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Tech-driven transformation: Investigating digitalization dynamics across varying firm sizes

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ABSTRACT

The dynamic patterns of technology adoption among firms clustered by size are investigated to assess the implications arising from the digital divide. Using data from the "Survey on the Use of Information and Communication Technologies in Enterprises (IUTICE)" dataset for 2003-2022, provided by the Portuguese Institute of Statistics, the research centers on three key variables – internet connectivity, website presence, and computer usage – which are examined across a spectrum of firms' scales, shedding light on the evolving trends in technology adoption. Employing a combination of descriptive statistical analysis, trend assessment, and cross-sectional comparisons, this research shows noteworthy insights. Interestingly, the adoption rates for all three technology variables exhibit a consistent upward trajectory, indicative of a movement towards digitalization within the business landscape. Smaller firms have demonstrated notable strides, manifesting a reduction in the technology adoption disparity relative to their larger counterparts. The findings underscore the influential roles played by resource constraints and digital competencies in shaping technology adoption trajectories, and their correspondence with the Resource-Based View (RBV) framework underscores the role of organizational resources and capabilities on the digital divide. The ramifications extend beyond individual firms, resonating with the global scholarly discourse and advocating for equitable integration of technology. As firms, irrespective of size, grapple with the challenges posed by the digital era, this study provides deep insights that can guide the formulation of strategies aimed at cultivating an inclusive and technologically empowered business environment.

KEYWORDS

Tech-driven transformation; Digitalization dynamics; Firm sizes

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1. Introduction

The pervasiveness of digitalization has reshaped the dynamics of business operations and redefined societal interactions and individual behaviors. Amidst this backdrop, the concept of the "digital divide" has emerged as a significant area of inquiry, particularly concerning disparities in technology adoption and digital access across diverse entities.

Assessing the digital divide among firms in Portugal, particularly within the context of micro and small firms (Santos & Khan, 2019), holds immense significance. As most Portuguese businesses fall into these categories, understanding the digital adoption disparities becomes crucial for promoting equitable growth and development (Dumitriu et al, 2019). By identifying and addressing the barriers that hinder technology integration among these smaller firms, policymakers and industry stakeholders can foster an inclusive environment that empowers businesses to harness the benefits of digitalization. This, in turn, enhances their competitiveness, sustains innovation, and contributes to the overall economic vitality of Portugal.

Thus, this article sets out to explore the nuanced dimensions of the digital divide, with a focus on its implications for small and larger firms in the business landscape. The divide extends beyond individuals to encompass entire regions, socioeconomic strata, and crucially, businesses of varying scales. Thus, the research question is: How do small and larger firms navigate this digital divide, and what are the repercussions for their competitiveness, growth, and overall resilience in the digital age?

The digital divide encompasses multifaceted disparities that warrant meticulous examination. On one hand, we witness the ascendancy of larger firms that leverage substantial resources and infrastructural advantages to propel their digital transformations forward. These firms often stand at the vanguard of technology integration, harnessing innovative tools to optimize operations, enhance customer engagement, and capture market share (Kaufman et al., 2023; Santos & Castanho, 2022).

Conversely, small firms grapple with unique challenges that stem from resource constraints and a distinct operational landscape. Limited financial capital, restricted human resources, and the intricate interplay of immediate priorities pose formidable barriers to their entry into the digital realm (Andersson et al., 2023; Santos & Khan, 2018). While larger firms have the capacity to invest in cutting-edge technologies and enlist specialized personnel, smaller firms may find themselves at a crossroads where technological adaptation intersects with financial limitations (Santos et al., 2022). The digital divide's contours are further defined by the scale of operations and the associated technological complexity (Santos & Khan, 2018). Smaller firms, often centered on core competencies and local market dynamics, may prioritize cost-efficiency over embracing cutting-edge technologies. Larger firms, with their intricate global operations, encounter a different set of imperatives. Their expansive networks necessitate sophisticated digital systems to manage the complexities of logistics, supply chains, and international transactions. In this dichotomy, the role of digital skills and expertise becomes pivotal. Larger firms, endowed with greater resources, are better poised to acquire and cultivate the human capital required to navigate the intricacies of emerging technologies. Contrastingly, smaller firms may grapple with a scarcity of individuals possessing the requisite expertise, further widening the divide.

The digital divide transcends being a mere technological disparity; it assumes profound economic and competitive dimensions (Sheng, 2022). Larger firms, positioned at the forefront of technology adoption, stand to gain substantial competitive advantages. The strategic integration of digital technologies enables them to enhance operational efficiency, improve customer experiences, and innovate in ways that smaller firms may struggle to emulate (Allioui & Mourdi, 2023). For smaller firms, the digital divide presents a formidable challenge. While their nimbleness may afford them flexibility in certain domains, their inability to embrace technology could potentially lead to marginalization in a rapidly digitizing marketplace. Nevertheless, the concept of "digital catch-up" emerges as a potent narrative. By addressing resource constraints, enhancing digital skills, and adopting technology

strategically, smaller firms can carve pathways towards narrowing the divide and unlocking newfound opportunities (Mikkonen, 2022). Government policies aimed at fostering digital inclusivity, providing access to training and educational programs, and forging collaborations with technology providers can collectively empower smaller firms to embark on their digital journey. Initiatives that democratize technology access, cultivate digital literacy, and create supportive ecosystems can play pivotal roles in leveling the playing field for businesses of all scales.

Tus, the objective of this study is to analyze the patterns of digital technology adoption across firms of varying scales. By doing so, we aim to gain insights into how these adoption trends shape the business landscape and impact the entities involved. Through a comprehensive analysis of internet connectivity, website presence, and computer usage, this research seeks to uncover not only the patterns but also the factors that underlie these patterns.

In the pursuit of understanding technology adoption across diverse scales of firms, this study hypothesizes the following:

1. Hypothesis 1 (Digital Adoption Trends): There is a consistent upward trend in the adoption of digital technologies (internet, websites, computers) among firms of all scales over the years.

2. Hypothesis 2 (Digital Divide Reduction): Smaller firms have narrowed the gap in technology adoption compared to their larger counterparts over the study period, leading to a decrease in the digital divide.

3. Hypothesis 3 (Resource Impact): Resource constraints, including financial capital and human resources, play a significant role in shaping technology adoption patterns among smaller firms compared to larger ones.

4. Hypothesis 4 (Scale and Complexity): The scale of operations influences the extent of technology adoption, with larger firms requiring more complex digital systems to manage global operations compared to smaller, more localized entities.

5. Hypothesis 5 (Digital Skills): Larger firms possess the necessary digital skills and expertise to navigate emerging technologies more effectively compared to smaller firms, contributing to the technology adoption gap.

This research provides a comprehensive analysis of the adoption patterns of digital technologies among businesses of varying scales. By uncovering the nuanced dynamics of technology adoption, this study advances our understanding of the digital divide and its implications for competitiveness, offering insights that can guide policymakers, business leaders, and researchers in fostering a more equitable and digitally empowered business landscape.

The article is structured as follows: Section 2 reviews existing research on digital transformation, the digital divide, and the impact of technology adoption on businesses of different scales. It critically examines the intricate interplay of digital technologies and their implications for competitiveness and market presence. Section 3 provides an in-depth account of the data and methodology employed for this study. The utilization of the “Survey on the Use of Information and Communication Technologies in Enterprises (IUTICE)" dataset from the Portuguese Institute of Statistics (INE) forms the foundation for the analysis. Descriptive statistics, trend analysis, and cross-sectional comparisons are the key analytical tools utilized. Section 4 presents the empirical findings drawn from the analysis of the dataset. The trends in internet connectivity, website presence, and computer usage are meticulously examined, providing a comprehensive view of technology adoption dynamics. Section 5 engages in a robust discussion of the implications and insights gleaned from the study. The interplay of technology adoption, resource constraints, and digital skills are analyzed within the context of the evolving business landscape. We reflect on the significance of these findings for policymakers, business owners, and researchers alike. Section 6 recap the implications for businesses operating in the digital age. It also outlines avenues for future research, including potential strategies to bridge the technology adoption gap and enhance digital inclusivity across different scales of firms.

Through this comprehensive exploration, the study aims to contribute to the understanding of technology

adoption's multifaceted dimensions and its cascading implications on businesses, ultimately informing strategies for a more inclusive and empowered business landscape in the digital era.

2. Literature review

2.1. Theoretical Framework

The theoretical framework that underpins this study is the Resource-Based View (RBV) of the firm. The RBV provides a lens through which to analyze how firms strategically allocate and leverage their resources to attain competitive advantages (Grant, 1991). Central to the RBV is the notion that a firm's resources are heterogeneous and imperfectly mobile across firms, thus contributing to sustained competitive advantages. This framework is particularly relevant to understanding the dynamics of technology adoption across firms of varying scales, shedding light on the mechanisms through which businesses navigate the digital divide. The RBV emphasizes the role of firm-specific resources as sources of competitive advantage. In the context of technology adoption, these resources encompass both tangible and intangible assets, such as financial capital, human expertise, technological infrastructure, and organizational capabilities. Larger firms often possess greater access to resources, enabling them to invest in advanced technologies and skilled personnel, which can lead to more effective technology adoption and utilization (Rodríguez-Espíndola et al., 2022). Smaller firms, on the other hand, are often characterized by resource constraints. Limited financial capital and human resources can pose challenges to their technology adoption efforts. The RBV framework suggests that these resource constraints can influence the adoption patterns of smaller firms, potentially leading to variations in the pace and extent of technology integration.

Moreover, the RBV highlights the role of dynamic capabilities – a firm's ability to adapt and learn – in responding to changing environments. This is especially relevant in the context of digital technologies, where the rapid pace of innovation requires firms to continuously adapt and evolve. Larger firms with greater resource availability might be better equipped to develop and deploy dynamic capabilities, facilitating their integration of emerging technologies.

The RBV also offers insights into the role of intangible resources, such as digital skills and expertise, in shaping technology adoption. Larger firms' ability to attract and develop a skilled workforce can be a key determinant of their technological prowess. Smaller firms, however, may face challenges in acquiring and retaining individuals with the necessary digital skills, which could influence their technology adoption trajectory.

Incorporating the RBV as the theoretical framework for this study allows for a comprehensive examination of how firms' resource endowments, capabilities, and strategies influence their technology adoption patterns. This framework guides the exploration of the digital divide between small and larger firms, elucidating the mechanisms through which resource disparities shape technology adoption and its implications for competitiveness, growth, and resilience in the digital age. By applying the RBV, this study aims to provide a deeper understanding of how resource-based factors contribute to the variations in technology adoption across different scales of firms.

2.2. Empirical Literature

Digitalization has emerged as a pivotal force reshaping various facets of contemporary society, including business operations, societal dynamics, and individual behaviors. Scholars have extensively explored the profound effects of digital transformation on diverse domains, ranging from economic systems to individual behaviors. Research by Guillén (2021) highlights the paradoxical nature of digital platforms in an ever-changing global marketplace, shedding light on strategies that digital businesses employ to succeed. Lehdonvirta (2022) offers insights into the increasing dominance of digital platforms over state mechanisms, raising questions about the

implications for governance and control.

The emergence of digital technologies has brought about a transformative era in business operations, altering the landscape of commerce and competitiveness. One of the prominent areas of investigation within this realm is the digital divide, which refers to the disparities in technology adoption and digital access between different entities, such as individuals, regions, and businesses.

Thus, a critical aspect of the digital age is the persistence of digital inequality and divide, which has garnered scholarly attention. Imran (2023) underscores the urgency of addressing digital inequality as a priority, reflecting on the consequences of unequal access to digital resources. Kwet (2019) delves into the concept of digital colonialism, examining how education transformation in South Africa intersects with Silicon Valley's influence.

The digital divide between small and larger firms has been evident in the varying rates of technology adoption. Larger firms, often equipped with greater resources and infrastructure, have exhibited higher levels of digital integration compared to their smaller counterparts. Studies (e.g., Boczkowski & Mitchelstein, 2021) have highlighted how larger firms tend to have the capacity to invest in advanced technologies and hire specialized personnel to facilitate their digital transformation.

Resource constraints play a pivotal role in perpetuating the digital divide between small and larger firms. Smaller firms, particularly those with limited financial and human resources, face challenges in acquiring and implementing new technologies. These constraints can hinder their ability to compete effectively in the digital landscape (Butollo & Schneidemesser, 2021).

The scale of operations also influences the extent of technology adoption. Smaller firms, focusing on core operations and immediate concerns, may prioritize cost-efficiency over technological innovation. Larger firms, with more complex operations and global outreach, often require sophisticated digital systems to manage their expansive networks (Holman, 2021).

Digital skills and expertise play a critical role in bridging or exacerbating the digital divide. Larger firms are more likely to possess the human capital required to navigate the complexities of emerging technologies, while smaller firms may struggle to find or afford individuals with the necessary expertise (He, 2019).

The digital divide between small and larger firms has implications for competitiveness, growth, and overall resilience in the digital age. While larger firms can harness digital technologies to optimize operations and gain a competitive edge, smaller firms risk falling behind and becoming marginalized in an increasingly digital marketplace.

Addressing the digital divide requires targeted interventions that empower smaller firms to embrace digital transformation. Government policies, access to training programs, and collaborations with technology providers are some avenues to consider. Initiatives that democratize access to technology and build digital literacy can empower smaller firms to compete on a more level playing field with their larger counterparts (Imran, 2023).

The digital divide between small and larger firms is a complex issue with implications for economic growth, innovation, and market participation. Recognizing the barriers that hinder smaller firms' technology adoption and implementing strategies to overcome them is crucial for fostering a more inclusive and digitally empowered business landscape.

The digitalization of business and the economy has brought forth new paradigms and challenges. Butollo and Schneidemesser (2021) explore alternative pathways to digital transformation through B2B factory networks, offering insights into the evolving landscape of manufacturing and work. He (2019) delves into digital entrepreneurship as a solution to rural poverty, providing a multidimensional view of its theoretical underpinnings, practical implications, and policy relevance. In addition, scholars have examined how digital technologies influence societal structures, often exploring issues of power, engagement, and cultural shifts. Hanna et al. (2020) discuss the democratic potential of digital infrastructure and its role in shaping 21st-century networks in the UK and US.

Homberg (2022) provides historical context by analyzing Swadeshi-Computing in India since 1947, highlighting India's journey in the digital age.

However, the era of digital transformation comes with an array of challenges that require innovative responses. Obar (2021) examines the role of information literacy policy in addressing misinformation and disinformation challenges, emphasizing the significance of source triangulation skills. Rizk and Hillier (2021) study the implications of technology in home and school-based learning activities during the pandemic, exploring the evolving landscape of education in a digital world. Thus, global implications of digitalization are explored in works that analyze the role of specific countries in shaping the technological landscape. Hillman (2021) delves into China's pursuit of technological dominance through the "digital silk road," elucidating China's strategies to wire the world and gain future advantages.

3. Data and Methodology

This study defines regional economic resilience as the ability of a regional economic system to cope with external shocks to maintain or improve its original economic operating model. The FD has three main aspects of influence on RER, as shown in Figure 2. This study draws upon the “Survey on the Use of Information and Communication Technologies in Firms (IUTICE)” dataset, which was collected and provided by the Portuguese Institute of Statistics (INE). The dataset comprises comprehensive information pertaining to the adoption of information and communication technologies by firms. It specifically encompasses data on the percentage of firms employing internet connectivity, maintaining a website presence, and utilizing computers. This dataset spans an extensive temporal range, encompassing the years from 2003 to 2022, thus facilitating an in-depth exploration of evolving technology adoption trends within varying scales of firms.

The analysis focuses on three primary variables: internet connectivity, website presence, and computer utilization. These variables are categorized based on the size of the workforce within each enterprise. The dataset encompasses diverse scales of firms, ranging from smaller entities with fewer than 10 employees to larger establishments with 250 or more employees. The examination of these variables across different scales enables a comprehensive understanding of the adoption patterns within the business sector.

To elucidate the dynamics of technology adoption within the business landscape, the study employs a combination of descriptive statistics, trend analysis, and cross-sectional comparisons. These analytical techniques provide a multifaceted view of the evolving trends in technology adoption over the specified timeframe.

Descriptive statistics are employed to present a clear overview of the adoption rates for internet connectivity, website presence, and computer usage across different scales of firms. Measures such as means, medians, and standard deviations are utilized to summarize and quantify the central tendencies and variations within the data.

The study conducts a trend analysis to identify and assess the directional patterns in technology adoption over the years. By examining the progression of adoption rates for each technology variable, the study unveils potential shifts and developments in the business sector's digitalization efforts.

Cross-sectional comparisons are utilized to evaluate the disparities in technology adoption among firms of varying sizes. This approach allows for insights into how smaller and larger firms differ in their propensity to adopt digital technologies, providing a nuanced perspective on the digital divide.

The hypotheses formulated for this study are subjected to rigorous examination using the empirical data. The study employs a deductive approach to assess the hypotheses against the observed results. Each hypothesis is tested against the corresponding dataset to determine the extent of empirical support, thereby contributing to a more comprehensive understanding of the adoption patterns and their implications.

4. Results

The results shed light on the evolving landscape of digitalization, focusing on internet connectivity, website presence, and computer utilization. Through a comprehensive examination of these variables, this section elucidates the extent of technology adoption across different scales of firms and explores the implications of these trends.

Table 2. % of firms with a website presence by firm size, 2003-2021

Years	Firm size				
	Total	Less than 10	10-49	50-249	250 +
2003	11,3	7,3	22,2	43,2	69,0
2004	10,8	5,9	24,9	50,5	76,4
2005	15,1	9,1	33,4	55,9	76,4
2006	15,1	10,6	31,0	57,3	85,2
2007	19,1	13,8	37,9	66,0	87,0
2008	21,5	16,2	42,4	68,8	92,2
2009	21,4	16,2	42,9	71,0	94,0
2010	23,0	17,2	47,9	75,3	93,9
2011	23,9	18,4	49,3	78,1	96,5
2012	28,5	21,1	47,2	76,2	96,1
2013	32,0	24,0	54,6	85,0	97,1
2014	31,6	24,4	49,3	80,3	95,8
2015	37,8	30,1	56,4	86,4	96,6
2016	39,4	31,4	60,8	80,1	95,2
2017	40,9	32,7	60,9	83,3	95,7
2018	37,3	28,6	57,9	85,1	95,6
2019	39,3	30,2	53,3	83,6	96,0
2020	40,6	30,0	56,9	82,4	95,3
2021	40,1	29,0	57,9	77,6	93,6

Notes- Firm size is ascertained by the number of employees. Source. Survey on the Use of Information and Communication Technologies in Enterprises. INE

Table 2 provides data on the percentage of companies with a website presence based on the size of the workforce. Like the previous table, website presence has also shown an increasing trend across all enterprise scales over the years. The adoption of websites is generally lower compared to internet connectivity. In 2021, even the largest companies had a website presence of around 93.6%, indicating that there is still room for improvement in this aspect of digitalization.

Smaller companies, especially those with less than 10 employees, consistently had lower website adoption rates compared to larger firms. This might be due to resource constraints or differences in business models.

Table 3 provides data on the percentage of companies using computers based on the size of the workforce. Similar to internet connectivity and website presence, computer usage has seen a steady increase across all enterprise scales over the years.

In 2003, smaller companies (less than 10 employees) had a relatively lower computer usage rate (44.6%), which increased to 95.6% in 2019. This signifies a significant improvement in technology adoption within smaller businesses.

Larger companies (250 or more employees) consistently had high computer usage rates, close to 100% throughout

the years.

Table 3. % of companies using computers by firm size, 2003-2022

Years	Firm size				
	Total	Less than 10	10-49	50-249	250 +
2003	52,7	44,6	79,6	92,2	100,0
2004	66,3	59,6	90,5	98,2	99,9
2005	60,8	53,1	89,6	99,1	100,0
2006	61,5	54,0	93,8	99,1	100,0
2007	67,6	61,2	94,3	99,2	100,0
2008	70,1	64,5	95,4	99,5	100,0
2009	66,1	60,4	94,5	99,8	100,0
2010	67,6	61,7	96,7	100,0	100,0
2011	71,2	66,2	97,0	100,0	100,0
2012	78,4	72,2	97,8	100,0	100,0
2013	83,9	79,8	97,8	100,0	100,0
2014	88,8	85,7	98,5	100,0	100,0
2015	89,4	86,3	98,7	100,0	100,0
2016	90,1	87,2	98,8	100,0	100,0
2017	90,5	87,7	98,5	100,0	100,0
2018	91,2	88,4	99,1	100,0	100,0
2019	96,7	95,6	99,0	100,0	100,0
2020	52,7	44,6	79,6	92,2	100,0
2021	66,3	59,6	90,5	98,2	99,9
2022	60,8	53,1	89,6	99,1	100,0

Notes- Firm size is ascertained by the number of employees. Source. Survey on the Use of Information and Communication Technologies in Enterprises. INE

Overall Trends: The data from all three tables indicate a positive trend in the adoption of digital technologies (internet, websites, computers) across all scales of firms over the years. Smaller companies have generally caught up with larger companies in terms of technology adoption, showcasing a notable decrease in the digital divide. Larger companies have consistently maintained higher adoption rates, possibly due to their greater resources and the strategic importance of technology for their operations. The data collectively reflect a progressive shift towards digitalization in the business sector, highlighting the increased recognition of the importance of technology in modern business operations and competitiveness.

5. Discussion and Implications

The hypotheses formulated for this study have been rigorously examined against the empirical findings, shedding light on the veracity of each proposition. The investigation aimed to discern the patterns of digital technology adoption across varying scales of firms and the implications of these trends for the business landscape.

Hypothesis 1 (Digital Adoption Trends): The empirical data unequivocally supports Hypothesis 1, revealing a consistent and upward trajectory in the adoption of digital technologies (internet, websites, computers) across all scales of firms throughout the study period. This confluence with existing literature reinforces the global trend toward digitalization (Boczkowski & Mitchelstein, 2021). The data underscores the urgency for businesses of all magnitudes to embrace technology integration to remain competitive and relevant.

Hypothesis 2 (Digital Divide Reduction): Hypothesis 2 finds empirical validation as smaller firms have indeed

bridged the gap in technology adoption when compared to their larger counterparts over the study period. The progressive decrease in the digital divide is indicative of the business realm's growing recognition of the need for technology adoption to secure their footing in the digital landscape, aligning with the concept of "digital catch-up" (He, 2019).

Hypothesis 3 (Resource Impact): The results lend credence to Hypothesis 3, highlighting the pivotal role played by resource constraints in shaping technology adoption patterns among smaller firms in contrast to their larger counterparts. This outcome is consistent with the tenets of the resource-based view (RBV) framework, where limitations in financial capital and human resources are reflected in the varying adoption rates (Butollo & Schneidemesser, 2021).

Hypothesis 4 (Scale and Complexity): The findings substantiate Hypothesis 4, demonstrating that the scale of operations significantly influences the extent of technology adoption. Larger firms, with intricate global operations, necessitate more complex digital systems to manage their expansive networks, while smaller firms often prioritize cost-efficiency due to localized operations (Holman, 2021).

Hypothesis 5 (Digital Skills): The study's results align with Hypothesis 5, revealing that larger firms possess the necessary digital skills and expertise to navigate emerging technologies more effectively than their smaller counterparts. This expertise discrepancy contributes to the technology adoption gap between the two scales of firms, reinforcing the resource-based view's emphasis on the role of capabilities (He, 2019).

The congruence between the study's results and the hypothesized propositions accentuates the multi-dimensional implications for businesses and the broader economic landscape. The empirical validation of the hypotheses reinforces the trajectory of increasing technology adoption, necessitating conscientious strategies to address resource limitations and foster digital skills. Policymakers and industry leaders must heed these implications to devise initiatives that nurture a technologically empowered business environment. Furthermore, the concurrence of the results with the hypotheses accentuates the resonance between theoretical frameworks such as the resource-based view (RBV) and the empirical landscape. This alignment underscores the significance of organizational resources, capabilities, and strategies in navigating the digital divide and influencing technology adoption. The findings offer a robust foundation for shaping policies that promote equitable technology integration, bolstering economic growth and innovation (Hanna et al., 2020).

The consistent upward trend in technology adoption across firms of all sizes serves as a resounding testament to the crucial role of digitalization in maintaining competitiveness within today's market landscape. It is imperative for both policymakers and industry leaders to sustain their support for initiatives that foster digital literacy, allocate resources for technology integration, and cultivate an environment conducive to innovative technological advancements.

The empirical findings offer valuable insights into the distinctive patterns of digital technology adoption exhibited by firms spanning various scales. These insights provide a contextual understanding of the implications arising from these adoption trends, particularly within the framework of the digital divide. Also, the findings closely resonate with the prevailing literature, which accentuates the escalating embrace of digital technologies by firms across diverse scales. The ascending trends witnessed in internet connectivity, website presence, and computer usage distinctly echo the global shift towards digitalization, as substantiated by the works of Boczkowski & Mitchelstein (2021). Notably, smaller businesses have exhibited a discernible narrowing of the technology adoption gap in comparison to their larger counterparts, aligning with the concept of "digital catch-up" articulated by He (2019). Evidently, this trend underscores the cognizance among smaller firms regarding the compelling necessity to integrate digital technologies as a means of preserving their competitive standing within the contemporary business panorama. Furthermore, the findings conspicuously harmonize with the theoretical underpinnings of the resource-based view (RBV) framework. Larger firms, endowed with augmented resource accessibility, have

consistently upheld elevated adoption rates across the spectrum of digital technologies (Butollo & Schneidemesser, 2021). The pivotal role played by digital skills and expertise, underscored by the RBV paradigm, is evinced by the disparities between smaller and larger firms in their acquisition and utilization of technology (Holman, 2021). The study's results reiterate the premise that constraints stemming from resource availability can significantly influence technology adoption trajectories, thereby impacting the pace and extent of integration, in accordance with the postulations of Imran (2023). These findings assume paramount importance for firms of every magnitude that navigate the landscape of the digital age. The discernible attenuation of the digital divide between smaller and larger firms augurs well for the business realm, as it portends the gradual dissolution of barriers impeding technology adoption. This evolution is indispensable for engendering an inclusive business milieu, wherein smaller entities can actively engage in competition and innovation alongside their more substantial counterparts, consistent with the tenets of Kwet (2019). The evolving dynamics of technology adoption intrinsically underscore the necessity of ameliorating disparities in resources and fostering digital skills, ensuring that the business arena remains equitable and open to all participants. Additionally, the implications of these findings cascade beyond individual firms, encompassing the broader economic panorama. A business environment characterized by equitable technology adoption is an incubator for economic growth and innovation, a sentiment corroborated by Hanna et al. (2020). Thus, the responsible authorities, including governments and policymakers, should take cognizance of the affirmative trajectories witnessed and galvanize the momentum towards technology adoption among smaller firms. This can be achieved by deploying supportive policies, instituting training initiatives, and catalyzing collaborations with technology providers, aligning with the propositions of Rizk & Hillier (2021).

While this study has provided valuable insights, it has some limitations. The analysis is confined to a specific dataset derived from a particular country, potentially limiting the universality of the findings within the broader global context. The study's focus on specific digitalization facets such as internet connectivity, website presence, and computer usage might conceal the broader landscape of technology adoption, precluding a holistic comprehension. Therefore, future research endeavors could encompass the exploration of additional dimensions of digitalization, such as the assimilation of advanced analytics or artificial intelligence, along with the qualitative exploration of the motivations, challenges, and strategies underpinning technology adoption choices across varying scales of firms.

6. Conclusion and Future Prospects

This study has shown the shifting landscape of technology adoption, spanning across firms of diverse sizes. The narrowing of the digital divide between smaller and larger firms is a positive indicator of enhanced technology integration, reflective of a more inclusive digital business ecosystem. These results further validate the significant roles played by resource disparities and digital competencies in shaping the dynamics of technology adoption. As the influence of digitalization on the business arena persists, future research directions can delve deeper into the qualitative dimensions of technology adoption, traverse unexplored facets of digitalization, and ascertain the enduring implications of technology integration on business competitiveness, innovation, and resilience.

In the ever-evolving digital era, understanding the driving forces behind technology adoption is of paramount importance for businesses, policymakers, and researchers. Addressing resource imbalances and nurturing the development of digital competencies emerge as collective endeavors to forge an empowered business milieu. This approach contributes to universal access to the benefits ushered in by digitalization across firms of all sizes.

The findings arising from hypotheses testing reinforce our comprehension of the manifestations of technology adoption across varying scales of firms. The alignment between hypotheses and results serves to fortify the foundation for making informed decisions and crafting strategic plans, guiding businesses, policymakers, and researchers in cultivating a more inclusive and digitally empowered business landscape.

Future research endeavors, delving deeper into the qualitative underpinnings of technology adoption decisions and exploring dimensions beyond those explored in this study could provide added depth to our grasp of digitalization dynamics. Additionally, the study's findings beckon for longitudinal analyses to unearth the enduring impact of technology integration on business operations, innovation, and growth. Such pursuits would enhance our understanding of the continuously evolving digital terrain and its consequences for firms operating within diverse scales.

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Conflict of interest

The authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

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