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Research Article

Platform models in small businesses: A challenge for mature companies

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Abstract

Objective: Understand the necessary conditions for small companies to adopt business models based on digital platforms. **Methodology:** The methods of Structural Equation Modeling by Partial Least Squares (PLS-SEM) and Necessary Condition Analysis (NCA) were applied in an online survey with 126 small companies to evaluate relationships of sufficiency and necessity of selected constructs in the adoption of business models based on digital platforms. **Results**: The necessary condition for small businesses to adopt digital platform-based business models is that they are at an early stage of their lifecycle before and during the peak of COVID-19, which indicates that platforms represent a challenge for mature small businesses grounded in the issue of entrepreneurial inertia. **Theoretical-methodological contributions:** Expansion of the literature on the adoption of digital business by small companies, adding the emerging NCA methodology to the research in this field of study and supporting evidence of the existence of business inertia in mature companies. **Relevance/originality**: Application of the emerging NCA methodology in an original online survey for the study of digital transformation of small businesses, identifying necessary factors in the adoption of platform-based models. **Social contributions:** References in the literature indicate that the adoption of digital platforms is a relevant strategy to improve competitiveness and small companies need to adapt to this new business model in order to overcome the impacts of COVID-19, defeating the business inertia present in mature companies.

Keywords: Small businesses; Digital platforms; Digital transformation; Business model.

Modelos de plataforma em pequenos negócios: Um desafio para as empresas maduras

Resumo

Objetivo: Compreender as condições necessárias para que pequenas empresas adotem modelos de negócios baseados em plataformas digitais. **Metodologia:** Os métodos de Modelagem por Equações Estruturais por Mínimos Quadrados Parciais (PLS-SEM) e Análise de Condição Necessária (NCA) foram aplicados em uma pesquisa online com 126 pequenas empresas para avaliar relações de suficiência e necessidade de constructos selecionados na adoção de modelos de negócios baseados em plataformas digitais. **Resultados**: A condição necessária para que pequenas empresas adotem modelos de negócio baseados plataforma digital é que elas estejam em um estágio inicial do seu ciclo de vida antes e durante o pico da COVID-19, o que indica que as plataformas representam um desafio para pequenas empresas maduras fundamentado na questão da inércia empresarial. **Contribuições teóricas-metodológicas:** Amplia-se a literatura acerca da adoção de negócios digitais por parte de pequenas empresas, somando a metodologia emergente de NCA às pesquisas desse campo de estudo e suportando evidências da existência de inércia empresarial nas empresas maduras. **Relevância/originalidade**: Aplicação da metodologia emergente de NCA em uma pesquisa original *online* para o estudo de transformação digital das pequenas empresas, identificando fatores necessários na adoção de modelos baseados em plataformas. **Contribuições sociais:** Referências na literatura indicam que a adoção de plataformas digitais é uma estratégia relevante para melhorar competitividade e pequenas empresas necessitam se adaptar a esse novo modelo de negócio na superação dos impactos da COVID-19, vencendo a inércia empresarial presente nas empresas maduras.

Palavras-chave: Pequenas empresas; Plataformas digitais; Transformação digital; Modelo de negócio.

INTRODUCTION

Digital transformation has gained great relevance in the last decade and can be conceptually defined, among other possibilities, as an important improvement in a company through the combination of computing, communication and connectivity (Vial, 2019). Small companies have been also adhering to this digital transformation seeking to develop their business models to obtain greater sales and better services to their consumers (Sudarnice et al., 2024).

The adoption of digital transformation has become more imperative with the advent of the COVID-19 pandemic. The pandemic has affected small companies hardly, and those that have managed to adapt using digital technology have outperformed their peers (Robertson et al., 2022). Digital transformation in small companies in developed countries has been accelerated by the COVID-19 pandemic (Kádárová, et al., 2023). On the other hand, in developing countries, the impact of COVID-19 has reached more the small companies, among other reasons due to structural limitations on the use of digital technology (Bai et al., 2021).

In this context, one of the most relevant strategies for companies that want to transform themselves digitally is the adoption of businesses based on digital platforms. Digital platforms have assumed an ever-growing role in the business ecosystem, and even those companies that do not develop their own platforms must identify the opportunities arising from this new economic practice (Gatautis, 2017).

Digital platforms are an innovation directly related to digital transformation, using technologies to connect people and organizations, forming a collaborative ecosystem in which significant volumes of value are added through exchanges between the parties (Parker et al., 2016). The European Commission (2016) defined a platform as an enterprise based on internet connectivity, which allows bilateral or multilateral transactions, generating value for the parties involved. Some important characteristics of platform-based models are the operation in a bilateral market, the presence of network effects, and the participation in an ecosystem (Kim, 2015).

When we evaluate this digital transformation scenario focusing on small and medium companies, a segment that represents more than 90% of the country's enterprises and accounts for approximately 30% of the gross domestic product and more than 50% of formal jobs, according to data from the Brazilian Industrial Development Agency in partnership with Getulio Vargas Foundation, we find references that indicate that the adoption of platforms and ecosystems can be an alternative for generating value for this segment (Cenamor et al., 2019).

Studies suggest that platforms offer new opportunities for small and medium companies in terms of new value propositions, new markets, and new access to resources (Jin & Hurd, 2018; Nambisan et al., 2018; Subramaniam et al., 2018). Digital platforms have shifted the focus of value creation to the network, which implies a drastic change for an organization (Li, Zheng, et al., 2017; Parker et al., 2017). Technologies such as e-commerce and social media have been widely and rapidly adopted, and the transformation resulting from these technologies goes beyond the usual internal improvements (Bai et al., 2021). The application of digital technology has made it possible to implement new processes throughout the value chain, especially in the sale and service links to consumers (Kádárová, et al., 2023).

However, many small and medium companies lack resources and capabilities, which can make it difficult to adopt a new and complex business model (Gupta & Bose, 2018; Karimi & Walter, 2016). Many entrepreneurs lack the appropriate technology expertise and, limited by their own past experience, are not easily convinced of the value of digital transformation (Santarelli & D'Altri, 2003). This cognitive inertia (Messner & Vosgerau, 2010) can be an obstacle when these entrepreneurs are forced to compete online (Li, Su et al., 2017). Therefore, the platform approach represents a paradigm that can enable entrepreneurial small and medium companies to benefit from digital platforms if adoption barriers are overcome (Cenamor, et al., 2017). This technology-driven transformation is not only desirable, but necessary for the maintenance of small businesses in the contemporary world (Sudarnice et al., 2024).

To understand the profile of small and medium companies that have adopted platform-based models in Brazil, we conducted an online survey of those responsible for 126 small businesses between March 2 and 15, 2021. In the sample, 90% of the companies have revenues below US$ 5 million per year and 92% have fewer than 100 employees.

Based on this information, we sought to find some common characteristics that may be necessary conditions for small companies looking to adopt a platform-based business model.

THEORETICAL FRAMEWORK

Small and medium companies have simple structures, and they are highly centralized in chief executive officers (CEOs). In most cases, the owner of the company and the CEO are the same person (Ghobakhloo et al., 2011). The owner is central to the company, since his decision influences all the organizational activities, both in the present and in the future (Chau, 1995; Lybaert, 1998; Fuller-Love, 2006; Smith, 2007).

The information technology adoption process in small and medium companies is also directly affected by senior management, which makes all decisions (Bruque & Moyano, 2007; Nguyen, 2009; Fuller & Lewis, 2002). These decisions are based on a combination of abilities, personal experience, judgment, and communication skills (Carson & Gilmore, 2000). Reinforcing this perspective, when discussing the entrepreneurs' digital transformation capabilities, Li, Su et al. (2017) indicated that, in small and medium companies, digital transformations were initiated and driven by owners. The success of this transformation is the result of several factors, including management's perception and attitude towards information technology, which directly impacts the process of adopting technology-based businesses (Drew, 2003; Lybaert, 1998; Qureshi & York, 2008; Thong et al.,1993; Thong & Yap, 1995).

Buxton and Walton (2014) demonstrated that the age of small and medium companies' owners or CEOs impacted the adoption of technology-based and e-commerce strategies, since the older generation of executives sees technology more as a threat than an opportunity.

The analysis of these studies leads to the perception that the decisions made by small and medium companies depend directly on their chief executive. Then, investigating whether older companies or older managers have greater resistance to adopting digital platforms and whether companies that have been operating for less time and managers that have been in business for less time have less resistance makes sense. The first hypothesis to be investigated here comes from this reasoning:

H1: The demographic characteristics of small and medium companies and their owners interfere directly with the development of digital platform-based businesses, with companies with a shorter period of activity and entrepreneurs with a shorter time in management having a greater propensity to develop businesses based on these platforms.

In 2021, the Brazilian Industrial Development Agency, along with Getulio Vargas Foundation, launched a survey of 2,572 small and medium companies and identified that the objective of "'establishing new bases for competition'", through digital transformation, obtained the lowest average of the entire survey. The practice of "participating in business platforms (marketplaces)" is not implemented to any degree by more than 80% of the companies surveyed, while more than 80% of the companies do not know how to develop forms of competition using multichannel strategies to access audiences with different profiles. In addition to identifying the low capacity of small and medium companies to

transform themselves through digital means, this data leads us to understand that it may be more feasible for companies in the early stages of development to venture into platform-based businesses.

Vial (2019) pointed out that business inertia can prevent companies from successfully performing their digital transformation journey. Existing resources and skills can act as barriers to disruption and innovation through digital technologies (Islam et al., 2017; Svahn et al., 2017; Srivastava & Shainesh, 2015; Wenzel et al., 2015).

When we look at the benefits of digital platforms, we notice that they allow startups to reach a massive scale and gain value in a very short period, which can be confirmed by observing the large number of unicorns (startups valued at over US$1 billion) based on digital platforms (Acs et al., 2017). It would be expected, therefore, that many of the new businesses still in the early stage of development have been thinking of in terms of digital platforms by their executives. Thus, we arrive at the elaboration of the second hypothesis to be tested in this work.:

H2: Companies in early life cycle stage are more likely to develop businesses based on digital platforms.

Studies by Kim et al. (2018) and Madrid-Guijarro et al., (2009) indicate that the fact that small and medium companies have limited resources for their survival makes them more likely to innovations that put them in a more comfortable situation in the market. FinTechs are an example of market innovation that is accessible to small and medium companies. Schueffel (2016) defines FinTechs as companies that combine finance and technology and produce digital solutions that meet the needs of payment methods, credit and financing, and investments. By taking these characteristics into consideration, we understand they can affect the dynamics of small and medium companies' operations (Lee & Shin, 2018).

Abassi et al. (2021), Baber (2020) and Odinet (2018) found that FinTechs increase the likelihood of small and medium companies obtaining credit at more attractive rates. In addition, the speed of obtaining credit is also greater with FinTechs (Rosavina et al., 2019; Sangwan et al., 2020). Gomber et al. (2018) and Lee e Shin (2018), pointed out FinTechs support small business owners with investment management advice at a lower cost. In short, there is a positive association between FinTechs and small and medium companies' efficiency (Abassi et al., 2021). We have therefore our third hypothesis to be tested:

H3: Companies that team up with digital financial institutions known as FinTechs are more likely to develop digital platform-based businesses.

In Table 1 we present the relationship between the hypotheses and the tested constructs.

METHOD

We used methodologies that, combined, helped to analyze whether there are direct relationships between:

i) the demographic characteristics of a small company and its propensity to adopt digital platform-based business models;

ii) the life cycle stage of a small company and its propensity to adopt digital platform-based business models;

iii) a small company's engagement with FinTechs and its propensity to adopt digital platform-based business models.

We collected data through an online primary survey of 126 companies between March 2 and 15, 2021. The distribution of the sample across the different sectors of the economy and by company size, defined by the number of employees, is in line with expectations. Table 2 presents the distribution of the sample surveyed by sector of activity and size.

For the purposes of this study, we considered three types of business based on digital platforms. These choices were based on the literature that discusses digital transformation in small companies. Bai e al. (2021) indicated that one objective of applying digital technology in small and medium companies is to increase non-traditional revenues through e-commerce and social media by marketing and advertising. Da Rocha et al. (2024) pointed out three types of platforms that small companies adhere to: sales platforms (marketplace), which facilitate transactions; interaction platforms, which facilitate promotion; and support platforms, which facilitate operations. These three types are directly associated with the types analyzed here:

Table 1

Relationship between hypotheses, constructs, and researched studies

Hypothesis	Definition of constructs	Theoretical reference (in order of appearance in the text)
H1: DE (DE1, DE2) → PP (PP1, PP2) The demographic characteristics of small and medium companies interfere directly with the development of digital platforms-based businesses. Companies with a shorter period of activity and entrepreneurs with a shorter time in management have a greater propensity to develop businesses based on these platforms.	DE: Company Demographics. DE1: Company operating time. DE2: Senior manager's working time in the company. PP: Platform Propensity. PP1: Current type of digital platform-based business model (marketplace; hidden advertising; subscription). PP2: Plans to adopt a platform-based business model in the future (marketplace; hidden advertising; subscription).	Bruque and Moyano (2007), Nguyen (2009), Ghobakhloo et al. (2011), Chau (1995), Lybaert (1998), Fuller-Love (2006), Smith (2007), Fuller and Lewis (2002), Carson and Gilmore (2000), Drew (2003), Qureshi and York (2008), Thong et al. (1993), Thong and Yap (1995), Li, Su et al. (2017), Buxton and Walton (2014).
H2: ECV (ECV1, ECV1) → PP (PP1, PP2) Companies in early life cycle stages are more likely to develop digital platforms-based businesses.	ECV: Life Cycle Stage. ECV1: Company life cycle stage before COVID-19 pandemic. ECV2: Current company life cycle stage, after the peak of the COVID-19 pandemic.	Vial (2019), Islam et al. (2017), Svahn et al. (2017), Srivastava and Shainesh (2015), Wenzel et al. (2015), Acs et al. (2017).
H3: IF (IF1, IF2) → PP (PP1, PP2) Companies that team up with digital financial institutions, known as FinTech, are more likely to develop digital platforms-based businesses.	IF: FinTech Interaction. IF1: Consider FinTech to meet the company's potential financial needs. IF2: Receive financial services from FinTech for the company's needs.	Abassi et al. (2021), Schueffel (2016), Rosavina et al. (2019), Odinet (2018), Sangwan et al. (2020), Lee and shin (2018), Baber (2020), Gomber et al. (2018), Kim et. al. (2018), Madrid-Guijarro et al. (2009).

Note: Elaborated by the authors.

Table 2

Distribution of the sample surveyed by sector of activity and size

Size (number of employees)	Basic, energy, and infrastructure industry	Consumer goods, retail, and healthcare	Technology, media and telecommunication	Professional and financial services	Total
10-19	4	10	12	13	39
20-49	7	20	12	19	58
50-99	0	5	5	3	13
100-149	3	1	7	3	14
150 -249	0	1	1	0	2
Total	14	37	37	38	126

Note: Elaborated by the authors.

- *Marketplace: a company that provides a website that brings together suppliers and buyers. In this model, the marketplace owner makes his profit by charging a processing fee;*
- Hidden advertising: a company that operates a website in which products/services are offered freely to consumers. Revenue is generated by advertisers, who pay to place ads on the website;
- Subscription: a company in which consumers pay a subscription, which can be monthly or annual, to receive a product/service.

We selected eight research questions that were associated with the dependent and independent variables of the model and that are related to the formulated hypotheses, as presented in Table 3.

Table 3

Variables, research questions, and study hypotheses

Question (construct)	Question description	Answer scale	Hypotheses
S4b (DE1: Company operating time)	How long has your business been operating?	6 – Less than three years 5 - Three years to less than six years 4 - Six years to less than 11 years 3 - 11 years to less than 16 years 2 - 16 years to less than 21 years 1 - 21 years or more	H1
S11b (DE2: Senior manager's working time in the company)	How long have you been working for the business?	6 – Less than three years 5 - Three years to less than six years 4 - Six years to less than 11 years 3 - 11 years to less than 16 years 2 - 16 years to less than 21 years 1 - 21 years or more	H1
Q1b (ECV1: Company life cycle stage before COVID-19 pandemic)	Which of the following options best describes the stage of your business life cycle prior to the COVID-19 outbreak in January 2020?	6 - Conception 5 - Inicialization 4 - Growth 3 - Maturity 2 - Decline 1 - Exit	H2
Q2b (ECV2: Current company life cycle stage after the peak of COVID-19 pandemic)	Which of the following options best describes the current stage of your business life cycle?	6 - Conception 5 - Inicialization 4 - Growth 3 - Maturity 2 - Decline 1 - Exit	H2
Q21r5 (IF1: FinTechs are considered to meet the company's potential financial needs)	If you needed to access cash for your business, which of the following sources would you consider?	1 – FinTech	H3
Q24r5 (IF2: Financial services from FinTechs for the needs of the company are received)	Which of the following options does your company receive financial services from?	1 – FinTech	H3
Q10br7r9r11 (PP1: Current type of digital platform-based business model (marketplace; hidden advertising; subscription)	Which of the following options best describes your current business model(s)?	Sum (Marketplace (1); Hidden Advertising (1); Subscription (1))	Dependent variable (DV)
Q12b r7r9r11 (PP2: Plans to adopt a platform-based business model in the future (marketplace; hidden advertising; subscription)	Which of the following options best describes the business model(s) you plan to change to in the future?	Sum (Marketplace (1); Hidden Advertising (1); Subscription (1))	Dependent variable (DV)

Note: Elaborated by the authors.

The descriptive results for each variable are in Table 4.

The Kruskal-Wallis' test obtained $\chi 2 = 810.81$, with GL = 7 and p = 2.20e-16, indicating that there are significant differences between the answers collected. The Mardia's test, for multivariate normality of the constructs, indicated that the data set of the final sample of 126 companies is non-normal, with Mardia's skewness = 492.74 (p = 1.21e-46) and Mardia's kurtosis = 8.45 (p = 0.00).

Based on the characteristics of this sample, we proceeded to the sufficiency analysis by applying Partial Least Squares Structural Equation Modeling (PLS-SEM). Some factors present in this study indicate modeling by PLS-SEM:

(i) the study seeks to better understand the established theory about the small company's characteristics that make it more likely to adopt digital platform-based business models, in an exploratory analysis;

(ii) a small population restricts the sample size;

(iii) there is no normality in the responses obtained or in the financial indicators (Hair et al., 2019).

The structural models were evaluated according to the methodology proposed by Hair et al. (2019). This evaluation considers the following steps, which will be used in the presentation of the results of the PLS-SEM models, ahead: (a) preliminary considerations; (b) measurement model evaluation; (c) structural model evaluation. All the analyzed models were the reflexive-reflexive type (type I), in which the measurements were all independent, but correlated, forming a hierarchical model of common factors (Becker et al., 2012).

Since the sufficiency analysis did not obtain all the statistically significant results, we complemented the study using the Necessary Condition Analysis (NCA). NCA complements, rather than replaces, traditional approaches to analyzing causal relationships. NCA provides new evidence that is not typically discovered in sufficiency analyses, particularly by the application of PLS-SEM. Before applying the NCA, it is essential that the necessary conditions identified are theoretically justified (Dul, 2016).

The approach used is based on the methodology proposed by Richter et al. (2020) for the combined use of PLS-SEM and NCA. The guidelines for combining PLS-SEM and NCA followed the steps:

(i) to specify the research objective and theoretical basis;

(ii) to prepare and check data, considering sample size and data distribution;

(iii) to perform PLS-SEM analysis,

(a) evaluating the measurement model, and

(b) the structural model;

(iv) to perform NCA;

(v) to interpret the results.

NCA identifies factors that are indispensable for a result, in our case the propensity to develop platform-based businesses, according to the necessity.

RESULTS

Sufficiency analysis by partial least squares structural equation modeling

The model for 126 companies, considering the constructs, was evaluated according to the sequence proposed by Hair et al. (2019), through the smartPLS 3 software (Ringle et al., 2015) and the consistent PLS-SEM model (PLSc) proposed by Dijkstra and Henseler (2015), with connection of all latent variables for the initial estimate and a path-based weighting scheme running 1,000 interactions. Subsequently, a full bias-adjusted and accelerated bootstrapping (BCa) with two tails with 10,000 interactions was performed (Streukens & Leroi-Werelds, 2016).

Table 4

Descriptive Results of the Selected Variables

Question	Average	Median	Minimum	Maximum	Standard seviation	Kurtosis Excess	Skewness	Hypothesis
S4b (How long has your company been operating?)	3.889	4	1	6	1.364	-0.187	-0.632	H1
S11b (How long have you been working for the business?)	4.302	5	1	6	1.197	0.648	-0.856	H1
Q1b (Which of the following options best describes your business lifecycle stage prior to the COVID-19 outbreak in January 2020?)	3.516	3	1	6	0.852	1.260	0.262	H2
Q2b (Which of the following options best describes your current business life cycle stage?)	3.222	3	1	6	1.007	0.610	0.719	H2
Q21r5 (If you needed to access cash for your business, which of the following sources would you consider using?)	0.214	0	0	1	0.410	-0.014	1.409	H3
Q24r5 (Which of the following options does your company receive financial services from?)	0.254	0	0	1	0.435	-0.702	1.144	H3
Q10br7r9r11 (Which of the following options best describes your current business model(s)?)	0.206	0	0	2	0.460	4.168	2.182	DV
Q12br7r9r11 (Which of the following options best describes the business model(s) you plan to change to in the future?)	0.278	0	0	3	0.544	5.322	2.158	DV

Note: Elaborated by the authors.

The reliability and validity results are found in Table 5. The model showed satisfactory results according to all indicators for the constructs company demographics and life cycle stage and did not show satisfactory results for the constructs FinTech interaction and platform propensity.

Table 5

Composite reliability and convergent validity

Constructs	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Company demographics	**0.821**	**0.839**	**0.827**	**0.707**
Life cycle stage	**0.755**	**0.773**	**0.761**	**0.617**
FinTech Interaction	0.372	0.375	0.373	0.230
Platform propensity	0.510	0.515	0.512	0.345

Note: Elaborated by the authors.

The discriminant validity of the measurement model was assessed using the Heterotrait-Monotrait (HTMT) ratio (Table 6). According to Hair et al. (2019), the Fornell-Lacker criterion does not present adequate results, especially when the loads of the constructs differ only slightly, with the HTMT test being preferable for discriminant analysis, accepting values below 0.90 as valid for structural models with conceptually similar constructs (Henseler et al., 2015).

Table 6

Heterotrait-Monotrait ratio

Constructs	Company demographics	Life cycle stage	FinTech Interaction	Platform propensity
Company demographics				
Life cycle stage	0.370			
FinTech Interaction	0.120	0.224		
Platform propensity	0.117	0.414	0.477	

Note: Elaborated by the authors.

The collinearity analysis, based on the variance inflation factors (VIFs), indicates that the perceived performance measurement variables and the latent variables do not present collinearity issues (VIF < 3). The values calculated for the VIFs for the measurement variables are presented in Table 7.

Table 7

Variance Inflation Factors (VIFs): Measurement Variables

	S4b	S11b	Q1b	Q2b	Q21r5	Q24r5	Q10b	Q12b
VIF	1.940	1.940	1.582	1.582	1.055	1.055	1.132	1.132

Note: Elaborated by the authors. S4b: How long has your company been operating?; S11b: How long have you been working for the business?; Q1b: Which of the following options best describes your business life cycle stage prior to the COVID-19 outbreak in January 2020?; Q2b: Which of the following options best describes your current business life cycle stage?; Q21r5: If you needed to access cash for your business, which of the following sources would you consider using?; Q24r5: Which of the following options does your company receive financial services from?; Q10b: Which of the following options best describes your current business model(s)?; Q12b: Which of the following options best describes the business model(s) you plan to change to in the future?

The power of the structural model was evaluated through the Pearson's coefficient of determination (R^2) and Cohen's effect size (f^2). The R^2 and the adjusted R^2 for the construct were 0.324 and 0.308, respectively. The f^2 effect size is presented in Table 8.

Table 8

Effect Size (f^2)

Construct	Company demographics	Life cycle stage	FinTech Interaction
Platform propensity	0.001	0.111	0.233

Note: Elaborated by the authors.

The standardized root mean-square residual (SRMR) indicator, which allows evaluating the fit of the structural model, obtained the value of 0.041, below the limit proposed by Henseler et al. (2015), of 0.080, demonstrating the model can be considered. The Q2 indicator of prediction accuracy model, calculated by the PLSpredict method proposed by Shmueli et al. (2019), which establishes the prediction accuracy model, was estimated with 10 groups and 10 repetitions, according to Table 9. Both the measurement variables and the latent variable obtained an index higher than the 0.00 mark proposed by Hair et al. (2019), denoting there is predictive relevance of the variables for the dependent construct.

Table 9

Prediction Accuracy (Q^2)

	Q10br7r9r11*	Q12br7r9r11**	Platform propensity
Q^2	0.005	0.007	0.015

Note: Elaborated by the authors. *Which of the following options best describes your current business model(s) (marketplace; hidden advertising; subscription)? **Which of the following options best describes the business model(s) you plan to change to in the future (marketplace; hidden advertising; subscription)?

The PLSc model presented inconsistencies in bootstrapping, a usual problem for models that do not satisfy the strict assumptions of common factor models, in which the correction factors are negative, and the square roots of these values are nonexistent (Becker, 2015; 2017). Thus, a traditional full bias-adjusted and accelerated bootstrapping (BCa) was performed with two tails with 10,000 interactions.

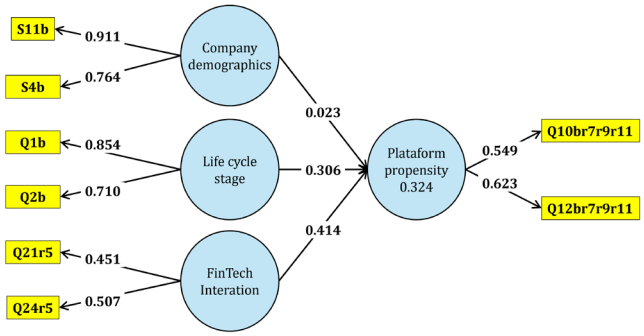
The path coefficient loadings of the PLSc and PLS models, as well as the results obtained with bootstrapping, were analyzed and indicate the relationships between the variables company demographics, life cycle stage, and fintech interaction and the platform propensity variable present loadings below 0.70, demonstrating a low sufficiency relationship between the independent variables and the dependent variable. It is important to notice that the relationships between life cycle stage and fintech interaction with platform propensity are statistically significant, with p-values lower than 0.05.

The relationships between the observed variables S4b (How long has your company been operating?) and S11b (How long have you worked for the business?) and the latent variable company demographics present loadings above 0.70 and are statistically significant ($p<0.05$). The relationships of the observed variables Q1b (Which of the following options best describes the stage of your business life cycle before the COVID-19 outbreak in January 2020?) and Q2b (Which of the following options best describes the stage of your business life cycle currently?) with the latent variable life cycle stage present loadings above 0.70 and are statistically significant. The relationships between the observed variables Q21r5 (If you need to access money for your business, which of the following sources would you consider using?) and Q24r5 (From which of the following options does your company receive financial services?) and the latent variable fintech interaction present loadings below 0.70 in the PLSc model and are not statistically significant. The relationships of the observed variables Q10br7r9r11 (Which of the following options best describes your current business model(s)? Marketplace; hidden advertising; subscription?) and Q12br7r9r11

(Which of the following options best describes the business model(s) to which you plan to change to in the future? Marketplace; hidden advertising; subscription?) and the latent variable platform propensity present loadings below 0.70 in the PLSc model with statistical significance. The results are presented in Table 10 and in Figure 1 (PLSc model) and Figure 2 (PLS model)

Figure 1

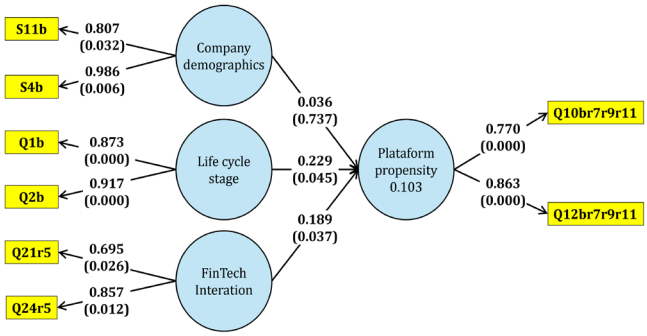
Structural model and path coefficient loadings of the PLSc model



Note: Elaborated by the authors..

Figure 2

Structural model, path coefficient loadings, and p-values of the PLS model



Note: Elaborated by the authors.

Necessary analysis applying necessary condition analysis:

NCA analyses were performed using a software developed to facilitate the process of drawing ceiling lines, calculating effect parameters, and creating bottleneck tables. The software, called NCA, is a package that runs with the R programming language obtained freely at http://cran.r-project.org/web/packages/NCA/index.html (Dul & Buij, 2021).

By default, we set the acceptable p-value to be less than 0.05 and ran 10,000 permutations (Dul et al., 2020). A general reference for the effect size of the necessary condition (d) proposed by Dul (2016) is 0<d<0.1 as a small effect, 0.1<d<0.3 as a medium effect, 0.3<d<0.5 as a large effect, and above 0.5 as a very large effect. A necessary condition hypothesis in the continuous case is rejected if the effect size d is less than 0.1 (Dul, 2016).

Based on these analysis parameters, we can observe in Table 11 that Q1b (life cycle stage before COVID-19) and Q2b (current life cycle stage) are the only dependent variables for which the necessary condition is confirmed for Q12br7r9r11 (Which of the following options best describes the business model(s) you plan to change to in the future? Marketplace; hidden advertising; subscription?).

According to Table 12, we identify the sequence of necessary conditions for Q12br7r9r11. Between the first and fourth rows of percentages in Table 12 (up to 30% of Q12br7r9r11), it is suggested that in our set of companies Q1b and Q2b are barely necessary to achieve this result. From the fifth line onwards (50% of Q12br7r9r11), Q1b (60%) and Q2b (60%) appear as necessary conditions at high levels. Looking at the other rows of the bottleneck table, from the 70% range of Q12br7r9r11, we see that Q1b and Q2b are present at significant levels. These percentages indicate that Q1b and Q2b are present in the companies surveyed that obtained greater Q12br7r9r11. In other words, the results indicate a necessary condition between the life cycle stage of a small company and its ambition to create a platform-based business in the future. Companies in the early stages of the life cycle (conception and startup) are those that plan to adopt a platform-based model in the future. These results can be also observed in Figure 3 and Figure 4.

Table 10

Structural model estimate (path coefficients)

Constructs / variables	Carga PLSc	Carga PLS	Sample Mean	Standard deviation	t Statistics	p-values
S4b ← Company demographics	0.764	0.807	0.722	0.376	2.149	0.032
S11b ← Company demographics	0.911	0.986	0.819	0.357	2.763	0.006
Q1b ← Life cycle stage	0.854	0.873	0.836	0.209	4.177	0.000
Q2b ← Life cycle stage	0.710	0.917	0.883	0.194	4.718	0.000
Q21r5 ← FinTech Interation	0.451	0.695	0.628	0.313	2.220	0.026
Q24r5 ← FinTech Interation	0.507	0.859	0.727	0.342	2.509	0.012
Q10br7r9r11 ← Propensão Plataforma	0.549	0.770	0.749	0.220	3.503	0.000
Q12br7r9r11 ← Propensão Plataforma	0.623	0.863	0.799	0.227	3.808	0.000
Demografia Empresa → Propensão Plataforma	0.023	0.036	0.042	0.108	0.336	0.737
Estágio do Ciclo de Vida → Propensão Plataforma	0.306	0.229	0.227	0.114	2.009	0.045
Interação *Fintech* → Propensão Plataforma	0.414	0.189	0.233	0.090	2.090	0.037

Note: Elaborated by the authors. S4b: How long has your company been operating?; S11b: How long have you been working for the business?; Q1b: Which of the following options best describes your business life cycle stage prior to the COVID-19 outbreak in January 2020?; Q2b: Which of the following options best describes your current business life cycle stage?; Q21r5: If you needed to access cash for your business, which of the following sources would you consider using?; Q24r5: Which of the following options does your company receive financial services from?; Q10b: Which of the following options best describes your current business model(s) (marketplace; hidden advertising; subscription)?; Q12b: Which of the following options best describes the business model(s) you plan to change to in the future (marketplace; hidden advertising; subscription)?

Table 11

Effect size (and p-value) for CE-FDH and CR-FDH models

Dependent variables	CE-FDH		CR-FDH	
	Q10br7r9r11	Q12br7r9r11	Q10br7r9r11	Q12br7r9r11
S4b	0.200 (0.624)	0.467 (0.148)	0.100 (0.624)	0.312 (0.130)
S11b	0.300 (0.614)	0.533 (0.181)	0.200 (0.393)	0.357 (0.120)
Q1b	0.400 (0.240)	**0.667 (0.000)**	0.200 (0.575)	**0.500 (0.000)**
Q2b	0.200 (0.816)	**0.600 (0.001)**	0.100 (0.816)	**0.452 (0.001)**
Q21r5	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
Q24r5	0.000 (1.000)	0.333 (0.252)	0.000 (1.000)	0.167 (0.252)

Note: Elaborated by the authors. S4b: How long has your company been operating?; S11b: How long have you been working for the business?; Q1b: Which of the following options best describes your business life cycle stage prior to the COVID-19 outbreak in January 2020?; Q2b: Which of the following options best describes your current business life cycle stage?; Q21r5: If you needed to access cash for your business, which of the following sources would you consider using?; Q24r5: Which of the following options does your company receive financial services from?; Q10b: Which of the following options best describes your current business model(s) (marketplace; hidden advertising; subscription)?; Q12b: Which of the following options best describes the business model(s) you plan to change to in the future (marketplace; hidden advertising; subscription)?.

Table 12

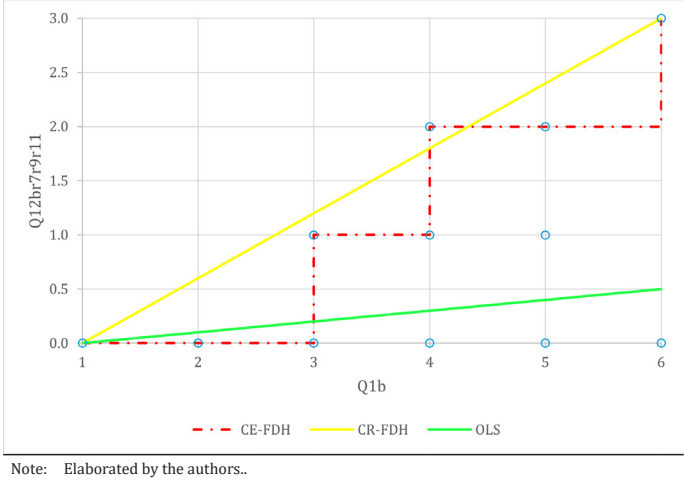
Bottleneck of the variable Q12br7r9r11 for the CE-FDH and CR-FDH models (percentual range)

Y	CE-FDH		CR-FDH	
	Q1b	Q2b	Q1b	Q2b
0	NN	NN	1.30	NN
10	40.0	20.0	11.00	3.40
20	40.0	20.0	20.80	13.80
30	40.0	20.0	30.50	24.20
40	60.0	60.0	40.3	34.60
50	60.0	60.0	50.00	45.00
60	60.0	60.0	59.80	55.40
70	NA	NA	69.50	65.80
80	NA	NA	79.30	76.20
90	NA	NA	89.00	86.60
100	NA	NA	98.80	97.10

Note: Elaborated by the authors. Q1b: Which of the following options best describes your business life cycle stage prior to the COVID-19 outbreak in January 2020?; Q2b: Which of the following options best describes your current business life cycle stage?; Q12br7r9r11: Which of the following options best describes the business model(s) you plan to change to in the future (marketplace; hidden advertising; subscription)?.

Figure 3

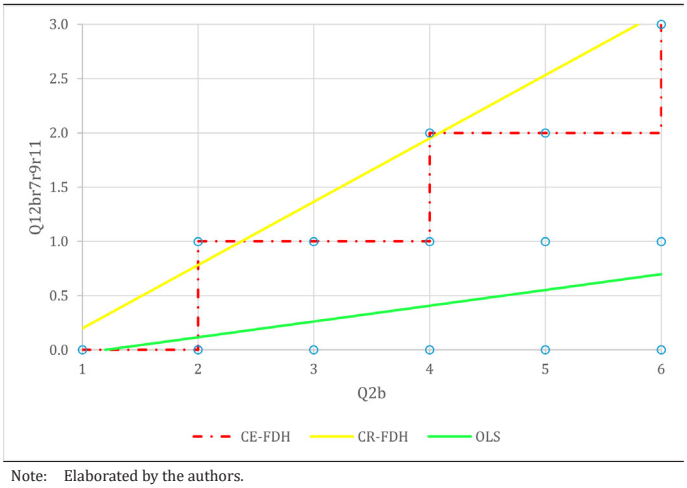
Necessary Condition Analysis Graph: Q1b – Q12br7r9r11



Note: Elaborated by the authors..

Figure 4

Necessary Condition Analysis Graph: Q2b – Q12br7r9r11



Note: Elaborated by the authors.

DISCUSSION

The analysis of the results showed that it is not possible to obtain a significant sufficiency relationship between company demographics (H1), life cycle stage (H2), and FinTech interaction (H3) with the platform propensity variable. In addition to the sufficiency analysis, we continue with the emerging analysis of necessary conditions (Dul, 2016). The results obtained indicated that the life cycle stage before COVID-19 and the current life cycle stage are the only dependent variables for which the necessary condition is confirmed for planning the adoption of a platform-based business model (Marketplace; Hidden Advertising; Subscription) in the future. That is, for small companies to adopt platform models, they need to be in the conception or startup stages.

When we look at the distribution of answers regarding plans to adopt a platform-based model in the future at the stage of the company life cycle after the peak of the COVID-19 pandemic, we found that 50% of companies in the conception stage and 36% of companies in the startup stage intend to adopt the platform model. Regarding the economic sector of small companies, 41% of companies in the technology sector, and 29% of companies in the industrial sector intend to adopt the platform model. Table 13 presents the distribution of the percentage of companies that intend to adopt the platform model by life cycle stage after the peak of COVID-19 and by economic sector.

The results obtained are in line with Vial (2019), who identified 35 studies that indicate business inertia as a factor that makes it difficult the adoption of business models that require digital transformation capabilities. Established and mature companies have greater difficulty in establishing business models that are

Table 13

Distribution of the percentage of companies that intend to adopt the platform model by life cycle stage after the peak of COVID-19 and by economic sector

Post-COVID-19 life cycle stage	Basic, energy and infrastructure industry (%)	Consumer goods, retail and healthcare (%)	Technology, media and telecommunications (%)	Professional and financial services (%)	Total (%)
1 - Exit	0	0			0
2 - Decline	0	29	40	0	17
3 - Maturity	38	24	41	10	25
4 - Growth	0	0	40	0	18
5 - Initialization		50	33	25	36
6 - Conceptualization	100	0	50		50
Total	29	22	41	8	24

Note: Elaborated by the authors. The table is a heatmap. Each cell ranges from 0-1, and is calculated by dividing the number of companies that have adopted the platform model by the total number of companies in that category. For example, for the "conception" row, 1/1 basic company adopted the platform model (100%), 0/1 retail company (0%), 1/2 technology company (50%) and there was no professional services company. In total, 2/4 companies in the conception stage adopted the platform model (50%).

highly dependent on digital technologies, such as the platform model. Similar results were presented by Islam et al. (2017), Svahn et al. (2017), Srivastava and Shainesh (2015), and Wenzel et al. (2015).

CONCLUSION

The number of publications on digital transformation in small companies has been growing significantly, indicating the importance of the topic for the academy and the management practice (Sarango-Lalangui et al., 2023). The digitalization movement among small and medium companies is characterized by the adoption of new technologies that allow small companies to adopt new transactional business models and interact with consumers through marketplaces and social networks (Da Rocha et al., 2024; Sarango-Lalangui et al., 2023; Bai et al., 2021). This work contributes to understand the dynamics of adoption of digital platforms-based business models by small companies, through an empirical approach based on Structural Equation Modeling (PLS-SEM) and Necessary Condition Analysis (NCA) and supported by a survey with 126 small Brazilian companies.

The universe of small companies is extremely important for the economic development of society in general. Small companies play a very large role in the countries' economy and need to adapt to the new business models that are emerging, which are mostly based on digital technologies and platform models and ecosystems, in order to survive in the long term, overcoming the impacts caused by the COVID-19 pandemic and expanding the reach of services of these companies to less developed regions (Sudarnice et al., 2024; Kádárová, et al., 2023; Robertson et al., 2022; Bai et al., 2021).

The fact that most of unicorns (emerging companies valued at more than US$ 1 billion) are digital platform-based models, which allow early-stage companies to reach massive scale and gain value in a very short period, may be a factor that directs entrepreneurs with nascent businesses to consider digital platforms-based business models for their enterprises (Acs et al., 2017).

On the other hand, small companies in more mature stages are not embracing this technological transformation nor appropriating the value created within digital platforms and need to overcome the business inertia and barriers imposed by existing capabilities through incremental innovation strategies and with initiatives to retrain leadership and employees (Vial, 2019; Islam et al., 2017; Svahn et al., 2017; Srivastava & Shainesh, 2015; Wenzel et al., 2015).

It is important to notice that this study has limitations related to self-response bias, which is mitigated by the significant number of companies of the sample and by the quantitative nature, which did not allow us to delve deeper into the reasons for the non-adoption of the platform model by the companies analyzed.

As a suggestion for new studies regarding the object of analysis of this work, we believe new investigations with small-sized companies could be of great value, with a greater number of interviewees. Longitudinal investigations that demonstrate the progress of platform adoption by small companies will also contribute to a better understanding of the topic. Moreover, a qualitative approach focused on a deeper understanding of the profile of the digital entrepreneur should be considered to identify the critical success factors for digital technologies-based small companies and evaluate how to overcome business inertia through government or private initiatives.

Conflict of interest statement

The authors declare that there is no conflict of interest.

Authors' statement of individual contributions

Roles	Contributions		
	Schur R. D.	Sabiá R.	Trabasso R.
Conceptualization	■		
Methodology	■		
Software	■		
Validation	■	■	
Formal analysis	■	■	
Investigation	■	■	
Resources	■	■	■
Data Curation	■		
Writing - Original Draf	■	■	
Writing - Review & Editing	■	■	■
Visualization	■	■	■
Supervision	■		
Project administration	■		
Funding acquisition	N.A.		

Note: Acc. CRediT (Contributor Roles Taxonomy): https://credit.niso.org/

Open Science: Data availability

The dataset supporting the results of this study is not publicly available.

Badge	Description
	This research was only possible thanks to the contribution of EY Brazil, which made available the primary data from the investigation conducted with a sample of 126 small Brazilian companies, with the aim of supporting the development and dissemination of applied scientific research. In accordance with the norms and policies that regulate the professional conduct of EY Brazil, including data protection provisions, it was not possible to disclose the evaluations and underlying data of this research. The authors thank EY Brazil for their support in carrying out this work.
	
	
	https://doi.org/10.14211/regepe.esbj.e2482pr
	Not applicable

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