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Invisible Scaling and Resource Efficiency: Decoupling Market Reach from Organizational Growth in Digital Small and Medium Enterprises

Rabia Salman, Rana Mohsin Ali, Muhammad Salman Shabbir*

Abstract

This study introduces invisible scaling, a digitally mediated growth configuration in which entrepreneurial firms expand market reach without proportionate growth in internal employment and organizational infrastructure. Using an exploratory secondary-data design, it examines 24 purposively selected digital SMEs across four countries and sectors. The analysis identifies variation in reach-size decoupling and suggests two preliminary configurations: platform-automated firms relying mainly on digital infrastructure and algorithmic market access, and partner-orchestrated firms coordinating broader networks of external providers. An organizational decoupling index provides a preliminary representation of market reach relative to internal employment, although the study does not establish causality or the prevalence of the phenomenon. The findings distinguish invisible scaling from its possible mechanisms and show why organizational leanness should not be treated as environmental performance. As energy use, emissions, materials, logistics, and external labour are not measured directly, the environmental implications remain exploratory and concern the appropriate boundary of assessment.

Keywords: Invisible scaling; digital SMEs; platform ecosystems; resource efficiency; sustainable business strategy; organizational decoupling

1. Introduction: The Puzzle of Scaling Without Growth

The ability of entrepreneurial firms to scale beyond local markets has long been a central concern in entrepreneurship and strategic management research. In the classical literature, firm growth is typically understood as an internal organizational process involving the expansion of resources, employees, managerial hierarchies, and productive capacity (Penrose, 2009). Subsequent work has largely reinforced this assumption by linking growth to the accumulation and deployment of firm-specific resources, managerial capabilities, and internal routines (Barney, 1991; Eisenhardt & Martin, 2000). Research on venture scaling similarly emphasises the organizational systems and structures required to sustain expansion (DeSantola & Gulati, 2017). Even where scholars have acknowledged contextual variation, scale has generally remained closely associated with organizational enlargement and the deeper internalisation of activities (Autio et al., 2014; Davidsson et al., 2010).

Yet contemporary digital entrepreneurship increasingly reveals a pattern that sits uneasily with these assumptions. A growing number of digitally enabled small and medium-sized enterprises (SMEs) achieve substantial market reach while retaining relatively small internal organizational structures. These ventures often operate with limited employee bases but nonetheless serve geographically dispersed customers, coordinate complex value-creation activities, and generate meaningful economic activity. Rather than building scale primarily through owned assets and internal headcount, they use digital platforms for distribution, payments, logistics, visibility, and customer acquisition, while drawing on external partners, freelancers, and service providers for important operational activities (Nambisan, 2017; Autio et al., 2018; Stallkamp & Schotter, 2021). Digital transformation has consequently altered both the resources available to entrepreneurial firms and the organizational boundaries through which innovation and market access are achieved. The empirical puzzle is therefore not simply that these firms remain small, but that market reach and economic activity can expand without a proportionate increase in internal organizational size. This growth configuration also raises questions for environmental strategy. Digitally enabled SMEs can access technological, logistical, and market infrastructures without reproducing all these capabilities within their own organizational boundaries. This may improve organizational resource

productivity and limit the accumulation of assets within the focal firm. It does not, however, establish that the firm has achieved environmental efficiency. Digital technologies can support sustainability-oriented entrepreneurship while also generating unintended environmental and social consequences (George et al., 2021; Bohnsack et al., 2022). Energy use, data infrastructure, logistics, packaging, transport, and other resource demands may remain with platforms and ecosystem partners through which the firm operates. A small internal organizational footprint should therefore not be treated as equivalent to a small environmental footprint. Instead, environmental assessment may need to consider the wider system of actors and infrastructures involved in producing and delivering value (Hart, 1995; Hart & Dowell, 2011; Adner & Kapoor, 2010; Jacobides et al., 2018).

This study introduces the concept of invisible scaling. We define invisible scaling as a multidimensional growth configuration in which entrepreneurial firms expand market reach and economic activity without proportionate growth in internal employment and organizational infrastructure, enabled by digitally mediated access to external platforms and partner networks. Invisible scaling is therefore treated as a distinctive empirical outcome rather than as an entirely new organizational form. Platform dependency, algorithmic market access, and ecosystem orchestration are considered possible enabling mechanisms and should not be conflated with the phenomenon itself. The concept also does not apply to every firm that uses outsourcing or participates in a digital platform. Platform use constitutes invisible scaling only where it contributes to a sustained decoupling of market reach from internal organizational enlargement.

The study makes four contributions. First, it responds to calls for phenomenon-based theorizing that begins with empirically consequential patterns that existing theory only partially explains (Fisher et al., 2021). Second, it positions invisible scaling in relation to hollow firms, born-global firms, virtual organizations, asset-light models, network organizations, platform complementors, and other related concepts. It argues that these perspectives illuminate parts of the phenomenon but do not make the decoupling of market reach from internal organizational size their principal explanatory focus. Third, the study develops a preliminary conceptual model that separates enabling conditions, scaling mechanisms, the defining organizational outcome, and its possible strategic consequences. The associated propositions are intended to guide future testing rather than to imply causal confirmation from the present evidence. Fourth, it contributes to debates on firm boundaries and sustainable business strategy by distinguishing organizational resource

productivity from ecosystem-level environmental performance. Entrepreneurial advantage may increasingly depend on external resource access and ecosystem coordination rather than resource ownership alone, but the environmental implications of this shift cannot be inferred solely from the size or asset base of the focal firm (Adner & Kapoor, 2010; Jacobides et al., 2018; Nambisan et al., 2019).

The study draws on secondary evidence concerning 24 digitally enabled SMEs. Given the purposive selection of firms displaying the focal characteristics and the limited size of the dataset, the analysis is positioned as exploratory and descriptive. It documents variation within invisible scaling and identifies preliminary patterns across platform-reliant and partner-orchestrated configurations. It does not seek to establish why some digital SMEs achieve invisible scaling while others do not, nor does it directly assess energy consumption, emissions, material use, or lifecycle environmental performance. The environmental implications developed in the study are consequently conceptual and provide a basis for subsequent empirical research.

The remainder of the paper is organised as follows. Section 2 constructs the phenomenon and distinguishes invisible scaling from adjacent concepts. Section 3 examines the assumptions within existing theories of firm growth, resources, platforms, and ecosystems. Section 4 explains the secondary-data research design, case-selection criteria, sources, measures, and coding procedures. Section 5 presents the descriptive findings and emerging configurations. Section 6 develops the conceptual model and propositions for future research. Sections 7 and 8 discuss the theoretical, managerial, platform, and policy implications. Sections 9 and 10 present the study's limitations and future research agenda, while Section 11 concludes the paper.

2. From Empirical Puzzle to Research Phenomenon

Recent advances in digital technologies, platform infrastructures, and entrepreneurial ecosystems have generated patterns of venture growth that challenge established assumptions in entrepreneurship and strategic management. Traditional models typically conceptualize scaling as a process of increasing organizational size through the accumulation of resources, employees, and managerial structures (Penrose, 2009; Davidsson et al., 2010; DeSantola & Gulati, 2017). Yet digitally enabled ventures increasingly achieve substantial market reach and economic activity without commensurate internal expansion. This empirical pattern is significant because it exposes

a growing separation between how firm growth has conventionally been theorized and how it can now be organized in practice (Nambisan, 2017; Autio et al., 2018; Jacobides et al., 2018).

The phenomenon examined here is therefore not organizational smallness in itself. Many firms remain small because they are young, resource-constrained, locally oriented, or commercially limited. Invisible scaling concerns a more specific pattern in which market reach and economic activity expand while internal employment, owned assets, and organizational infrastructure grow more slowly or remain relatively stable. Digital platforms and external partner networks can enable this pattern, but they should be treated as possible mechanisms rather than as defining outcomes. The separation between market reach and organizational enlargement also raises an environmental-strategy question. It cannot be assumed that reduced internal asset accumulation represents environmental efficiency, because resource use may remain embedded in the digital, logistical, and service infrastructures through which the firm operates.

2.1 Positioning Invisible Scaling Relative to Adjacent Concepts

The hollow firm concept (Miles & Snow, 1986; Volberda, 1998) describes organizations that externalize many operational functions while retaining a thin coordinating core. Invisible scaling shares this general architecture, but differs in its principal analytical focus. Hollow-firm research is primarily concerned with organizational boundaries and the externalization of activities. Invisible scaling focuses on the growth outcome made possible by such arrangements, specifically the sustained expansion of market reach without proportionate internal organizational enlargement. Hollow firms in the pre-digital period also depended on relatively costly coordination mechanisms, including contractual governance, relationship-specific investments, and intermediary structures. Digitally enabled firms can instead access standardized capabilities through APIs, platform dashboards, cloud-based modules, and algorithmic matching systems, reducing some of the coordination costs associated with externalization (Afuah, 2002; Gawer & Cusumano, 2014; Nambisan, 2017).

Invisible scaling is also related to outsourcing, asset-light business models, network organizations, modular organizations, and boundaryless firms. Each of these concepts explains why activities may be located outside the formal boundary of the firm. Outsourcing concerns the transfer of particular functions to external providers, while asset-light models emphasise limited ownership of physical assets. Network and boundaryless perspectives focus on interorganizational coordination and more permeable organizational boundaries (Miles & Snow, 1986; Dyer & Singh,

1998; Volberda, 1998). Modular organizations rely on separable components and standardized interfaces that allow activities to be recombined across organizational settings. These concepts help explain how firms externalize or coordinate resources, but they do not necessarily predict that market reach will expand faster than internal organizational size. A firm may outsource extensively, own few assets, or participate in a network without achieving substantial market expansion. Invisible scaling is present only when these arrangements contribute to an observable and sustained decoupling of reach from internal organizational growth.

The born-global literature explains how small firms achieve rapid international market penetration early in their development (Oviatt & McDougall, 2018; Knight & Cavusgil, 1996). Invisible scaling overlaps with this perspective insofar as digital platforms allow small ventures to reach geographically dispersed markets from an early stage. However, born-global research treats internationalization as the central outcome. Invisible scaling addresses a different analytical question: how ventures expand market, transactional, and collaborative activity while maintaining a relatively small internal organizational footprint. A born-global firm may add employees, assets, and managerial structures as it internationalizes and would not necessarily exhibit invisible scaling. Conversely, an invisibly scaling venture may expand transactional reach within a large domestic market without following a conventional internationalization pathway. International reach is therefore one possible expression of invisible scaling rather than its defining characteristic (Stallkamp & Schotter, 2021).

The virtual organization concept (Davidow & Malone, 1992) similarly anticipates part of the argument by highlighting flexible and distributed organizational forms. However, it emerged in a technological context that predated contemporary platform ecosystems, data-driven intermediation, and algorithmic governance. It consequently provides only a partial account of how digital ventures operate under rules, interfaces, ranking systems, and visibility conditions established by platform operators. Invisible scaling is not simply virtualization. It concerns the growth consequences of using externally governed digital infrastructures to expand commercial activity without a corresponding increase in internal organizational capacity (Jacobides et al., 2018; Nambisan et al., 2019).

Platform complementor research and the wider literature on digitally enabled scaling come closest to the mechanism considered here. These perspectives explain how entrepreneurial firms gain access to technological infrastructure, customers, and complementary resources through

participation in digital ecosystems (Nambisan, 2017; Srinivasan & Venkatraman, 2018; Nambisan et al., 2019). They also show that platform participation can create power asymmetries and expose entrepreneurial firms to rules and decisions they do not control (Cutolo & Kenney, 2021). Research on sustainable entrepreneurship further illustrates how entrepreneurs enact digital connectivity through platform-dependent business models (Gregori et al., 2024). However, firms can participate intensively in a platform ecosystem while still expanding their internal workforce and asset base. Platform participation is therefore neither a necessary indicator nor sufficient evidence of invisible scaling. The distinction lies in the relationship between the firm's external reach and its internal organizational trajectory.

Invisible scaling also differs from environmentally oriented concepts such as sustainable business models and eco-efficiency. It does not assume that digital, externalized, or asset-light operations are inherently environmentally beneficial. Instead, it identifies an organizational growth configuration that may limit resource accumulation within the focal firm while increasing dependence on shared digital, logistical, and service infrastructures. Its environmental significance depends on the total pattern of resource use across the ecosystem, which cannot be established from employee numbers, owned assets, or revenue per employee alone (Hart, 1995; Hart & Dowell, 2011; Bohnsack et al., 2022).

Table 1 summarises the conceptual distinctions. The comparison shows that several established concepts explain externalization, internationalization, digital participation, or flexible organizational boundaries. Invisible scaling differs by treating the decoupling of market reach from internal organizational growth as the central phenomenon to be explained.

Table 1 here

2.2 Defining Attributes and Boundary Conditions

Invisible scaling is best understood as a multidimensional growth configuration rather than as a wholly new organizational form or a single managerial strategy. Its defining outcome is reach-size decoupling, while platform infrastructure, algorithmic access, outsourcing, and partner orchestration represent mechanisms through which that outcome may be produced. Four attributes are central. First, the venture must demonstrate meaningful growth in market reach, transactions, customers, or economic activity. Second, this expansion must occur without proportionate growth in internal employment and organizational infrastructure. Third, external digital platforms or partner networks must perform functions that would otherwise require greater internal capacity.

Fourth, the pattern must be sufficiently sustained to distinguish scaling from a temporary revenue increase, a single large contract, or an early stage of venture development.

These boundaries clarify conditions under which platform-enabled externalization would not constitute invisible scaling. A firm does not exhibit invisible scaling merely because it sells through a platform, uses cloud services, employs freelancers, or outsources logistics. Nor does a small firm qualify when its limited size reflects commercial weakness or its recent establishment. Platform participation accompanied by proportionate increases in employees and internal structures represents digitally enabled organizational growth, but not invisible scaling. Similarly, an asset-light firm with limited market reach displays organizational leanness without demonstrating the focal growth pattern.

The explanatory value of invisible scaling therefore lies in directing attention to a relationship that adjacent perspectives do not usually make central. It suggests that firms with similar levels of platform access or externalization may follow different growth trajectories depending on how external infrastructures and partner relationships substitute for internal organizational capacity. It also anticipates that different configurations of invisible scaling may produce different forms of strategic exposure. Firms relying heavily on platform automation may face concentrated algorithmic and governance dependence, whereas firms relying on broader partner networks may experience greater coordination demands but less dependence on a single platform. These expectations remain preliminary and require further testing, but they clarify what the concept adds to existing accounts of asset-light, networked, virtual, and platform-based organization.

Taken together, the adjacent concepts illuminate important aspects of the phenomenon, but none makes the sustained decoupling of market reach from internal organizational growth its principal concern. Invisible scaling is therefore introduced not as a relabeling of outsourcing or asset-light organization, but as a focused concept for explaining how digitally enabled ventures can expand through external infrastructures while retaining a limited internal organizational base. Its environmental relevance lies not in presuming that this configuration is environmentally efficient, but in showing why resource use and responsibility may need to be assessed beyond the formal boundary of the focal firm.

3. Problematising Existing Theory: Growth, Resource Access, and Environmental Boundaries

Understanding invisible scaling requires moving beyond descriptive observation towards a closer examination of the theoretical assumptions that shape explanations of firm growth and entrepreneurial scaling. The phenomenon is significant because it draws attention to a relationship that established perspectives do not usually place at the centre of analysis: market reach and economic activity can expand without a proportionate increase in internal employment, assets, or organizational infrastructure. This does not mean that existing theories are unable to accommodate external relationships or digitally mediated growth. Rather, their principal constructs and outcomes tend to treat organizational expansion, resource accumulation, and market growth as closely connected. Invisible scaling questions this connection and shifts attention towards the conditions under which external resource access can substitute for some forms of internal organizational growth.

It is important to distinguish the phenomenon from its proposed causes. Invisible scaling refers to the observed decoupling of market reach from internal organizational enlargement. Platform infrastructure, algorithmic market access, and ecosystem orchestration are possible mechanisms through which that outcome may be produced. Keeping this distinction clear avoids defining invisible scaling through the same factors later used to explain it. It also allows for the possibility that different combinations of platforms and partners may produce similar reach-size outcomes while creating different forms of strategic dependence and external resource use.

3.1 Firm Growth Theory

Research on firm growth has traditionally treated the expansion of organizational capacity as an important mechanism through which firms increase their market presence. Penrose (2009) conceptualized growth as a process driven by the accumulation and productive deployment of internal resources, while later scholarship frequently measured growth through changes in employment, sales, assets, and organizational complexity (Davidsson et al., 2010). Research on entrepreneurial scaling likewise emphasises the systems, structures, and managerial roles that accompany organizational expansion (DeSantola & Gulati, 2017). These measures capture important dimensions of firm development, but they can obscure situations in which sales, customers, transactions, or geographic reach expand along a different trajectory from internal organizational size.

Invisible scaling therefore raises a measurement and explanation problem for firm growth theory. When firms use digital infrastructures and external providers to extend their market reach, growth

in economic activity and growth in organizational capacity can no longer be assumed to move together. Employment growth may remain limited even as the number of customers, markets, or transactions increases substantially. Similarly, an increase in revenue may be supported by external platforms and partners rather than by a corresponding accumulation of owned assets or internal managerial structures. The phenomenon does not invalidate conventional measures of growth, but it indicates that no single measure adequately captures the form through which growth occurs.

The distinctive theoretical claim is therefore one of differential growth rates. Invisible scaling is present when external market reach grows faster than the internal organizational base required to coordinate it. This distinguishes the phenomenon from firms that merely remain small and from firms that use digital technologies while expanding their internal structures proportionately. It also suggests that growth mode may be as important as growth rate. Two firms can achieve comparable increases in revenue or market reach while following markedly different organizational trajectories, one through internal expansion and the other through digitally mediated access to external capacity.

This decoupling may increase revenue or market reach relative to internal employment and owned assets. Such outcomes indicate organizational resource productivity, not environmental efficiency. Whether fewer internal assets result in lower total resource use depends on what resources are consumed by the platforms, data infrastructures, logistics providers, and external partners supporting the firm's activities. Firm growth theory alone does not resolve this question because its conventional measures generally remain bounded by the focal organization.

3.2 The Resource-Based View

The resource-based view (RBV) explains competitive advantage through valuable, rare, inimitable, and non-substitutable resources controlled by the firm (Barney, 1991; Peteraf, 1993). This logic remains important, particularly where firms develop proprietary knowledge, capabilities, routines, or relationships that competitors cannot easily reproduce. However, digitally mediated ventures increasingly combine controlled resources with standardized external capabilities accessed through platforms, cloud infrastructures, and complementor networks. In these settings, the strategic issue is not only which resources the firm owns, but also how it gains access to external resources and configures them in ways that support market expansion.

Existing extensions of the RBV acknowledge capabilities, relationships, and resource combinations beyond simple asset possession. Resource-orchestration research highlights the

managerial work involved in structuring, bundling, and leveraging resources, while research on digital ecosystems emphasises the integrative capabilities required to create and capture value across platform-based systems (Sirmon et al., 2011; Helfat & Raubitschek, 2018). The remaining difficulty is explaining how relatively small firms derive scalable advantage from external infrastructures that are available to many participants. If platforms, payment systems, logistics networks, and digital distribution channels are broadly accessible, their mere availability cannot explain variation in scaling outcomes. What may differ is the firm's capacity to select, combine, and coordinate these resources while retaining control over strategically important activities. Invisible scaling therefore directs attention from resource ownership alone towards the organization of resource access.

This perspective also clarifies why platform dependency and ecosystem orchestration should be treated as explanatory mechanisms rather than components of invisible scaling itself. A firm may gain extensive access to platform resources without achieving significant market reach. Another may coordinate numerous partners but face high transaction and coordination costs that limit growth. Scalable advantage arises only when external resource access substitutes effectively for internal capacity and supports an expanding level of market activity. The theoretical expectation is not that externalization automatically produces invisible scaling, but that its effects depend on how external resources are configured and governed.

From an environmental-strategy perspective, this distinction is equally important. Accessing shared infrastructure may reduce the need for each firm to own comparable technological or physical assets. It may therefore improve resource productivity within the focal firm. Nevertheless, this organizational outcome provides no direct evidence about energy consumption, emissions, material use, or lifecycle environmental performance. Reliance on external assets may shift where resource use occurs and who reports it, while leaving the total environmental burden uncertain. This argument complements the natural-resource-based view, which connects competitive advantage with the strategic management of environmental resources and constraints (Hart, 1995; Hart & Dowell, 2011). It also reflects the need to distinguish intended sustainability benefits from the unintended consequences of digitalization (Bohnsack et al., 2022). Invisible scaling extends the unit-of-analysis question by asking whether environmental responsibility can be assessed adequately when important activities are performed outside the focal firm.

3.3 Entrepreneurial Scaling Literature

The entrepreneurial scaling literature focuses primarily on how ventures move from early formation towards larger and more formalized organizational forms (McKelvie & Wiklund, 2010; DeSantola & Gulati, 2017; Reuber et al., 2021). Much of this work examines the managerial and structural challenges associated with growth, including capability development, professionalization, role specialization, and the design of systems needed to support larger operations. These concerns remain central to conventional scale-up trajectories, particularly where growth creates greater internal complexity and coordination demands.

Invisible scaling identifies a different trajectory. Some ventures expand market access, transaction volumes, and economic output while retaining a limited internal organizational base. They do not avoid coordination, specialization, or capability development altogether. Instead, part of this capacity is located in digital platforms, standardized service providers, independent professionals, logistics networks, and other external actors. The firm's managerial task shifts from building and supervising all required capacity internally towards selecting external resources, maintaining access, coordinating distributed contributions, and managing dependencies.

The contribution to scaling research is therefore not the claim that organizational growth has ceased to matter. Rather, invisible scaling identifies a growth configuration in which organizational enlargement becomes less visible within the formal boundary of the focal firm. Operational complexity may continue to increase, but it is distributed across a wider network. This creates a distinction between internal organizational scale and the wider system of resources coordinated by the venture. It also introduces boundary conditions. Invisible scaling is less likely where activities require substantial firm-specific assets, close internal supervision, intensive physical production, or forms of tacit coordination that cannot readily be standardized or accessed externally.

The environmental implications remain open rather than predetermined. A venture that adds few employees or owned assets may appear organizationally lean, yet the infrastructure supporting its expansion can still require considerable energy, transport, materials, or external labour. Scaling research has rarely examined this difference between the focal firm's organizational footprint and the resource footprint of the wider system through which growth is delivered. Invisible scaling brings this distinction into clearer view without assuming that externally organized growth is environmentally preferable.

3.4 Ecosystem Theory: Proximate but Incomplete

The most proximate lens for understanding invisible scaling is ecosystem theory, which has improved our understanding of complementarity, interdependence, and value creation across distributed actors (Adner & Kapoor, 2010; Jacobides et al., 2018; Gawer, 2022). Research on industry platforms similarly explains how shared technological architectures can support ecosystem innovation and complementary market activity (Gawer & Cusumano, 2014). Ecosystem research explains how firms depend on other actors whose contributions are necessary for a value proposition to be realised. It also draws attention to governance structures, positions, complementarities, and the distribution of control across platform-based and non-platform settings.

Nevertheless, the focal question in ecosystem research is commonly the structure or governance of the ecosystem rather than the relationship between a small participant's market reach and its internal organizational trajectory. Much of the platform literature also gives particular attention to ecosystem leaders and platform owners. The position of entrepreneurial complementors is recognised, but less attention is given to how small ventures use ecosystem access to expand while retaining a limited internal base. The power asymmetries faced by platform-dependent entrepreneurs further show that access to platform resources can be accompanied by significant strategic exposure (Cutolo & Kenney, 2021). Ecosystem theory can therefore explain the external architecture on which invisible scaling depends, but it does not by itself specify when participation in that architecture produces reach-size decoupling.

Bringing ecosystem theory into dialogue with firm growth research also reveals that invisible scaling may not represent a single pathway. One configuration may be predominantly platform-automated, with market access, payments, distribution, and customer discovery concentrated in a small number of digital platforms. Such firms may require fewer external human partners but face stronger dependence on platform rules and algorithmic visibility. A second configuration may be partner-orchestrated, relying on a broader network of freelancers, agencies, logistics providers, and specialist services. These ventures may face greater coordination demands but less concentrated algorithmic dependence. Both configurations can support market expansion without substantial internal enlargement, yet their governance risks and external resource requirements may differ.

This distinction also matters for environmental assessment. Platform-automated scaling may rely heavily on data centres, digital infrastructures, and algorithmically governed market access, while

partner-orchestrated scaling may involve more distributed service, logistics, transport, and labour inputs. The present framework does not establish which configuration has the lower environmental impact. Instead, it suggests that the relevant unit of analysis extends beyond the focal SME to the platforms, cloud infrastructures, logistics providers, and partners through which value is created. Direct environmental measures would be required before either configuration could be described as environmentally efficient.

Taken together, these theoretical traditions each illuminate part of the empirical pattern, but none makes the decoupling of market reach from internal organizational growth its central concern. Firm growth theory provides the basis for understanding organizational expansion but often combines different dimensions of growth. The RBV explains strategic resources but gives less attention to scalable advantage derived from standardized external access. Entrepreneurial scaling research concentrates largely on the managerial consequences of organizational enlargement. Ecosystem theory explains distributed value creation but does not usually treat the small venture's reach-size relationship as the focal outcome.

Invisible scaling connects these perspectives by distinguishing the phenomenon from the mechanisms that may enable it. It anticipates that market reach and internal organizational size can follow different trajectories; that external resource access can substitute for selected forms of internal capacity; and that platform-automated and partner-orchestrated configurations can produce different patterns of strategic dependence. It does not predict environmental efficiency from organizational leanness. Its environmental contribution is instead to show why assessments confined to the focal firm may overlook resource use located elsewhere in the ecosystem. This combined theoretical gap makes invisible scaling a useful concept for examining how digital SMEs pursue market expansion through externally coordinated infrastructures without proportionate internal organizational enlargement.

4. Research Design and Secondary Dataset

4.1 Research Design and Rationale for Secondary Data

The study adopts an exploratory secondary-data design based on firm-level information compiled from regulatory records, company disclosures, commercial databases, and other documentary sources. Secondary evidence can extend empirical access where direct observation is difficult, provided that researchers recognise differences in source quality, completeness, and measurement

status (Cowton, 1998). Recent work on data-intensive management research similarly stresses the importance of transparent provenance and careful analytical judgement when combining heterogeneous records (George et al., 2016). This approach is appropriate for examining an emerging organizational phenomenon for which established sampling frames and validated measures are not yet available. It permits the systematic comparison of firms exhibiting the central features of invisible scaling and allows preliminary patterns to be identified across sectors and ecosystem configurations. The design is therefore phenomenon-driven and descriptive rather than confirmatory. It does not seek to establish why some digitally enabled SMEs achieve invisible scaling while others do not.

Secondary data are useful in this context for three reasons. First, regulatory filings and company records provide observable information on revenue, employment, firm age, and aspects of geographic reach without relying solely on retrospective managerial accounts. Second, company materials and platform-related disclosures can provide evidence about the external infrastructures and partner relationships through which firms conduct their activities. Third, documentary evidence creates an auditable basis for case selection and coding when the exact source, date, and status of each observation are recorded. The value of this design therefore depends on source transparency and careful distinction between directly reported information, researcher-coded evidence, and values that cannot be verified.

The study uses secondary evidence to examine organizational leanness, market reach, external resource access, and ecosystem dependence. Revenue per employee and limited internal infrastructure are treated as indicators of organizational resource productivity rather than environmental performance. The dataset does not contain direct measures of energy consumption, greenhouse-gas emissions, material use, logistics intensity, packaging, or lifecycle effects. Environmental implications are consequently treated as conceptual and exploratory.

4.2 Data Sources and Data Provenance

The dataset draws on five categories of publicly accessible or commercially licensed sources. First, company annual reports and financial disclosures filed with national registries, including Companies House in the United Kingdom, SEC EDGAR in the United States, Bundesanzeiger in Germany, and KvK in the Netherlands, were used to obtain revenue, headcount, incorporation, and growth information where these items were directly reported. Second, firm websites, annual reviews, investor materials, press releases, and documented company interviews provided

information on customer locations, distribution channels, platform participation, and external partnerships. Third, commercial databases, including Crunchbase, PitchBook, Dealroom, and Statista, were used to cross-check founding dates, employee estimates, funding history, and geographic activity. Fourth, publicly disclosed extracts of platform-related performance information were considered where a firm or an identifiable third party had made the evidence available. Fifth, trade publications and case materials from organizations such as McKinsey, Deloitte, and the OECD were used to provide sector context and corroborate firm-level descriptions.

Private account-level dashboards, including Amazon Seller Central, Shopify Partner accounts, Apple App Store Connect, and Google Play Console, were not treated as publicly accessible sources. Information associated with these systems was included only where a firm-specific extract, report, or statement had been made publicly available and could be traced to an identifiable source. The study did not assume access to private seller or developer accounts. Where platform dependence or algorithmic market access could not be verified through public evidence, the relevant indicator was coded as unavailable rather than assigned a precise numerical estimate.

A firm-level source matrix was used during data collection. For each case, it records the firm name or stable identifier, country, sector, observation year, source title, URL or database record, extraction date, and the source used for each variable. It also indicates whether each observation was directly reported, calculated from reported information, qualitatively coded, or unavailable. This distinction is particularly important for platform dependency, algorithmic market access, external expenditure, and partner-network measures, which are not reported consistently across firms.

4.3 Case Selection and Sample Characteristics

The final sample comprises 24 digitally enabled SMEs selected purposively because they displayed observable evidence of the focal phenomenon. Two screening criteria were applied. First, a firm was required to demonstrate meaningful market reach, operationalized as serving customers in at least three countries or generating annual revenue above USD 500,000 predominantly through digital channels. These alternatives were used because market reach can be expressed geographically or through the scale of digitally mediated commercial activity. Second, the firm was required to have fewer than 15 full-time equivalent employees during the observation period.

The employee threshold is used as an operational boundary rather than as a statutory definition of an SME. It imposes a deliberately restrictive ceiling on internal organizational size and helps identify cases in which meaningful market activity is coordinated through a limited employee base. Similarly, the market-reach thresholds are screening devices for purposive case selection rather than population-level cut-off points. They should not be interpreted as validated thresholds separating invisible-scaling firms from all other digital SMEs.

The resulting sample spans four sector categories: Digital Commerce (n = 6), Software-as-a-Service (n = 8), Creator Economy (n = 5), and Digitally Mediated Services (n = 5). Firms are located in the United Kingdom (n = 7), United States (n = 9), Germany (n = 4), and the Netherlands (n = 4). Founding years range from 2016 to 2021, with a mean venture age of 5.5 years at the time of observation. The cross-sector and cross-country composition was intended to capture variation in how digitally enabled firms combine platform infrastructure, external partners, and limited internal employment.

Because the cases were selected partly on evidence of market reach and organizational smallness, the sample cannot be used to estimate the prevalence of invisible scaling or to determine why some firms achieve it while others do not. It is designed to document variation among cases that exhibit the broad configuration. The absence of a comparison group of digital SMEs following conventional internal growth trajectories limits causal and explanatory inference. The analysis is therefore presented as an exploratory comparison rather than a representative test of digital SME growth.

Table 2 here

4.4 Indicator Operationalization and Coding Procedures

The analysis distinguishes the defining outcome of invisible scaling from the mechanisms that may enable it. Market reach relative to internal organizational size is treated as the focal outcome. Platform dependency, algorithmic market access, ecosystem partners, and external resource use are treated as possible enabling characteristics. A composite invisible scaling score is retained only as a descriptive summary and is not used as a dependent variable in explanatory models, thereby avoiding overlap between the outcome and its proposed predictors.

FTE employment records the number of full-time equivalent employees reported for the relevant observation year. Where multiple headcount figures were available, preference was given to regulatory filings or dated company reports. Annual revenue records reported turnover for the

corresponding financial year. Revenue per FTE is calculated as annual revenue divided by FTE employment and is interpreted as an indicator of organizational resource productivity. It is not treated as a measure of energy, material, or environmental efficiency.

Market reach is captured using evidence on countries served, the geographic distribution of customers, and the proportion of revenue generated outside the firm's home market. The market reach index ranges from 0 to 1. Each component, its source, and the treatment of unavailable information are reported in the coding protocol. Where international revenue share or customer-geography diversity could not be verified, the index was not completed through researcher estimation. A simpler measure based on the number of countries served is therefore also identified as a robustness check.

Platform dependency captures the extent to which customer acquisition, distribution, payment, or service delivery relies on third-party digital platforms. It is coded using a documented multi-indicator rubric and normalized to a 0-to-1 scale for descriptive comparison; it should not be interpreted as a directly observed revenue share. The coding evaluates the number and strategic importance of platform-mediated activities, with full criteria and worked examples set out in the coding protocol.

Algorithmic market-access reliance captures evidence that customer discovery or commercial visibility depends materially on search rankings, recommendation systems, app-store placement, marketplace ranking, or comparable algorithmic processes. The indicator is expressed as a coded percentage estimate derived from traceable documentary evidence. Because it does not represent verified account-level analytics for every firm, it is interpreted as approximate and used cautiously in the exploratory analysis.

Ecosystem partners count records the number of identifiable external collaborators reported in firm documentation, including agencies, logistics providers, software integrators, and continuing specialist partners. The measure should be interpreted as the number of publicly observable partners rather than a complete census of every external relationship. Occasional suppliers and one-off contractors are excluded. External spend percentage is a coded documentary estimate based on reported expenditure and the externally provided core activities identifiable in firm records. Because audited expenditure ratios are not available for every case, the indicator is treated as approximate and interpreted cautiously.

The organizational decoupling index provides a descriptive representation of the relationship between market reach and internal size. It is calculated as:

$$\text{Organizational Decoupling Index} = \text{Market Reach Index} / \ln(\text{FTE} + 1)$$

The natural logarithm is used to reduce the disproportionate influence of differences in employee numbers within a very small range and to avoid an undefined value for zero. Higher values indicate greater market reach relative to internal employment within the present sample. The index is not interpreted as an environmental-decoupling measure, and its value has no inherent high or low meaning without a comparison group or external benchmark.

Sensitivity to this functional form is considered through three alternatives: market reach per FTE, the difference between standardized market reach and standardized log-transformed FTE, and countries served relative to FTE. Complete case-level inputs were not available for all alternative specifications, so these checks are identified as priorities for subsequent validation rather than presented as completed tests.

The composite invisible scaling score combines platform dependency, external expenditure, ecosystem-partner density, and market reach per FTE. It is reported descriptively to characterise the broader configuration but is not used as a dependent variable in explanatory regression models because this would create mechanical overlap with its component measures.

4.5 Source Triangulation and Coding Reliability

Each firm-level observation was checked against independent corroborating sources where possible. Because source availability varied by firm and variable, a uniform minimum number of sources was not imposed. Regulatory or audited records were treated as the preferred source for financial and employment information. Company disclosures were used for operating models, customer reach, platform relationships, and named partners. Commercial databases and trade reports were used principally for corroboration rather than as substitutes for unavailable firm-level evidence.

Variables requiring researcher judgement were coded using a written protocol specifying definitions, inclusion rules, exclusion rules, source priorities, and worked examples. A formal inter-coder reliability coefficient is not reported because the coding exercise was not designed as an independent double-coding study. Accordingly, judgement-based indicators are treated as provisional, and any future reliability claim should be based on a documented independent recoding exercise.

The supporting materials provide the full source matrix, coding protocol, case-level values, reconciliation decisions, and analysis code. No public repository location is claimed. Where confidentiality or database licensing restricts redistribution of a source document, the supporting file provides the complete citation, extraction details, and coded evidence without reproducing protected material.

4.6 Analytical Strategy

The analysis proceeds in five stages. Stage 1 audits the provenance, completeness, and coding status of each firm-level observation. Records lacking sufficient documentary support are reported as unavailable or converted from precise numerical estimates into broader qualitative indicators. Stage 2 reports descriptive statistics and firm-level distributions for employment, revenue, market reach, revenue per FTE, ecosystem partners, and the organizational decoupling measures. Medians, ranges, and individual case distributions are emphasised because the purposively selected sample is small.

Stage 3 specifies validation tests for the organizational decoupling index using the alternative formulas described above. Complete firm-level inputs were unavailable for all alternatives, so no rank-order stability, case-level comparison, or one-person-firm sensitivity result is reported. The sample mean is treated as a descriptive value and is not characterised as inherently high in the absence of an external benchmark.

Stage 4 compares emerging patterns across sectors and ecosystem configurations. Rather than dividing ecosystem-partner counts at the median, the analysis retains continuous information and uses case profiles and graphical comparisons. Particular attention is given to the contrast between platform-automated configurations, characterised by concentrated platform and algorithmic dependence, and partner-orchestrated configurations, characterised by broader external partner networks. Sector comparisons are treated as preliminary because the number of cases within each category is small.

Stage 5 reports selected Spearman correlations as exploratory descriptions of association. These coefficients are not presented as causal tests or as confirmation of the theoretical propositions. Two-sided p-values are reported where available. Confidence intervals are not presented because case-level ranks were unavailable for re-estimation. No moderation claim is made without an estimated interaction model, and no proposition is labelled supported or partially supported when its stated relationship has not been directly examined.

No OLS model is estimated for the composite invisible scaling score because several proposed predictors are incorporated into its construction and are highly collinear. Such a specification would generate mechanical associations rather than independent explanatory effects. The choice of statistical procedures is not based solely on the Shapiro-Wilk results for individual variables; model-based analyses require assessment of the assumptions relevant to their residuals and specification.

The analysis is intended to describe a preliminary set of cases, evaluate the usefulness of the reach-size decoupling measure, and identify patterns for subsequent testing with larger and more representative datasets. It does not establish causal effects or direct environmental consequences. The environmental interpretation remains exploratory because the evidence concerns organizational structure and the location of activities rather than emissions, energy use, material consumption, or lifecycle environmental performance.

5. Empirical Findings and Exploratory Results

The findings are presented as an exploratory description of variation within the 24 purposively selected firms. Because the cases were selected partly on evidence of substantial market reach and limited internal employment, the analysis does not estimate the prevalence of invisible scaling or explain why some digital SMEs achieve it while others do not. The results instead document the organizational characteristics of the cases, examine preliminary associations, and identify patterns that can inform subsequent testing. The theoretical propositions are therefore not classified as supported or partially supported.

5.1 Descriptive Statistics

Table 3 reports the descriptive statistics for the principal firm-level indicators retained after the source and coding audit. Annual revenue ranges from USD 295,000 to USD 3.2 million, with a mean of USD 1.21 million and a median of USD 955,000. This variation indicates that the cases differ substantially in their level of commercial activity. FTE employment ranges from 1 to 10, with a mean of 4.5 and a median of 4.0. Countries served range from 4 to 31, with a mean of 14.6 and a median of 13.5. The combination of limited internal employment and geographically dispersed activity is consistent with the reach-size pattern used to select the cases.

Revenue per FTE ranges from approximately USD 140,000 to USD 400,000, with a mean of USD 250,132 and a median of USD 251,944. These figures indicate considerable economic output

relative to internal employment, although they should be interpreted as measures of organizational resource productivity rather than environmental efficiency. They do not capture the labour, infrastructure, energy, logistics, or material resources supplied by actors outside the focal firm.

The number of publicly identifiable ecosystem partners ranges from 5 to 45, with a mean of 21.3 and a median of 19.0. This measure represents a minimum observable partner network rather than a complete record of every external relationship. The mean platform dependency score is 0.83, while the mean coded estimate of algorithmically mediated revenue is 68.5%. These documentary indicators suggest that external digital infrastructure is important across the sample, although the figures should be interpreted as approximate rather than as verified account-level analytics.

The composite invisible scaling score has a mean of 0.82 and a standard deviation of 0.10. It is reported only as a descriptive summary of the broader configuration. The principal analytical outcome remains market reach relative to organizational size, kept separate from platform dependency, external resource use, and ecosystem-partner structure.

Table 3 here

5.2 Exploratory Association Patterns

Table 4 reports selected Spearman rank correlations among the principal variables. The coefficients and their two-sided p-values are presented as exploratory descriptions rather than population estimates or tests of causal relationships. Given the small purposive sample and the absence of re-estimated case-level confidence intervals, the magnitude, direction, and substantive plausibility of each association receive greater emphasis than statistical significance alone.

The relationship between platform dependency and market reach is positive but modest (Spearman $r = 0.334$, two-sided $p = 0.111$). This pattern does not provide strong evidence that platform dependency alone is associated with greater market reach. It suggests instead that access to platform infrastructure may be one element within a wider growth configuration. Firms can rely heavily on digital platforms without necessarily achieving greater geographic or transactional reach, while firms with more extensive partner networks may scale through less platform-concentrated arrangements.

Ecosystem-partner count is positively associated with revenue per FTE (Spearman $r = 0.633$, two-sided $p < 0.001$). Although the coefficient is consistent with the possibility that external partner coordination supports organizational resource productivity, it does not establish that partner

orchestration causes higher productivity. Sector, business model, firm age, revenue composition, and the quality of external relationships may also account for this pattern.

Table 4 here

A particularly notable result is the strong negative association between ecosystem-partner count and platform dependency (Spearman $r = -0.946$, two-sided $p < 0.001$). Rather than treating this relationship as evidence of a single continuum of invisible scaling, it points to a possible distinction between two configurations. Some firms rely heavily on platform automation and a relatively limited number of external human partners. Others rely on broader partner networks while displaying lower dependence on a single platform or algorithmic access system. This contrast is examined further in Section 5.8.

Correlations involving coded revenue percentages are interpreted cautiously because firm-specific account-level evidence is not uniformly observable. Algorithmic revenue percentage and external spend percentage are therefore treated as documentary estimates rather than audited continuous measures. Their associations are used to identify exploratory patterns, not to support precise causal claims.

5.3 Platform Infrastructure Leverage and Market Reach

The evidence relevant to Proposition 1 concerns whether greater platform infrastructure leverage is associated with higher market reach relative to organizational size. The organizational decoupling index is therefore treated as the focal descriptive outcome, while platform dependency remains a separate enabling characteristic. This separation prevents the mechanism from being incorporated into the measure it is intended to explain.

The present evidence does not provide a direct coefficient between the platform-dependency measure and the organizational decoupling index because complete case-level observations were unavailable for re-estimation. This limitation prevents a direct proposition-level test. Any subsequent estimate should be interpreted cautiously because the platform measure is based on documentary coding and the cases were selected on evidence of market reach and organizational smallness. The analysis does not demonstrate that platform leverage produces reach-size decoupling.

The modest relationship between platform dependency and market reach alone indicates that platform access is not sufficient to explain the observed growth pattern. Platform infrastructure

may provide distribution, payment, customer-acquisition, or service-delivery capabilities, but firms still differ in their ability to combine these resources with complementary partners, internal capabilities, and viable business models. The evidence is therefore more consistent with a configurational interpretation than with a single-mechanism account.

Access to shared platform services may also reduce the need to reproduce certain capabilities within the focal firm. This interpretation concerns organizational structure and internal resource commitments. It does not establish that platform-mediated market access reduces total energy use, emissions, or other environmental effects.

5.4 Ecosystem Orchestration, Organizational Productivity, and Strategic Exposure

The evidence relevant to Proposition 2 concerns the relationship between ecosystem-partner structure, organizational resource productivity, and dependence on externally governed access conditions. Ecosystem-partner count is treated as a continuous measure to preserve variation across the small sample and is supplemented with case-level evidence about the functions performed by external actors.

The positive association between ecosystem-partner count and revenue per FTE (Spearman $r = 0.633$) suggests that firms coordinating larger observable partner networks also tend to generate greater revenue relative to internal employment. This pattern is consistent with the view that external partners can provide productive capacity without requiring every activity to be internalized. However, the result remains associational. It does not show that partner count itself creates productivity, nor does it capture differences in partner quality, contractual arrangements, coordination costs, or the amount of labour located outside the focal firm.

The observed strategic-exposure pattern shows that firms with broader partner networks tend to display lower platform dependency rather than greater algorithmic exposure. The evidence therefore does not support a general claim that ecosystem orchestration simultaneously increases productivity and platform exposure. Instead, it indicates that partner orchestration and platform automation may represent alternative ways of organizing external capacity. Platform-automated firms may face greater exposure to platform rules, rankings, and access conditions, whereas partner-orchestrated firms may face more dispersed coordination and relationship risks.

No conclusion about environmental performance follows directly from either configuration. Partner orchestration may locate labour, logistics, transport, and other activities outside the focal firm, while platform automation may rely more heavily on digital infrastructure and platform-

operated systems. Direct data on energy, emissions, material use, logistics, and external labour would be required to compare their environmental consequences.

5.5 Ecosystem Architecture and Growth Resilience

Proposition 3 concerns whether diversification of platform and partner relationships strengthens growth resilience. Here, growth resilience refers to the continuity and recovery of commercial growth rather than ecological sustainability. The cross-sectional analysis cannot test moderation because no interaction model or longitudinal measure of growth resilience is available.

Within the present cases, platform count is negatively associated with current revenue growth (Spearman $r = -0.841$, two-sided $p < 0.001$). This relationship should not be interpreted as evidence that platform diversification reduces growth because the temporal ordering is unknown. Firms may diversify after experiencing platform saturation, changes in visibility, or growth constraints. Alternatively, younger firms experiencing rapid growth may remain concentrated on one platform because they have not yet developed additional channels.

No moderation test is reported because a median-split comparison would discard variation and would not estimate an interaction effect. The present evidence supports only a descriptive observation: platform concentration, diversification, and current growth vary together within the selected cases, but their direction of influence cannot be determined. Testing whether ecosystem diversification strengthens growth resilience would require longitudinal data on platform portfolios, disruption events, revenue volatility, and recovery over time.

5.6 Sector-Level Patterns

The sector profiles show that invisible scaling is unlikely to follow a uniform pathway. Given the small number of cases in each category and the purposive sampling design, sector differences are presented descriptively rather than as population-level effects. Kruskal-Wallis significance tests based on unverified continuous estimates are not used as the main basis for interpretation.

Creator Economy ventures record the highest mean organizational decoupling index at 0.758 and a mean revenue per FTE of approximately USD 204,000 as shown in Table 5. Their case profiles indicate strong reliance on platform-mediated discovery and distribution, often combined with very limited internal employment. SaaS ventures have a mean decoupling index of 0.583 and mean revenue per FTE of USD 206,208. These firms commonly use cloud infrastructure, app marketplaces, self-service delivery, and digitally mediated customer acquisition.

Digital Commerce ventures have a lower mean decoupling index of 0.460 but the highest mean revenue per FTE at USD 351,302. Their profiles indicate more extensive reliance on logistics, fulfilment, payment, and specialist service partners. Digitally Mediated Services firms record the lowest mean decoupling index at 0.365 and mean revenue per FTE of USD 245,140. Their activities depend more heavily on human-mediated service delivery and client-specific interaction. These patterns reinforce the distinction between platform-automated and partner-orchestrated scaling. Creator Economy and SaaS cases generally display stronger platform-mediated configurations, whereas Digital Commerce and Digitally Mediated Services cases rely more extensively on external partner networks. The categories remain provisional and partly overlap. They should not be treated as fixed sector types or as evidence that every firm within a sector scales in the same manner.

The sector profiles also suggest different forms of external resource dependence. Platform-intensive cases rely more heavily on digital infrastructure and algorithmically governed market access. Partner-intensive cases depend more visibly on logistics, fulfilment, professional services, and distributed labour. These observations identify where resource use may be located, but they do not determine its total environmental magnitude.

Table 5 here

5.7 Organizational Decoupling and Robustness Checks

The organizational decoupling index is calculated as the market reach index divided by the natural logarithm of FTE plus one. It provides a descriptive measure of market reach relative to internal employment. Across the 24 selected cases, the mean value is 0.543 as shown in Table 6. This value is not described as inherently high because no external benchmark or comparison sample is available.

The index varies across firms and sectors. Creator Economy ventures have the highest mean value, followed by SaaS, Digital Commerce, and Digitally Mediated Services. The highest observed value, 1.024, belongs to a one-person Creator Economy case. This case illustrates the sensitivity of the index to very small employee counts and should not be treated as conclusive evidence of exceptional organizational decoupling without robustness analysis.

Three robustness alternatives are specified for the organizational decoupling index: market reach per FTE, the difference between standardized market reach and standardized log-transformed FTE, and countries served relative to FTE. Complete case-level inputs were unavailable for consistent

calculation across all alternatives and for the exclusion of one-person firms. Consequently, the correlation range, stability of sector ordering, and alternative sample means are not reported. These checks remain necessary validation analyses for subsequent research.

These checks are necessary because no single functional form can be treated as the definitive measure of reach-size decoupling. The logarithmic specification reduces the influence of differences in employee counts and avoids an undefined value at zero, but alternative measures place different weight on very small firms. The index is therefore presented as a preliminary descriptive tool requiring validation in a broader sample.

The index should not be interpreted as environmental decoupling. It measures the relationship between market reach and internal employment, not the relationship between economic growth and energy use, emissions, materials, or other environmental pressures.

Table 6 here

5.8 Configurations of Invisible Scaling

The combined findings point to two preliminary configurations rather than a single linear model of invisible scaling. The first is a platform-automated configuration. Firms in this group use digital platforms, self-service systems, and algorithmically mediated market access to reach customers while retaining a very small internal employee base. Their principal strategic exposure arises from concentrated dependence on platform rules, interfaces, rankings, and access conditions.

The second is a partner-orchestrated configuration. These firms coordinate broader networks of logistics providers, agencies, software integrators, independent professionals, and other external actors. They tend to display lower platform concentration and higher revenue per FTE, but their operating model requires the coordination of more dispersed relationships. Their principal exposure lies in partner reliability, service quality, contractual dependence, and the management of activities located outside the focal firm.

These configurations are preliminary and should not be treated as mutually exclusive categories. Some firms combine platform automation with substantial partner orchestration, while others may move between configurations as they grow. The distinction nevertheless provides a theoretically coherent interpretation of the strong negative relationship between platform dependency and partner count, indicating that external capacity can be organised through more than one configuration.

No multiple regression of the composite invisible scaling score is presented because platform dependency, external spend, and ecosystem-partner density contribute to the construction of that score. Entering the same measures as predictors would produce partly mechanical associations, compounded by severe multicollinearity and an unfavourable ratio of observations to predictors. The study therefore limits its quantitative claims to descriptive and exploratory associations. The findings consequently make a focused empirical claim. The 24 cases demonstrate that meaningful market reach can coexist with limited internal employment, and they reveal variation in how external digital and partner resources are organized. They do not establish that platform dependency or externalization causes invisible scaling, that ecosystem diversification moderates growth resilience, or that organizational leanness produces environmental efficiency. Those relationships remain propositions for future testing using larger, more representative, longitudinal, and environmentally informed datasets.

6. Theoretical Model

6.1 Core Conceptual Architecture

Building on the theoretical discussion and exploratory patterns identified in the cases, the conceptual model of invisible scaling is structured around three layers presented in Figure 1. The model distinguishes enabling conditions and scaling mechanisms from the defining outcome of invisible scaling. This separation is important because platform dependency, external resource access, and ecosystem orchestration may help explain invisible scaling, but they are not themselves evidence that the phenomenon has occurred.

Figure 1 here

The first layer identifies the enabling conditions that make externally supported growth possible in digitally mediated settings. These include: (a) standardized external infrastructures that perform functions once requiring substantial internal investment; (b) digital coordination technologies that reduce the cost of managing distributed activities and partners; and (c) platform governance systems that allocate visibility, distribution, and market access through digital interfaces and algorithmic processes. These conditions allow small firms to gain access to technological, operational, and market capabilities without owning or reproducing all of them internally (Nambisan, 2017; Autio et al., 2018; Jacobides et al., 2018).

These enabling conditions are widely available within many digital markets, but their availability does not automatically produce invisible scaling. Firms differ in their ability to select, combine, and coordinate external resources. Some firms use platform infrastructure while continuing to expand their internal employment and organizational structures. Others remain organizationally small but fail to achieve meaningful market reach. Invisible scaling arises only where external infrastructures and relationships substitute effectively for selected forms of internal capacity and support sustained market expansion.

The second layer specifies four mechanisms through which entrepreneurial firms may convert these conditions into growth outcomes: platform infrastructure leverage, ecosystem resource access, distributed value creation, and algorithmic market access. Platform infrastructure leverage refers to the use of externally provided systems for functions such as payment, distribution, hosting, fulfilment, and customer interaction. Ecosystem resource access concerns the use of external partners and specialist providers for capabilities not retained within the firm. Distributed value creation describes the coordination of productive activity across organizational boundaries. Algorithmic market access refers to customer discovery and commercial visibility mediated through search, ranking, recommendation, or marketplace systems (Srinivasan & Venkatraman, 2018; Nambisan et al., 2019).

These mechanisms are interdependent but need not be present in equal measure. The exploratory evidence suggests two broad configurations. In a platform-automated configuration, firms rely heavily on digital platforms, self-service systems, and algorithmically mediated customer access while coordinating relatively few external human partners. In a partner-orchestrated configuration, firms draw on broader networks of agencies, logistics providers, software integrators, independent professionals, and specialist service providers while displaying less concentrated platform dependence. These configurations are treated as ideal types rather than mutually exclusive categories. A firm may combine elements of both or move between them as its activities develop. The third layer captures the defining outcome of the model: market reach and economic activity expand more rapidly than internal organizational size. This reach-size decoupling distinguishes invisible scaling from conventional growth trajectories in which increasing market activity is accompanied by corresponding increases in employment, assets, and managerial structure. The organizational decoupling index provides a preliminary descriptive representation of this

relationship, but it is not part of the conceptual definition itself and does not establish the existence of a separate organizational form.

The model also distinguishes the defining outcome from its possible consequences. Invisible scaling may be associated with higher revenue relative to internal employment, lower accumulation of owned assets, and greater dependence on externally governed infrastructures. These consequences may differ between platform-automated and partner-orchestrated configurations. Platform-automated firms may face concentrated exposure to platform rules, ranking systems, and access decisions. Partner-orchestrated firms may face more dispersed risks associated with coordination, contractual relationships, service quality, and partner reliability.

The environmental implication of the model is deliberately narrower. Market expansion without proportionate internal asset accumulation may improve organizational resource productivity within the focal firm. It does not establish environmental efficiency. Energy consumption, logistics, transport, digital infrastructure, material use, and labour may remain distributed across platforms and ecosystem partners. The net environmental consequences therefore depend on resource use across the wider system rather than on the internal size of the focal firm alone (Hart, 1995; Hart & Dowell, 2011). Direct environmental measures would be required to determine whether invisible scaling reduces total resource use or shifts its location and reporting boundary.

6.2 Theoretical Propositions for Future Research

The secondary-data cases inform the development of the propositions but do not provide confirmatory tests of them. The purposive sample, cross-sectional design, measurement approach, and absence of a comparison group prevent causal conclusions. The propositions are therefore presented as theoretically grounded relationships for examination in larger, independently sampled, and preferably longitudinal studies.

Proposition 1: Platform infrastructure leverage and reach-size decoupling.

Digital platforms can provide small firms with access to distribution, payment, hosting, customer-acquisition, and service-delivery capabilities that would otherwise require greater internal investment. Platform access alone, however, is insufficient to produce invisible scaling. Its effect depends on whether the externally provided capabilities substitute for internal organizational capacity and can support sustained market activity. Platform use that merely complements proportional growth in employment or assets represents digitally enabled growth, but not invisible scaling.

The relevant outcome is therefore not market reach alone or a composite score containing platform dependency. It is market reach relative to internal organizational size. This relationship should be examined using an independently measured reach-size decoupling outcome and a platform-leverage measure that is not included in constructing that outcome.

Proposition 1: *Greater platform infrastructure leverage will be associated with stronger reach-size decoupling when externally provided platform capabilities substitute for, rather than merely complement, internal organizational capacity.*

This proposition does not imply that shared platform infrastructure improves environmental performance. It concerns the location and organization of productive capacity. Its environmental consequences depend on the resource intensity of the platform infrastructure and the activities it supports.

Proposition 2: Alternative scaling configurations and strategic exposure.

The case patterns indicate that invisible scaling may be achieved through different combinations of external resources. Platform-automated firms rely more heavily on standardized digital systems and algorithmically mediated market access. Partner-orchestrated firms coordinate broader networks of external organizations and specialist providers. Both configurations can support market expansion with limited internal employment, but they are likely to produce different forms of dependence.

Platform automation concentrates influence in the hands of platform operators and increases exposure to changes in ranking, access, fees, interfaces, and governance rules. Partner orchestration distributes productive activity across a wider network and may support higher revenue relative to internal employment, but it introduces coordination costs and dependence on the availability, reliability, and performance of external actors. The strong negative relationship observed between partner count and platform dependency in the exploratory cases is consistent with this distinction, although it does not confirm it.

Proposition 2: *Platform-automated and partner-orchestrated forms of invisible scaling will be associated with different patterns of strategic exposure: platform-automated configurations will exhibit greater dependence on platform governance and algorithmic access, whereas partner-orchestrated configurations will exhibit greater dependence on interorganizational coordination and partner reliability.*

This formulation separates ecosystem orchestration from algorithmic exposure rather than assuming that the same configuration necessarily produces both. It also avoids treating revenue per FTE as environmental efficiency. Revenue relative to internal employment reflects organizational productivity, while the wider resource and environmental effects remain outside the scope of that measure.

Proposition 3: Ecosystem diversification and growth resilience.

Firms that depend heavily on a single platform or a narrow set of ecosystem relationships may be particularly vulnerable to changes in access conditions, ranking systems, contractual terms, or partner availability. Diversifying platform and partner relationships may reduce this exposure by creating alternative routes to customers and productive resources. Diversification can also increase coordination costs and may initially coincide with slower growth as firms invest in additional channels and relationships.

The cross-sectional negative relationship between platform count and current revenue growth cannot establish whether diversification improves or weakens later performance. Firms may diversify in response to prior exposure, platform saturation, or growth constraints. A valid assessment requires longitudinal evidence showing platform concentration before a disruption, the nature of the disruption, subsequent changes in ecosystem architecture, and the firm's growth or recovery trajectory.

Proposition 3: *Among firms with high platform dependency, greater diversification of platform and partner relationships will weaken the adverse effect of platform disruption on subsequent growth resilience.*

Here, growth resilience refers to the continuity and recovery of commercial performance rather than ecological sustainability. Testing this proposition requires an interaction model or a longitudinal event-based design. A correlation between platform count and current revenue growth does not constitute a moderation test.

Taken together, the propositions explain invisible scaling as an outcome produced by the configuration of external resource access rather than by any single platform or partner characteristic. They also establish clear boundaries between organizational productivity, strategic exposure, growth resilience, and environmental performance. The present study provides exploratory evidence relevant to these relationships, but their causal direction, boundary conditions, and environmental consequences remain matters for future empirical testing.

7. Implications for Entrepreneurship and Sustainable Business Strategy

The exploratory evidence on invisible scaling carries several implications for entrepreneurship and sustainable business strategy. First, it directs attention to the analytical separation between market reach and internal organizational size. The organizational decoupling index provides a preliminary way of representing this relationship, but its sample mean should not be treated as inherently high without an external benchmark or comparison group. The more defensible conclusion is that the cases display meaningful variation in the extent to which market reach is achieved through limited internal employment. Conventional indicators such as headcount, asset ownership, or revenue per employee may therefore provide an incomplete account of entrepreneurial growth where important capabilities are accessed through platforms and external partners.

This observation contributes to firm-growth research by shifting attention from the amount of growth towards the organizational mode through which it occurs. Firms with similar levels of revenue or market reach may follow markedly different trajectories. Some build internal employment, assets, and managerial structures, while others access productive and market-facing capabilities through external digital infrastructures. Invisible scaling is not simply the use of platforms or outsourcing. It occurs where external resource access substitutes effectively for selected forms of internal capacity and produces sustained reach-size decoupling. Resource access may therefore complement resource ownership as a basis for entrepreneurial growth, although the present cases do not establish the causal importance of any single mechanism.

A second implication concerns the relationship between ecosystem architecture and entrepreneurial capability. Dynamic-capabilities research emphasises the capacity to sense changing conditions, seize emerging opportunities, and reconfigure organizational resources (Eisenhardt & Martin, 2000; Teece, 2007). Invisible scaling suggests that reconfiguration may increasingly extend beyond resources controlled directly by the firm. Entrepreneurs may need to evaluate platform concentration, reorganise partner portfolios, preserve alternative routes to customers, and adjust the balance between automated and human-mediated activities. These tasks point towards an ecosystem-level reconfiguration capability concerned with resources and relationships distributed across organizational boundaries.

The cross-sectional evidence does not show that diversification improves subsequent performance. Firms may add platforms or partners after experiencing declining visibility, saturation, or prior

growth constraints. Diversification may therefore be a response to vulnerability rather than its solution. The theoretical implication is that ecosystem reconfiguration should be understood as a temporal process. Its value depends on when diversification occurs, which dependencies it reduces, and whether the new relationships provide genuinely independent routes to customers and resources. Longitudinal evidence is required before this capability can be linked to growth resilience.

Third, the findings suggest that invisible scaling is better understood as a configurational form of growth than as a single homogeneous pathway. The contrast between ecosystem-partner count and platform dependency points towards two broad configurations. Platform-automated firms rely more heavily on standardized digital infrastructure, self-service delivery, and algorithmically mediated market access. Partner-orchestrated firms depend on broader networks of logistics providers, agencies, software integrators, independent professionals, and other external actors. Both configurations can support market expansion without substantial internal enlargement, but they create different managerial demands and forms of strategic exposure.

Platform-automated firms may face concentrated dependence on platform governance, including changes in fees, interfaces, rankings, recommendation systems, and access conditions. Partner-orchestrated firms may be less exposed to a single digital intermediary but more dependent on contractual coordination, partner reliability, and service quality. These configurations are not mutually exclusive, and firms may combine or move between them. Their value lies in clarifying why platform dependence and partner orchestration should not be combined uncritically within a single invisible-scaling score.

The descriptive sector patterns are consistent with this configurational interpretation. Creator Economy and SaaS cases tend to display stronger reliance on digital distribution and algorithmically mediated discovery, while Digital Commerce and Digitally Mediated Services cases depend more visibly on logistics, fulfilment, professional services, and human coordination. These differences should not be interpreted as statistically established sector effects because the groups are small and purposively selected. They nevertheless indicate that sector, business model, firm age, revenue structure, and task characteristics may shape the form that invisible scaling takes. The boundary conditions are equally important. Invisible scaling is less likely where value creation depends on substantial firm-specific physical assets, close internal supervision, tacit knowledge that cannot be transferred readily, or production processes requiring continuing organizational

control. It is also unlikely where platform use merely complements proportional internal expansion. The concept is most relevant where activities can be standardized, divided across organizational boundaries, digitally coordinated, and accessed without significant growth in the focal firm's internal capacity.

Alternative explanations must also be recognised. High revenue per employee may reflect favourable margins, founder-intensive labour, intellectual-property income, sector characteristics, or under-recorded external labour rather than superior ecosystem coordination. Similarly, a small internal workforce may result from venture age, temporary staffing choices, or incomplete employment reporting. The present study therefore identifies patterns requiring further explanation rather than demonstrating that external resource access is their sole cause.

The environmental contribution follows from this boundary argument rather than from evidence of direct environmental improvement. Invisible scaling can make the focal firm appear lean because employment, assets, and operational activities remain limited within its formal boundary. However, organizational leanness and revenue per employee are not measures of environmental performance. Energy use, emissions, transport, packaging, digital infrastructure, material consumption, and labour may be located within the platforms and partner networks that support the venture's activities.

Sustainable business strategy should therefore distinguish focal-firm organizational resource productivity from ecosystem-level environmental performance. This distinction is consistent with the natural-resource-based view, which connects competitive advantage with the management of environmental resources and constraints (Hart, 1995; Hart & Dowell, 2011), but extends the assessment boundary beyond resources controlled directly by the firm. Where value creation depends on external digital and logistical infrastructures, environmental responsibility cannot be evaluated adequately from the focal SME's internal footprint alone.

The study does not determine whether platform-automated or partner-orchestrated scaling has lower environmental consequences. Platform-based models may rely heavily on data centres and digital infrastructure, while partner-based models may involve more transport, logistics, materials, and distributed labour. Direct evidence on energy consumption, greenhouse-gas emissions, material flows, logistics intensity, and relevant Scope 3 activities would be needed to compare these configurations. The contribution is therefore to identify a problem of environmental assessment, not to claim that invisible scaling is environmentally efficient.

Taken together, these implications position invisible scaling as a preliminary framework for examining how entrepreneurial growth is organized across firm and ecosystem boundaries. The concept helps explain why market reach, internal organizational size, and ecosystem resource use should be treated as related but distinct dimensions. It also shows that the strategic advantages of external resource access are accompanied by new dependencies and uncertain environmental consequences. These relationships require further testing, but they provide a clearer basis for connecting digital entrepreneurship, ecosystem strategy, and environmental responsibility.

8. Implications for Managers, Platforms, and Environmental Policy

The practical implications should be interpreted in light of the study's exploratory design. The 24 cases illustrate how digitally enabled firms can combine limited internal employment with substantial market activity, but they do not establish causal effects or represent the wider population of digital SMEs. The following implications therefore identify issues that entrepreneurs, platform operators, and policymakers may need to consider rather than practices whose performance effects have been confirmed by the present data.

8.1 For Entrepreneurs

For entrepreneurs, the central implication is that a limited internal organization does not remove the need to manage resources and dependencies. Invisible scaling changes where these resources are located and how they are governed. Entrepreneurs may coordinate fewer employees and own fewer assets, but they can remain dependent on platforms, logistics providers, agencies, software integrators, independent professionals, and other external actors. Managing invisible scaling therefore requires attention to the wider operating system surrounding the firm rather than to internal capacity alone.

Platform dependency should be monitored as a strategic exposure, particularly where customer discovery, distribution, payment, or service delivery depends on a small number of externally governed systems. Entrepreneurs can map which activities depend on each platform, identify functions for which no immediate alternative exists, and assess the consequences of changes in fees, visibility, access rules, or technical interfaces. Developing alternative customer-acquisition routes, maintaining portable customer data where permitted, and avoiding unnecessary concentration may reduce exposure. However, the present study does not show that diversification automatically improves growth. Additional platforms and partners can also increase cost and

coordination demands, and diversification may occur only after a firm has already encountered growth constraints.

The distinction between platform-automated and partner-orchestrated scaling suggests different managerial priorities. Platform-automated ventures should pay particular attention to algorithmic visibility, changes in platform governance, and dependence on self-service infrastructures. Partner-orchestrated ventures require stronger processes for selecting, coordinating, and reviewing external providers. Service continuity, contractual clarity, partner reliability, data access, and the ability to replace important collaborators may be more consequential for these firms. Many ventures will combine both configurations and will therefore need to manage platform concentration and partner coordination simultaneously.

The preliminary sector patterns also indicate that risk management should reflect the firm's operating model. Creator Economy and SaaS ventures may depend more heavily on digital distribution, platform-mediated discovery, and cloud-based delivery. Digital Commerce firms may be more exposed to logistics, fulfilment, inventory, packaging, and delivery partners. Digitally Mediated Services firms may depend more strongly on external professional labour and client-specific coordination. These patterns are descriptive rather than prescriptive, but they help identify the types of dependency that may require attention.

Entrepreneurs should also avoid treating a small employee base or limited ownership of assets as evidence of strong environmental performance. An ecosystem resource review can identify which activities are performed internally, which are supplied externally, and where significant energy, transport, material, packaging, and labour requirements may be located. Such a review cannot replace a formal environmental assessment, but it can prevent the focal firm's organizational leanness from being mistaken for ecosystem-level environmental efficiency. Where environmental data are available, supplier and platform selection can include evidence on emissions reporting, energy sources, logistics practices, material use, and relevant environmental standards.

8.2 For Platform Operators

Invisible scaling also has implications for platform operators because small firms may depend on platform-controlled infrastructure for visibility, distribution, transactions, and customer relationships. Platform governance is therefore not merely a technical concern. Changes in ranking systems, interfaces, fees, eligibility rules, data access, or account status can affect the commercial

continuity of entrepreneurial participants. This asymmetry is particularly important where a venture has few alternative routes to its customers (Jacobides et al., 2018; Nambisan et al., 2019). Platform operators can reduce avoidable uncertainty by communicating material rule and interface changes clearly and with reasonable notice. Transparent explanations of performance criteria, accessible appeal processes, and proportionate account-review procedures may help smaller participants respond to changes without assuming that algorithms or governance rules will remain fixed. Portability mechanisms can also reduce excessive dependence by allowing firms, subject to privacy and legal requirements, to retain appropriate customer, transaction, and performance information when using additional channels.

These measures should not be presented as empirically demonstrated outcomes of the current study. They follow from the governance dependence identified by the conceptual model and case patterns. Further research is needed to determine which governance practices improve venture resilience without undermining platform integrity, consumer protection, or competitive incentives. Platform operators also occupy an important position in ecosystem-level environmental reporting. Because shared digital, fulfilment, and logistics infrastructures support large numbers of smaller firms, environmental information held by the platform may be necessary for those firms to assess their wider footprint. Platform-level reporting on energy consumption, renewable-energy use, data-centre efficiency, delivery emissions, packaging, returns, and other material activities could help participating SMEs understand impacts that are not visible within their own organizational records.

The study does not show that shared platform infrastructure necessarily reduces total environmental effects. Shared systems may avoid some duplication, but they can also support greater transaction volumes and associated energy, logistics, or material use. Environmental reporting should therefore include absolute impacts as well as efficiency measures where feasible. Clear allocation methods would also be needed before platform-level resource use could be attributed credibly to individual participating firms.

8.3 For Policymakers

For policymakers, invisible scaling raises a measurement issue. Employment remains an important indicator of firm size, but it may not capture the market reach, platform dependence, or externally coordinated activity of digitally enabled ventures. SME support and growth assessments could therefore complement employment-based classifications with indicators of customer reach,

digital-channel concentration, platform portfolios, revenue patterns, and reliance on external partners. Such indicators should supplement rather than replace established measures, particularly because the organizational decoupling index remains preliminary and has not been validated against a representative comparison group.

Policy frameworks should also recognise that some small ventures operate within highly concentrated systems of digital intermediation. A firm may be small in employment terms yet commercially dependent on a platform operator with considerable influence over visibility, distribution, transactions, or access to customers. This creates potential concerns for competition, procedural fairness, data portability, and business continuity. Regulatory attention may be warranted where rule changes, account restrictions, or ranking systems can materially affect smaller participants and where effective alternative channels are limited.

The present evidence does not determine whether additional regulation would improve SME performance or ecosystem resilience. It does, however, indicate that the governance conditions surrounding platform participation form part of the growth environment of digital SMEs. Policy assessment should therefore consider not only whether firms can access a platform, but also the terms under which access is maintained, modified, suspended, or transferred.

Environmental policy presents a related boundary problem. Firms with few internal assets may have limited direct emissions while depending extensively on cloud services, digital marketplaces, logistics systems, and external providers. Environmental reporting confined to the focal SME may therefore omit material activities elsewhere in its value chain. This concern is consistent with the wider argument that environmental responsibility can extend beyond resources directly controlled by the firm (Hart, 1995; Hart & Dowell, 2011).

Policymakers could encourage proportionate ecosystem-level disclosure from major platform, cloud, fulfilment, and logistics providers. Standardised information on relevant energy use, emissions, packaging, transport, and other environmental indicators would help SMEs assess their external dependencies. Support programmes could also provide smaller firms with practical methods for identifying environmentally significant partners and interpreting relevant Scope 3 information. These proposals remain policy implications of the conceptual argument rather than direct findings on environmental performance.

9. Limitations

This study has several limitations that define the scope of its contribution. First, the sample contains 24 purposively selected firms exhibiting substantial market reach and limited internal employment. Because firms were selected partly on the defining outcome, the study cannot estimate how common invisible scaling is, explain why some digital SMEs achieve it while others do not, or compare invisible scaling with conventional internal growth. The findings describe variation within the selected phenomenon rather than relationships that can be generalised statistically to a wider population.

Second, the cross-sectional design limits causal and temporal interpretation. Platform dependency, partner structure, revenue growth, and organizational size were observed within a limited period. Their ordering cannot be established. Firms may diversify platform relationships because of prior exposure or declining growth, rather than diversification determining subsequent performance. Similarly, high revenue per employee may precede external partner development or result from sector characteristics, favourable margins, intellectual property, or founder-intensive labour. Longitudinal data would be required to separate these possibilities.

Third, the secondary sources vary in coverage, timing, and reliability. Regulatory filings provide relatively strong evidence for revenue and employment but offer limited information on platform relationships, customer acquisition, external labour, and partner networks. Company statements and commercial databases provide wider coverage but may use different definitions or reporting periods. Publicly visible partner counts represent minimum observable networks rather than complete records of external relationships.

Private platform dashboards were not assumed to be publicly accessible. Measures such as algorithmic revenue percentage and external spend percentage cannot be treated as precise continuous variables where firm-specific account or expenditure evidence is unavailable. Uncertain observations were coded qualitatively or reported as unavailable, and the numerical estimates that remain are interpreted cautiously. Even with source triangulation, some measurement uncertainty persists.

Fourth, the organizational decoupling index is preliminary. Its value depends on the construction of the market reach measure and the functional relationship specified between reach and FTE employment. Very small employee counts, particularly one-person firms, can influence the resulting rankings. Alternative specifications and sensitivity tests are needed, but consistent case-

level inputs are not available across all measures. The sample mean has no inherent interpretation without a benchmark or comparison group.

Fifth, the study does not capture the full employment or resource footprint of the firms. Low internal employment may coexist with substantial use of freelancers, agencies, logistics workers, software providers, and other external labour. Revenue per FTE therefore measures output relative to recorded internal employment, not total labour productivity across the ecosystem. More complete evidence on external work and service inputs could change the interpretation of organizational leanness.

Sixth, the four sector categories provide a useful descriptive structure but remain provisional. Creator Economy, SaaS, Digital Commerce, and Digitally Mediated Services firms vary internally, and some cases may combine characteristics of more than one category. The small number of firms in each group also prevents strong claims about sector-level differences. The platform-automated and partner-orchestrated configurations should similarly be treated as preliminary ideal types rather than established classifications.

Finally, the study contains no direct measures of energy use, greenhouse-gas emissions, material consumption, packaging, transport intensity, cloud-computing demand, or lifecycle environmental impacts. Revenue per FTE, organizational decoupling, and external resource use are not environmental-performance measures. The study therefore cannot determine whether invisible scaling reduces total resource consumption, improves environmental efficiency, creates rebound effects, or transfers environmental pressures beyond the focal firm. Its environmental contribution is limited to identifying the need for a wider assessment boundary.

10. Future Research Agenda

The exploratory analysis opens several directions for empirical and theoretical research. First, future studies should construct broader samples containing both invisible-scaling and comparison firms. Relevant comparison groups include digitally enabled SMEs with limited market reach, firms that scale through internal employment and asset growth, and firms combining internal expansion with external ecosystems. A transparent sampling frame would allow researchers to estimate the prevalence of invisible scaling and examine which conditions distinguish it from other growth trajectories.

Second, the organizational decoupling index requires further validation. Research should compare alternative measures of market reach, internal organizational size, assets, transaction volume, and

external capacity. Market reach per employee, residuals from reach-on-size models, elasticity-based measures, and standardized distance scores should be evaluated across larger samples. Studies should also examine sensitivity to one-person firms, sector, venture age, national context, and the treatment of external labour. This would clarify whether reach-size decoupling is a stable construct or varies according to measurement choices.

Third, longitudinal data are needed to test the theoretical propositions. Panel studies could track platform dependency, partner structures, employee growth, customer reach, revenue volatility, and ecosystem changes over time. This would allow researchers to examine whether external resource access precedes reach-size decoupling, follows prior growth, or develops jointly with it. Longitudinal designs are particularly important for testing whether ecosystem diversification weakens the effect of platform disruption on subsequent growth resilience.

Fourth, future research should refine the distinction between platform-automated and partner-orchestrated scaling. Larger datasets could examine whether these configurations arise inductively and whether hybrid forms are common. Comparative case studies, cluster analysis, and configurational methods could test how platform dependence, partner breadth, task characteristics, sector, and internal capabilities combine to produce different reach-size outcomes. Such studies should avoid assuming that all forms of externalization belong to a single linear construct.

Fifth, strategic exposure requires direct measurement. Research could examine platform suspensions, ranking changes, fee increases, interface modifications, logistics failures, partner withdrawal, and other disruption events. Relevant outcomes include revenue volatility, customer loss, recovery time, channel substitution, and changes in organizational structure. Event-based and longitudinal designs would help determine which ecosystem architectures improve resilience and which merely redistribute risk.

Sixth, the wider employment implications of invisible scaling merit systematic analysis. Future studies should estimate internal and external labour together, including freelancers, agency workers, logistics personnel, specialist contractors, and platform-mediated service providers. This would clarify whether invisible scaling reduces total labour requirements, changes employment relationships, or relocates work beyond the focal firm's formal boundary.

Seventh, the relationship between invisible scaling and innovation remains uncertain. Organizational leanness may allow firms to experiment rapidly by accessing external capabilities, but dependence on standardized platforms and providers may also constrain differentiation or

long-term capability development. Research linking reach-size decoupling with product launches, service development, patents, customer experimentation, and capability accumulation could examine these competing possibilities.

Finally, future studies should assess environmental performance directly. Relevant measures include Scope 1 and Scope 2 emissions, material Scope 3 categories, cloud-energy estimates, data-centre use, delivery emissions, transport distance, packaging, returns, material consumption, and lifecycle indicators. Such evidence would allow researchers to compare the focal firm's organizational footprint with the total resource demands of the ecosystem through which its activities are delivered.

Environmental research should also compare platform-automated and partner-orchestrated configurations. Digital-service models may concentrate impacts in data infrastructure and electricity use, while commerce and partner-intensive models may involve more logistics, materials, packaging, and distributed labour. Absolute environmental impacts should be considered alongside efficiency measures because increased market activity may offset reductions in resource use per transaction. Only through such evidence can researchers determine whether invisible scaling produces environmental improvement, burden transfer, or a mixture of both.

11. Conclusion

This study introduced invisible scaling as a digitally mediated growth configuration in which entrepreneurial firms expand market reach and economic activity without proportionate growth in internal employment and organizational infrastructure. Evidence from 24 purposively selected digital SMEs illustrates that meaningful commercial and geographic reach can coexist with a limited internal organizational base. The study does not establish that platform dependency, ecosystem orchestration, or algorithmic market access causes this outcome. Instead, it documents variation within the phenomenon and develops a preliminary conceptual model for future testing. The findings also suggest that invisible scaling may take more than one form. Platform-automated configurations rely heavily on digital infrastructure, self-service systems, and algorithmically mediated market access. Partner-orchestrated configurations depend more extensively on logistics providers, agencies, software integrators, independent professionals, and other external actors. Both can support reach-size decoupling, but they create different coordination demands and forms of strategic exposure.

For entrepreneurship research, the central contribution is to separate market growth from internal organizational enlargement and to distinguish the defining outcome from the mechanisms that may produce it. Resource access can substitute for selected forms of resource ownership, but the effectiveness and risks of this substitution depend on the wider ecosystem. The framework therefore connects firm growth, platform participation, and ecosystem coordination without treating them as interchangeable constructs.

For sustainable business strategy, the principal implication is one of assessment boundaries. Organizational leanness and revenue per employee may indicate internal resource productivity, but they do not demonstrate environmental efficiency. Platforms and partners may carry energy use, emissions, transport, materials, labour, and other resource demands outside the formal boundary of the focal firm. Invisible scaling should therefore be assessed at both firm and ecosystem levels.

The environmental implications advanced here remain conceptual because the dataset contains no direct environmental-performance measures. Future research must test whether invisible scaling reduces total resource use, shifts environmental pressures to external actors, or produces different outcomes across platform-automated and partner-orchestrated configurations. With these limitations recognised, invisible scaling offers a focused basis for examining how digital SMEs expand through external infrastructures while retaining a limited internal organizational base.

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Table 1. Invisible Scaling in Relation to Adjacent Concepts

Concept	Definition	Primary unit of analysis	Principal mechanism	Main outcome	Key boundary condition	Distinction from invisible scaling
Hollow firm	An organization that retains a small coordinating core while externalizing many operating activities	Firm and its organizational boundaries	External contracting and coordination	Reduced internal scope	Externalized activities need not generate greater market reach	Explains organizational externalization rather than reach-size decoupling
Outsourcing	Transfer of selected activities to external providers	Activity or transaction	Contractual delegation	Lower costs, flexibility, or access to specialist capabilities	Can occur without changes in firm growth or market reach	Invisible scaling requires an observable growth outcome, not externalization alone
Asset-light business model	A model based on limited ownership of physical or productive assets	Business model	Access to assets rather than ownership	Lower capital intensity	Asset-light firms may still expand employment and organizational structures	Focuses on asset ownership rather than the relationship between reach and organizational size
Network organization	A firm embedded in continuing relationships with external organizations	Interorganizational network	Relational coordination and resource exchange	Joint value creation and flexibility	Network participation may support stability rather than scaling	Invisible scaling focuses on growth achieved without proportionate internal expansion
Modular organization	An organization in which separable activities or components can be recombined across standardized interfaces	Organizational architecture	Modularity and interface standardization	Flexibility and recombination	Modularity does not necessarily produce substantial market growth	Modularity can enable invisible scaling but is not its defining outcome

Boundaryless firm	An organization with permeable internal and external boundaries	Organizational form	Cross-boundary collaboration	Flexibility and knowledge exchange	Permeable boundaries can coexist with substantial internal growth	Emphasises boundary permeability rather than reach-size decoupling
Born-global firm	A young firm that enters multiple international markets rapidly	Firm and internationalization pathway	Early international market orientation	Rapid internationalization	The firm may expand its workforce and assets as it internationalizes	International reach is one possible expression of invisible scaling
Virtual organization	A distributed organization coordinated through information technologies	Organizational form	Technology-enabled coordination	Flexible and dispersed operations	Virtual structures may exist without significant scaling	Invisible scaling concerns the growth consequence rather than virtualization itself
Platform complementor	A firm that creates value through participation in a platform ecosystem	Platform participant	Access to platform infrastructure, users, and complementary resources	Platform-mediated value creation	Complementors may internalize resources as they grow	Platform participation is a mechanism, not evidence of invisible scaling by itself
Digitally enabled scaling	Expansion supported by digital technologies and infrastructures	Venture growth process	Digital replication, automation, and market access	Rapid extensive growth or	Digital growth may still involve proportional organizational enlargement	Invisible scaling specifies growth without corresponding internal expansion
Invisible scaling	Sustained expansion of market reach and economic activity without proportionate internal organizational growth	Relationship between external reach and internal organizational trajectory	Platform-mediated resource access and external ecosystem coordination	Reach-size decoupling	Requires verified market expansion, limited internal enlargement, and sustained external mediation	Makes the divergence between market reach and organizational size the focal outcome

Table 2. Sample Characteristics of Digitally Enabled SMEs Included in the Secondary Dataset

Characteristic	Value	Notes
Sample size (N)	24 firms	
Countries	4 (UK, US, Germany, Netherlands)	UK = 7, US = 9, DE = 4, NL = 4
Sector categories	4	SaaS = 8, DC = 6, CE = 5, DMS = 5
Founding year range	2016 to 2021	Mean = 2018.5
Mean FTE employees	4.5 (SD = 2.4)	Range: 1 to 10
Mean annual revenue	\$1.21M (SD = \$864K)	Range: \$295K to \$3.2M
Mean countries served	14.6 (SD = 7.7)	Range: 4 to 31
Mean platform dependency score	0.83 (SD = 0.11)	Scale: 0 to 1
Mean ecosystem partners	21.3 (SD = 12.4)	Range: 5 to 45
Mean revenue per FTE	\$250,132 (SD = \$76,741)	

Note. DC = Digital Commerce; CE = Creator Economy; DMS = Digitally Mediated Services. All monetary values are reported in USD.

Table 3. Descriptive Statistics and Normality Tests for Key Study Variables

Variable	Mean	SD	Min	Median	Max	Normal?
FTE Employees	4.50	2.38	1	4.0	10	Yes (W = 0.933, p = 0.111)
Annual Revenue (USD)	\$1,205,208	\$864,434	\$295K	\$955K	\$3.2M	No (W = 0.885, p = 0.011)
Countries Served	14.62	7.69	4	13.5	31	Yes (W = 0.950, p = 0.272)
Platform Dependency Score	0.83	0.11	0.62	0.85	0.97	Yes (W = 0.936, p = 0.134)
Ecosystem Partners Count	21.33	12.42	5	19.0	45	Yes (W = 0.933, p = 0.111)
Revenue per FTE (USD)	\$250,132	\$76,741	\$140K	\$251,944	\$400K	Yes (W = 0.951, p = 0.283)
Market Reach Index	0.81	0.08	0.68	0.80	0.95	Yes (W = 0.930, p = 0.097)
External Spend (%)	75.75	11.51	55.7	77.1	93.8	Yes (W = 0.957, p = 0.374)
Algorithmic Revenue (%)	68.51	20.10	34.2	73.7	96.1	Yes (W = 0.927, p = 0.082)
Invisible Scaling Score	0.82	0.10	0.62	0.86	0.93	No (W = 0.887, p = 0.011)
Revenue Growth YoY (%)	51.55	18.36	22.1	49.1	88.1	Yes (W = 0.967, p = 0.582)

Note. Normality assessed by Shapiro-Wilk test (n = 24). Platform dependency is a normalized documentary score; algorithmic revenue and external spend are coded estimates rather than audited account-level measures. Non-normal variables were examined using non-parametric methods in the exploratory tests.

Table 4. Spearman Rank Correlation Matrix for Core Invisible Scaling Variables

Variable	1	2	3	4	5	6	7
1. Platform Dependency	1.000	- 0.946***	0.974***	0.992***	0.334	-0.555**	0.971***
2. Ecosystem Partners	- 0.946***	1.000	- 0.891***	- 0.968***	-0.175	0.633***	- 0.888***
3. Algorithmic Rev %	0.974***	- 0.891***	1.000	0.958***	0.355	-0.537**	0.964***
4. External Spend %	0.992***	- 0.968***	0.958***	1.000	0.297	- 0.595***	0.961***
5. Market Reach Index	0.334	-0.175	0.355	0.297	1.000	-0.193	0.426*
6. Revenue per FTE	-0.555**	0.633***	-0.537**	- 0.595***	-0.193	1.000	-0.538**
7. Invisible Scaling	0.971***	- 0.888***	0.964***	0.961***	0.426*	-0.538**	1.000

Note. Spearman rho coefficients; n = 24. *p < 0.05, **p < 0.01, ***p < 0.001.

Table 5. Sector-Level Heterogeneity in Invisible Scaling, Algorithmic Dependence, and Revenue Efficiency

Sector	N	Inv. Scaling Score	Algorithmic Rev (%)	Rev/FTE (USD)	Platform Dep.	Eco. Partners
Creator Economy	5	0.914	94.1%	\$204,000	0.956	6.6
SaaS	8	0.890	78.1%	\$206,208	0.888	15.8
Digital Commerce	6	0.773	58.8%	\$351,302	0.762	32.3
Digitally Mediated Services	5	0.680	39.2%	\$245,140	0.696	31.8
Kruskal-Wallis H		19.41***	21.41***	14.30**	19.89***	21.30***

Note. **p < 0.01, ***p < 0.001 (Kruskal-Wallis H test, df = 3). Monetary values in USD.

Table 6. Organizational Decoupling Index by Sector Category

Sector Category	Mean Decoupling Index	Mean Market Reach Index	Mean FTE	Mean Inv. Scaling Score
Creator Economy	0.758	0.750	1.8	0.914
SaaS	0.583	0.900	3.9	0.890
Digital Commerce	0.460	0.817	5.8	0.773
Digitally Mediated Services	0.365	0.708	7.0	0.680
Overall (N = 24)	0.543	0.810	4.5	0.820

Note. Organizational decoupling index = market reach index / $\log(\text{FTE} + 1)$. Higher values indicate greater decoupling of market reach from organizational size.