



The Spiral of Innovating and Digitalizing: Innovation Shaped by Past Digitalization and Shaping Intention to Adopt New Digital Technology

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Abstract. Digital technology in a firm enhances its capabilities and thereby may promote its innovation. In turn, innovation, for its full development and marketing, may benefit from adoption of new digital tools. Thereby the relationship between digitalizing and innovating can plausibly be hypothesized to be an ongoing reciprocal coupling, that over time may spiral upward in competitive firms and downward in others. Reciprocity is analyzed with a survey in 2021 of a globally representative sample of 30,939 firms around the world, asking about their current innovation, antecedent digitalization, and intended future digitalization. Past and especially recent digitalization are found to promote product innovation and particularly process innovation in a firm. In turn, product innovation, and especially process innovation, are promoting intention to adopt new digital technology in the near future. Findings contribute to accounting for the coupling between digitalizing and innovating as a spiral that is ongoing and weak, but mutually reinforcing.

Keywords: digitalization, innovation, adoption of technology, dynamic capability, firms.

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1. Introduction

A firm may adopt digital technology. The firm may also innovate. The issue is, how can the relationship between digitalization and innovation be accounted for? The prevailing account considers digitalization as a dynamic capability (Linde,

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Sjödin, Parida, & Wincent, 2021). Dynamic capability refers to “the businesses’ ability to integrate, build, and reconfigure not only internal but also external competencies to address changing environments rapidly” (Teece, Pisano & Shuen, 1997, p. 516). Digital technology is a dynamic capability that may aid performance and performance-related outcomes such as innovation (Pisano & Teece, 1994; Kraus et al., 2019; Soltanifar, Hughes, & Göcke, 2021).

However, we suggest that the relationship is more reciprocal, in that innovation also spurs digitalization. The arguments here are that a particular digital technology obsolesces in production and marketing, that a particular innovation obsolesces on the market, that both innovating and digitalizing tend to be ongoing processes in a competitive business, and that, therefore, innovating calls for adopting new digital technology to keep on innovating.

Performance is well-known to be affected by digitalization. Digitalization of entrepreneurial initiatives connotes performance related to outcomes such as innovation or exporting (Nambisan, 2017; Schøtt et al., 2022; Tolba et al., 2022). The effect of digitalization on performance was seen during the pandemic (Schøtt et al., 2022; Tolba et al., 2022). The motives of businesses in post-shock, such as survival, and opportunism, induced firms’ alterations in resource allocation behavior (Soluk, 2022). Thus, the ability of businesses is an encouraging factor in mobilizing dynamic capability among businesses (Liao, Kickul, & Ma, 2009). But less is known about the effects of past digitalization or today’s digitalization upon intention to adopt new digital technology.

State of the art suggests a reciprocal relationship. Innovation motivates adoption of digital technology, for widely marketing the innovation and more. Reciprocally, adopted digital technology is a capability that may be utilized for innovation. Indeed, as digital technology obsolesces, early adoption may entail a counterproductive inertia, whereas competition pressures for continuous adoption. Accordingly, the relationship can be imagined metaphorically as a spiral. More specifically, firms that innovate and digitalize to stay abreast in the competition, may move in an upward spiral, while less competitive firms fall off or move downward in the spiral. The research gap addressed in this study is our limited understanding of the spiral between innovating and digitalizing as a dynamic capability.

These considerations frame the research question, *what is the relationship between innovating and digitalizing, when digital technology is considered a dynamic capability?*

Here, we ascertain the effects of dynamic capability in the form of early and recent digitalization upon today’s process and product innovation, and the effects of today’s innovation upon intention to adopt new digital technology in the near future. The hypotheses are tested by analyzing a globally representative sample of 30,939 firms, surveyed in 2021 by the Global Entrepreneurship Monitor (2022). The high degree of global representativeness implies that findings can be generalized to the world’s businesses.

The analyses show that past and especially recent digitalization are promoting product innovation and particularly process innovation in a firm. In turn, product innovation, and especially process innovation, are found to promote intention to soon adopt new digital technology.

The findings contribute to accounting for the relationship between innovating and digitalizing as a form of dynamic capability, where the relationship is weak but mutually reinforcing over time.

2. Theoretical Perspective and Hypotheses

Our theoretical argument is that today's innovation is hardly affected by early adoption of digital technology, because of the obsolescence of digital technology, but that today's innovation is strongly promoted by recent digitalization. In turn, today's innovation, together with past digitalization — in the recent past rather than the more distant past — are spurring intention to adopt new digital technology.

2.1. Dynamic Capability

The adoption of emergent digital technologies for nurturing entrepreneurship education activities and for use in industries is debated (Secundo, Rippa, & Meoli, 2020; Skeete, 2018). A proactive entrepreneurial logic guides dynamic capabilities under situations of endogenous change (Newey & Zahra, 2009). The dynamic capabilities approach illustrates that businesses with well-developed capabilities can reconfigure and facilitate their resource profiles in quick response to a changing market (Lim, Morse, & Yu, 2020; Sufyan, Aleem, Ameer, & Mustak, 2021). Digital foundation plays an underlying role in new services and capabilities (Tilson, Lyytinen, & Sørensen, 2010). The process of adoption of product or service digitalization (i.e. to digitize non-digital products or services) requires dynamic capabilities even among small and medium firms controlled by families (Cirillo et al., 2023; Soluk & Kammerlander, 2021). Businesses need to draw up different strategies over time related to changes. Firms need to adopt new services and new products to survive in a competitive market (Liao et al., 2009). Entrepreneurship ecosystems involve not only an almanac of individual and organizational elements but also include dynamic capabilities and culture (Guerrero, Urbano, & Gajón, 2017).

Adoption of new technologies is likely to be a necessity for businesses to engage with new processes, novel products, or new business plans. Adoption may lead them to go further than previously considered. Cirillo et al. (2022) pointed out that the adoption of new technologies gives rise to a positive impact on productivity. Dynamic capabilities give rise to a more critical role in the

adaptation of businesses compared to previous functions or strategies (Newey & Zahra, 2009). The presence of leaders and actors of digital transformation, from non-digital to digital appears to be of importance. The digital transformative leader, who fosters digital transformation entrepreneurship, is considered as a leadership profile for digital transformation (Schiuma et al., 2022). There are significant differences in the collections of supporting innovation ecosystem actors throughout the transformation from lower to higher levels of digitalization (Beliaeva et al., 2019). The individual capabilities of actors, such as managers and owners, need to change to collective capabilities (Snow, Fjeldstad, & Langer, 2017).

Incumbents must create a system of dynamic capabilities for digital transformation as an ongoing process (Velu, 2017; Warner & Wäger, 2019). Aggarwal, Posen, & Workiewicz (2017) pointed out that the process of generating efficacy and organizational memory produces heterogeneity in businesses' adaptive capacity to differing kinds of technological change. However, businesses try to alter opportunities in different environments. It is of importance for being an innovative business to survive and having unique selling proposition in a competitive market (de Paula et al., 2022; Liao et al., 2009).

Businesses alter structures related to innovation and consider new roles of digitalizing and innovating which improve the absorptive capacity (Vigren, Kadefors, & Eriksson, 2022). Businesses will be likely to be more innovative if they have capabilities not only among their main actors but also among organizational headquarters and employees. This is because they already have the capability of adopting new changes. The integrative capability develops businesses if they follow a dynamic interplay between adoption and knowledge (Eisenhardt & Martin, 2000; Liao et al., 2009; Woiceshyn & Daellenbach, 2005). The capability of adopting new changes may broaden their horizons and vision to create and innovate new products and services. The digital technologies being used to date in innovation and visual learning exhibit features of interactivity and capacity (Soltanifar et al., 2020). Innovation leads actors to intend more different functions of technology, which is expanding with high speed (Amankwah-Amoah et al., 2021; Yoo, Henfridsson, & Lyytinen, 2010; Zaheer, Breyer, & Dumay, 2019). Therefore, there appears to be a spiral between past digitalization, innovation, and intention to digitalize which is based on the dynamic capability of businesses. The ability of businesses leads them to mobilize their capability dynamically (Liao et al., 2009). Understanding the spiral of innovation and digitalization as based on dynamic capability is of importance. Adoption leads businesses to go further than previously considered. It can be derived by the individual capabilities of businesses' actors (Snow et al., 2017). A ready actor with an actual capability may have a potential capability of adoption and acceptance (Cassetta et al., 2020). Performance expectancy and openness have a positive impact on entrepreneur's acceptance intention of artificial intelligence

(Upadhyay, Upadhyay, & Dwivedi, 2022). Innovation is thus related to adoption of digital technology.

Dynamic capability in businesses is balancing redundancy and requisite as organizational capabilities. It enables business model evolution (Velu, 2017). The dynamic capability has vital consequences for businesses to acquire resources to update facilities, resources which are based on new technology. Indeed, the dynamic capability leads businesses to acquire more capabilities (Cohen & Levinthal, 1990; Lewin, Massini, & Peeters, 2011; Liao et al., 2009).

This consideration of digital technology as a form of dynamic capability paves the way for developing hypotheses.

2.2. Hypotheses

2.2.1. Digitalization Affecting Innovation

Studies concluded that e-business technologies give rise to a positive impact on internationalization when they are embedded within process and organizational innovations (Cassetta et al., 2020). In addition, Tolba and colleagues (2022) pointed out that early digitalization and particularly recent digitalization in firms form capabilities promoting entrepreneurial performance and exports. So, innovations can be affected by adoption of technology, as exports are affected by digitalization (Karim, Nahar, & Demirbag, 2022). The dynamic capability appears to often be based on individual capability. Then, the individual capabilities of actors based on collective capabilities will be an important factor in the performance outcomes (Snow et al., 2017). The capability will lead entrepreneurs to be more creative based on different ways to adopt changes to survive, not only in disruptions, but also in competitive markets with consideration of different capabilities (Aggarwal et al., 2017; Soluk, 2022; Velu, 2017; Warner & Wäger, 2019). This discussion suggests the following hypothesis concerning the impact of early and recent digitalization on innovation, Dynamic capability is known to be a fundamental factor for innovation in businesses. The dynamic managerial capability of the entrepreneur plays an important role as an antecedent of process and product innovation (Mostafiz et al., 2021). Businesses that already adopted technology have a dynamic capability, even in small and medium-sized businesses (Cirillo et al., 2022; Soluk & Kammerlander, 2021). Prior adoption among businesses may play a notable role in accepting new process and product innovation. Entrepreneurs in these businesses already have been guided by dynamic capabilities (Newey & Zahra, 2009). The capability in previous functions may help create new knowledge. The recognition of different digital functions brings about positive consequences to create new products and present new services (Tilson et al., 2010). Some disruptions can also play another role in pushing businesses to figure out their capability and knowledge. The external enabler role of disruption shows that businesses are encouraged to draw

up different strategies to survive (Davidsson, Recker, & Von Briel, 2020; 2021; Samsami & Schøtt, 2022). After the disruption, adoption of digitalization has not expanded so fast in wealthy societies (Samsami & Schøtt, 2022), possibly because they already have adopted digitalization in an earlier stage.

Hypothesis 1. Digital technology positively affects innovation. Specifically, early digitalization and especially recent digitalization are promoting process innovation (H1a and H1b) and product innovation (H1c and H1d).

2.2.2. Innovation Affecting Intention to Adopt New Digital Technology

Innovation in processes and products may lead businesses to find themselves in need of new technological functions in the future. Therefore, innovation is not only affected by past digitalization but innovation can also play an important role in pursuing further digitalization with different functions in the future. Innovativeness is based on the evaluation of the digitalization process of entrepreneurs, particularly as the process that became critical during the phase of the Covid-19 pandemic is now behind us. The evaluation of the digitalization among entrepreneurs in the period of disruption leads scholars to clarify how entrepreneurs' performance will then evolve (Schøtt et al., 2022). Plechero et al. (2021) showed that the development of innovation networks influences newly emerging industries such as new media. Those businesses hoping to survive in the coming years, should first adopt digital technology. Then, they need to refit themselves and their capability and businesses to face reality (Gobble, 2018). Adoption of digital technology is precisely observed among businesses that already have a capability of being innovative, because the actors in these businesses tested their individual capability via new processes and products (Snow et al., 2017; Tilson et al., 2010). New products will require businesses to adopt a new organizing logic of innovation (Yoo, 2010). Scholars point out that information technology plays a critical role in the success of new services if actors ignore some of its benefits (Kitsios & Kamariotou, 2021). This discussion leads us to specify the following hypothesis concerning the effect of innovation on intention to adopt new technology,

Hypothesis 2. Innovation positively affects intention. Specifically, process innovation and product innovation both promote intention to adopt new digital technology (H2a and H2b).

2.2.3. Past Digitalization Affecting Intention to Adopt New Digital Technology

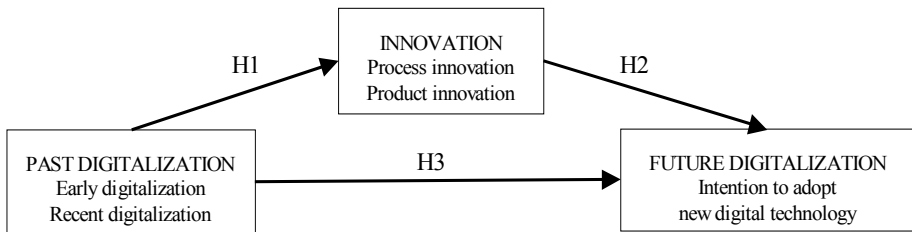
A business that digitalized in the past, has acquired experience with the technology and thus has knowledge preparing it to adopt new digital technology (Eisenhardt & Martin, 2000; Liao et al., 2009; Woiceshyn & Daellenbach, 2005). Moreover, the digital technology that the business adopted in the past, is likely to be obsolete in the present, and is thus in need of replacement or augmentation. For both reasons, past digitalization in the business is likely to trigger an intention to adopt new digital technology in the foreseeable future (Cijan et al., 2019).

Moreover, again, even related to the intention of digitalization, the external enabler role of disruption may be enacted (Davidsson et al., 2020; Davidsson et al., 2021), which leads businesses to adopt different functions in the future, as the early disruption has been followed by intentions to digitalize, entailing some divergence (Samsami & Schött, 2022). Adopting can be because of post-shock motives (Soluk, 2022). This leads to specifying the following hypothesis,

Hypothesis 3. Digital technology positively affects intention. Specifically, early digitalization and especially recent digitalization promote intention to adopt new digital technology (H3a and H3b).

The hypotheses form a causal scheme, Figure 1.

Figure 1. Hypothesized effects.



3. Research Design

Our ideas are about business endeavours anywhere, so the population of interest is the world’s businesses. Digitalization in businesses around the world has been surveyed in 2021 by the research consortium known as the Global Entrepreneurship Monitor, GEM (2022). GEM is scheduled to make its survey publicly available by 2025 on its website www.gemconsortium.org.

GEM conducted its survey in 47 countries across all regions with diverse economies and cultures, so they are fairly representative of the societies around the world. In each country, GEM randomly sampled adults asking whether they own and manage a starting or operating business, thereby randomly sampling businesses. The high degrees of representativeness of sampling of countries and then businesses imply that findings can be generalized, with usual statistical uncertainty, to the world’s businesses. By this two-level design, GEM sampled 30,939 businesses, nested in the 47 countries.²

2. AE (494), BR (638), BY (456), CA (531), CL (3142), CO (399), CY (401), DE (486), DO (1278), EG (414), ES (4016), FI (358), FR (426), GR (424), GT (1205), HR (374), HU (393), IE (449), IL (294), IN (1073), IR (616), IT(194), JP(276), KR (609), KZ(906), LU (302), LV (407), MA (339), NL (392), NO (136), OM (361), PA (516), PL (1095), QA (739), RO (302), RU (245), SA (1025), SD (936), SE (567), SI (236), SK (306), SW (295), TR (862), UK (294), US (439), UY (552), ZA (741).

3.1. Measurements

3.1.1. Early and Recent Digitalization

Adoption of digital technology was measured in the survey in mid-2021 by asking the responding entrepreneur in the business,

In response to the coronavirus pandemic, has your business made any changes in its use of digital technologies for selling your product or service?

The entrepreneur replied by giving one of these four possible answers,

- *Yes – you adopted digital technologies in response to the coronavirus pandemic.*

- *Yes – you enhanced the initial plans you had with new or improved digital technologies.*

- *No – you already planned a range of digital technologies before the coronavirus pandemic.*

- *No – your business can function without digital technologies.*

The four response options entail two dichotomies,

- *early digitalization, as adoption before the pandemic, is reported by the second and third responses, and*

- *recent digitalization, as adoption during the pandemic, is reported by the first and second responses.*

3.1.2. Intention to Adopt New Digital Technology

Intention to adopt in the future is measured by asking the entrepreneur,

Do you expect your business will use more digital technologies to sell your product or service in the next six months?

The entrepreneur's response was recorded as No, Maybe, or Yes, where few responses were classified as Maybe. These values form an ordinal variable 1, 2, and 3, respectively, for use as dependent variable in a multilevel ordered logit model (Liu, 2015; Pituch & Stevens, 2015; Heck & Hallinger, 2014).

3.1.3. Process Innovation and Product Innovation

Process innovation is measured by asking the entrepreneurs,

Are any of the technologies or procedures used for this product or service new to people in the area where you live, or new to people in your country, or new to the world?

The response is coded on an ordinal scale going from 1 if not new to any, through 2 if new locally, and 3 if new nationally, up to 4 if new to the world. This ordinal variable is here used as a dependent variable. This measure of process innovation is used in the annual global GEM report (Global Entrepreneurship Monitor, 2022). An earlier formulation of the question has been extensively used for innovation research (e.g. Schøtt & Jensen, 2016).

Product innovation is measured by asking,

Are any of your products or services new to people in the area where you live, or new to people in your country, or new to the world?

The response is coded on the 4-point scale, used as a dependent variable. This measure of product innovation is used in the GEM global report, and an earlier version has been used in much research.

Process innovation and product innovation are positively correlated, of course, but not so high as to form a reflective index of innovation. It is informative to analyze each of the two forms of innovation.

3.1.4. Control Variables

We are able to include control variables in the multivariate analyses through the GEM survey (Laviada et al., 2022). Innovation and digitalization are influenced by various conditions that should be controlled for by measures of the characteristics of businesses and entrepreneurs (Vanaelst et al., 2006). The GEM survey enables the study to control for,

Gender of the responding business owner, in GEM recorded as male (coded 0) and female (coded 1).

- Age of the entrepreneur, measured as years of age.
- Education of the entrepreneur, coded into years of schooling to highest completed degree.
- Age of the business, measured in years, logged to reduce skewness.
- Number of employees as a numerical variable, logged to reduce skewness.
- Number of owners as a numerical variable, logged to reduce skewness.
- Sector, measured categorically as extracting, transforming, business services, and consumer-oriented.
- Self-efficacy is queried by asking for agreement with the statement, *“You personally have the knowledge, skill and experience required to start a new business”*, measured as a five-point Likert scale, going from Strongly disagree (coded 1) up to Strongly agree (coded 5).
- Risk-willingness is indicated by rating, *“You would not start a business for fear it might fail.”* measured on the five-point Likert scale.
- Opportunity-perception is measured by agreement with *“In the next six months, there will be good opportunities for starting a business in the area where you live”*, on the five-point Likert scale.
- Networking is indicated by the answer to *“How many people do you know personally who have started a business or become self-employed in the past 2 years? Would it be none, one, few or many people?”*, coded as a numerical variable, 0 none, 1 one, 2 two to four, 5 five or more.
- Four motives for the business were measured by asking the entrepreneur to rate, on a five-point Likert scale, each of four reasons for running the business,
- Please tell me the extent to which the following statements reflect the reasons you are trying to start a business.

- To make a difference in the world.
- To build great wealth or a very high income.
- To continue a family tradition.
- To earn a living because jobs are scarce.

Furthermore, we also control for national wealth, GDP per capita (logged), coded from the World Bank.

3.2. Technique for Analysis of the Data

We are focusing on three outcomes, process innovation, product innovation, and intention to adopt new digital technology. First, recall that our dependent variables – process and product innovation and intention – are measured on ordinal scales so ordered logit modelling is appropriate.

Second, each outcome varies among businesses around the world. Part of this variation in the world is between countries, and part is among the businesses within the countries. The proportion that is between countries is ascertained by the intraclass correlation coefficient ICC (the variance between groups as proportion of the sum of the variance between groups and the variance within the groups) (e.g. Heck et al., 2014, p. 8). In our data, we estimate the proportion of variation between the countries as 7.1% for process innovation, 7.9% for product innovation, and 10.1% for intention to adopt. Each of the three variations between countries is substantial, indicating that analyses should take variation between countries into account. Accordingly, our two-level hierarchical data on businesses nested within countries are appropriately analysed by two-level hierarchical modelling (Snijders and Bosker, 2012).

For these two reasons, in combination, the appropriate modelling is multilevel ordered logit modelling, as implemented in SPSS (Liu, 2015; Pituch & Stevens, 2015; Heck & Hallinger, 2014). Accordingly, we use multilevel ordinal logit modeling to test effects on process innovation, on product innovation, and on intention to adopt (Table 5).

4. Results

The background of the adults and businesses is summarized in Table 1. Businesses do not find good opportunities to start a business in the area where they live. Furthermore, entrepreneurs expressed that they personally have a good knowledge, enough skills and experience required to launch or start a new business. However, they prefer not to start a business because they are not risk-willing but would fear failure. Entrepreneurs personally know other entrepreneurs who have started a business or become self-employed in the last two years, showing that their networking is rather extensive.

Table 1. Characteristics of the businesses

Gender of the entrepreneur	Percent females	41%
Age of entrepreneur	Years of age, mean (Standard dev.)	41.0 (12.2)
Education	Years of schooling, mean (SD)	13.8 (5.7)
Self-efficacy	Scale 1 to 5, mean (SD)	4.1 (1.2)
Opportunity-assessment	Scale 1 to 5, mean (SD)	3.3 (1.4)
Risk-willingness	Scale 1 to 5, mean (SD)	3.3 (1.5)
Networking	Scale 0 to 3, mean (SD)	1.4 (1.1)
Motive: Make difference	Scale 1 to 5, mean (SD)	2.9 (1.5)
Motive: Accumulate wealth	Scale 1 to 5, mean (SD)	3.3 (1.5)
Motive: Continue family tradition	Scale 1 to 5, mean (SD)	2.5 (1.6)
Motive: Earn living	Scale 1 to 5, mean (SD)	3.8 (1.4)
Sector: Extractive	Percent of businesses in this sector	6%
Sector: Transformative	Percent of businesses in this sector	23%
Sector: Business services	Percent of businesses in this sector	21%
Sector: Consumer services	Percent of businesses in this sector	50%
Age of business	Years of age of business, mean (SD)	5.7 (9.9)
Owners	Number of owners, mean (SD)	1.7 (1.6)
Employees	Number of employees, mean (SD)	4.5 (19.1)

The businesses are described further by correlations among the variables of interest in our study, Table 2. Correlations are all positive among the components of the process innovation, product innovation, intention to digitalize, recent digitalization, and early digitalization, but the correlations tend to be weak. Therefore, it is appropriate to analyze both the innovation in process and product as well as adoption of digital technology in different three periods, early, recent, and future.

Table 2. Correlations among variables of interest

	Process innovation	Product innovation	Intention to digitalize	Recent digitalization
Process innovation				
Product innovation	0.61 ***			
Intention to digitalize	0.17 ***	0.16 ***		
Recent digitalization	0.15 ***	0.12 ***	0.38 ***	
Early digitalization	0.08 ***	0.07 ***	0.05 ***	0.04 ***

† p<0.10 * p<0.05 ** p<0.01 *** p<0.001

4.1. Digitalization and Innovation

A look at the timing of digitalization is in order, Table 3. Most businesses had adopted digital technology early – before the pandemic. Fewer adopted digital technology during the first year or so of the pandemic, which is actually quite

many, considering the short time span, and considering that most had already adopted. Furthermore, many intended to adopt new digital technology in the near future, including a considerable proportion of businesses that had adopted recently or earlier.

Table 3. Innovativeness of businesses

	Process innovation	Product innovation
New to the world	3%	4%
New to people in the country	5%	6%
New to people in the local area	15%	16%
Not new to any	76%	74%
Total	100%	100%
N businesses	29,622	29,639

Table 4. Timing of digitalization of businesses

	Early adoption	Recent adoption	Intend to adopt
Yes	45%	41%	48%
May be			13%
No	55%	59%	39%
Total	100%	100%	100%
N businesses	29,000	29,000	29,219

A look at innovativeness is informative, see Table 4. Most businesses had no innovation, neither process innovation nor product innovation. This is not surprising when bearing in mind that by far most businesses are extremely small.

4.2. Testing Effects Between Digitalization and Innovation

Our first substantive question is, how is digital technology affecting innovation? Effects on process innovation and on product innovation are estimated by multilevel ordinal logit modeling in models A and B in Table 5. Hypothesis 1 posits that digital technology positively affects innovation. This comprises the following four more specific hypotheses.

Hypothesis 1a states that early digitalization promotes process innovation. This hypothesis is tested in model A. The coefficient is positive, 0.311 ($p < 0.001$), supporting H1a.

Hypothesis 1b states that recent digitalization promotes process innovation. This is tested in model A. The coefficient is positive, 0.592 ($p < 0.001$), supporting H1b. The effect of recent digitalization on process innovation is larger than the effect of early digitalization.

Hypothesis 1c states that early digitalization promotes product innovation. This is tested in model B. The coefficient is positive, 0.219 ($p < 0.001$), supporting H1c.

Hypothesis 1d states that recent digitalization promotes product innovation. This is tested in model B. The coefficient is positive, 0.390 ($p < 0.001$), supporting H1d. The effect of recent digitalization on product innovation is larger than the effect of early digitalization.

In short, early digitalization and especially recent digitalization are promoting product innovation and especially process innovation.

Our second substantive question is, how is innovation affecting intention to adopt new digital technology? The effects on intention are tested in model C. Hypothesis 2 states that innovation positively affects intention. This comprises the following two hypotheses.

Hypothesis 2a posits that process innovation promotes intention to adopt new digital technology. This is tested in model C. The positive coefficient, 0.136 ($p < 0.001$) demonstrates that innovation in processes leads businesses to intend to adopt new digital technology, supporting H2a.

Hypothesis 2b states that product innovation promotes intention to adopt new digital technology. The positive coefficient, 0.066 ($p = 0.001$) illustrates that innovation in products has a positive impact upon intention to adopt new digital technology, supporting H2b.

In short, both process innovation and product innovation are promoting intention to adopt new digital technology in the near future.

Our third substantive question is, how is past digitalization affecting intention to adopt new digital technology? Hypothesis 3 states that digital technology positively affects intention. This comprises the following two hypotheses.

Hypothesis 3a states that early digitalization promotes intention to adopt new digital technology. The positive coefficient in model C, 0.322 ($p < 0.001$) demonstrates that early digitalization has a positive impact on intention to adopt new digital technology in the near future.

Hypothesis 3b posits that recent digitalization promotes intention to adopt new digital technology. The positive coefficient, 1.488 ($p < 0.001$) shows that recent digitalization has a positive influence on intention to adopt new digital technology in the near future. The effect of recent digitalization is much larger than the effect of early digitalization.

In short, early digitalization and especially recent digitalization are promoting intention to adopt new digital technology in the near future.

Table 5. Innovation and intention to digitalize, dependent on early and recent digitalization

Model Term		Process innovation	Product innovation	Intention to adopt new digital technology
		Model A	Model B	Model C
Threshold for process innovation	1	1.673 ***		
	2	2.990 ***		
	3	4.282 ***		
Threshold for product innovation	1		1.409 ***	
	2		2.727 ***	
	3		3.867 ***	
Threshold for intention	0			0.092
	1			0.721 ***
Early digitalization		0.311 *** H1a	0.219 *** H1c	0.322 *** H3a
Recent digitalization		0.592 *** H1b	0.390 *** H1d	1.488 *** H3b
Process innovation				0.136 *** H2a
Product innovation				0.066 *** H2b
Gender: Female		-0.199 *	-0.021	0.049
Sector: Extractive		-0.092	-0.378 **	-0.220 **
Sector: Transforming		0.037	-0.054	-0.046
Sector: Business services		0.166 ***	-0.048	0.051
Age of business		-0.177 ***	-0.275 ***	-0.286 ***
Owners		0.098 ***	0.094 ***	-0.018
Employees		0.173 ***	0.137 ***	0.045
Age of entrepreneurs		-0.037 †	-0.059 ***	-0.064 **
Education		0.064 *	0.077 **	0.027
Self-efficacy		0.076 ***	0.068 **	0.043 **
Opportunity-assessment		0.053 *	0.025	0.077 ***
Risk-willingness		-0.008	0.032 *	0.040
Networking		0.118 ***	0.091 ***	0.098 *
Motive: Make a difference		0.406 ***	0.432 ***	0.215 ***
Motive: Accumulate wealth		0.045 *	0.009	0.160 ***
Motive: Family tradition		0.047 *	0.011	-0.005
Motive: Earn a living		-0.051	-0.043	0.039
GDP per capita		0.132	0.179 *	-0.295 **
Country		yes	yes	yes
	N countries	47	47	47
	N businesses	26,089	26,148	25,395

Multilevel ordered logit model, with random effect of country.

For sector, the reference is the consumer-oriented sector.

Process and product innovation are coded 1, 2, 3, 4.

Intention to adopt new digital technology is coded 1, 2, 3.

The national-level independent variable is standardized.

The individual-level numerical independent variables are standardized and centered within country.

The dichotomous variables are 0 and 1 dummies.

† $p < 0.10$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

These effects between digitalizing and innovating justify the metaphor of the spiral. It shows us that the spiral is working and how it is working, through mutually beneficial effects.

5. Discussion

The analyses address the research question, *what is the relationship between innovating and digitalizing, when digital technology is considered a dynamic capability?* The analyses use a sample of businesses around the world. The high degree of global representativeness implies that findings can be generalized, with usual uncertainty, to the world's businesses. Here, we discuss the findings, contributions, limitations, and further research.

5.1. Findings

The analyses tested the effects of dynamic capabilities in the form of early and recent digitalization upon today's process and product innovation, and the effects of today's innovation upon intention to adopt new digital technology.

The study finds that today's innovation is promoted by early adoption of digital technology, and even stronger promoted by recent digitalization. As Vigren and colleagues (2022) demonstrate, firms change their modes of innovation and consider new roles in innovating which improve their absorptive capacity. It shows that businesses that already adopted digital technology, can be more innovative, which promotes exporting among businesses (Tolba et al., 2022). This is because they already improved their capability through digitalization. Individual capabilities of actors involved in digitalization are enabling them to embrace the capacity of being innovative in new processes and new products.

Today's innovation, together with past digitalization, are spurring intention to adopt new digital technology in the near future. This finding is in line with the integrative capability. The integrative capability is aligned with a dynamic interplay between adoption and knowledge (Eisenhardt & Martin, 2000; Liao et al., 2009; Woiceshyn & Daellenbach, 2005). Firms that are already involved in digitalization have a back and forth interplay between their knowledge and their adoption. We see that they already have digital functions and they make innovations in processes and products, but it leads them to intend to become even more digitalized in the future. As predicted, the capability of adoption broadens the horizons and vision of businesses not only to be more creative but also more digitalizing. This finding also is in line with other studies (Amankwah-Amoah et al., 2021; Yoo et al., 2010; Zaheer et al., 2019). Overall, this emphasizes that there is a spiral between past digitalization, innovation, and intention to digitalize

which is based on the dynamic capability of businesses, due to the ability of businesses to mobilize their capability dynamically (Liao et al., 2009).

5.2. Contribution to Theory

Our findings make a theoretical contribution to dynamic capability as following the spiral of innovating and digitalizing. These results contribute to accounting for the reciprocal and mutually reinforcing relationship between digitalizing and innovating and justifying its simple — even simplistic — depiction as a spiral. With consideration of our spiraling finding, businesses may benefit by paying much attention to have an interplay between their knowledge and adoption. The positive effect of adoption of digital- technology in the past upon the performance of businesses based on their capability makes a contribution to accounting for ecosystem embeddedness of digitalization. This embeddedness positively moderates performance-related outcomes, such as innovating in processes and products. This contribution elaborates previous studies (Schøtt et al., 2022).

5.3. Practical Relevance of the Findings and Contributions

A practical implication of this research is to remind businesses to adopt new technologies faster, especially when existing technology is ageing. It will have positive consequences for them to be more innovative and develop a stronger intention to digitalize even further, particularly in today's competitive markets. Businesses need to take into account that actors are pressured to adopt new digital technology as soon as possible, which helps to improve their capability. Adoption will be a critical factor in surviving in the market via the development of unique selling propositions. Consequently, to recognize opportunities, and obtain resources, an entrepreneur appears to need to have a blend of entrepreneurial capabilities and dynamic capabilities (Hisrich, 2013). Those businesses that have adopted digital technology may have stronger dynamic capability to be more innovative. The businesses can take further advantage of this innovation if the innovation inspires them to adopt new digital technology ongoingly. So there is a spiral of early as well as recent digitalization, that is past digitalizing, to innovating, and finally to intention to adopt new technology in the near future.

5.4. Limitations in This Analysis of the Spiral

A major limitation is in the available data. For analyzing the reciprocal effects between digitalizing and innovation, as this unfolds over time, it would have been informative to have panel data on a sample of firms, measuring both innovation

and digitalization at several points in time. Our strategy has been to analyze a sample of firms reporting current innovation, antecedent early and recent digitalization, and intention for future digitalization.

Another limitation is that we have analyzed the coupling between digitalizing and innovating without seriously considering variation around the world (we merely controlled for each country's GDP per capita). However, both innovating and digitalizing differ among societies, and conceivably also their relationship differs from one society to another. Innovating and digitalizing may have a loose coupling in some societies and a tight coupling in other societies, depending on the national ecosystem of institutions and resource-endowments.

5.5. Further Research on the Spiral

Businesses are innovating in the context of their national (or regional) innovation system (Toshevsk-Trpchevska et al., 2020), and they are digitalizing in the context of their national (or local) digital ecosystem. Both innovation systems and digital ecosystems differ widely from country to country, and from region to region, entailing differences among societies and communities in innovation and in digitalization. Therefore, we should also expect that the relationship between innovating and digitalizing differs among societies and among regions. It may be expected that the coupling will be tight in some societies and loose in other societies. The strength of the relationship will, we would hypothesize, depend on the innovation system and the digital ecosystem, and specifically on their institutions and resource-endowments. Research on institutions and resource-endowments shaping the coupling between innovating and digitalizing, as it differs among societies around the world, will expectedly contribute to understanding the local nexus between the digital ecosystem and the innovation system.

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