that leverage the platform to develop innovative complements that extend the platform’s core functionality (Gawer, 2014; Kapoor, 2018; Jacobides, Cennamo & Gawer, 2018). By producing valuable complements, they contribute to the ecosystem’s value proposition and make the platform more attractive to users. For example, Apple’s iOS ecosystem constitutes a large number of developers (i.e., complementors) that leverage the iOS platform to develop innovative apps (i.e., complements) for iPhone users. Such ecosystems are said to be generative, in that they have the ability to generate a variety of innovative output through contributions from a large number of diverse actors (Zittrain, 2005; Yoo, Henfridsson & Lyytinen, 2010).

Since the success of platform ecosystems depends on complementors generating innovative output, managing their incentives is critical. Incentives are required “not only for joining the platform, but also for contributing high quality, innovative complements throughout the ecosystem’s evolution” (Panico & Cennamo, 2022, p. 507). In an ecosystem setting, platform firms rely on a distinct set of incentive mechanisms that relate to (1) sharing of boundary resources, such as application programming interfaces (APIs) and software development kits (SDKs) (Ghazawneh and Henfridsson, 2013), (2) provision of information in the form of API documentation and community forums, (3) conferring autonomy in the form of decision rights and

(4) giving pecuniary and nonpecuniary rewards (Chen et al., 2022). While many of these incentives relate to value creation, the giving of pecuniary rewards is more oriented towards value capture²¹. As is widely recognized in the innovation literature, the ability to appropriate value incentivizes complementors to undertake innovation in the first place (Miric, Boudreau & Jeppesen, 2019; Arrow, 1962; Levin et al., 1987; Laursen and Salter, 2014; Teece, 1986), making pecuniary rewards particularly important.

Revenue-sharing is a prominent pecuniary incentive mechanism used by many platforms. It stipulates how value is to be appropriated between complementors and the platform firm. Revenue-sharing schemes often come in the form of consignment contracts whereby complementors continue to own their innovations (e.g., apps) but are required to share an agreed-upon percentage of revenue with the platform firm, each time a complement is sold (Avinadav et al., 2021; Avinadav et al., 2022). The more favorable schemes for complementors are the ones where they pay the least share to platform firms. If platform firms employ aggressive revenue-sharing schemes, requiring complementors to share a large percentage of their revenue, they may dampen complementors' incentives to participate (Tiwana, 2013). While it is recognized that different types of revenue-sharing schemes can have a strong impact on complementors' incentives to participate and innovate in the ecosystem, as yet very little is known about how the choice of revenue-sharing schemes affects complementor activity. More specifically, there is a lack of work exploring the impact of revenue-sharing on the nature of innovative output within an ecosystem.

Accordingly, in this paper we study the effectiveness of revenue-sharing by investigating its impact on innovative output – specifically in terms of variety and quality. Platform firms seek a greater variety of complements to enhance the platform's appeal to a wider audience of users

²¹ Although revenue sharing schemes can also affect value creation, the more direct impact is on value capture.

(Panico & Cennamo, 2022), and they also seek innovative output that is of high quality to enhance users' consumption benefits from using the platform (Cennamo, 2018; McIntyre et al., 2021). Incentive mechanisms such as revenue-sharing play a role in influencing complementors to undertake efforts towards generating such output. Therefore, by exploring whether this mechanism is effective in achieving the desired results, we seek to gain a richer understanding of how platform firms incentivize complementors and shape generative output in their ecosystems.

To conduct our study, we exploit a quasi-experiment wherein Shopify, a platform firm, implements a distinct rule change to its revenue-sharing scheme, lowering it from 20% to 0%. This natural experiment-like change allows for similar identification as field experiments (Aral and Walker 2011, Goldfarb and Tucker 2011, Animesh et al. 2011, Tucker and Zhang 2011, Tucker 2011), and therefore we use it to analyze the impact of revenue-sharing on the nature of generative output produced by complementors. We do this by using a difference-in-differences approach that studies the differential effect of a specific intervention (i.e., revenue-share change) on an outcome (e.g., variety of apps) by comparing the changes in outcome over time between a 'treatment group' (i.e., Shopify's innovation ecosystem) and a 'control group' (i.e., WooCommerce's innovation ecosystem).

The analyses reveal that a reduction in the revenue-sharing scheme has a positive effect on variety of complements, as well as a positive spillover effect on the quality of complements. Together, the results demonstrate that a reduction in revenue-sharing is an effective incentive mechanism that motivates complementors to participate and engage in innovative activity.

Our paper makes several contributions. *First*, it advances the literature on platform governance. While a burgeoning stream of research has identified a variety of governance mechanisms used by platform firms to guide complementor activity (e.g., Ghazwaneh &

Henfridsson, 2013; Rietveld, Schilling & Bellavitis, 2019; Zhang, Li & Tong, 2020; Koo & Eesley, 2021), research on these instruments and their effectiveness is currently limited (McIntyre et al., 2021:21). By empirically demonstrating the effectiveness of revenue sharing, a particular (pecuniary) governance mechanism used by platform firms to incentivize complementors, this paper takes steps to quantify the impact of governance on complementor activity.

Second, this study advances the line of work that examines how changes to a governance mechanism affects complementor activity (e.g. Claussen et al., 2013), and in doing so, deepens our understanding on the dynamics and evolution of governance design. *Third*, this paper adds to a more nuanced understanding of the quantity-quality trade-off, which suggests that an increased level of innovative output often comes at the expense of lower quality, especially in more mature ecosystems like Shopify's (Wareham et al., 2014; McIntyre et al., 2020). Our findings challenge this common understanding by demonstrating that this need not always be the case – and that increased quantity can at times be accompanied by improved quality.

Lastly, this paper extends generativity-oriented work on digital platforms by offering a better understanding of how generative output is shaped through governance. While there is much work on generative architectures, primarily in the Information Systems domain, “there is very little research that considers how governance and other (non-technical) aspects can drive generativity” (Autio & Thomas, 2020: 29). By examining the effect of revenue-sharing (a particular governance mechanism) on the variety and quality of generative output, this study draws attention to the substantial influence that governance has on the nature of generative output within an ecosystem.

The structure of the paper is as follows. In the first section we offer a brief background of digital platforms and the incentives used by platform firms to motivate complementors. We then highlight the context of the study and describe the method. This is followed by an analysis of the results. We end with a discussion on the contributions, as well as limitations and future research directions.

BACKGROUND

Digital platforms ecosystems have become an integral part of the modern economic landscape. These ecosystems often constitute a foundational technology (i.e. platform) around which a constellation of autonomous actors organize to co-create value (Gawer, 2014; Kapoor, 2018; Jacobides, Cennamo & Gawer, 2018). These actors, referred to as complementors, provide innovative complements to extend the platform's core functionality. With low barriers to entry, little or no up-front costs for developing and publishing complements and simultaneous direct market access to a large number of potential customers, platform ecosystems provide a valuable business environment for a variety of complementors (Deilen & Wiesche, 2021). These complementors can range from firms to hobbyists (Boudreau & Jeppesen, 2015) that have insights into specific user needs and possess the distinct knowledge and skills required to meet them (Hilbolling, Berends, Deken & Tuertscher, 2021).

Complementors are indispensable to platform ecosystems (Carst & Hu, 2023). They play a strategic role in enhancing the ecosystem's value proposition (Jacobides et al., 2018; Tsujimoto et al. 2018; Deilen & Wiesche, 2021; Carst & Hu, 2023) and impact its survival and success (Brandenburger and Nalebuff 1996). As such, the platform ecosystem's value is rooted in the complementarity of the platform and its complements (Jacobides et al., 2018). Here, complementarity refers to the condition under which the value of products used together exceeds the sum of their parts (Baldwin, 2018). In the context of platform ecosystems, complementarity

goes both ways: complements have limited value without the platform core (e.g., an app has no value without an operating system), and the value of a platform depends on the availability of complements that extend the functionality of the platform. Neglecting complementors in an ecosystem may lead to the failure of both the platform and the realization of the core value proposition (Adner 2021; Liang et al. 2022). As such, managing the incentives of complementors is critical.

Incentives

It is generally accepted that procuring an innovation involves incentivizing actors to undertake research effort. Especially within the organizational economics domain, scholars view innovation through the lens of effective incentive design (Holmstrom & Milgrom, 1994; Lerner & Wulf, 2007; Manso, 2011; Eklund, 2022). They view innovation as an outcome that is facilitated through effectively incentivizing self-interested actors, where the gains from an action go directly to the party undertaking the research effort (Dosi et al., 2003; Hart & Moore, 1990; Hölmstrom, 1979). The challenge organizations face is that innovation is inherently risky (Hölmstrom, 1989). Thus, firms need to incentivize actors appropriately to ensure favorable innovation outcomes (Eklund, 2022). As Yanadori & Cui (2013) highlight, “obtaining high quality knowledge workers does not automatically guarantee innovation. To capitalize on these workers’ knowledge, firms need to establish incentive mechanisms that encourage them to act in a way that promotes innovation (Gupta, Tesluk, and Taylor, 2007)” (p. 1503).

Much of the research in this area examines how different managerial incentive mechanisms can facilitate and encourage innovation outcomes (Lerner & Wulf, 2007; Manso, 2011). This work often examines equity-based executive pay policies and CEO compensation, with results indicating that incentives which link compensation to the long-term value of the firm’s equity are associated with greater subsequent innovation (Lerner & Wulf, 2007; Sheikh, 2012; Nguyen, 2018;

Hellmann & Thiele, 2011). Option-based compensation is considered particularly useful, as Manso (2011) finds that “the optimal innovation-motivating incentive scheme uses a combination of stock options with long vesting periods, option repricing, golden parachutes and managerial entrenchment” (p.1823).

While these incentives are well-suited for promoting innovation within an organization, they are inadequate for more open forms of innovation where innovators are autonomous actors that have no direct authority relations with the firm. Here, firms cannot avail managerial hierarchy and therefore utilize a different set of incentives. Consider the case of open innovation, which has received much scholarly attention over the last decade (Chesbrough, 2006, von Hippel, 2005, von Krogh et al., 2003, Dahlander and Gann, 2010, Van de Vrande et al., 2010, Lichtenthaler, 2011). First introduced by Chesbrough (2003), the concept of open innovation refers to how firms can make use of external knowledge to improve innovation performance. The promise of open innovation is appealing in that it increases a firm’s capacity to innovate by tapping into a pool of diverse knowledge transcending organizational boundaries (West & Bogers, 2014).

Contests and tournaments are the most popular ways of engaging in open innovation (Chesbrough and Brunswicker, 2013). In these contests, a firm (the seeker) facing an innovation-related problem broadcasts the problem to a population of independent agents (the solvers) who decide whether they have the relevant knowledge to provide a solution (Terweisch & Xu, 2008; Felin & Zenger, 2014). Incentives are central to these contests and tournaments (Nalebuff and Stiglitz, 1983, Taylor, 1995). Awarding prizes for the most valuable solution is the most common mechanism utilized. In a fixed-prize contest, the seeker announces a prespecified award with a fixed amount, which is granted to solvers according to a preannounced award allocation structure (Terweisch & Xu, 2008). In exchange for the pecuniary reward (i.e., prize), the property rights to

the winning solution are usually ceded to the focal firm (Felin & Zenger, 2014). Firms essentially buy the rights to the best solution—while the prize and intrinsic rewards from participation compensate solvers for their efforts and intellectual property (Felin & Zenger, 2014). Terweisch & Xu (2008) show that the winner-take-all prize is the most optimal reward mechanism that generates the strongest incentives for solvers to exert efforts, especially for ideation projects.

In an ecosystem setting, platform firms do not set up contests as in an open innovation community. This is because they do not specify upfront the problem to be solved. Instead, given the nature of a generative platform (Garud et al., 2008; Kallinikos et al., 2013), platform firms wish for innovations to emerge on their own. Here complementors choose the problem they wish to solve and innovate accordingly. For example, Apple did not specify upfront that it wished for a ‘flashlight’ app to be invented for its iPhone. Rather, it was developed independently (by Chris and Ryan McGarthy) and made available by Apple in 2010 after undergoing extensive review. Given the different nature of problem-solving in an ecosystem setting, platform firms rely on a distinct set of mechanisms aimed at motivating complementors to participate and undertake innovative activities.

These incentive mechanisms can be grouped into four main categories: (1) sharing of boundary resources, such as application programming interfaces (APIs) to assist complementors with development (Ghazawneh and Henfridsson, 2013); (2) provision of information in the form of API documentation and community forums to prompt desired behaviors and improve complementors’ performance (Chen et al., 2022); (3) conferring autonomy in the form of decision rights to grant flexibility; and (4) giving pecuniary and nonpecuniary rewards (Chen et al., 2022).

As mentioned earlier, while many of these incentives relate to value creation, the granting of pecuniary rewards relates more to value capture (much like prizes in an open innovation context,

and options in a traditional organizational context). To attract complementors' investments that often bear opportunity cost, platform firms have to create "economic incentives for ecosystem members" (Gawer & Cusumano, 2008). They need to ensure and signal that complementors can profit from participating in the focal platform (Miric, Boudreau, & Jeppesen, 2019).

Revenue Sharing

Revenue-sharing is a prominent pecuniary incentive mechanism used in platform ecosystems. Here, platform firms stipulate the terms along which value is appropriated for the complements developed. Revenue-sharing requires complementors to share an agreed-upon percentage of revenue with the platform firm, each time a complement is sold (Avinadav et al., 2021; Avinadav et al., 2022), in exchange for the right to own their innovation (e.g., apps) and have access to the platform's user base (instead of entering the market on their own) (Chen et al., 2022). Revenue sharing is used by a variety of platforms to incentivize complementors. For example, app developers on the iOS and Android operating systems get to keep 70% of the revenue generated through their apps, just as sellers on Amazon and Alibaba keep 90% of the revenue, while sharing a small portion of their sales (typically 10%) with the platform firm as a commission. Similarly, the creator economy motivates creators by sharing ad revenue (Bhargava, 2022). For instance, when content creators on YouTube generate ad revenue, 55% of it is given to the creators, with YouTube keeping 45%.

In setting their revenue-sharing schemes, platform firms may adopt a fixed scale where they keep a predetermined percentage, or a moving scale where the percentage rises (a rising scale) or decreases (a sliding scale) with an increase in sales volume (Tiwana, 2013). The choice can have a strong impact on complementors' incentives to participate in the ecosystem. The more favorable schemes for complementors are the ones where they pay the least share to platform firms, as this allows them to appropriate the most value. Employing aggressive revenue-sharing schemes,

where complementors are required to share a large percentage of their revenue, may dampen complements' incentives to participate, especially where complementors can turn to competing platforms that have more favorable terms. As such, platform firms seek to set revenue-share schemes in a way that incentivize complementors to innovate and remain within their ecosystem.

Although it is acknowledged that the choice of revenue-sharing scheme can have a significant impact on complementors' incentives to participate in the ecosystem (Tiwana, 2013), as yet very little is known about how this key decision affects complementor activity. More specifically, there is a lack of understanding concerning the effectiveness of this mechanism, specifically in how it incentivizes and shapes innovative activity within an ecosystem. We contribute to such an understanding by exploiting a quasi-experiment wherein Shopify, a platform firm, made a significant change to its revenue-sharing scheme, lowering it from 20% to 0%. We present details on this change in the following section.

SHOPIFY

Shopify is an e-commerce platform that provides users²² (i.e., merchants) the ability to create and customize online stores for their businesses. It helps these merchants manage orders and process payments, as well as enables them to create, execute and analyze marketing campaigns to better sell their products. Much like other e-commerce platforms, Shopify provides these core functionalities, but also has an ecosystem of developers that create apps to extend the functionality of the platform. These apps offer additional features that make the platform more attractive to users. Shopify has a dedicated marketplace, the Shopify App Store, where developers make their apps available to users. Currently, Shopify has over 8,000 apps that provide various features that

²² Note, users on e-commerce platforms are different from users that are commonly referred to on other platforms (for example, consumers using the Android platform). In this context, users can be companies, entrepreneurs, or individuals, and they are often referred to as 'merchants' or 'vendors' as they set up online stores to sell their products.

make the platform more attractive. For instance, the Oberlo app helps users connect to suppliers in China through AliExpress, while the Laviyo app enables email marketing and automates store communications. As one Shopify user states, “I wouldn’t use Shopify without apps. It’s a precondition for using Shopify, and it’s a major efficiency enhancer” (Shopify, 2022).

When it comes to developing apps for Shopify, the opportunity has always been enticing, with complementors generating about \$12.5 billion in revenue in 2020. While developers are given the freedom to price their apps how they like – i.e., freemium model, one-time fees or subscription – they are required to share a percentage of their revenues with Shopify once they start making sales in the marketplace. The revenue sharing schemes (also referred to as a revenue split) stipulate the percent of revenue collected by Shopify, the platform firm, each time an app is bought by a user. This revenue share is essentially a commission charged by the platform firm and can range from 0% to 50%, depending on the platform. Much like its competitors, Shopify had a 20% revenue share scheme for many years (or 20/80 revenue split).

On June 29th, 2021, during its annual developer conference (Unite 2021), Shopify announced that it was lowering the revenue share to 0%, whereby developers would keep 100% of their revenue for the first \$1 million they earned on Shopify’s App Store (effective August 1st, 2021). In other words, Shopify would no longer take a cut for the first million dollars made by developers, and the benchmark would reset each year. Furthermore, it was announced that Shopify would also cut its commission rates for developers who make more than \$1 million, down to 15% (from 20%). In a press release highlighting this change, Shopify stated that by reducing the revenue share to 0%, it is “significantly increasing the opportunity for developers to build and grow their businesses” and “while more generous terms mean less for [Shopify] near term... this more equitable approach will *encourage greater innovation...*” (emphasis added; Shopify, 2021).

As the statement highlights, encouraging innovation is one of the primary motivations of the rule change. Accordingly, we use the natural experiment-like conditions to study the effectiveness of revenue-sharing on complementors' innovative activity. The level of innovation is often captured through the *variety* of apps in platform ecosystems (Cennamo & Santalo, 2019); therefore, we specifically examine the impact of the revenue-share change on variety. We also examine the effectiveness of the revenue-share change on the *quality* of innovative output²³.

Hypotheses Development

Variety. In platform ecosystems, innovation is captured through the variety (or diversity) of complements available (Cennamo & Santalo, 2019; Cennamo, 2018; Cottrell & Nault, 2004; Zhu & Iansiti, 2012). Depending on the type of platform, variety can be captured in terms of purpose (as for apps) or genre (as for games). A greater variety of complements is desired because it increases a platform's value by enhancing its appeal to a wider audience of users. It also enables users to derive different types of benefits, as opposed to similar benefits (as in the case where there are more of the same type of complements). As such, platform firms offer incentives to complementors to undertake innovative activity and generate a variety of complements. The reduction in revenue share percentage from 20% to 0%, as implemented by Shopify, reflects such incentives (since it offers more favorable terms to the developers).

As the innovation literature suggests, improved incentives often encourage greater participation (Boudreau, 2012; Farrell & Weiser, 2003). Especially as illustrated in the open innovation context, higher pecuniary rewards attract more actors to undertake research efforts

²³ As a supplementary analysis, we also examine the effectiveness of the revenue-share change on the *quantity* of complements (See Appendix B). We do not include quantity as a primary outcome of interest because although it is an important indicator of complementor activity, it is not a sufficient indicator of innovative activity. For instance, in the case where the quantity of apps increases, it is possible that many apps offer the same functions, and therefore is not reflective of greater innovation.

(Hofstetter, Zhang & Herrmann, 2018). Among other things, pecuniary rewards serve as a form of positive competence feedback that symbolizes achievement and stimulates intrinsic motivation, thus influencing participation and creative efforts (Hofstetter et al., 2018; Eisenberger and Rhoades, 2001; Harackiewicz, Manderlink, and Sansone, 1984; Reeve and Deci, 1996; Reeve, Olson, and Cole, 1985). Therefore, given the potentially higher pecuniary rewards resulting from the rule change, we expect new developers, who otherwise would not have considered participating, to join the ecosystem and develop new apps. We also expect *extant* developers to consider more opportunities for development.

Boudreau (2012) shows that the more complementors that can access a generative platform, the greater the subsequent innovation. Specifically, in his study of software applications, he finds a tight link between the number of complementors, and the variety of complements generated. He attributes the greater variety to the diversity and distinct specializations of the complementors. A diverse pool of complementors bring with them diverse knowhow, and differences in experimentation, which results in a variety of innovative output (Baldwin and Clark 2000; Chesbrough 2006; Yoo et al. 2008, 2010b; von Hippel 2005). This is especially true if the platform firm attracts a more heterogeneous a group of complementors, because with heterogenous actors, innovation is distributed “not only among [actors] of the same ilk, but also across [actors] of different kinds” (Yoo et al., 2010: 730). Moreover, as Boudreau (2012) emphasizes, the regular flux of complementors in and out of the ecosystem – or the “churn” of complementors can be in itself a source of novelty (see Baldwin & Clark, 2000).

The open innovation context also confirms that larger solver populations lead to the generation of more diverse solutions, and therefore, firms engaging in contests and tournaments seek to attract larger solver populations by offering better incentives (Terweisch & Xu, 2008).

Following this logic, we expect that a reduction to the revenue-share percentage offers better incentives to participate and will therefore result in an increase in the variety of apps in Shopify's marketplace.

Hypothesis 1 – A decrease in the revenue-share scheme will result in an increase in the *variety* of complements.

Quality. Platform firms also seek to encourage the generation of innovative output that is of high quality. Quality is a complex, multidimensional construct (Garvin, 1984). Generally, innovation quality can be defined through variables like performance, effectiveness, reliability and features among others (Haner, 2002). In terms of complement quality in particular, Hilbolling, Berends, Deken & Teurtscher (2021) discern two key dimensions: (1) the integrity of the complement (i.e., how well it operates with the platform), and (2) the functionality provided by the complement in the platform ecosystem. From a user-demand perspective, quality captures how much benefit the customer derives from using the product (e.g., Binken & Stremersch, 2009; Xu et al., 2010). In line with this perspective, we view complement quality as a representation of consumption benefits stemming from functionality. Quality in terms of functionality regards the unique content or utility complements provide (Hilbolling et al., 2021).

Consumers' perception of the quality of individual complements has one of the greatest influences on the overall value of the ecosystem (Rietveld, Schilling & Bellavitis, 2019). The presence of high-quality complements increases platform value by enhancing the consumption benefits from using the platform (Cennamo, 2018; McIntyre et al., 2021). Indeed, it has been shown that high-quality complements, generally referred to as "hits" (Corts & Lederman, 2009) or "superstars" (Binken & Stremersch, 2009), can critically affect users' platform adoption. At the same time, an influx of low-quality complements can lead to a platform's failure. Consider the

case of the Atari platform. After leading the early videogame industry, it lost its momentum following a ‘crash’ in which the market was saturated with hundreds of lower-quality games (Coughlan, 2004). Since Atari had not developed a technology for locking out unauthorized games, it was unable to prevent the entry of opportunistic developers, who flooded the market with poor quality games. At a time when consumers had few ways to distinguish good from bad games, bad games drove out good ones (Boudreau & Hagi, 2009).

Although Farrell and Weiser (2003) insist on the importance of bringing a large number of complementors onto a platform with the metaphor of letting a thousand flowers bloom, Wareham et al. (2014) rightly caution that “if a thousand flowers grow, inevitably, some will be undesirable and harmful to the ecosystem. In the extreme, the unconstrained growth of low-quality innovations can kill a platform” (p.1212). As the Atari example indicates, too many complementors in an ecosystem can result in an influx of low-quality complements. Boudreau’s (2012) study of the software application industry also reveals evidence that as the pool of complementors gets larger, the quality of complements deteriorates; Specifically, the later cohorts of complementors tend to generate complements that are ‘less compelling’ than earlier cohorts. This deterioration in quality may result from opportunistic behaviors such as free-riding by complementors, as well as complementors withholding improvements to their complements as the profit potentials reduce from overcrowding (Cennamo & Santaló, 2019).

With the decrease in revenue-share incentivizing more complementors to participate in Shopify’s case, there is a similar risk of overcrowding which can lead to and manifest in the availability of many low-quality apps (Boudreau, 2012). This is especially likely because Shopify already has over 7,000 apps in its marketplace (compared to the 700 apps that WooCommerce

has). Due to this risk, we expect this rule change to have a negative spillover effect on quality, such that on average, more lower-quality complements will be added in the ecosystem.

Hypothesis 2 – A decrease to the revenue-share scheme will lead to a decrease in the *quality* of complements.

METHOD

To conduct the analysis, we use the difference-in-differences (DiD) approach, which is a statistical technique that attempts to mimic an experimental research design using observational study data (Angrist & Pischke, 2009). It studies the differential effect of a specific intervention or treatment (in our case, revenue share change) on an outcome (e.g., variety of apps) by comparing the changes in the outcome over time between the ‘treatment group’ and a ‘control group’. In other words, DiD takes into consideration (1) how a group mean changes before and after an intervention in the treatment group, and (2) compares this change with the mean over time of a similar (control) group which did not undergo the intervention. As suggested by the name, the DiD estimator is the difference of their mean differences. In other words, the DiD estimator takes the difference in the treatment group before and after the treatment (*the treatment effect*) and subtracts the difference in the control group before and after the treatment (*the trend over time*), as in the following formula:

$$(\text{Treatment_post} - \text{Treatment_pre}) - (\text{Control_post} - \text{Control_pre}) = \text{DiD estimate}$$

In mathematical terms, we are interested in estimating three coefficients as in the following equation:

$$Y = \beta_0 + \beta_1 * \text{Treated} + \beta_2 * \text{Post} + \beta_3 * \text{Treated} * \text{Post} + e$$

Where Y is the outcome variable, $Treated$ is a dummy variable indicating the treatment group (=1) and control group (=0); $Post$ is a dummy variable indicating pre (=0) and post (=1) treatment; and

$Treatment*Post$ is a dummy variable indicating whether the outcome was observed in the treatment group AND it was observed after the intervention (=1), or any other case (=0).

Here, β_0 represents the average outcome of the control group before the treatment; β_1 represents the difference between the treatment and the control group before the treatment; β_2 represents how much the average outcome of the control group has changed in the post-treatment period; Finally, β_3 is the key parameter that we are interested in estimating (it is the difference in difference estimator). It represents how much the average outcome of the treatment group has changed in the period after the treatment, compared to what would have happened to the same group had the intervention not occurred. If $\beta_3=0$, we can conclude that the treatment had no effect.

Difference-in-differences is used in observational settings where exchangeability cannot be assumed between the treatment and control groups. DiD relies on a less strict exchangeability assumption, i.e., in absence of treatment, the unobserved differences between treatment and control groups are the same over time. Hence, difference-in-differences is a useful technique to use when randomization on the individual level is not possible (Angrist & Pischke, 2009). The approach removes biases in post-intervention period comparisons between the treatment and control group that could be the result from permanent differences between those groups, as well as biases from comparisons over time in the treatment group that could be the result of trends due to other causes of the outcome.

In this study, Shopify's innovation ecosystem is the treatment group, while the control group is WooCommerce's innovation ecosystem, where no change was made to the revenue sharing scheme. WooCommerce is Shopify's direct competitor in the e-commerce space, with both

platforms being among the top 3 platforms in terms of e-commerce usage²⁴. WooCommerce has a similar ecosystem of developers, yet it has not lowered its revenue share scheme and continues to implement a 20% revenue share. Although WooCommerce has fewer apps than Shopify overall, it satisfies the assumption of parallel trends for the two variables of interest (i.e., variety and quality), making it a suitable control group (see following section for details).

Variables

Difference-in-differences analyses require data from pre- and post-intervention. Therefore, we created panel datasets surrounding the Revenue Share Change (i.e. the “treatment”) on August 1st 2021, for both Shopify and WooCommerce. We created separate panels for the two variables, namely, variety and quality. To measure these variables and construct the panels, we started by web-scraping relevant information from Shopify’s App Store and WooCommerce’s Extensions Marketplace.

Variety. In the platform literature, variety is often measured by the number of additional app categories introduced in an ecosystem (e.g., Cennamo and Santalo, 2019; Ghazawaneh and Henfridsson, 2013). While data on categories is available for Shopify and WooCommerce, we find it to be an inadequate measure in this setting because both platforms use different categories and group them differently. They also change category names and groupings over time. For instance, Shopify initially had over 20 categories, but it now has 6 main categories with a plethora of sub-categories under each. This of course is not a reflection of reduced variety, but a reorganization.

To accurately measure variety over time, we relied on topic modeling. We started by collecting app descriptions for all the apps listed on each marketplace and then applied Latent Dirichlet Allocation (LDA), a generative probabilistic topic model to the collection of texts (Blei,

²⁴ <https://trends.builtwith.com/shop/traffic/Entire-Internet>

Ng, & Jordan, 2003). LDA is one of the most popular topic modelling techniques used to classify texts to a particular topic. A key benefit of LDA is that it does not require classification by humans. Instead, it has structure emerge from the text data. The method uses a ‘Bag of Words’ approach where the semantics and meaning of sentences are not evaluated. Rather, the method evaluates the frequency of words. It is therefore assumed that the most frequent words within a topic will present an aboutness of the topic (Asmussen & Møller, 2019). (See Blei (2012) for a detailed description of LDA).

One crucial human choice when using LDA is the number of topics to be estimated by the algorithm. The appropriate number of topics can differ greatly, depending on the purpose of the analysis. Usually, a low number of topics is used for a general overview and a higher number of topics is used for a more detailed view (Asmussen & Møller, 2019). Since we wanted to capture the variation between the large number of apps in Shopify’s App Store (over 7000+), we preferred a large number of topics.

When running LDA on the Shopify dataset, we set the number of topics to 70 – balancing between having too many topics to be interpretable and too few to allow meaningful variation²⁵. We used the Gibbs sampling algorithm, and following prior work, set the topic smoothing parameter α to 0.7 (i.e., $50/k$, where k = number of topics) (Griffiths & Steyvers, 2004). See Appendix C for complete details.

When running the LDA on WooCommerce’s dataset, we made a few adjustments to the parameters because the corpus was relatively smaller – due to a fewer number of apps (700+), and shorter length of app descriptions. To avoid the risk of overfitting the model, we reduced the

²⁵ We arrived at 70 topics based on a perplexity analysis (See Appendix C for details).

number of topics to 50, and to encourage sparsity in the resulting topic distributions, we used a lower value for the topic smoothing parameter α -- setting it to 0.1 (instead of the default 50/k).

Both LDA models captured many dimensions (or topics) along which apps described themselves. For instance, for Shopify, topics 70 and 17 related to shipping and deliveries, while topic 15 is related to inventory management. Similarly, some topics concerned marketing (e.g., topics 67, 63, and 37) while others concerned social media integrations like topic 21 (WhatsApp), topic 28 (Instagram) and topic 61 (Facebook). Similarly, for WooCommerce topics were related to a variety of features such as payments (e.g., topic 37), shopping carts (e.g., topics 13 and 33), and advertising (e.g., topic 39). See Appendix C for a complete list of topics and associated terms for both Shopify and WooCommerce.

Following Haans (2019), we used these topics to compute the *distinctiveness* of each app as $\sum_{T=1}^k ABS [(\theta_{T,i} - \bar{\theta}_{T,I})]$, where $\theta_{T,i}$ indicates an app i 's weight for topic T, and $\bar{\theta}_{T,I}$ indicates the market I 's average weight for topic T at that point in time²⁶. Essentially, for each app, we calculated the absolute deviations from the overall marketplace average for every topic at that point in time. This allowed us to measure how distinct (or unique) a particular app was, relative to all other apps launched before it in the marketplace²⁷. We used these scores to create a panel with data 18 months before and after the rule change – i.e., from February 2020 to February 2023. We decided on 18 months for the pre- and post- intervention periods in order to have enough data points for comparison.

²⁶ Note, we use rolling averages to calculate the market's average weight for each topic, because the marketplace average changes depending on the time of the app's launch. For instance, for an app launched in August 2020, the average includes all the apps launched before it. Similarly, for an app launched in February 2023, the average accounts for all the additional apps launched up to that point in time.

²⁷ We assume that app descriptions do not change drastically over time.

Quality. Both Shopify and WooCommerce offer users the ability to provide feedback on apps by rating them on a scale from 1 to 5 (where a score of 1 reflects poor quality and 5 reflects high quality). Following past work, we used these app ratings as a proxy for quality (e.g., Claussen, Kretschmer & Mayrhofer, 2013). This enabled us to focus on quality from the user’s perspective, as app ratings often reflect how beneficial users find the app to be.

Since more recent apps do not have sufficient time to gather feedback from users, many of the newer apps, especially on WooCommerce’s marketplace, did not have any ratings. For this reason, we excluded the more recent apps when creating the panel dataset, such that we shortened the pre- and post- intervention period to 12 months each (instead of 18 months, as in the previous case), from August 2020 to August 2022²⁸. This way, we still had enough data points for comparison, while also ensuring that missing data did not bias the results.

Comparability Assumption

A key assumption of the research design requires that Shopify and WooCommerce apps are comparable, in that they have ‘parallel’ trends (Bertrand et al., 2004). To assess whether this assumption holds, we conducted a pre-treatment trend analysis involving a regression analysis on the pre-treatment periods. It included an interaction term between time and the group indicator (*Treated*). A significant interaction term would suggest a violation of the parallel trends assumption. In contrast, if the coefficient of the interaction term is not statistically significant, it indicates that there is no systematic difference in trends between the treatment and control groups before the treatment is introduced.

Table 3.1 indicates that the interaction terms for both cases were not statistically significant, therefore the parallel trends assumption is satisfied in both cases. In other words, it can

²⁸ Doing so excluded the missing data from September 2022 to February 2023.

be assumed that there is no systematic difference in trends between Shopify and WooCommerce before the treatment was introduced²⁹.

Table 3.1. Tests for Parallel Trends

	Variety	Quality
	(1)	(2)
Month	-0.0004 (0.00004)	0.001 (0.0007)
Treated	-1.098 (1.239)	0.312 (0.019)
Month x Treated	0.00004 (0.0005)	-0.002 (0.0001)

Note . Standard errors are given in parentheses

Model Specifications

Variety. To determine the treatment effect of the revenue-sharing change on the variety of apps, we estimated the following model specification:

$$Y_{it} = \beta_0 + \beta_1 \text{Treated}_i + \beta_2 \text{Treated}_i * \text{Post}_t + \delta_2 X_{it} + T_t + \varepsilon_{it}$$

Where Y_{it} is the *distinctiveness* for app i in month t ; β_0 is the intercept; β_1 represents the difference between the treatment and the control group before the revenue change; *Treated* is a dummy variable that equals 1 for Shopify apps, and 0 for WooCommerce apps; *Post* is a dummy variable that equals 1 for the months after the rule change, and 0 for the months before the change; β_2 is the coefficient of interest and identifies the treatment effect of the revenue change (*Treated*Post*); X_{it} is a vector containing control variables, T_t is a vector of month fixed effects and ε_{it} is the error term.

²⁹ We also assessed this assumption by visually examining the data points for variety and quality in the pre-intervention periods for both Shopify and WooCommerce (See Appendix D).

Here, the two control variables used are the *number of new apps*³⁰ in each month and the *number of new developers*³¹ in each month. Since both factors may explain the variance in the variety of apps across the platforms, we included them in the model to account for differences between the two groups. We also included a full set of month fixed effects to control for month-by-month variations that may affect the results. As is common practice, we omitted the time regressor *Post* from the model because we included fixed time effects³².

Quality. To determine the treatment effect of the revenue-sharing change on the quality of apps, we estimated the following model specification:

$$Y_{it} = \beta_0 + \beta_1 Treated_i + \beta_2 Treated_i * Post_t + \delta_2 X_{it} + T_t + \varepsilon_{it}$$

Where Y_{it} is the *quality* for app i in month t ; β_0 is the intercept; β_1 represents the difference between the treatment and the control group before the revenue change; *Treated* is a dummy variable that equals 1 for Shopify apps, and 0 for WooCommerce apps; *Post* is a dummy variable that equals 1 for the months after the rule change, and 0 for the months before the change; β_2 identifies the treatment effect of the revenue change (*Treated*Post*); X_{it} is the control variable; T_t is a vector of month fixed effects and ε_{it} is the error term.

Here, the control variable used was the *number of ratings* for each app, since it was possible for the number of ratings to explain some variance in the app ratings (our measure of quality). As with the previous model, we also included a full set of month fixed effects to control for month-

³⁰ Both Shopify and WooCommerce provide information on the launch date for each app. We used this information to calculate the number of new apps introduced each month.

³¹ Both Shopify and WooCommerce provide information on the developer for each app. We used this information, alongside the launch dates, to identify the new developers per month.

³² Including both can lead the multicollinearity issues, as the information captured by the time regressor (*Post*) would be already accounted for by the time fixed effects.

by-month variations that may affect the results. Once again, we omitted the time regressor *Post* from the model because we included fixed time effects.

RESULTS

The results of the analyses are presented in Table 3.2. Column 1 indicates that the treatment effect on variety is positive and significant, indicating that the reduction in revenue share had a positive effect on the variety of apps, as hypothesized. Specifically, the distinctiveness score increased by 0.095 more than it would have in the absence of the rule change. Note, while 0.095 may appear like a small value, in Shopify’s dataset, the distinctiveness scores varied by values as small as 0.001 (and up to 0.2); therefore, suggesting an increase of 0.095 is a meaningful change.

Table 3.2. Effect of Revenue-Sharing Change

	Variety	Quality
	(1)	(2)
Intercept	0.663*** (0.042)	0.433*** (0.239)
TREATED	-0.292*** (0.052)	-0.165 (0.209)
TREATED x POST	0.095* (0.039)	0.725* (0.301)
New Apps	0.001 (0.001)	
New Developers	-0.002 (0.002)	
Ratings		0.0004*** (0.000)
Observations	8,064	3,885
R-squared	0.886	0.123
Month Fixed Effects	Yes	Yes

Notes. Standard errors are given in parentheses. *, ** and *** indicate significant at the 5%, 1% and 0.1% levels, respectively

Column 2 indicates that the treatment effect on quality is positive and statistically significant, revealing that the revenue share reduction had a positive spillover effect on the quality

of apps, instead of a negative spillover effective as we had predicted. Specifically, Shopify had app ratings that were on average 0.725 points higher than they would have been in the absence of the rule change. While this result is counterintuitive, it offers opportunities to consider alternative explanations. For instance, it is possible that the increased profit potential resulting from a reduction in the revenue-share change incentivized complementors to develop higher quality apps. It is also possible that the rule change attracted better-quality developers, as well as more experienced developers who contributed better quality apps (in addition to adding more variety in the ecosystem). We discuss these results and their implications further in the following section.

DISCUSSION

This paper makes contributions to the literature on (1) platform governance, namely the effectiveness of revenue-sharing as a pecuniary incentive mechanism; (2) governance dynamics; (3) the quantity-quality trade-off; and also extends (4) generativity-oriented work on ecosystems.

Platform Governance

Primarily, this paper advances the literature on platform governance, which studies the design, deployment and enforcement of governance mechanisms through which platform firms exert influence over actors participating in their ecosystems (Schilling, 2005; Tiwana, 2013; Wareham, Fox & Giner, 2014). Extant work in this area has examined different governance mechanisms used by platform firms to enable value creation, such as gatekeeping (Zhang, Li & Tong, 2018), selectively promoting complements (Rietveld, Schilling & Bellavitis, 2019), rewarding high quality complements (Claussen, Kretschmer & Mayrhofer, 2013), providing boundary resources (Ghazwaneh & Henfridsson, 2013), and altering algorithms (Koo & Eesley, 2021). While these studies have produced valuable insights on how platform firms govern

complementor activity, this paper is the among the first to study a mechanism that is more oriented towards value capture (or value appropriation).

By examining the impact of revenue-sharing, a particular pecuniary governance mechanism used by platform firms to incentivize complementors, this paper takes steps to empirically illustrate and quantify the impact that such mechanisms have on complementor activity. Our findings reveal that a reduction in the revenue share has a positive effect on the variety of complements, as well as a positive spillover effect on the quality. Together, the results demonstrate that a reduction in revenue-sharing is an effective incentive mechanism that motivates complementors to participate and engage in innovative activity.

These findings challenge earlier work that suggests there might be a trade-off between ecosystem size and innovativeness, such that the level of innovativeness decreases as the number of complements increase (Panico & Cennamo, 2022). Taking a demand-based approach, Panico & Cennamo (2022) use simulation experiments to show that there exists a trade-off between size and innovativeness, with the strength of user preferences ultimately determining whether a larger ecosystem can also be more innovative. They argue that user preferences can change over an ecosystem's evolution, particularly due to the different composition of users over time (Cennamo et al., 2018; Rietveld & Eggers, 2018)³³. Most interestingly, they observe that the trade-off between ecosystem size and ecosystem innovativeness is most prominent in the later stages of platform evolution due the strength of indirect network effects. Our results contradict this finding, since in our case, the level of innovation did not decrease, despite an increase in quantity³⁴; and moreover, there was no such trade-off despite the ecosystem's level of maturity. This finding demonstrates

³³ For instance, in the early stages, consumers with strong preferences for innovativeness may be more likely to join the platform whereas later platform adopters will tend to weigh more the size of the ecosystem in their consumption decision. See also Binken & Stremersch, (2009)

³⁴ As shown in our supplementary analysis, Appendix B.

that ecosystem dynamics are not solely influenced by user demand, but that they can be shaped by the platform firm through its exercise of specific governance mechanisms.

Additionally, this study reveals that despite the risk of oversaturation, it is possible to advance innovation and quality in more mature ecosystems like Shopify's, by utilizing the correct governance mechanisms. Given the effectiveness of this mechanism at this stage in the ecosystem's life cycle, it is likely that implementing the same rule change earlier in the ecosystem's life cycle may have been even more effective in motivating greater innovation (i.e., increased variety) – especially since user preferences would have also favored more variety at that time (Rietveld & Eggers, 2018). In any case, using this incentive mechanism at this juncture proves to be a valuable and strategically viable decision.

Governance Dynamics

This study is also among the first to offer insight on how *changes* to a governance mechanism affects complementors' innovative activity. As Chen et al (2022) identify in their review of the governance literature, there is a lack of research exploring how ecosystem governance changes over time and how these changes impact the ecosystem. Although some studies have examined the effects of rule changes, most of them pertain to transaction platforms, and therefore do not relate to innovative activities of complementors. For example, Wessel et al. (2017) investigate the effect of relaxing the screening process on Kickstarter, Koo & Eesley (2021) study the effect of a change in ranking algorithms and Chung et al (2024) examine the impact of Lyft and Uber's driver access restriction. As yet, only one other study has examined the effect of a rule change in an innovation context. Claussen, Kretschmer, and Mayrhofer (2013) examine a rule change by Facebook by which apps with higher user engagement were allowed to send out more notifications. They find that this change motivated existing complementors to improve the quality of their apps.

While our study is similar in that it also examines the effect of a rule change, it is different in three important ways. First, instead of examining the effect on existing complements (i.e., quality improvement), our study includes newly generated complements within an ecosystem. Second, instead of examining the impact on one specific outcome (i.e., quality), we examine the impact on two outcomes and explore their interconnected nature. Third, while Claussen et al. (2013) looked at Facebook in isolation and did not have any competitors to compare with, we use a difference-in-differences approach, with WooCommerce as a control group, allowing us to determine the effects of the change more accurately. Overall, by exploring how a governance rule change impacts innovative activity, this paper deepens our knowledge on the dynamics and evolution of governance design.

Quantity-Quality Trade-off

This paper also adds to a more nuanced understanding of the widely recognized quantity-quality trade-off which suggests that an increase in the number of complements often comes at the expense of a deterioration in quality, especially in more mature ecosystems like Shopify's, where there is risk of overcrowding, as well as opportunistic behaviors such as free-riding by complementors (Wareham et al., 2014; Cennamo & Santaló, 2019; Geva, Barzilay, & Oestreicher-Singer, 2019; Wang, Li, & Singh, 2018; McIntyre et al., 2020). Our results indicate that this need not always be the case. As demonstrated in this study, a reduction in revenue share not only motivated more output generation³⁵ and greater variety, but it also had a positive effect on the quality of complements, indicating that increased quantity can (at times) be accompanied by improved quality.

³⁵ As shown in our supplementary analysis, Appendix B.

Although the findings seem counterintuitive, they offer an opportunity to consider alternative explanations for the impact of increased participation on the quality of apps. While it is argued that an increase in complements can reduce profit potential from overcrowding, causing complementors to withhold improvements to their complements (Cennamo & Santaló, 2019), the findings in this study suggest the possibility that despite the increase in the number of complements, the higher profit potential (from the reduced revenue-sharing) may incentivize complementors to generate better quality apps, so that they can attract more users and thus generate more profit. It also suggests the possibility that the reduction in revenue-sharing incentivizes more higher-quality developers to join the platform and thus contribute better quality apps.

Relatedly, the findings highlight the importance of considering the circumstances under which complement quantity increases, in order to better assess the relative impact on quality. For instance, when the influx of complementors/complements is due to lower access control (Boudreau, 2012), there is a greater possibility of low-quality complements; but in a case where an influx of complementors/complements is due to better pecuniary incentives, without any changes to access control (as in this study), there need not be a similar effect. Moreover, since pecuniary incentives are ultimately tied to performance (such that complementors earn more revenue if their products are well-received by users), they offer complementors greater motivation to improve the quality of their complements in order to maximize their profit potential.

Ecosystem Generativity

This paper also extends generativity-oriented work on ecosystems by developing a better understanding of how generative output is shaped through governance. Influentially defined by Zittrain (2006) as a technology's overall capacity to produce unprompted change "driven by large, varied and uncoordinated audiences" (p. 180), generativity is viewed as a "useful concept to understand the dynamic and unbounded nature of digital innovations" (Um, Yoo, Watal,

Kulathinal & Zhang, 2013: 4). In platform ecosystems, generativity manifests through a large number of complementors generating innovative complements that are not always conceivable to the platform firm itself (Dattée, Alexy & Autio, 2018). As Wareham, Fox, and Giner (2014) highlight, “although it is possible to cultivate generativity within the boundaries of a single firm, the generative potential is substantially increased in a looser arrangement of heterogeneous actors who pursue self-interested, innovative activities in a distributed and scalable ecosystem” (p.1198).

Extant scholarship, primarily in the information systems domain, examines how generativity results from the technological design – or architecture – of a platform (Tiwana, 2013; Um et al., 2013: 4; Yoo et al., 2010; Yoo, Boland, Lyytinen and Majchrzak, 2012; Tilson, Lyytinen & Sørensen, 2010). This line of work highlights modularity – i.e., the degree to which complex systems are divided into smaller re-combinable modules that function together as a whole (Baldwin & Clark, 2000) – as a key design feature of generative platforms.

In comparison to the considerable work on generative architectures, “there is very little research that considers how governance and other (non-technical) aspects can drive generativity” (Autio & Thomas, 2020: 29). Developing a better understanding of how firms use these mechanisms to shape generativity is particularly important because although the architecture influences complementors’ *ability* to participate in the ecosystem, governance influences actors’ *motivation* to participate and innovate (Tiwana, 2013). Instead of leaving the generative process to unfold on its own solely as a result of the platform’s generative architectures, platform firms actively shape generativity within their ecosystems by utilizing a variety of governance mechanisms. A study of these governance mechanisms is required to offer a more complete picture of how generative output is shaped within an ecosystem setting (Thomas & Tee, 2022; Chen et al., 2022).

In this paper we take a step in this direction by examining how the revenue-sharing mechanism can be used to shape generative output within ecosystems. We not only examine the impact on the variety (or innovativeness) of the generative output, but we also examine the impact on quality. This is important because at times quality is subsumed under other constructs such as innovativeness in generativity-oriented work (e.g., Panico & Cennamo, 2022). In recognizing quality as a distinct attribute of generative output and studying it independently, our paper draws attention to the various ways in which governance can impact different dimensions of generative output.

Limitations & Future Research

The contributions of this study need to be considered in light of its limitations. The effectiveness of revenue-sharing as observed in this study is relevant to the particular context, and therefore, may not be generalizable to platforms outside this context. Future research should explore whether these findings hold in different contexts. Moreover, although we exploit a quasi-experiment and use a very close competitor as a control group, with the parallel trends' assumption being satisfied, we acknowledge that it is possible that the outcomes observed are not entirely due to the intervention (i.e., change in revenue share), and that there may be other influences affecting the outcomes. To add further confidence to our findings and improve our understanding of the effectiveness of revenue-sharing, similar studies should be carried out in the future, especially under different circumstances and using different methods. Relatedly, it is important to note that we used topic modelling to determine distinctiveness scores, making our results dependent on our measurement of variety. Future studies should consider other alternatives to this measure.

While this study's objective was to study the impact of revenue sharing on the variety and quality of innovative output, future research can extend this work to assess the impact of these outcomes on user activity. Ultimately, platform firms seek to govern their complementor

ecosystems in an effort to attract more users (Jacobides et al., 2018). Therefore, it would be useful to connect the findings in this paper to the user/demand side. This is an important step because although we find the results to be positive overall, it remains to be seen whether these outcomes affect user adoption. For instance, does the increase in the variety of complements lead to increased adoption as predicted by indirect network effects, or are users indifferent at these more mature stages in an ecosystem's lifecycle? Extending the analysis to incorporate users will offer a more complete analysis of the impact that governance has on an ecosystem.

Similarly, while this study is concerned with the impact of incentive mechanisms on the nature of innovative output, there are opportunities to examine other effects on output. For instance, there is a possibility that the pricing strategies used by existing developers change in response to the lower revenue share, in a way that negatively affects users. Developers offering free apps or using freemium models might be more inclined to switch to paid options given the 0% revenue share and their increased ability to profit. Such a result might harm users in the long run and would be worth exploring to develop a more nuanced understanding of how a change in one mechanism can have several effects simultaneously.

Finally, although this study examines the impact of the rule change in a mature ecosystem, it would be worthwhile to explore the effects of similar incentive mechanisms in an ecosystem that is in earlier stages of its lifecycle. As Panico and Cennamo (2022) highlight, "the different stages of the evolution of a platform ecosystem call for different strategies.... There is a constant need to align complementors' incentives to the stage of the ecosystem's evolution" (p.509). Studying the effectiveness of governance mechanisms at various stages of evolution can help advance a more granular and dynamic understanding of incentivizing innovation in ecosystems.

CHAPTER 4 - ESSAY 3

A CONFIGURATIONAL EXAMINATION OF PLATFORM GOVERNANCE MECHANISMS

INTRODUCTION

Digital platforms have transformed the nature of business and economic activity. Based on foundational technologies upon which a range of external actors converge and co-create value (Gawer, 2009), digital platforms have made business activities easier than ever before and have enhanced firms' abilities to deliver increasingly complex solutions to consumers (Williamson & De Meyer, 2012). Digital platforms are often associated with ecosystems that constitute (1) the platform firm, (2) the platform's end-users, and (3) complementors – i.e., the set of actors that leverage the platform to develop innovative complements that extend the platform's core functionality (Gawer, 2014; Kapoor, 2018; Jacobides, Cennamo & Gawer, 2018).

A key challenge for platform firms within such ecosystems is to effectively guide the activities of ecosystem participants. This requires appropriate *platform governance*, which refers to the design, deployment and enforcement of governance mechanisms through which platform firms exert influence over actors participating in their ecosystems (Schilling, 2005; Tiwana, Konsynski & Bush, 2010; Boudreau, 2012; Tiwana, 2013; Wareham, Fox & Giner, 2014; Huber, Kude & Dibbern, 2017; Chen, Tong, Tang & Han, 2022). These governance mechanisms include, but are not limited to, rules, standards and guidelines with which actors must comply (Boudreau & Hagiu, 2009), and entail both hard regulations and soft nudges (Claussen, Kretschmer & Mayrhofer, 2013; Zhang et al., 2018) pertaining to matters such as decision rights, incentive structures and control mechanisms (Tiwana, 2013).

Much of the empirical scholarship on platform governance examines platform firms' use of specific mechanisms such as gatekeeping (Zhang, Li & Tong, 2018), selectively promoting

complements (Rietveld, Schilling & Bellavitis, 2019), rewarding high quality complements (Claussen, Kretschmer & Mayrhofer, 2013), providing boundary resources (Ghazwaneh & Henfridsson, 2013), and altering algorithms (Koo & Eesley, 2021). By highlighting complementors' responses to these mechanisms, these studies have produced valuable insights on how platform firms govern complementor activity and shape ecosystem value.

However, a focus on individual mechanisms limits our understanding of platform governance for several reasons. First, as Chen, Tong, Tang and Han (2022) remark: "Though many studies have examined how particular governance instruments or design features influence complementors' participation and performance on the digital platform, research on the comparison between multiple instruments or design features and platform owners' choices among them remains scarce. Little do we know about how to decide on the optimal design features in different platform contexts" (p.23). Since platform firms utilize a *variety* of governance mechanisms to collectively shape ecosystem activity (Wareham et al., 2014), it is also important to understand how these different mechanisms *combine* to influence ecosystem outcomes. For instance, different governance mechanisms impact actors' decisions to participate in the ecosystem differently, and therefore, differences in combinations of mechanisms may have implications for outcomes such as platform adoption and usage. Research has yet to quantify such differences (Bogers, Sims & West, 2019), leaving us with relatively little knowledge in this regard.

Second, although effective governance is recognized as essential to a platform's competitive performance (Gawer, 2014), much of extant research tends to examine the impact of a governance mechanism in one ecosystem, resulting in a limited understanding of platform governance within a competitive context. As Jacobides, Cennamo and Gawer (2018) state, "we need to consider ecosystems in their competitive context...[since] the attractiveness of conditions

in one ecosystem is a comparative assessment of what the alternatives are” (p.2269). Third, while it is important to govern the activities of both complementors *and* users within an ecosystem, extant studies tend to view governance in relation to complementors only, with user-oriented governance often being overlooked.

In this paper I seek to fill these gaps by asking: *What configurations of platform governance mechanisms (pathways) lead to enhanced platform adoption by both users and complementors?* By identifying such configurations, I develop an understanding of how platform governance mechanisms combine to shape ecosystem participation. I use the e-commerce landscape as the empirical context for this study, which constitutes platforms that provide users (i.e., merchants) the ability to create and customize online stores for their businesses. These platforms often have an ecosystem of third-party developers (i.e., complementors) that create apps to extend the functionality of the core platform.

To conduct the analyses, I apply fuzzy-set Comparative Qualitative Analysis (fsQCA), which is a case-based configurational approach (Ragin, 2008) that views organizations as “multidimensional constellation[s] of conceptually distinct characteristics that commonly occur together” (Meyer, Tsui & Hinings, 1999: 1175). The main objective of fsQCA is to identify different configurations (or ‘causal recipes’) that enable or disable specific empirical outcomes (e.g., high platform adoption). This is achieved by determining consistent connections within a set of cases using Boolean minimization. Since e-commerce platforms govern the actions of both users and complementors, I conduct two separate analyses. In the first, I examine the configurations of *user-oriented* governance mechanisms that contribute towards high platform

adoption, and in the second I examine the configurations of *complementor-oriented* governance mechanisms that contribute towards high platform adoption³⁶.

The results indicate that (1) high platform adoption can be achieved through distinctly different governance mechanism combinations; (2) incentive mechanisms are more salient than control mechanisms when seeking high platform adoption (in terms of both users and complementors); and (3) complementor and user analyses are interconnected, such that complementor-oriented governance can inform not only complementors' platform adoption, but also inform a better understanding of *users'* platform adoption. As such, assessing ecosystem-level outcomes requires comprehensive examinations of both user- and complementor- specific governance mechanisms and outcomes, because relying on only one analysis can leave out important details in understanding ecosystem performance.

Broadly speaking, this paper contributes to the literature on platform governance by (1) shifting focus from a particular governance mechanism and its impact, to highlighting the various ways in which governance mechanisms combine to shape ecosystem participation; (2) shifting empirical focus from one (or a few) ecosystems to competing ecosystems by studying governance in a competitive landscape; and (3) highlighting the importance of user-oriented governance in ecosystems where users also generate output. Overall, this paper advances a more nuanced understanding of platform governance, the development of which is increasingly important as digital platforms continue to integrate further into the economic fabric.

³⁶ While the overall purpose of these mechanisms remains the same for both users and complementors, the design features through which they are enacted differ for both groups, thus warranting separate analyses.

PLATFORM GOVERNANCE

Governance refers to the way in which an organization makes and implements decisions in pursuit of its objectives. It involves the structures, processes, and institutions within and around organizations that allocate power and resource control among participants (Davis, 2005). Governance has long been fundamental to strategic management research, with scholars devoting much attention to understanding how interorganizational exchanges are governed. The vast scholarship has focused on two main types of governance: (1) contractual and (2) relational.

Contractual governance involves the use of formal contracts to reduce risk and uncertainty in exchange relationships (Lusch & Brown, 1996; Williamson, 1985). These contracts represent obligations to perform particular actions in the future (Macneil, 1978), and they are often enforced by a third party, such as courts. Many scholars recognize that the governance of interorganizational exchanges involves more than formal contracts. Interorganizational relationships are typically repeated exchanges embedded in social relationships. Relational governance emerges from the values and agreed-upon processes found in these social relationships (Heide and John, 1992). Here, the enforcement of obligations, promises, and expectations occurs through social processes that promote norms of flexibility, solidarity, and information exchange (Poppo & Zenger, 2002). As such, relational governance can enhance exchange performance by embedding information flows in social ties rather than in contracts (Uzzi, 1990). Relational governance primarily involves the set of relational norms that develop over time, as well as trust, which emerges from repeated interactions in social relationships (Zaheer & Venkatraman, 1995; Dyer & Singh, 1998). Through these social processes, relational governance may function to mitigate the precise exchange hazards targeted by formal contracts—hazards associated with exchange-specific asset investments, difficult performance measurement, and uncertainty (Poppo & Zenger, 2002).

In the ecosystem context, since ecosystem participants are autonomous actors and no direct

authority relations exist between them and the platform firm, platform firms cannot avail managerial hierarchy or resort to traditional formal contracting (Gawer, 2014). As such, they cannot ‘force’ specific behaviors or actions as in the case of employees or partners. Similarly, given the vast number of ecosystem participants, relational governance is impractical, with relations between the actors being more market-like. Therefore, platform firms must rely on a different set of governance mechanisms to create conditions that are conducive to attracting, incentivizing and enabling the sustained participation of ecosystem actors.

Platform governance broadly refers to the means through which platform firms exert influence over actors within their ecosystems in order to guide value co-creation activities (Schilling, 2005; Tiwana, 2013). Here, the idea is to shape the ecosystem, not fully direct it (Williamson & De Meyer, 2012). This often involves setting rules, standards and guidelines with which actors must comply (Boudreau & Hagiu, 2009; Tiwana, 2013), and entails both hard regulations and soft nudges (Zhang, Li & Tong, 2018).

Although the platform literature largely refers to governance in relation to complementors, given their direct engagement in the value co-creation process (e.g., Wareham et al., 2014; Tiwana, 2013; Chen et al., 2022), platform governance also encompasses users. In contrast to traditional forms of organizing, platform afford users a more active role in value co-creation (Jacobides et al., 2018; Autio & Thomas, 2020), as they can take on roles as ideators, designers, and/or intermediaries (Lusch & Nambisan, 2015), and can also act as resource integrators. In their capacity as active participants, users can trigger novel ways of generating and realizing value. As such, platform governance entails governing the actions of both users and complementors.

Governance Mechanisms

Platform governance is “exercised through a portfolio of interrelated and purposefully designed governance mechanisms” (Staub, Haki, Aier & Winter, 2022: 909). These mechanisms pertain to matters such as decision rights, control, and pricing (Tiwana, 2013), and can be distinguished in terms of the tensions they address (Wareham et al., 2014). For instance, while some mechanisms foster output variety, others enforce standardized output; similarly, while some enforce control to reduce undesirable variance, others confer autonomy to promote desirable variance; furthermore, while some mechanisms direct actions towards a collective purpose, others promote the advancement of individual motives (Wareham et al., 2014). In their comprehensive review of platform governance, Chen, Tong, Tang & Han (2022) find that the mechanisms of incentive and control often take center stage in digital platform ecosystems. They emphasize that these mechanisms (in most cases) are enacted through digital design features.

Drawing on their work, as well as others (e.g., Tiwana, 2013; Wareham et al., 2014, Huber et al., 2017), I highlight seven governance mechanisms, all of which may influence platform adoption. Five of these mechanisms relate to incentives, while the other two relate to control. These mechanisms apply to both users and complementors, albeit in different ways.

Incentive Mechanisms

(1) Resource Provision. Platform firms often provide resources to ecosystem participants to assist them in their value creating activities. This provision of resources is viewed as an incentive mechanism as it motivates and encourages actors to participate and contribute (Chen et al., 2022). Users are often offered technical/customer support through email, phone or live chat for when they require assistance. They are also provided with additional tools to help them better utilize the respective platform. Depending on the type of platform, these resources can come in various forms,

such as creator tools (e.g., logo makers, name generators, video makers), advanced business resources that help with strategy and planning, as well as advanced analytic functions.

In the case of complementors, platform firms often provide boundary resources – i.e., tools that serve as the interface between the platform firm and complementors (Ghazawneh and Henfridsson, 2013). These boundary resources are often in the form of application programming interfaces (APIs), software development kits (SDKs), code libraries (Chen et al., 2022), as well as automated testing tools and integration support (Tiwana, 2013; Huber et al., 2017). These resources assist complementors in developing complements that are well integrated with the platform (von Hippel & Katz, 2002; Ghazawneh and Henfridsson, 2013). In addition to these technical resources, platform firms may also provide marketing resources such as market reports, sales templates and joint marketing campaigns (Huber et al., 2017) to help them market their complements to users.

Together, these resources offered by digital platforms make it easier for users and complementors to generate value by helping them save time, improve their skills, and achieve their goals more effectively. This in turn makes the platform more attractive and can result in greater participation.

(2) Information Provision. In addition to providing resources, platform firms provide useful information to prompt desired behaviors and to improve users' and complementors' performance (Chen et al., 2022). Platform firms often provide information to users in the form of user guides and tutorials to help them familiarize themselves with the platform. They may also provide platform-facilitated community forums where users can connect and interact with one another to share tips and advice. The platform firm can also provide complement-related information to users. For instance, it may provide a list of top-performing complements in the

ecosystem, in order to guide users towards certain complements (Rietveld et al., 2019). Often, platform firms also provide ratings and reviews of complements in order to guide users' decisions. By providing such information to users, platform firms can influence their perception of an ecosystem's depth and breadth (Chen et al., 2022).

In the case of complementors, platform firms provide interface-related information to prompt desired behaviors (Chen et al., 2022). This often involves establishing communication channels between complementors and the platform firm, where guidelines, rules and regulations are shared, as well as updates regarding important developments. In some cases, platform firms may offer more detailed and valuable information through workshops, webinars and developer conferences, such as hackathons (Fang, Wu & Clough, 2021). Platform-facilitated community forums may also be established for complementors to communicate with one another and collectively contribute to community solution catalogues. Platform firms may also provide customer-related information to complementors (Chen et al., 2022). For instance, they may provide customers' usage data to assist them with complement development. Similarly, they may provide market insights into what users are searching for, so that complementors can better cater to their needs.

As with resource provision, information provision is an incentive mechanism that assists users and complementors in their value creating activities by clarifying important issues, simplifying tasks, and helping with problem-solving; thus, making the platform more attractive.

(3) Value Appropriation Regimes. Platform firms often set different rules about how value is appropriated. These rules are often set in ways that incentivize participation. In cases where users generate monetary value, the platform firm often stipulates a percentage to be shared

in the form of commission. For instance, when ad revenue is generated by content creators on YouTube, 45% of revenue is taken by YouTube, with 55% being given to the creators.

With respect to complementors, platform firms charge complementors various fees. For instance, some platforms charge publishing fees when complementors list their complements on the platform's marketplace. Similarly, they may have in place various revenue sharing schemes that stipulate how value is appropriated between the platform firm and complementors (Chen et al., 2022). These regimes essentially create a shared fact that binds together the interest of the complementors and the platform firm (Tiwana, 2013). Platform firms may adopt a fixed scale where they keep a predetermined percentage, or a moving scale where the percentage rises (a rising scale) or decreases (a sliding scale) with an increase in sales volume (Tiwana, 2013). The choice can have a strong impact on complementors' incentives to participate in the ecosystem. If they are required to share a large percentage of revenue, they may not be so inclined to participate, especially when considering other competitors in the market. Essentially, by making value appropriation regimes more favorable to users and complementors, platform firms can incentivize them to join and remain in the ecosystem.

(4) Autonomy. Platform firms often grant participants some degree of autonomy in conducting value-creating activities on the platform. Conferring autonomy is generally understood in terms of decision rights, whereby the platform firm devolves some rights of decision-making to ecosystem participants (Tiwana, 2013; Hagi & Wright, 2009; Bauner, 2015). For users, decision rights may involve the right to set prices of items they wish to sell on a platform – such as physical products in marketplaces, or content on social media. It may also include the right to customize the platform's interface to their liking.

For complementors, decision rights include the right to use and modify the platform interface, as well as rights to develop products, set prices, and market and promote complements. Granting these decision rights to complementors allows greater autonomy in product development, transactions and interactions with customers (Boudreau, 2010; Chen, Pereira & Patel, 2020). For instance, in platforms where the right to decide prices has been delegated to complementors (i.e., more decentralized decision rights), complementors may offer their complements for free, use a freemium model (that involves in-app purchases), or charge users a one-time fee or an ongoing subscription fee. In platforms where complementors do not have this right (the decision rights are more central), complement prices are set by the platform firm, thus constraining the level of flexibility granted to complementors. The degree of flexibility and discretion afforded to complementors shapes their incentives and willingness to contribute.

Overall, granting decision rights to ecosystem participants creates a stronger sense of ownership and higher degree of freedom, motivating participants to join the platform (Ye & Kankanhalli, 2018).

(5) Rewards. Rewards are one of the most basic forms of incentives and are often used by platform firms to attract and retain both users and complementors. Scholars have shown how offering pecuniary and non-pecuniary rewards can encourage platform adoption and boost performance (Ceccagnoli et al., 2012; Rietveld, Schilling & Belavitis, 2019; Wen, Forman & Graham, 2013). For users, rewards may be in the form of discounts or points that can be used towards future purchases. They may also include features on a platform's promotional page (such as "Success Stories") or badges that signify high performance.

For complementors, platform firms may offer financial incentives for high-quality contributions. They may also offer promotional rewards as continued inducements for enacting

value-creating activities (Li & Agarwal, 2017). These promotional rewards come in the form of recommendations, certifications and featuring, which help selected complementors enhance their reputation, draw customers' attention and improve sales growth (Chen, Wei & Zhu, 2018; Huang, Singh & Srinivasan 2014). Such rewards may have spillover effects such that they incentivize other complementors to make similar high-quality contributions.

Control Mechanisms

Control mechanisms are equally as important as incentive mechanisms. They involve the enforcement of rules and standards (Evans & Schmalensee, 2007) to facilitate coordination and to ensure the activities of external actors are aligned with the interests and objectives of the platform firm and ecosystem (Tiwana, 2013). The platform firm is able to exercise control due to its ownership over the core platform technology, giving it “architectural leverage” over other actors within the ecosystem (Thomas et al., 2014). While too much control can hinder the incentives of external actors, too little control can compromise an ecosystem (Boudreau, 2010). The two most important control mechanisms are access control and output control.

(1) Access Control. Access control is a key control mechanism that determines the extent to which external actors have access to the platform and its resources (Chen et al., 2022). It includes all the rules and regulations that stipulate who is allowed to use the platform and in what ways (Tiwana, 2013; Huber et al. 2017; Ghazawneh & Henfridsson, 2013). Many platforms do not exercise strict access control when it comes to users, by making them essentially free to use. In cases where platforms do exercise access control, it is often in the form of access fees, whereby users incur a cost (either one-time or recurring) to use the platform.

Platform firms also exert access control on complementors through access fees whereby complementors have to incur a cost to gain access to the boundary resources when developing complements. Some platforms also use screening criteria based on which complementors are either

denied or granted access and entry (Casadesus-Masanell & Campbell, 2019; Kwon, Oh, & Kim, 2017). Charging access fees and using screening mechanisms serve as filters to weed out low-quality contributors at the early stage (Dushnitsky, Piva, & Rossi-Lamastra, 2020; Hossain, Minor, & Morgan, 2011; Song, Chen, & Li, 2021).

In a sense, access control can be viewed as a form of ‘input control’ (Cardinal, 2001) in the same way that organizations select which candidates to hire as employees from a pool of applicants (Tiwana, 2013). The lower the access control, the easier it is for actors to join and participate in the ecosystem, and the higher the access control, the more difficult it is to join and participate.

(2) Output Control. In addition to input (or access) control, platform governance requires output control, which refers to the measures that the platform firm uses to monitor, evaluate and validate output in the ecosystem (Tiwana, 2013). This is necessary for quality assurance and reliability, and to maintain coherence in the ecosystem. Allowing all types of output in an ecosystem can jeopardize a platform’s reputation and negatively impact the ecosystem’s overall value proposition.

In ecosystems where users generate some type of output, they are often bound by rules and standards with which they must comply. Failure to comply with the rules can often result in restrictions being placed on use, or removal of the user. For example, users who violate Instagram’s policies and community guidelines may have their accounts temporarily or permanently suspended. Sometimes feedback systems are also used to evaluate user performance or behavior.

When considering the activities of complementors, output control is necessary to ensure seamless integration of the complements with the platform (Tiwana, 2013). For this reason, platform firms use various measures to assess whether the complements adhere to specific

inclusion criteria. Based on various screening and review processes, the complement is either allowed or rejected on a platform's marketplace. This practice is often referred to as gatekeeping. Although some scholars view gatekeeping as a form of access control (e.g., Tiwana, 2013; Zhang et al. 2018), careful consideration makes it apparent that it is a form of output control because it evaluates fully developed complements and assesses whether they are up to the standard to be made officially available to users³⁷. These criteria do not prevent complementors from accessing the boundary resources and trying to develop complements – instead these criteria determine whether the complements are up to the standard for being listed or not. Gatekeeping is useful to weed out complements that are potentially damaging to the ecosystem (Tiwana, 2013), and to limit competitive crowding (Boudreau & Jeppesen, 2015). This type of assessment and evaluation is used extensively by platforms like Apple that have a strict review process and certification requirements that determine whether an app meets all the guidelines and standards before being made available to users (Zhang et al., 2018, Tiwana, 2013). For instance, by not allow imitating apps on its App Store, Apple encourages original submissions from developers (Zhang et al., 2018).

Platform firms also rely on feedback from users as a means to evaluate output. For instance, users may provide reputation scores (Fan et al., 2016; Li, Fang, Lim & Wang, 2018), ratings, and reviews (Choi, Cho, Yim, Moon, & Oh, 2019) to share their personal experience and opinions regarding the quality and usefulness of the offerings (Chen et al., 2022). These feedback systems allow platform firms to evaluate complementor performance (Lin, Zhang, & Tan, 2019; Yi, Jiang, Li, & Lu, 2019), and they also enable complementors to take corrective actions to further improve

³⁷ Gatekeeping is often viewed as access control because it *limits access to the complement marketplace*. Here, I highlight that it does *not* limit access to the *boundary resources* and does not affect complementors' ability to develop applications. By making assessments around the standards and requirements of the app (and making a decision based on this evaluation), gatekeeping essentially functions as an output control mechanism.

their output (Huang, Boh & Goh, 2017). This self-correction by complementors constitutes a secondary mechanism by which platform firms utilize output control to improve complement quality, and by extension, value creation (Chen et al., 2022).

Taken together, these seven governance mechanisms influence both user and complementor decisions regarding platform adoption. While the overall purpose of these mechanisms remains the same for both users and complementors, the design features through which they are enacted differ for both groups. Since platforms often utilize a combination of governance mechanisms (Boudreau & Hagi, 2009; Tiwana, 2013; Wareham et al., 2014) that may affect ecosystem outcomes differently, in this study I examine the configurations of platform governance mechanism (pathways) that lead to enhanced platform adoption.

METHOD

Since the research question seeks to uncover various combinations, I utilize a configurational approach to conduct the analyses. I use fuzzy-set Qualitative Comparative Analysis (fsQCA), which is a comparative method that is viewed as a ‘middle road’ between the qualitative and quantitative approach (Ragin, 2008). It provides a way of undertaking case-based configurational analysis, focusing on the necessary and sufficient conditions for an outcome (Ragin, 2008; Greckhamer, Misangyi, Elms & Lacey, 2008; Crilly, 2011; Fiss, 2011). fsQCA takes the perspective that cases (in our study, platforms) are constituted by combinations of conditions (i.e., governance mechanisms), and that the relationships between these conditions and the outcome of interest (i.e., high platform adoption) are best understood in terms of set membership (Ragin; 2000, Fiss, 2007; Ragin; 2008). The main objective of fsQCA is to identify different conditions (or ‘causal recipes’) that enable or disable specific empirical outcomes, and this is achieved by determining consistent connections within a set of cases using Boolean Algebra (instead of correlational methods).

A key benefit of fsQCA is that it can handle situations of considerable causal complexity, making it particularly suited to address the research question. It accounts for complex (configurational) causality by assuming (1) *equifinality*, in that there may be several paths to an outcome; (2) *conjunctural causality*, in that multiple independent explanatory conditions may be necessary to explain a given outcome; and (3) *asymmetric causality*, which suggests the presence of an outcome may require different explanations than the absence of the same outcome (Misangyi, Greckhamer, Furnari, Fiss, Crilly & Aguilera, 2017).

Another benefit of fsQCA is that it can deal with small-N (e.g., between 12 and 40 cases) as well as large-N (40+ cases) populations equally well (Greckhamer, Misangyi & Fiss, 2013). In fact, QCA was originally developed specifically for small-N settings. Small-N studies require high familiarity with the context of study and are useful to examine emergent theoretical attributes and relationships. Given the empirical context and nature of this study (i.e., small-N setting), fsQCA is a very suitable method to conduct the analyses.

Context

The empirical setting for this study is the e-commerce landscape, which constitutes digital platforms that provide users (i.e., merchants) the ability to create and customize online stores for their businesses. These platforms help users manage orders and process payments, and also enables them to create, execute and analyze marketing campaigns to better sell their products. While the platforms provide the core functionalities, they often have an ecosystem of third-party developers that create apps (also referred to as add-ons, extensions or plug-ins) that extend the functionality of the core platform. These apps offer additional features that make the platform more attractive to users. For instance, the Oberlo app on Shopify helps users connect to suppliers in China through AliExpress.

It is often challenging to study alternative governance schemes either because most digital platforms tend to have similar governance policies or because different platforms in different domains may be too heterogeneous to be comparable (Chen, Richter & Patel, 2021). The e-commerce landscape offers a unique opportunity to examine alternative governance arrangements because there are many platforms that operate and compete in this space, and although they generally offer the same foundational technology, they utilize a variety of different governance mechanisms to guide both user and complementor activities within their ecosystems. Since they often combine these mechanisms differently, these platforms exhibit sufficient variation for examining the efficacy of alternate combinations of governance mechanisms.

To select cases for my analyses I used a database provided by Builtwith, a website profiler tool that tracks usage statistics of e-commerce platforms. Using Builtwith's list of 100 e-commerce platforms that form the 'eCommerce Usage Distribution in the United States', I selected platforms that met the following criteria to ensure they were comparable cases. First, since I was interested in both user- and complementor-oriented governance, I included platforms that had complement marketplaces in their ecosystems. In other words, I excluded the platforms that did not offer any third-party apps, add-ons, extensions or plug-ins. Second, I selected platforms that had been active for at least 10 years. This ensured that ecosystems in their initial stages were not being compared to ecosystems in their more mature stages, especially since the governance mechanisms (and user adoption) would naturally be different at the different stages of platform development (Wareham et al., 2014). Finally, it was important to ensure that the platforms selected were directly competing in the same market (i.e., the United States). This meant that I did not select platforms like Tiendanube and Base, because although they contributed to the usage distribution in the US, their

primary markets were Argentina and Japan respectively. This selection criteria ensured that the cases were comparable and resulted in a selection of 30 platforms.

Using these cases, I investigated which governance mechanism configurations exist in ecosystems exhibiting high platform adoption (and which governance mechanism configurations exist in ecosystems exhibiting the *absence* of high platform adoption³⁸). In the following sections I explain how I conducted the fsQCA analyses.

Configurational Model

The first step in a fsQCA study is to construct a configurational model by selecting an outcome and theoretically relevant conditions (or attributes) that may play a role in explaining the outcome. Since e-commerce platforms govern the actions of both users and complementors, I constructed two configurational models (to conduct two separate analyses).

The first model examines the configuration of user-oriented governance mechanisms that contribute towards users' high platform adoption. Based on the key governance mechanisms identified in the literature review, I considered the following attributes in the **user-oriented model**: (1) *extended resource provision*, (2) *extended information provision*, (3) *high autonomy*, and (4) *access control*. (Details on these attributes will follow in section 3.3.1).

Rewards were not included in the model as e-commerce platforms do not have any design features to reward users with. Similarly, *value appropriation regimes* were not included in the model because most platforms do not have rules about how user-value is appropriated³⁹. Likewise,

³⁸ More details on why in section 3.4

³⁹ In the early years of e-commerce it was very common for platforms to charge transaction fees, whereby users had to share a portion of their revenue (per sale) with the platform firm. This transaction fee was like a commission, and would range from 0% to 5%, depending on the platform. As the e-commerce landscape has evolved, this practice is no longer as common.

output control was excluded since platforms have very minimal need to monitor or evaluate the storefronts created by users on their platform.

The second model examines the configuration of complementor-oriented governance mechanisms that contribute towards complementors' high platform adoption. For this **complementor-oriented model** I considered the following attributes: (1) *extended information provision*, (2) *rewards*, (3) *favorable value appropriation regime*, (4) *access control* and (5) *output control*. (Details on these attributes will follow in section 3.3.2)

Resource provision was not included in the model since all e-commerce platforms provide similar resources, mostly in the form of application programming interfaces (APIs) and software development kits (SDKs)⁴⁰. Similarly, *autonomy* was not included in the model because all platforms in the study offer similar decision rights to complementors, such that they are free to use the platform's code for app development and to price their complements however they please.

Data Calibration

After selecting the attributes for the configurational model(s), the next step in a fsQCA study is to define sets and calibrate the case data into these sets based on substantive theoretical knowledge, which requires intimacy with the theoretical and empirical context (Ragin, 2008). Crisp sets indicate whether cases are members of a given set – they have either full membership ('fully in') denoted by the number 1, or full non-membership ('fully out') denoted by a 0. Fuzzy

⁴⁰ To facilitate with app development, e-commerce platforms provide complementors with application programming interfaces (APIs), which are sets of protocols and definitions for building and integrating apps. Almost all the platforms have APIs that conform to the REST architecture, which is a widely used inter-application communication protocol. The benefit of REST APIs is that they allow loose coupling between the platform's server and the client application (i.e., programming language), allowing both to evolve independently. Since the REST architecture is widely-used, there are several client application libraries that already exist, making it easier for developers to use the platform APIs. Most e-commerce platforms also offer complementors software development kits (SDKs), which are a collection of development tools that assist in the value-creating process. They also offer code libraries and testing tools to facilitate complementor activities.

sets take matters further and determine the *degree* of set membership, between 0 and 1. This can be done using either a direct or indirect method of calibration.

The direct method involves transforming variables into sets calibrated along three substantively meaningful thresholds: full membership in a set [1], full non-membership in a set [0], and the cross-over point [0.5], which is “the point of maximum ambiguity (i.e., fuzziness) in the assessment of whether a case is more in or out of a set” (Ragin, 2008: 30). The crossover point essentially anchors a fuzzy set’s midpoint between full membership and full non-membership (Ragin, 2000: 158). In other words, the direct method of calibration requires numerically defining a given variable’s values for the three thresholds (0, 1 and 0.5). These anchor points are used to then transform the variable’s original values into fuzzy-set membership scores ranging from 0 to 1 (using transformations based on the log odds of full membership).

In instances where numerical values cannot be assigned to the three thresholds, an indirect method of calibration is used. The indirect method uses linguistic definitions and knowledge to set meaningful thresholds and assign membership scores. These breakpoints can take various values. For instance, a four-value fuzzy set permits membership scores of ‘fully out [0]’, ‘more out than in’ [0.33], ‘more in than out’ [0.67] and ‘fully in’ [1]. Given the nature of this study I used both the direct and indirect method of calibration, depending on the attribute.

User-oriented Model

In this section I outline the criteria used for the assignment of membership scores for the user-oriented model (See Table 4.1 for summary; Appendix E for details).

Outcome: High Platform Adoption (Users). For the user-oriented model, I examined users’ high platform adoption as the outcome of interest and measured it in terms of the platform’s usage distribution in the US market. This data was gathered from BuiltWith which provides

information on the number of websites powered by each e-commerce platform. According to the data gathered, there are more than 13 million websites powered by various e-commerce platforms in the United States.

For calibration, platforms with usage over 12% were viewed as exhibiting high platform adoption by users, and thus coded as fully in [1] the *set of platforms with high platform adoption*. Platforms with usage below 0.01% were viewed as not exhibiting high adoption, and therefore, coded as ‘fully out’ [0] of this set; the crossover point was set at 2% based on a natural gap in the data. Note, these thresholds were selected based on natural gaps in the data identified through x-plots (and confirmed through cluster analysis).

Extended Resource Provision. E-commerce platforms provide users with resources to help them better manage their online stores. For instance, most platforms provide technical support to help users when they encounter problems, marketing tools to help run promotions and advertise, and data analysis tools to help users assess their performance and make better data-driven decisions. While these resources are similar across platforms, some platforms distinguish themselves by offering additional resources. In the e-commerce landscape, these extended resources can come in the form of omni-channel services.

Omni-channel services enable the integrated use of multiple sales channels from a single platform, and therefore help users increase their reach. These channels include mobile, social media and in-person. In other words, in addition to offering the ability to create online storefronts (traditional websites), these platforms now offer resources to (1) create better mobile-responsive storefronts, (2) integrate social commerce (i.e., sales and marketing through social media apps like TikTok and Instagram); and (3) use point-of-sale software that enables in-person (in-store) sales. The growth of both “bricks to clicks” and “clicks to bricks” suggests that a fluid blend of physical

and digital shopping is the most effective approach for success. This combined approach has numerous benefits, and therefore platforms that offer these resources may appear more attractive to users.

Accordingly, platforms that offered resources for all three channels – mobile, social media and point of sale – were coded as “fully in” [1] the *set of platforms with extended resource provision*, and platforms that offered resources for two of these channels, were coded as “more in than out” [0.67] of the set. Platforms that offered resources for only one channel were coded as “more out than in” [0.33], while platforms that did not offer resources for any of the three channels were coded as “fully out” [0] of the set of platforms with extended resource provision.

Extended Information Provision. E-commerce platforms also provide users information to improve their performance. This is often in the form of guides, blogs, tutorials and webinars that help users familiarize themselves with the platform and its features. While most platforms provide similar information, some distinguish themselves by offering additional valuable information. This extended information often comes in the form of (1) extensive learning opportunities, often in the form of a dedicated learning function (e.g., Academy); (2) platform-facilitated community forums where users interact with one another to exchange information, problem solve and seek inspiration; and (3) platform-sponsored events where users can network and share knowledge.

E-commerce platforms offer various combinations of these information sources (or none at all). Therefore, platforms that offer three of these features were coded as “fully in” [1] the *set of platforms with extended information provision*, and those offering two of the features were coded as “more in than out” [0.67]. Meanwhile, platforms that offered only one of these design features

were coded as “more out than in” [0.33], and those that offered none of these were coded as “fully out” [0].

High Autonomy. E-commerce platforms grant users varying degrees of autonomy in how they design their online storefronts. While some platforms offer standardized templates that lack flexibility, other platforms offer users various apps, extensions, and/or integrations to customize their stores (extending the platform’s functionality), enabling users to design their stores in ways that work best for them. For instance, by providing apps like Oberlo in its marketplace, Shopify gives users the ability to create storefronts powered by dropshipping – a retail fulfillment method where sellers list products on their website without keeping inventory. Without such an app, users would not be able to engage in dropshipping on Shopify’s platform, thus placing limits on how they design their storefronts.

While all the platforms selected for this study offer apps (or add-ons, extensions, integrations), they do so to varying degrees. While some offer many customization options, others offer limited choices (either because they have highly curated marketplaces, or because they are unable to attract sufficient complementors in the ecosystem). The customization options range from 6 to over 13,000, with most cases offering options in the hundreds.

Accordingly, platforms with customization options over 1000 were viewed as granting high autonomy to users, and thus coded as fully in [1] the *set of platforms with high autonomy*. Platforms with customization options below 30 were viewed as not exhibiting high autonomy, and therefore, coded as ‘fully out’ [0] of this set; the crossover point was set at 300 based on a natural gap in the data (and confirmed through cluster analysis)⁴¹.

⁴¹ Note, these thresholds were selected based on natural gaps in the data identified through x-plots (and confirmed through cluster analysis).

Access Control. E-commerce platforms generally impose access control on users in the form of access fees. Many of these platforms are subscription-based, in that users have to pay a monthly or annual fee to continue using the platform. In these cases, access is limited depending on the type and amount of subscription fees. In contrast, some platforms are free to use, with options to upgrade to a paid plan when needed. In these cases, it is easier for users to access the platform as there is no financial commitment necessary upfront.

Platforms that require annual subscriptions, and therefore a higher financial commitment, were coded as “fully in” [1] the *set of platforms with access control*, and those with monthly subscriptions fees were coded as “more in than out” [0.67] of the set. Platforms that offered a free plan option along with some monthly subscription plans were coded as “more out than in” [0.33], while platforms that were completely free to use were coded as “fully out” [0] of the set of platforms with access control.

Table 4.1. Calibration Criteria (User-oriented Model)

Conditions	Calibration Criteria for Membership Score Assignment	
Extended Resource Provision	1	3 out of 3: (1) mobile; (2) social media; (3) in-person (point of sale)
	0.67	2 out of 3: (1) mobile; (2) social media; (3) in-person (point of sale)
	0.33	1 out of 3: (1) mobile; (2) social media; (3) in-person (point of sale)
	0	0 out of 3: (1) mobile; (2) social media; (3) in-person (point of sale)
Extended Information Provision	1	3 out of 3: (1) extensive learning; (2) community forum; (3) events
	0.67	2 out of 3: (1) extensive learning; (2) community forum; (3) events
	0.33	1 out of 3: (1) extensive learning; (2) community forum; (3) events
	0	0 out of 3: (1) extensive learning; (2) community forum; (3) events
High Autonomy	1000 (1)	High customization in terms of apps/add-ons
	300 (0.5)	Some customization in terms of apps/add-ons
	30 (0)	Limited customization in terms of apps/add-ons
Access Control	1	Annual subscription fee
	0.67	Monthly subscription fee
	0.33	Free option with some subscription options
	0	Free

Complementor-oriented Model

In this section I outline the criteria used for assignment of membership scores for the complementor-oriented configurational model (See Table 4.2 for summary; Appendix E for details).

Outcome: High Platform Adoption (Complementors). For the complementor-oriented model, I examined complementors' high platform adoption as the outcome of interest. Since data is often not available on the exact number of complementors participating in the ecosystem, I used the number of complements in each ecosystem as a proxy for measuring complementor adoption⁴².

In the platforms selected for this study, complements (in the form of apps, extensions or add-ons) ranged from 6 to over 13,000. Accordingly, platforms with over 1000 complements in their marketplaces were viewed as exhibiting high platform adoption for complementors, and thus coded as fully in [1] the *set of platforms with high platform adoption*. Platforms with less than 30 complements were viewed as not exhibiting high platform adoption, and therefore, coded as 'fully out' [0] of this set; the crossover point was set at 300 based on a natural gap in the data (and confirmed through cluster analysis).

Extended Information Provision. E-commerce platforms provide information to complementors in the form of detailed documentation that explains how to use the API, as well as tutorials and app design guidelines that assist in development activities. They also provide information on key updates to the platform, in the form of Changelogs, as well as announcements

⁴² Although in some ecosystems a few complementors may provide a large number of complements (and it is possible to have a long tail of complementors with only 1 or 2 complements), this is not the case in ecommerce innovation ecosystems. Here, most complementors offer only 1 or 2 complements, thus making the number of complements a good proxy for the number of complementors. [This was verified by examining the output of developers in the various ecosystems.]

and articles on dedicated blogs. This information helps with integration and interoperability of the apps and the platform.

While most platforms provide similar information, some distinguish themselves by offering additional valuable information. This extended information often comes in the form of (1) extensive learning opportunities, such as expert training and courses, (2) platform-facilitated community forums (dedicated to developers) to help exchange information and seek guidance; and (3) platform-hosted events in the form of developer conferences and workshops where developers gather to learn and network.

Often, platforms offer various combination of these information sources (or none at all). Therefore, platforms that offer three of these features were coded as “fully in” [1] the *set of platforms with extended information provision*, and those offering two of the features were coded as “more in than out” [0.67]. Meanwhile, platforms that offered only one of these features were coded as “more out than in” [0.33], and those that offered none of these were coded as “fully out” [0] of the set.

Rewards. E-commerce platforms tend to offer non-pecuniary promotional rewards to complementors. They reward high quality apps by promoting them on their marketplaces under headings such as ‘editor’s picks’ or ‘recommended apps’. This not only signals high quality but gives complementors greater visibility. Some e-commerce platforms also give complementors the opportunity to earn certifications. Certified apps are tagged with labels that signal high quality (e.g., “Certified by” or “Built for”) and are similarly promoted in the marketplace as superior apps. In this way platform firms incentivise complementors to develop higher quality apps that meet user needs.

Since the platforms in the dataset either offered promotional rewards or chose not to offer any, I used crisp sets to calibrate the data for this attribute. Platforms that offered promotional rewards to complementors (e.g., recommended, featured, certified) in their respective marketplaces were coded as “fully in” [1] the *set of platforms with rewards*, while those that did not offer any promotional rewards were coded as “fully out” [0] of the set.

Favorable Value Appropriation Regimes. Although complementors are often free to set the prices of their apps, platform firms have rules that specify how the value is appropriated each time an app is bought by a user. The revenue share (or revenue split) guidelines stipulate the percent of revenue to be shared with the platform firm, per transaction (i.e., each time an app is bought by a user). This revenue share can be viewed as a commission and can range from 0% to 50%. Platform firms seek to set revenue share regimes in a way that incentivize complementors to keep making their apps available to users in their ecosystem. Here, the more favorable value appropriation regimes (for complementors) are the ones where they pay the least share to platform firms.

Given the range of 0% to 50% observed in the data, platforms with revenue share percentages lower than 10% were coded as “fully in” [1] in the *set of platforms with favorable value appropriation regimes*. Platforms with revenue share schemes higher than 40% were viewed as predatory and coded as fully out [0]⁴³ of the set. As the natural midpoint, 25% revenue share was set as the cross-over point.

⁴³ Note, two platforms in the study allowed only free apps in their marketplace and therefore did not allow any revenue to be generated. In these cases, I viewed it as 100% of the value going to the platform, and therefore assigned a numerical value of 100% to these cases. Accordingly, they were coded as ‘fully out’ [0] of the set of firms with favorable value appropriation regimes.

Access Control. E-commerce platforms exercise access control by setting rules around who can and cannot use the platform's boundary resources (e.g., APIs and SDKs) to create apps. In some cases, the interface and boundary resources are made available to all developers equally, but in other cases, the platform firm restricts their access to a select number of complementors. The platform firm either invites key industry partners to create apps, or requests interested parties to apply for partnership status. In this way, access is limited, and the platform firm exercises more control over who is allowed to create apps for its platform.

Accordingly, platforms that made their resources available to select partners only were coded as "fully in" [1] the *set of platforms with access control*. Platforms that required registration were viewed as utilizing screening mechanisms to determine whether the applicants were allowed to access the platform or not, and therefore were coded as "more in than out" [0.67] of the set. Platforms that made their boundary resources available to all interested developers but had some limitations in terms of use (such as requiring a specific programming language), were coded as "more out than in" [0.33], while platforms that were accessible to all developers equally were coded as "fully out" [0] of the set of platforms with access control.

Output Control. E-commerce platforms use various means to monitor and evaluate developers' apps. They have standards and predefined criteria that developers are required to meet before submitting their apps to the platform. They also have review processes in place to ensure that the apps meet the requirements before they are published (i.e., listed) on the app marketplace. Platform firms also rely on feedback from users to evaluate the published apps. This feedback is often in the form of ratings and reviews which enable the platform firm and complementors to take corrective actions if necessary. Since information on the app criteria and review process is not

made available equally for all platforms, in this study, I relied on the feedback system to gauge output control.

Accordingly, platforms that had both ratings and reviews were coded as “fully in” [1] the *set of platforms with output control*, while platforms that had only ratings, and no reviews, were coded as “more in than out” [0.67]⁴⁴ of the set. Platforms that had the option for ratings and reviews but did not have any completed ratings/reviews available in the marketplace, were coded as “more out than in” [0.33], while platforms with no option for ratings or reviews were coded as “fully out” [0] of the set of platforms with output control.

Table 4.2. Calibration Criteria (Complementor-oriented Model)

Conditions	Calibration Criteria for Membership Score Assignment	
Extended Information Provision	1	Both extensive learning & developer forum
	0.67	Extensive learning or developer forum
	0.33	Only developer forum, but inactive
	0	Neither extensive learning nor any developer forum
Rewards	1	Promotional rewards in the complement marketplace
	0	Promotion rewards in the complement marketplace
Favorable Value Appropriation Regime	10% (1)	Low revenue share percentage, most favorable
	25% (0.5)	Moderate revenue share percentage (midpoint)
	40% (0)	High revenue share percentage; least favorable
Access Control	1	Boundary resources accessible to select partners only
	0.67	Boundary resources accessible to those who apply (and make it past the screening)
	0.33	Boundary resources accessible to all developers, but with some limitations
	0	Boundary resources accessible to all developers
Output Control	1	Ratings & reviews
	0.67	Only ratings (many)
	0.33	Option available, but no ratings or reviews available
	0	No ratings or reviews option

⁴⁴ It is highly unlikely to have a review without a rating.

Fuzzy-Set Analysis

After calibrating the data, the next step in a fsQCA study is to conduct a sufficiency analysis by first constructing truth tables⁴⁵. I used the fsQCA package in R to construct two different tables for the two models. Truth tables list all possible configurations that may be associated with the outcome of interest and determine the frequency observed for each. As is common practice, I removed the configurations which did not occur among the 30 cases⁴⁶. Referred to as logical remainders, these configurations were logically possible, but empirically not observed. Next, I examined the consistency of the remaining configurations. Consistency refers to the proportion of cases with a given configuration that also display the outcome. Following Ragin (2008), I used the consistency score of 0.80 to identify configurations that were reliably associated with the outcome. Configurations with a consistency score over 0.80 were coded as 1 for the outcome, while configurations with a consistency score below 0.8 were coded as 0 for the outcome. Based on these truth tables, I was able to analyze set relations between the conditions and outcome through Boolean minimization in R.

As is customary in fsQCA studies, I also conducted counterfactual analyses for both models. Here, the truth tables and Boolean minimization helped identify governance mechanism configurations that were associated with the *absence* of the outcome (i.e., high platform adoption). The results of the four analyses are reported in the following section.

⁴⁵ Note, before a sufficiency analysis, it is important to conduct a necessity analysis that identifies any necessary causal conditions which must be present for an outcome to occur. I conducted necessity analyses for all conditions and their negation, for both models, using the recommended benchmark of 0.9 for the consistency score (Greckhamer et al., 2018; Ragin, 2009), but did not find any necessary conditions. I then proceeded with the sufficiency analysis as mentioned.

⁴⁶ As is best practice for small-N QCA studies, I determined the frequency threshold as 1. So any configuration that did not occur in at least one case, was removed from the list. Note, frequency thresholds can be higher than 1 in large-N QCA studies.

RESULTS

In this section I report the findings of the four analyses in the form of configurational charts where full circles indicate the presence of a condition, and the crossed circles indicate the absence of a condition (Fiss, 2011). The larger circles indicate core conditions – i.e., conditions for which the evidence indicates a strong causal relationship with the outcome of interest⁴⁷; and the small circles indicate peripheral conditions – i.e., conditions for which the evidence for a causal relationship with the outcome is weaker (Fiss, 2011)⁴⁸.

User-oriented Analyses

Table 4.3 reports the configurations of user-oriented governance mechanisms in platforms exhibiting the presence of the outcome (i.e., high platform adoption).

Table 4.3. Configurations for the Presence of High Platform Adoption (User)

	Solution	
	1	2
Extended Resource Provision	●	●
Extended Information Provision	●	●
Autonomy		●
Access Control	⊗	
Raw Coverage	0.476452	0.468603
Unique Coverage	0.102041	0.0941916
Consistency	0.828104	0.78968
Overall Solution Coverage	0.57	
Overall Solution Consistency	0.80	

⁴⁷ These are conditions that form both the parsimonious and intermediate solution. Note, a parsimonious solution is a more simplified but equivalent expression, compared to the intermediate (and complex) solution(s). It is obtained by employing a less conservative approach over the empirical evidence and includes remainders in the minimization process.

⁴⁸ These conditions occur only in the intermediate solutions.

The results indicate two configurations of governance mechanisms associated with users' high platform adoption. The first configuration constitutes the presence of both extended resource and information provision, combined with the absence of access control (indicating low or no access fees). The second configuration also constitutes the presence of both extended resource and information provision, but this time combined with presence of high autonomy (indicating high customization options in the form of apps, add-ons, extensions or plugins).

These two configurations highlight that while both extended resource and information provision are important to users, there are two distinct paths to high platform adoption: one that lowers access fees, and the other that offers greater customization to users in designing their storefronts. Both paths attract users for different reasons. While low access fees remove barriers to entry and give more actors the option to use (or try out) a platform, high customization grants greater flexibility and gives users more freedom to design their storefronts in ways that suit them best.

Notice, that because the degree of customization is based on the number of third-party apps, the first path interestingly suggests that high platform adoption does not require a large number of apps in an ecosystem. In fact, in the absence of access control, the number of apps is not even a consideration. This is interesting, as it is often suggested that due to indirect network effects (Hagiu & Wright, 2011), the number of complements in an ecosystem drives platform adoption on the user side. While the second path confirms this, the first path offers an additional understanding: that platform adoption can also be high in cases where there is little to no access control.

In the e-commerce space, platforms with the absence of access control are often open-source platforms that are available for free (or have free options alongside paid plans). Open-

source platforms like PrestaShop and WooCommerce are indeed some of the cases that have membership in the first configuration (in which the absence of access control is a core condition).

Furthermore, the second configuration constitutes both open-source platforms that offer high customization (such as OpenCart), as well as Software-as-a-Service (SaaS) platforms like Shopify and Weebly that similarly offer high customization. SaaS platforms remove much of the complexity of e-commerce by allowing users to essentially ‘rent’ the software that is built and maintained by the platform itself. SaaS platforms with membership in this configuration have high customization, signalling thriving innovation ecosystems (with many apps), further highlighting the importance of complements in such managed ecosystems.

The overall solution consistency is 0.80, indicating that the configurations can be reliably associated with the presence of the outcome – i.e., high platform adoption⁴⁹. The overall solution coverage is 0.57, indicating that the cases with these configurations represent a decent proportion of cases that exhibit the outcome; thus, demonstrating empirical relevance.

Counterfactual Analysis. Table 4.4 reports the counterfactual analysis: the configurations of user-oriented governance mechanisms in platforms exhibiting the absence of the outcome (i.e., the absence of high platform adoption).

⁴⁹ A more detailed explanation: The overall solution consistency of 0.80 indicates that most cases that exhibit the configurations are members of the set that exhibit the outcome (i.e., high adoption), and therefore the configurations can be reliably associated with high platform adoption.

Table 4.4. Configurations for the Absence of High Platform Adoption (User)

	Solution		
	1	2	3
Extended Resource Provision	⊗	⊗	⊗
Extended Information Provision		⊗	
Autonomy			⊗
Access Control	⊗		
Raw Coverage	0.425261	0.489571	0.350522
Unique Coverage	0.068336	0.105456	0.0637311
Consistency	0.816463	0.939933	0.844972
Overall Solution Coverage	0.66		
Overall Solution Consistency	0.86		

The analysis reveals three configurations that lead to the absence of high platform adoption (in users). In all three configurations, there is an absence of extended resource provision (a core condition), combined with the absence of (1) access control, (2) extended information provision, and (3) high autonomy, respectively. This suggests that the absence of any of these peripheral conditions combined with the absence of extended resource provision makes the platform less attractive to users, inhibiting it from achieving high adoption. These configurations emphasize the importance of extended resource provision in the form of omni-channel services, especially in today's evolving world of social commerce and the blending of physical and online sales. Their importance is such that while the presence of these extended resources is a core condition in configurations that exhibit high adoption, their absence (as a core condition once again) results in the absence of high adoption.

The overall solution consistency is 0.86, indicating that the configurations can be reliably associated with the absence of the outcome – i.e., the absence of high platform adoption. The overall solution coverage is 0.66, indicating that the cases with these configurations represent a decent proportion of cases that exhibit the absence of the outcome; thus, demonstrating empirical relevance.

Complementor-oriented Analyses

Table 4.5 reports the configurations of complementor-oriented governance mechanisms in platforms exhibiting the presence of the outcome (i.e., high platform adoption)

Table 4.5. Configurations for the Presence of High Platform Adoption

	Solution		
	1	2	3
Extended Information Provision		●	●
Reward	●	●	⊗
Favorable Value Appropriation	⊗		⊗
Access Control	⊗	⊗	⊗
Output Control	●	●	⊗
Raw Coverage	0.360179	0.533184	0.110365
Unique Coverage	0.223714	0.195377	0.110365
Consistency	0.93968	0.110365	0.930818
Overall Solution Coverage	0.67		
Overall Solution Consistency	0.91		

The results indicate three configurations, or causal recipes, that lead to high platform adoption when it comes to complementors. The first configuration constitutes the presence of rewards (i.e., promotional rewards) and output control (i.e., ratings and reviews), combined with the absence of a favorable value appropriation regime (i.e., high revenue share) and access control (indicating that the platform is accessible to anyone). The absence of access control seems to be balanced with the presence of output control such that although many developers have access to the platform, their output is evaluated to keep the ecosystem healthy. Similarly, the rewards make these platforms attractive. It seems that developers are not opposed to paying the higher revenue share provided that they have greater access and are rewarded and evaluated appropriately.

Open-source platforms like OpenCart and WooCommerce have membership in this configuration. This is not surprising as they tend not to have access control. But these open-source

platforms stand out because despite being open to everyone, they manage the ecosystem using output control and rewards. Other open-source platforms like Silius do not have membership in this configuration because they are unable to manage the open ecosystem in a way that incentivizes complementors to participate.

The second configuration constitutes the presence of extended information provision, rewards, and output control, combined with the absence of access control (a peripheral condition). SaaS platforms like Wix and Shopify have membership in this configuration and once again highlight the importance of well-managed ecosystems where developers are offered extended information in the form of extensive learning opportunities and community forums, promotional rewards, and app evaluation through reviews and ratings.

The third configuration constitutes the presence of extended information provision (as a peripheral condition), combined with the absence of rewards, favorable value appropriation regimes, access control and output control. This configuration represents platforms like MivaMerchant that are very tightly controlled by the platform firm, and because they work with only a select number of partners, do not utilize incentive mechanisms to attract other complementors.

Together, the configurations indicate three distinct paths to complementors' high platform adoption in the e-commerce space. The overall solution consistency is 0.91, indicating that the configurations can be reliably associated with the presence of the outcome – i.e., high platform adoption. The overall solution coverage is 0.67, indicating that the cases that exhibit the configurations represent a decent proportion of cases that exhibit the outcome; thus, demonstrating empirical relevance.

Counterfactual Analysis. Table 4.6 reports the counterfactual analysis: the configurations of complementor-oriented governance mechanisms in platforms exhibiting the absence of the outcome – i.e., the absence of high adoption.

Table 4.6. Configurations for the Absence of High Platform Adoption (Complementor)

	Solution					
	1	2	3	4	5	6
Extended Information Provision	⊗	●	⊗	⊗	⊗	⊗
Reward	⊗	⊗	⊗	●		⊗
Favorable Value Appropriation		●	⊗	●	●	●
Access Control	●	⊗	⊗	⊗	⊗	
Output Control	⊗		●	●	⊗	⊗
Raw Coverage	0.420735	0.121157	0.07474738	0.10006	0.122966	0.291742
Unique Coverage	0.209162	0.0313441	0.0458107	0.10006	0.0216998	0
Consistency	0.910039	0.980488	0.976378	0.817734	0.980769	1
Overall Solution Coverage	0.73					
Overall Solution Consistency	0.91					

The results indicate six configurations, or causal recipes, that lead to the absence of high platform adoption, when it comes to complementors. Instead of delving into the details of each configuration, I find it is more insightful to identify patterns across the six configurations. Most notably, it seems that the absence of incentive mechanisms is what forms the core conditions of all the configurations, while control mechanisms (whether absent or present) are peripheral conditions for all six configurations. As such, it seems that a breakdown in incentive mechanisms (or the inability to use them appropriately) is what largely leads to the absence of high platform adoption when it comes to developers. This makes sense as complementors' investments in the ecosystem often bear opportunity costs, and therefore it is vital for platform firms to ensure and signal that complementors can benefit from participating in the platform.

The overall solution consistency is 0.91, indicating that the configurations can be reliably associated with the absence of the outcome – i.e., the absence of high platform adoption. The

overall solution coverage is 0.73, indicating that the cases that exhibit the configurations represent a decent proportion of cases that exhibit the absence of the outcome; thus, demonstrating empirical relevance.

DISCUSSION

With scholarly interest in digital platforms and ecosystems on the rise, many studies have contributed towards developing a better understanding of how platform firms govern the actions of ecosystem participants to shape the value creation process. While this research has highlighted the effectiveness of key governance mechanisms used by platform firms, there remains a lack of understanding around how various mechanisms combine to shape ecosystem outcomes (Chen et al., 2022). In this paper I took a step in this direction by undertaking a configurational examination of platform governance mechanisms to better understand how they combine to shape participation in platform ecosystems.

The results of the study reveal several insights. First, high platform adoption can be achieved through distinctly different governance mechanism combinations. In the case of e-commerce platforms, both open-source platforms and SaaS platforms exhibit high platform adoption in terms of both users and complementors, and as such it cannot be said that one approach is superior to the other. This indicates that platforms with more centralized governance (i.e., SaaS platforms) can have the same ecosystem level outcome as more decentralized platforms which are governed less directly by platform firms and rely more on community efforts (i.e., open-source platforms). This finding stands in contrast to the findings of Chen, Richter & Patel (2021) that suggest semi-decentralized platforms (that lie somewhere in between centralized and decentralized platforms) are higher performing governance structures. While the findings of their study hold true for blockchain platforms, the findings of this study are specific to the e-commerce landscape, thus highlighting the importance of context in such studies. As Chen, Tang, Tong & Han (2022) remark,

“it is unlikely for us to see a universally optimal set of strategic choices for all platforms. Such relationships are likely to vary across different types of platforms with different business focuses, across different institutions governing the platforms in different locations, and across different stages of platform development” (p.169).

Second, the analyses reveal that incentive mechanisms are more salient than control mechanisms when it comes to attracting and sustaining ecosystem participation. These incentive mechanisms appear equally important to users and complementors, even though they are implemented differently for both groups. As the results indicate, for both the user-oriented model and the complementor-oriented model, most of the core conditions in configurations representing the *presence* of high platform adoption were the *presence of incentive mechanisms*, and similarly, for both models, most core conditions in configurations representing for the *absence* of high platform adoption involved the *absence of incentive mechanisms*. In most of these configurations, especially in the complementor model, the control mechanisms tended to be peripheral conditions at best. These findings support mechanism design theory which emphasizes the importance of incentive compatibility when designing high-performing governance structures (Mookherjee, 2006; Hurwicz & Reiter, 2006; Hurwicz, 2008; Maskin, 2008; Myerson, 2008). In other words, the findings suggests that platform firms seeking to enhance platform adoption must put more effort towards design features that enact incentive governance mechanisms, because although control mechanisms are required to manage ecosystems, incentive mechanisms play a greater role in driving platform adoption.

Third, this study illustrates the interconnectedness of complementor- and user- oriented governance. Specifically, it shows how complementor governance can inform a better understanding of users’ platform adoption. Since configuration 2 in the user-oriented solution for

the presence of high platform adoption finds that high customization (or the availability of many apps) plays a role in driving users' platform adoption, the complementor analysis helps understand how the platforms with membership in this outcome govern complementor activities to drive this generation of apps. This suggests that while user-oriented mechanisms directly influence users' decisions to participate in an ecosystem, complementor-oriented mechanisms can also *indirectly* influence user participation by extending the functionality of the platform and making the platform more attractive to users.

This illustration complements the economics literature on platforms that views network effects as fundamental drivers of platform competition (Rochet and Tirole, 2003; Armstrong, 2006; Rysman, 2009). In particular, it confirms the notion of indirect network effects (also referred to as cross-side network effects), as a self-reinforcing mechanism whereby the benefit of a platform to a user depends positively on the number of complementors in the ecosystem (and vice versa) (Hagiu & Wright, 2011). While others have confirmed the idea of complementor-to-user network effects (e.g., Song, Xue, Rai & Zhang, 2018), this study informs a better understanding of how complementor governance mechanisms combine to affect users' platform adoption.

At the same time, this study suggests that platform adoption need not always be dependent on indirect network effects. In other words, the number of complementors in an ecosystem is not a requisite to driving user adoption. As configuration 1 of the user-oriented solution highlights, platform adoption can also be high in cases where there is little to no access control, and thus the emphasis is no longer placed so strongly on the complements. This path offers an additional understanding of how platform firms govern their platforms to attract participation and offers more insight into how they may position themselves differently within the same competitive landscape.

Taken together, the results of the analyses reveal that assessing ecosystem outcomes should involve comprehensive examinations of both user- and complementor- specific governance mechanisms (and outcomes); and caution should be exercised when making judgement about ecosystem-level performance based on only one type of analysis. Consider the case of Squarespace as an example. It has membership in the set of platforms exhibiting the *absence of complementors*’ high platform adoption (because it has only 31 complements in its ecosystem), making it appear as if it is not performing well. This in fact is not true. Despite holding membership in the *absence of complementors*’ high platform adoption, Squarespace has membership in the set of platforms exhibiting the *presence of users*’ high platform adoption, with a usage distribution of 14% (which is the second highest usage distribution in the dataset). This signifies that Squarespace can attract high user participation without a thriving complementor ecosystem, as confirmed by configuration 1 in the user-oriented solution. By taking a distinctly different approach – that of a highly curated platform (that is governed accordingly) – Squarespace is still able to attract a large number of users. Therefore, to relate its ‘performance’ in terms of complementors’ platform adoption would be doing it a disservice. As such, one must consider ‘performance’ holistically, by conducting both user-oriented and complementor-oriented analyses.

Contributions and Limitations

In addition to these insights, this paper advances discourse on platform governance in several important ways. First, by shifting focus from studying the impact of a specific governance mechanism, to configurations of governance mechanisms, it broadens the scope of empirical research on platform governance. It highlights the various ways in which mechanisms combine to shape outcomes such as platform adoption, and thereby offers a deeper exploration of how platform firms enact governance to manage their ecosystems (and how this enactment through

design features differs between participants – i.e., users vs. complementors). This allows for a greater appreciation of the intricacies involved in designing governance policies that are well-aligned.

Second, by shifting focus from one (or a few) platforms, to a set of direct competitors within a landscape, this study offers a comparison of governance mechanisms across platform ecosystems. By empirically discerning which configuration of governance mechanisms contribute to high platform adoption, it offers insight into what sets some platform ecosystems apart from others. By underscoring various pathways to success, it also provides evidence against the ‘winner-takes-all’ dynamic (whereby strong network effect can drive competition between platforms to an outcome where the winner ‘takes all’; Eisenmann et al., 2006). Moreover, by highlighting which configuration of governance mechanisms contribute to the *absence* of high platform adoption, the study also sheds light on why certain platforms may not perform as well – and may eventually fail. While scholars have offered explanations for why platforms may fail (e.g., Van Alstyne, Parker & Choudary, 2016), empirical studies only consider successful platform ecosystems as the context of their studies (e.g., Claussen et al., 2013; Kapoor & Agarwal, 2017), leaving a gap in our understanding of what factors contribute to failure – or the inability to achieve high success. Studying a competitive landscape in this paper allows for a closer look at what factors may and may not work in terms of governance. Taken together, the study emphasizes that effective governance is essential to a platform’s competitive performance.

Finally, this study sheds light on the importance of user-oriented governance which tends to get overlooked in the literature. Existing studies mostly view governance in relation to complementors, by examining either the impact on complementor activities (e.g., Zhang et al., 2020), complementor responses to changes (e.g., Koo & Eesley, 2021), or complementor

performance outcomes (e.g., Rietveld, Ploog & Nieborg, 2020; Claussen et al., 2013). This is understandable as complementors are viewed as engaging in direct joint value creation with the platform, and therefore, governing their activities is essential for managing ecosystem value (as is the case with other, more traditional ‘partners’). Yet, as the e-commerce context in this study indicates, governing user activities is also important in some ecosystems. Where users generate some form of output that contributes to the ecosystem’s value proposition, governing the actions of users becomes essential.

This paper is not without limitations. Given the nature of fsQCA studies, it is difficult to generalize outside the empirical context. While this study has revealed important insights, there remains more work to be done in this direction, with studies examining governance mechanism configurations under different contexts, as well as across different *types* of platforms (e.g., exchange vs. innovation platforms). Additionally, while this study has examined platform adoption as the outcome of interest, future studies can contribute by examining other ecosystem outcomes such as innovation or growth. Conducting such studies will help the development of managerial prescriptions regarding which combination of governance mechanisms should be used, and which combinations should be avoided when considering specific outcomes of interest. Moreover, given that governance policies evolve, future studies can examine how the configuration of mechanisms changes over time, depending on the stage of platform development (Chen et al., 2022), as well as external environmental conditions (Tiwana et al., 2010). Together, these studies have the potential to advance a deeper understanding of platform governance.

In addition to governance, a platform’s technical architecture is a key pillar of ecosystem organizing. It serves as the ecosystem’s DNA and impacts the ability of actors to participate in an ecosystem (Tiwana, 2013). While an examination of the underlying architecture of platforms

remains outside the scope of this study, the governance mechanisms studied indirectly shed some light on architecture, given that both pillars are interconnected. For example, the provision of extended resources to complementors depends on the underlying level of modularity within an ecosystem, and the degree to which the architecture is open to complementors. Moreover, it is possible that control mechanisms were not as salient as incentive mechanisms in this study because control is more appropriately implemented through the platform's architecture, and less so through governance mechanisms. As many scholars recognize, platform firms' power largely arises from their control over the technological architecture (e.g., Kretschmer, Leiponen, Schilling & Vasudeva, 2022). Therefore, future work must more explicitly study the interrelationship between governance and architecture by examining various configurations of both aspects within different ecosystems. Such studies have the potential to add a more layered understanding of the various ways in which these two aspects align to drive ecosystem outcomes.

Concluding Remarks

This study is especially relevant given the prevalence of platform ecosystems today, as is particularly evident in the e-commerce space, with entrepreneurs and established businesses increasingly shifting to digital platforms. Since ecosystem participants' value creation activities are critical to platform success (Jacobides et al., 2018; McIntyre & Srinivasan, 2017), developing a better understanding of how platform firms govern these activities is essential. By examining platform governance mechanisms configurations that guide both user and complementor activity, particularly within a competitive landscape, I have taken steps to contribute towards a more nuanced understanding.

APPENDIX A LDA Analysis

Table A 1. LDA Analysis Parameters

Parameters	Description	Default Value
alpha	Topic smoothing parameter. Griffiths and Steyvers (2004) recommend setting at 50/k, where k is the number of topics.	50/30
delta	Specifies the parameter of the prior distribution of the term distribution over topics. Griffiths and Steyvers (2004) recommend setting this to 0.1 (which is why this is the default value in the topicmodels package)	0.1
iter	Number of Gibbs iterations	2000
burnin	number of omitted Gibbs iterations at beginning	0
thin	Number of omitted in-between Gibbs iterations	Same as iter
seed	Used to call set.seed for Gibbs sampling. Setting a seed helps with reproducibility.	NA
nstart	Number of repeated random starts	1
best	All draws are returned if best = FALSE. If TRUE, only the draw with the highest posterior likelihood is returned (i.e., only the best model over all the runs with respect to the log-likelihood is returned)	TRUE

As with the number of topics, there is no right way to set the values for these parameters, so I first used the recommended default values, and then for cross-validation (which involves running the LDA several times under several different conditions), I made changes to some of the parameters such as *iter*, *burnin* and *thin*. These parameters control how many Gibbs sampling draws are made: The first *burnin* iterations are discarded and then every *thin* iteration is returned for *iter* iterations (Grün & Hornik, 2011). Changing the parameters in the cross-validation step did not significantly affect the results, therefore the initial results (using default values for parameters) were retained.

Table A 2. Top 10 Terms (All 30 Topics)

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10
actor	case	develop	platform	knowledg	servic	platform	seller	standard	inform
platform	vote	system	worker	communiti	manag	seller	platform	platform	provid
valu	juror	technolog	work	share	custom	trust	equilibrium	organ	studi
side	bias	standard	gig	vol	suppli	market	price	collabor	one
activ	experi	platform	labor	social	firm	mechan	profit	manag	system
coordin	tabl	patent	manag	effect	busi	effect	model	project	govern
new	seller	mobil	employ	studi	chain	buyer	commiss	architectur	new
digit	ingroup	industri	crowdwork	govern	vol	review	fee	share	differ
manag	level	applic	job	behavior	product	transact	optim	oper	make
metaorgan	estim	product	algorithm	manag	industri	relationship	product	develop	relat

Topic 11	Topic 12	Topic 13	Topic 14	Topic 15	Topic 16	Topic 17	Topic 18	Topic 19	Topic 20
blockchain	platform	app	platform	platform	complementor	innov	platform	partner	ecosystem
govern	cost	platform	market	generat	platform	open	firms	complementor	valu
decentr	token	develop	network	effect	app	technolog	particip	rule	innov
contract	servic	updat	strategi	valu	owner	model	develop	govern	manag
transact	price	user	owner	content	entri	product	technolog	partnership	actor
social	invest	control	design	signal	product	manag	specific	valu	role
central	market	effect	effect	variabl	effect	process	control	platform	emerg
platform	trip	extens	competit	game	coopetit	new	firm	practic	api
vote	ico	award	open	result	competit	collabor	signific	ecosystem	captur
develop	time	complement	manag	control	develop	communiti	influen	manag	creation

Topic 21	Topic 22	Topic 23	Topic 24	Topic 25	Topic 26	Topic 27	Topic 28	Topic 29	Topic 30
task	agent	share	digit	platform	resourc	platform	social	manag	crowdfund
crowdsourc	model	economi	platform	data	boundari	rule	user	govern	platform
valu	simul	social	data	develop	system	download	platform	organ	financi
solver	market	servic	busi	case	digit	common	power	problem	fund
worker	social	asset	new	interview	servic	condit	media	capabl	market
crowd	number	custom	market	govern	develop	creativ	algorithm	structur	project
qualiti	valu	econom	innov	busi	generat	applic	content	firm	equiti
work	system	market	economi	digit	mobil	particip	advertis	knowledg	investor
driver	chang	valu	global	applic	app	govern	agenc	coordin	firm
compet	firm	busi	technolog	unit	inform	term	practic	organiz	financ

Table A 3. Complete List of Topics, Terms & Labels

TOPIC NO.	TOP 10 TERMS	PAPERS	TOPIC NAME
Topic 1	actor	Berkowitz and Souchaud - 2024 - Filling successive technologically-induced governance gaps: meta-organizations as regulatory innovation intermediaries	Coordination
	platform	Cantù et al. - 2021 - The role of relational governance in innovation platform growth: The context of living labs	
	valu	Lehtinen et al. - 2019 - Megaprojects as organizational platforms and technology platforms for value creation	
	side	Leong et al. - 2023 - Coordination in a Digital Platform Organization	
	activ		
	coordin		
	new		
	digit		
	manag		
	metaorgan		
Topic 2	case	Kwan et al. - 2023 - Crowd-Judging on Two-Sided Platforms: An Analysis of In-Group Bias	Consensus Governance
	vote	Simcoe - 2012 - Standard Setting Committees Consensus Governance for Shared Technology Platforms	
	juror		
	bias		
	experi		
	tabl		
	seller		
	ingroup		
	level		
	estim		
Topic 3	develop	Boudreau - 2017 - Platform-Based Organization and Boundary Choices: Opening-Up While Still Coordinating and Orchestrating	Mobile Industry
	system	Ding and Hioki - 2024 - Intellectual property strategy and the governance of technological platform-driven global value chains: The case of Qualcomm	
	technolog	Holgersson et al. - 2018 - The evolution of intellectual property strategy in innovation ecosystems: Uncovering complementary and substitute appropriability regimes	
	standard	Lee and Gereffi - 2021 - Innovation, upgrading, and governance in cross-sectoral global value chains: the case of smartphones	
	platform	Niedermayer - 2013 - On platforms, incomplete contracts, and open source software	
	patent		
	mobil		
	industri		
	applic		
	product		

Topic 4	platform	Bucher et al. - 2021 - Pacifying the algorithm – Anticipatory compliance in the face of algorithmic management in the gig-economy	Gig Economy
	worker	Chen - 2023 - Are we only all by ourselves? A double-level perspective to cope with the insecurity of the nonstandard gig work model	
	work	Gol et al. - 2019 - Crowdwork platform governance toward organizational value creation	
	gig	Huang - 2023 - Algorithmic management in food-delivery platform economy in China	
	labor	Jeronimo et al. - 2022 - From the Rule of Thumb to the Rule of the Algorithms: Command and Control in Ride-Hailing Platforms	
	manag	Meijerink and Keegan - 2019 - Conceptualizing human resource management in the gig economy: Toward a platform ecosystem perspective	
	employ	Rolf et al. - 2022 - Towards privatized social and employment protections in the platform economy? Evidence from the UK courier sector	
	crowdwork	Wagner et al. - 2021 - Exploring the boundaries and processes of digital platforms for knowledge work: A review of information systems research	
	job	Waldkirch et al. - 2021 - Controlled by the algorithm, coached by the crowd – How HRM activities take shape on digital work platforms in the gig economy	
	algorithm	Weber et al. - 2021 - Steering the transition from informal to formal service provision: labor platforms in emerging-market countries	
Topic 5	knowledg	Choi et al. - 2020 - Where does knowledge-sharing motivation come from? The case of third-party developer in mobile platforms	Communities
	communiti	Liu et al. - 2023 - Impact of Community-Based Governance Mechanisms on Transaction Intention on a Second-Hand Trading Platform	
	share	*Sarafan et al. - 2022 - Knowledge sharing in project-based supply networks	
	vol	*Sun et al. - 2023 - How to drive green innovation of manufacturing SMEs under open innovation networks – the role of innovation platforms’ relational governance	
	social	Wang et al. - 2022 - The influence of community engagement on seller opportunistic behaviors in e-commerce platform	
	effect	Xu et al. - 2023 - The more open, the better? Research on the influence of subject diversity on trust of tourism platforms	
	studi	Yin et al. - 2023 - Impacts of regulatory strategies on member’s knowledge sharing in virtual brand communities based on ecosystem-oriented business models in China	
	govern		
	behavior		
	manag		
Topic 6	servic	*Das and Dey - 2021 - Global manufacturing value networks: Assessing the critical roles of platform ecosystems and Industry 4.0	Servitization
	manag	*Johnson et al. - 2021 - Reconciling and reconceptualising servitization research: drawing on modularity, platforms, ecosystems, risk and governance to develop mid-range theory	
	custom	*Kapoor et al. - 2022 - A platform ecosystem view of servitization in manu.pdf	
	suppli	Li et al. - 2022 - Exploring the governance mechanisms for value co-creation in PSS business ecosystems	

	firm	*Rosca et al. - 2022 - Coordinating multilevel collective action: how intermediaries and digital governance can help supply chains tackle grand challenges	
	busi	van Kalsbeek et al. - 2020 - Controlling and enabling practices to manage supply in online service triads	
	chain		
	vol		
	product		
	industri		
Topic 7	platform	Beck et al. - 2023 - Guardians of Trust: How Review Platforms Can Fight Fakery and Build Consumer Trust	Trust
	seller	Bei and Gielens - 2023 - The One-Party Versus Third-Party Platform Conundrum: How Can Brands Thrive?	
	trust	Guo et al. - 2021 - How Trust Leads to Commitment on Microsourcing Plaforms: Unraveling the Effects of Governance and Third-Party Mechanisms on Triadic Microsourcing Relationships	
	market	Li et al. - 2018 - An Investigation on Incentive Strategies in Community Building in Business-to-Business Electronic Markets	
	mechan	Liu and Gao - 2023 - Which is more effective for platform performance: Punishments or incentives?	
	effect	Sen et al. - 2023 - Managing two-sided B2B electronic markets: Governance mechanisms, performance implications, and boundary conditions	
	buyer	Wei et al. - 2021 - The effects of platform governance mechanisms on customer participation in supplier new product development	
	review		
	transact		
	relationship		
Topic 8	seller	Chu and Wu - 2021 - Designing online platforms for customized goods and services: A market frictions-based perspective	Mathematical Models
	platform	Li et al. - 2023 - Asymmetric Information of Product Authenticity on C2C E-Commerce Platforms: How Can Inspection Services Help?	
	equilibrium	Papanastasiou et al. - 2023 - Improving Dispute Resolution in Two-Sided Platform: The Case of Review Blackmail	
	price	Teh - 2022 - Platform Governance	
	profit	Wei and Guo - 2023 - The optimal licensing strategy and commission in a.pdf	
	model		
	commiss		
	fee		
	optim		
	product		
Topic 9	standard	Costabile et al. - 2022 - Building digital platform ecosystems through standardization: an institutional work approach	Collaborative Platforms
	platform	De Reuver et al. - 2015 - Collective action for mobile payment platforms: A case study on collaboration issues between banks and telecom operators	
	organ	Lindgren et al. - 2023 - Compatibility promotion for standard development within shared platforms: A rising tide does not lift all boats	

	collabor	Radaelli et al. - 2024 - Platform evolution in large inter-organizational collaborative research	
	manag		
	project		
	architectur		
	share		
	oper		
	develop		
Topic 10	inform	Anderson et al. - 2022 - Electric Vehicles Are a Platform Business: What Firms Need to Know	Ecosystem Governance
	provid	Bai and Velamuri - 2021 - Contextualizing the Sharing Economy	
	studi	Blackburn et al. - 2023 - Digital Platforms for the Circular Economy: Exploring Meta-Organizational Orchestration Mechanisms	
	one	Budde et al. - 2024 - Leading the transition to multi-sided platforms (MSPs) in a B2B context – The case of a recycling SME	
	system	Cennamo et al. - 2020 - Managing Digital Transformation Scope of Transformation and Modalities of Value Co-Generation and Delivery	
	govern	Chan et al. - 2022 - Bolstering ratings and reviews systems on multi-sided platforms: A co-creation perspective	
	new	Constantinides et al. - 2018 - Platforms and Infrastructures in the Digital Age	
	differ	Cossey et al. - 2023 - Inherently unstable? Scaling, mission drift, and the comparative performance of community-based platforms in the sharing economy	
	make	Cutolo and Kenney - 2021 - Platform-dependent entrepreneurs: Power asymmetries, risks, and strategies in the platform economy	
	relat	De Reuver et al. - 2011 - Governance of flexible mobile service platforms	
		de Reuver et al. - 2018 - The Digital Platform: A Research Agenda	
		Fenwick et al. - 2019 - The End of ‘Corporate’ Governance: Hello ‘Platform’ Governance	
		Fürstenau et al. - 2019 - A process perspective on platform design and management: evidence from a digital platform in health care	
		Hacker et al. - 2023 - Commit or Not? How Blockchain Consortia Form and Develop	
		Howell and Potgieter - 2021 - Uncertainty and dispute resolution for blockchain and smart contract institutions	
		Islam et al. - 2023 - Understanding transaction platform governance and conflicts: A configuration approach	
		Koo and Eesley - 2021 - Platform governance and the rural–urban divide: Sellers’ responses to design change	
		Kretschmer et al. - 2022 - Platform ecosystems as meta-organizations: Implications for platform strategies	
		Mei et al. - 2022 - Governance mechanisms implementation in the evolution of digital platforms: a case study of the Internet of Things platform	
		Michalke et al. - 2022 - Exploring engagement, well-being, and welfare on engagement platforms: Insight into the personal service sector from the DACH region	
		Otto and Jarke - 2019 - Designing a multi-sided data platform: findings from the International Data Spaces case	
		Perren and Kozinets - 2018 - Lateral Exchange Markets: How Social Platforms Operate in a Networked Economy	
		Rong et al. - 2021 - Matching as Service Provision of Sharing Economy Platforms: An Information Processing Perspective	

		Saadatmand et al. - 2019 - Configurations of platform organizations: Implications for complementor engagement	
		Salminen et al. - 2023 - How Feature Changes of a Dominant Ad Platform Shape Advertisers' Human Agency	
		Schwarz and Hirschheim - 2003 - An extended platform logic perspective of IT governance: managing perceptions and activities of IT	
		Trabucchi et al. - 2021 - Idle Asset Hunters—The Secret of Multi-sided Platforms	
		Wessel et al. - 2017 - Opening the floodgates: the implications of increasing platform openness in crowdfunding	
		Zachariadis et al. - 2019 - Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services	
Topic 11	blockchain	Chen et al. - 2021 - Decentralized Governance of Digital Platforms	Blockchain
	govern	Goldberg and Schär - 2023 - Metaverse governance: An empirical analysis of voting within decentralized autonomous organizations	
	decentr	Leiponen et al. - 2022 - The dApp economy a new platform for distributed innovation?	
	contract	Nguyen and Nguyen - 2022 - Understanding platform market value through decentralization governance-An integrative model from signaling and mechanism design theory	
	transact	Pereira et al. - 2019 - Blockchain-based platforms: Decentralized infrastructures and its boundary conditions	
	social	Schmeiss et al. - 2019 - Designing Governance Mechanisms in Platform Ecosystems: Addressing the Paradox of Openness through Blockchain Technology	
	central	Zhan et al. - 2023 - A conceptual model and case study of blockchain-enabled social media platform	
	platform	Zhao et al. - 2022 - Task management in decentralized autonomous organization	
	vote		
	develop		
Topic 12	platform	Chod et al. - 2022 - Platform Tokenization Financing, Governance, and Moral Hazard	Incentives
	cost	Chung et al. - 2024 - Platform Governance in the Presence of Within-Complementor Interdependencies: Evidence from the Rideshare Industry access control	
	token	Gan et al. - 2023 - Decentralized Platforms Governance, Tokenomics, and ICO Design	
	servic	Ke et al. - 2020 - Pricing and equilibrium in on-demand ride-pooling markets	
	price	Martin and Orlando - 2007 - Barriers to network-specific investment	
	invest	Rochet and Tirole - 2003 - Platform Competition in Two-Sided Markets	
	market		
	trip		
	ico		
	time		
Topic 13	app	Foerderer - 2020 - Interfirm exchange and innovation in platform ecosystems: Evidence from Apple's Worldwide Developers Conference	App Developers

	platform	Foerderer et al. - 2021 - And the Winner Is....? The Desirable and Undesirable Effects of Platform Awards	
	develop	Hilbolling et al. - 2021 - Sustaining Complement Quality for Digital Product Platforms: A Case Study of the Philips Hue Ecosystem	
	updat	Song et al. - 2018 - The Ecosystem of Software Platform: A Study of Asymmetric Cross-side Network Effects and Platform Governance	
	user	Tiwana - 2015 - Evolutionary Competition in Platform Ecosystems	
	control	Tiwana - 2015 - Platform Desertion by App Developers	
	effect	Tiwana et al. - 2010 - Platform Evolution: Coevolution of Platform Architecture, Governance and Environmental Dynamics	
	extens		
	award		
	complemen t		
Topic 14	platform	Chen et al. - 2022 - Governance and Design of Digital Platforms: A Review and Future Research Directions on a Meta-Organization	Platform Design (& Reviews)
	market	Hein et al. - 2020 - Digital platform ecosystems	
	network	Jia et al. - 2021 - Multisided platform research over the past three decades: A bibliometric analysis	
	strategi	Jing et al. - 2023 - Performance investment and price decisions of two-sided platforms under multiple quality regulation strategies	
	owner	Poniatowski et al. - 2022 - Three layers of abstraction: A conceptual framework for theorizing digital multi-sided platforms	
	design	Spaeth and Niederhöfer – 2022 – Compatibility promotion between platforms: The role of open technology standards and giant platforms	
	effect	Tura et al. – 2018 – Platform design framework conceptualisation and application	
	competit	Yang et al. – 2020 – Customer management in Internet-based platform firms: review and future research	
	open		
	manag		
Topic 15	platform	Cennamo and Santaló – 2019 – Generativity Tension and Value Creation in Platform Ecosystems	Generativity
	generat	Hukal et al. - 2020 - Platform Signaling for Generating Platform Content	
	effect	Inoue - 2021 - Indirect innovation management by platform ecosystem governance and positioning: Toward collective ambidexterity in the ecosystems	
	valu	Lin et al. - 2022 - Reward or punish: investigating output controls and content generation in the multi-sided platform context	
	content	Miremadi et al. - 2023 - Fostering generativity in platform ecosystems: How open innovation and complexity interact to influence platform adoption	
	signal	Xia Zhao et al. - 2023 - Customer Complaint Avoidance: A Randomized Field Experiment on Platform Governance Based on Value Co-Creation and Appropriation	
	variabl		
	game		
	result		
	control		
Topic 16	complemen tor	Chen et al. - 2022 - Platform Governance Design in Platform Ecosystems: Implications for Complementors' Multihoming Decision	

	platform	Foerderer et al. - 2018 - Does Platform Owner's Entry Crowd Out Innovation? Evidence From Google Photos	Complementor Dynamics
	app	Kang and Suarez - 2023 - Platform Owner Entry Into Complementor Spaces Under Different Governance Modes	
	owner	Rietveld et al. - The Coevolution of Platform Dominance and Governance Strategies: Effects on Complementor Performance Outcomes	
	entri	Van Angeren and Karunakaran - 2023 - Anchored Inferential Learning: Platform-Specific Uncertainty, Venture Capital Investments by the Platform Owner, and the Impact on Complementors	
	product	Yoo et al. - 2022 - Coopetition in a platform ecosystem: from the complementors' perspective	
	effect	Zhang et al. - 2022 - Platform governance matters: How platform gatekeeping affects knowledge sharing among complementors	
	coopetit		
	competit		
	develop		
Topic 17	innov	Abhari et al. - 2022 - Modeling Social Product Development Process, Technology, and Governance	Open Innovation Platforms
	open	Bogers et al. - 2017 - The open innovation research landscape: established perspectives and emerging themes across different levels of analysis	
	technolog	Choi et al. - 2022 - The impact of a platform company's open innovation activities on its firm value: in the perspective of the venture ecosystem	
	model	Osorno and Medrano - 2022 - Open Innovation Platforms: A Conceptual Design Framework	
	product	West - 2017 - Open Source Platforms Beyond Software: From ICT to Biotechnology	
	manag		
	process		
	new		
	collabor		
	communiti		
Topic 18	platform	Goldbach et al. - 2018 - Differential effects of formal and self-control in mobile platform ecosystems: Multi-method findings on third-party developers' continuance intentions and application quality	Platform Participation
	firms	Kathuria et al. - 2020 In the Realm of Hungry Ghosts: Multi-Level Theory for Supplier Participation on Digital Platforms	
	particip	Van de Kaa et al. - 2019 - The governance of platform development processes: A metaphor and a simulation model	
	develop	Yang et al. - 2019 - Improving relationship performance on platforms: the role of platform technology usage in promoting justice	
	technolog		
	specific		
	control		
	firm		
	signific		
	influenc		
Topic 19	partner	Haki et al. - 2024 - Dynamic capabilities for transitioning from product platform ecosystem to innovation platform ecosystem	

	complemen tor	Huber et al. - 2017 - Governance Practices in Platform Ecosystems: Navigating Tensions Between Cocreated Value and Governance Costs	Complementor Governance
	rule	Hurni et al. - 2021 - Complementor dedication in platform ecosystems: rule adequacy and the moderating role of flexible and benevolent practices	
	govern	Wareham et al. - 2014 - Technology Ecosystem Governance	
	partnership		
	valu		
	platform		
	practic		
	ecosystem		
	manag		
Topic 20	ecosystem	Brea - 2023 - A framework for mapping actor roles and their innovational potential in digital ecosystems	Innovation Ecosystems
	valu	Dai et al. - 2024 - Navigating tensions between value creation and capture in ecosystems	
	innov	Daymond et al. - 2023 - Managing ecosystem emergence and evolution: Strategies for ecosystem architects	
	manag	Dedehayir et al. - 2018 - Roles during innovation ecosystem genesis: A literature review	
	actor	Foss et al. - 2023 - Ecosystem leadership as a dynamic capability	
	role	Jacobides et al. - 2018 - Towards a theory of ecosystems	
	emerg	Pujadas et al. - 2024 - The value and structuring role of web APIs in digital innovation ecosystems: The case of the online travel ecosystem	
	api	Reiter et al. - 2024 - Managing multi-tiered innovation ecosystems	
	captur	Thomas et al. - 2022 - Processes of ecosystem emergence	
	creation	Uzunca et al. - 2022 - Governance rigidity, industry evolution, and value capture in platform ecosystems	
Topic 21	task	Blohm et al. - 2018 - How to Manage Crowdsourcing Platforms Effectively	Crowdsourcing
	crowdsourc	Deng et al. - 2016 - The Duality of Empowerment and Marginalization in Microtask Crowdsourcing	
	valu	Jiahui Mo et al. - 2021 - Competing Tasks and Task Quality An Empirical Study of Crowdsourcing Contests	
	solver	Uzunca and Kas - 2023 - Automated governance mechanisms in digital labour platforms: how Uber nudges and sludges its drivers	
	worker		
	crowd		
	qualiti		
	work		
	driver		
	compet		
Topic 22	agent	Querbes - 2018 - Banned from the Sharing Economy: An Agent-based Model of a Peer-to-Peer Marketplace for Consumer Goods and Services	Misc.
	model		
	simul		
	market		

	social		
	number		
	valu		
	system		
	chang		
	firm		
Topic 23	share	Basukie et al. - 2020 - Big data governance and algorithmic management in sharing economy platforms: A case of ridesharing in emerging markets	Sharing Economy
	economi	Etter et al. - 2019 - Sharing Economy, Sharing Responsibility? Corporate Social Responsibility in the Digital Age	
	social	Farmaki and Kladou - 2020 - Why do Airbnb hosts discriminate? Examining the sources and manifestations of discrimination in host practice	
	servic	Kozlenkova et al. - 2021 - Sharing economy: International marketing strategies	
	asset	Ma et al. - 2020 - Enhancing Customer Civility in the Peer-to-Peer Economy: Empirical Evidence from the Hospitality Sector	
	custom	Wirtz et al. - 2019 - Platforms in the peer-to-peer sharing economy	
	econom	Zhang et al. - 2020 - The governance practices of sharing platforms: Unpacking the interplay between social bonds and economic transactions	
	market	Zhang et al. - 2023 - The impact of incumbents' operational and governance responses on the sharing economy: An asset orchestration perspective	
	valu		
	busi		
Topic 24	digit	*Andreoni and Roberts - 2022 - Governing digital platform power for industrial development: towards an entrepreneurial-regulatory state	Platform Regulation
	platform	*Ferrari - 2023 - State roles in platform governance: AI's regulatory geographies	
	data	*Gawer - 2022 - Digital platforms and ecosystems: remarks on the dominant organizational forms of the digital age	
	busi	*Gleiss et al. - 2023 - Identifying the patterns: Towards a systematic approach to digital platform regulation	
	new	*Khan et al. - 2023 - Non-market strategies and disruptive innovation in the platform economy	
	market	*Paredes-Frigolett and Pyka - 2022 - The global stakeholder capitalism model of digital platforms and its implications for strategy and innovation from a Schumpeterian perspective	
	innov	Safadi and Watson - 2023 - Knowledge monopolies and the innovation divide: A governance perspective	
	economi	Song - 2019 - The Digital Entrepreneurial Ecosystem—a critique and reconfiguration	
	global	Sussan and Acs - 2017 - The digital entrepreneurial ecosystem.pdf	
	technolog	*Yi et al. - 2023 - Cultivating Regional Innovation Ecosystems in the Digital Age: Case Studies of Four Cities in China	
Topic 25	platform	De Prieëlle et al. - 2022 - The Role of Ecosystem Data Governance in Adoption of Data Platforms by Internet-of-Things Data Providers: Case of Dutch Horticulture Industry	Data

	data	Jovanovic et al. - 2022 - Co-evolution of platform architecture, platform services, and platform governance: Expanding the platform value of industrial digital platforms	
	develop	Jovanovic et al. - 2022 - Managing a blockchain-based platform ecosystem for industry-wide adoption: The case of TradeLens	
	case	Schreieck et al. - 2023 - Governing innovation platforms in multi-business organizations	
	interview	Veeneman et al. - 2018 - PETRA: Governance as a key success factor for big data solutions in mobility	
	govern	Weiss et al. - 2022 - Learning to be a Platform Owner: How BMW Enhances App Development for Cars	
	busi		
	digit		
	applic		
	unit		
Topic 26	resourc	Eaton et al. - 2015 - Distributed Tuning of Boundary Resources: The Case of Apple's iOS Service System	Boundary Resources
	boundari	Karhu et al. - 2018 - Exploiting and Defending Open Digital Platforms with Boundary Resources: Android's Five Platform Forks	
	system	Kazan et al. - 2016 - Towards a Framework of Digital Platform Competition: A Comparative Study of Monopolistic & Federated Mobile Payment Platforms	
	digit	Thomas and Tee - 2022 – Generativity: A systematic review and conceptual framework	
	servic	Wulfert - 2023 - Boundary resource management in innovation ecosystems: The case of e-commerce	
	develop		
	generat		
	mobil		
	app		
	inform		
Topic 27	platform	Hsieh and Vergne - 2023 - The future of the web? The coordination and early-stage growth of decentralized platforms	Collective Governance
	rule	Mannan and Pek - Platform cooperatives and the dilemmas of platform worker-member participation	
	download	Miric et al. - 2023 - Trade-offs to using standardized tools: Innovation enablers or creativity constraints?	
	common	O'Mahony and Karp - 2022 From proprietary to collective governance: How do platform participation strategies evolve?	
	condit		
	creativ		
	applic		
	particip		
	govern		
	term		
Topic 28	social	Curchod et al. - 2020 - Working for an Algorithm: Power Asymmetries and Agency in Online Work Settings	Power
	user	Willis - 2023 - 'Trust and safety': exchange, protection and the digital market–fortress in platform capitalism	

	platform	Elambert - 2023 - What Link between Legitimacy and Response to Incentives on a CrowdworK Platform? The Foule Factory Case	(& Social Media Platforms)
	power	Harracá et al. - 2023 - How Digital Platforms Organize Immaturity: A Sociosymbolic Framework of Platform Power	
	media	McCarthy et al. - 2023 - The Dark Side of Digitalization and Social Media Platform Governance: A Citizen Engagement Study	
	algorithm	Reuber and Fischer - 2022 - Relying on the engagement of others: A review of the governance choices facing social media platform start-ups	
	content	Xiang - 2022 - YouTube and the protocological control of platform organizations	
	advertis	Yates - 2023 - How platform businesses mobilize their users and allies: Corporate grassroots lobbying and the Airbnb 'movement' for deregulation	
	agenc		
	practic		
Topic 29	manag	Altman et al. - 2022 - The Translucent Hand of Managed Ecosystems Engaging Communities for Value Creation and Capture	Organizing
	govern	Chen et al. - 2022 - Externalization in the Platform Economy: Social Platforms and Institutions	
	organ	Nambisan and Luo - 2021 - Toward a Loose Coupling View of Digital Globalization	
	problem	Piazza et al. - 2019 - Governance Considerations for Seeker–Solver Relationships: A Knowledge-Based Perspective in Crowdsourcing for Innovation Contests	
	capabl	Schmidt and Foss - 2023 - Modularity, Adaptation Problems, and the Governance and Problem-Solving Capabilities of Core Firms in Ecosystems	
	structur	Zhong and Sun - 2020 - The more the better: Relational governance in platforms and the role of appropriability mechanisms	
	firm		
	knowledg		
	coordin		
	organiz		
Topic 30	crowdfund	Cumming et al. - 2021 - Equity Crowdfunding and Governance Toward an Integrative Model and Research Agenda	Crowdfunding
	platform	Gutiérrez-Urtiaga and Sáez-Lacave - 2018 - The promise of reward crowdfunding	
	financi	Jiang et al. - 2021 - Where and how to launch your forestry crowdfunding campaign? Evidence from China	
	fund	Langley - 2016 - Crowdfunding in the United Kingdom: A Cultural Economy	
	market	Meoli et al. - 2022 - Financial literacy and security-based crowdfunding	
	project		
	equiti		
	investor		
	firm		
	financ		

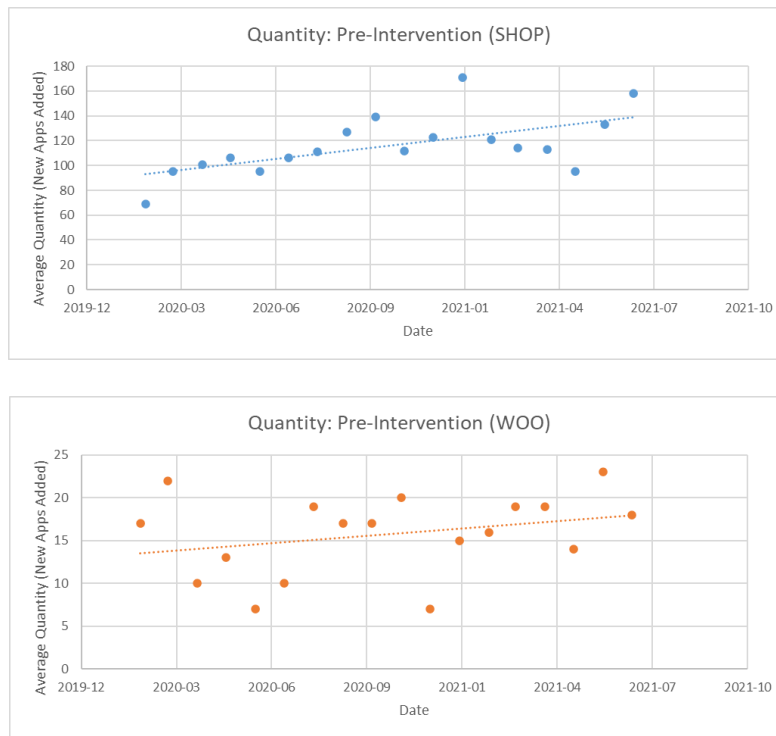
APPENDIX B

Supplementary Analysis: Quantity

Quantity. Both Shopify and WooCommerce provide information on the launch date for each app (i.e., when the app was made available on the marketplace). We used this information to calculate the number of new apps introduced each month. We then created a panel with data 18 months before and after the rule change – i.e., from February 2020 to February 2023. We decided on 18 months for the pre- and post- intervention periods in order to have enough data points for comparison.

When examining the data points in the pre-intervention periods for both Shopify and WooCommerce, we found that the assumption of parallel trends was satisfied (with both platforms exhibiting a parallel upward trend), allowing us to proceed with the difference-in-differences analysis for quantity (See Figure 1A below).

Figure B 1. Parallel Trends: Quantity



Model Specification. To determine the treatment effect of the revenue-sharing change on the quantity of apps, we estimated the following model specification:

$$Y_{it} = \beta_0 + \beta_1 \text{Treated}_i + \beta_2 \text{Treated}_i * \text{Post}_t + \delta_2 X_{it} + T_t + \varepsilon_{it}$$

Where Y_{it} is the *number of apps* in month t ; β_0 is the intercept; β_1 represents the difference between the treatment and the control group before the revenue change, β_2 identifies the treatment effect of the revenue change, T_t is a vector of month fixed effects and ε_{it} is the error term.

Results. The results of the difference-in-differences analysis reveal that the revenue share reduction did indeed incentivize developers to generate more apps (Table 1A). The treatment effect is different from zero and statistically significant, suggesting that the revenue share reduction had a positive impact on the quantity of apps. Specifically, the quantity increased by 60 apps more than it would have in the absence of the rule change.

Table B 1. Effect of Revenue-Share Change

	Quantity
	(1)
Intercept	-7.167 (15.232)
TREATED	100.333*** (6.989)
TREATED x POST	60.035*** (9.753)
Month Fixed Effects	Yes

Notes . Standard errors are given in parentheses.

Through the lens of indirect network effects, an increase in the number of apps is a positive outcome because it creates more value for users. It also creates a feedback loop whereby more incentives are created for complementors to join the platform and innovate. But as previously mentioned, innovativeness of apps is equally (if not more) important, with users being concerned with the diversity of complements, and not just their quantity (Zhu & Iansiti, 2012). Accordingly, to assess the overall impact of the rule change on the nature of generative output, it is important to examine the impact on the variety of apps.

APPENDIX C

LDA – Topic Modelling Details

SHOPIFY

Data Cleaning

The scraped dataset included information on 7,449 apps from Shopify’s App Store. To clean the data, I started by removing apps with no descriptions, as well as apps that had descriptions in languages other than English. This resulted in a total of 7,325 app descriptions, which I loaded into the R environment. Then, I cleaned the data following the steps suggested by Asmussen and Møller (2019): I converted all the words to lowercase and removed all punctuation, numbers and whitespaces; and I also removed stop words – which are terms like “can” and “the” that do not add value to the aboutness of a topic⁵⁰.

Number of Topics

Since there were a large number of apps in Shopify’s App Store (over 7000+), a large number of topics was preferred, in order to appropriately capture the variation between them. While there is no concrete way to select the most optimal number of topics, Asmussen and Møller (2019) suggest that visualizing the perplexity can provide an aid for the decision.

Perplexity Analysis to determine number of topics.

Perplexity is a measure used in information theory to evaluate language models, where a low score indicates a better generalisation model (see Blei & Lafferty, 2007; Xu and Raschid, 2016; Zhao et al., 2015). A low perplexity score means that the model is confident and accurate in its predictions. In other words, lower perplexity indicates better predictive performance of the model⁵¹. The criterion for selecting the right number of topics is to find the balance between a useable number of topics and, at the same time, to keep the perplexity as low as possible.

To calculate perplexity, I followed Asmussen & Møller (2019) and divided the data into training and test sets, such that 75% of the papers were used for training the model, and the remaining 25% were used for testing. The LDA algorithm was run on the training set, and the test set was used to validate the results. I selected 60, 70 and 80 as the number of ‘candidate’ topics to be evaluated and calculated the perplexity for each. The goal was to find the lowest number of topics, which at the same time had a low perplexity.

⁵⁰ As is often the case, this was an iterative process, as it is difficult to identify all misread and non-value adding words a priori. As part of the iterative process, I ran several preliminary LDA analyses to check for the terms per topic. These steps revealed several special characters and terms like “Shopify” and “app” that had to be removed.

⁵¹ A high perplexity score means that the model is uncertain and inaccurate in its predictions.

Code

```
#split data into training and test sets

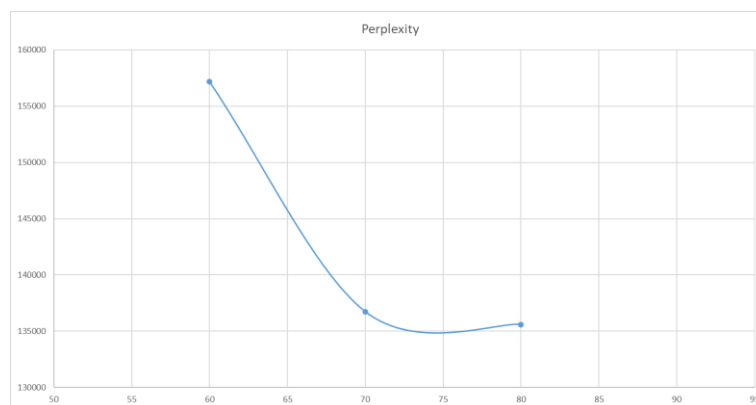
set.seed(123)
splitter <- sample(1:nrow(dtm), 0.75 * nrow(dtm))
train_set <- dtm[splitter, ]
test_set <- dtm[-splitter, ]

# Perform LDA analysis using different number of topics (k = 60, 70, 80)
lda_model <- LDA(train_set, k = 80, control = list(alpha = 50/80))

#Calculate perplexity
perplexity <- perplexity(lda_model, newdata = test_set)

# Print perplexity
print(perplexity)
```

Figure C 1: Results of Perplexity Analysis



Topics	Perplexity
60	157165.7
70	136735
80	135610

As seen in the figure above, the slope of the fitted line started to gradually decline at 70 topics. Therefore, I selected 70 as the number of topics to be estimated.

Running the LDA

After selecting the number of topics, I ran the LDA analysis on the entire set of app descriptions, using the `lda` function in the ‘topicmodels’ R package (Grün & Hornik, 2011). I used the Gibbs sampling algorithm and following prior recommendations by Griffiths and Steyvers (2004), set the topic smoothing parameter α (alpha) to $50/k$ ($50/70$ in this case).

Table C 1. Shopify Topics (70)

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10
information	users	merchants	payment	seo	loyalty	conversion	make	help	price
details	access	also	free	speed	brand	increase	right	questions	prices
customer	account	helps	pay	search	customers	customer	easier	impact	products
automatically	user	allows	fees	site	customer	improve	better	faq	pricing
data	store	provides	amount	traffic	program	rate	customers	like	size
created	login	offers	plan	improve	rewards	help	making	answers	product
order	verification	merchant	payments	optimize	affiliate	reduce	help	provide	wholesale
paid	website	like	flow	google	referral	rates	people	faqs	quantity
realtime	age	available	protection	results	reward	helps	sure	answer	table
every	accounts	enables	cost	website	points	satisfaction	decisions	every	offer
Topic 11	Topic 12	Topic 13	Topic 14	Topic 15	Topic 16	Topic 17	Topic 18	Topic 19	Topic 20
experience	easily	inventory	business	stock	customers	delivery	data	store	store
customers	bulk	manage	ecommerce	back	gift	date	automatically	stores	online
shopping	allows	sync	focus	items	message	time	integration	multiple	owners
better	changes	orders	every	inventory	card	order	sales	code	every
providing	edit	amazon	grow	keep	via	pickup	system	add	owner
personalized	update	import	needs	low	cards	day	sync	location	designed
provide	schedule	channels	businesses	alerts	even	days	pos	easily	stores
enhance	multiple	across	growing	soon	allowing	local	orders	customers	instore
live	quickly	connect	built	levels	experience	within	manual	locations	ecommerce
seamless	updates	management	small	coming	unique	deliveries	accounting	map	offline
Topic 21	Topic 22	Topic 23	Topic 24	Topic 25	Topic 26	Topic 27	Topic 28	Topic 29	Topic 30
customer	page	easy	product	search	customers	shop	video	customers	data
support	pages	makes	products	using	shoppers	shops	instagram	new	analytics
chat	product	use	variants	find	purchase	und	videos	without	insights
live	show	way	variant	smart	buy	perfect	feed	feature	reports
whatsapp	display	simple	descriptions	advanced	buyers	mit	slider	existing	performance
team	collection	wishlist	description	quickly	buying	work	showcase	view	track
widget	top	fast	selected	recommendations	convert	module	gallery	faster	dashboard
via	landing	effective	tabs	instant	lets	every	display	quick	realtime
messenger	displayed	quick	information	filters	now	die	website	bring	view
service	scroll	even	assign	customers	sales	lets	shoppable	well	understand
Topic 31	Topic 32	Topic 33	Topic 34	Topic 35	Topic 36	Topic 37	Topic 38	Topic 39	Topic 40
content	images	store	email	want	orders	offers	store	theme	required
create	product	visitors	send	like	generate	upsell	also	customize	easy
blog	image	address	sms	many	automatically	value	using	design	coding
posts	text	right	notifications	choose	invoices	offer	ready	customizable	without
generate	upload	redirect	abandoned	select	order	increase	know	look	minutes
post	photos	countries	emails	use	create	free	important	fully	use
use	add	content	customers	simply	labels	average	simple	match	setup
pages	background	addresses	carts	may	print	bundles	inside	editor	just
seconds	photo	prevent	automated	dont	invoice	purchase	website	style	need
articles	alt	protect	marketing	well	easily	order	company	templates	install

Topic 41	Topic 42	Topic 43	Topic 44	Topic 45	Topic 46	Topic 47	Topic 48	Topic 49	Topic 50
get	ecommerce	social	currency	application	cart	products	mobile	order	time
need	service	media	based	per	add	brands	store	orders	save
help	platform	store	language	allows	button	dropshipping	apps	tracking	money
best	logistics	link	multiple	online	checkout	fast	works	status	real
dont	fulfillment	share	supports	functionality	page	quality	number	fulfillment	work
everything	services	links	local	plus	show	suppliers	web	automatically	spend
work	provide	website	automatically	allowing	bar	retailers	device	number	automatically
started	solutions	customers	location	cloud	customers	thousands	devices	fulfill	lot
running	solutions	icons	languages	complete	buttons	business	menu	track	creating
team	warehouse	allows	different	dashboard	sticky	find	phone	process	saving
Topic 51	Topic 52	Topic 53	Topic 54	Topic 55	Topic 56	Topic 57	Topic 58	Topic 59	Topic 60
reviews	products	visitors	sales	stores	returns	one	custom	set	need
trust	collections	popup	boost	support	return	click	options	based	file
review	product	email	increase	tax	subscription	just	add	rules	digital
proof	collection	list	helps	enables	subscriptions	place	fields	create	export
display	also	site	drive	online	branded	single	text	tags	files
badges	specific	popups	conversions	multiple	portal	clicks	option	different	import
widgets	create	convert	revenue	world	like	now	types	tag	csv
website	sale	build	engagement	fully	exchange	multiple	metafields	specific	download
collect	related	pop	traffic	around	ecommerce	install	create	allows	easily
widget	allows	website	dynamic	system	revenue	shown	available	per	sell
Topic 61	Topic 62	Topic 63	Topic 64	Topic 65	Topic 66	Topic 67	Topic 68	Topic 69	Topic 70
google	features	discount	products	see	solution	marketing	customers	using	shipping
facebook	tool	discounts	sell	customers	management	platform	customer	create	rates
ads	powerful	create	print	take	process	customer	form	easily	labels
feed	use	sales	create	able	automate	campaigns	contact	manage	ship
tracking	interface	codes	design	try	seamlessly	tools	create	directly	shipments
shopping	control	bar	demand	today	manage	brands	using	admin	services
events	user	code	custom	next	seamless	growth	allow	clients	checkout
pixel	provide	countdown	designs	start	operations	campaign	forms	easy	carriers
campaigns	full	promotions	selling	give	streamline	build	request	booking	connect
tag	easytouse	timer	care	way	automation	personalized	like	customer	offer

Table C 2. WooCommerce Topics (50)

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10
add	manage	automatically	reminder	vat	widget	product	advanced	make	customers
custom	orders	cost	subscriptions	track	orders	bulk	using	can	coupons
fields	pdf	add	customers	made	tool	subscriptions	will	brand	gift
checkout	automatically	easily	plugin	charge	tools	images	site	marketing	offer
registration	receive	costs	customer	rules	based	edit	help	specific	helps
create	format	content	customizable	advanced	payment	variation	points	track	discounts
account	automatic	smart	day	remove	new	variations	export	referrals	coupon
form	posts	boxes	additional	pricing	website	image	event	blocks	purchase
forms	many	reports	easy	services	visitors	multiple	give	build	product
page	antifraude	profit	existing	number	guarantee	add	deposit	range	cards

Topic 11	Topic 12	Topic 13	Topic 14	Topic 15	Topic 16	Topic 17	Topic 18	Topic 19	Topic 20
site	line	cart	via	sync	based	customers	store	shipping	inventory
purchase	quickly	plugin	define	integration	user	offers	integrate	free	login
pay	review	popup	per	automate	price	revenue	services	customers	secure
unique	letting	use	separate	list	roles	marketplace	solution	rates	shop
directly	sorting	shopping	needs	sales	product	key	website	offer	live
website	offers	button	catalog	sell	add	build	makes	methods	enable
visitors	options	floating	removing	click	cart	subscribe	trusted	get	provide
conversions	content	added	receive	grow	products	account	monthly	options	method
sticky	using	abandonment	optimize	walmart	quantity	integrates	mobile	based	number
use	online	quick	upload	inventories	pricing	videos	reach	domestic	management
Topic 21	Topic 22	Topic 23	Topic 24	Topic 25	Topic 26	Topic 27	Topic 28	Topic 29	Topic 30
product	discount	sales	shoppers	offers	reviews	customers	easily	manage	product
products	validate	store	tabs	countries	collect	orders	access	accounts	one
pages	rules	increase	complete	suite	users	checkout	system	within	extension
customers	apply	get	give	brands	items	delivery	solution	custom	directly
create	integrated	create	customizable	latest	schedule	time	advanced	site	products
display	engage	buy	use	visitors	available	users	features	costs	import
page	customers	boost	control	events	social	allows	filters	create	amazon
shop	site	business	online	engage	powerful	date	taxydromiki	indepth	marketplace
plugin	per	using	interface	wish	display	customer	filter	seamlessly	click
add	store	ecommerce	easily	spending	customer	process	switch	phone	affiliate
Topic 31	Topic 32	Topic 33	Topic 34	Topic 35	Topic 36	Topic 37	Topic 38	Topic 39	Topic 40
order	store	abandoned	create	customers	products	payments	offer	google	get
automatically	product	carts	can	allow	subscription	payment	solution	product	store
email	products	stores	print	checkout	using	credit	relevant	ads	quote
send	allow	recover	courier	products	offer	accept	perfect	campaigns	tracking
new	date	customers	tickets	cart	offers	via	marketing	pro	customer
extension	display	site	cancel	order	create	card	api	control	security
via	search	orders	greece	can	increase	take	order	feed	features
sms	make	allows	voucher	users	value	allows	time	provides	powered
manually	find	support	add	items	customers	gateway	provides	generated	enable
numbers	time	can	vouchers	place	marketing	pay	seamless	manager	area
Topic 41	Topic 42	Topic 43	Topic 44	Topic 45	Topic 46	Topic 47	Topic 48	Topic 49	Topic 50
wholesale	online	sell	store	email	customer	plugin	fees	stock	customer
store	packages	tools	products	can	can	allows	minutes	products	automatic
special	software	special	orders	price	plugin	easy	businesses	time	adds
add	giving	export	integration	users	support	provide	separate	extension	online
set	store	automatically	manage	customers	share	users	displaying	schedule	fast
import	google	group	data	emails	customers	country	selection	weekly	history
plugin	xml	member	sell	number	payment	online	orders	presenting	login
allinone	allowing	point	allows	customizer	system	shop	rich	wordpress	storefront
sales	plus	dashboard	connect	subscriptions	set	owners	functionality	details	fixed
take	shipping	wishcom	list	customize	buttons	per	amazon	sales	contact

APPENDIX D

Figure D 1. Parallel Trends: Variety

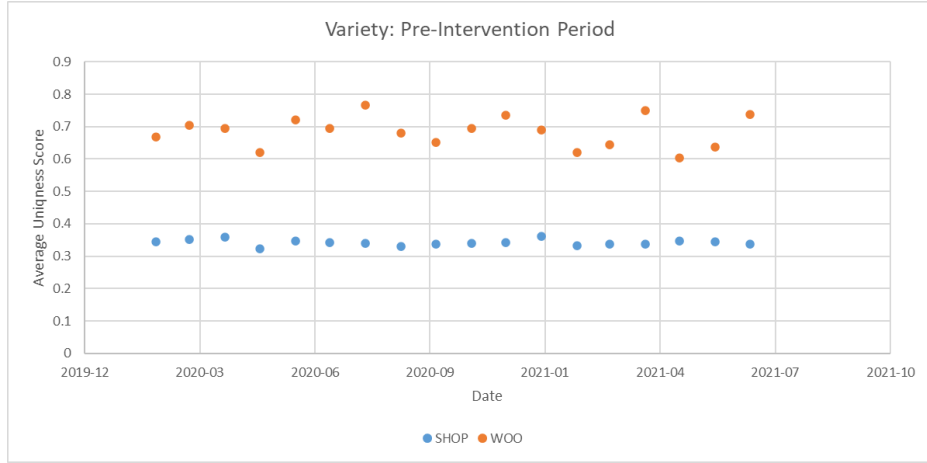
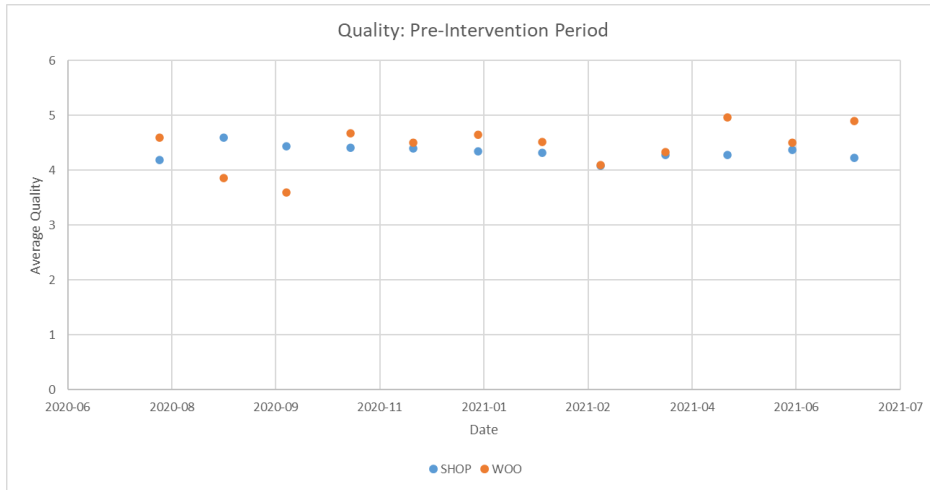


Figure D 2. Parallel Trends: Quality



2	Squarespace	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media - Point of Sale 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: <i>Courses & memberships</i> - Basic: Blog, Guides, Webinars, Videos <p>(3) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No reviews or ratings of extensions <p>(2) Community forum for users</p> <ul style="list-style-type: none"> - Forum for users 	31 extensions 156 templates (themes)	<p>Monthly subscription</p> <p>Personal, Business, Commerce basic, Commerce advanced</p> <p>(\$23, \$33, \$36, \$65 monthly)</p> <p>(Can also pay annually for lower rate)</p>
		3/3 → 1	2/3 → 0.67		0.67
3	Wix	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media - Point of Sale 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: Wix Learn (video courses and lessons) - Basic: Wix Blog, Web Design Inspiration <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Ratings only (no reviews) <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Wix Forum Community 	500+ Apps (Wix AppMarket) 800+ themes	Free + Monthly Subscription
		3/3 → 1	2/3 → 0.67		0.33
4	WooCommerce	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media - Point of Sale 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: WooCommerce Live (channel) - Basic: Blog, Documentation, Guides <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Reviews and ratings <p>(3) Community Forum</p> <ul style="list-style-type: none"> - No forum on the platform (only on Facebook) 	800+ extensions 77+ themes	Free

		3/3 → 1	2/3 → 0.67		0
5	Ecwid By Lightspeed	Sales channels (in addition to online/website) - Mobile - Social Media - Point of Sale 3/3 → 1	(1) Extended Information (Platform) - Yes: Ecwid Academy, Podcast - Basic: Tutorials, Guides, Blog, Showcase (2) Extended Information (Complements) - Reviews and ratings (3) Community Forum -No 2/3 → 0.67	260+ apps, tools and extensions in App Market	Free + Monthly/Annual Subscriptions Free, Venture, Business, Unlimited 0.33
6	Duda	Sales channels (in addition to online/website) - Mobile - Social Media - Point of Sale 3/3 → 1	(1) Extended Information (Platform) - Yes: Duda University, Video Library, eBooks - Basic: Blog, Tutorials, Webinars, Success Stories (2) Extended Information (Complements) - No reviews or ratings (3) Community Forum - Duda Community 2/3 → 0.67	43 apps and integrations in App Store 120 themes	Monthly Memberships (can also pay annually to save) Basic, Team & Agency, Custom 0.67
7	Weebly	Sales channels (in addition to online/website) - Mobile - Social Media: no - Point of Sale 2/3 → 0.67	(1) Extended Information (Platform) - No [Basic: Weebly Blog, Guides] (2) Extended Information (Complements) - Ratings & reviews (3) Community Forum - Community Forum - Seller Community 2/3 → 0.67	380 apps in App Center 60 themes	Free + monthly/annual subscription options 4 plans: Free, personal, professional & performance 0.33

8	OpenCart	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: no - Point of Sale <p style="text-align: right;">2/3 → 0.67</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: OpenCart Books - Basic: OpenCart Blog, Documentation <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Very few reviews and ratings <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Community Forum <p style="text-align: right;">2/3 → 0.67</p>	<p>13,000 + extensions 1,800+ themes</p> <p>(OpenCart Extension Store)</p>	Free	0
9	Big Cartel	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: no - Point of Sale <p style="text-align: right;">2/3 → 0.67</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: Blog, video tutorials] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No <p>(3) Community Forum</p> <ul style="list-style-type: none"> - No <p style="text-align: right;">0/3 → 0</p>	<p>30 addons 18 themes well-chosen & stick to essentials</p> <p>Most of Big Cartel's addons are actually integrations though another tool called Zapier</p>	Free + Monthly Subscription Plans	0.33
10	PrestaShop	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media - Point of Sale 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: Training, E-learning courses, PrestaShop Academy - Basic: PrestaShop Blog, video tutorials <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Ratings and reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Forum for users (in various languages) - The platform also posts in the forum with updates, news and announcements 	<p>4100+ modules in Addons Marketplace</p> <p>2000+ themes/templates (7 free themes, rest are paid)</p>	Free	

		3/3 → 1	3/3 → 1		0
11	Adobe Commerce	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: third party app - Point of Sale: third-party app 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: Training - Basic: Documentation, Guides, Videos and tutorials <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Very few ratings and reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - The Community Hub - Forums 	3,600+ integrations and extensions through Adobe Commerce Marketplace	<p>Free+ 2 paid plans: Commerce Pro and Managed Services</p> <p>Customized pricing; have to ask for quote (can be around \$22,000 per year)</p> <p>The free version is kept separate; it is called Magento Open Source</p>
		1/3 → 0.33	2/3 → 0.67		0.33
12	Zen cart	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile: third party app - Social Media: third party app - Point of Sale: third-party app 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: Blog, Docs] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No <p>(3) Community Forum</p> <ul style="list-style-type: none"> - User Forum 	1,800 plugins in Plugin Library	Free
		0/3 → 0	1/3 → 0.33		0

13	Big Commerce	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: third party app - Point of sale: third-party app 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: BigCommerce University (training from experts), Podcast - Basic: Ecommerce Blog, webinars, Documentation & videos, User docs, guides <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Ratings & reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Community forum 	<p>900+ apps & integrations</p> <p>300+ themes</p>	<p>Annual Subscriptions</p> <p>(Plans mention monthly rates, but <i>billed annually</i>; rates higher if monthly)</p> <p>Standard, Plus, Pro, Enterprise</p>	<p>1/3 → 0.33</p> <p>3/3 → 1</p> <p>1</p>
14	Webflow	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: only marketing, not selling - Point of sale: no 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: Webflow TV (Stream highly curated and original Webflow content); Courses, Webflow University - Basic: Blog, ebooks, webinars, whitepapers <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Webflow Forum 	<p>26 apps in Marketplace</p> <p>2,000+ templates</p>	<p>Free + Monthly Memberships</p> <p>Basic, CMS, Business, Enterprise</p>	<p>1/3 → 0.33</p> <p>2/3 → 0.67</p> <p>0.33</p>
15	Shopline	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media - Point of sale 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: Blog, video tutorials] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Ratings and Reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - No 	<p>198 apps in App Store</p>	<p>Monthly Membership (3 plans)</p> <p>(can also pay annually to save)</p>	

		3/3 → 1	1/3 → 0.33		0.67
16	osCommerce	Sales channels (in addition to online/website) - Mobile: third-party app (osCommerce Mobile Assistant) - Social Media: only for marketing - Point of sale: third-party app 0/3 → 0	(1) Extended Information (Platform) - No [Basic: News, live shops, documentation] (2) Extended Information (Complements) - No reviews or ratings (3) Community Forum - Forums 1/3 → 0.33	245 add-ons	Free 0
17	Volusion	Sales channels (in addition to online/website) - Mobile - Social Media: marketing only - Point of sale 2/3 → 0.67	(1) Extended Information (Platform) - No [Basic: Ecommerce Blog, webinars, guides, white paper] (2) Extended Information (Complements) - No (3) Community Forum -No 0/3 → 0	80 services & integrations in the Volusion Marketplace Curated “services” and “integrations” offered by Partners Many free fully customizable themes, all provided by Volusion (not third party)	Monthly Subscriptions (can also pay annually) Personal, Professional, Business, Prime 0.67
18	Oracle Commerce	Sales channels (in addition to online/website) - Mobile - Social Media: marketing only - Point of sale 2/3 → 0.67	(1) Extended Information (Platform) - Extensive: Oracle Learning Channel, Oracle University -Basic: Documentation, Tutorials (2) Extended Information (Complements) - Almost no ratings & reviews (3) Community Forum - Oracle Community (for customers) 2/3 → 0.67	51 Apps under Oracle Cloud Marketplace (specifically for Oracle Commerce)	Personalized. Need to request quotes. Usually quite expensive. 1

19	nopCommerce	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: marketing only - Point of sale <p style="text-align: right;">2/3 → 0.67</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: Training, Showcase of Live Stores - Basic: Documentation <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Ratings & reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Community Forums <p style="text-align: right;">3/3 → 1</p>	<p>720 Extensions in nopCommerce Marketplace</p> <p>60 Themes</p>	Free	0
20	J2Store	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: third-party app - Point of sale: third-party app <p style="text-align: right;">1/3 → 0.33</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: Blog] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No <p>(3) Community Forum</p> <ul style="list-style-type: none"> - No <p style="text-align: right;">0/3 → 0</p>	6 extensions in Extensions Marketplace	Free	0
21	Salesforce	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: only marketing - Point of sale: third-party app <p style="text-align: right;">1/3 → 0.33</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Extensive: Learning on Trailhead - Basic: Documentation, Guide <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Ratings & Reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Trailblazer Community - IdeaExchange <p style="text-align: right;">3/3 → 1</p>	<p>47 apps under AppExchange</p> <p>And 300 Add-ons provided by Salesforce</p>	Three paid plans, Starter, Growth & Plus. Need to request quotes. Usually quite high; because targeted to big retailers.	1

22	Miva Merchant	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media: marketing only - Point of sale: no <p>1/3 → 0.33</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: Miva Blog, guides, webinars, videos, whitepapers] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No ratings and reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Miva Forums <p>1/3 → 0.33</p>	450 apps in App Marketplace	<p>Personalized. Need to request quotes. Usually quite expensive.</p> <p>1</p>
23	Hika Shop	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media - Point of sale: no <p>2/3 → 0.67</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Basic: Blog, Documentation, Tutorials <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No ratings & reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Hika Forum <p>1/3 → 0.33</p>	138 Integrations & Add-ons	<p>Free + 2 Paid Plans (Essential, Business)</p> <p>0.33</p>
24	Drupal Commerce	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile - Social Media - Point of sale <p>3/3 → 1</p>	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: Blogs, news, webinars, documentation, videos] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No reviews and reviews of modules <p>(3) Community Forum</p> <ul style="list-style-type: none"> - Drupal Answers forum, but not very active <p>0/3 → 0</p>	<p>251 modules under extensions (aka integrations in module library)</p> <p>14 themes</p> <p>Access to code</p>	<p>Free</p> <p>0</p>
25	CS-Cart	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile: third-party app 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - Yes: CS-Cart Academy - Basic: Documentation, Video Tutorials 	<p>192 add-ons (in Add-on Market)</p> <p>34 themes</p>	<p>Free + Monthly Subscriptions</p>

		<ul style="list-style-type: none"> - Social Media: third party apps - Point of sale: third-party app <p style="text-align: right;">0/3 → 0</p>	<ul style="list-style-type: none"> (2) Extended Information (Complements) <ul style="list-style-type: none"> - Ratings & Reviews (3) Community Forum <ul style="list-style-type: none"> - Community Forums <p style="text-align: right;">3/3 → 1</p>	Access to code.	0.33	
26	Sylius	<ul style="list-style-type: none"> Sales channels (in addition to online/website) <ul style="list-style-type: none"> - Mobile: no - Social Media: no - Point of sale: no <p style="text-align: right;">0/3 → 0</p>	<ul style="list-style-type: none"> (1) Extended Information (Platform) <ul style="list-style-type: none"> - Extensive: Sylius Fundamentals Course - Basic: E-books, videos, blog (2) Extended Information (Complements) <ul style="list-style-type: none"> - No ratings and reviews (3) Community Forum <ul style="list-style-type: none"> - Sylius Forum <p style="text-align: right;">2/3 → 0.67</p>	113 Plugins in Sylius Store	Free	0
27	Amplience	<ul style="list-style-type: none"> Sales channels (in addition to online/website) <ul style="list-style-type: none"> - Mobile - Social Media: no - Point of sale <p style="text-align: right;">2/3 → 0.67</p>	<ul style="list-style-type: none"> (1) Extended Information (Platform) <ul style="list-style-type: none"> - Basic: Blog, Webinars & Videos, News, Reports, Whitepapers (2) Extended Information (Complements) <ul style="list-style-type: none"> - No ratings & reviews (3) Community Forum <ul style="list-style-type: none"> - No <p style="text-align: right;">0/3 → 0</p>	40 Apps & Integrations in Marketplace	Two paid plans, Starter & Enterprise. Need to request quotes. Usually quite high (ex: \$25k annually for Starter); because targeted to big retailers. [Also, has to pbe paid annually]	1
28	Shift4Shop	<ul style="list-style-type: none"> Sales channels (in addition to online/website) <ul style="list-style-type: none"> - Mobile: no - Social Media: third-party app - Point of sale: no 	<ul style="list-style-type: none"> (1) Extended Information (Platform) <ul style="list-style-type: none"> - Yes: eCommerce University - Basic: Integrated Blog & Webinars (2) Extended Information (Complements) <ul style="list-style-type: none"> -No (very little) (3) Community Forum <ul style="list-style-type: none"> - eCommerce Forum 	400+ apps 100+ free themes	Free + Monthly membership Unlimited enterprise-grade plan for \$0 with Shift4 (minimum \$500 processed per month) Or starting at \$29/month with PayPal	

		0/3 → 0	2/3 → 0.67		0.33
29	FoxyCart	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile: no - Social Media: no - Point of sale: no 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: Blog, Documentation] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - No <p>(3) Community Forum</p> <ul style="list-style-type: none"> - No 	67 Integrations	<p>Monthly Memberships</p> <p>(Standard, Advanced, Enterprise)</p>
		0/3 → 0	0/3 → 0		0.67
30	X-Cart	<p>Sales channels (in addition to online/website)</p> <ul style="list-style-type: none"> - Mobile: no - Social Media: third party app - Point of sale: third party app 	<p>(1) Extended Information (Platform)</p> <ul style="list-style-type: none"> - No [Basic: X-Cart eCommerce Blog, Webinars, Knowledge Base] <p>(2) Extended Information (Complements)</p> <ul style="list-style-type: none"> - Ratings & reviews <p>(3) Community Forum</p> <ul style="list-style-type: none"> - No 	<p>600+ addons</p> <p>35 themes</p>	<p>Monthly Subscriptions</p> <p>3 plans:</p> <p>199/mo</p> <p>299/mo</p> <p>499/mo</p>
		0/3 → 0	1/3 → 0.33		0.67

Table E 2. Calibration (Complementor-Oriented Model)

	E-Commerce Platform	Extended Information Provision	Rewards	Favorable Value Appropriation Regime	Access Control	Output Control
1	Shopify	<p>Learning</p> <ul style="list-style-type: none"> - Basic: Guides, Documentation, Shopify Partner Blog, Developer changelog - Extensive: ShopifyDevs YouTube Channel, ShopifyDevs Twitch channel, Discord servers, Twitter (ShopifyDevs), Shopify Academy (some courses exclusively for developers & partners) <p>Community Forum</p> <ul style="list-style-type: none"> - Developer Forums - Partners & Developers Community (within Shopify Community Forum) 	<p>Complement Promotion</p> <ul style="list-style-type: none"> - “Shopify adds indicators of quality to apps, and promotes high quality apps” - Apps that meet all of our criteria are given <i>Built for Shopify</i> status, our highest level of recognition and achievement. 	<p>Revenue Split</p> <ul style="list-style-type: none"> - 80/20 - Another reduced plan offered, where 0% commission on first 1mil USD gross annual, and then 15% revenue share <p>[Average of 20, 15, 0 is 11.66]</p> <p>12% goes to platform</p>	<p>Type of Complementor</p> <ul style="list-style-type: none"> - Anyone 	<p>Many ratings and reviews in app market</p>
		1	1		0	1
2	Squarespace	<p>Learning</p> <ul style="list-style-type: none"> - Basic: API Documentation, Changelog <p>Community Forum</p> <ul style="list-style-type: none"> - No (Squarespace Forum for users only) 	<p>No Complement Promotion</p>	<p>Revenue Split</p> <ul style="list-style-type: none"> - 75/25 <p>25% goes to platform</p>	<p>Type of Complementor</p> <ul style="list-style-type: none"> - Partners only 	<p>No reviews or ratings of extensions</p>
		0	0		1	0
3	Wix	<p>Learning:</p> <ul style="list-style-type: none"> - Extensive: Velo by WIX → Velo Courses (learn coding), Articles, Video Tutorials, Velo Blog - Basic: Developer Support: Documentation, Guides, Tutorials 	<p>Complement Promotion</p> <ul style="list-style-type: none"> - “We occasionally pick apps to promote in the App Market. They could appear in the Trending Now section, or in other curated collections” 	<p>Revenue Split</p> <p>Partners keep 100% of their revenue in their first 12 months with Wix</p>	<p>Type of Complementor</p> <ul style="list-style-type: none"> - Developers (need to learn Velo) 	<p>Ratings only</p>

		(specifically for accounting, fulfillment & dropshipping apps) Community Forum - Velo Forum 1		After first year: revenue split of 80/20 [Average of 0% and 20% → 10%] 10% goes to platform 1		0.33	0.67
4	WooCommerce	Learning: - Basic: Guides, Code References, Documentation Community Forum - WooCommerce Community Forum - GitHub Repositories, WooCommerce Community Slack, WooCommerce on Reddit 0.67	Complement Promotion - “Our Favorites” 1	Revenue Split - 70/30 30% goes to platform	Type of Complementors - Developers using JavaScript & Partnership options	0.33	Reviews and ratings 1
5	Ecwid	Learning - Basic: API Documentation, API. Changelog Community Forum - Discussions (not so active) - Developer Community on Slack 0.33	Complement Promotion - Recommended Apps 1	Revenue Split - 80/20 20% goes to platform	Type of Complementor - Anyone	0	Reviews and ratings 1
6	Duda	Learning - Extensive: Duda Academy for Developers - Basic: Guides, API Reference, Changelog, Tutorials Community Forum - No (Duda Community Forums for users, not complementors)	Complement Promotion - Apps in the Spotlight	Revenue Split - 75/25 25% goes to platform	Type of Complementor “Partners” (requires meeting w/Duda) “Currently, the API for apps is limited to a number of people”		No reviews or ratings

		0.67	1		1	0
7	Weebly	<p>Learning: - Basic: Documentation, Guides, Tutorials</p> <p>Community Forum - Weebly Developer Community (not very active)</p>	<p>Complement Promotion - Highest Rated</p>	<p>Revenue Split - 70/30 split 30% goes to platform</p>	<p>Type of Complementor - Anyone</p>	<p>Ratings & reviews</p>
		0.33	1		0	1
8	OpenCart	<p>Learning - Basic: Developer Guides, Documentation, Blog - Extensive: Video Tutorials, OpenCart Masterclass (190 videos, 4 courses); OpenCart Books [</p> <p>Community Forum - Community Forum has Developer section [active]</p>	<p>Complement Promotion - Featured - OpenCart Certified - Premium Partner</p>	<p>Revenue Split - Depends on sales [50% - 25% commission rate] - \$700 sales per month: 50% commission rate - \$701 - \$849 sales per month: 40% commission rate - \$850 - \$999 sales per month: 30% commission rate - \$1,000+ sales per month: 25% commission rate [Average is 35% commission] 35% goes to platform</p>	<p>Type of Complementor - Partners & Developers</p>	<p>Ratings & Reviews</p>
		1	1		0	1

9	Big Cartel	<p>Learning: - Basic: Developer Newsletter, API Changelog (stay updated on new features, improvements, bug fixes)</p> <p>Community Forum - No</p>	No Complement Promotion	<p>Revenue Split - 75/25</p> <p>25% goes to platform</p>	Type of Complementor - Select 'friends'	No ratings and reviews
		0	0		1	0
10	PrestaShop	<p>Learning - Basic: Devdocs, How-to, Cheat Sheet, Tutorials, Developer Blog - Extensive: PrestaShop Module Development Book</p> <p>Community Forum - PrestaShop Forums</p>	Complement Promotion - Official Partners	<p>Revenue Split - Range: 60/40 - 80/20 - "PrestaShop applies a <i>degressive commission</i> according to the turnover realized</p> <p>[Average: 70/30]</p> <p>30% goes to platform</p>	Type of Complementor - Developers & Partners	Ratings and reviews
		1	1		0	1
11	Adobe Commerce	<p>Learning: - Extensive: DevBlog - Basic: API Reference, Guides, Video Tutorials</p> <p>Community Forum - Community Forum, Slack, Adobe Developer on YouTube, Adobe Developer on Twitter, GitHub, Tech Blog</p>	Complement Promotion - "Gold Solution Partner", "Silver Solution Partner" "Bronze Solution Partner" Tags	<p>Revenue Split - 85/15</p> <p>15% goes to platform</p>	Type of Complementor - Partners & Developers	Very few ratings and reviews
		1	1		0	0.33

12	Zen cart	<p>Learning - Basic: Developer Docs</p> <p>Community Forum - Zen Cart Forum (active)</p>	No Complement Promotion	<p>Revenue Split - N/A because plugins are free only</p> <p>100% of value goes to platform</p>	Type of Complementor - Anyone	No ratings and reviews
		0.67	0		0	0
13	Big Commerce	<p>Learning - Basic: API Documentation, Developer Blog</p> <p>Community Forum - Community Forum (Also: Communities on Slack, Twitter, Discord, YouTube) - Community section under Help Center to ask questions</p>	Complement Promotion - BigCommerce Recommends - Top Apps	<p>Revenue Split - 80/20</p> <p>+ Also charges one-time listing fees</p> <p>20% goes to platform</p>	Type of complementors - Anyone	Ratings & reviews
		0.67	1		0	1
14	Webflow	<p>Learning - Basic: API Docs, Changelog</p> <p>Community Forum - Developer Forums</p>	No Complement Promotion	<p>Revenue Split - 20/80 for Professional Expert Partner - 10/90 for Enterprise Expert Partner</p> <p>[Average: 15%]</p> <p>15% goes to the platform</p>	Type of Complementor - Anyone	No reviews or ratings
		0.67	0		0	0
15	Shopline	<p>Learning - Basic: API & References, Documentation</p> <p>Community Forum</p>	No Complement Promotion	<p>Revenue Split - 70/30</p> <p>30% goes to the platform</p>	Type of Complementor - Anyone	Reviews & Ratings

		- No 0	0	0	0	1
16	osCommerce	Learning - Basic: API documentation Community Forum - No 0	No Complement Promotion 0	Revenue Split - 75/25 25% goes to platform 0	Type of Complementor: - Select Development Partners 1	No reviews or ratings 0
17	Volusion	Learning - Basic: API Documentation Community Forum - No 0	No Complement Promotion 0	Revenue Split - 70/30 (premier partner) - 80/20 (preferred partner) [average: 75/25] 25% goes to platform 0	Type of Complementor - Partners only 1	No ratings or reviews 0
18	Oracle Commerce	Learning - Basic: Developer Blog Community - Developer Community - Developer Forum 0.67	Complement Promotion - Featured Apps - Top-rated Apps 1	No revenue split, but 3% publishing fee (it is only one time, so cannot compare to revenue share). [View revenue share as 100/0] 0% goes to the platform	Type of Complementor - Anyone; have to register first 0	Almost no ratings & reviews (for the Commerce specific apps) 0.33

19	nopCommerce	<p>Learning:</p> <ul style="list-style-type: none"> - Extensive: Training & Online Courses for Developers - Basic: Documentation, Developer Guides, Developer Tutorials <p>Community Forum</p> <ul style="list-style-type: none"> - nopCommerce Forums (for Developers) 	<p>Complement Promotion</p> <ul style="list-style-type: none"> - Featured Products - Certified Developer Badge 	<p>Revenue Split</p> <ul style="list-style-type: none"> - 75/25 <p>25% goes to platform</p>	<p>Type of Complementor</p> <ul style="list-style-type: none"> - Anyone 	<p>Ratings & reviews & Certifications</p>
		1	1		0	1
20	J2Store	<p>Learning</p> <ul style="list-style-type: none"> - Basic only <p>Community Forum</p> <ul style="list-style-type: none"> - No 	<p>No Complement Promotion</p>	<p>Revenue Split</p> <ul style="list-style-type: none"> - 75/25 <p>25% goes to platform</p>	<p>Type of Complementor</p> <ul style="list-style-type: none"> - Partners 	<p>No ratings and reviews</p>
		0	0		1	0
21	Salesforce	<p>Learning</p> <ul style="list-style-type: none"> - Basic: Documentation, Developers Blog - Extensive: Developers Podcast, Learning from Trailhead <p>Community Forum</p> <ul style="list-style-type: none"> - Partner Community (inactive) 	<p>No Complement Promotion</p>	<p>Revenue Split</p> <ul style="list-style-type: none"> - 85/15 <p>15% goes to platform</p>	<p>Type of Complementor</p> <ul style="list-style-type: none"> - Anyone 	<p>Ratings & Reviews</p>
		0.67	0		0	1
22	Miva Merchant	<p>Learning</p> <ul style="list-style-type: none"> - Basic: Miva Docs, Miva Reference Guide - Extensive: Developer Training Series (video training) <p>Community Forum</p> <ul style="list-style-type: none"> - No 	<p>No Complement Promotion</p>	<p>Revenue Split</p> <ul style="list-style-type: none"> - 75/25 <p>25% goes to platform</p>	<p>Type of Complementor</p> <ul style="list-style-type: none"> - Anyone 	<p>No ratings and reviews</p> <p>(option available, but almost nothing filled out)</p>
		0.67	0		0	0.33
23	Hika Shop	<p>Learning</p>		<p>Revenue Split</p>		

		- Basic: Developer Documentation Community Forum - HikaShop Forum with section for developers 0.33	No Complement Promotion 0	- 85/15 15% goes to platform	Type of Complementor - Anyone 0	No ratings and reviews 0
24	Drupal Commerce	Learning - Basic: Developer guide, video library Community Forum - No ('Discussions' only for users) 0	Complement Promotion - Featured 1	Revenue Split - All extensions are free 100% value created goes to platform	Type of complementors - Developers & Certified Partners 0	No ratings or reviews of modules 0
25	CS-Cart	Learning Basic: Add-on Development Guide, Tutorials Community Forum - Developers section on Community Forum [not super aactive] 0.33	Complement Promotion - Recommended add-ons 1	Revenue Split - 75/25 25% goes to the platform	Type of Complementor - Requires registration (w/ company name) 0.67	Ratings & Reviews 1
26	Sylius	Learning - Basic: Partner Guide Community Forum - No 0	No ratings and reviews 0	Revenue Split - 75/25 25% goes to the platform	Type of Complementor - Partners only. 1	No ratings and reviews (option available, but not used) 0.33

27	Amplience	Learning - Basic: Documentation, Partner Training Community Forum - No	No ratings and reviews		Type of Complementor - Partners only [Can register, but have to be agencies; not individual]	No ratings and reviews
		0	0		1	0
28	Shift4Shop	Learning - Basic [API Documentation, Guides, API Reference] Community Forum - Developer Forum (active)	Complement Promotion - Featured Apps	Revenue Split - 60/40 40% goes to platform	Type of Complementor - Have to be a 'partner'	Very minimal reviews
		0.67	1		1	0.33
29	FoxyCart	Learning: - Basic: API Reference, Cheat sheet, Tutorials, Examples Community Forum - No	No Complement Promotion	Revenue Split - 85/15 15% goes to platform	Type of Complementor - Select few third-parties	No ratings and reviews
		0	0		1	0
30	X-Cart	Learning: -Basic: API Documentation Community Forum - Forum (same as for users because they are also developers, given the open source nature] – has some dedicated space for app development	Complement Promotion - Recommended Add-ons	Revenue Split - 75/25 (Can request payout when balance exceeds \$100) 25% goes to platform	Type of Complementor - Only Select Development Partners	Ratings & Reviews
		0.33	1		1	1

REFERENCES

- Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of management*, 43(1), 39-58.
- Adner, R. (2021). *Winning the right game: How to disrupt, defend, and deliver in a changing world*. MIT Press.
- Aiken, M., Dewar, R., DiTomaso, N., Hage, J., & Zeitz, G. (1975). *Coordination of Human Services*. San Francisco: Josey-Bass.
- Alt, R. (2022). Electronic Markets on platform culture. *Electronic Markets*, 32(3), 1019-1031.
- Altman, E. J., Nagle, F., & Tushman, M. L. (2022). The Translucent Hand of Managed Ecosystems: Engaging Communities for Value Creation and Capture. *Academy of Management Annals*, 16(1), 70–101.
- Aneesh, A. (2009). Global labor: Algoratic modes of organization. *Sociological theory*, 27(4), 347-370.
- Angrist, J. D., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.
- Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of informetrics*, 11(4), 959-975.
- Armstrong, M. (2006). Competition in two-sided markets. *The RAND journal of economics*, 37(3), 668-691.
- Armstrong, M., & Wright, J. (2007). Two-sided markets, competitive bottlenecks and exclusive contracts. *Economic Theory*, 32, 353-380.
- Asmussen, C. B., & Møller, C. (2019). Smart literature review: a practical topic modelling approach to exploratory literature review. *Journal of Big Data*, 6(1), 1-18.
- Autio, E., & Thomas, L. D. 2020. Value co-creation in ecosystems: Insights and research promise from three disciplinary perspectives. *Handbook of digital innovation*. Edward Elgar Publishing.
- Avinadav, T., Chernonog, T., & Khmel'nitsky, E. (2021). Revenue-sharing between developers of virtual products and platform distributors. *European Journal of Operational Research*, 290(3), 927-945.
- Avinadav, T., Chernonog, T., Meilijson, I., & Perlman, Y. (2022). A consignment contract with revenue sharing between an app developer and a distribution platform. *International Journal of Production Economics*, 243, 108322.
- Baldwin, C. Y., & Woodard, C. J. (2009). The architecture of platforms: A unified view. *Platforms, markets and innovation*, 32, 19-44.
- Bardhan, P. (2002). Decentralization of governance and development. *Journal of Economic perspectives*, 16(4), 185-205.
- Barney, J. B. (1999). How a firm's capabilities affect boundary decisions. *MIT Sloan Management Review*.
- Barney, J. B., & Hansen, M. H. (1994). Trustworthiness as a source of competitive advantage. *Strategic management journal*, 15(S1), 175-190.
- Bart, Y., Shankar, V., Sultan, F., & Urban, G. L. (2005). Are the drivers and role of online trust the same for all web sites and consumers? A large-scale exploratory empirical study. *Journal of marketing*, 69(4), 133-152.

- Basukie, J., Wang, Y., & Li, S. (2020). Big data governance and algorithmic management in sharing economy platforms: A case of ridesharing in emerging markets. *Technological Forecasting and Social Change*, 161, 120310.
- Batagelj, V., & Cerinšek, M. (2013). On bibliographic networks. *Scientometrics*, 96(3), 845-864.
- Bauner, C. (2015). Mechanism choice and the buy-it-now auction: A structural model of competing buyers and sellers. *International Journal of Industrial Organization*, 38, 19-31.
- Beck, B. B., Wuyts, S., & Jap, S. (2023). Guardians of Trust: How Review Platforms Can Fight Fakeness and Build Consumer Trust. *Journal of Marketing Research*, 00222437231195576.
- Bhargava, H. K. (2022). The creator economy: Managing ecosystem supply, revenue sharing, and platform design. *Management Science*, 68(7), 5233-5251.
- Binken, J. L., & Stremersch, S. (2009). The effect of superstar software on hardware sales in system markets. *Journal of Marketing*, 73(2), 88-104.
- Blackburn, O., Ritala, P., & Keränen, J. (2023). Digital Platforms for the Circular Economy: Exploring Meta-Organizational Orchestration Mechanisms. *Organization & Environment*, 36(2), 253-281.
- Blei, D. M. (2012). Probabilistic topic models. *Communications of the ACM*, 55(4), 77-84.
- Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent dirichlet allocation. *Journal of machine Learning research*, 3(Jan), 993-1022.
- Blei, D.M. & Lafferty, J.D. (2007). A correlated topic model of science. *Ann Appl Stat.*1(1):17-35.
- Bogers, M., Sims, J., & West, J. (2019). What is an ecosystem? Incorporating 25 years of ecosystem research.
- Boudreau K. (2010) Open platform strategies and innovation: Granting access versus devolving control. *Management Sci.* 56(10):1849-1872.
- Boudreau, K. J. (2012). Let a thousand flowers bloom? An early look at large numbers of software app developers and patterns of innovation. *Organization Science*, 23(5), 1409-1427.
- Boudreau, K. J., & Hagiou, A. (2009). Platform rules: Multi-sided platforms as regulators. *Platforms, markets and innovation*, 1, 163-191.
- Boudreau, K. J., & Jeppesen, L. B. (2015). Unpaid crowd complementors: The platform network effect mirage. *Strategic management journal*, 36(12), 1761-1777.
- Brandenburger, A. M. (1995). *Power play (A): Nintendo in 8-bit video games*. Harvard Business School.
- Bridoux, F., & Stoelhorst, J. W. (2022). Stakeholder governance: Solving the collective action problems in joint value creation. *Academy of Management Review*, 47(2), 214-236.
- Broadus, R. N. (1987). Toward a definition of “bibliometrics”. *Scientometrics*, 12, 373-379.
- Brutus, S., Aguinis, H., & Wassmer, U. (2013). Self-reported limitations and future directions in scholarly reports: Analysis and recommendations. *Journal of management*, 39(1), 48-75.
- Bucher, E. L., Schou, P. K., & Waldkirch, M. (2021). Pacifying the algorithm-Anticipatory compliance in the face of algorithmic management in the gig economy. *Organization*, 28(1), 44-67.
- Caillaud, B., & Jullien, B. (2003). Chicken & egg: Competition among intermediation service providers. *RAND journal of Economics*, 309-328.
- Carst, A. E., & Hu, Y. (2023). Complementors as ecosystem actors: a systematic review. *Management Review Quarterly*, 1-57.

- Casadesus-Masanell, R., & Campbell, N. (2019). Platform competition: Betfair and the UK market for sports betting. *Journal of Economics & Management Strategy*, 28(1), 29-40.
- Casadesus-Masanell, R., & Hałaburda, H. (2014). When does a platform create value by limiting choice?. *Journal of Economics & Management Strategy*, 23(2), 259-293.
- Catalini, C. & Gans, J. S. (2016). Some Simple Economics of the Blockchain.
- Ceccagnoli, M., Forman, C., Huang, P., & Wu, D. J. (2012). Cocreation of value in a platform ecosystem! The case of enterprise software. *MIS quarterly*, 263-290.
- Cennamo, C. (2018). Building the value of next-generation platforms: The paradox of diminishing returns. *Journal of Management*, 44(8), 3038-3069.
- Cennamo, C. (2021). Competing in digital markets: A platform-based perspective. *Academy of Management Perspectives*, 35(2), 265-291.
- Cennamo, C., & Santaló, J. (2019). Generativity tension and value creation in platform ecosystems. *Organization science*, 30(3), 617-641.
- Chen, L., Tong, T. W., Tang, S., & Han, N. (2022). Governance and design of digital platforms: A review and future research directions on a meta-organization. *Journal of Management*, 48(1), 147-184.
- Chen, L., Yi, J., Li, S., & Tong, T. W. (2022). Platform governance design in platform ecosystems: Implications for complementors' multihoming decision. *Journal of Management*, 48(3), 630-656.
- Chen, W., Wei, X., & Zhu, K. (2018). Engaging voluntary contributions in online communities: A hidden Markov model. *MIS Quarterly*, 42(1): 83-100.
- Chen, Y., Richter, J. I., & Patel, P. C. (2021). Decentralized governance of digital platforms. *Journal of Management*, 47(5), 1305-1337.
- Chesbrough, H. (2006). Open innovation: a new paradigm for understanding industrial innovation. *Open innovation: Researching a new paradigm*, 400, 0-19.
- Choi, A. A., Cho, D., Yim, D., Moon, J. Y., & Oh, W. (2019). When seeing helps believing: The interactive effects of previews and reviews on e-book purchases. *Information Systems Research*, 30(4), 1164-1183.
- Choi, G., Nam, C., Kim, S., Jung, H. J., & Lee, C. H. (2020). Where does knowledge-sharing motivation come from? The case of third-party developer in mobile platforms. *Journal of Knowledge Management*, 24(7), 1681-1704.
- Chung, H. D., Zhou, Y. M., & Ethiraj, S. (2024). Platform governance in the presence of within-complementor interdependencies: Evidence from the rideshare industry. *Management Science*, 70(2), 799-814.
- Claussen, J., Kretschmer, T., & Mayrhofer, P. (2013). The effects of rewarding user engagement: The case of Facebook apps. *Information Systems Research*, 24(1), 186-200.
- Colquitt, J. A. (2001). On the dimensionality of organizational justice: a construct validation of a measure. *Journal of applied psychology*, 86(3), 386.
- Constantinides, P., Henfridsson, O., & Parker, G. G. (2018). Platforms and Infrastructures in the Digital Age. *Information Systems Research*, 29(2), 381-400.
- Corts, K. S., & Lederman, M. (2009). Software exclusivity and the scope of indirect network effects in the US home video game market. *international Journal of industrial Organization*, 27(2), 121-136.
- Costabile, C., Iden, J., & Bygstad, B. (2022). Building digital platform ecosystems through standardization: An institutional work approach. *Electronic Markets*, 32(4), 1877-1889.

- Crane, D. (1972). *Invisible colleges: Diffusion of knowledge in scientific communities*. Chicago: University of Chicago Press
- Cuccurullo, C., Aria, M., & Sarto, F. (2016). Foundations and trends in performance management. A twenty-five years bibliometric analysis in business and public administration domains. *Scientometrics*, *108*, 595-611.
- Curchod, C., Patriotta, G., Cohen, L., & Neysen, N. (2020). Working for an algorithm: Power asymmetries and agency in online work settings. *Administrative science quarterly*, *65*(3), 644-676.
- Cusumano, M. A., Gawer, A., & Yoffie, D. B. (2019). *The business of platforms: Strategy in the age of digital competition, innovation, and power*. New York: Harper Business.
- Cutolo, D., & Kenney, M. (2021). Platform-dependent entrepreneurs: Power asymmetries, risks, and strategies in the platform economy. *Academy of management perspectives*, *35*(4), 584-605.
- Dahlander, L., & Gann, D. M. (2010). How open is innovation?. *Research policy*, *39*(6), 699-709.
- Danaher, J., Hogan, M. J., Noone, C., Kennedy, R., Behan, A., De Paor, A., ... & Shankar, K. (2017). Algorithmic governance: Developing a research agenda through the power of collective intelligence. *Big data & society*, *4*(2), 2053951717726554.
- Das, T. K., & Teng, B. S. (1998). Between trust and control: Developing confidence in partner cooperation in alliances. *Academy of management review*, *23*(3), 491-512.
- De Jong, B. A., Kroon, D. P., & Schilke, O. (2017). The future of organizational trust research: A content-analysis and synthesis of future research directions. In *Human cooperation: Trust in social dilemmas*. Oxford University Press.
- Deilen, M., & Wiesche, M. (2021). The role of complementors in platform ecosystems. In *Innovation Through Information Systems: Volume III: A Collection of Latest Research on Management Issues* (pp. 473-488). Springer International Publishing.
- Deng, X. (Nancy), Joshi, K. D., & Galliers, R. D. (2016). The Duality of Empowerment and Marginalization in Microtask Crowdsourcing: Giving Voice to the Less Powerful Through Value Sensitive Design. *MIS Quarterly*, *40*(2), 279-302.
- Diodato, V. (1994). *Dictionary of bibliometrics*. Binghamton, NY: Haworth Press.
- Duriau, V. J., Reger, R. K., & Pfarrer, M. D. (2007). A content analysis of the content analysis literature in organization studies: Research themes, data sources, and methodological refinements. *Organizational research methods*, *10*(1), 5-34.
- Dushnitsky, G., Piva, E., & Rossi-Lamastra, C. (2022). Investigating the mix of strategic choices and performance of transaction platforms: Evidence from the crowdfunding setting. *Strategic Management Journal*, *43*(3), 563-598.
- Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review*, *23*(4), 660-679.
- Eaton, B., Elaluf-Calderwood, S., Sørensen, C., & Yoo, Y. (2015). Distributed tuning of boundary resources. *MIS quarterly*, *39*(1), 217-244.
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of management journal*, *50*(1), 25-32.

- Eisenmann, T., Parker, G., & Van Alstyne, M. (2011). Platform envelopment. *Strategic management journal*, 32(12), 1270-1285.
- Eisenmann, T., Parker, G., & Van Alstyne, M. W. (2006). Strategies for two-sided markets. *Harvard business review*, 84(10), 92.
- Eklund, J. C. (2022). The knowledge-incentive tradeoff: Understanding the relationship between research and development decentralization and innovation. *Strategic Management Journal*, 43(12), 2478-2509.
- Elambert, J. (2023). What Link between Legitimacy and Response to Incentives on a Crowdwork Platform? The Foule Factory Case: *Revue d'économie Politique*, Vol. 133(5), 791–842.
- Evans, D. S., & Schmalensee, R. (2007). *Catalyst code: the strategies behind the world's most dynamic companies*. Harvard Business School Press.
- Faguet, J. P. (2014). Decentralization and governance. *World Development*, 53, 2-13.
- Fan, Y., Ju, J., & Xiao, M. (2016). Reputation premium and reputation management: Evidence from the largest e-commerce platform in China. *International Journal of Industrial Organization*, 46(1): 63-76.
- Farrell, J., & Katz, M. L. (2000). Innovation, rent extraction, and integration in systems markets. *The journal of industrial economics*, 48(4), 413-432.
- Felin, T., & Zenger, T. R. (2014). Closed or open innovation? Problem solving and the governance choice. *Research policy*, 43(5), 914-925.
- Foerderer, J. (2020). Interfirm Exchange and Innovation in Platform Ecosystems: Evidence from Apple's Worldwide Developers Conference. *Management Science*, 66(10), 4772–4787.
- Foerderer, J., Kude, T., Mithas, S., & Heinzl, A. (2018). Does Platform Owner's Entry Crowd Out Innovation? Evidence from Google Photos. *Information Systems Research*, 29(2), 444–460.
- Foerderer, J., Lueker, N., & Heinzl, A. (2021). And the Winner Is ...? The Desirable and Undesirable Effects of Platform Awards. *Information Systems Research*, 32(4), 1155–1172.
- Foss, N. J., Schmidt, J., & Teece, D. J. (2023). Ecosystem leadership as a dynamic capability. *Long range planning*, 56(1), 102270.
- Furnari, S., Crilly, D., Misangyi, V. F., Greckhamer, T., Fiss, P. C., & Aguilera, R. V. (2021). Capturing causal complexity: Heuristics for configurational theorizing. *Academy of Management Review*, 46(4), 778-799.
- Garfield, E. (2004). Historiographic mapping of knowledge domains literature. *Journal of information science*, 30(2), 119-145.
- Gawer, A. (2009). Platforms, markets and innovation: an introduction. In: Gawer, A. (Ed.), *Platforms, Markets and Innovation*. Edward Elgar, Cheltenham, UK and Northampton, Mass, pp. 1–16.
- Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research policy*, 43(7), 1239-1249.
- Gawer, A. (2021). Digital platforms' boundaries: The interplay of firm scope, platform sides, and digital interfaces. *Long Range Planning*, 54(5): 102045.
- Gawer, A. (2022). Digital platforms and ecosystems: Remarks on the dominant organizational forms of the digital age. *Innovation*, 24(1), 110–124.

- Gawer, A., & Henderson, R. (2007). Platform owner entry and innovation in complementary markets: Evidence from Intel. *Journal of Economics & Management Strategy*, 16(1), 1-34.
- Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: the boundary resources model. *Information systems journal*, 23(2), 173-192.
- Gol, E. S., Stein, M. K., & Avital, M. (2019). Crowdwork platform governance toward organizational value creation. *The Journal of Strategic Information Systems*, 28(2), 175-195.
- Goldbach, T., Benlian, A., & Buxmann, P. (2018). Differential effects of formal and self-control in mobile platform ecosystems: Multi-method findings on third-party developers' continuance intentions and application quality. *Information & Management*, 55(3), 271-284.
- Greckhamer, T., & Gur, F. A. (2021). Disentangling combinations and contingencies of generic strategies: A set-theoretic configurational approach. *Long Range Planning*, 54(2), 101951.
- Greckhamer, T., Furnari, S., Fiss, P. C., & Aguilera, R. V. (2018). Studying configurations with qualitative comparative analysis: Best practices in strategy and organization research. *Strategic Organization*, 16(4): 482-495.
- Greckhamer, T., Misangyi, V., & Fiss, P.C. (2013). The two QCAs: From a small-N to a large-N set theoretic approach. *Research in the Sociology of Organizations*, 38: 49-75.
- Greenberg, J. (1993). Stealing in the name of justice: Informational and interpersonal moderators of theft reactions to underpayment inequity. *Organizational behavior and human decision processes*, 54(1), 81-103.
- Grofman, B. & Schneider, C. Q. (2009). An introduction to crisp set QCA, with a comparison to binary logistic regression. *Political Research Quarterly*, 62, 662-672.
- Grün, B., & Hornik, K. (2011). topicmodels: An R package for fitting topic models. *Journal of statistical software*, 40, 1-30.
- Gulati, R., Puranam, P., & Tushman, M. (2012). Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic management journal*, 33(6), 571-586.
- Gulati, R., Wohlgezogen, F., & Zhelyazkov, P. (2012). The two facets of collaboration: Cooperation and coordination in strategic alliances. *Academy of Management Annals*, 6(1), 531-583.
- Guo, W., Straub, D., Zhang, P., & Cai, Z. (2021). How Trust Leads To Commitment On Microsourcing Platforms: Unraveling The Effects Of Governance And Third-Party Mechanisms On Triadic Microsourcing Relationships. *MIS Quarterly*, 45(3).
- Gupta, A. K., Tesluk, P. E., & Taylor, M. S. (2007). Innovation at and across multiple levels of analysis. *Organization science*, 18(6), 885-897.
- Haans, R. F. (2019). What's the value of being different when everyone is? The effects of distinctiveness on performance in homogeneous versus heterogeneous categories. *Strategic Management Journal*, 40(1), 3-27.
- Hagiu, A., & Wright, J. (2015). Multi-sided platforms. *International journal of industrial organization*, 43, 162-174.
- Halaburda, H., Jan Piskorski, M., & Yıldırım, P. (2018). Competing by restricting choice: The case of matching platforms. *Management Science*, 64(8), 3574-3594.

- Harracá, M., Castelló, I., & Gawer, A. (2023). How Digital Platforms Organize Immaturity: A Sociosymbolic Framework of Platform Power. *Business Ethics Quarterly*, 33(3), 440–472.
- Harrison, G. W., & List, J. A. (2004). Field experiments. *Journal of Economic literature*, 42(4), 1009-1055.
- Hart, O., & Moore, J. (1990). Property Rights and the Nature of the Firm. *Journal of political economy*, 98(6), 1119-1158.
- Hellmann, T., & Thiele, V. (2011). Incentives and innovation: A multitasking approach. *American Economic Journal: Microeconomics*, 3(1), 78-128.
- Hilbolling, S., Berends, H., Deken, F., & Tuertscher, P. (2021). Sustaining complement quality for digital product platforms: A case study of the Philips Hue ecosystem. *Journal of Product Innovation Management*, 38(1), 21-48.
- Hofstetter, R., Zhang, J. Z., & Herrmann, A. (2018). Successive open innovation contests and incentives: winner-take-all or multiple prizes?. *Journal of Product Innovation Management*, 35(4), 492-517.
- Holmström, B. (1979). Moral hazard and observability. *The Bell journal of economics*, 74-91.
- Holmstrom, B. (1989). Agency costs and innovation. *Journal of Economic Behavior & Organization*, 12(3), 305-327.
- Holmstrom, B., & Milgrom, P. (1994). The firm as an incentive system. *The American economic review*, 972-991.
- Huang, J., Boh, W. F., & Goh, K. H. (2017). A temporal study of the effects of online opinions: Information sources matter. *Journal of Management Information Systems*, 34(4): 1169-1202.
- Huang, Y., Singh, P. V., & Srinivasan, K. (2014). Crowdsourcing new product ideas under consumer learning. *Management Science*, 60(9): 2138-2159.
- Huber, T. L., Kude, T., & Dibbern, J. (2017). Governance practices in platform ecosystems: Navigating tensions between cocreated value and governance costs. *Information Systems Research*, 28(3), 563-584.
- Hukal, P., Henfridsson, O., Shaikh, M., & Parker, G. (2020). Platform Signaling for Generating Platform Content. *MIS Quarterly*, 44(3), 1177–1205.
- Hurni, T., Huber, T. L., Dibbern, J., & Krancher, O. (2021). Complementor dedication in platform ecosystems: Rule adequacy and the moderating role of flexible and benevolent practices. *European Journal of Information Systems*, 30(3), 237–260.
- Iansiti, M., & Levien, R. (2004). Strategy as ecology. *Harvard business review*, 82(3), 68-78.
- Inoue, Y. (2021). Indirect innovation management by platform ecosystem governance and positioning: Toward collective ambidexterity in the ecosystems. *Technological Forecasting and Social Change*, 166, 120652.
- Islam, H. A., Farrell, M., Nair, A., & Zhang, J. (2023). Understanding transaction platform governance and conflicts: A configuration approach. *Technological Forecasting and Social Change*, 189, 122382.
- Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic management journal*, 39(8), 2255-2276.
- Jeronimo, R. C., Scorsone, E. A., & Guedes, S. N. R. (2022). From the Rule of Thumb to the Rule of the Algorithms: Command and Control in Ride-Hailing Platforms. *Journal of Economic Issues*, 56(2), 530-536.

- Jia, X., Cusumano, M. A., & Chen, J. (2021). Multi-Sided Platform Research Over the Past Three Decades: A Bibliometric Analysis. *International Journal of Technology Management*, 87(2–4), 113–144.
- Kale, P., Singh, H., & Perlmutter, H. (2000). Learning and protection of proprietary assets in strategic alliances: Building relational capital. *Strategic management journal*, 21(3), 217–237.
- Kallinikos, J., Aaltonen, A., & Marton, A. (2013). The ambivalent ontology of digital artifacts. *MIS quarterly*, 357–370.
- Kang, H. Y., & Suarez, F. F. (2023). Platform Owner Entry Into Complementor Spaces Under Different Governance Modes. *Journal of Management*, 49(5), 1766–1800.
- Kapoor, R. (2018). Ecosystems: Broadening the locus of value creation. *Journal of Organization Design*, 7(1): 1–16.
- Karhu, K., Gustafsson, R., & Lyytinen, K. (2018). Exploiting and Defending Open Digital Platforms with Boundary Resources: Android’s Five Platform Forks. *Information Systems Research*, 29(2), 479–497.
- Kathuria, A., Karhade, P. P., & Konsynski, B. R. (2020). In the Realm of Hungry Ghosts: Multi-Level Theory for Supplier Participation on Digital Platforms. *Journal of Management Information Systems*, 37(2), 396–430.
- Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *The American economic review*, 75(3), 424–440.
- Kellogg, K. C., Valentine, M. A., & Christin, A. (2020). Algorithms at work: The new contested terrain of control. *Academy of management annals*, 14(1), 366–410.
- Kim, W.C., & Mauborgne, R. (1998). Procedural justice, strategic decision making, and the knowledge economy. *Strategic management journal*, 19(4), 323–338.
- Klein, P. G., Mahoney, J. T., McGahan, A. M., & Pitelis, C. N. (2019). Organizational governance adaptation: Who is in, who is out, and who gets what. *Academy of management review*, 44(1), 6–27.
- Koo, W. W., & Eesley, C. E. (2021). Platform governance and the rural–urban divide: Sellers' responses to design change. *Strategic Management Journal*, 42(5), 941–967.
- Kretschmer, T., Leiponen, A., Schilling, M., & Vasudeva, G. (2020). Platform ecosystems as meta-organizations: Implications for platform strategies. *Strategic Management Journal*.
- Kumar, N., Scheer, L. K., & Steenkamp, J. B. E. (1995). The effects of perceived interdependence on dealer attitudes. *Journal of marketing research*, 32(3), 348–356.
- Kwan, A. P., Yang, S. A., & Zhang, A. H. (2024). Crowd-judging on two-sided platforms: An analysis of in-group bias. *Management Science*, 70(4), 2459–2476.
- Landsman, V., & Stremersch, S. (2011). Multihoming in two-sided markets: An empirical inquiry in the video game console industry. *Journal of Marketing*, 75(6), 39–54.
- Leiponen, A., Thomas, L. D. W., & Wang, Q. (2022). The dApp economy: A new platform for distributed innovation? *Innovation*, 24(1), 125–143.
- Leong, C., Lin, S., Tan, F., & Yu, J. (2023). Coordination in a Digital Platform Organization. *Information Systems Research*, isre.2023.1226.
- Lerner, J., & Wulf, J. (2007). Innovation and incentives: Evidence from corporate R&D. *the Review of Economics and Statistics*, 89(4), 634–644.
- Li, H., Fang, Y., Lim, K., & Wang, Y. (2018). Platform-based function repertoire, reputation, and sales performance of e-marketplace sellers. *MIS Quarterly*, 43(1): 207–236.

- Li, Z., & Agarwal, A. (2017). Platform integration and demand spillovers in complementary markets: Evidence from Facebook's integration of Instagram. *Management Science*, 63(10), 3438-3458.
- Lichtenthaler, U. (2011). Open innovation: Past research, current debates, and future directions. *Academy of management perspectives*, 25(1), 75-93.
- Lin, Z., Zhang, Y., & Tan, Y. (2019). An empirical study of free product sampling and rating bias. *Information Systems Research*, 30(1): 260-275.
- Lind, E. A., & Van den Bos, K. (2002). When fairness works: Toward a general theory of uncertainty management. *Research in organizational behavior*, 24, 181-223.
- Liu, Y., & Gao, W. (2023). Which is more effective for platform performance: Punishments or incentives? *Industrial Marketing Management*, 110, 117–128.
- Luo, Y. (2007). The independent and interactive roles of procedural, distributive, and interactional justice in strategic alliances. *Academy of Management journal*, 50(3), 644-664.
- Lusch, R. F., & Nambisan, S. (2015). Service innovation. *MIS quarterly*, 39(1), 155-176.
- Malone, T. W., & Crowston, K. (1990, September). What is coordination theory and how can it help design cooperative work systems?. In *Proceedings of the 1990 ACM conference on Computer-supported cooperative work* (pp. 357-370).
- Manso, G. (2011). Motivating innovation. *The journal of finance*, 66(5), 1823-1860.
- McIntyre, D. P., & Srinivasan, A. (2017). Networks, platforms, and strategy: Emerging views and next steps. *Strategic management journal*, 38(1), 141-160.
- McIntyre, D., Srinivasan, A., Afuah, A., Gawer, A., & Kretschmer, T. (2021). Multisided platforms as new organizational forms. *Academy of Management Perspectives*, 35(4), 566-583.
- Mesquita, L. F., & Brush, T. H. (2008). Untangling safeguard and production coordination effects in long-term buyer-supplier relationships. *Academy of Management Journal*, 51(4), 785-807.
- Meyer, A., Tsui, A., Hinings, C. R., *Configural Approaches to Organizational Analysis* (1993). *Academy of Management Journal*, 36, 1175-1195
- Miric, M., Boudreau, K. J., & Jeppesen, L. B. (2019). Protecting their digital assets: The use of formal & informal appropriability strategies by App developers. *Research Policy*, 48(8), 103738.
- Miric, M., Ozalp, H., & Yilmaz, E. D. (2023). Trade-offs to using standardized tools: Innovation enablers or creativity constraints? *Strategic Management Journal*, 44(4), 909–942.
- Misangyi, V, Greckhamer, T, Furnari, S., Fiss, P., Crilly, D., & Aguilera, R. (2017). Embracing causal complexity: The emergence of a neo-configurational perspective. *Journal of Management*, 43(1): 255-282.
- Misangyi, V. F., & Acharya, A. G. (2014). Substitutes or complements? A configurational examination of corporate governance mechanisms. *Academy of Management Journal*, 57(6), 1681-1705.
- Moorman, C., Zaltman, G., & Deshpande, R. (1992). Relationships between providers and users of market research: The dynamics of trust within and between organizations. *Journal of marketing research*, 29(3), 314-328.
- Nambisan, S., & Sawhney, M. (2011). Orchestration processes in network-centric innovation: Evidence from the field. *Academy of management perspectives*, 25(3), 40-57.

- O'Mahony, S., & Karp, R. (2022). From proprietary to collective governance: How do platform participation strategies evolve? *Strategic Management Journal*, 43(3), 530–562.
- Okhuysen, G. A., & Bechky, B. A. (2009). 10 coordination in organizations: An integrative perspective. *Academy of Management Annals*, 3(1), 463-502.
- Orlikowski, W. J., & Scott, S. V. (2015). The algorithm and the crowd. *Mis Quarterly*, 39(1), 201-216.
- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.
- Panico, C., & Cennamo, C. (2022). User preferences and strategic interactions in platform ecosystems. *Strategic Management Journal*, 43(3), 507-529.
- Papanastasiou, Y., Yang, S. A., & Zhang, A. H. (2023). Improving Dispute Resolution in Two-Sided Platforms: The Case of Review Blackmail. *Management Science*, 69(10), 6021–6037.
- Parker, G. G., & Van Alstyne, M. W. (2005). Two-sided network effects: A theory of information product design. *Management science*, 51(10), 1494-1504.
- Pavlou, P. A. (2002). Institution-based trust in interorganizational exchange relationships: the role of online B2B marketplaces on trust formation. *The Journal of Strategic Information Systems*, 11(3-4), 215-243.
- Pavlou, P. A., & Gefen, D. (2004). Building effective online marketplaces with institution-based trust. *Information systems research*, 15(1), 37-59.
- Peteraf, M. A. (1993). The cornerstones of competitive advantage: a resource-based view. *Strategic management journal*, 14(3), 179-191.
- Poppo, L., & Zenger, T. (2002). Do formal contracts and relational governance function as substitutes or complements?. *Strategic management journal*, 23(8), 707-725.
- Poppo, L., Zhou, K. Z., & Li, J. J. (2016). When can you trust “trust”? Calculative trust, relational trust, and supplier performance. *Strategic management journal*, 37(4), 724-741.
- Pritchard, A. (1969). Statistical bibliography or bibliometrics. *Journal of documentation*, 25, 348.
- Ragin, C.C. (2000). *Fuzzy-Set Social Science*. Chicago: University of Chicago Press.
- Ragin, C. C. (2008). What is Qualitative Comparative Analysis?
- Reiter, A., Stonig, J., & Frankenberger, K. (2024). Managing multi-tiered innovation ecosystems. *Research Policy*, 53(1), 104905.
- Reuber, A. R., & Fischer, E. (2022). Relying on the engagement of others: A review of the governance choices facing social media platform start-ups. *International Small Business Journal*, 40(1), 3-22.
- Rietveld, J., & Eggers, J. P. (2018). Demand heterogeneity in platform markets: Implications for complementors. *Organization Science*, 29(2), 304-322.
- Rietveld, J., Ploog, J. N., & Nieborg, D. B. (2020). Coevolution of platform dominance and governance strategies: Effects on complementor performance outcomes. *Academy of Management Discoveries*, 6(3), 488-513.
- Rietveld, J., Schilling, M. A., & Bellavitis, C. (2019). Platform strategy: Managing ecosystem value through selective promotion of complements. *Organization Science*, 30(6), 1232-1251.
- Rochet, J. C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, 1(4), 990-1029.

- Rochet, J. C., & Tirole, J. (2006). Two-sided markets: a progress report. *The RAND journal of economics*, 37(3), 645-667.
- Rong, K., Sun, H., Li, D., & Zhou, D. (2021). Matching as Service Provision of Sharing Economy Platforms: An Information Processing Perspective. *Technological Forecasting and Social Change*, 171, 120901.
- Ryall, M. D., & Sampson, R. C. (2009). Formal contracts in the presence of relational enforcement mechanisms: Evidence from technology development projects. *Management science*, 55(6), 906-925.
- Rysman, M. (2009). The economics of two-sided markets. *Journal of economic perspectives*, 23(3), 125-143.
- Sanchez, R., & Mahoney, J. T. (1996). Modularity, flexibility, and knowledge management in product and organization design. *Strategic management journal*, 17(S2), 63-76.
- Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo vadis, dynamic capabilities? A content-analytic review of the current state of knowledge and recommendations for future research. *Academy of management annals*, 12(1), 390-439.
- Schilling, M. A. (2003). Technological leapfrogging: Lessons from the US video game console industry. *California management review*, 45(3), 6-32.
- Sen, A., Kumar, A., Dubey, V., & Gupta, A. (2023). Managing two-sided B2B electronic markets: Governance mechanisms, performance implications, and boundary conditions. *Journal of Business Research*, 169, 114257.
- Shi, X., Li, F., & Chumnumpan, P. (2020). The use of product scarcity in marketing. *European Journal of Marketing*, 54(2), 380-418.
- Simcoe, T. S., Graham, S. J., & Feldman, M. P. (2009). Competing on standards? Entrepreneurship, intellectual property, and platform technologies. *Journal of Economics & Management Strategy*, 18(3), 775-816.
- Simon, H. A. (1997). *Models of bounded rationality: Empirically grounded economic reason* (Vol. 3). MIT press.
- Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the Association for Information Science and Technology*, 24(4), 265-269.
- Song, P., Xue, L., Rai, A., & Zhang, C. (2018). The Ecosystem of Software Platform: A Study of Asymmetric Cross-Side Network Effects and Platform Governance. *MIS Quarterly*, 42(1), 121-142.
- Strahilevitz, L. J. (2005). Information asymmetries and the rights to exclude. *Mich. L. Rev.*, 104, 1835.
- Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of management review*, 20(3), 571-610.
- Suddaby, R. (Ed.). (2010). Editor's comments: Construct clarity in theories of management and organization. *Academy of management review*, 35(3), 346-357.
- Sundararajan, A. (2014). What Airbnb gets about culture that Uber doesn't. *Harvard Business Review Digital Articles*, Nov. 27.
- Sunyaev, A. (2020). Distributed ledger technology. *Internet computing: Principles of distributed systems and emerging internet-based technologies*, 265-299.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18(7), 509-533

- Teh, T. (2022). Platform Governance. *American Economic Journal: Microeconomics*, 14(3), 212–254.
- Terwiesch, C., & Xu, Y. (2008). Innovation contests, open innovation, and multiagent problem solving. *Management science*, 54(9), 1529-1543.
- Thaler, R., & Sunstein, C. (2008). Nudge: Improving decisions about health, wealth and happiness. In *Amsterdam Law Forum; HeinOnline: Online* (p. 89).
- Thibaut, J., & Walker, L. (1978). A theory of procedure. *Calif. L. Rev.*, 66, 541.
- Thomas, L. D., & Tee, R. (2022). Generativity: A systematic review and conceptual framework. *International Journal of Management Reviews*, 24(2), 255-278.
- Tiwana, A. (2013). *Platform ecosystems: aligning architecture, governance, and strategy*. Newnes.
- Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Research Commentary-Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics. *Information Systems Research*, 21(4): 675–687.
- Trabucchi, D., Moretto, A., Buganza, T., & MacCormack, A. (2020). Disrupting the disruptors or enhancing them? How blockchain reshapes two-sided platforms. *Journal of Product Innovation Management*, 37(6), 552-574.
- Tsujimoto, M., Kajikawa, Y., Tomita, J., & Matsumoto, Y. (2018). A review of the ecosystem concept—Towards coherent ecosystem design. *Technological forecasting and social change*, 136, 49-58.
- Tyler, T. R., & Bies, R. J. (1990). Beyond formal procedures: The interpersonal context of procedural justice. In J. S. Carroll (Ed.), *Applied Social Psychology and organizational settings*. (77-98). Hillsdale, NJ: Lawrence Erlbaum
- Uzunca, B., & Kas, J. (2023). Automated governance mechanisms in digital labour platforms: How Uber nudges and sludges its drivers. *Industry and Innovation*, 30(6), 664–693.
- Uzunca, B., Sharapov, D., & Tee, R. (2022). Governance rigidity, industry evolution, and value capture in platform ecosystems. *Research Policy*, 51(7), 104560.
- Van Alstyne, M. W., Parker, G. G., & Choudary, S. P. (2016). Reasons platforms fail. *Harvard business review*, 31(6), 2-6.
- Van Angeren, J., & Karunakaran, A. (2023). Anchored Inferential Learning: Platform-Specific Uncertainty, Venture Capital Investments by the Platform Owner, and the Impact on Complementors. *Organization Science*, 34(3), 1027–1050.
- Van Loo, R. (2016). Rise of the digital regulator. *Duke LJ*, 66, 1267.
- Von Hippel, E., & Katz, R. (2002). Shifting innovation to users via toolkits. *Management science*, 48(7), 821-833.
- Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014). Technology ecosystem governance. *Organization science*, 25(4), 1195-1215.
- Weiss, N., Wiesche, M., Schrieck, M., & Krcmar, H. (2022). Learning to be a Platform Owner: How BMW Enhances App Development for Cars. *IEEE Transactions on Engineering Management*, 69(6), 4019–4035.
- West, J. (2003). How open is open enough?: Melding proprietary and open source platform strategies. *Research policy*, 32(7), 1259-1285.
- West, J., & Bogers, M. (2011). Profiting from external innovation: A review of research on open innovation. Available at SSRN 1949520.
- Williamson, O. E. (1985). Assessing contract. *The Journal of Law, Economics, and Organization*, 1(1), 177-208.

- Williamson, P. J., & De Meyer, A. (2012). Ecosystem advantage: How to successfully harness the power of partners. *California management review*, 55(1), 24-46.
- Winter, S. G. (2000). The satisficing principle in capability learning. *Strategic management journal*, 21(10-11), 981-996.
- Xu, Z., & Raschid, L. (2016, June). Probabilistic financial community models with latent dirichlet allocation for financial supply chains. In *Proceedings of the Second International Workshop on Data Science for Macro-Modeling* (pp. 1-6).
- Yanadori, Y., & Cui, V. (2013). Creating incentives for innovation? The relationship between pay dispersion in R&D groups and firm innovation performance. *Strategic management journal*, 34(12), 1502-1511.
- Yang, Q., Wang, Q., & Zhao, X. (2019). Improving relationship performance on platforms: The role of platform technology usage in promoting justice. *Journal of Business & Industrial Marketing*, 34(5), 965-976.
- Yi, C., Jiang, Z., Li, X., & Lu, X. 2019. Leveraging user-generated content for product promotion: The effects of firm-highlighted reviews. *Information Systems Research*, 30(3): 711-725.
- Yin, J., Chen, Z., Li, M., Zhu, D., & Guo, J. (2023). Impacts of regulatory strategies on member's knowledge sharing in virtual brand communities based on ecosystem-oriented business models in China. *Asia Pacific Business Review*, 1-27.
- Yoffie, D. B., Gawer, A., & Cusumano, M. A. (2019). A study of more than 250 platforms a reveal why most fail. *Harvard Business Review*.
- Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). Research commentary—the new organizing logic of digital innovation: an agenda for information systems research. *Information systems research*, 21(4), 724-735.
- Yuan, Y., Feng, B., Lai, F., & Collins, B. J. (2018). The role of trust, commitment, and learning orientation on logistic service effectiveness. *Journal of Business Research*, 93, 37-50.
- Zaheer, A., & Venkatraman, N. (1995). Relational governance as an interorganizational strategy: An empirical test of the role of trust in economic exchange. *Strategic management journal*, 16(5), 373-392.
- Zhang, Y., Li, J., & Tong, T. W. (2022). Platform governance matters: How platform gatekeeping affects knowledge sharing among complementors. *Strategic Management Journal*, 43(3), 599-626.
- Zhao, W., Chen, J. J., Perkins, R., Liu, Z., Ge, W., Ding, Y., & Zou, W. (2015, December). A heuristic approach to determine an appropriate number of topics in topic modeling. In *BMC bioinformatics* (Vol. 16, pp. 1-10). BioMed Central.
- Zhong, Q., & Sun, Y. (2020). The more the better? Relational governance in platforms and the role of appropriability mechanisms. *Journal of Business Research*, 108, 62-73.
- Zhu, F., & Liu, Q. (2018). Competing with complementors: An empirical look at Amazon.com. *Strategic management journal*, 39(10), 2618-2642.
- Zittrain, J. (2005). Searches and Seizures in a Networked World. *Harv. L. Rev. F.*, 119, 83.
- Zittrain, J. (2006). The Generative Internet, 119 *Harvard Law Review* 1974.
- Zittrain, J. (2009). *The future of the internet: and how to stop it*. Penguin UK.