THE EFFECT OF FINTECH INVESTMENTS ON LISTED BANKS: EVIDENCE FROM AN ITALIAN SAMPLE

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Abstract

This paper analyses whether and how investments in financial technology (FinTech) affect performance, risk, and value of listed Italian banks. This paper tests the effect of return on equity (*ROE*) and capital asset pricing model (CAPM) *Beta* coefficient — and, secondly, of the price-to-book value (*PBV*) ratio, on a sample of 17 Italian listed banks from 2013 to 2019, representing the largest institutions operating in the Italian banking industry. The FinTech variable is declined into two different statuses: digital active banks and digital-focused banks. The study adds useful insights to the positive effects of innovation on banks' value, in a market, like the Italian one, where investments in FinTech have spread in recent years. Controlling for other financial statements and market variables, the presence of FinTech investments does not affect the *CAPM Beta* coefficient, while the relationship is positive and significant with *ROE* for digital active banks only, and with the *PBV* for digital-focused banks. These results confirm a positive effect on performance for banks investing in FinTech, while greater expectations from investors and a positive effect on bank value creation are significant for digital-focused banks only.

Keywords: Bank, FinTech, Performance, Risk, Value

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1. INTRODUCTION

At the end of 2016, the market had one of the highest branch-to-population ratios in Europe and a very low level of online banking penetration. Factors that have discouraged this growth are 1) the small size of banking institutions, which makes it difficult to make large investments such as technology upgrades, and 2) the need for many institutions to restructure their balance sheets and reduce their risk levels following the 2008 and subsequent banking crises, in response to the entry of Basel III (KPMG, 2020).

In recent years, by providing existing financial services in a more efficient, accessible and economical way, innovation in financial technology (FinTech) has forced traditional banks to innovate in order to maintain their competitive level. Increased competitiveness of FinTech solutions compared to traditional banking means in response to crises such as the COVID-19 outbreak (Vasenska et al., 2021).

However, only some banking firms have dedicated financial sources to invest in the digitalization of their business model, with the advisory guidance of FinTech companies or by acquiring those firms through mergers and acquisitions (M&A) operations (Brandl &

Hornuf, 2020; Hornuf, Klus, Lohwasser, & Schwienbacher, 2021), rather than directly investing in FinTech projects in-house. Other studies investigate these relationships (Hung & Luo, 2016), and provide suggestions on how a decision-making approach can be built up (Kou, Olgu Akdeniz, Dinçer, & Yüksel, 2021).

In this paper, traditional banks that have implemented FinTech solutions in their offerings, and not only as a means of increasing efficiency in process delivery, are classified as "digital active". Other banks that were established in the last decade as a response to the rise of FinTech, and that largely base their own businesses on such innovative solutions, are here labelled as "digital-focused".

As reported in the literature review section of this paper, to the authors' knowledge, and for both types of institutions, there are no studies reporting comprehensive empirical evidence on the effects of the implementation of FinTech services inside credit institutions and their effect on bank value. The main purpose of this research is to analyse how technological innovation has affected the banks' ability to perform and create value and, above all, to contribute to the research on whether or not the banks that have addressed this wave of innovation have increased their value, or their profitability, more than proportionally compared to banks that have limited themselves to offering their customers traditional banking services.

In particular, the model developed for the analysis will focus on the Italian context, to deduce whether the value of digital active banks that have invested in digitalization processes is higher than that of incumbents which operate through traditional products and relationships. In Italy, the operating and distribution model of banks is still focused on physical networks and has an insufficient level of digitalization of products and processes. Italian banks offer technological services mainly with regard to the online account component, provided by almost all the banks analysed, and digital lending, which has a very large service growth potential, and was provided at the end of 2019 by only a third of the sample. Digital investment has been characterized in recent years by significant growth rates (Bank of Italy, 2019), meaning that Italy is a suitable geographical area for testing the value effect of FinTech.

The research investigates a sample of 17 Italian listed banks from 2013 to 2019, which represent the largest institutions operating in the industry and the by far largest market share in the country, exploring the influence of FinTech innovation in banking services through the effect on return on equity (*ROE*), on the capital asset pricing model (CAPM) *Beta* coefficient (*Beta*) and on price-to-book value ratio (*PBV*). Controlling for other financial statements and market variables, the attitude towards FinTech projects does not affect the *CAPM Beta* coefficient, while the relationship with *ROE* is positive and significant for digital active banks only, and with the *PBV* for digital-focused banks. These results confirm a positive current performance for traditional banks investing in FinTech, while greater expectations from investors and a positive effect on bank value creation are significant for digital-focused banks only. The results are deliberately independent of the COVID-19 outbreak effects as the most recent year in the analysis is 2019. The study adds useful insights to the positive effects of innovation on prospective banks' value as well as on systematic risk, which appears to not be affected by FinTech, and contributes to other controversial results found in the literature when comparing the banks' risk-taking attitude after approaching FinTech, and other sources of risks, mainly including reputational, operational or cybersecurity factors.

The research can be extended to other countries in which the banking industry is dominated by publicly traded institutions; it is mainly based on hand-collected independent variables, so they require processing financial statements and official press releases published by issuers.

The paper is organized as follows: Section 2 reports the literature review and hypotheses development, Section 3 describes the research design and data, Section 4 provides the results and Section 5 presents the discussion, finally, Section 6 concludes the paper.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. FinTech and banking: A general picture

Past studies have tried to analyse the disruptive effect that digital innovation and the advent of FinTech have had on the traditional banking system, focusing on the growth of technology start-ups and new joiners and using, in most cases, past performance measures. FinTech investments significantly increased after the global financial crisis of 2008–2009, amounting to over $165 billion in the last decade, according to data from Venture Scanner (Imerman & Fabozzi, 2020).

According to a broad literature review by Takeda and Ito (2021), existing financial institutions are incorporating FinTech to improve customer satisfaction as a response to its deterioration following the rise of FinTech companies. Partnering with FinTech companies is an appropriate approach according to research by Ashta and Biot-Paquerot (2018), in addition to Zalan and Toufaily (2017), while Trelewicz (2017) and Lui and Lamb (2018) suggest that financial institutions should consider developing FinTech solutions in-house.

Regarding the effect of bank FinTech investments on business, the following evidence emerges. Siek and Sutanto (2019) studied how banks' business models and profitability have been affected by information systems innovation. The results show that banks have been affected by FinTech payment systems since 2015, with the emergence of new start-ups. Regarding the adoption of FinTech for loan and investments purposes, a positive effect of investments on bank profitability is only documented if the banks are able to be efficient in traditional services as well (Desai, Meena, Vinutha, & Jayakumar, 2019). Furthermore, those kinds of investments can need time to be effective in terms of efficiency and performance, especially when they deeply redefine the bank business model.

In the methodology section, further details are provided on how the impact of FinTech investments on bank value can be analysed through a theoretical approach.

2.2. FinTech, bank value, performance and risk

Li, Spigt, and Swinkels (2017) focused on the reaction of German bank share prices to the rise of FinTech start-ups between 2010 and 2016: a positive relationship emerges between the growth of FinTech investments and M&A deals, and the incumbents share the returns. Zalan and Toufaily (2017), researching the Middle East and North African ecosystems, found that incumbents' preferred strategy to face future disruption is the bank-FinTech collaboration, which will create new value for ecosystem partners and speed up innovation. Hornuf et al. (2021), through qualitative research, analysed the pressure of technology-driven companies offering financial services in the traditional banking sector to modernize their businesses in Canada, France, Germany and the United Kingdom. They found that banks were often investing in small FinTech businesses and the relationship between small FinTech companies and the largest financial institutions generates more value.

Although a study by Dranev, Frolova, and Ochirova (2019) demonstrates initial positive abnormal returns in the stock market due to FinTech M&As, but which turn negative in the long run, recent and more specific evidence from Carlini, Del Gaudio, Porzio, and Previtali (2022), based on a wide sample of EU and US banks, show stock markets' initial negative abnormal market returns that, however, in terms of size are limited and quickly absorbed by the market.

Considering the impact of FinTech bank investments on value, several authors have focused on the retrospective performance of the bank, finding mixed results. Phan, Narayan, Rahman, and Hutabarat (2020) verified the negative influence that financial technologies have on the performance of Indonesian banks, concluding that the rise of FinTech start-ups has significantly negatively affected the return on assets (*ROA*) and *ROE* of the considered sample. In addition, it emerges that more mature, higher-value and state-owned banks are less impacted than newer, lower-capital private banks. In 2007, before the inception of the FinTech revolution, Lin (2007) examined, using a US sample, how information technology could affect banks' value creation, finding a negative relationship between technology and profitability indicators (return on investment (*ROI*), *ROE* and *ROA*). According to research by Liu et al. (2021), the FinTech approach allows a positive and significant impact on *ROE* and nominal interest margin profit, while a positive but non-significant effect on *ROA* was found. Data from China (Chen, You, & Chang, 2021) support the positive and significant impact of FinTech products on the non-financial performance of banks: the perceived usefulness of such products increases customer satisfaction, banks' service quality and employee efficiency, and helps reduce perceived shortcomings associated with the difficulty of use.

Despite it being shown empirically that investments in FinTech contribute to improving banks' total factor productivity (Wang, Xiuping, & Zhang, 2021b), they seem not to be able to guarantee an immediate response in terms of bank performance. Ky, Rugemintwari, and Sauviat (2019) researched with a sample of East African banks what the effects are of the use of virtual deposits on bank profitability: it emerges that this increases bank profitability, but that the effects can be seen in the long term rather than in the short.

The *PBV* expresses the expectations that investors have regarding the value that the bank's management will create for shareholders (Bogdanova, Fender, & Takáts, 2018). Another element that positively influences *PBV* is cross-selling: banks, through multi-business products, are able to intercept customers with other products, which complement the service for which they have turned to the bank (Kamakura, 2008). This evidence leads to our two first hypotheses:

H1: FinTech investments are positively related to future performance, affecting bank value positively.

H2: FinTech investments have no significant effect on bank present performance.

Regarding the risk profile, despite there being a documented positive effect of FinTech on credit risk in the case of Chinese banks (Cheng & Qu, 2020; Bao & Huang, 2021), a survey on Italian credit institutions reported no significant effects on overall kinds, such as strategic, credit and market risk (Bank of Italy, 2019). An extreme value theory (EVT)-based analysis of equity returns by Chaudhry, Ahmed, Huynh, and Benjasak (2022) on data between 1992 and 2019 shows that technology firms bear a higher tail risk compared to financial firms, but are less likely to fall into distress conditions due to shocks in the system. The impact of FinTech innovations on the banks' overall risk is controversial, as some studies (Ashta & Herrmann, 2021) highlight the potential impact of advanced techniques on operational risks as well. Cybersecurity risks are mentioned as a key operational risk factor by Najaf, Mostafiz, and Najaf (2021), who suggest strong cooperation by banks and technology firms in abating such risk. Concerns regarding potentially increasing systemic risks from the implementation of FinTech, and the need for the international cooperation of regulators, are also supported by Vučinić (2020).

The relationship between FinTech solutions and banks' risk-taking is also controversial. Considering a sample of 534 banks from 24 Organization of Islamic Cooperation (OIC) countries, Banna, Hassan, and Rashid (2021) find that a higher degree of FinTech-based financial inclusion leads to intensified risk-taking by banks. According to an empirical study by Wang, Liu, and Luo (2021a), based on observations for the period 2011–2018, there is strong evidence that banks' risk-taking in China was initially exacerbated by the development of FinTech, but subsequently weakened, resulting in a U-shaped trend. Following the above-mentioned mixed results from the literature, the paper's expectation is to find no significant evidence of systematic risk being affected by those investments:

H3: FinTech investments have no significant effect on bank systematic risk.

3. RESEARCH DESIGN

The aim of this empirical research is to test whether and how bank performance and value are affected by FinTech investments. The effect on performance is tested using *ROE* as the measure of performance

(Model 1), the *CAPM Beta* coefficient as for risk (Model 2) and *PBV* as for value (Model 3). Since all three can be potentially affected by the same financial statement and market elements, we use the same explanatory variables for the three models.

$$Y_{jt} = \alpha_1 + \beta_1 FinTech1_{Jt} + \beta_2 FinTech2_{Jt} + \beta_3 Size_{Jt} + \beta_4 Cap_{jt} + \beta_5 Leverage_{jt} + \beta_6 NPL_{Jt} + + \beta_7 Liq_{jt} + \beta_8 ROA_{jt} + \beta_9 CIR_{jt} + \beta_{10} GDP_{jt} + \beta_{11} Inf_{jt} + \partial_t + \epsilon_{jt} \quad (1)$$

where, for bank $j = 1$ to N and time $t = 1$ to T, Y takes the meaning of *ROE* (net income on equity capital) (Model 1), *CAPM Beta* coefficient (Model 2) and *PBV* (price-to-equity capital per share) (Model 3), from the Bloomberg database. Variables are calculated using annual data from the balance sheet and income statement, adding the stock price at the end of the year. The *CAPM Beta* coefficient is calculated using the daily returns of the last two years.

ROE is considered by practitioners to be a good indicator of bank profitability in bank valuation, based on balance sheet data which are always available at least annually. In both dividend-based and excess return valuation models, it is possible to perform decompositions that show how much the value is conditioned by the profitability of the bank itself.

As far as risk is concerned, the *Beta* coefficient is considered: it is the sensitivity of the stock return to changes in the market return representing systemic risk, i.e., the component of risk that cannot be eliminated through portfolio diversification. Among the various components of the cost of capital (CAPM), the *Beta* coefficient is the only element that varies from one bank to another.

The price-to-book value (*PBV*) represents the perception of the market about a bank's health and ability to generate profits. It could be understood as the bank's goodwill, i.e., the greater value that management is able to create given a certain level of assets and liabilities (Bogdanova et al., 2018).

In detail, the theoretical framework in which the three dimensions analysed could be represented can be described through a simple dividend discount model in a steady growth framework (Gordon model):

$$P_0 = \frac{EPS_0(1+g)\cdot payout\ ratio}{r_E - g} \quad (2)$$

where, EPS_0 are earnings per share expected in year 0, *payout ratio* measures the dividend-to-earnings ratio, r_E is the systematic cost of capital, ideally calculated referring to CAPM and g is the expected growth rate. From equation (1) we can replace EPS_0 with $ROE_0 BV_0$, since *ROE = EPS/BV*:

$$P_0 = \frac{ROE_0 BV_0(1+g)\cdot payout\ ratio}{r_E - g} \quad (3)$$

Thus, we can express the stock price on book value of equity:

$$\frac{P_0}{BV_0} = \frac{ROE_1(1+g)\cdot payout\ ratio}{r_E - g} \quad (4)$$

Therefore, bank investments can affect the *PBV* ratio through *ROE*, the cost of equity, the growth rate and the payout ratio. The main goal of the present paper is to understand whether investments in FinTech affect indirectly the *PBV* ratio, through the effect on *ROE* and cost of equity or whether an effect can be linked to growth opportunities/payout ratio.

FinTech1 and *FinTech2* are two dummy variables that take the value of one if the bank invests in FinTech, and zero otherwise. *FinTech1* takes the value of one only if the bank can be classified as "digital active", which typically denotes banks that were established as traditional banks, and later included digital services in their offerings through FinTech investments. *FinTech2* takes the value of one only if the bank can be classified as "digital-focused": a definition that refers to banks established during the last decade in response to the rise of FinTech investments.

Table 1. Degree of digitalization/approach to FinTech

Banks' classification	***Definition***
Traditional banks	Banks that have not significantly invested in FinTech, unless to enhance their own process efficiency.
Digital active (*FinTech1*)	Established as traditional banks, performed substantial investments in FinTech to add digital services in their offerings.
Digital-focused (*FinTech2*)	Banks recently established in response to the rise of FinTech investments.

Investment in FinTech is considered if the bank, through platforms, provides digital services for loans and deposits (instant lending, digital lending, advance payment of invoices), without the need for any physical interaction with the institution. In addition, when a bank offers this type of service, it also uses robo-advisory and big data. This information was hand-collected from the strategic plans, financial statements and official press releases of each institution. In this way the exact year in which banks integrated this type of service could be determined.

In Models 1, 2 and 3, the following control variables from the Bloomberg database were considered, in order to capture both micro and macroeconomic effects: *Size*, the logarithm of total assets; *Cap*, a measure of bank capitalization, which is the shareholder capital on total assets; *Leverage*, the debts on shareholder capital; *NPL*, a measure of credit risk, the non-performing loans on total loans; *Liq*, a measure of liquidity risk, which is equal to loans on medium long-term deposits; *ROA*, which is net income on total assets; *CIR*, the cost-to-income ratio, which is equal to operating costs on revenues; and *Inf*, near inflation report. Lastly, Italian *GDP* growth rate and inflation were collected annually from the World Bank data set and Bank of Italy data, respectively. All the models are estimated through the fix effects (FE) estimator and ∂_t are year fixed effects to control for time-varying heterogeneity. The FE estimator is used because it produces consistent parameters even if bank-specific effects can be linked to other variables.

FinTech investments in the Italian banking sector started growing significantly from 2014, in the case of online deposits, and from 2015, in the case of digital lending. This evidence is confirmed by analysing the presence of FinTech

investments in the sample: the dummy *FinTech* is equal to zero for all the banks in 2013. For this reason, the sample used includes all listed Italian banks with active shares from 2013 to 2019, to have a complete picture of the phenomenon.

4. RESULTS

In Table 2, we provide the descriptive statistics on variables involved in the analysis. Table 3 contains Model 1, 2 and 3 results, respectively.

Table 2. Descriptive statistics

Variable	*Min*	*Max*	*Mean*	*Median*	*Std*
ROE	-0.93200	0.56792	0.06271	0.06236	0.17812
Beta	0.2686	1.6810	1.0813	1.0610	0.2847
PBV	0.04610	7.29130	1.33183	0.66397	1.55997
Size	7.11918	13.66519	10.72170	10.64060	1.58033
Cap	0.03114	12.59944	0.77574	0.06916	2.72352
NPL	0.04426	2.26714	1.24063	1.31555	0.49779
Leverage	0.07353	31.11030	13.88843	13.45874	6.74992
Liq	0.002395	0.93684	0.22733	0.20710	0.17732
ROA	-0.03225	0.90196	0.02757	0.00672	0.09639
CIR	0.11923	0.95863	0.56232	0.57806	0.13598
GDP	-1.84000	1.67000	0.50027	0.78000	0.99370
Inf	0.00000	1.10000	0.53554	0.50000	0.37203

Note: This table provides the summary statistics of the variables used in the two regressions. The sample consists of 17 banks corresponding to 112 observations during the period 2013–2019.

In general, the sample is characterized by a scarce performance (*ROE* at 0.06% level on average) but with a goodwill generation effect on average (*PBV* higher than 1). However, the standard deviation of *PBV* is high, showing a great difference among banks. The mean of *Beta* coefficient is around 1, highlighting the cyclical effect of the bank sector.

The effect on *ROE* can be explained by looking at the other financial variables, like the level of *ROA* and cost-to-income ratio (*CIR*).

Table 3. Bank value and FinTech

	(1)	*(2)*	*(3)*
Intercept	0.7852***	-0.7008	3.4888**
	(0.2429)	(0.5270)	(1.4451)
FinTech1	0.1074**	0.0004	0.3258
	(0.0457)	(0.0992)	(0.2720)
FinTech2	0.0110	-0.0356	0.8644*
	(0.0869)	(0.1884)	(0.5167)
Size	-0.0333***	0.1561***	-0.1936***
	(0.0095)	(0.0206)	(0.0564)
Cap	-0.0033	0.0110	-0.0326
	(0.0065)	(0.0140)	(0.0384)
Leverage	-0.0074**	-0.0059	0.028
	(0.0031)	(0.0067)	(0.0183)
NPL	-0.2098***	0.0902	-1.2005***
	(0.0390)	(0.0845)	(0.2319)
Liq	-0.0134	0.0595	-2.9070***
	(0.1213)	(0.2632)	(0.7215)
ROA	-0.2110	-0.1568	-1.5355
	(0.1818)	(0.3944)	(1.0817)
CIR	-0.0809	0.1808	0.7279
	(0.1191)	(0.2584)	(0.7087)
GDP	0.1514	-0.0847	1.602**
	(0.1237)	(0.2683)	(0.7359)
Inf	0.4838	-0.2061	4.7302
	(0.5716)	(1.2400)	(3.4005)
Time FE	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes
R^2	0.4902	0.5526	0.7647
R^2 adj.	0.3980	0.4717	0.7222
F-value	5.3164	6.8309	17.9742
p-value	0.0000	0.0000	0.0000

*Note: This table shows the FE estimation results on the effect of FinTech on banks' ROE (Model 1), CAPM Beta coefficient (Model 2) and PBV (Model 3), for a sample of 17 banks over the 2013–2019 period. All specifications control for bank individual effects and year-fixed effects. P-values are based on robust standard errors (in brackets). *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.*

Despite the results showing a positive effect of FinTech on performance, the relationship is significant only for *FinTech1* firms (digital active, or traditional banks which added digital services through FinTech investments), while it is not significant for digital-focused (*FinTech2*) firms, supporting *H1* for the latter.

The significance of the *FinTech1* dummy might capture a potential advantage for digital active banks compared to traditional banks, as the former might simply be more proactive towards technological investments and innovations, and as such be able to improve their own current performances compared to the latter.

The relationship was also tested after replacing *ROE* with *ROA* and the *CIR*, and dropping *ROA* and *CIR* from the explanatory variables, respectively (not reported). In any case, the FinTech dummies are non-significant.

The effect on *ROE* is significant only for digital active banks, meaning that we have an effect on current performance.

The findings support *H3* for both digital active and digital-focused banks. According to our research, investments in FinTech do not affect significantly bank systematic risk (see Model 2 results). One key to the results is that a *CAPM Beta* does not represent the best approximation of the banks' risk, since most of the banks in the sample are small and idiosyncratic risk prevails in these banks compared to the systemic risk represented by such a measure.

A third result is that *FinTech2* dummy (digital-focused banks) has a significant and positive effect on *PBV* ratio, supporting *H1* for such corporates. The results highlight that investment in FinTech by digital-focused banks allows them to add on average 0.8644 of stock price for unity of shareholders' capital, confirming that it is an important value driver together with non-performing loans (*NPL*) management and liquidity level. The *PBV* captures, for example, partnerships or M&A deals with innovative FinTech start-ups, as well as the direct undertaking of FinTech investments project, which are usually seen by investors as a growth opportunity for the bank. The use of artificial intelligence to define risk more accurately could look at this as an added value. To verify that *PBV* does not depend on profitability, *ROE* was introduced as an independent variable in the regression on the multiple (not reported), which confirms a non-significant relationship between profitability and *PBV*.

5. DISCUSSION

The effects on current performance (*ROE*), which are significant only for traditional banks that have added digital services thanks to FinTech, may signal that those financial institutions, already prone to innovation, are able to maintain a certain competitive advantage compared to the industry mean, as well as in terms of customer satisfaction (Chen et al., 2021). Such findings would confirm the results from Liu et al. (2021), which support that a FinTech approach brings positive impacts on *ROE* (and nominal interest margin profit).

For digital-focused banks, instead, technological innovation might have a positive impact on profitability in the medium to long term due to the time required for the actual benefits of this digitalization to accumulate. These findings are in line with the results obtained by Vovk, Denysova, Rudoi, and Kyrychenko (2021). Those results still have to be considered in line with Scott, Van Reenen, and Zachariadis (2017), who showed that technological innovation, represented by the introduction of the SWIFT code in the banking environment, has no effect on the same year bank performance. Furthermore, Fuentelsaz, Gómez, and Palomas (2012) highlight that Spanish banks showed positive effects from the adoption of automated teller machines (ATMs) with a time gap of 4–5 years, in terms of operating cost savings and profitability. The number of FinTech start-ups offering very low-cost services is growing, increasing competition against the incumbents, who are forced to decrease their commissions and who, due to their traditionalism, find it difficult to exploit the profit mechanisms of start-ups, whose profitability is particularly linked to advertising on their platforms, as well as scale economies and data collected on customer preferences. In addition, BigTechs are becoming increasingly important, and with the exponential amount of capital at their disposal, the competition could get tough. For traditional banks with limited FinTech orientation, the results are consistent with the findings of Phan et al. (2020), where the current performances of Indonesian banks were significantly impaired by incumbent FinTech innovative solutions.

The Model 2 results confirm the effect of *Leverage* and *NPL* on the *Beta* coefficient (Beltrame, Previtali, & Sclip, 2018). Considering the systematic risk, as highlighted by Porzio, Previtali, and Del Gaudio (2020) research, banks' investments in FinTech have increased especially due to the level of internal risks, such as operational, strategic, and reputational ones. A focus on other sources of risks, such as operational and cybersecurity types, is suggested by studies by Ashta and Herrmann (2021) and Najaf et al. (2021). The impact of FinTech on the adopting banks' risk-taking appears to be limited, as supported by Wang et al. (2021a) and in contrast to the research of Banna et al. (2021).

On the relationship between FinTech investments and bank value, the paper's results might support the view of consistent value creation for digital-focused banks, and appear more in line with Carlini et al. (2022) than with Dranev et al. (2019), for the long-run results reported in their research. The view of Bogdanova et al. (2018), where the *PBV* is a relevant indication of the expectations that investors have regarding the bank's management ability in creating value for shareholders, and of Kamakura (2008) on the positive impact of cross-selling in a bank's *PBV*, seem confirmed.

6. CONCLUSION

The present paper analyses whether and how bank investments in FinTech affect bank performance and value across its essential dimensions. Systematic risk measures are not significantly influenced by the presence of FinTech investments for Italian listed banks, during the period 2013 to 2019. On the contrary, there is a significant and positive relationship respectively between the FinTech variable and the independent one, price-to-book value, for digital-focused corporates, and between FinTech and *ROE* for digital active banks only. Those results imply that bank investments in FinTech, rather than a reduction of systematic risk and cost of equity as a whole, allow: for traditional banks, better performances in terms of current profitability compared to their industry average; for new market entrants, a higher level of value creation is due to the future bank performance expectations.

The Italian banking environment is still rather traditional and the more advanced banks have only started to fully introduce FinTech services since 2017. Italian banks' investments in FinTech grew

from 2019 to 2020 by 200%, reaching an annual expenditure of 316 million (Bank of Italy, 2019).

ROE remains a useful indicator for understanding a company's past performance but does not capture the prospects for the bank's future value. Investments in innovative solutions and the adoption of FinTech in the bank's offerings are associated with an increase in a bank's profitability compared to more traditional peers. Such results may suggest that financial institutions already prone to innovation are able to maintain a certain competitive advantage compared to the industry mean, as well as in terms of customer satisfaction (Chen et al., 2021). Such findings would also confirm the results from Liu et al. (2021), which support that a FinTech approach brings positive impacts on *ROE* (and nominal interest margin profit).

PBV, on the other hand, can be considered a proxy for the bank's prospects growth: a value below one or in the average will suggest the need to evolve the bank's business model. The positive effects on the banks' value analysed in this paper appear more in line with Carlini et al. (2022) than with Dranev et al. (2019), for the long-run results reported in their research. The view of Bogdanova et al. (2018), where the *PBV* is a relevant indication of the expectations that investors have regarding the bank's management ability in creating value for shareholders, and of Kamakura (2008) on the positive impact of cross-selling in a bank's PBV, seem confirmed. *PBV* allows for capturing intangible components that do not influence balance sheet results, such as: expectations in FinTech investment projects, that would consist of higher visibility of the banks to the investors' view and allow digital-focused banks greater access to technology services; the ability to effectively cut operating costs, through lower resourcing in terms of staff and number of branches, which are possible thanks to the evolution of business models due to the use of new technologies favoured by the market; development in the banks' risk assessment, thanks to artificial intelligence, big data and robo-advisory, which make it possible to improve credit quality, reducing non-performing loans and creating early warning systems that signal when the risk reaches significant thresholds, despite other sources of risks (such as reputational and cyber-related) arising; opportunities related to cross-selling on a larger scale, within the bank's own applications, which allow it to offer services from other companies as well.

A step forward in respect of these results should be represented by an extension of the analysis across other countries, as well as enlarging the sample period. Such analysis could be useful in highlighting if banks in several countries answer differently across value dimensions such as current performance, expected performance and the cost of equity. In addition, different kinds of banks could be tested in the sample (i.e., commercial banks versus investments banks and traditional banks versus shadow banks).

Moreover, the FinTech variables adopted by this research are not continuous and do not capture the different amounts of sensitive technological investments undertaken by each single financial institution over time. Such amounts could be meaningfully compared, as an example, to the banks' size and to the industry mean, or to the market share as well.

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APPENDIX

Table A.1. Correlation matrix

	Size	*Cap*	*Leverage*	*NPL*	*Liq*	*ROA*	*CIR*	*GDP*	*Inf*
Size									
Cap	0.16								
Leverage	-0.1	-0.54****							
NPL	0.28**	0.2*	-0.4****						
Liq	-0.15	-0.084	0.26**	-0.6****					
ROA	-0.19*	-0.062	-0.18	-0.073	0.049				
CIR	-0.037	0.093	-0.12	-0.3**	0.1	0.27**			
GDP	-0.05	-0.0059	-0.091	-0.1	0.12	-0.023	0.28**		
Inf	0.015	0.017	-0.093	-0.011	-0.089	0.018	0.27**	0.18	

Note: *, **, *** and **** indicate statistical significance at the 10%, 5%, 1% and 0.1% level, respectively.

Table A.2. Variance inflation factor (VIF) with and without year factor

Variables	*VIF with year factor*			*VIF without year factor*		
	GVIF	*Df*	*GVIF ^ (1/(2 * Df))*	*GVIF*	*Df*	*GVIF ^ (1/(2 * Df))*
Year	6911.269566	6	2.089119			
dummytot (status to *FinTech1* and *FinTech2*)	4.253630	2	1.436117	3.249252	2	1.342598
Size	1.304928	1	1.142334	1.184344	1	1.088276
Cap	1.793997	1	1.339402	1.722546	1	1.312458
Leverage	2.509653	1	1.584188	2.265216	1	1.505053
NPL	2.187121	1	1.478892	2.140974	1	1.463207
Liq	2.687797	1	1.639450	2.433410	1	1.559939
ROA	1.784862	1	1.335987	1.760378	1	1.326792
CIR	1.524741	1	1.234804	1.475732	1	1.214797
GDP	87.798506	1	9.370086	1.160158	1	1.077106
Inf	262.778404	1	16.210441	1.181738	1	1.087078

Note: Considering the analysis of VIF we identified a very high value for the index related to the year factor. Notwithstanding, the sensitivity analysis conducted excluding this variable showed that the model estimates do not change significantly and the interpretation of the results is not affected by the collinearity issue. For this reason, we think we can ignore the problem in this specific case.