International Centre for Innovation Technology and Education

Solvay Brussels School Economics & Management

ULB

The Entrepreneurial Returns to Incumbents' Digital Transformation

Authors

Jacques Bughin
Solvay Brussels School of Economics and Management, Université Libre de Bruxelles, iCite, Brussels, MachaoneAdvisory, Brussels, FortinoCapital, Brussels, Antler, Amsterdam and Portulans Institute, Washington - email : : bughinjacquesrenejean@gmail.com

Nicolas van Zeebroeck
Solvay Brussels School of Economics and Management, Université Libre de Bruxelles, iCite - email : Nicolas.van.Zeebroeck@ulb.be

iCite Working Paper 2021-048

The entrepreneurial returns to incumbents' digital transformation

Jacques Bughin
iCITE
Solvay Brussels School of Economics and Management
Université libre de Bruxelles
50, avenue F.D. Roosevelt - CP114
1050 Brussels (Belgium)
Jacques.Bughin@ulb.be

Nicolas van Zeebroeck
iCITE
Solvay Brussels School of Economics and Management
Université libre de Bruxelles
50, avenue F.D. Roosevelt - CP114
1050 Brussels (Belgium)
Nicolas.van.Zeebroeck@ulb.be

Abstract

Returns on investing into digital technologies by incumbents may be low as result of them facing adjustment costs. We derive benchmarks of returns to digital investments while demonstrating that returns are enhanced by strategic renewal *at sufficient* turbulence levels. We also demonstrate the relative contribution of four organizational drivers (risk-appetite, threat sensing, new capabilities, and leadership involvement) in shaping those returns, through their joint effects on both strategic renewal propensity and incumbent organizations' commitment to large digital investment programmes. Entrepreneurial leadership is a core component of successful digitization programmes both directly through top management involvement in digital projects, as well as indirectly though leadership building awareness of value at risk and by engaging in complementary digital capabilities.

***Keywords**: Digitalization, Digital transformation, strategic renewal, adjustment costs, entrepreneurial leadership*

INTRODUCTION

The pace of diffusion of digital technologies within economies has accelerated in recent years, yet the disturbing evidence is that the returns to those digital investments might have remained low at both the macro- level of economies and the micro-economic level of incumbent corporations.

In general, the issue might be due to adjustment costs. Regarding the economy-wide level, the issue of adjustment costs translates into the paradox of poor productivity gains tied to digital technology diffusion (Cardona et al. , 2013; Acemoglu et al. 2014). For general-purpose technologies such as digital technologies, social returns scale only with time lags (David ,1990; Jovanovitch and Rousseau, 2004). Craft (2018) had reminded us that electricity led to a major productivity boost, but only when electricity moved from lighting as the exclusive "killer app", to a powerful input to mechanize production facilities a few decades later.

At the firm level, the entrepreneurial journey for incumbents to invest boldly in digital may have been hampered by many factors. The first angle is that companies such as Kodak, or Blockbuster, - at least at the early days of digital technology diffusion, may have misread the disruptive potential of digital technologies (Tripsas and Gavetti 2000). The second angle is that digital technologies often lead to a strategic dilemma for incumbents. On one hand, disruptive innovations enabled by those technologies, may not be attractive in the short-term (Ansari, et al. 2016; Christensen and Bower, 1996), while on the other hand, waiting too long to exploit their disruptive nature may bring higher competitive risk (Donoughue, 2010; Lee et al, 2016).

A third angle is the notion that incumbents often lack the right capabilities associated with digital technologies (e.g. Teece, et al, 2016 and Nambisan, et al.2017). Brynjolfsson and Hitt (2000) were among the first to demonstrate how the persistent lack by incumbent firms of complementary capabilities to internet-based technologies limit returns to digital investment. Bughin (2016) shows

how returns to a particular digital technology- big data- were boosted by new capabilities, such as the ability to migrate to cloud-based infrastructure, and the capacity to generate new data insights often through the mastering of new machine learning techniques. Kohli and Melville (2018) synthesized the literature on digital innovations and concluded that incumbent organizations have a hard time to reconfigure and expand their resources and capabilities to boost digital technology adoption returns.

All the above suggests that a fourth angle to adjustment costs is that companies often lack the right entrepreneurial leadership to guide through the strategic renewal that may correlate with successful digital transformation (Helfat and Peteraf, 2015, Wagner and Wager, 2014). After all, in case of high uncertainty, leadership must translate into direct involvement in new actions, as well as work "beyond the scene" to help the organization to move towards renewal in face of disruption. Bloom et al., (2012) emphasized the difficulty in acquiring/ building *new management* practices, as an enabling factor to benefit from technology diffusion in organizations.

The contribution of this paper is threefold. Through an extensive worldwide survey, we are possibly the first to provide robust estimates of returns to digital technologies investments by incumbents. We find those returns to digital investment may be attractive both in absolute terms, and in comparison with traditional investments. But those returns are not easy to achieve and are largely influenced by the interplay between external factors (turbulence) and internal organizational factors (ability to finetune, or renew strategy). The third contribution is to show that internal factors matter a lot for getting good returns out of digitization, with entrepreneurial leadership being critical to boost organizations to scale digital investment along strategic renewal.

On top of those findings, our work is based on a statistically robust procedure, where organizational factors act as powerful instruments to digital investments, and with a set of surveys across years that involve multiple industries and countries. The limitation is however that the panel structure remains narrow, and that data are survey-based. Second, we also deliver a view on the mix of organizational

factors that affect digital returns- in particular, capabilities with respect to competition have the largest contribution to scaling digital investment and to incentivize incumbents to renew strategy. Still, all organizational factors discussed by scholars matter- and their combination makes a material difference into incumbents' growth profiles.

DATA SOURCES AND DESCRIPTIVE INSIGHTS

Our research relies on a set of direct data originating from *three consecutive annual* surveys conducted by TNS Sofres in early 2017, 2018, 2019 on behalf of McKinsey and Company regarding corporate digital transformations. The surveys were sent to a representative panel of 12,000 C-level executives, cutting across a wide range of industries (professional services, finance, high-tech, are the three main pools of respondents), firm size and regions, with a response rate varying between 7% to 10% in each case. The respondents are exclusively CEO or board managers, or business unit leaders -if not board managers. This is crucial as typical questions concern managerial choices. The procedure of data collection is based on TNS professional practices, as one premier global market research firm. The procedure has been validated in multiple studies; see among others Bughin, LaBerge and Melbye, 2016.

There is no sign of answer bias—possibly facilitated by managers able to skip questions, but the implication is that the balanced data requirement of this research, makes the original respondents set to be reduced by about 50%. Still, for each year of the study, the full balanced sample is about 450 firms —and the sample is representative of worldwide GDP distribution, with about 20% of firms from North-America, 35% from Europe at large, 20% from Asia for example, averaged out over the 3 years.

One final drawback of the sample is that the survey responses are confidential to TNS. This is a *sine qua non* condition for respondents to reveal company specific valuable information around their organizational assets, competences, strategic moves, and is strictly enforced by the agency.

Table 1a- about here –

Industry and size distribution across all three surveys, 2016-2018

Table 1b- about here

Sample features, mid year 2017, %

Table 1a and 1b provide a snapshot of the data collected, and point to some key remarks:

a) Representativeness. The mix of industries and size of companies are clearly *not* representative of economies—e.g., the sample is first of all representative of *large firms*. The average size is about 2,5 US billion of revenue and more than 15,000 employees, or a revenue per employment in the range of 200,000 USD, accounting for full -time equivalent. Some industries such as High-tech and financial services are over-represented. Nevertheless, for the scope of this research, which focuses on large incumbents' returns to digital investment, and their drivers, we note that *the sample may be qualified to have good representation*. As an experiment, we compare our statistics with those large publicly quoted firms as maintained among others by the NewYork Stern School. First, the annual top line growth in our sample (7,8%), matches the top line growth of large public firms (at 8%), while the sampled productivity measures (revenue and revenue growth per employee), compare well those to the average of employee productivity of US and the Eurozone firms, with differences never exceeding 5% difference for each year of observation. Likewise, the digital revenue share for incumbents over the average of the 3 years was 22%, in line with other public estimates.

b) Digital maturity. Already 5 out of 6 incumbents *have launched a digital transformation journey by the year 2018* (this was 51% of them by 2016 and grew to 77 % by end of 2017), so that a large part of our sample has already had good experience of digitization. Size however matters, as digital

transformation programmes have not been rolled out yet for more than one third of companies with less than 100 employees.

c) Digital natives' scale. Digital natives had remained a limited species compared to the scale of incumbents: in our sample, there was about one digital native for about 4 traditional firms engaged in digital transformations per industry in the years 2016-2018. Further, the digital natives' aggregate industry revenue share has reached just above 12%, for 22%*80,5%= 17,7% for incumbents. A fairer comparison would be a like for like comparison; which would imply that a digital native company generates 12,2%/(17,7%/4), or 2,75 times *more digital revenue* than one industry incumbent. This is in line with practice, and means that digital natives have achieved a significantly larger scale of business than traditional incumbents in the process of digitization.

d) Digital capital efficiency. The capital intensity seems to be favourable to digital, as the digital/non digital ratio is on average (15%/22%)/(78%/85%)=0,75, providing already some perspective that committing a great part of investments to digital may be return-enhancing for incumbent companies

e) Competition. Incumbents have evaluated that 32% of their revenue could be at risk, absent any action in digitization. As this is 2,5 times larger than the market share captured to date by digital natives, the gap can only be traced to the competitive battle of digitization *among all other incumbents*. Further, competition may be more or less turbulent, based on whether firms continue the same conduct and strategy, or pivot, based on the dynamics of digitization (Chesbourg, 2010 or Mendelson, 2017). We measure the level of strategic reaction of a firm as the degree of change brought to its corporate strategy *in response to* digitization, while we define turbulence as the sales weighted average level of strategic reaction played by *third party incumbents*. The survey offers a 5-level scale for answers, which we recharacterize as low (1 and 2: no response, or only minor ad-hoc changes to the strategy),

medium (3: a coordinated plan but no change to long-term corporate strategy), or high (that is, 4 and 5: significant changes to the long-term corporate strategy or introduced the disruption itself). The average answer (outside the focal firm) is just above 3, which implies that incumbent competition has rather taken *an incremental* approach to digitization.

f) Adjustment costs. As per the discussion in the introduction, we also collected information of four possible types of organizational adjustment costs that may limit returns to digitization. The first is linked to the issue of identity risk aversion (Kammerlander, et al. 2018). Respondents were asked whether their organization's aversion to risk and experimentation prevails and is a major obstacle to achieving its digital objectives. In our sample, *one incumbent firm out of three can be classified as risk-averse* Next, we have explored the role of capabilities as suggested by Brynjolfsson and Hitt (2003) in the field of economics, or Teece and others (2016) in the field of strategy. We do not have measures of capabilities per se, but we exploit the answer to the question regarding the self-perceived digital capabilities of the firm relative to its competitors on a 7-level scale, from "significantly behind peers" (1) to "significantly ahead of peers" (7). Again, based on the distribution of answers, about *one incumbent firm out of six* claims to be materially behind its peers. Our other factor is related to the intensity of involvement of the CEO in pushing and scaling the strategy and digital initiatives of the firm (self-reported on a 1 to 4 scale), In the economic literature, Tambe and Hitt (2011) emphasize the importance of top-down direction for technology absorption. The same has been proclaimed in the IS literature (e.g. Gurbaxani and Dunkle (2019)), while the leadership literature is also claiming the importance of leadership for digital transformation (Porfírio et al. ,2021). *In our sample, we find that 40% of incumbent firms feel being restrained by lack of CEO leadership commitment towards digitization.*

INCUMBENT RETURNS TO DIGITIZATION

Return to digitization: a priori vision

Table 2a about here

ROI evaluation of last digital initiative

Table 2a introduces an indication of the ROI captured by incumbent firms regarding their *last digital* initiative. We first note that 34% did mention that "they do not know", as responses are not imposed to respond to questions. This is reassuring, as we want to make sure that our data are not polluted by random guesses, and that answers a fortiori are also valuable information. For the respondents who filled an ROI measure in the questionnaire, the average annual ROI on the last digital investment out of the distribution is 10,4%, compared to a ROI on total investment of large firms at about 6,8%, according to estimates by the NewYork Stern School, for 2017, - in line with the idea of better capital efficiency we have derived from our sample.

The answers' distribution exhibits a large spread. 33% (out of 66% who have provided an answer -or a full one half of the answers), states that their ROI from their most recent digital investment has not reached 10%. On one extreme, 14% (out of 66%=21%) have been generated negative returns. At the other extreme, up to 5% are stating that ROI in digital transformation can be rather attractive, with ROI of more than 100%.

Table 2b about here

ROI evaluation of last digital initiative by firm profile

Table2b further splits the data between poorly digital – that is, those where most of the revenue is still non digital (65% of them, generating 5% of digital revenue in total revenue) – and digitally advanced, companies (35% of incumbents, generating 26% of revenue through digitization). The portion of companies which exhibits negative returns is roughly the same between the two groups of firms, but

the median ROI is twice bigger for the most digitally advanced incumbents than others (15% versus 8%), leading to the idea that scaling investment is a valuable play.

Incumbent's return to digitization: base line regression results

The above can only be taken as illustrative, as the computation does not control for difference in industry, size, extent of strategy change, or still competition intensity. Further, the reported returns are *truncated,* as they refer only to maximum one year of revenue accruing from digital implementation (as being the last initiative). We would expect returns from investments to be cumulative over the years, and thus, returns in Table 2 are just a lower bound to the true benefits of increasing the level of digital investments.

To get more robust estimates, we now shift towards a more structural regression model of digital technology diffusion returns. Let us then denote R_{ijt} as the expected revenue of firm *i* in industry *j* in period $t+3$. As in Bresnahan et al. (2002), we measure the return to digital investment as the b factor to the *growth in* R_{ijt} from spent in digital investments. We thus write a simple baseline model where the growth in revenue, dlog (R_{ij}) is linked to digital investment (D_{ij}) :

$$\text{dlog}\,(R_{ij}) = \alpha + \beta log(DI_{ij}) + \mu F_j + \sigma Z_{ij} \quad + \varepsilon_{ij} \qquad (1)$$

Where DI relates to (cumulative) digital investments, Z' is a vector of control variables , while F is a vector of industry fixed factors, that is extended to corporate fixed effects, when we use the more restrained panel data set as a robust test.

The main hypothesis regarding (1) is that: $\boldsymbol{H1: \beta > 0}$ *and especially, given possible digital capital efficiency,* $\boldsymbol{H1': \beta > \beta'}$ *where* $\boldsymbol{\beta'}$ *is the return to traditional investments.* Note that we do not have a measure of investments outside of digital ones in our sample. In order to provide a sense of $\boldsymbol{\beta'}$, we use data compiled by Aswath Damodaran, from the Stern School of Business at New York University[1],

[1] Useful Data Sets (nyu.edu)

for the same three years of our sample. From those data sets, the world Tobin's Q from public quoted firms was around 2, and the weighted cost of capital, (wacc), has oscillated from just below 6% for the US and up to 7% worldwide. From those date, a world benchmark will be that in the range of $\boldsymbol{\beta}$'= 6,9%*2= 14% as averaged out of the three years in our sample.

In Z, we control first for the focal corporation's type of diversification, that is mono: mono- versus multiple products, product: product only versus extension to servitization. The effect of diversification on revenue growth tests the concept of economies of scope, with the corporate strategy arguing for an inverted U-shaped relationship between corporate diversification and firm performance (Rumelt, 1974), even if this relationship is also a matter of product related and market context (Chommer, et al. 2019). In general, it somewhat pays to diversify its product offering, but servitization is especially the type of diversification that enhances firm performance, especially through the complementarity with digitization (Kohtamäki et al. (2020).

We also include various indicators of size, as a test of economies of scale. We use both market share and revenue as separate variables, as their ratio gives insights on the effect on industry demand shift to corporate performance. Market share may somewhat enhance performance (Edeling and Himme, 2018), but the effect may be rather small. The effect of size on revenue growth tests for economies of scale, which often are limited or negative, often as a result of organizational inefficiencies increasing with size (Leibenstein 1966). We also look at the effect of competition mix, in particular we include in Z, how digital natives have been able to take market share. If the effect is essentially a disruptive effect, we expect digital natives' inroads to reduce the growth of incumbent firms (Cozzolino et al. 2018). If however, digital leads to new ways to increase market needs, the effect could even be positive. Finally, we also control for labor intensity in ability to grow. The effect of labor intensity on firms performance is unknown a priori, but can be negative if this limits scaling- but the relationship may also be positive, if labor is a specialized knowledge based resource. (see Santoro, et al. 2019).

Table 3a provides the results of estimating (1) through OLS regressions. We use the year 2017 as main illustration in this research, as the median year- , but for robustness, we also test our regressions with three indicators of digital investments,- first, using level of investment, then using the share of revenue spent on digital investments (digital spent intensity), and finally, digital intensity versus other incumbents,- as a measure of relative commitment versus peers. Table 3b computes the results for each year (cross section) as well as by using the panel sample regarding returns.

Table 3a- about here

OLS regression (1) estimates

Table 3b- about here

Derived incumbent returns to digital

We first comment on Table 3b, as a synthesis of the all return estimates. Taking the average results across all estimations and DI metrics, the return to digital investment is systematically significant at <1% risk, and averages β=26% (standard deviation of 3,5%), after all controls. This confirms that β is large, and likely larger than β' (which we have estimated to be in the range of 14%), in line with our hypothesis **H1**. Note as well that those returns are twice larger than those shown in table 2a/2b , but which were truncated at the level of one year only. Finally, Regarding the full picture of estimates in Table 3a, there are only a few control variables that have power of statistical significance. Among others, labor intensity clearly exerts a negative, albeit, economically small impact on sales growth, while product specialisation proves to build more growth than a product diversification strategy.

ENTREPREUNARIAL LEADERSHIP AND INCUMBENTS' RETURNS TO DIGITIZATION

Baseline extension

The baseline, while illustrative of possibly good returns to digital investments, suffers from three evident drawbacks.

1) The first drawback is that returns to digitization should likely be linked to how incumbents conduct changes. After all, we have documented that incumbents still remain dominant in aggregate regarding digital revenue build up within their industry, and their conduct will likely be driven by their intent to reallocating resources towards digital or not.

2) The second drawback is that our baseline estimates lead to rather clustered returns to digital (coefficient of variation for β is 3,5/26,5= 13,3%), while corporations report a much wider range as seen in Table 2a. Sure, the table relates to the firm's last investment, but it is hard to believe that the portfolio of digital initiatives embedded in total investment may have led to such risk reduction through pooling of digital initiatives. In fact, at the sample mean, the baseline regression highlights that the largest effect on corporate sales growth is about 0,8 points per year from digital investment, and one standard deviation plus or minus in one incumbent's digital investment intensity, explains less than one point of growth, or 10% difference in total sales momentum. This looks small if digital stands on average at 22% of sales- and top analysts have suggested that digital has been growing at double digits a year[2].

3) The third drawback is that the regression estimate is rather "static"- we might expect reverse causation in that strong returns to digital leads companies to reinvest more in digital as a form of virtuous cycle. This cycle would mean that traditional regression estimates suffer

[2] Gartner analysis of IT spent (outside communication and device-) has been at about 4,5% nominal growth a year, for the average of 2016 to 2018, with digital standing for 80% of the total, or 3,6%. As digital is about 50% of total spent, and half is devoted to revenue programme, digital revenue related IT spending should have grown at 15% a year,

from endogeneity bias, and we might expect that this cycle is clearly dependent on how incumbents decide to play its digitization programme.

Incumbent's strategic renewal

We now contend that the return variance is limited if digital investments are *not scaled* through strategic renewal. This follows Mithas and Rust (2016)'s finding that the IT-productivity relationship is mediated by firm strategy, and reflects on the idea that digital technologies often lead to market disruption, requiring companies to adapt strategy and business model in order to sustain more aggressive competition (Mendelson, 2017).[3] We introduce strategic component S_{ij}, in equation (2) which measures the "boldness" of the strategic posture adopted by the focal firm in addressing the challenges raised by digital technology. A "bold" strategy is one of high strategy change *combined* with a commitment to spend high investment in digital as this clearly pictures departure from or changes to the original core business of the firm. Bughin and van Zeebroeck (2017) had further demonstrated that this strategic posture is one of the best path responses to digitization, in line of the strategic literature above.

Companies are not operating in a vacuum. We have already mentioned that firms tend to take an incremental approach to digitization. We thus define a dummy variable T, which when T=1 implies that a company is facing more competitive intensity conditions, based on the level (low v. high) of "digital turbulence", (El Sawy et al. 2010). Building on the theories of disruptive innovation (Charitou and Markides 2003, an Adner and Kapoor 2016), our contention here is that in situations of intensive technology-driven change, more offensive strategies and investments are required to overcome the competitive pressure due to successful adoption by competing firms and new entrants (Ho et al. 2017).

Equation (2), as an extension to (1), now reads:

[3] Such strategic moves inspired or motivated by digital innovation are discussed at length e.g. in Bughin and van Zeebroeck (2017b).

$$\text{dlog}\,(R_{ij}) = \alpha + \lambda \times\ (1 + t \times T_{ij})\ *\ \log(D_{ij}) \times S_{ij} + \mu F_j + \sigma Z_{ij} + \varepsilon_{ij} \qquad (2)$$

Where b' $= \lambda \times \left(1 + t \times T_{ij}\right) \times S_{ij}$ is the returns to digital investments

*Where the new hypothesis is that **H2**: (b> $\boldsymbol{\lambda} \times$ **low strategy and** b' < $\boldsymbol{\lambda} \times$ **bold strategy);** Furthermore,*

***H3**: $\boldsymbol{t < 0}$*

Accounting from entrepreneurial changes

The above still does not account for the possibility that returns lead to a virtuous cycle of companies investing more in digital. Likewise, we still do not know why companies may be attracted to develop bold strategy and commit more investment resources than peers. Here-after, we *endogenize* the decision to adopt or not an offensive strategy as well as extent of investment, with the fundamental insight that the extent of organizational leadership condition the breadth of *change in strategy and resources allocation* by incumbent firms.

As discussed before, four features of organizations have been put forward by scholars as vectors of change, and as such can be used as natural instrument to equation (2). The first is risk aversion, (denoted by RA), towards digitization ((Karimi and Walter, 2015), the second is the extent of capabilities (CAP) to rollout in digitization, the third is the sensing of the environment (SENSE), and especially how companies sense the urgency of disruption; the last is the commitment of CEO to digitization, (CEO). In practice, we estimate two models, one with differentiated effects on both digital investments and strategic change, and another one that blends the two effects. One advantage of this is to make sure to identify the channels by which digital returns are created, and whether there is complementarity or substitution between entrepreneurial factors on investment and strategic change. We define our new equation (3):

$$\log(D_{ij}) \times S_{ij} = \alpha' + c.RA_{ij} + d.CAP_{ij} + e.SENSE_{ij} + f.CEO_{ij} + \mu' F \quad + \varepsilon'_{ij} \qquad (3)$$

*where the next hypotheses **H4** are: c<0,and d,e, f >0*

Results

The final model is one of the two equations (2)-(3), which we estimate through 2SLS regression. The equation (3) is being first estimated, and the computed value arising from the fit in (3) are then used to estimate (2) as a way to control for possible endogeneity bias. We first discuss new estimates of returns to digital investments (Table 4), while Table 5 zooms into the results of equation (3). For simplicity, we only report the coefficients linked to the returns to digitization, but all regressions continue to include industry and regional dummies, as well as all other controls in the vector Z. Those control variables and their effects are not materially changed versus the base line model (1). Regarding equation (3); control variables are reported in Appendix 1. For simplicity, we report the data in Table 4 based on above or below turbulence.

Table 4- about here

Returns to digitization estimates- turbulence and strategy change intensity comparison

The first observation is that, with equation (2), the fit is more able to explain the spread of returns, as returns are clearly seen to depend on the mix of turbulence and strategic changes. In fact, the returns to digital investments now vary between -3% to 49% (for statistically significant cases) for our mid sample year 2017 , versus between 27-29% in the base line case. Secondly, we find strong support for **H2**. Absent a strategic change that is at least medium, digital investments are *not* associated with any extra growth. Worse, the coefficient becomes *negative* for companies with no strategic changes, when the firms are in a situation of large turbulence. Second, the coefficients for medium and bold moves are now boosted, versus the base line. Third, the elasticity coefficients associated with medium and bold strategic change are twice bigger than the average b, reflecting that much better returns can be achieved when *digitization is associated with strategic changes*.

One clear point is that returns are systematically lower under high than low turbulence, highlighting the role of competition as driver of returns, and thus confirming **H3**. One other subtle change is that only bold strategies significantly boost return, under high turbulence. What matters seems more the relative than the level of investment to generate digital returns. Such a prescription would be in line with the implications of the Red Queen Competition theory (Robson 2005, Derfus et al. 2008, Ho et al. 2017).

Table 5- about here

Antecedents to digital spent and related strategic posture

Turning now to equation (3) estimates, we find again strong evidence in favour of **H4** (see Table 5).[4]

A first observation is that an organization's level of risk aversion exerts a negative, effect on strategic change and investment, albeit this effect is imprecisely estimated. Second, the level of involvement of the CEO to digital initiatives exhibits a strong positive association with strategic offensiveness. CEO involvement may lead to reduced level of digital investment, but this effect is not significant. Third, having digital capabilities ahead of the competition is strongly and positively associated both with strategic offensiveness and with digital investments. Finally, sensing the risk on current incumbency revenue exhibits a similar pattern of boosting bold strategic changes.

Table 6- about here

Enterpreneurial effects comparison

[4] For clarity and lack of space, we here only present results for the cas of digital investment intensity- anf for our mid case 2017.

Table 6 further compares the relative contribution of the effects, based on the parameter estimates and the standard deviation in the distribution of the organizational variables. Overall, one standard deviation of those variables leads to a change of 1,8 (respectively, 3,4) points in top line growth linked to scaling digital investment/ (resp.,exerting strategic renewal)- that is, a significant impact. In general however, the two effects are more or less substitute as the total effect of bold strategy combined is reduced to 1,4 points of growth a year,- but this estimated effect on top line growth from organizational changes is already twice bigger than the effect estimated from equation (1) alone . Further, 1,4 points is a significant change for one standard deviation— assuming a normal distribution, the difference between the low and best quartiles in digital transformation is about 2,1points (or 29%) higher long-term growth difference. At incumbent "wacc" of 7% as per the Stern School by 2017, this gain if perennial, may lead to three times larger shareholder value between best and top quartile.

A final point is that relative capabilities drive the most of the effect on returns to digitization- the main reason is that capabilities have a rather strong impact on renewal, and capabilities have a multiplier effect on the blended renewal and investments as scale. Still, in total this explains 45% of total effects,- thus all drivers have their say in determining the impact on strategic renewal.

DISCUSSION AND CONCLUSIONS

This study has put new light on incumbent returns to digitization, and how those returns are endogenously determined by a series of organizational enablers that favor or limit scaling of investments and strategic changes of incumbents. Our results are consistent with Mithas and Rust (2016)'s argument that returns to digitization are crucially mediated by firm strategy.

Results also make common sense, e.g. that digital returns may be twice larger than traditional as a result of capital efficiency and market extension (which is visible in the sense that digital native market share intensity does not reduce the sales momentum of incumbents in our results, every other thing equal). Also, returns with multiple of 2-4 times their cost of capital for digital is as large, if not larger

than, other forms of new forms of capital such as distributed computing, intellectual capital, or intangible and R&D (Biontis et al. 2015, Peters and al., 2017 and Lee et al. 2005). Finally, our results make clear that the option to engage in digital is quickly out of the money for incumbent-- as digital maturity makes it harder to obtain large returns from digital investments, and only would arise when companies are adopting the most offensive strategy to profit from their digital investments. These findings are consistent with El Sawy et al. (2010)'s discussion of the role of digital eco-dynamics.

Clearly, the move to offensive play is also strongly embedded in organizational elements—with high organizational barriers leading to evasive returns. Those organizational barriers, we find, are also clearly linked to limited entrepreneurial skills and assets among incumbents; in our research, close to 40% of incumbents thought that CEO, and top management at large, were not active enough in the digitization programme. As main respondents to the survey, executives also acknowledge that their organization (and themselves by extension) were still too risk averse, having invested poorly in capabilities versus their competitors; among others. It is thus time to inject digital-savvy entrepreneurship into incumbent companies to reach the frontier of returns that are possible out of digitization.

REFERENCES

Adner, R. and R. Kapoor. 2016. Innovation ecosystems and the pace of substitution: Re-examining technology S-curves, *Strategic Management Journal*, 37, 625–648.

Agarwal, R., & Tiwana, A. (2015). Evolvable Systems: Through the Looking Glass of IS. *Information Systems Research*, 26(3), 473-479.

Ansari, S., Garud, R., & Kumaraswamy, A. (2016). The disruptor's dilemma: TiVo and the US television ecosystem. *Strategic Management Journal*, *37*(9), 1829-1853.

Bharadwaj, A., O. El Sawy, P. Pavlou and N. Venkatraman (2013), Digital business strategy: toward a next generation of insights, *MIS Quarterly*, 37(2), 471-482.

Bloom, N., R. Sadun and J. Van Reenen (2012), Americans do IT better: US multinationals and the productivity miracle, *The American Economic Review*, 102(1), 167-201.

Bontis, N., Wu, S., Chen, M. C., Cheng, S. J., & Hwang, Y. (2005). An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of intellectual capital*.

Bresnahan, T. F., Brynjolfsson, E., & Hitt, L. M. (2002). Information technology, workplace organization, and the demand for skilled labor: Firm-level evidence. *The Quarterly Journal of Economics*, 117(1), 339-376.

Brynjolfsson, E. and L. Hitt (2000), Beyond computation: Information technology, organizational transformation and business performance, *The Journal of Economic Perspectives*, 14(4), 23-48.

Bughin, J. (2016). Reaping the benefits of big data in telecom. *Journal of Big Data*, *3*(1), 1-17.

Bughin, J. , M. Laberge and A. Melbye, (2016), The case for digital reinvention, *McKinsey Quarterly*

Bughin, J. and N. van Zeebroeck (2017), The Best Response to Digital Disruption, *MIT Sloan Management Review*, 58(4).

Cardona, M., Kretschmer, T., & Strobel, T. (2013). ICT and productivity: conclusions from the empirical literature. *Information Economics and Policy*, 25(3), 109-125.

Caesarius, L. M., & Hohenthal, J. (2018). Searching for big data: How incumbents explore a possible adoption of big data technologies. *Scandinavian Journal of Management*, *34*(2), 129-140.

Charitou, C. and C. Markides. 2003. Responses to disruptive strategic innovation, *MIT Sloan Management Review*, 44(2), 55-64.

Mendelson, H, 2017, Business Models, Information Technology, and the Company of the Future, *MIT Technology review*

Chesbrough, H, 2010, Business Model Innovation, *Long Range Planning,* vol 43

Christensen, C. M., & Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic management journal*, *17*(3), 197-218.

Cozzolino, A., Verona, G., & Rothaermel, F. T. (2018). Unpacking the disruption process: New technology, business models, and incumbent adaptation. *Journal of Management Studies*, *55*(7), 1166-1202.

Crafts, N. (2018). The productivity slowdown: is it the 'new normal'?. *Oxford Review of Economic Policy*, *34*(3), 443-460.

David, P. A. (1990). "The Dynamo and the Computer: A Historical Perspective on the Modern Productivity Paradox". *American Economic Review*. Papers and Proceedings. **80** (2): 355–61

Derfus, P, P. Maggitti, C. Grimm and K. Smith (2008), The red queen effect: competitive actions and firm performance, Academy of Management Journal 51(1), pp. 61-80.

Donoughue P. Beyond the fear of cannibalisation will the book publishing industry survive the digital revolution? Logos. 2010;21(3):167–78

Dutta, A., H. Lee and M. Yasai-Ardekani. 2014. Digital systems and competitive responsiveness: The dynamics of IT business value, *Information & Management*, 51(6), 762-773.

Edeling, A., & Himme, A. (2018). When does market share matter? New empirical generalizations from a meta-analysis of the market share–performance relationship. *Journal of Marketing*, *82*(3), 1-24.

Leibenstein, Harvey (1966), "Allocative Efficiency vs. X-Efficiency", *American Economic Review*, **56** (3): 392–415.

El Sawy, O., A. Malhotra, Y. Park and P. Pavlou (2010), Research commentary - Seeking the configurations of digital ecodynamics: it takes three to tango, *Information Systems Research*, 21(4), 835-848.

Giachetti, C., J. Lampel and S. Pira. 2016. Red Queen Competitive Imitation in the UK Mobile Phone Industry, *Academy of Management Journal*, August 1, 2016.

Gurbaxani, V. and D. Dunkle, (2019), Gearing up for successful digital transformation, *MIS Quarterly Executive*, Sept., 18:3.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic management journal*, *24*(10), 997-1010.

Henderson, R. (1993), Underinvestment and Incompetence as Responses to Radical Innovation: Evidence from the Photolithographic Alignment Equipment Industry, The *RAND Journal of Economics*, 24(2), 248-270.

Ho, J., F. Tian, A. Wu, and S. Xu. 2017. Seeking Value Through Deviation? Economic Impacts of IT Overinvestment and Underinvestment, *Information Systems Research*.

Jovanovic, Boyan, and Peter L. Rousseau. "General purpose technologies." *Handbook of economic growth*. Vol. 1. Elsevier, 2005. 1181-1224.

Kammerlander, N, Koenig, A & Richards, M 2018, 'Why do incumbents respond heterogeneously to disruptive innovations? The interplay of domain identity and role identity.', Journal of management studies, vol. 55, no. 7, pp. 1122-1165. https://doi.org/10.1111/joms.12345

Karimi, J. and Z. Walter. (2015). Corporate entrepreneurship, disruptive business model innovation adoption, and its performance: The case of the newspaper industry, *Long Range Planning*, 49(3), 342-360.

Kohtamäki, M., Parida, V., Patel, P. C., & Gebauer, H. (2020). The relationship between digitalization and servitization: the role of servitization in capturing the financial potential of digitalization. *Technological Forecasting and Social Change*, *151*, 119804.

Koellinger, P. (2008), The relationship between technology, innovation, and firm performance: Empirical evidence from e-business in Europe, *Research policy,* 37(8), 1317-1328.

Kohli**,** R and Melville**,** N. (2019). **"**Digital innovation**:** A review and synthesis." Information Systems Journal 29(1): 200-223

Klos, C., Spieth, P., Clauss, T., & Klusmann, C. (2021). Digital Transformation of Incumbent Firms: A Business Model Innovation Perspective. *IEEE Transactions on Engineering Management.*

Langley, P., & Rieple, A. (2021). Incumbents' capabilities to win in a digitised world: The case of the fashion industry. *Technological Forecasting and Social Change*, *167*, 120718.

Lee, S. Y. T., Gholami, R., & Tong, T. Y. (2005). Time series analysis in the assessment of ICT impact at the aggregate level–lessons and implications for the new economy. *Information & Management*, *42*(7), 1009-1022.

Lee, M., Choi, H., Cho, D., & Lee, H. (2016). Cannibalizing or complementing?. The impact of online streaming services on music record sales. *Procedia Computer Science*, *91*, 662-671

Leibenstein, Harvey (1966), "Allocative Efficiency vs. X-Efficiency", *American Economic Review*, **56** (3): 392–415.

Lindenberg, E. B., and S. A. Ross, 1981, Tobin's q ratio and industrial organization. Journal of Business 54, 1-32.

Mendelson, H, 2017, Business Models, Information Technology, and the Company of the Future, *MIT Technology review*

Mithas, S. and R. Rust. 2016. How Information Technology Strategy and Investments Influence Firm Performance: Conjecture and Empirical Evidence, *MIS Quarterly*, 40(1), 223-245.

Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital innovation management: reinventing innovation management research in a digital world. *MIS Quarterly, 41*(1), 223–238.

Peters, R. H., & Taylor, L. A. (2017). Intangible capital and the investment-q relation. *Journal of Financial Economics*, *123*(2), 251-272.

Porfírio, J. A., Carrilho, T., Felício, J. A., & Jardim, J. (2021). Leadership characteristics and digital transformation. *Journal of Business Research*, *124*, 610-619).

Robson, A. (2015), Complex evolutionary systems and the Red Queen, *The Economic Journal* 115(504), pp. 211-224.

Schommer, M., Richter, A., & Karna, A. (2019). Does the diversification–firm performance relationship change over time? A meta-analytical review. *Journal of Management Studies*, *56*(1), 270-298.

Santoro, G., Thrassou, A., Bresciani, S., & Del Giudice, M. (2019). Do knowledge management and dynamic capabilities affect ambidextrous entrepreneurial intensity and firms' performance?. *IEEE Transactions on Engineering Management*.

Teece DJ, Peteraf MA, Leih S (2016) Dynamic capabilities and organizational agility: risk, uncertainty and entrepreneurial management in the innovation economy. California Management Review 58(4):13–35

Van Zeebroeck, N., Kretschmer, T., & Bughin, J. (2021). Digital "is" Strategy: The Role of Digital Technology Adoption in Strategy Renewal. *IEEE Transactions on Engineering Management*.

Witschel, D., Döhla, A., Kaiser, M. *et al.* Riding on the wave of digitization: insights how and under what settings dynamic capabilities facilitate digital-driven business model change. *Journal of Business Economics* **89,** 1023–1095 (2019).

Table 1a- Industry and size distribution across all three surveys, 2016-2018

Sectors	% in sample	% launched digital transformation, cumulative by 2018
Automotive and assembly	7	89
Business, legal, and professional services	22	70
Consumer packaged goods	5	86
Financial services	21	81
Healthcare systems/pharma and medical products	9	80
High tech	13	77
Infrastructure	5	72
Media and entertainment	5	82
Retail	5	77
Telecom	4	88
Travel, transport, and logistics	5	86
Employee size		
1-99	29	62
100-499	13	77
500-999	6	85
1,000-10,000	21	77
10,001-20,000	7	95
20,001-50,000	8	96
50,001+	15	99

Source: TNS, authors' computation

Table 1b- Sample features, mid year 2017, %

Variable	Mean	StDev	Min	Max
Revenue Growth	7,87	2,25	1	12
Share of revenue spent on digital investments	14,59	21,11	0	100
Digital investment compared with competitors	2,76	1,07	1	5
Overall firm reaction to digital shock	3,16	1,12	1	5
Degree of digital turbulence in industry (excl. focal firm)	3,16	0,37	2,33	3,82
Share of revenue at risk of digital disruption	31,94	28	0	100
Nb of employees (range)	3,91	2,65	1	9
Firm revenues (range)	3,6	2,68	1	10
Market share of the focal firm	24,61	25,85	0	100
Market share held by digital native firms	12,19	15,12	0	100
Market share held by traditional competitors	16,4	19,22	0	100
Market share held by incumbent competitors competing in digital way	39,58	30,21	0	100
Market share held by incumbents from adjacent industries	7,23	8,69	0	75
Firm is public	0,26	0,44	0	1
Firm's main focus is B2C	0,22	0,41	0	1
Firm portfolio is mono-product or mono-service	0,18	0,38	0	1
Firm portfolio includes products	0,59	0,49	0	1
Risk aversion	0,25	0,43	0	1
CEO support to digital	0,21	0,41	0	1
Digital capabilities wrt competitors	4,01	1,75	1	7

Source: TNS survey, 2017 (median year). Note: unbalanced dataset

Table 2a. ROI evaluation of last digital initiative

Question: "Consider your organization's most recent digital initiative and for which the outcome is largely known.

Please give your best estimate of the initiative's annual return on invested capital."

ROI	Average among incumbents
Less than 0%	14%
0% to 10%	19%
11% to 20%	19%
21% to 99%	11%
100% or more	3%
Don't know	34%

Source: TNS Survey, 2017

Table 2b. ROI evaluation of last digital initiative by firm profile

Question: "Consider your organization's most recent digital initiative and for which the outcome is largely known.

Please give your best estimate of the initiative's annual return on invested capital."

ROI	Incumbent competing substantially in new ways (>20% of business is digital)	Incumbent competing primarily in traditional ways (>80% of business is not digital)
Less than 0%	21%	20%
0% to 10%	18%	38%
11% to 20%	33%	27%
21% to 99%	21%	13%
100% or more	7%	3%
Total firms split	**35%**	**65%**

Source: TNS survey 2017, authors' computations

Table 3a. OLS regression (1) estimates, three different investment specifications

	Log of digital investment	Share of revenue spent on digital investments	Digital investment compared with competitors
Log of digital investment	0.2855***		
	(0.0957)		
Share of revenue spent on digital investments		0.0152**	
		(0,007)	
Digital investment compared with competitors			0.2934***
			(0.0955)
Nb of employees (range)	-0.1649**	-0.1495*	-0.1555**
	(0.0822)	(0.0841)	(0.0737)
Firm revenues (range)	-0.0041	0.0573	0.0580
	(0.0834)	(0.0805)	(0.0713)
Market share of the focal firm	-0.0013	-0.0013	-0.0029
	(0.0051)	(0.0052)	(0.0046)
Market share held by digital competitors	0.0044	0.0036	0.0005
	(0.0051)	(0.0050)	(0.0044)
Firm is public	-0.0325	-0.1166	0.0480
	(0.3272)	(0.3249)	(0.2545)
Firm's main focus is B2C	-0.1353	-0.0849	-0.0352
	(0.2826)	(0.2815)	(0.2541)
Firm portfolio is mono-product/ mono-service	0.5294*	0.4873*	0.5276**
	(0.2841)	(0.2856)	(0.2390)
Firm portfolio is product exclusive	-0.2267	-0.2324	-0.1879
	(0.2608)	(0.2612)	(0.2367)
Constant	7.6855***	8.1316***	7.0581***
	(0.7953)	(0.7825)	(0.7592)
R^2	0.15	0.15	0.13
number of firms	417	417	530
region control	Y	Y	Y
industry control	Y	Y	Y
firm control	N	N	N

s.e. in brackets, 2017 mid year; **/**/***=significant at 10%/5%/1%*.

Table 3b. b estimates range, as per equation (1)

	2016	2017	2018	2016-18 panel
Log of digital investment	0.2452***	0.2855***	0.3215***	0.2217***
	(0.0823)	(0.0957)	(0.0832)	(0.0673)
digital investments intensity	0.0137**	0.0152**	0.0160**	0.0144**
	(0.0055)	(0.0061)	(0.0063)	(0.0065)
Digital investment compared with competitors	0.2704***	0.2934***	0.3029***	0.2691***
	(0.0813)	(0.0955)	(0.1101)	(0.0863)
number of firms	417	417	530	112
region control	Y	Y	Y	Y
industry control	Y	Y	Y	Y
firm control	N	N	N	Y

notes:

1. standard errors in bracket ; */**/***=*significant at 10%/5%/1%.*

2. Panel data= 2 *112= 224 data points, outside fixed effects

Table 4- Returns to digitization estimates- turbulence and strategy change intensity comparison

	Digital investment		Digital intensity		Digital above peers	
digital investment	low turbulence	high turbulence	low turbulence	high turbulence	low turbulence	high turbulence
X Low strategy	0.2462	-0.0539	0.0046	-0.0304*	-0.1438	0.0043
	(0.2009)	(0.1696)	(0.0119)	(0.0181)	(0.1815)	(0.1921)
X Medium strategy	0.4299**	0.2675	0.0454**	0.0242	0.0727	0.3654**
	(0.1725)	(0.1914)	(0.0228)	(0.0181)	(0.1900)	(0.1848)
X Bold strategy	0.4081***	0.2893**	0.0235***	0.0156*	0.0497	0.4864***
	(0.1537)	(0.1436)	(0.0078)	(0.0093)	(0.1564)	(0.1305)
R^2	0.23	0.20	0,20	0,19	0.15	0,23
Industry	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y

*Notes: Control vector Z not reproduced. S; in brackets. */**/***=significant at 10%/5%/1%.*

Table 5- Antecedents to digital spent and related strategic posture

	Digital investment	Strategic response
Risk aversion	-0.9686	-0.0307
	(-17.209)	(0.0499)
Level of CEO involvement in digital	-10.979	0.0941***
	(-10.243)	(0.0252)
Digital capabilities wrt competitors	1.6685***	0.0967***
	(0.5154)	(0.0128)
Share of revenues at risk of digital disruption	0.3390***	0.0031***
	(0.0510)	(0.0008)
R^2	0.43	0.35
N	392	446
Industry F.E.	Y	Y
Region F.E.	Y	Y

Notes: Control vector Z not reproduced. Y =Yes, N= No. F.E= fixed effects.

*Standards robust errors in brackets. */**/***=significant at 10%/5%/1%.*

Table 6 -relative effect on returns

	Digital investment	Strategic response	Digital investment X strategic response
Risk aversion (RA)	3%	5%	11%
Level of CEO involvement in digital (CEO)	30%	13%	2%
Digital capabilities wrt competitors (CAP)	19%	60%	45%
Share of revenues at risk of digital disruption (SENSE)	49%	23%	42%
total effects on top line (points of growth)	1,79	3,40	1,36
% total growth	0,23	0,43	0,17

Appendix : Firm control effects on digital investments/strategic posture

Table A.1. Control effects on digital investments and strategic responses

	Digital investment	Digital investment: Low turbulence	Digital investment: High turbulence	Strategic response	Strategic response: Low turbulence	Strategic response: High turbulence
Nb of employees (range)	-0.8345	0.6561	-1.8001*	0.0077	0.0205	-0.0012
	(0.6609)	(0.7935)	-10.358	(0.0174)	(0.0320)	(0.0233)
Firm revenues (range)	-0.5772	-0.3873	-0.3344	-0.0078	-0.0219	0.0042
	(0.5506)	(0.4382)	(0.9647)	(0.0165)	(0.0299)	(0.0215)
Market share of the focal firm	-0.0605	-0.0518	-0.0776	-0.0003	-0.0013	0.0008
	(0.0488)	(0.0476)	(0.0901)	(0.0012)	(0.0021)	(0.0017)
Market share held by digital competitors	-0.0961**	-0.0740	-0.1091	-0.0000	0.0004	0.0000
	(0.0463)	(0.0478)	(0.0831)	(0.0011)	(0.0019)	(0.0015)
Firm is public	-0.3720	-21.082	0.4224	0.0819	0.0835	0.0626
	-22.936	-24.718	-45.754	(0.0589)	(0.0894)	(0.0897)
Firm's main focus is B2C	3.7127*	0.4497	7.4283*	0.0462	0.1326*	0.0334
	-20.940	-12.137	-39.584	(0.0527)	(0.0784)	(0.0762)
Firm portfolio is mono-product or mono-service	-0.6723	-16.412	-0.3895	-0.0203	-0.0594	0.0196
	-21.963	-13.940	-48.421	(0.0631)	(0.0903)	(0.0900)
Firm portfolio includes products	29.435	0.5673	55.482	0.0387	0.0408	0.0698
	-20.054	-17.630	-33.895	(0.0485)	(0.0910)	(0.0637)
Constant	12.6917**	12.5596*	26.4861***	-0.4259**	-0.4279	-0.1679
	-63.055	-66.239	-100.197	(0.1983)	(0.2896)	(0.3028)

WORKING PAPERS 2013

001 - Exploring europe's r&d deficit relative to the us: differences in the rates of return to r&d of young leading r&d firms - Michele Cincera and Reinhilde Veugelers

002 - Governance typology of universities' technology transfer processes - A. Schoen, B. van Pottelsberghe de la Potterie, J. Henkel.

003 - Academic Patenting in Belgium: Methodology and Evidence – M. Mejer.

004 - The impact of knowledge diversity on inventive performance at European universities – M. Mejer

005 - Cross-Functional Knowledge Integration, Patenting and Firm's Performance – M. Ceccagnoli, N. van Zeebroeck and R. Venturini.

006 - Corporate Science, Innovation and Firm Value, M. Simeth and M. Cincera

WORKING PAPERS 2014

007 - Determinants of Research Production at top US Universities – Q. David.

008 - R&D financing constraints of young and old innovation leaders in the EU and the US – M. Cincera, J. Ravet and R. Veugelers

009 - Globalization of Innovation Production; A Patent-Based Industry Analysis – J. Danguy

010 - Who collaborates with whom: the role of technological distance in international innovation – J. Danguy

WORKING PAPERS 2015

011 - Languages, Fees and the International Scope of Patenting – D. Harhoff , K. Hoisl, B. van Pottelsberghe de la Potterie , C. Vandeput

012 - How much does speed matter in the fixed to mobile broadband substitution in Europe? – M. Cincera, L. Dewulf, A. Estache

013 - VC financing and market growth – Interdependencies between technology-push and market-pull investments in the US solar industry – F. Schock, J. Mutl, F. Täube, P. von Flotow

014 - Optimal Openness Level and Economic Performance of Firms: Evidence from Belgian CIS Data – M. Cincera, P. De Clercq, T. Gillet

015 - Circular Causality of R&D and Export in EU countries – D. Çetin, M. Cincera.

016 - Innovation and Access to Finance – A Review of the Literature – M. Cincera, A. Santos.

WORKING PAPERS 2016

017 - Effectiveness of Government intervention in the SME sector: Evidence from the Brussels-Capital Region – G. E. Fombasso, M. Cincera.

018 - A review of corporate R&D intensity decomposition – P. Moncada-Pastemò-Castello.

019 - The laws of action and reaction: on determinants of patent disputes in European chemical and drug industries – R. Kapoor, N. van Zeebroeck.

020 - How do the normativity of headquarters and the knowledge autonomy of subsidiaries co-evolve? – M. Hansmans, G. Liu.

WORKING PAPERS 2017

021 - The case for offensive strategies in response to digital disruption – J. Bughin, N. van Zeebroeck.

022 - Access to finance as a pressing problem: Evidence from innovative European firms – A. Santos, M. Cincera.

023 - Platform play among incumbent firms: the wrong focus? – N. van Zeebroeck, J. Bughin.

024 - Social Movements – M. Hensmans, K. van Bommel.

025 - Decoding Patent Examination Services – L. Gimeno-Fabran, B. van Pottelsberghe de la Potterie.

026 - Countries Attractiveness: An Analysis of EU Firms's Decisions to (De) Localize R&D Activities – M. Cincera, A. Santos.

WORKING PAPERS 2018

027 - The impact of EUREKA projects on the economic performance of R&D SMEs – M. Cincera, G. Fombasso.

028 - Forecasting short-term transaction fees on a smart contracts platform – C. Hoffreumon, N. van Zeebroeck.

029 - Sharing the risk of innovative investment: Assessing the effect of new European financing instrument - M. Cincera, A. Santos.

030 - Academic scientists: The golden opportunity for high-tech companies – L. Dewulf, M. Cincera.

WORKING PAPERS 2019

031 - Experimentation, Learning and Stress. The Role of Digital Technologies in Strategy Change – J. Bughin, T. Kretschmer, N. van Zeebroeck.

032 - Types of Innovation and Firm Performance – M. Cincera, E. Ince.

033 - Competition and Innovation: Evidence from Worldwide Corporate R&D Spenders - M. Cincera, E. Ince, A. Santos.

WORKING PAPERS 2020

034 - Selectivity versus Reach: Flattening the Curve of Covid 19 for Joint Health and Economic Prosperity – J. Bughin.

035 - How firms will affect the Future of Work – J. Bughin.

036 - Making Sense of the Covid-19 (SARS-CoV-2) Pandemic – J. Bughin.

037 - F.O.G. and Teleworking: Some Labor Economics of Covid-19 – J. Bughin , M. Cincera

038 - Learning from 20 Years of Research on Innovation Economics – B. van Pottelsberghe de la Potterie.

039 - The Value of Platform Strategy. It's the Ecosystem, Stupid! - J. Gossé, C. Hoffreumon, N. van Zeebroeck, J. Bughin.

040 - Ten Moments of Truths for the Covid-19 Crisis – J. Bughin.

041 – The Great Employee Divide: Clustering Employee « Well-being » Challenge during Covid-19 – J. Bughin, M. Cincera, D. Reykowska, M. Żyszkiewicz.

042 - Perceptive Risk Clusters of European Citizens and NPI Compliance in face of the Covid-19 Pandemics – J. Bughin, M. Cincera, D. Reykowska, M. Żyszkiewicz, R. Ohme.

WORKING PAPERS 2021

043 - Make it or Break it: Vaccination Intention at the Time of Covid-19 – J. Bughin, M. Cincera, K. Peters, D. Reykowska, M. Żyszkiewicz, R. Ohme.

044 - Covid-19 Endemism and the Control Skeptics - J. Bughin, M. Cincera, D. Reykowska, M. Żyszkiewicz, R. Ohme.

045 - Vaccination or NPI? A Conjoint Analysis of German Citizens' Preferences – J. Bughin, M. Cincera, E. Kiepfer, D. Reykowska, F. Philippi, M. Żyszkiewicz, R. Ohme, D. Frank.

046 - Is this Time Different? Corporate Resilience in the Age of Covid-19 – J. Bughin, S. Berjoan, F. Hinterman, Y. Xiong.

047 - Big Data is Decision Science: the Case of Covid-19 Vaccination - J. Bughin, M. Cincera, D. Reykowska, R. Ohme.

048 - The Entrepreneurial Returns to Incumbents' Digital Transformation - J. Bughin, N. van Zeebroeck.