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The Impact of Corporate Sustainability and Digitalization on International Banks' Performance

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Francisco Javier Forcadell
ESIC Business & Marketing School and
Rey Juan Carlos University
Elisa Aracil
ICADE Business School, Comillas Pontifical University
Fernando Úbeda
Autonomous University of Madrid

Abstract

We analyse the implications for international banks of two contemporary megatrends: corporate sustainability (CS) and digitalization. The digital environment and the availability of massive data from customers generate asymmetric information for banks to the detriment of customers, who experience individual vulnerabilities such as privacy rights. This can hinder the positive influence of digitalization in banks' performance, with relevant managerial and political implications. In this context, the reputation generated by CS strategies can constitute a credence factor that reduces customers' fears of opportunistic behavior and information asymmetries. We test and find support for our hypothesis over a panel data of large international banks from developed countries. Our findings shed light on the mutual reinforcement of CS and digitalization strategies in enhancing banks' market performance and efficiency.

Policy Implications

- Our study shows that digitalization requires the complementary action of CS-based reputation to enhance banks' performance. This suggests the need for reputation building in those sectors (public and private) immersed in the digital transformation. By doing so, organizations can reduce information asymmetries for their main stakeholders. Since CS efforts exhibit an important potential for building organizational reputation, governments should stimulate the firms' CS investments.
- Banks' survival against disruptive forces urges to reconsider the basis of its business model. It is not sufficient to react against digital-born companies' menace with M&A-driven strategies. For that reason, we suggest that including CS in the basis of the banking business model can contribute to achieving better market performance and efficiency and to overcoming fierce competition by new entrants.
- Central Banks are promoting concentration processes implying layoffs that erode the reputation of the banking industry. In this scenario, the embeddedness of CS in banks' business models can counteract this negative reputational effect. Thus, we demonstrate that digitalized banks (that presumably reduce their staff) only obtain good performance if at the same time they care about sustainability issues (which encompasses staff-related actions as an important stakeholder for the bank).

Corporate sustainability (CS) and digitalization are increasingly primary for firms, society and policy makers internationally. Competitive, social and institutional pressures on these two areas have been pushing corporations, and in particular banks, to improve their impact on society and the environment and to engage in digital transformation. For example, pressure groups such as BankTrack intensively question international banks' lending practices on critical aspects such as climate change (i.e. funding to fossil fuels) or socially excluded groups. Additionally, there is a growing demand from customers of sustainability-related products, delivered through digital channels. The 2008 financial crisis was an example of the financial industry's significance for economic development. However, the bailouts by the public

sector and the subsequent macroeconomic shocks (Hallerberg and Markgraf, 2018) prompted social aversion to banks and severely damaged their reputations (Ruiz et al., 2014). Since then, many banks have engaged in CS initiatives to restore tarnished reputations (Forcadell and Aracil, 2017a; Mattila et al., 2010). At the same time, the digital era has stimulated a transformation of the financial business from brick and mortar to click and mortar (De Young et al., 2007).

Although information asymmetries are pervasive in all sectors, traditionally they are noteworthy in the banking industry (Furfine, 2001) since borrower quality is not easily observable and can alter the risk profile of banks (Levine, 2004). In the digital environment, data and firm capabilities for analyzing and predicting customer behavior reduce asymmetric information significantly, constituting a source of competitive advantage (Davenport and Dyché, 2013). Further, providing financial services in a branch-less scenario allows banks to reduce transaction costs and reach a wider number of clients (Niemand et al., 2017). Therefore, digitalization can enhance banks' performance and efficiency, understood as minimizing costs and maximizing revenues.

However, digital strategies are not free of burden. Data collection and privacy concerns constitute a growing issue in global politics (Flyverbom et al., 2017). Digital ubiquity may generate a problem of asymmetric information against banks (Granados and Gupta, 2013). Indications of opportunistic behaviour in the financial sector have led to an increased mistrust (Hoepner et al., 2016). In particular, the increased availability of data from clients generates fears of opportunistic threat and may cause reputational damage due to job displacements. Against this backdrop, a reputation for CS may ease these asymmetries, boosting customers' trust and confidence in financial institutions and minimizing the menace associated with digitalization.

Although the CS phenomenon has spawned massive research attraction (e.g. Bansal and Song, 2017), digitalization is a less explored area (Teece, 2018) because of its novelty. Moreover, the intersection of CS and digitalization as a potential booster of banks' performance remains largely unexplored.

We empirically test the combined effect of CS and digitalization over a 14-year panel of 112 international banks from developed countries. Our results suggest that the combination of digitalization and CS strategies yields better returns than when applied in isolation, improving banks' market performance and efficiency.

Digitalization in the financial industry: reducing asymmetric information for banks

Digitalization encompasses the deployment of technologies and information based on digital data (Scholz, 2017). Technological advances have led to a digital ecosystem in which banks conduct business based on multi-channels (online banking), platforms (crowd-lending), data management (big data analysis), artificial intelligence (financial robo-advisors), blockchain (cryptocurrencies), and related infrastructures such as 5G, cloud computing and machine learning (OECD, 2017). Data, the oil of the digital era (The Economist, 2017), is both the primary driver of the digital revolution and a crucial business resource to generate competitive advantages (West, 2019). Big data can create value for banks since it offers the possibility of predicting customer behavior (George et al., 2014). The digital ecosystem produces competitive advantages from external data, as opposed to traditional business focused on an efficient allocation of internal resources (Brenner, 2018). A customer centric digital strategy consists of predictive analytical tools (Davenport and Dyché, 2013) that help in understanding the customer relationship and improve lending decisions. For example, data generate into better credit scoring systems that allow banks to overcome asymmetrical information and increase their productivity (Agarwal and Hauswald, 2006).

The management of asymmetric information constitutes the foundation of financial intermediation (i.e. Allen and Santomero, 1997, 2001; Diamond, 1984), and shapes banks' performance (Scholtens, 2009). Diamond (1984) argued that intermediaries overcome asymmetric information problems by minimizing the cost of selection and monitoring information. These asymmetries arise in transactions where the distribution of information is unequal among the parties involved. Information asymmetries are particularly pronounced in any given financial agreement (Leland and Pyle, 1977) and generate adverse selection issues, since the borrower knows better than the lender whether the contract conditions will be met. In sum, asymmetric information hinders the maximization of banks' performance. A reduction in the cost of information can decrease information asymmetries between banks and their customers (Allen and Santomero, 1997). In the contemporary digital environment, banks can strategically use data to build proprietary information systems that soften information asymmetries and adverse selection threats, thus improving the lending process and their performance (Scholtens, 2009). We can counter-argue that digitalization may also entail several drawbacks in the bank side, for example being the target of cybercriminals. However, for the purposes of this article, we restrict our reasoning to the effect of digitalization on information asymmetries. Therefore, we argue that digitalization can tackle the problem of asymmetric information for banks, positively influencing their market and economic performance and their efficiency.

Corporate sustainability in the financial industry: reducing asymmetric information for banks' customers

The digital revolution produces major threats to individuals (Scholz, 2017) with the potential to transform our economy and society (Helbing, 2015). In this manner, digitalization is known as a double-edged sword which entails potential negative consequences for individuals and societies (Brenner, 2018) as a result of the asymmetries of information that it generates. In other words, the asymmetric information created by the digital environment may prompt client vulnerabilities in the form of privacy loss (Helbing, 2015) or

increased cybercrimes contingencies (Yar, 2013). This has the potential to affect customers but also societies, institutions and regulatory bodies, since individuals demand privacy rights and governments must protect this social interest (Scholz, 2017). Additional vulnerabilities from the digital revolution may include an exacerbation of the digital divide (Ragnedda and Muschert, 2013) that creates economic and social inequalities (Klonner and Nolen, 2010).

CS relates to the management of non-financial aspects such as economic, environmental and social concerns. CS performance reduces information asymmetries (Cho et al., 2013; Diebecker and Sommer, 2017) due to the appetite for non-financial company information. In particular, CS generates reputation for banks (Forcadell and Aracil, 2017a; Herzig and Moon, 2013). This reputation contains information about banks that attenuates the asymmetry of information between them and their customers in favour of the latter (Cho et al., 2013; Cui et al., 2018). In turn, reputation is considered a credence factor (Nienaber et al., 2014) that can enhance trustworthiness (Klewes and Wreschniok, 2009) which involves the psychological expectation that an agent will not behave opportunistically (Bunduchi, 2005; Kim et al., 2009). Trust facilitates lasting commercial relations, especially if there is no tangible product (services) and no physical facilities (online transactions as opposed to face-to-face). In the bank-customer relationship, the reputation generated by CS decreases information asymmetries in favour of customers since it improves transparency and reliability (Hoepner et al., 2016) and reduces the risk of opportunistic behaviour by the bank (Dyer, 1997).

The effect of digitalization and CS on banks' performance through the reduction of information asymmetries

In this section, we argue that the reduction of information asymmetries both on the side of the banks – via digitalization, and on the side of the customers – via CS, enhances banks' economic and market performance and efficiency. The literature identifies some direct effects of CS and digitalization on firm performance. Orlitzky et al.'s (2003) meta-study highlights the linkage between CS and performance results from internal forces that lead to efficiency gains and external forces such as enhanced reputation (Aguilera-Caracuel et al., 2017). CS actions related to total quality management (e.g. reducing energy consumption, ensuring healthy labour conditions) improve processes and reduce risks. In the specific case of the financial industry, environmental risks are mostly indirect but may result in controversies and scandals if funding proceeds are devoted to polluting projects. In fact, increasingly banks include a veto in their funding policies for non-environmentally compliant projects, which follows the Equator Principles agreement and other voluntary guidelines adopted as soft regulations. For example, by the end of 2018 the UN signed an early agreement with 30 leading financial institutions to launch the Principles for Responsible Banking initiative. Thus, sustainable strategies can lower risks because they minimize negative externalities (Pomering and Dolnicar, 2009), avoiding fines or negative press and therefore increase efficiency (Boehe and Cruz, 2010). In addition, efficiency may be enhanced by the CS-based reputation leading to improvements in funding terms (Jiraporn et al., 2014) or improved potential to attract and retain skilled labour (Turban and Greening, 1997).

In turn, digitalization is a key means by which services firms generate value from their investments (Kathuria et al., 2014). In this manner, digital innovations within the banking industry reduce the cost of financial intermediation (Ozili, 2018) by allowing better service for existing clients and attracting new customers. Barnir et al. (2003) highlight that digitalization reduces information asymmetries by dramatically improving the availability of information. This enhances knowledge of competitors' pricing and product offerings, which leads to internal efficiencies. In the same vein, Berg et al. (2018) find that consumers' digital data or digital footprint leads to better lending decisions and default prediction. Therefore, digitalization, similar to CS, may affect efficiency from both a cost and a revenue perspective.

One-step further, we argue that the combination of CS and digitalization mutually reinforce each other, yielding better results than in isolation. Digitalization allows banks to hold valuable customer information, which constitutes a source of potential client vulnerabilities. We argue that reputation from CS may balance those information asymmetries (Su et al., 2016). CS signals non-financial attributes (Shenkar and Yutchman-Yaar, 1997) which constitutes a relevant information about the future behaviour of banks. Therefore, reputation built from CS strategies can successfully overcome the potential clients' fears from the asymmetric information that benefits banks. Thus, the negative consequences that digitalization may entail for customers, in terms of information asymmetries, can be overcome by the CS-based reputation. Therefore, a joint strategy of CS and digitalization may strengthen its effects on banks' performance.

Because of the above, we propose the following:

> **Hypothesis**: The interaction between corporate sustainability and digitalization enhances banks' performance

Methods

Sample

We empirically test our hypothesis over a sample of 112 large international commercial banks (assets in excess of US$2bn) from 13 developed countries, over the period 2003–2016, with 653 observations (See Table 1). Data sources include Thomson Reuters, OECD and the World Bank database, and its availability has determined the size of the sample.

Dependent variables

We measure financial performance using four different variables, the first two are stock-market measures and the next two are efficiency and accounting-based measures: price-to-

book-value, annual share performance, the ratio of non-interest expenses to total net income, and return on assets (ROA).

The price-to-book-value ratio is a proxy to growth opportunities (Fama and French, 2000), and a predictor of returns on equity (Beaver and Ryan, 2000; Capaul et al., 1993). Specifically, banks with higher price-to-book are more profitable, deliver faster growth in deposits and total assets, are more cost efficient, and present better solvency ratios (Jordan, et al., 2011). Intangible assets such as digitalization and CS, underly the relationship between price-to-book and performance (Trueman et al., 2000). The annual equity returns show the stock price change and the dividend payments over the period (Aebi et al., 2012). The literature has identified that digitalization (Jabłonski, 2018), and CS (Brammer et al., 2006) as sources of equity performance. In turn, the ratio of non-interest expenses to total net income (Lin and Zhang, 2009) is a proxy of banks' efficiency, a reduction meaning an efficiency improvement. Finally, our fourth measure of banks' performance is ROA (Aebi, et al., 2012; Berger et al., 2005; Liang et al., 2013).

The accounting-based measures tap only historical aspects of performance and may be subject to manipulation by managers (Garcia-Castro et al., 2010). The stock-market measures of performance would solve these limitations since they are less susceptible to managerial manipulation and represent investors' evaluations of a firm's ability to generate future economic earnings. However, the problem of the stock-market measure is that it converts the investors' valuation of future performance into a performance measure. Given the debate over the proper measure of financial performance, we used both types of financial performance measures. The stock market-based measures allow analysis of the long-term relationship between performance and the complementarities of CS and digitalization, as opposed to the short-term orientation of the accounting based-measures.

Table 1. Sample distribution by country (2003–2016)

	Number of banks	Observations
Australia	1	7
Canada	9	78
Denmark	3	16
France	2	11
Germany	1	9
Greece	3	13
Italy	6	54
Norway	2	11
Portugal	2	25
Spain	3	30
Switzerland	3	32
United Kingdom	4	45
United States of America	73	322
Total	112	653

Independent variables

Our independent variables of interest are digitalization and CS. Since the development of CS and digitalization strategies involves a gradual generation of specific and valuable knowledge (Tang and Tang, 2012), we propose cumulative measures.

We take as a departing point for assessing the banks' CS the annual variation of the integrated environmental, social and governance (ESG) rating (ΔESG_{ijt}) (Cheng et al., 2014; Dahlsrud, 2008). The dummy variable $ESG2_{ijt}$ takes the value one when $\Delta ESG_{ijt} > 0$ and $\Delta ESG_{ijt-1} > 0$, that is, two consecutive years of improvement, and zero otherwise, trying to capture consistency and continuous development of voluntary actions over time (Sharma and Vredenburg, 1998). We define CS (CS_{ijt}) as the interaction between this dummy variable ($ESG2_{ijt}$) and ΔESG_{ijt}.

We base our banks' digitalization measurement on its potential for cost reduction (Frame and White, 2004; Hess and Francis, 2004) since technological innovations are necessarily associated to their economic returns (Foss et al., 2011). We estimate the stochastic meta-frontier of banks included in our sample (i.e. the measure of international optimal costs of bank i in the country j in year t) using the two-step methodology developed by Huang et al. (2014). For doing so, we estimate a translog cost function (Berger et al., 2005; Bos and Schmiedel, 2007; Lozano-Vivas and Pasiouras, 2010), including the following variables: banks' total loans and investments (output variables), total employee expenses and total non-interest operating expenses (input variables), the debt/equity ratio (controls), and, t and t^2 (trend variables). We define the technological gap as the distance to this meta-frontier (Fontin and Lin, 2019; Forcadell et al., 2019). The most efficient banks place themselves in the meta-frontier and thus their technological gap is one. The variation of this technological gap determines the bank's digitalization efforts ($DIGI_{ijt}$).

The variable $DIGI3_{ijt}$ equals one when $DIGI_{ijt} > 0$, $DIGI_{ijt-1} > 0$, and $DIGI_{ijt-2} > 0$, and zero otherwise, thereby identifying banks that improved digitalization for at least the last three consecutive years (Alonso-Borrego and Forcadell, 2010; Tushman and Nadler, 1986). We define digitalization ($DIGIS_{ijt}$) as the interaction between $DIGI3_{ijt}$ and $DIGI_{ijt}$, trying to capture a sustained digitalization effort by the bank.

Control variables

Banks' performance is controlled by the following variables. The bank size is measured by the natural logarithm of number of employees ($Empl_{ijt}$), which has a high correlation with total assets. The restructuring process of banks is controlled with the annual change in the ratio employee to assets ($\Delta Empl/Asset_{ijt}$). The solvency risk is measured by the Tier-1 capital adequacy ratio (Aebi et al., 2012; Scholtens, 2009; Simpson and Kohers, 2002) and the non-performing loans ratio (NPL_{ijt}) (Beltratti and Stulz, 2009; Berger et al., 2005) both variables are lagged one period. Finally, we include the return on assets (ROA_{ijt}), the annual variation of loans ($\Delta Loans_{ijt}$) (Dietrich and Wanzenried, 2010; Simpson and Kohers, 2002) and the natural logarithm of non-interest

expenses ($Cost_{ijt}$) (Albertazzi and Gambacorta, 2009). We use three contextual variables, the evolution of monetary policies measured with the 3 month interbank rate (Rf_{jt}), economic growth ($Growth_{jt}$) (Albertazzi and Gambacorta, 2009; Bernanke et al., 1999) and the percentage of mobile cellular telephone subscriptions over the total population ($Mobile_{jt}$) (Koenig-Lewis et al., 2010; Liu and Li, 2010).

Model specification

We specify the following model:

$$Performance_{ijt} = z\delta_1 + \alpha_1 DIGIS_{ijt} + \alpha_2 CS_{ijt} + \alpha_2 DIGIS_{ijt} * CS_{ijt} + \rho_1 \widehat{v}(DIGIS)ijt + \rho_2 \widehat{v}(CS)ijt + e_1,$$

where $Performance_{ijt}$ denotes our dependent variables, z is the vector of exogenous variables included in the model, δ_1 represents the coefficients of exogenous variables, and e_1 is the error term. Corporate sustainability (CS_{ijt}) and digitalization ($DIGIS_{ijt}$) may cause an endogeneity bias (Garcia-Castro et al., 2010), which we treat by using a control function (Imbens and Wooldrige, 2007). In the first step, we apply a Tobit specification to estimate the reduced forms of CS_{ijt} and $DIGIS_{ijt}$. In the second step, we include the error terms $\widehat{v}(CS)_{ijt}$ and $\widehat{v}(DIGIS)_{ijt}$, obtained in the reduced forms.

Since heteroscedasticity is a potential issue in our model, we incorporate the Huber sandwich estimator to obtain a more consistent estimation. The problem of serial correlation is treated by a cluster-robust variance estimator, clustering by country of origin. As the number of countries used to define the bank clusters is low (13 countries), we cannot ensure an asymptotic behaviour. Therefore, to estimate the significance levels of the coefficient of independent variables (Davidson and Flachaire, 2008) and the potential problem of serial correlation, we use wild cluster bootstrap with Rademacher weights. Since some countries have a small number of observations (see Table 1), feasible GLS is more efficient than OLS (Cameron and Miller, 2015).

Results

Descriptive statistics are presented in Table 2, whereas Table 3 shows the estimations based on the four different measures of performance: model 1 includes the price-to-book ratio, model 2 the annual equity return, model 3 the efficiency ratio, and model 4 the ROA.

The coefficients of digitalization ($DIGIS_{ijt}$) and CS (CS_{ijt}) are negative and significant in models 1 and 2, that is, digitalization and CS decrease the two stock market-based performance measures used. However, the coefficients of the interaction term ($DIGIS_{ijt}$*CS_{ijt}) are positive and significant. Thus, both strategies only improve the market-based performances of banks when they occur simultaneously, namely, the financial markets only recognize the value generation of CS and digitalization efforts if they are performed simultaneously. These findings support our hypothesis. In model 3, the coefficients of digitalization ($DIGIS_{ijt}$) and CS (CS_{ijt}) are non-significant. However, the coefficient of the interaction term ($DIGIS_{ijt}$*CS_{ijt}) is negative and significant. Therefore, only those banks that make efforts in CS and digitalization enhance their cost efficiency, which supports our hypothesis.

Finally, in model 4 the coefficients of digitalization ($DIGIS_{ijt}$) and CS (CS_{ijt}) and their interaction are non-significant. This divergent finding can be interpreted as the difficulty of capturing complementarities between intangible assets by short-termed accounting measures of performance (Ogden and Watson, 1999). This contrasts with our previous findings and suggests that the simultaneous involvement in CS and digitalization strategies enhance market-based measures of performance and efficiency, but it fails to deliver an improvement in ROA.

The coefficient of $\widehat{v}(DIGIS)_{ijt}$ is significant in the stock market-based measures models (model 1 and model 2) which enables us to control the endogeneity bias. The conditional numbers of previous models are too high, which may indicate a multicollinearity problem. To estimate model 5, we follow Beaver and Ryan (2000) who distinguish two sources of variation in price-to-book: bias and lags in book value. The bias is controlled by temporal fixed effect, and the lags effects are controlled by the current and six lagged equity returns. To solve potential multicollinearity problems, we have excluded Rf_{jt} and $Growth_{jt}$. The lags included reduce the sample to 387 observations and 60 banks. The findings of model 5 in Table 4 are analogous to those of model 1, which confirms its robustness.

We perform some post-hoc analyses to control for country of origin potential effects. Since our sample is concentrated on US banks (see Table 1), we calculate the dummy variable RW_j, which takes value 0 for the US banks and 1 otherwise, and its interactions $DIGIS_{ijt}$*RW_j, CS_{ijt}*RW_j, and $DIGIS_{ijt}$*CS_{ijt}*RW_j. Models 6, 7, 8 and 9 in Table 5 confirm our previous results since the coefficients of the interactions are not significant. Therefore, the combined effect of CS and digitalization on performance is similar for US and non-US banks.

Conclusions

Our empirical results from a sample of 112 global banks over the period 2003–2016 confirm that the combination of CS and digitalization strategies contributes to banks' market performance and efficiency. Our analysis confirms that the greater the CS-reputation of a bank, the more it can benefit from digital strategies. This is in line with the idea we suggested about the bidirectional nature of information asymmetries between banks and customers. Digitalization reduces information asymmetries in favour of banks since it allows them to predict customer behaviour. However, digitalization boosts information asymmetries on the side of customers. CS contributes to alleviate this problem since it signals reputation and trustworthiness (Hoepner et al., 2016).

Our analysis shows that CS enhances efficiency, in line with prior studies (i.e. Boehe and Cruz, 2010). However, CS on its own does not improve market performance, which

Table 2. Descriptive statistics

Variables	Obs.	Mean	S.D.	Median	Min.	Max.	Skewness	Kurtosis
Price-to-Book	635	1.492	1.040	1.309	0.037	1.543	7.200	109.086
Equity Return	653	0.078	0.311	0.102	−0.858	1.543	0.025	4.535
Efficiency	653	0.662	0.188	0.638	0.186	2.520	3.699	29.172
ROA	653	0.007	0.009	0.008	−0.108	0.045	−4.593	46.680
Asset(bn.US$)	653	123.310	5.650	93.972	2,189	3,647.54	0.143	1.962
ESG	653	54.871	21.970	50.883	15.543	90.998	0.119	1.555
DIGIS	653	0.001	0.002	0.000	0.000	0.020	3.442	16.343
CS	653	0.001	0.045	0.000	0.000	0.470	6.930	58.232
Empl	653	9.647	1.664	9.642	5.298	12.565	−0.160	2.174
ΔEmpl/Asset	653	0.643	16.339	−0.021	−8.130	416.577	25.326	645.101
ΔLoans	653	0.003	0.006	0.002	−0.012	0.038	1.572	8.522
ΔCost	653	0.001	0.084	−0.004	−0.470	0.624	0.863	17.326
TIER-1	653	0.116	0.030	0.116	0.055	0.323	1.154	7.418
NPL	653	0.050	0.126	0.016	0.001	1.018	5.498	36.174

Table 3. Estimates

	Price-to-book Model 1	Equity returns Model 2	Efficiency Model 3	ROA Model 4
$DIGIS_{ijt}$	−11.030****	−8.035****	−2.859	−0.007
CS_{ijt}	−0.464**	−0.491****	0.050	0.001
$DIGIS_{ijt}$*CS_{ijt}	174.860**	245.695**	−65.688***	1.912
ROA_{ijt}	10.088***	2.316**	−4.366***	
$Empl_{ijt}$	−0.091****	−0.004	0.019**	−0.001****
$\Delta Empl/Asset_{ijt}$	−0.000	−0.000	−0.000	−0.000
$\Delta Loans_{ijt}$	15.286*	8.077***	−3.139**	0.048
$\Delta Cost_{ijt}$	−0.374	−0.258**	0.245****	0.030*,****
$Tier1_{ijt-1}$	5.197****	0.820**	−0.559*	−0.012
NPL_{ijt-1}	0.071	0.019	−0.094**	−0.010***
$Growth_{jt}$	−0.031	−0.016	0.024****	0.002***
Rf_{jt}	6.648	−1.785	−5.103****	−0.034
$Mobile_{jt}$	−0.293	−0.027	−0.025	0.000
$\hat{v}(DIGIS)_{ijt}$	0.319*	0.079**	−0.060****	−0.001
Constant	1.799***	−0.085	0.807***	0.015**
Number of observations	635[a]	653	653	653
Banks	109[a]	112	112	112
Max VIF.	6.390	6.380	6.380	6.380
Condition number	35.818	35.818	35.818	34.359
R^2	0.316	0.299	0.168	0.365

Notes: The coefficients are the same for CRVE (Cluster Robust Variance Estimators) and WCB (Wild Cluster Bootstrap) estimates, but the errors are different. These coefficients, robust standards errors for CRV and *p-values* for WCB estimates are not shown in this table but can be obtained from the authors upon request. We include temporal and firm dummies for all estimations. Because $\hat{v}(DIGIS)_{ijt}$ and $\hat{v}(CS)_{ijt}$ are correlated, we have included only $\hat{v}(DIGIS)_{ijt}$.
[a]The availability of data reduces the sample in this model.; ****p < .001; ***p < 0.01; **p < 0.05; *p < 0.1.

could be reflecting that these investments are negatively valued when there is not a joint digitalization strategy. In other words, investors may reward CS investments as long as they fulfil a function of signalling reputation that can be used to overcome the negative effects of digitalization on information asymmetries. This confirms Diebecker and Sommer (2017), who report a null or even positive effect of some CS dimensions on information asymmetries. Therefore, efforts in digitalization and CS are only yielding positive results for those banks making progress in both areas. Moreover, the null impact of digitalization strategies on performance may seem counterintuitive. One reason could rely on the fact that proactive strategies tend to outperform defensive ones (Chakravarthy, 1982). In other words, defensive digitalization strategies developed as a mere reaction to a fierce competitive environment are unable to improve

Table 4. Robustness checks to control bias and lags in book-value

	Price-to-book Model 5
$DIGIS_{ijt}$	0.611
CS_{ijt}	−0.077*
$DIGIS_{ijt}$*CS_{ijt}	136.726****
ROA_{ijt}	−0.061****
$Empl_{ijt}$	−0.000
$\Delta Empl/Asset_{ijt}$	−1.657
$\Delta Loans_{ijt}$	−0.007
$Tier1_{ijt-1}$	0.354**
$\Delta Cost_{ijt}$	0.611
$Growth_{jt}$	
Rf_{jt}	
$Mobile_{jt}$	−0.258
$Equity\ Returns_{ijt}$	0.530****
$Equity\ Returns_{ijt-1}$	0.443****
$Equity\ Returns_{ijt-2}$	0.343****
$Equity\ Returns_{ijt-3}$	0.308****
$Equity\ Returns_{ijt-4}$	0.233****
$Equity\ Returns_{ijt-5}$	0.163****
$Equity\ Returns_{ijt-6}$	0.087****
Constant	1.863***
Number of observations	387
Banks	60
Max VIF.	4.780
Condition number	31.427
R^2	0.688

Notes: Please refer to footnote on Table 3.
****p < .001; ***p < 0.01; **p < 0.05; *p < 0.1.

performance. However, banks that combine their technology investments with other intangible resources such as CS (Sebastian et al., 2017) proactively build a competitive advantage that translates into better performance. Therefore, banks advancing in the digitalization process without engaging in sustainable strategies, hence overlooking the relevance of CS investments, are not able to generate positive performance from their digitalization efforts.

Information asymmetries are a key issue within the banking industry since borrowers have better information about their creditworthiness than the bank (Levine, 2004). These asymmetries originate adverse selection when banks are unable to discriminate risky borrowers that should be penalized with a higher interest rate charge. We argue that digitalization, and in particular data management capabilities, can minimize information asymmetries. Moreover, we posit that these capabilities allow banks to predict customer behaviour (Kerr and Earle, 2013) which is a valuable tool to cross-sell and prevent non-performing-loans. Nevertheless, digitalization entails unintended consequences for firms and individuals (Brenner, 2018; Scholz, 2017). Namely, a digital, branch-less environment, prompts opportunistic threats and vulnerability concerns among clients related to privacy rights. Plus, for those customers that are unwilling and/or unskilled to accept technological changes, digitalization may further deepen the digital divide (Ragnedda and Muschert, 2013). In addition, banks' digital transformation is associated with job displacement that damages their reputation (Wilkinson, 2005).

Since banks subsequently collect and lend money from/to the public, confidence and trust are pivotal (Hoepner et al., 2016). CS-based reputation can potentially mitigate digitalization drawbacks. Therefore, CS and digitalization complement each other, providing a joint effect on performance that exceeds that of each of them individually considered. Our results show that the two concepts are mutually reinforcing. Digitalization empowers clients and extends financial inclusion, which is associated with wellbeing. In turn, CS reputation mitigates opportunistic threats and client vulnerabilities such as privacy rights in a digital context where asymmetric information (data) benefits banks.

Banks' activity has traditionally been viewed as a natural response to asymmetric information and transaction costs (Leland and Pyle, 1977). The apparent implication is that if

Table 5. Robustness checks based on geographical distribution of sample

	Price-to-book Model 6	Equity returns Model 7	Efficiency Model 8	ROA Model 9
$DIGIS_{ijt}$	−16.956****	−10.930****	1.567	−0.044
CS_{ijt}	−0.246****	−0.558****	0.154***	−0.006****
$DIGIS_{ijt}$*CS_{ijt}	217.404****	273.338****	−89.486****	1.292
RW_j	0.234	−0.025	0.056**	−0.003***
$DIGIS_{ijt}$*RW_j	22.516****	13.712	−5.219	−0.375
CS_{ijt}*RW_j	−0.611	0.208	−0.266***	0.016
$DIGIS_{ijt}$*CS_{ijt}*RW_j	−782.510	−686.688	−71.867	17.243
Number of observations	635[a]	653	653	653
Banks	109[a]	112	112	112
Max VIF.	3.550	3.550	3.550	3.550
Condition number	31.792	31.792	31.792	31.792
R^2	0.311	0.299	0.147	0.388

Notes: Please refer to footnote on Table 3.
****p < .001; ***p < 0.01; **p < 0.05; *p < 0.1.

these market failures are diminished, banks will become less important (Allen and Santomero, 2001). However, the financial transformation undergone over the last decades shifts banks from their traditional intermediary role of taking deposits and converting them into loans towards a value-added, commission based range of services which explain banks' lasting relevance. Several years ago Bill Gates stated that 'banking is necessary, banks are not', anticipating fierce competition from non-banks that replicate basic financial services. In this scenario, bringing together digitalization and CS efforts enables banks to react to disruptive, digital-born competitors, be they fintech or tech-giants. Whilst these new entrants possess the technological resources, traditional banks can differentiate themselves by signalling superior reputation for CS.

Our results suggest that CS can successfully strengthen the capacity of banks to meaningfully profit from the opportunities of the digital transformation. These findings complement the 'business case' for CS (e.g. Salzmann et al., 2005). We suggest that the implementation of CS along with digitalization strategies can incorporate, at a firm level, the ethical values needed to complement emergent big data technologies. In this manner, this paper contributes to the nascent literature on data-ethics (Boyd and Crawford, 2012; Richards and King, 2014), where CS can play a significant role in the protection of privacy (Barocas and Nissenbaum, 2014), with relevant political implications.

From a social perspective, since banks play a crucial role in economic development (Levine, 2004), the combination of digitalization and CS can also produce enhanced customer wellbeing. In fact, digital financial services open up relevant opportunities to enhance financial inclusion, leading to mutual prosperity for both banks and society (Forcadell and Aracil, 2017b; Sarma and Pais, 2011).

Finally, our results yield implications for world leaders to tackle these new economic realities. First, we agree with Huotari and Hanemann (2014) on the need to develop new tools to assess renewed financial globalization with the growing significance of newcomers (technological players). Second, although CS has a positive influence on reducing information asymmetries, regulations can also help to overcome these market failures (Levine, 2004). However, we argue that in the digital era, the role of regulatory bodies needs to be focused on protection laws concerning privacy data and its use by technological giants and Internet platforms, other than banks, that base their business model on other areas (e.g. advertising). Success in this urgent task can reduce opportunistic threats and vulnerabilities associated with the amount of data that companies collect from digital sources. In this manner, governments and policy makers can improve social well-being in partnership with private companies. Finally, a new regulatory setting must be established for the different standards of digital financial intermediation. Since digitalization introduces novel financial practices that largely differ from the traditional 'brick-and-mortar' model, a new legal framework must be developed under this new paradigm (Frost et al., 2019; Jones and Knaack, 2019).

Managerial implications can be extended to other sectors as the digitalization-sustainability framework is a common issue across industries. Moreover, the global policy implications are relevant since the cross-roads between digital and sustainable strategies extend beyond the organization, transforming society and influencing market conditions.

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Author Information

Francisco Javier Forcadell is an Associated Professor of Management, Rey Juan Carlos University. He focuses on diverse aspects of CSR, innovation, and corporate strategy. He has published in several top journals (six of them listed in the top 10th percentile of JCR categories), including *Research Policy, Long Range Planning, Journal of World Business, Corporate Social Responsibility and Environmental Management, Journal of Business Ethics, Business Ethics: A European Review, Journal of Economic Surveys*, and *Scientometrics*.

Elisa Aracil is an Assistant professor of Economics, Universidad Pontificia Comillas-ICADE. Her research interests cover finance, digitalization and sustainability. Her work has been published in relevant scientific journals such as *Corporate Social Responsibility and Environmental Management,* and *Business Ethics: A European Review* amongst others.

Fernando Úbeda is an Associated Professor of Finance, Universidad Autónoma de Madrid. He holds a Ph.D. in finance and a Master's in International Business. He has several publications in international business, strategy, technology, and banking. He collaborates with the Spanish State Research Agency.