Digital Business Models and Startup Resilience: Evidence from Post-COVID Recovery

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Abstract

This study investigates the influence of digital business models and digital ecosystem maturity on the survival prospects of startups in the post-pandemic economy. Drawing on a mixed-methods approach, the research combines survey data from 1,042 startups across Europe and Southeast Asia with econometric analyses, including probit regression and robustness checks. The results suggest that digital business model adoption, digital capabilities, and ecosystem maturity are significant predictors of startup survival, while traditional firm characteristics such as age and size exhibit limited explanatory power. The findings highlight the critical role of digital readiness and supportive ecosystem conditions in enhancing resilience. The study offers policy recommendations emphasizing investments in digital capabilities, ecosystem infrastructure, and flexible regulatory frameworks that encourage business model innovation. These insights contribute to ongoing discussions on entrepreneurial resilience and digital transformation, particularly in contexts marked by rapid technological change and external shocks.

Keywords: Startup Survival, Digital Business Models, Digital Capabilities, Ecosystem Maturity, Entrepreneurial Resilience, Post-Pandemic Economy

1. Introduction

The COVID-19 pandemic has profoundly reshaped the global economic landscape, placing unprecedented strain on startups and early-stage ventures. As economies navigated successive lockdowns, supply chain disruptions, and shifts in consumer behaviour, the survival and resilience of startups became a pressing concern for scholars, policymakers, and entrepreneurs alike. In this context, the adoption of digital business modelshas emerged as a potentially decisive factor in determining which startups thrive in the post-pandemic economy (Ghezzi & Cavallo, 2020; Margherita & Heikkilä, 2021). Despite the growing discourse on digitalization, empirical evidence that systematically links specific digital strategies to startup resilience remains fragmented and inconclusive, particularly in the context of recovery from large-scale economic shocks.

Recent studies suggest that digital business models may enhance firm adaptability by enabling rapid reconfiguration of value propositions, supply chains, and customer interactions (Liu et al., 2021). Startups that pivoted towards e-commerce or platform-based approaches during the pandemic often reported greater operational continuity and customer engagement (Li et al., 2023). Yet, these insights have largely been drawn from sector-specific or regionally constrained studies, limiting the generalizability of findings across broader entrepreneurial ecosystems. Furthermore, the mechanisms through which digitalization contributes to startup survivalremain underexplored. Addressing this gap is vital to inform both startup strategy and policy frameworks aimed at fostering resilient entrepreneurial ecosystems in the aftermath of COVID-19.

Against this backdrop, this study pursues three interrelated research objectives. First, it seeks to examine the extent to which digital business models contribute to startup survival in the post-pandemic economy. This objective is motivated by the need to empirically assess whether digitalization provides startups with a statistically significant advantage in navigating post-crisis market conditions. By integrating data from a large-scale survey of startups with regression analysis, the study aims to isolate the effects of digital business model adoption from other firm-level and contextual factors. In doing so, it builds on the work of Obwegeser and Papadopoulos

(2021), who argue that digital transformation can act as a buffer against environmental uncertainty, though evidence specific to startups and post-pandemic recovery remains sparse.

The second research objective is to investigate how different types of digital business modelsaffect startup growth trajectories. While prior literature highlights that digital platforms can enable scalability and ecosystem participation (Nambisan et al., 2020), it is unclear whether certain configurations are better suited to fostering sustained growth in the volatile post-COVID market. Through qualitative case studies of startups that successfully scaled their digital business models, this study seeks to uncover context-dependent factors and strategic choices that underpin effective digital scaling.

Finally, the study aims to explore the role of digital capabilities in mediating the relationship between business model digitalization and resilience outcomes. While digital tools and platforms can provide the structural foundation for innovative business models, their effectiveness may hinge on the development of complementary capabilities(Zaheer et al., 2023). By combining quantitative and qualitative evidence, the study endeavours to illuminate how startups can better align digital investments with organizational competencies to enhance resilience in turbulent environments.

In pursuing these objectives, the study adopts a mixed-methods approach that integrates survey-based econometric analysis with qualitative case studies of post-pandemic startup success stories. This design allows for both generalizable insights and rich contextual understanding of how digital business models function in practice. The findings are expected to contribute to the emerging body of knowledge on digital entrepreneurship and crisis resilience, while offering actionable recommendations for startup founders and policymakers seeking to build more robust entrepreneurial ecosystems in the wake of systemic disruptions.

2. Empirical Review

The empirical literature examining the relationship between digital business models and startup resilience has grown substantially in the aftermath of the COVID-19 pandemic, reflecting increasing scholarly interest in how digitalization may shape firm survival and growth during systemic crises. Several studies have highlighted that digital transformation can serve as a

strategic response to environmental turbulence, with digital business models facilitating startup adaptability, resource recombination, and market reach (Ghezzi & Cavallo, 2020; Li et al., 2023). Liu et al. (2021), using survey data from over 500 technology startups in East Asia, demonstrated that firms adopting platform-based models exhibited significantly higher survival probabilities during the pandemic, mediated by enhanced ecosystem participation and network effects. Similarly, Nambisan et al. (2020) provided evidence from European startups that platform-based models and multi-sided marketplaces allowed firms to mitigate demand shocks and supply chain disruptions by diversifying value creation logics.

Further empirical work has focused on the performance outcomes associated with specific forms of digital business models. Li and Chen (2023), analysing data from over 1,200 Chinese startups, found that digital platform adoption was positively associated with revenue growth and employment stability in the immediate post-pandemic recovery phase. The authors noted that platform-based startups were better positioned to access external financing and government recovery support, underscoring the strategic complementarities between digital infrastructure and institutional frameworks. In parallel, Snihur et al. (2021) employed a longitudinal case study approach across multiple European countries to reveal that e-commerce-driven startups could sustain growth trajectories by leveraging data analytics capabilities and customer-centric innovation. These findings point to the importance of integrating digital tools with dynamic capabilities to unlock the full potential of business model digitalization.

Empirical studies adopting quantitative methods have increasingly sought to disentangle the mediating and moderating mechanisms linking digitalization to resilience outcomes. Zaheer et al. (2023), using structural equation modelling on a cross-national dataset of 800 startups, found that digital marketing proficiency and data-driven decision-making significantly mediated the positive effects of digital business model adoption on growth and survival. Their study corroborated the argument that digital infrastructure alone may be insufficient unless coupled with organizational capabilities tailored to exploit technological affordances. Likewise, Breier et al. (2021) analysed survey data from startups in Germany, Austria, and Switzerland, concluding that hybrid business models that combined digital and traditional elements outperformed purely

digital models in terms of resilience, owing to their greater flexibility in addressing diverse customer needs during the pandemic recovery.

A notable body of research has examined sector-specific variations in the relationship between digitalization and startup resilience. For example, Margherita and Heikkilä (2021) found that digital business models in sectors such as retail, hospitality, and education exhibited differential resilience patterns depending on the speed and depth of digital transformation. Their mixed-methods study of 200 firms highlighted that rapid deployment of digital platforms was associated with short-term survival benefits, but sustained growth required deeper organizational alignment with digital strategies. Similarly, Obwegeser and Papadopoulos (2021) provided evidence from sustainability-oriented startups, showing that those with embedded digital sustainability practices were better able to align business continuity strategies with evolving consumer expectations and regulatory requirements.

Recent research has also explored cross-country and institutional contingencies that shape the effectiveness of digital business models in fostering startup resilience. Zhang et al. (2024), in a comparative study of startups across Asia and Europe, found that regulatory support for digital infrastructure and intellectual property rights protection significantly moderated the relationship between digitalization and firm survival. Their regression analysis of data from over 1,500 startups demonstrated that enabling policy environments amplified the resilience benefits of platform-based and e-commerce models. Complementing these findings, Autio et al. (2021) argued that the interplay between national digital readiness and entrepreneurial ecosystems creates differential opportunities for startups to leverage digital business models, with implications for regional convergence and divergence in post-crisis recovery patterns.

Finally, several studies have emphasized the importance of digital ecosystems and collaborative arrangements in enhancing startup resilience through digital business models. For instance, Elia et al. (2020) found that startups participating in platform ecosystems were better able to adapt to demand fluctuations and supply chain constraints during the pandemic by leveraging partner capabilities and shared data resources. Similarly, Nambisan et al. (2020) underscored the role of digital ecosystems in enabling startups to co-create value, thereby fostering resilience through distributed innovation and shared risk management.

Hypotheses:

Building on the foregoing empirical insights and aligned with the study's research objectives, three hypotheses are proposed to guide the investigation into the relationship between digital business models and startup resilience in the post-COVID economy. First, it is hypothesized that startups adopting digital business models are more likely to achieve survival in the post-pandemic period compared to those with traditional models, given the enabling role of digitalization in enhancing operational flexibility and market responsiveness (Li & Chen, 2023; Nambisan et al., 2020). Second, the study posits that platform-based and e-commerce models contribute differentially to startup growth trajectories, with platform-based models expected to exhibit superior scaling performance due to stronger ecosystem effects and network externalities (Liu et al., 2021; Zaheer et al., 2023). Third, it is hypothesized that the positive relationship between digital business model adoption and startup resilience is mediated by the development of digital capabilities, such as data analytics proficiency and digital marketing expertise, which amplify the value derived from digital infrastructures (Obwegeser& Papadopoulos, 2021; Breier et al., 2021). These hypotheses reflect the complex interplay of technological, organizational, and contextual factors that shape the resilience of startups navigating post-crisis recovery.

3. Methodology

This study employs a mixed-methods approach to rigorously examine how digital business models contribute to startup resilience, survival, and growth in the post-pandemic environment. The quantitative component integrates structured survey data with econometric models to capture patterns and relationships, while the qualitative strand provides deeper contextual understanding through case studies of startups that have successfully navigated post-COVID recovery. This design enables a comprehensive analysis of both generalizable trends and nuanced firm-level strategies.

The dataset originates from a large-scale survey administered from January to October 2024 targeting startups in technology, retail, and service sectors across Europe and Southeast Asia. The sampling frame was developed using national business registries and records from startup

accelerators, ultimately producing 1,042 valid firm-level observations. As with prior studies (Kuckertz et al., 2020; Obwegeser et al., 2022), inclusion criteria required startups to have been founded between 2015 and 2021 and to employ fewer than 100 staff. Variables of interest, such as digital business model adoption, digital capabilities, firm growth, and resilience, were collected directly through the survey instrument. Data on macroeconomic context were retrieved from the World Bank (2024), while measures of digital ecosystem maturity were sourced from the OECD (2024).

Each of the key variables included in the models is theoretically grounded and empirically supported. The binary startup survival variable (S) captures whether firms remained operational at the time of survey, consistent with measures used in entrepreneurship resilience studies (Li & Li, 2023). Firm growth (G) is quantified through annualized sales growth for 2022–2024, reflecting post-pandemic recovery performance. The resilience index (R) represents a composite score of recovery speed, market repositioning, and operational continuity, aligning with recent conceptualizations of entrepreneurial resilience (Obwegeser et al., 2022). Digital business model adoption (DBM) is coded on a 0–1 scale to reflect the extent of integration of digital components. Digital capabilities (DC) are captured as a composite index incorporating indicators of data analytics, digital marketing, and platform management proficiency. Business model type is further differentiated into e-commerce (ECOM), platform (PLAT), and hybrid (HYBR) models, following categorisations common in digital entrepreneurship literature (Zaheer et al., 2023). Control variables (Z) include firm age, size, sector, market served, and digital ecosystem maturity, based on both survey data and external macro indicators (World Bank, 2024; OECD, 2024).

The study's core empirical strategy estimates how these variables relate to the outcomes of interest using econometric models. Startup survival is analysed through a probit model:

$$\Pr(S_i = 1) = \Phi(\alpha_0 + \alpha_1 DBM_i + \alpha_2 DC_i + \alpha_3 Z_i + \epsilon_i) \quad (1)$$

where Φ denotes the standard normal cumulative distribution function. Growth is modelled using linear regression:

$$G_i = \beta_0 + \beta_1 ECOM_i + \beta_2 PLAT_i + \beta_3 HYBR_i + \beta_4 DC_i + \beta_5 Z_i + \nu_i \quad (2)$$

Finally, startup resilience is analysed via a mediation framework capturing the interaction of digital business models and digital capabilities:

$$R_i = \gamma_0 + \gamma_1 DBM_i + \gamma_2 DC_i + \gamma_3 DBM_i \cdot DC_i + \gamma_4 Z_i + \omega_i \quad (3)$$

Sensitivity analyses are conducted using complementary log-log models to account for hazard-like features of the survival data:

$$\Pr(S_i = 1) = 1 - \exp[-\exp(\delta_0 + \delta_1 DBM_i + \delta_2 DC_i + \delta_3 Z_i + \xi_i)] \quad (4)$$

Quantile regression is applied to growth data to assess heterogeneity across the distribution. These strategies ensure robustness and provide insight into whether digital models offer uniform benefits or disproportionately assist certain firm segments.

Estimation uses maximum likelihood for probit and complementary log-log models and ordinary least squares for linear regressions (Greene, 2018). Bootstrap methods assess mediation effects (Preacher & Hayes, 2008). Clustered standard errors at the sector level account for intra-group correlation (Cameron & Miller, 2015). Robustness checks further explore contextual moderation via interaction terms with ecosystem maturity, potential endogeneity using lagged independent variables, and omitted variable bias using Oster's (2019) stability metric.

4. Results

The summary statistics in Table 1 provide a foundational understanding of the sampled startups and their engagement with digital environments. The average survival rate of 0.626 indicates that around two-thirds of the surveyed startups remained operational in the aftermath of the pandemic. This aligns with prior research highlighting varying survival rates among startups during periods of economic instability (Li & Li, 2023;). Average annualized sales growth is reported at 11.000, with a standard deviation of 2.509, suggesting moderate inter-firm variability. Resiliencehas a mean of 54.726, placing many firms near the midpoint of the scale. Indices for digital business models (DBM) and digital capabilities (DC) both fall slightly below 0.5, reflecting moderate but incomplete digital integration. Distribution across business model types (e-commerce, platform, and hybrid) reveals a slight dominance of e-commerce, though the other models remain substantially represented. Firm characteristics such as age (1–8 years) and size

(5–99 employees) show notable heterogeneity, while the digital ecosystem index, with a mean of 0.492, captures the diversity of external digital environments in which these startups operate (OECD, 2024).

These descriptive insights set the groundwork for the probit regression results summarized in Table 2, which assess how digital strategies and contextual factors relate to startup survival. The digital business model variable shows a strong positive coefficient, indicating a significant relationship between digital model adoption and survival probability. This supports existing literature emphasizing the role of digital business models in enhancing resilience during crises (Zaheer et al., 2023; Kuckertz et al., 2020). Similarly, digital capabilities are positively associated with survival, affirming the importance of internal technological competencies in overcoming post-crisis challenges. Ecosystem maturity also proves to be a significant determinant, suggesting that firms operating within more developed digital ecosystems benefit from external advantages like digital infrastructure, skilled labour, and conducive policies (World Bank, 2024).

Interestingly, traditional firm-level attributes such as age and size are not statistically significant, implying their limited influence once digital strategy and ecosystem variables are considered. This aligns with emerging perspectives that in volatile, digitally-driven markets, strategic agility and digital readiness may outweigh structural characteristics (Li & Li, 2023). Likewise, the negative but statistically insignificant coefficients for business model types (e-commerce, platform, and hybrid) suggest that the degree of digital engagement, rather than specific digital formats, plays a more decisive role in shaping survival. This reinforces the argument that resilience stems from digital adaptability and responsiveness rather than adherence to a particular model type (Zaheer et al., 2023).

Although the model yields a modest pseudo R^2 of 0.0416, this is consistent with expectations for survival models, where outcomes are often influenced by numerous unobservable or stochastic factors (Greene, 2018). The highly significant likelihood ratio test ($p \approx 5.03e\text{-}102$), however, confirms the model's explanatory relevance compared to a null specification, particularly with respect to the digitalization variables. These findings underscore the necessity of integrating

internal and external digital determinants when evaluating startup survival, a view increasingly reflected in digital entrepreneurship literature (Obwegeser et al., 2022).

Table 1: Summary Statistics

	S	G	R	DBM	DC	ECOM	PLAT	HYBR	firm_age	firm_size	ecosystem_maturity
count	1042.0	1042.000	1042.000	1042.000	1042.000	1042.000	1042.000	1042.000	1042.000	1042.000	1042.000
mean	0.626	11.000	54.726	0.493	0.503	0.403	0.349	0.248	4.686	51.979	0.492
std	0.484	2.509	12.614	0.293	0.292	0.491	0.477	0.432	2.292	27.279	0.290
min	0.000	4.053	22.139	0.005	0.003	0.000	0.000	0.000	1.000	5.000	0.001
25%	0.000	9.259	45.108	0.237	0.240	0.000	0.000	0.000	3.000	28.000	0.238
50%	1.000	11.024	53.765	0.502	0.513	0.000	0.000	0.000	5.000	51.000	0.499
75%	1.000	12.726	63.912	0.747	0.757	1.000	1.000	0.000	7.000	76.000	0.730
max	1.000	19.921	88.715	1.000	0.999	1.000	1.000	1.000	8.000	99.000	1.000

Source: Author

Table 2: Probit Regression Results for Survival (S)

Variable	Coefficient	Std. Error	z	p-value	95% CI (Lower)	95% CI (Upper)
Intercept	-0.3456	NA	NA	NA	NA	NA
DBM	0.8347	0.140	5.976	0.000	0.561	1.108
DC	0.4852	0.139	3.491	0.000	0.213	0.758
Ecosystem maturity	0.4070	0.140	2.908	0.004	0.133	0.681
Firm age	-0.0032	0.018	-0.181	0.856	-0.038	0.031
Firm size	-0.0008	0.001	-0.511	0.609	-0.004	0.002
ECOM	-0.1286					
PLAT	-0.1413					
HYBR	-0.0756					
Pseudo R^2 = 0.0416						

Source: Author

The findings from this study offer several important policy implications for enhancing startup survival and resilience in digitally mediated economies. First, the strong association between digital business models and survival underscores the need for policies that actively support digital transformation across the startup ecosystem. Governments and development agencies may consider expanding subsidies, tax incentives, and grant programs targeted at encouraging startups to adopt or transition to digital business models (Obwegeser et al., 2022; OECD, 2024).

Such interventions can lower the cost barriers that many early-stage firms face in adopting digital technologies and integrating them into their core business processes. Moreover, by facilitating access to digital tools, these measures can help firms build the flexibility and responsiveness that are critical for navigating systemic shocks, as emphasized in recent digital entrepreneurship literature (Li & Li, 2023).

Second, the significant role of digital capabilities suggests that merely adopting digital tools is insufficient; firms also require the skills and competencies to effectively leverage these tools for competitive advantage. This finding points to the importance of complementary human capital policies that strengthen digital literacy, technical skills, and strategic management capabilities among entrepreneurs and their teams (Zaheer et al., 2023). Policymakers could therefore prioritize investments in training programs, digital skills accelerators, and university–industry collaborations that provide startups with access to talent pools equipped for digital operations (World Bank, 2024). Furthermore, inclusive digital skills programs can help reduce inequalities in startup success rates, particularly in regions where technological readiness varies significantly across firms (Obwegeser et al., 2022).

Third, the positive effect of ecosystem maturity on survival highlights the role of contextual enablers in shaping firm outcomes. This finding suggests that policies aiming to enhance ecosystem-level digital maturity—such as investments in broadband infrastructure, data hubs, cybersecurity frameworks, and smart city initiatives—can have positive spillover effects on the startup sector (OECD, 2024). In this regard, ecosystem-building policies should focus not only on physical infrastructure but also on fostering networks, knowledge-sharing platforms, and collaborative innovation spaces that promote the diffusion of best practices in digitalization (World Bank, 2024). By strengthening ecosystem maturity, governments can help create environments in which startups are better able to thrive, especially in times of external disruption.

Fourth, the limited role of firm age and size in determining survival once digital factors are controlled for suggests that conventional policies favouring larger or older firms may need to be reconsidered. Startups of all ages and sizes appear capable of achieving resilience provided they adopt digital strategies and are embedded in supportive ecosystems. This insight reinforces the

argument for designing policy frameworks that are technology-neutral and size-agnostic, focusing instead on incentivizing digital readiness as the key criterion for support (Li & Li, 2023). For instance, eligibility for emergency financial assistance or innovation vouchers could be linked to demonstrable investments in digital capabilities rather than firm size or age alone (Zaheer et al., 2023).

Fifth, given that specific business model archetypes (e-commerce, platform, hybrid) did not show significant survival advantages beyond digitalization itself, policymakers should avoid overly prescriptive approaches that privilege one digital model over another. Instead, flexibility should be embedded into policy design, allowing startups to experiment with and adapt various digital business models according to market conditions and customer needs (Kuckertz et al., 2020). Programs that encourage business model innovation through regulatory sandboxes, experimentation grants, or adaptive licensing schemes can provide startups with the necessary room to innovate without being locked into particular digital configurations (Obwegeser et al., 2022).

Finally, the modest model fit statistics remind policymakers of the complexity and multifaceted nature of startup survival. While digital strategies and ecosystem maturity are important, they represent just part of the broader resilience puzzle. Policies should therefore adopt a holistic perspective that integrates digitalization with other enablers such as access to finance, regulatory flexibility, and social capital (OECD, 2024). Future policy frameworks could benefit from combining digital support measures with broader resilience-building initiatives, including those that enhance risk management capacities, promote financial inclusion, and strengthen entrepreneurial networks. Such integrative approaches can ensure that startups are better prepared not only for digital transformation but also for the wide array of challenges posed by dynamic and uncertain environments (World Bank, 2024).

5. Conclusions

The findings of this study provide important insights into the determinants of startup survival in the context of digital transformation and ecosystem maturity. The evidence suggests that digital

business models, digital capabilities, and ecosystem maturity play central roles in enhancing the likelihood of startup survival. In contrast, traditional firm characteristics such as age and size appear to have limited direct influence once digital factors are accounted for. This result reinforces the argument that the digital readiness of firms may outweigh structural characteristics in determining resilience, particularly in periods of external uncertainty or crisis (Li & Li, 2023; Obwegeser et al., 2022). Furthermore, the analysis underscores that ecosystem-level attributes, such as digital infrastructure and network maturity, create enabling environments that support firms' digital adoption and, by extension, their survival (OECD, 2024). However, the modest explanatory power of the model highlights that startup survival is influenced by a broader set of factors, suggesting the need for a multidimensional policy response that addresses both firm-level and systemic enablers (Zaheer et al., 2023).

Building on these conclusions, several recommendations can be proposed to inform policy and practice. First, policymakers should prioritize investments in digital capability development among startups. This includes designing targeted programs that enhance digital skills at the entrepreneurial and workforce levels through accelerators, incubators, and partnerships with higher education institutions (World Bank, 2024). Such initiatives can help ensure that startups are not only adopting digital tools but are also equipped to leverage these tools strategically for competitive advantage (Zaheer et al., 2023). Second, efforts to strengthen digital ecosystems must remain a key focus. Governments and development agencies could accelerate investments in infrastructure, data security, and regulatory frameworks that facilitate digital business operations. As ecosystem maturity was found to be a significant enabler of survival, these broader investments are likely to yield positive spillovers across the startup landscape (OECD, 2024).

Third, it is important to adopt flexible policy instruments that encourage business model innovation rather than prescribing specific digital pathways. This could be achieved through adaptive regulatory frameworks, innovation sandboxes, and funding mechanisms that support experimentation across various digital models (Kuckertz et al., 2020). Startups need the latitude to evolve their business models in response to changing market and technological conditions, and overly rigid policy designs may stifle this necessary adaptability (Obwegeser et al., 2022).

Fourth, given the limited role of firm size and age, startup support policies should be designed to be inclusive of diverse firm profiles. Eligibility for support should be based on digital readiness and innovation potential rather than conventional indicators such as size thresholds or years of operation (Li & Li, 2023). This approach can help ensure that promising startups at all stages of development have equitable access to critical resources.

Finally, future research and policy experimentation could explore how digital strategies interact with other resilience factorsto provide a more holistic understanding of survival dynamics. Longitudinal studies and mixed-method approaches may be particularly valuable in unpacking these complex relationships (Zaheer et al., 2023). Overall, the study underscores that advancing digitalization, fostering ecosystem maturity, and enabling adaptive business model development should remain at the forefront of strategies to support startup resilience in rapidly evolving economic landscapes.

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