UNIVERSITY OF SUSSEX | BUSINESS SCHOOL | SCIENCE POLICY RESEARCH UNIT

Evaluating the Impact of Internal and External Factors on the Evolution of Digital Platforms into Superapps

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Abstract

This study investigates the dynamic interplay between internal organizational factors and external environmental influences in shaping the growth trajectories of digital platforms into superapps. Through a mixed-methods approach, incorporating both qualitative insights from comparative case studies of established superapps and quantitative analysis using an ordered probit model, this research dissects the strategic evolution of digital platforms within varying regulatory and governance frameworks. The analysis reveals that while internal factors such as human capital, financial resources, and technological infrastructure critically drive the transformation process, external factors like government functioning, regulatory quality, and civil liberties significantly shape the platforms' expansion capabilities and strategic decisions. By integrating empirical evidence with theoretical discussions, this study contributes to a deeper understanding of the digital platform economy and offers strategic insights for stakeholders aiming to navigate or foster the growth of superapps in diverse global contexts.

Keywords: Superapps; Digital Platforms; Regulatory Quality; Government Functioning; Civil Liberties; Mixed-Methods Analysis; Digital Economy.

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1. Introduction

In a world increasingly driven by digital convenience, over 60% of consumers globally report a high level of interest in “superapps” (Statista, 2022). While a clear definition of the word “superapp” may vary, the term initially appeared around 2010 (van der Vlist et al., 2024) and is consistently described as multifunctional digital platforms that integrate a wide range of services to become central in everyday life (Chen et. al, 2018, Steinberg et al., 2022; van der Vlist et al., 2024; Hasselwander, 2024). The superapp strategy has seen significant success in Asian markets with platforms such as WeChat, GoJek, Grab, Alipay, Kakao, and LINE (Steinberg et al., 2022). A trend now making headway in Western markets, as shown by Elon Musk's ambition for an 'everything app' with Twitter (X) and Mark Zuckerberg's plans for Meta and WhatsApp (Prud’homme et al., 2023). In the UK and Europe, companies like Revolut are also pursuing to expand into financial 'super apps', reflecting a wider movement towards integrated digital solutions (Revolut, 2022).

Despite the strong consumer interest and the expanding body of literature on digital platforms and super apps, most existing research has primarily concentrated on theoretical frameworks. Steinberg et al. (2022) have centred their work on theoretical analysis, while other scholars, such as Hein et al. (2020) and Van der Vlist (2024), have utilized thematic analyses and literature syntheses to explore super apps' descriptions and taglines. As well as comparative case studies that have largely catered the Asian market, as shown by the works of Schreieck et al. (2023) and Yang et al. (2016), or employed exploratory case study methods, focusing on the prominent Chinese superapp WeChat (Chen et al., 2018; Cheng et al. 2020; Schreieck et al., 2023,2024; Jia et al., 2022). The studies offer valuable insights into the factors influencing the rise of super apps and help build a comprehensive understanding of the topic, yet they fall short in providing a causal perspective and remain mostly unsubstantiated through empirical research, as empirical studies on the topic remain scarce.

Hasselwander approached this gap with a work that stands out by laying the groundwork for empirical research through a causal analysis that relies on a regression model, providing data-driven understanding of the internal factors driving the transformation of ‘ride-hailing’ digital platforms into super apps (2024). Nevertheless, the study does not empirically address external environmental factors that include the government and regulations, which the author and other scholars have identified as crucial in their theoretical frameworks, highlighting an important area for future research and expansion. External factors play a significant role in the context of superapps, as External factors play a significant role in the context of super apps. As Steinberg et al. (2022) and Jia et al. (2022) argue, the growth of super apps is not solely driven by technological innovation or business strategies but is also significantly shaped by the broader institutional context, including alignment with national policies and regional support. Creating an area for expanding the study of superapps across different functionalities beyond just 'ride-hailing, and the importance of incorporating external factors including government and regulatory considerations, that can significantly impact companies' strategic and operational decisions.

Given that the study of super apps and their emergence is still relatively new, there is a clear opportunity to build upon Hasselwander's empirical evidence, as well as the insights provided by other scholars. Research should incorporate both external and internal factors to develop a more integrated understanding of the dynamics at play in the growth of digital platforms. Addressing this gap would not only enhance the theoretical discourse but also offer a more holistic view of the factors driving the success and evolution of super apps in global contexts. The approach could lead to more effective strategies for developing and sustaining these platforms in the rapidly evolving digital landscape and help answer the uncoordinated regulatory approaches worldwide, with no single model or best practices for digital platform governance (Afina et al., 2024).

1.1 Research Question

How do internal organizational factors and external environmental factors shape the growth trajectories of a single-function digital platform into a superapp?

To answer this the following sub-questions will be explored:

1. To what extent do the internal organizational factors contribute to the growth and transformation of digital platforms into superapps?
2. To what extent does the *functioning of government* as an external environmental factor affect the growth of digital platforms into superapps?
3. To what extent does the *regulatory quality* as an external environmental factor affect the growth of digital platforms into superapps?
4. To what extent do *civil liberties* as an external environmental factor affect the growth of digital platforms into superapps?

To answer the research question, the study aims to understand the internal and external environmental factors shape the growth trajectories of a single-function digital platform into a superapp. A comprehensive review of the existing literature will establish the foundation for this study. Followed by an in-depth mixed-methods analysis, initially gathering qualitative insights through a comparative case study of prominent superapps worldwide. The qualitative phase will lay the groundwork for a later quantitative analysis that will further investigate the factors and their effects. In the quantitative phase, a base model for internal factors will be constructed, and three hypotheses of external factors will be introduced to examine the impact. The findings will be discussed in the context of current theories, with conclusions drawn on practical strategies and suggestions for future research.

2. Literature Review

The literature review explores the strategic evolution of digital platforms into superapps, focusing on both the internal drivers of innovation and the external regulatory impacts. Further dissecting how organizational capabilities, governments, and regulations shape the digital landscape.

2.1 Super-app Strategy

Super-app strategy aligns with the traditional concept of diversification, which Ansoff (1957) described as a high-risk growth strategy requiring new skills and techniques. However, in the digital platform context, this diversification can be more easily implemented compared to traditional firms because of the flexibility and scalability of digital services (Van der Vlist, 2024; Hasselwander, 2024). As follows, a super-app strategy represents a diversification approach, as it involves expanding the digital platform's offering, effectively transforming it into an integrated service provider across various domains.

Digital platforms have significantly affected market structures and interactions, evolving beyond traditional "seller-buyer" dynamics into bilateral or multilateral markets (Gibson, 2024). Central to their operation is the aggregation and analysis of vast amounts of user-generated data, which enhances platform services also enables targeted advertising and monetization strategies (Gawer, 2022). A significant feature of digital platforms is their reliance on network effects, where the platform's value increases as more users participate leading to dominant market positions (Cusumano et al. 2019; Gawer, 2022; Gibson, 2024).

Through adopting a 'micro-innovation strategy' digital platforms further foster innovation and continually introduce incremental expansions (Yang et al., 2016), by allowing third-party developers to build complementary products and services. Thereby creating a network of interconnected offerings that extend the platform's core functionality and broadens capabilities within its system (Helmond, 2015; Yang et al., 2016; Cusumano et al. 2019). As these micro-innovations accumulate, they enable the platform to expand functionality and effectively building an integrated ecosystem or "Mini-app ecosystems" (Schreick et al. 2023). Mini-app ecosystem consists of small applications designed to perform specific tasks within a larger host app, making the main platform more versatile, allowing users to access diverse services without leaving the main app. Mini-apps simplify development and reduce entry barriers, aligning well with integration strategies that enhance larger platforms. These strategies include Collection, Consolidation, Symbiosis, and Assemblage, which range from partial to full integration, improving functionality across platforms (Schreieck et al., 2024). Assemblage, the most comprehensive approach, fully integrates diverse platforms to create a seamless, highly functional user experience, earlier labelled as "all-in-one apps" (Chen, et al., 2018) or "Swiss-army-style apps" (Steinberg, 2020).

Van der Vlist et al. approached these concepts from a different perspective, further expanding on their detailed static view by providing a dynamic outlook and introducing the concept of 'super-appification.' Super-appification signifies a shift from isolated innovations within individual apps to a more comprehensive approach, where the integration of multiple services under one umbrella accelerates the pace and scope of innovation known as “super apps” (Van der Vlist ; 2024). It reflects a strategic evolution where platforms are no longer just aggregators of services but also represent new forms of corporate power and influence in the digital economy (Van der Vlist ; 2024).

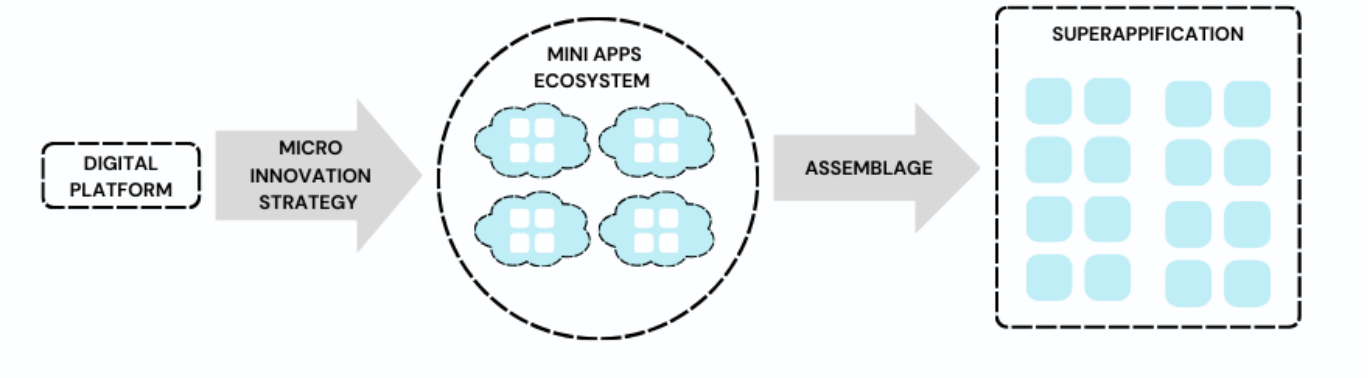

Figure 1.1: The diagram illustrating the expansion strategy of a digital platform into a superapp was conceptualized and developed based on a comprehensive review of the relevant literature

The corporate power has been explored in prior article by Steinberg et. al as they explain that the term "super app" does not necessarily mean that they are "super" by emphasizing that while these apps consolidate multiple functionalities and services within a single platform, their "super" status is primarily due to their massive scale and the monopolistic power of the corporations behind them (2022). Which have the financial and operational capacity to integrate various services and expand extensive networks. This expansion is driven by corporate strategies, including mergers, acquisitions, and partnerships, which enables platforms to integrate and control a wide range of services. (Jia et. al, 2022, Hasselwander, 2024).

Corporate strategy raises an important question about the role and alignment of internal organizational factors to achieve competitive advantage in such dynamic environments (Teece, 2011), as how these organizations leverage their financial and operational resources to execute strategies, drive innovation, and expand their dominance in the market.

2.2 Internal Organizational Factors

The evolution and diversification of digital platforms are influenced by various internal factors that can either propel or hinder their journey toward becoming superapps. Grounded in foundational knowledge, it has long been recognized that one of the key drivers of this transformation can be attributed to the size of the workforce. As companies expand their employee base, they harness the benefits of economies of scale, which are crucial for innovation and diversification (Chandler, 1977). Larger workforce allows firms to invest more in research and development, leading to greater specialization and the creation of new products and markets (Porter, 1985). This growth fosters the development of advanced organizational structures, enhances efficiency, reduces costs, and generates resources that fuel further diversification (Teece, 1986; Pavitt, 1991). Evidenced by recent studies for the importance of dynamic managerial capabilities in the digital economy as managers with more human capital, including their knowledge and expertise, are better equipped to sense opportunities and threats (Heubeck and Meckl, 2022; Hasselwander,2024). In addition to workforce size, the age of the platform itself plays a significant role in determining its ability to transform into a super app. As Hasselwander (2024) notes, younger platforms are more agile, adaptable, and willing to take risks compared to their older, more established counterparts.

Growth in digital platforms is driven not solely by increasing the number of employees and age, but also by making strategic financial decisions. The iterative process of development, supported by multiple funding rounds, is crucial for platforms to adapt and grow. Each funding round offers companies a chance to reassess their goals, pivot if needed, and integrate new features in response to market trends and user feedback (Rochet & Tirole, 2003; Hasselwander, 2024).

For a super app strategy to succeed, financial stability is vital to support the growth of diverse services. A stability reflected in the type and amount of funding secured, which significantly affects a firm's performance (Wang & Lee, 2023; Hasselwander, 2024). Investors and investments are vital for the growth of digital platforms, providing capital for development, marketing, and scaling, as well as strategic support to improve efficiency and market positioning. In the early stages, funding from investors helps overcome cash flow issues and supports continued growth (Gantenbein and Engelhardt, 2012). Investors also bring deep industry knowledge that help lower transaction costs(Rangaswamy et al., 2020). However, as the number of investors grows, especially with some becoming lead investors, there may be governance challenges such as conflicts of interest, less transparency, and a misalignment with the platform’s goals, which can limit the influence of smaller investors and reduce investment diversity (Shen et al., 2020).

Acquired companies often gain access to new capabilities and technologies that enhance their existing services, courtesy of the acquiring company’s resources. The acquiring firm not only gains explicit resources like technology and patents but also taps into the tacit knowledge of the acquired company’s employees, processes, and organizational culture including the practical know-how, problem-solving capabilities,

and innovative mindsets that have been developed within the acquired company over time (Leonard and Sensiper, 1998). Such integration provides a competitive edge, allowing the platform to expand its service offerings (Hitt et al., 2001; Chesbrough, 2003; Hanelt et al., 2021; Hasselwander, 2024). For publicly listed companies, Initial public offerings (IPOs) give significant growth opportunities by offering access to capital markets, which allows for increased resource acquisition, strategic expansions, and enhanced credibility (Lefebvre, 2023).

Internal factors, such as human capital, technological infrastructure, financial resources, and organizational capital play a vital role in the growth of digital platforms into superapps (Hasselwander, 2024). However, van der Vlist et al. (2024) and Schreieck et al. (2024) reason that the external environment, surrounding factors such as regional contexts, local regulations, and geopolitical tensions, also plays a crucial role in shaping the strategies and outcomes of digital platforms, particularly in the case of super apps. Despite the evident impact of these external factors, the authors highlight that their influence remains significantly under-examined in quantitative terms (van der Vlist et al., 2024). Suggesting a need for more comprehensive research that quantitatively assesses the external determinants of digital platform growth into superapp, thereby providing a fuller understanding of the complex dynamics at play in the global digital economy.

2.3 External Factors

Having explored the internal factors that drive the growth of digital platforms, it is central to understand how the government, legal regulations, and civil liberties of the country are are deeply tangled with the transformation of digital platforms and how they shape corporate strategies of digital platforms. Each of these elements plays a pivotal role in shaping the environment in which these digital platforms run and expand.

2.3.1 Functioning of Government

The functioning of government covers how well a government carries out its roles and responsibilities, including policy implementation, public service delivery, and maintaining transparency and accountability (Freedom House, 2024). Transparent and accountable governance is crucial for keeping political stability, also for fostering an environment that encourages economic growth and digital innovation. Norris (2014) emphasizes that good governance supports democratic legitimacy and stability, which in turn helps create a climate where innovation can thrive. Effective governance leads to the development of inclusive institutions, which are key to fostering creativity and advancements in digital technologies, as highlighted by Acemoglu and Robinson (2012). They explore that these inclusive institutions, often a result of sound governance, create a supportive environment for innovation. A notion that aligns with Schumpeter's (1942) concept of "creative destruction," which suggests that continuous technological renewal in the economy is driven by freedom and opportunity within a dynamic governance framework. On the other hand, when governance is extractive and lacks democratic participation, it often results in institutions that block innovation and create barriers to

protect established interests, thereby hindering the growth of new digital platforms (Acemoglu & Robinson, 2012). In such scenarios, monopolistic practices may dominate, and regulations may be tailored to protect existing firms, limiting the emergence of new and innovative digital enterprises (Hein et. al, 2020). Steinberg et al. further posit that super apps can be viewed as choke points within the platform economy, raising questions about their impact as monopolies or oligopolies in the digital age (2022).

China's government exercises strong control over its domestic internet, using regulations to keep digital platforms aligned with state interests and to maintain political stability (Afina et al., 2024). This centralization of control reflects the state's function to prioritize political stability over market freedom. In contrast, the US takes a more laissez-faire approach, valuing market freedom and minimal government intervention, which allows digital platforms to flourish under less restrictive regulations (Afina et al., 2024). Jia & Kenney support this and point out that the US has been more lenient in enforcing antitrust regulations in recent decades compared to the past, allowing firms to attain significant market power (2021). This relaxed regulatory environment has contributed to the rapid consolidation of the online digital industry in the US, allowing firms to establish strong, sometimes near-monopolistic, positions. Equally, in China, antitrust regulations are a relatively recent development and have seen limited enforcement, giving platforms considerable freedom to develop their business models. However, as China increasingly views its tech firms as “national champions,” it contends with the challenge of balancing innovation with fair competition (2021).

Given the significant influence that government functioning has on digital platform growth and innovation, it is essential to explore this relationship more systematically and their path into superapps. Thus, building to hypothesize that the level of government functioning plays a critical role in shaping the landscape of digital innovation, proposing the following hypothesis:

Null Hypothesis (H_0): *The level of functioning of the government does not significantly affect the growth of digital platforms into superapps.*

Alternative Hypothesis (H_1): *A higher level of functioning of the government significantly demotes the growth of digital platforms into superapps.*

2.3.2 Regulatory Quality

Another critical factor influencing the trajectory of digital platforms is regulatory quality which refers to the ability of a government to formulate and implement sound policies and regulations that promote private sector development and economic growth (Riker,2022). In regions like the European Union, robust antitrust laws including the Digital Markets Act (DMA) and the Digital Services Act (DSA) have been implemented to regulate digital platforms. These laws target large digital platforms, often referred to as "gatekeepers" to prevent them from abusing their market dominance and to ensure fair competition (Liberto, D. (2024). Companies such as Uber have faced obstacles in navigating these regulatory landscapes, which aim to prevent monopolistic practices and promote competition (Hasselwander, 2024). Interestingly, some may argue that in

emerging markets with a balanced approach to regulation, organizations have found fertile ground to thrive, in contrast to developed markets where stricter regulations may inhibit their growth (Chander, 2019; Evans & Schmalensee, 2016). Kitching et. al challenge the conventional view that regulation is solely a burden on businesses as they argue that regulation should be seen as a dynamic force that can both enable and constrain business performance (2015). For example, the European Union's top court upheld strict net neutrality rules, asserting that Internet Service Providers must treat all internet traffic equally and manage all online data uniformly without discrimination, thereby reinforcing the importance of a level playing field on the internet (Ahava, 2020).Such a stance reflects a regulatory environment that promotes fairness and competition, and is particularly helpful to smaller digital entities, as it guarantees them equal footing in competing with larger platforms, thereby fostering a more inclusive and competitive digital environment. On the other hand, in regions with poor regulatory quality, the phenomenon of regulatory capture may occur (Stigler, 1971), where dominant firms benefit from weak enforcement, entrenching their positions and stifling competition. This dynamic can either solidify the dominance of existing players or hinder the emergence of new contenders.

Given the divergent effects of regulatory quality on the evolution of digital platforms, as shown by varying regional cases, this research aims to examine the relationship between the level of regulatory quality and the transformative potential of digital platforms into superapps.

Null Hypothesis (H_0): *There is no significant relationship between the quality of regulations and the likelihood of digital platforms evolving into superapps.*

Alternative Hypothesis (H_1): *Countries with high-quality regulations are less likely to see digital platforms evolve into superapps, as such regulations hinder monopolistic practices and promote a competitive market landscape, dispersing innovation across multiple platforms.*

2.3.3 Civil Liberties

Civil liberties are fundamental rights and freedoms protected by the Constitution that limit the government's power over individuals (Cornell Law School, 2024). In the digital age, these liberties have taken on new dimensions. Digital technologies offer tools that enable individuals to exercise and safeguard their rights and freedoms, thus supporting the expansion of platforms by fostering trust and engagement (Molnar, 2021). However, this potential is undermined when digital platforms face challenges related to civil rights violations. For instance, algorithmic biases can perpetuate discrimination, particularly affecting marginalized communities. Such issues erode user trust, which in turn hinders platform growth (McGlinchey, 2021).

Furthermore, the reliance of digital platforms, especially superapps, on extensive data collection compromises personal autonomy and privacy, posing risks to individual rights and potentially impeding platform growth as users become wary of how their data is used (Sadowski, 2019). In regions with high civil liberties, platforms must navigate stringent privacy laws such as the GDPR ,a legal framework for managing personal data collection and processing in and outside the EU (Information Commissioner's Office, 2024), balancing growth with compliance to avoid legal repercussions and reputational damage (Gregorio, 2021). Acknowledging these issues, the European Union has advanced the concept of a "digital rule of law" to adapt traditional legal frameworks to the unique challenges posed by digital platforms, as demonstrated by the EU's Digital Services Act (DSA), which aims to maintain legal robustness while balancing platform regulation with individual rights and freedoms (Engel and Groussot, 2023; Afina, 2024).

Building on these considerations, the following hypothesis is proposed:

Null Hypothesis (H0):
There is no significant relationship between the civil liberties and the likelihood of digital platforms evolving into superapps.

Alternative Hypothesis (H1):
Countries with higher protections for civil liberties are less likely to see digital platforms evolve into superapps.

2.3.4 Hypotheses Summary

Drawing from literature, the following table summarizes and differentiates the key factors influencing the growth and regulation of digital platforms, focusing on regulatory quality, the functioning of government, and civil liberties:

Aspect	Functioning of Government	Regulatory Quality	Civil Liberties
Focus	Overall operation and responsibilities of government	Quality and effectiveness of regulations	Protection of individual rights and freedoms
Scope	Policy implementation, public service, governance	Antitrust laws, competition rules, market regulations	Privacy laws, anti-discrimination policies, freedom rights

Objective	Ensure political stability, economic growth, and innovation	Promote fair competition and prevent monopolistic practices	Safeguard personal freedoms
Key Elements	Transparent governance, inclusive institutions, regulatory environment, and market freedom	Robust policies, enforcement of regulations, prevention of monopolies, dynamic regulatory environments	Data privacy, algorithmic fairness, trust-building, balancing platform growth with legal compliance

Table 2.1: Summary of external factors to aid in differentiation between each factor

2.3.5 Internal and External Factors Summary

The following table summarizes the internal and external factors influencing the growth and development of digital platforms into superapps, as drawn from the existing literature:

Internal Factors	**External Factors**
Human capital	Function of Government
Funding (Amount & Rounds)	Regulation Quality
Number of Investors & Lead Investors	Civil Liberties
Age of platform	-
Acquisition status	-
IPO status	-

Table 2.2: Internal and External factors impacting the growth of superapps according to literature

3. Methodology

3.1 Case Study

As part of the primary research method, a comparative case study from prominent superapps acknowledged in academic and grey literature will aid in understanding the key features and strategies that drive the success of a superapp, allowing a deeper insight on the varied approaches companies take in adapting and expanding to local conditions (Flyvbjerg, 2006). Companies like WeChat, Grab, Gojek, Rappi and Revolut are working within local government and regulatory rules, balancing innovation with compliance to succeed in different environments. Through categorizing the identified features a robust framework for understanding the factors can be created. This framework will not only inform the qualitative analysis but will also serve as a basis for developing the dependent variable in the quantitative phase later.

WeChat

In 2011, Tencent introduced WeChat as a simple messaging app, which quickly evolved into the first "superapp" by adding features such as photo sharing, group chats, and "Moments," a social media-like function (Jia et al., 2022). Agile teams at Tencent continuously expanded WeChat's features to meet user demands, and a turning point came with the launch of WeChat Pay, allowing users to transfer money and make payments, supporting various third-party services like e-commerce, gaming, and public utilities (Chen et al., 2018). This integration allowed users to manage tasks such as shopping or paying bills within a single app. Tencent leveraged its existing user base from platforms like QQ and benefited from the Chinese government's restrictions on foreign social media apps to further boost WeChat's growth (Yang et al., 2016; Chen et al., 2018; Jia et al., 2022). Aligning WeChat's development with government digital initiatives helped it navigate China's regulatory landscape (Jia et al., 2022). As well, the Chinese government has incorporated WeChat into public service delivery, enhancing its utility and reach (Cheng et al., 2022), and implemented data governance strategies to support the digital economy fostering the platform. The government also uses WeChat for social media influence on control narratives and align with national goals also to maintain censorship and surveillance by enabling the state authorities to monitor private conversations and track user activity (Zhang & Wei, 2020).

Grab and Gojek

Building on the success of WeChat, Southeast Asian ride-sharing platforms like Go-Jek and Grab also embraced their rapid rise and strategic evolution. Gojek, an Indonesian company, and Grab, a Malaysian-Singaporean company, both achieved significant milestones shortly after their launch. Their ability to scale rapidly and adapt to local market needs positioned them with a valuation over $10 billion and more than 100 million downloads (Ellis, 2018; Chandler C., 2019; Duong, 2024). Success was fuelled by technological innovation, strategic regulatory adaptation, and their ability to formalize community-driven solutions (Qadri & D'Ignazio, 2022).

Grojek's transformation was accelerated by the strategic addition of new features, a focused diversification that allowed them to dominate the Indonesian market before considering regional expansion. While, Grab adopted a regionally expansive strategy, quickly entering markets across Southeast Asia with $8.6 billion in funding from investors like Didi Chuxing, Toyota, and Microsoft, diversifying into sectors like food delivery, groceries, and healthcare (Chandler C., 2019; Duong, 2024). A crucial development was SoftBank's $250 million investment in 2014, which provided capital and strategic guidance to enhance its competitiveness against Uber (Chandler C., 2019). Additionally, partnerships with Mastercard and Credit Saison enabled Grab to offer digital wallets, loans, and other financial services, broadening its scope beyond transportation (Chandler C., 2019; Grab, 2024). Gojek attracted significant investments from global giants like Google and Tencent, raising $3.1 billion, and at that time initiatives were introduced to support cashless transactions in Indonesia, aligning with broader national goals of digital economy growth (Gojek, 2019). This allowed Gojek to integrate digital payment solutions like GoPay (Gumilar et al., 2019). The secured funds and new regulations enabled in time expansion in the region where it began competing directly with Grab (Chandler C., 2019). Both platforms had to manoeuvre through complex and initially unclear regulatory landscapes. In Indonesia, the absence of specific regulations for ride-hailing services led to conflicts with traditional taxi operators, prompting the government to establish guidelines that included price caps, vehicle standards, and driver registration requirements (Gumilar et al., 2019). These regulations aimed to level the playing field between new ride-hailing services and traditional taxis, ultimately recognizing ride-hailing as a legitimate part of the transportation ecosystem (Gumilar et al., 2019). Since then, both platforms have operated within these guidelines without encountering significant regulatory challenges hindering their expansion.

Rappi

On the other side of the globe a Colombian-based company named Rappi successfully navigated various external factors to evolve from a delivery service into a superapp (Khoso, 2020). Similar to Grab, SoftBank invested $1 billion in Rappi and also providing strategic support to enhance their operations to allow them to mirror the trajectory of Asian superapps (Reuters, 2019). Rappi has diversified its services beyond delivery by

incorporating financial offerings into its platform while adhering to Colombian regulations, which are at the forefront of fintech regulation in Latin America, second only to those in Brazil (Latam Republic, 2024). As a prime example, the collaboration with Banco Davivienda for RappiPay, providing Rappi with the necessary financial ability and regulatory compliance to offer digital banking (Reuters, 2022).

However, Rappi also faced regulatory challenges, particularly concerning labor laws (Connell, 2020). The company's practice of classifying delivery workers as independent contractors, rather than employees, has sparked debates amid proposed labor reforms in Colombia (Bernier, M. 2023). These reforms aim to modernize labor laws while balancing protections for workers and the needs of companies like Rappi. Colombia's regulatory environment has played a dual role in Rappi's evolution into a superapp (Moloney, A.,2022). The supportive stance toward fintech innovation has allowed Rappi to expand its financial services (Reuters, 2022). On the other hand, compliance with labor rights and e-commerce laws remains a challenge, as Colombian regulators have required Rappi to adhere to electronic commerce laws (Connell, 2020).

Revolut

In Europe the supeapps are lagging behind in development and adoption compared to their Asian counterpart (Lanistar, 2023), Revolut a prominent fintech company, is ambitiously evolving into a financial "super-app" in the region. Originally founded to tackle the high fees and unfavourable exchange rates associated with international money transfers offered by traditional banks (Russon, M.-A., 2019). Revolut has experienced exponential growth amassed over 40 million customers worldwide and expanded its operations to more than 35 countries by 2024 (Mistry, 2024). The company's super-app strategy integrates various services, including payments, investments, savings, insurance, and even lifestyle features like travel bookings (Wise, 2024).

However, Revolut's aggressive expansion has encountered significant regulatory barriers, particularly in Europe. The European Central Bank (ECB) identified substantial deficiencies in Revolut's financial crime controls and governance, prompting demands for improvements to meet regulatory standards (Bloomberg, 2024). This follows earlier challenges in obtaining a UK banking license, where issues related to the company's IT systems and governance structures led to prolonged delays (Kalyeena Makortoff, 2024). It was only in July 2024 that Revolut finally secured these licenses after enhancing its internal controls, expanding its workforce, and working closely with local regulators to address compliance concerns (Revolut, 2024).

These regulatory setbacks underscore the difficulties Revolut faces in achieving its super-app vision amid the European landscape of stringent regulatory scrutiny. As the company strives to transform itself into a comprehensive digital platform, these challenges could hinder its progress. Nevertheless, Revolut remains committed in its ambition, leveraging strategic partnerships and internal improvements to navigate the

complex regulatory environment and strengthen its competitive position as a comprehensive platform.

To conclude, the development and success of superapps such as WeChat, Grab, Gojek, Rappi, and Revolut are shaped by a range of country-specific dynamics, including regulatory environments, economic conditions and internal organizational factors. In China, WeChat benefited from government policies that restricted foreign competition and promoted digital integration, while in Southeast Asia, Grab and Gojek navigated diverse regulations and localized their services to fit varied market needs. Rappi's growth in Colombia was facilitated by supportive fintech regulations, despite facing labor law challenges, whereas Revolut contends with stringent European regulatory scrutiny and cultural preferences for specialized services, highlighting the complex interplay of national dynamics in superapp evolution.

3.2 Research Design

This study employs a sequential exploratory mixed-methods approach carried by a pragmatic philosophy (Saunders et. al, 2016), integrating qualitative and quantitative methodologies to investigate the impact of internal and external factors on the evolution of digital platforms into superapps. The qualitative part consisted of a comparative case study of both established and emerging superapps from diverse global contexts, as identified in the academic and grey literature, to develop a nuanced, context-specific understanding of the factors influencing superapp growth and their respective roles. The outcomes of this phase provide a comprehensive framework for understanding superapps, which facilitates the identification of common features that drive their expansion. These identified features will inform the construction of the dependent variable in the quantitative phase of the research. Building on these insights, the quantitative phase employs an ordered probit model to analyze the relationship between the identified features and the growth trajectory of superapps. The ordered probit model allows for the estimation of the probability of their growth across an ordinal scale, given the presence of specific internal and external factors, thereby enabling a robust quantitative assessment of the factors that significantly contribute to their development into superapps.

3.3 Data Collection

The dataset used for the base model is obtained from Crunchbase's Daily Export CSV files for 'Organizations' and 'Investments' as of June 2024. The source includes detailed information on approximately three million entities, containing full profiles of companies, startups, and investors. It features insights on funding history, key personnel, and sector affiliations (Crunchbase,2024). Crunchbase data has been effectively used in earlier studies, notably by Hasselwander (2024). Their work demonstrated the robustness and relevance of the data in analysing digital platforms, which aligns well with the focus of this study. The data can be requested from Crunchbase through (crunchbase.com).

For hypotheses 1 and 3, the indicators (Functioning of Government and Civil Liberties) were collected from the Freedom in the World 2024 report (Freedom House, 2024). The report is one of the most widely read and cited reports on political rights and civil liberties (Freedom House, 2024). It provides detailed indicators for 195 countries and 15 territories based on assessments by external analysts. Analysts assess countries using direct research, consultations, and various information sources like news, NGOs, and governments. The data is publicly available through (freedomhouse.org).

The data used for the second hypothesis was sourced from the 2022 edition of the Worldwide Governance Indicators (WGI), specifically focusing on the regulatory quality metric. The WGI project, managed by Daniel Kaufmann, Aart Kraay, and Massimo Mastruzzi, provides extensive governance quality indicators across various countries. Policymakers use WGI data to make informed decisions about governance reforms and resource allocation. The indicators are crucial in identifying weaknesses in governance structures and in planning strategic improvements Handoyo, S. (2023). The data is publicly available through (govindicators.org).

From the large Crunchbase dataset, organizations that are either listed in the category and category group with the keywords "mobile" or "software" are filtered. The study focused on organizations that were active and had accessible funding information. No specific constraints related to the age or size of the companies were applied, as the aim was to include all digital platforms with the potential to become, or that currently function as, superapps, regardless of their scale or duration of operation. After removing duplicates, the data set resulted in a total of 63,047 records. Data from Freedom House and the World Governance Indicators (WGI) were merged by matching records using the country alpha-3 code (ISO 3166). For the regulatory quality indicator, the total number of observations decreased to 62,929 due to missing data for certain countries.

3.4 Variable Definition

The dependent variable was achieved from a two-step approach. *First*, a generated binary filter was applied using the keywords "financial services," "delivery," "transportation," "e-commerce," "communication," "digital payments," "entertainment," and "social media". The keywords were identified from the comparative case study analysis and in the Crunchbase data from 'category' and 'category group' columns (Table 3.1). Companies were assigned a value of 1 if any of these features were present, and 0 if not. This binary classification was then used to categorize companies into an ordinal variable indicating their level as digital platforms by summing the number of features present for each observation (Appendix A1). Which paved the way for the *second step* to code the dependent variable **Digital Platform Status (s_app)** as a three level ordered response, where level "2" indicates companies offering three or more features and are categorised as "fully-fledged superapps". Those offering two features were categorised as "potential superapps" with a value of "1", while firms with only one feature were classified as "single-function" applications and a value of "0". The two-step approach extends the binary variable used by Hasselwander (2024) that simplified the outcome to a dichotomous choice to a categorial variable allowing an analysis of multiple hierarchically structured categories that reflects the natural progression of platform development explained in literature (Steinberg, 2022; Van der Vlsit,2024). An ordered variable can effectively capture the transition from one stage to another, reflecting the progression in app functionalities and integration as superapps typically evolve from single-function apps, gradually integrating added services and functionalities.

Table 3.1 presents the categorization and grouping of the identified superapps as listed in the Crunchbase dataset.

Name	**Category**	**Category Gorup**
Wechat[1]	Apps,Messaging,Mobile Apps	Apps,Information Technology,Internet Services,Messaging and Telecommunications,Mobile,Software
Gojek	Consumer Applications,E-Commerce,Food Delivery,Logistics,Payments,Transportation	Apps,Commerce and Shopping,Financial Services,Food and Beverage,Payments,Software,Transportation
Grab	Delivery,Enterprise Software,Logistics,Supply Chain Management	Administrative Services,Software,Transportation
Rappi	Consumer Goods,Delivery,E-Commerce,Food and Beverage,Food Delivery,Mobile Apps,Web Development	Administrative Services,Apps,Commerce and Shopping,Consumer Goods,Food and Beverage,Mobile,Software,Transportation
Revolut	Banking,Financial Services,FinTech,Mobile Payments	Financial Services,Lending and Investments,Mobile,Payments,Software

Table 3.1 Category and Category Group keywords from Crunchbase dataset

The independent variables were drawn upon literature and they identify the most relevant internal resources. They reflect the digital platforms' internal resources and are; ***Number of employees (emp_ord)*** a categorical variable with 9 categories to stand for the human capital, each category represents a range of the number of employees in an organization. The levels are defined as: 1 for 1-10 employees, 2 for 11-50 employees, 3 for 51-100 employees, continuing incrementally, with 9 representing organizations with 10,000+ employees. Financial Resources that include ***Number of Funding Rounds*** *(num_funding_rounds****), Total funding in USD*** *[log scaled] (log_tf)*, ***Acquired*** *(binary dummy variable), and* ***IPO*** *(binary dummy variable)*. In addition, to the **Age** (log_age) of the organization in years [log scaled]. Log transformations were conducted to variables that were not normal and had high levels of skewness and kurtosis (Stock & Watson, 2015). Due to limitations in the dataset, ***Number of Investors*** *(invstrs)* and **Number of Lead Investors** (lead_invstrs) were used as substitute proxy for Number of Investments and Lead Investments that were used in earlier study by Hassselwander(2024) to approximate their effect. In financial markets, the number of investors serves as a strong indicator of investment volume and market activity. (Corporate Finance Institute, 2024). The base model includes 9 variables, Table 3.2 presents an overview of key variables used in the quantitative analysis:

Variable Code	Variable Name	Description	Expected Sign
s_app	Digital Platform Status	Ordinal variable "2" – Fully fledged superapp "1" – Potential Superapp "0" – Single-function Application	
Human Capital			
emp_ord	Employee Ordinal	An ordinal variable with nine distinct categories, each representing a specific range of employee base.	Positive significant relationship with the dependent variable (Heubeck and Meckl, 2022; Hasselwander,2024)
Financial Variables			
log_tf	Total Funding (log scale)	Total funding amount raised in usd (log scale)	Positive relationship with the dependent variable (Hasselwander,2024
invstrs	Number of Investors (invstrs)	Total number of distinct investors that have financially backed a digital platform.	Positive relationship with the dependent variable (Hasselwander,2024
lead_invstrs	Number of Lead Investors (lead_invstrs)	Total number of primary investors who have taken a leading role in the funding rounds of a digital platform.	Positive relationship with the dependent variable (Hasselwander,2024
num_funding_rounds	Number of funding rounds	Number of times a digital	Positive (Hasselwander,2024

		platform has successfully secured funding from investors	
acq	Acquired	Binary variable indicating if the organization was acquired (1) or not (0)	Positive (Hitt et. al, 2001; Chesbrough, 2003; Hanelt et al., 2021; Hasselwander,2024)
ipo	IPO: Initial Public Offering	Binary variable indicating if the organization is ipo listed (1) or not (0)	Positive (Lefebvre, 2023).
Age			
log_age	Age of digital platform	Platform's age in years (log_scale)	Negative (Hasselwander,2024)

Table 3.2 Base Model Variable Definition

These variables will be used in the ordered probit model to examine their influence on the digital platform status, which is categorized into single-function applications, potential superapps, and fully-fledged superapps.

3.5 Base Model Selection

The decision to use the ordered probit model for this analysis stems from its suitability in managing ordinal data, which in this case includes three categories of varying levels of digital platform development (Stock & Watson, 2015). The methodological choice is rooted in the characteristics of the dependent variable and the presumption of a normally distributed error term, aligning closely with the notions underpinning the ordered probit model (Torres-Reyna, 2008). Although the log-likelihood for the Ordinary Least Squares (OLS) regression is higher for the model, it inappropriately treats ordinal data as if the differences between categories are uniformly spaced, or a multinomial logit model, which neglects any inherent order within the categories, the ordered model effectively captures the natural ordering present in the data. It acknowledges that the transition from a "single-function application" to a "potential-superapp" may not equate in magnitude or implications to the shift from a "potential-superapp" to a "superapp" (Torres-Reyna, 2008; Greene, 2012; Stock & Watson, 2015).

Moreover, given that the dependent variable is ordinal, both the ordered probit and ordered logit models were suitable for the analysis. However, the decision to favour the ordered probit model over an ordered logit model was substantiated by the McFadden R-squared, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) results, which showed a marginally better fit (Agresti, 2010; Stock & Watson, 2015). These tests underscored the model's capacity to elucidate the determinants that influence the classification of digital platforms, thereby offering more robust insights into the developmental stages of digital platform evolution (Agresti, 2010; Stock & Watson, 2015). As shown in (Appendix A3)

The model selection was further validated through a 5-fold cross-validation to assess the generalizability of the model (Agresti, 2010). The cross-validation analysis provided a consistent performance metric across the folds, with an average predictive accuracy of 0.9492, confirming that the ordered probit model was the most right for the data at hand (StataCorp, 2023).

Prior to performing the ordinal probit regression analysis, the proportional odds assumption was assessed to ensure that the relationships between the predictor variables and the odds of being in higher categories of the digital platform level were consistent across thresholds (Agresti, 2010). The assumption was validated, confirming the robustness of the ordinal probit regression model. Each model is defined in terms of a regression on a latent variable y^*:

$$y^* = \mathbf{x}\beta + \varepsilon$$

The ordered probit base model can be written as:

$$\mathbf{Y_i^*} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 employee\_ordinal}_i + \boldsymbol{\beta_2}\log(\boldsymbol{total\_funding\_usd_i}) + \boldsymbol{\beta_3 investors_i} + \boldsymbol{\beta_4}\text{lead\_investors\_count}_i + \boldsymbol{\beta_5 Number\ of\ Funding\ rounds_i} + \boldsymbol{\beta_6 Acquired_i} + \boldsymbol{\beta_7 IPO_i} + \boldsymbol{\beta_8 log(age)}_i + \boldsymbol{\epsilon_i}$$

where:

- Y_i^* is the latent continous variable
- Y_i is the obsereved ordinal varaible defined as:

$$Y_i = \begin{cases} 0 \ if\ Y_i^* \leq \mu_1 \\ 1 \ if\ \mu_1 < Y_i^* \leq \mu_2 \\ 2 \ if\ Y_i^* > \mu_2 \end{cases}$$

- $\boldsymbol{\beta_0 is\ an\ intecept}$
- $\boldsymbol{\beta_1, \beta_2, \ldots . \beta_8 are\ the\ cofficients\ for\ the\ independent\ varaibales}$
- $\boldsymbol{\epsilon_i is\ the\ error\ term, assumed\ to\ follow\ a\ standard\ normal\ distribution}$
- μ_1 *and* μ_2 *are the threshold parameters that partition the latent variable* Y_i^* *into the obsereved ordinal categories*

3.6 Hypotheses Specifications

3.6.1 Hypothesis 1: Functioning of Government

$$Y_i^* = \beta_0 + \beta_1 employee\_ordinal_i + \beta_2 \log(total\_funding\_usd_i) + \beta_3 investors_i + \beta_4 \text{lead\_investors\_count}_i + \beta_5 Number\ of\ Funding\ rounds_i + \beta_6 Acquired_i + \beta_7 IPO_i + \beta_8 log(age)_i + \boldsymbol{\beta_9 Functioning\ Government_i} + \epsilon_i$$

Variable Code	Variable Name	Description	Expected Sign
Func_gov	Functioning government	How well a government carries out its roles and responsibilities	Negative

Table 3.3 Hypothesis 1 Variable Definition

3.6.2 Hypothesis 2: Regulatory Quality

$$Y_i^* = \beta_0 + \beta_1 employee\_ordinal_i + \beta_2 \log(total\_funding\_usd_i) + \beta_3 investors_i + \beta_4 \text{lead\_investors\_count}_i + \beta_5 Number\ of\ Funding\ rounds_i + \beta_6 Acquired_i + \beta_7 IPO_i + \beta_8 log(age)_i + \boldsymbol{\beta_{10} Regulatory\ Qualtity_i} + \epsilon_i$$

Variable Code	Variable Name	Description	Expected Sign
Reg_quality	Regulation Quality	The ability of a government to formulate and implement sound policies and regulations that promote private sector development and economic growth	Negative

Table 3.4 Hypothesis 2 Variable Definition

3.6.3 Hypothesis 3: Civil Liberties

$$Y_i^* = \beta_0 + \beta_1 employee\_ordinal_i + \beta_2 \log(total\_funding\_usd_i) + \beta_3 investors_i + \beta_4 \text{lead\_investors\_count}_i + \beta_5 Number\ of\ Funding\ rounds_i + \beta_6 Acquired_i + \beta_7 IPO_i + \beta_8 log(age)_i + \boldsymbol{\beta_{11} Civil\ Liberties_i} + \epsilon_i$$

Variable Code	Variable Name	Description	Expected Sign
cvl_lib	Civil Liberties	The fundamental rights and freedoms that are guaranteed to individuals	Negative

Table 3.5 Hypothesis 3 Variable Definition

3.7 Marginal Effects

In an ordered probit model, the coefficient related to a specific variable does not directly indicate its influence (Torres-Reyna, 2008). Instead, the marginal effect is calculated to evaluate the variable's impact on the probability of a certain outcome. The marginal effect measures the change in the probability of the dependent variable for each unit increase in the independent variable (Long & Freese,2014; Stock & Watson2015).

$$Xj = \frac{\partial E(Y_i^* | x_i^T)}{\partial Xij} = \frac{\partial x_i^T}{\partial Xij}$$

3.8 Estimation Technique

The ordinal probit model was estimated using Maximum Likelihood Estimation (MLE) in Stata/BE 18, with the 'oprobit' command facilitating the analysis. The use of MLE in this context is advantageous due to its efficiency and the unbiased nature of the parameter estimates, provided that the necessary regularity conditions are met (Greene, 2012). To account for potential heteroskedasticity, robust standard errors were employed using the 'vce(robust)' option (StataCorp, 2023). This approach ensures that the estimated standard errors are reliable, and the statistical inferences drawn from the model are valid, even in the presence of heteroskedasticity (Torres-Reyna, 2008; Stock & Watson, 2015).

3.9 Data Limitations

1. The Crunchbase dataset has limitations, including potential selection bias since it might not represent all digital platforms, particularly smaller startups or those that do not report their data. This can skew analysis towards more visible, prominent firms. The dataset relies on self-reported or publicly available information, which may be incomplete or inaccurate. It often misses details on funding rounds, especially for early-stage or private companies. User-submitted data may also contain inconsistencies or errors. Furthermore, the dataset's large size poses challenges in effective data management and analysis.
2. The dependent variable, Digital Platform Status, is constructed in a two-step approach based on specific keywords ("financial services," "delivery," "transportation," etc.). This approach could potentially exclude emerging digital platforms that do not explicitly align with these predefined keywords. This categorization might also overlook the nuances of certain platforms that do not fit exactly into the defined categories but exhibit characteristics of a superapp. To address these limitations, the analysis attempted to broaden the scope by incorporating additional sub-keywords filters for each category. These extra filters, detailed in the appendix, were likely intended to capture a wider range of companies, including those that are evolving into superapps but weren't initially categorized due to the limitations of the original keywords. **(Appendix A1).** Additionally, the study classified all digital platforms with three or more features as superapps, without considering that there might be certain combinations of features may actually qualify a platform as a superapp.
3. There are missing observations, particularly in the regulatory quality indicator from the Worldwide Governance Indicators (WGI), which led to a reduction in the dataset size from 63,047 to 62,929 records. Missing data can reduce the robustness of statistical analysis and potentially bias the results if the missing data is not random (Stock & Watson, 2015).
4. The model may exhibit omitted variable bias as it excludes several relevant factors—such as technological infastructure, intellectual property assets, network effects, user engagement, and competitive dynamics that have been identified in literature as critical to the growth of digital platforms into superapps

(Schreieck, 2023; Van der Vlist, 2024; Hasselwander, 2024). This exclusion could lead to skewed results, potentially overstating or understating the impact of the variables that were included, which were not considered in the analysis (Stock & Watson, 2015). These limitations stem from constraints in data collection and the available timeframe to gather data.

4. Results

This part addresses the research question by analysing the factors influencing the transition of digital platforms from single-function applications to potential and fully-fledged superapps. It presents the results of both internal factors and external factors including government functionality and regulatory quality and civil liberties to understand their impact on platform development.

4.1 Descriptive Statistics

4.1.1 Distribution of Digital Platforms

Figure(4.1) shows that 60,764 **(95.1%)** of the digital platforms in the dataset are single-function, providing only a limited set of services, while 1,974 **(3.1%)** are potential superapps. In contrast, only 309 **(0.5%)** are superapps.

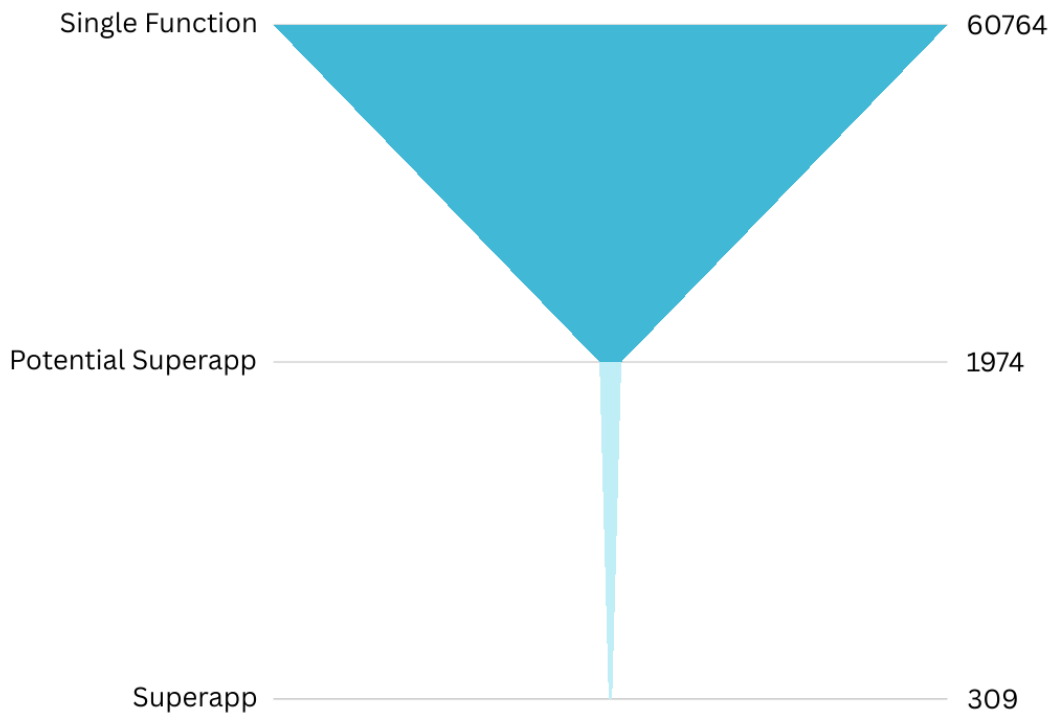

Figure 4.1 Digital Platform to Superapp Funnel from dataset

Single-function applications (Value 0)

From the dataset, figure (4.2) presents an overview of the distribution of single-function applications across various countries, with a total of 60,764 recorded instances. The United States emerges as the most significant contributor, accounting for 26,026 applications, which constitutes 42.83% of the total dataset. China follows with 4,514 applications (7.43%), and the United Kingdom, contributing 4,381 applications (7.21%).

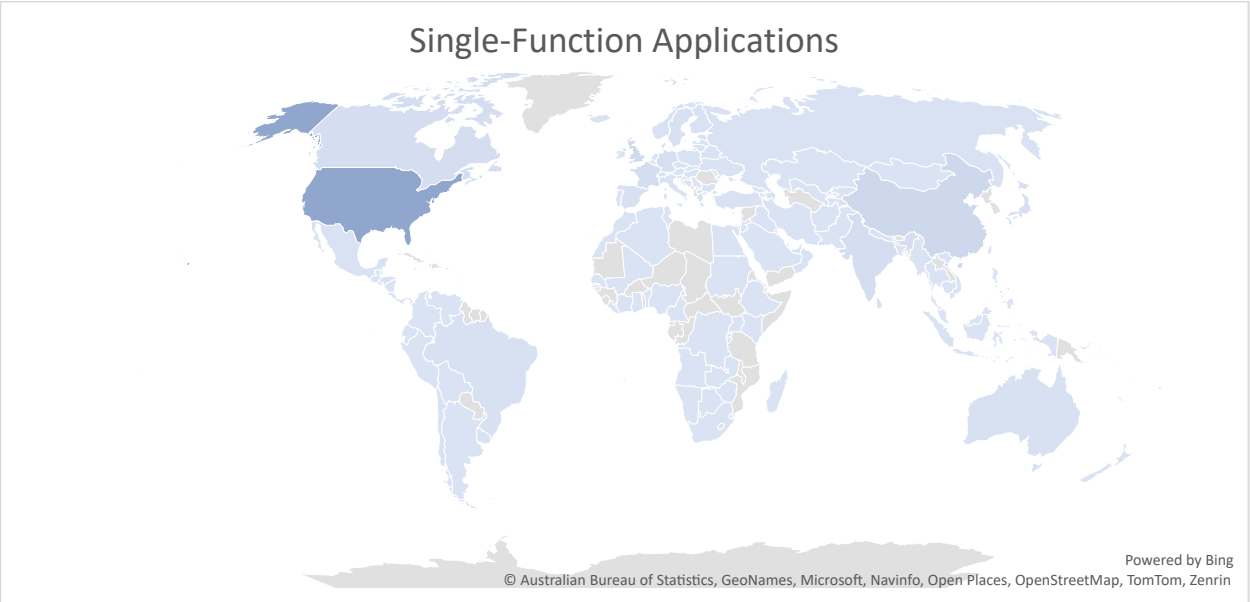

Figure 4.2 Single-function applications (Value 0) from dataset

Potential Super-apps (Value 1)

A similar distribution pattern is seen in potential superapps, though with notable differences in concentration and scale. The United States again emerges as the dominant contributor, with 765 applications, which accounts for 38.75% of the total, underscoring its leading role in this domain as well. The United Kingdom follows with 185 applications (9.37%), indicating its significant involvement in the development of digital platforms, China with 63 applications (3.19%). Figure (4.3):

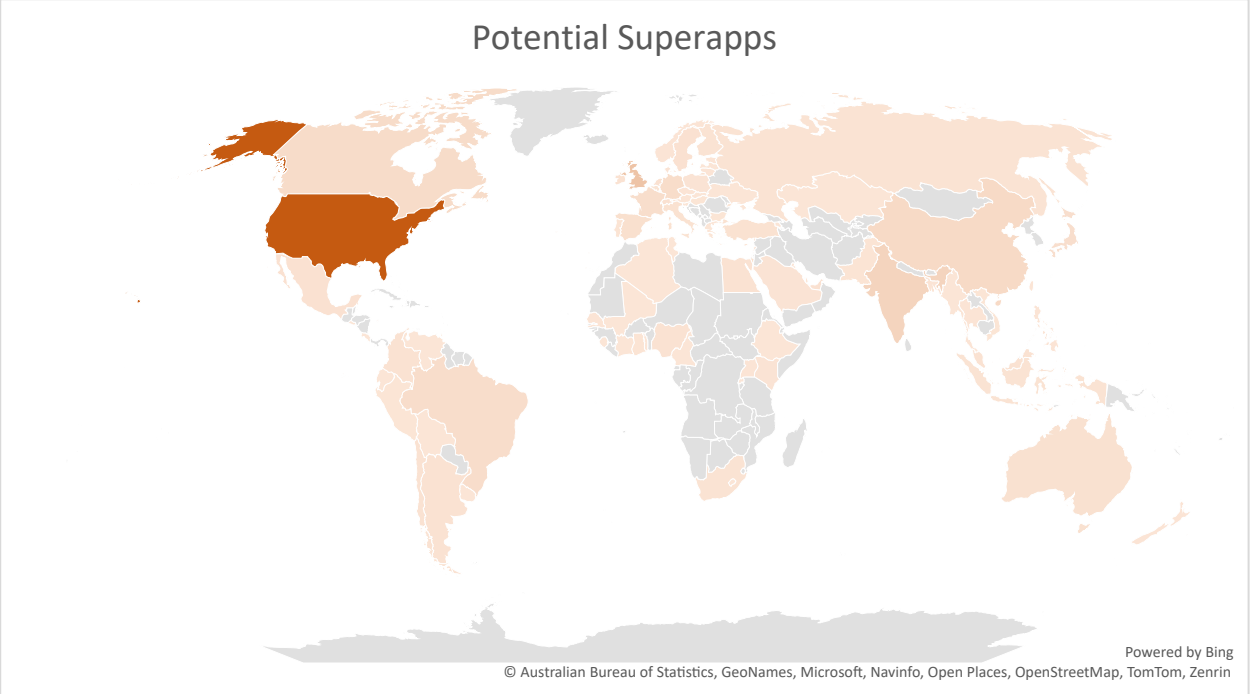

Figure 4.3 Potential Superapps (Value 1) from dataset

Fully fledged Superapps (Value 2)

This dataset records 309 instances of fully-fledged superapps, with the United States dominating the landscape, contributing 103 applications, which forms 33.33% of the total. The United Kingdom also plays a significant role, with 22 applications, making up 7.12% of the total. The data suggests that while many single-function applications exist globally, only a small percentage transition into potential superapps, and even fewer become fully-fledged superapps. Specifically, in the case of the United States, **2.94%** of single-function applications transition into potential superapps, and only **0.40%** ultimately become fully-fledged superapps. For the United Kingdom, **4.22%** of single-function applications become potential superapps, and **0.50%** become fully-fledged superapps. Figure (4.4)

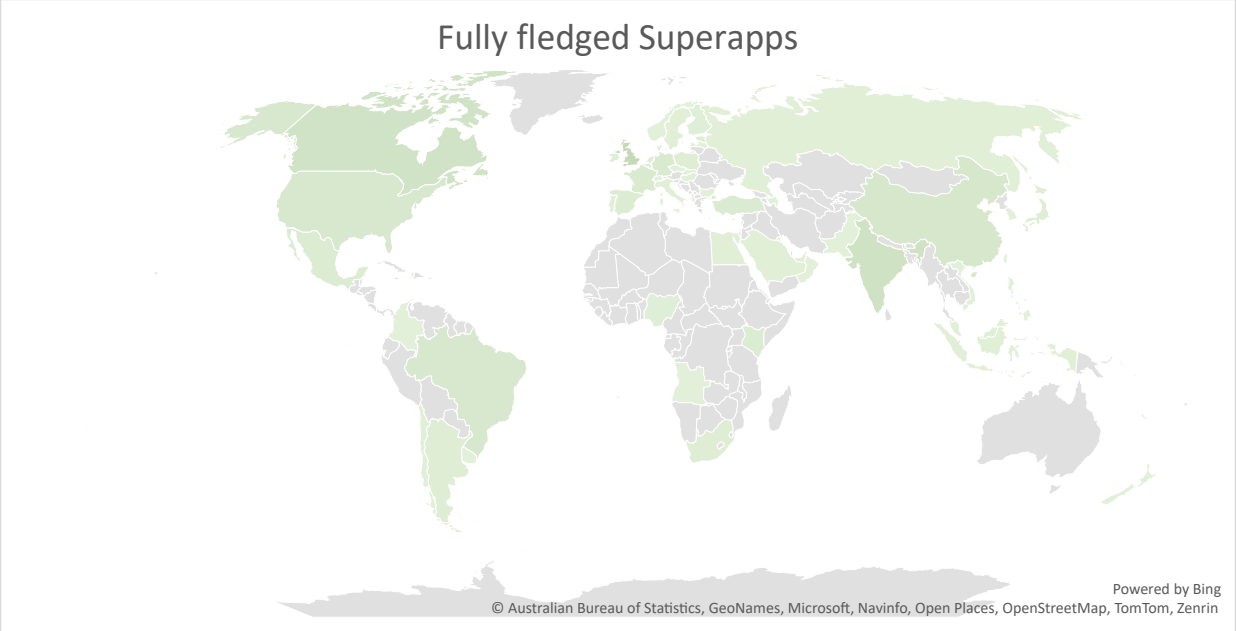

Figure 4.4 Superapps (Value 2) from dataset

4.1.2 External Indicators

The data across the three charts (4.5, 4.6, and 4.7) provide a comparative analysis of government functioning, regulatory quality, and civil liberties respectively in different regions that represent the central locations where the superapps examined in the case study have been developed. Europe, the USA, and the UK consistently perform above the world average in all three metrics, indicating strong government functionality, high regulatory quality, and a robust protection of civil liberties. In contrast, Asia shows lower scores across the board, particularly in government functioning and civil liberties, suggesting moderate effectiveness and some restrictions on freedoms. China consistently scores the lowest in all categories, reflecting significant challenges in these areas, which points to a restrictive and less effective governance environment and aligning with broader observations of China's governance structure, which is often characterized by centralized control and limited individual freedoms (Bardhan, 2020). Colombia's performance varies aligning with the world average in government functioning but falls below it in regulatory quality and civil liberties, highlighting areas that require improvement.

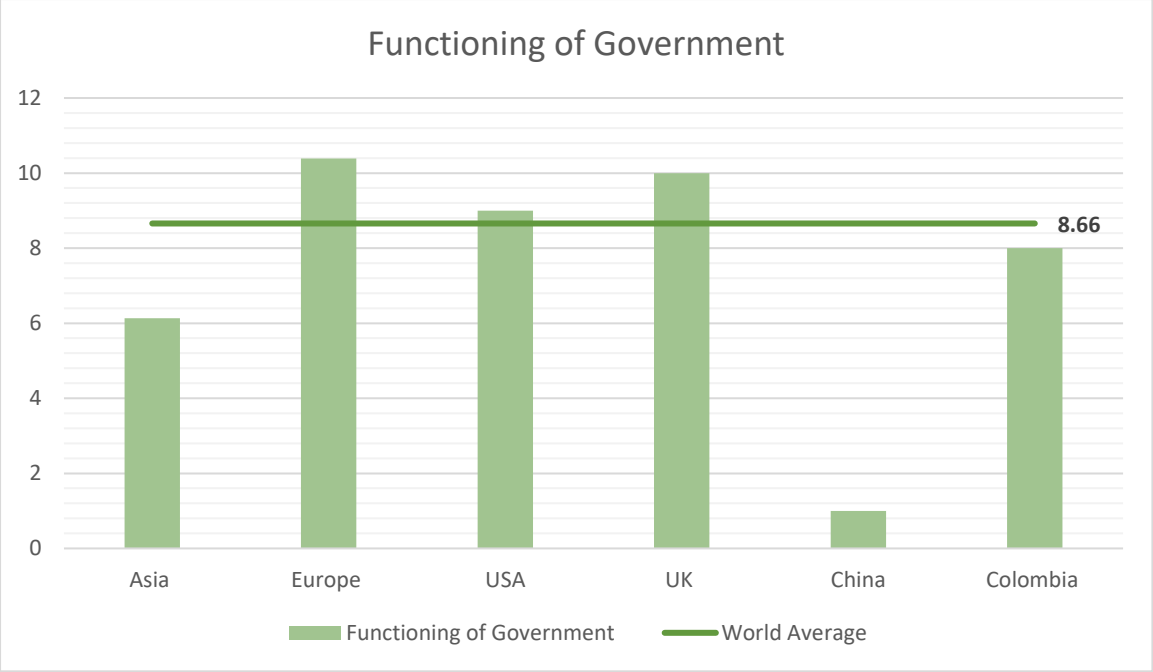

Figure 4.5 Functioning of Government from dataset

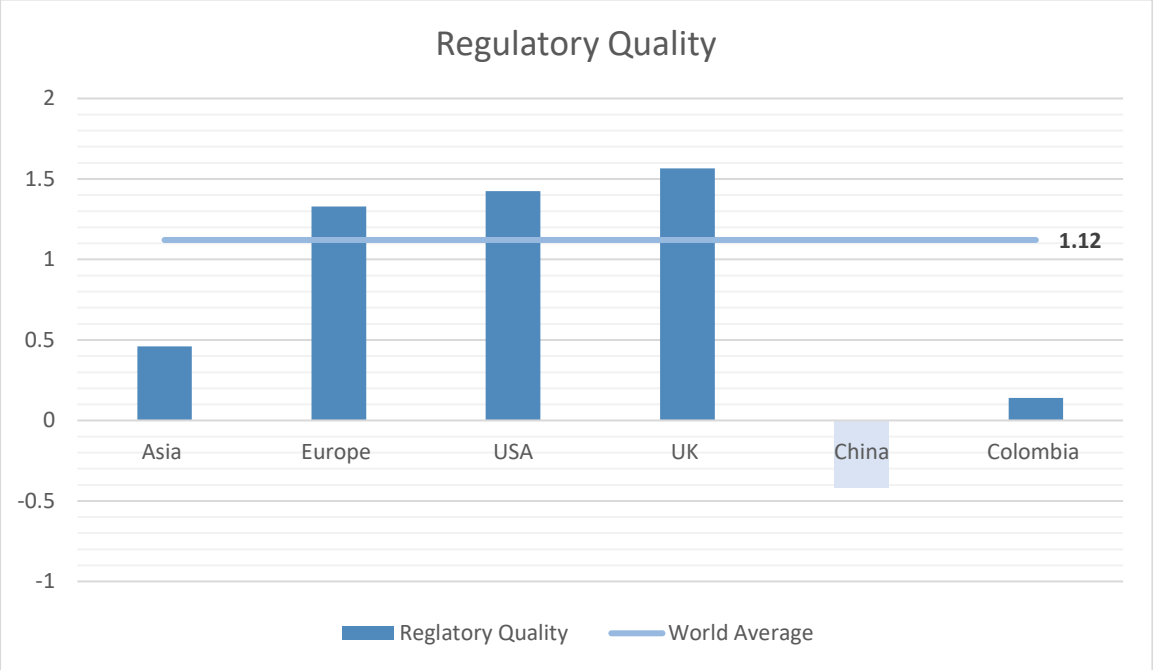

Figure 4.6 Regulatory Quality from dataset

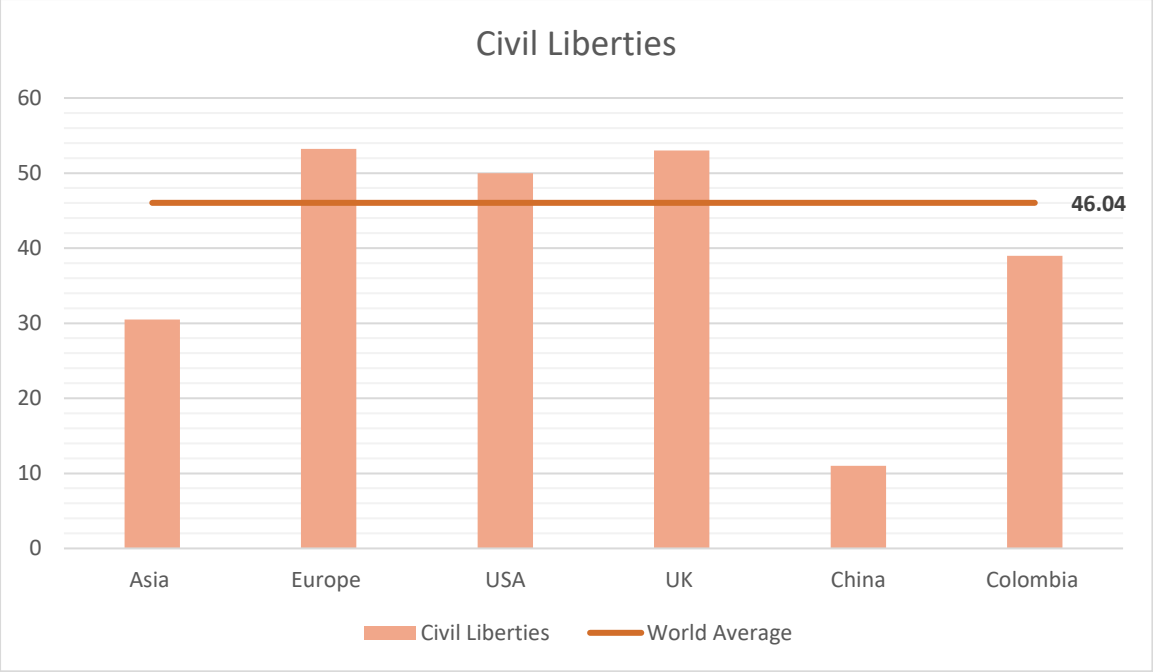

Figure 4.7 Civil Liberties from dataset

4.1.3 Variables summary statistics

The summary statistics table presented here offers a straightforward overview of the main measures for our dataset, including the mean, median, standard deviation, and range for each variable. These metrics are essential for understanding the general characteristics and distribution of the data, setting the stage for deeper analysis. (Table 4.1)

Variable Name	Mean	SD	Min	Max	N
s app	0.041	0.222	0.000	2	63,047
num funding rounds	2.84	2.224	1.000	41	63,047
log age	2.237	0.618	0.076	6.274	63,047
log tf	14.816	2.312	0.000	30.975	63,047
invstrs	7.327	10.513	1	199	63,047
lead invstrs	1.403	1.483	0	38	63,047
acq	-	-	0	1	63,047
ipo	-	-	0	1	63,047
emp ord	-	-	1	9	63,047
Hypotheses					
H1: func gov	8.657	2.783	0.000	12	63,047
H2: reg quality	1.121	.717	-2.046	2.214	62,929
H3: cvl lib	46.039	13.169	5.000	60	63,047

Table 0.1 Summary Statistics

4.2 Base Model Results

The base model assesses the influence of internal organizational factors on the progression of digital platforms into superapps, the thresholds (cut1 = 1.783 and cut2 = 2.580) represent the estimated cut points on the latent variable scale that differentiate between the categories of the ordinal dependent variable which in this case the digital platform status and are statistically significant, confirming that the model effectively differentiates between the ordered categories of the outcome variable (Stock & Watson, 2015). This shows the critical role that internal factors such as human capital and financial resources play in shaping the trajectory of digital platforms toward becoming superapps.

However, the McFadden Pseudo R-squared value of 0.0115, while typically lower than the traditional R-squared values used in linear regression (Stock & Watson, 2015), indicates that the model explains only a small proportion of the variance in the dependent variable. This suggests that the model can differentiate between outcome categories, nonetheless there may be additional factors not accounted for by the current set of independent variables (StataCorp, 2023). To justify this, as mentioned earlier in the data limitations a key internal resource that the study has not incorporated into the analysis is the technological infrastructure due to difficulty in acquiring a reliable data variable that adequately captures the nuances of it from the dataset. Hasswelwander accentuated that a robust and scalable technological infrastructure is essential for seamlessly integrating the wide range of services and functionalities offered by the superapps (2024), enabling the provision of new digital affordances that empowers complementors to create and offer these functionalities on top of the platform, contributing to the platform's evolution towards a super app model as supported by Hein et. al, 2020.

The table presents the results of the ordered probit model performed to examine the relationship between internal factors and the digital platform status.

	(1) Base Model
num_funding_rounds	0.0602***
	(11.55)
log_age	-0.0186
	(-1.14)
log_tf	-0.0162**
	(-2.87)
invstrs	0.00249*
	(2.43)

lead_invstrs	-0.0325***
	(-3.88)
acq	0.0673*
	(2.32)
ipo	-0.152*
	(-2.27)
emp_ord	0.0452***
	(5.64)
/	
cut1	1.783***
	(23.40)
cut2	2.580***
	(33.14)
McFadden Pseudo R-squared	0.0115
Log likelihood	-10598.6
Log likelihood_null	-10722.1
Degrees of Freedom	8
AIC	21217.3
BIC	21307.8
No. of observations	63047

Table 0.1 Base model (Ordered Probit Model)

In the context of this analysis, the average marginal effects provide insight into how changes in each independent variable affect the likelihood of the digital platform status.

Variable	**Dy/dx (Single function)**	**Dy/dx (Potential Superapp)**	**Dy/dx (Superapp)**
Number of funding rounds	-0.0047303	0.0038876	0.0008426
Total funding [log scale]	0.0012711	-0.0010447	-0.0002264
Investors	-0.0001955	0.0001607	0.0000348
Lead Investors	0.0025534	-0.0020985	-0.0004548
Acquired	-0.0052888	0.0043467	0.0009421
IPO	0.011952	-0.0098229	-0.0021291
Employee Ordinal	-0.0035495	0.0029172	0.0006323

Table 0.2 Average Marginal Effects for Base Model

The analysis reveals several key relationships:

Employee Ordinal

A larger number of employees slightly enhances the chances of achieving superapp status, raising the probability by approximately 0.06% and for 'potential superapps' by 0.29%. Aligning with the literature emphasizing workforce size as a driver of innovation and diversification through economies of scale (Chandler, 1977; Porter, 1985; Teece, 1986; Pavitt, 1991; Heubeck and Meckl, 2022; Hasselwander, 2024).

Number of funding rounds

Number of funding rounds positively impact the probability of a platform transitioning into a 'potential superapp' by 0.38% and becoming a superapp, although modestly, with increases of approximately 0.08%. The results align with the findings from literature, where an increase in the number of funding rounds was also found to positively influence a platform's trajectory towards becoming a superapp (Hasselwander, 2024). Funding rounds provide the necessary capital for the platform to expand its service offerings and supports the iterative process of digital platform development that is critical for sustaining operational capabilities and enhancing strategic positioning within competitive markets (Barney, 1991; Rochet & Tirole, 2003; Hasselwander, 2024). As seen also form the case studies of Grab, Gojek and Rappi and how they leveraged multiple funding rounds to scale their operations.

The number of investors and **lead investors:**

Used as a proxy for number of investments and lead investments, ***Number of Investors*** *(invstrs)* showed positive significance into transitioning to higher levels by 0.016% and 0.0034% for each unit increase. Multiple investors can bring a wide range of expertise and connections to the platform. Wang and Li (2023) highlight that a broader pool of investors can offer valuable insights, guidance, and resources, which are crucial when navigating the complex process of market expansion and service integration. Additionally, a larger number of investors often correlates with greater risk tolerance, as a diversified investor base can absorb some of the risks associated with expansion strategies (Hasselwander, 2024).

While the **Number of Lead Investors** (lead_invstrs) showed negative impact with -0.2% and -0.045% on each level. Lead investors may have different priorities or incentives compared to smaller investors or the platform itself (Segal, 2024). This can create conflicts in decision-making and resource allocation specifically if companies wanted to diversify as lead investors may push for strategies or exits that benefit them but are not optimal for the expansion of the digital platform (Shen et al., 2020; Segal, 2024)

Total funding in USD *[log scaled]*

The negative coefficient shows that an increase in total funding in USD [log-scaled] (log_tf) is associated with a decrease of -0.104% and -0.02264% in the probability of becoming a "potential superapp" and a "superapp," respectively. This finding aligns with the existing study by Hasselwander (2024). While well-funded companies are typically better equipped for growth, securing substantial funding usually means giving investors shares in return for their capital, creating greater pressure to meet short-term financial goals, such as achieving profitability, and fulfilling investor demands. In contrast, platforms pursuing a super app strategy might choose alternative fundraising methods, like crowdfunding or grants which can offer greater flexibility and quicker decision-making processes (Petty, 2023; Hasselwander, 2024).

Interestingly, researchers have also found that companies with higher funding levels often achieve greater success by concentrating on their core strengths and maintaining their existing market position rather than opting for diversification immediately (Gitau; 2015).

Acquired *and* ***IPO***

The positive coefficient for **Acquired** suggests that if a platform is acquired, it has a higher probability of advancing in status, increasing by approximately 0.43% and 0.09% for each level. This integration can offer a competitive advantage by enabling the platform to enhance and broaden its range of services more effectively (Hitt et al., 2001; Chesbrough, 2003; Hanelt et al., 2021; Hasselwander, 2024). On the other hand, the negative coefficient for **IPO** suggests that platforms going public are 0.98% less likely to become a ‘potential superapp’ and 0.21% less likely to become a ‘superapp.’ While the initial assumption was that going public (IPO) would positively influence a platform's potential to become a superapp, the negative coefficient suggests otherwise. This may indicate that publicly listed platforms encounter challenges, such as heightened regulatory scrutiny, reduced operational flexibility, or shareholder pressures. For instance, Graham et al. (2005) demonstrate how these pressures can deter firms from pursuing long-term strategies, while Chemmanur et al. (2010) suggest that the reduced operational flexibility of public companies may hinder their ability to pivot quickly and experiment with new business models

4.3 Hypotheses Results

The results present the impact of governance and regulatory factors using ordered probit models for three hypotheses: Functioning Government, Regulatory Quality, and Civil Liberties. Each hypothesis explores how different aspects of governance influence the growth of single-function digital platforms into superapps. Results from these models provide insights into how governmental and regulatory environments can affect firm growth and strategic choices. The interpretation of the results will be further discussed in the discussion; section (5).

4.3.1 Hypothesis 1: Functioning of Government

Table 4.4 presents the results of the Ordered Probit Model used to test Hypothesis 1, which examines the impact of adding the variable 'Functioning Government' to the model.

	(1) Base Model	(2) Hypothesis 1
s_app		
num_funding_rounds	0.0602***	0.0607***
	(11.55)	(11.60)
log_age	-0.0186	-0.0181
	(-1.14)	(-1.10)
log_tf	-0.0162**	-0.0158**
	(-2.87)	(-2.81)
invstrs	0.00249*	0.00254*
	(2.43)	(2.49)
lead_invstrs	-0.0325***	-0.0321***
	(-3.88)	(-3.83)
acq	0.0673*	0.0722*
	(2.32)	(2.47)
ipo	-0.152*	-0.154*
	(-2.27)	(-2.30)
emp_ord	0.0452***	0.0425***
	(5.64)	(5.25)
Functioning Government		**-0.00668***
P value (0.042)		(-2.03)

/		
cut1	1.783***	1.730***
	(23.40)	(21.03)
cut2	2.580***	2.527***
	(33.14)	(30.16)
McFadden Pseudo R-squared	0.0115	0.0117
Log likelihood	-10598.6	-10596.8
Log likelihood_null	-10722.1	-10722.1
Degrees of Freedom	8	9
AIC	21217.3	21215.6
BIC	21307.8	21315.2
No. of observations	63047	63047

Table 0.3 Hypothesis 1 Model (Ordered Probit Model)

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.5 presents the marginal effects of the variable Functioning Government (func_gov) on the predicted probabilities of different outcome categories in the ordered probit model.

_predict	dy/dx	std. err.	z	P>|z|	[95% conf. interval] lower	[95% conf. interval] upper
Single-function	0.0005249	0.0002587	2.03	0.042	0.0000178	0.0010319
Potential	-0.0004314	0.0002126	-2.03	0.042	-0.0008481	-0.0000147
Superapp	-.0000935	.0000463	-2.02	0.044	-0.0001843	-2.65e-06

Table 0.4 Average Marginal Effects for Hypothesis 1

4.3.2 Hypothesis 2: Regulatory Quality

Table 4.6 presents the results of the Ordered Probit Model used to test Hypothesis 2, which examines the impact of adding the variable 'Regulatory Quality' to the model.

	(1) Base Model	(2) Hypothesis 2
s_app		
num_funding_rounds	0.0602***	0.0614***
	(11.55)	(11.71)

log_age	-0.0186 (-1.14)	-0.0150 (-0.91)
log_tf	-0.0162** (-2.87)	-0.0107 (-1.89)
invstrs	0.00249* (2.43)	0.00274** (2.69)
lead_invstrs	-0.0325*** (-3.88)	-0.0330*** (-3.93)
acq	0.0673* (2.32)	0.0847** (2.89)
ipo	-0.152* (-2.27)	-0.152* (-2.27)
emp_ord	0.0452*** (5.64)	0.0342*** (4.20)
Regulatory Quality P value (0.000)		**-0.0823***** **(-6.21)**
/		
cut1	1.783*** (23.40)	1.764*** (23.06)
cut2	2.580*** (33.14)	2.563*** (32.81)
McFadden Pseudo R-squared	0.0115	0.0133
Log likelihood	-10598.6	-10562.7
Log likelihood_null	-10722.1	-10705.6
Degrees of Freedom	8	9
AIC	21217.3	21147.5
BIC	21307.8	21247.0
No. of observations	63047	62929

Table 0.5 Hypothesis 2 Model (Ordered Probit Model)

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.7 presents the marginal effects of the variable Regulatory Quality (reg_quality) on the predicted probabilities of different outcome categories in the ordered probit model.

_predict	dy/dx	std. err.	z	P>|z|	[95% conf. interval] lower	[95% conf. interval] upper
Single-function	0.0064614	0.0010427	6.20	0.000	0.0044178	0.0085051
Potential Superapp	-0.0053133	0.000858	-6.19	0.000	-0.006995	-0.0036317
Superapp	-0.0011481	0.0001941	-5.91	0.000	-0.0015286	-0.0007676

Table 0.6 Average Marginal Effects for Hypothesis 2

4.3.3 Hypothesis 3: Civil Liberties

Table 4.8 presents the results of the Ordered Probit Model used to test Hypothesis 3, which examines the impact of adding the variable 'Civil Liberties' to the model.

	(1) Base Model	(2) Hypothesis 3
s_app		
num_funding_rounds	0.0602***	0.0614***
	(11.55)	(11.72)
log_age	-0.0186	-0.0160
	(-1.14)	(-0.97)
log_tf	-0.0162**	-0.0151**
	(-2.87)	(-2.69)
invstrs	0.00249*	0.00262*
	(2.43)	(2.57)
lead_invstrs	-0.0325***	-0.0324***
	(-3.88)	(-3.88)
acq	0.0673*	0.0770**
	(2.32)	(2.63)
ipo	-0.152*	-0.157*
	(-2.27)	(-2.34)
emp_ord	0.0452***	0.0396***
	(5.64)	(4.87)

Civil Liberties		**-0.00255*****
P value (0.000)		**(-3.69)**
/		
cut1	1.783***	1.681***
	(23.40)	(20.36)
cut2	2.580***	2.478***
	(33.14)	(29.49)
McFadden Pseudo R-squared	0.0115	0.0121
Log likelihood	-10598.6	-10592.5
Log likelihood_null	-10722.1	-10722.1
Degrees of Freedom	8	9
AIC	21217.3	21207.0
BIC	21307.8	21306.6
No. of observations	63047	63047

Table 0.7 Hypothesis 3 Model (Ordered Probit Model)

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.9 presents the marginal effects of the variable Civil Liberties (cvl_liberties) on the predicted probabilities of different outcome categories in the ordered probit model.

_predict	dy/dx	std. err.	z	P>|z|	[95% conf. interval] lower	[95% conf. interval] upper
Single-function	0.0002003	0.0000544	3.68	0.000	0.0000937	.0003069
Potential	-0.0001646	0.0000447	-3.68	0.000	-0.0002523	-0.000077
Superapp	-0.0000357	9.86e-06	-3.62	0.000	-0.000055	-0.0000163

Table 0.8 Average Marginal Effects for Hypothesis 3

5. Discussion and contributions

Building on the results outlined in the earlier section, the following interpretation and discussion will focus on the external environmental factors and the key insights presented in the comparative case study, descriptive statistics and the regression models. The discussion will be targeting the research question in (Section 1.1) and the hypotheses developed (2.3.1;2.3.2;2.3.3).

5.1 Discussion

5.1.1 Hypothesis 1: Functioning of Government

The analysis conducted using the ordered probit model tested the null hypothesis *that the level of government functioning does not significantly impact the growth of digital platforms into superapps*. The results indicated a p-value, a statistical measure that helps determine the significance of the results obtained from a hypothesis test (Stock & Watson, 2015) of 0.042, which is below the significance threshold of 0.05, leading to the rejection of the null hypothesis. The marginal effects analysis reveals a negative marginal effect for the "Functioning Government" variable, indicating that a one-unit increase is associated with a -0.00935% decrease in the probability of the outcome being categorized as a superapp.

Therefore, the finding suggests that *a higher level of government functioning significantly inhibits the growth of digital platforms and digital innovation*. For instance, in countries with well-functioning governments, such as the UK and other European nations as seen from the indicators (4.1.2), digital platforms face significant challenges in evolving into superapps. This is exemplified by Revolut's journey, which encountered numerous obstacles due to stringent governmental regulations as seen in the comparative case study (87239.3.1). Superapps are often viewed as monopolistic practices in the digital age (Steinberg, 2022) and Crisanto et al. (2021) highlight that governments are increasingly scrutinizing the activities of large technology companies, particularly concerning antitrust issues and potential market power abuses. In contrast, in countries with lower levels of government functioning, monopolistic practices may be more prevalent, and regulations may be designed to protect existing firms, thereby stifling the emergence of new and younger digital enterprises (Hein et al., 2020). This dynamic is evident in China, where WeChat's exponential growth was facilitated by the Chinese government.

5.1.2 Hypothesis 2: Regulatory Quality

After conducting the ordered probit model to evaluate the null hypothesis that stated *there is no significant relationship between the quality of regulations and the likelihood of digital platforms evolving into superapps*, the results revealed by a p-value of [0.000]. This p-value, being less than the established significance threshold of 0.05, leads to the rejection of the null hypothesis and reinforcing the interpretation that *countries with high-quality regulations are less likely to see digital platforms evolve into superapps*. The marginal effects analysis reveals a notable negative marginal effect for the "Regulatory

Quality" variable, where a one-unit increase is associated with a -0.1148% decrease in the probability of the outcome being categorized as a superapp. Where the McFadden Pseudo R-squared a slight improvement (from 0.0115 to 0.0133), indicating that the overall explanatory power of the model has marginally increased with the addition of the new variable.

However, the coefficients for most predictors remain stable compared to the Base Model but the significance of total funding (log_tf) changes due to the introduction of the new variable. This indicates that the impact of total funding on platform development is influenced by the regulatory environment as investment decisions can be influenced by regulatory uncertainty (Schwark, 2023). The Base Model's negative coefficient for total funding was likely overstated because it was partly capturing unmeasured regulatory effects (Wooldridge, 2016). By adding "Regulatory Quality," the model better distinguishes these influences, showing that the negative effect of funding is less significant when regulatory factors are considered.

When observing the relationship between regulatory quality and digital platform status it suggests that higher regulatory quality can increase the likelihood of platforms remaining single-function while discouraging their evolution into superapps. Research on regulatory burden by Djankov et al. (2002), indicates that stricter regulations and higher compliance costs particularly affect firms that operate across multiple sectors, making it challenging for platforms to diversify. Similarly, theories on market entry barriers from Porter (1980) and studies by Klapper et al. (2006) highlight how strict regulations can create obstacles to entering new markets, which can inhibit the growth of superapps that aim to offer a wide range of services. Additionally, digital platform research by Kenney and Zysman (2016) stresses how regulatory environments shape platform strategies, often leading them to focus on core competencies rather than diversifying into complex, multi-service offerings.

5.1.3 Hypothesis 3: Civil Liberties

The statistical analysis provided robust evidence against the null hypothesis, which posited that *no significant relationship between the civil liberties and the likelihood of digital platforms evolving into superapps*. With a p-value of 0.000, the null hypothesis is rejected, as this value falls below the 0.05. The analysis of marginal effects further supports this finding, revealing that a one-unit increase in the "Civil Liberties" variable correlates with a decrease of -0.00357% in the probability of a digital platform being categorized as a superapp. This low yet significant negative marginal effect shows *that countries with robust protections for civil liberties are less likely to see digital platforms evolve into superapps*. This is likely because, in regions with strong civil liberties, platforms face stringent regulations that restrict extensive data collection and usage, crucial components for the typical superapp model, which thrives on integrating multiple services and extensive data analytics to offer seamless user experiences. This echoes Sadowski's (2019) concerns about data collection compromising personal autonomy and privacy, potentially discourages the transformation into superapps due to user wariness about data practices.

5.2 Theoretical contribution

The present article advances the scholarly understanding of superapp development by examining both the external environmental factors and internal organizational dynamics that shape the evolution of single-function digital platforms into comprehensive superapps. Building on Hasselwander's foundational work on internal factors, this research extends the analytical framework to include key external elements, thereby offering a more holistic perspective on the complex forces driving superapp growth across diverse global contexts. The study reveals that the number of funding rounds and the size of the workforce significantly increase the likelihood of a platform transitioning into a superapp, underscoring the critical role of sufficient capital and a capable workforce in fostering innovation and service expansion. However, it also identifies a contradiction with benefits while resources are vital, excessive total funding and the involvement of lead investors can have negative effects. High levels of funding may create pressure to achieve short-term financial targets, potentially undermining the broader diversification necessary for superapp evolution. Similarly, lead investors might impose strategic directives that clash with the platform's long-term growth objectives. These findings highlight the importance of aligning governance structures and investor dynamics with the platform's strategic vision to ensure sustainable growth.

This study makes a significant contribution to the field by empirically testing the impact of external environmental factors an area previously acknowledged as crucial in theoretical discussions but not extensively explored through quantitative methods. By integrating both organizational capabilities and broader institutional contexts, the research provides a nuanced examination of the factors influencing digital platforms' strategic decisions and growth trajectories as they transform into superapps. Moreover, the results show that high levels of government functionality, regulatory quality, and civil liberties negatively impact the evolution of platforms into superapps. These findings suggest that stringent regulatory environments, robust governance, and strong civil liberties protections may deter platforms from adopting superapp strategies due to increased compliance costs, barriers to market entry, and restrictions on data practices. Thus, while resources and capabilities are essential, the broader regulatory and governance environment also plays a pivotal role in shaping the strategic directions of digital platforms.

5.3 Future Research

Conducting longitudinal studies to track the evolution of superapps over time would provide a dynamic understanding of how these platforms adapt to changing institutional contexts and evolving country dynamics. The approach would identify key trends and strategic shifts, adding depth to insights gained from the static cross-sectional study. Furthermore, complementing this with a detailed examination of consumer behavior and user adoption patterns would enrich the focus on organizational and environmental factors. Although the study discussed civil liberties, but by deeply understanding the user

perspective, researchers could better detect why some platforms successfully transform into superapps while others falter. A holistic view would combine temporal changes with consumer-driven insights to offer a comprehensive analysis of superapp development.

6. Resources

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Appendix

A1.

Feature/Function	Variable	Corresponding words
Required Parameters		
Software	software	“software” “information technology”
Mobile	mobile	“mobile” “apps” “platform” “mobile apps” “application”
Additional Parameters		
Financial Services	fs	"financial services" "fintech" "banking" "investment" "finance" "bnpl" “lending and investments”
Digital Payments	dp	"mobile payments" `"payments"' "payment" "digital payments"
Delivery (Mobility)	delivery	"delivery" `"food delivery"' "parcel delivery" "grocery delivery" ""
Transportation	ride	"transportation" `"ride hailing"' "ride sharing" "ride sourcing"
E-commerce	ec	"e-commerce" `"commerce and shopping"' "commerce" "shopping" "retail" "marketplace" "shipping"
Communication	commu	"messaging" `"messaging and telecommunications"' "community and lifestyle" "telecommunications"
Entertainment	ent	"music" `"gaming"' "media and entertainment"
Social Media	sm	"social media" `"social network"' "blogging platforms"

A2.

Employee Ordinal

As a categorical variable, the variable is presented in frequency distribution table.

	Freq.	Percent	Cum.
1	19820	31.44	31.44
2	25998	41.24	72.67
3	6731	10.68	83.35
4	5319	8.44	91.79
5	2334	3.70	95.49
6	1319	2.09	97.58
7	1005	1.59	99.17
8	226	0.36	99.53
9	295	0.47	100.00
Total	63047	100.00	

A3.

Variable	(1) Linear Model	(2) Ordered Probit	(3) Ordered Logit
Number of funding rounds	0.00708***	0.0602***	0.121***
	(12.11)	(11.55)	(11.37)
Age [log scaled]	-0.00229	-0.0186	-0.0485
	(-1.37)	(-1.14)	(-1.33)
Total funding in usd [log_scaled]	-0.00193***	-0.0162**	-0.0348**
	(-3.61)	(-2.87)	(-2.74)
Investors	0.000317**	0.00249*	0.00590**
	(3.07)	(2.43)	(2.68)
Lead Investors	-0.00334***	-0.0325***	-0.0623***
	(-3.79)	(-3.88)	(-3.47)
Acquired	0.00713*	0.0673*	0.130*
	(2.53)	(2.32)	(1.98)
IPO	-0.0121*	-0.152*	-0.387*
	(-2.00)	(-2.27)	(-2.53)
Number of Employees	0.00491***	0.0452***	0.0997***
	(6.01)	(5.64)	(5.67)
Constant	0.0452***		
	(6.20)		
/			
cut1		1.783***	3.233***
		(23.40)	(18.84)
cut2		2.580***	5.269***
		(33.14)	(29.42)
McFadden Pseudo R-squared / R- Squared	0.0048	0.0115	0.0107
Log likelihood	5622.3	-10598.6	-10607.8
Log likelihood_null	5469.1	-10722.1	-10722.1
Degrees of Freedom	8	8	8
AIC	-11226.7	21217.3	21235.7
BIC	-11145.2	21307.8	21326.2

No. of observations	63047	63047	63047

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$