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The Dark Side of the Moon? Fintech and Financial Stability

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The Dark Side of the Moon? Fintech and Financial Stability

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Abstract

Rapid advances in digital technology are revolutionizing the financial landscape. The rise of fintech has the potential to make financial systems more efficient and competitive and broaden financial inclusion. With greater technological complexity, however, fintech also poses potential systemic risks. In this paper, I use a novel dataset to trace the development of fintech (excluding cryptocurrencies) and empirically assess its impact on financial stability in a panel of 198 countries over the period 2012–2020. The analysis provides interesting insights into how fintech correlates with financial stability: (i) the impact magnitude and statistical significance of fintech depend on the type of instrument (digital lending *vs*. digital capital raising); (ii) the overall effect of all fintech instruments together turns out to be negative because of the overwhelming share of digital lending in total, albeit statistically insignificant; and (iii) while digital capital raising is estimated to have a positive effect on financial stability in advanced economies, its effect is negative in developing countries. Fintech is still small compared to traditional institutions, but rapidly expanding in riskier segments of the financial sector and creating new challenges for policymakers.

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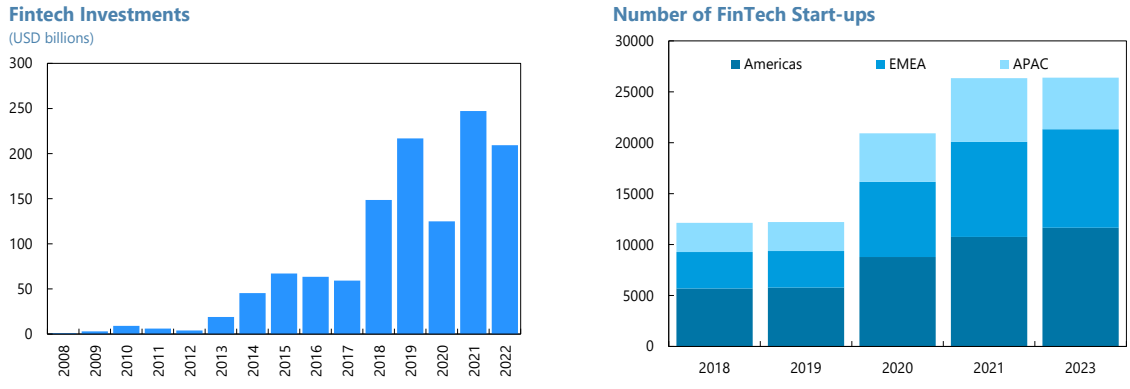
I. INTRODUCTION

Rapid advances in digital technology are certainly revolutionizing the financial landscape, with a global surge in products and companies that employ innovative productivity-enhancing technologies to improve and automate traditional financial services. The total value of start-up investments into fintech—financial technology—worldwide increased from US$1 billion in 2008 to US$247 billion in 2022 (Figure 1). This unabating rise of fintech is creating new opportunities and challenges in the financial services sector—from consumers to financial institutions and policymakers across the globe. It certainly has the transformative potential to make financial systems more efficient and competitive and broaden financial inclusion to the under-served populations. These prospective gains from fintech, however, are conditional on an appropriate regulatory framework. Furthermore, with greater technological complexity and exposure to cybersecurity threats, fintech also poses significant potential systemic risks to financial stability and integrity. In view of that, policymakers need to proactively assess the adequacy of regulatory frameworks for fintech to harness its benefits while mitigating risks to financial stability.

Fintech is still small compared to traditional financial institutions, but rapidly expanding, especially in riskier segments of the financial sector. There is a scarce but growing literature on fintech and its implications for financial stability, with mixed results on whether it is a threat or opportunity (Minto, Voelkerling, and Wulff, 2017; Pantielieieva *et al.*, 2018; Fung *et al.*, 2020; Pieri and Timmer, 2020; Vucinic, 2020; Feyen *et al.*, 2021; Daud *et al.*, 2022; Nguyen and Dang, 2022). On the one hand, fintech could mitigate financial risks by enhancing decentralization and diversification, deepening financial markets, and enhancing efficiency and transparency in the delivery of financial services. On the other hand, fintech could become vulnerable to cybersecurity risks, amplify market volatility, compound aggregate risk-taking and contagious behavior among both consumers and financial institutions, and thereby undermine financial stability. As shown in Figure 2, this ambiguity in the relationship between fintech and financial stability is consistent with the findings of a broader literature on how financial innovation affects financial stability (Merton, 1992; Allen and Gale, 1994; Mishkin, 1999; Caminal and Matutes, 2002;

Figure 1. Fintech Across the World



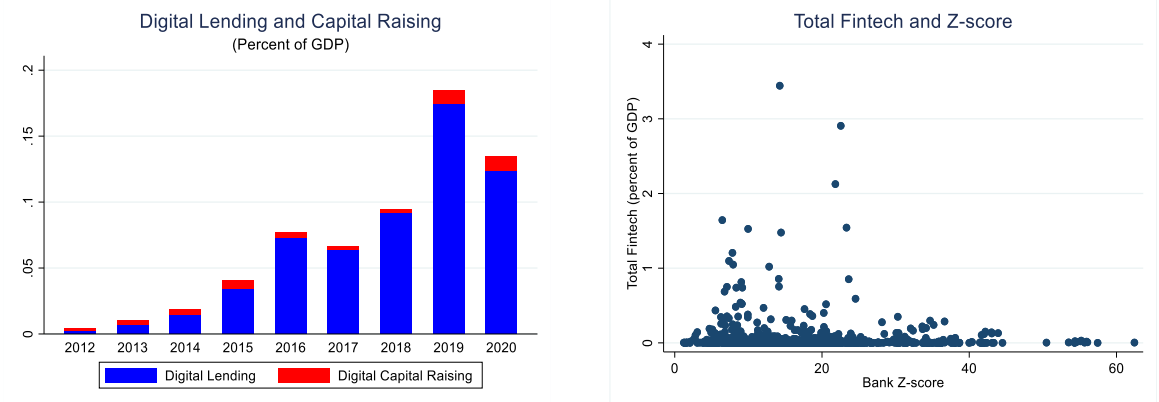
Source: KPMG; BCG; CrunchBase; Statista; author's calculations.

Berger, 2003; Dynan, Elmendorf, and Sichel, 2006; Rajan, 2006; Chou, 2007; Claessens, 2009; Gubler, 2011; Henderson and Pearson, 2011; Gennaioli, Shleifer, and Vishny, 2012; Beck, Georgiadis, and Straub, 2014; Laeven, Levine, and Michalopoulos, 2015; Beck *et al*., 2016; Goetz, 2018).

In this paper, I use a novel cross-country dataset to trace the development of fintech (excluding cryptocurrencies) and conduct an analysis to empirically identify its impact on financial stability in a panel of 198 countries over the period 2012–2020. The analysis provides interesting insights into how fintech correlates with financial stability as gauged by the bank *z-score*. First, the impact magnitude and statistical significance of fintech on financial stability depend on the type of instrument (digital lending *vs*. digital capital raising). While digital lending as a share of GDP has a statistically insignificant negative effect on the *z-score*, digital capital raising as a share of GDP has a large and statistically significant positive effect on financial stability. Second, the impact of all fintech instruments altogether turns out to be negative because of the overwhelming share of digital lending in total, albeit statistically insignificant at conventional levels. Third, while digital capital raising is estimated to have a positive effect on financial stability in advanced economies, its effect remains negative among developing countries. These findings suggest that lending activity facilitated by fintech platforms may involve greater financial risk due to concentration and over-reliance on data-driven algorithms, while capital raising opportunities provided by fintech institutions help decentralize and diversify risk in the financial system, at least in advanced economies. It is also important to take into account that new financial technologies with complex network structures, especially on the lending front, are yet to be tested in economic downturns.

Altogether, the analysis presented in this paper finds that fintech—even at its infancy—could have significant effects on financial stability. While the magnitude and direction of this impact depends on the type of fintech instrument, the overall effect still appears to be statistically insignificant, since the average volume of fintech instruments amounts to 0.1 percent of GDP during the period 2012–2020, compared to 55 percent of GDP in domestic credit to the private sector. Looking forward, however, fast-growing and evolving fintech will have a greater effect on financial stability and consequently important policy implications, especially with increasing

Figure 2. Global Fintech Volume and Financial Stability



Source: CCAF; World Bank; author's calculations.

adaptation by large established institutions and big-tech companies. Not only do fintech firms tend to take on more risks themselves, but they also exert pressure on traditional financial institutions by degrading profitability, loosening lending standards improperly, and increasing risk-taking in operations and transactions (Cornaggia, Wolfe, and Yoo, 2018; FSB, 2019; Baba *et al*., 2020; An and Rau, 2021; Wang, Liu, and Luo, 2021; Ben Naceur *et al*., 2023; Haddad and Hornuf, 2023). Furthermore, as shown by recent developments, systemic financial risks can arise from institutions that individually are not systemically important for the financial system. Therefore, maintaining financial stability and integrity requires strong regulatory institutions, better use of technology in regulation, extensive cross-border coordination and appropriately calibrated prudential regulations for a level playing field and effective monitoring and supervision of traditional and emerging financial institutions (Arner *et al*., 2017; He *et al*., 2017; Magnuson, 2018; Boot, *et al*., 2021; Adrian *et al*., 2023; Bains and Wu, 2023).

The remainder of this paper is structured as follows. Section II provides an overview of the data used in the empirical analysis. Section III describes the econometric methodology and presents the findings. Finally, Section IV summarizes and provides concluding remarks.

II. DATA OVERVIEW

The empirical analysis presented in this paper is based on a panel dataset of annual observations covering 198 countries over the period 2012–2020. The dependent variable is financial stability as measured by the country-level bank *z-score*, which is a widely used measure of "distance to default" (Laeven and Levine, 2009; Demirguc-Kunt and Huizinga, 2010; Beck, De Jonghe, and Schepens, 2013). Most indicators of financial stability focus on the absence of systemic episodes during which the financial system fails to function, but it is also important to capture systemic resilience to stress. To this end, comparing financial buffers against risk, the bank *z-score* provides an explicit measure of the banking system's solvency risk on a continuous basis. The ratio is calculated as follows:

$$z - score_{it} = \frac{(ROA_{it} + CAR_{it})}{\sigma(ROA_{it})}$$

in which ROA_{it}, CAR_{it} and $\sigma(ROA_{it})$ denote return on assets, the capital-asset ratio, and the standard deviation of return on assets, respectively, in country i and time t. Accordingly, the higher the value of *z-score*, the higher the level of financial stability.[2]

The key explanatory variable of interest in this analysis is the volume of fintech transactions (excluding cryptocurrencies) as a share of GDP. The primary fintech data is obtained from the Cambridge Centre for Alternative Finance (CCAF) database, which divides fintech developments into two main categories: (i) digital lending and (ii) digital capital raising (CCAF, 2021; Ran, Rau, and Ziegler, 2022). Digital lending is the volume of lending instruments through digital platforms,

[2] The bank z-score is calculated for country-years with no less than 5 bank-level observations and country-level aggregate figures based on bank-by-bank unconsolidated data from Bankscope and Orbis. Accordingly, it covers financial institutions with banking license, which may exclude some fintech enterprises.

including balance sheet lending, peer-to-peer and marketplace lending, debt-based lending, and invoice trading. Digital capital raising refers to the volume of capital raising instruments through digital platforms, including investment-based crowdfunding such as real estate crowdfunding, and non-investment-based crowdfunding such as donation-based or reward-based crowdfunding. To have a broad measure of fintech developments, I combine digital lending and digital capital raising with other types of fintech (such as micro finance and pension-led funding) and scale it by GDP.[3]

I also introduce a range of control variables, including real GDP per capita, real GDP growth, consumer price inflation, trade openness as measured by the share of exports and imports in GDP, financial development as measured by domestic credit to the private sector as a share of GDP, and government stability and bureaucratic quality as measured by composite indices constructed by the International Country Risk Guide (ICRG). These series are drawn from the World Bank's Global Financial Development (GFD) and World Development Indicators (WDI) databases and the ICRG database.

Descriptive statistics for the variables used in the empirical analysis are provided in Table 1. There is a great degree of dispersion across countries and over time in terms of financial stability. The mean value of the bank *z-score* is 16.8 over the sample period, but it shows significant variation from a minimum of -0.3 to a maximum of 62.4. The main explanatory variable of interest is fintech, measured by (i) digital lending, (ii) digital capital raising and (iii) total including all fintech instruments as a share of GDP. These fintech measures exhibit substantial cross-country heterogeneity during the sample period. With an upward trend in the amount of fintech transactions, the mean value of digital lending is 0.1 percent of GDP with a minimum of nil and a maximum of 3.4 percent. Likewise, the volume of digital capital raising as a share of GDP ranges from a minimum of nil to a maximum of 0.5 percent, with a mean value close to 0 percent over the sample period. Other explanatory variables show analogous patterns of considerable variation across countries, highlighting the importance of economic and institutional differences.

Table 1. Summary Statistics

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Bank z-score	1,427	16.8	9.5	-0.3	62.4
Fintech					
Digital lending	594	0.1	0.3	0.0	3.4
Digital capital raising	1,093	0.0	0.0	0.0	0.5
Total	1,118	0.1	0.2	0.0	3.4
Real GDP per capita	1,738	13,706	18,765	263	167,809
Real GDP growth	1,738	2.2	5.9	-54.2	86.8
Inflation	1,620	5.3	21.1	-4.3	557.2
Trade openness	1,581	90.9	58.4	10.0	442.6
Domestic credit to the private sector	1,528	55.0	43.5	1.1	258.9
Government stability	1,242	7.1	1.1	4.0	11.0
Bureaucratic quality	1,242	2.2	1.1	0.0	4.0

Source: CCAF; GFD; WDI; author's calculations.

[3] The CCAF dataset excludes mobile money and internet banking, which are also operated by traditional financial institutions.

III. Empirical Strategy and Results

The empirical objective of this paper is to investigate the impact of fintech (excluding cryptocurrencies) on financial stability in a large panel of 198 countries over the period 2012–2020. Taking advantage of the panel structure in the data, I estimate the following baseline specification:

$$z_{it} = \beta_1 + \beta_2 fintech_{it} + \beta_3 X_{it} + \eta_i + \mu_t + \varepsilon_{it}$$

where z_{it} denotes financial stability as measured by the logarithm of the *z-score* of the banking system in country i and time t; $fintech_{it}$ represents (i) the volume of digital lending as a share of GDP, (ii) the volume of digital capital raising as a share of GDP, or (iii) the volume of all fintech instruments as a share of GDP[4]; X_{it} represents a vector of control variables including the logarithm of real GDP per capita, real GDP growth, inflation, trade openness, domestic credit to the private sector, and measures of government stability and bureaucratic quality. The η_i and μ_t coefficients denote the time-invariant country-specific effects and the time effects controlling for common shocks that may affect financial stability across all countries in a given year, respectively. ε_{it} is the idiosyncratic error term. I account for possible heteroskedasticity, autocorrelation and cross-sectional dependence within the data by using the Driscoll-Kraay (1998) standard errors, which are particularly robust in a panel with a shorter time dimension.

The empirical analysis provides interesting insights into how fintech endeavors affect financial stability across countries and over time. The impact magnitude and statistical significance of fintech on financial stability varies according to the type of instrument (digital lending *vs*. digital capital raising) when the model with control variables is estimated for the entire sample of countries. As presented in Table 2, the estimated coefficient on the volume of digital lending as a share of GDP in column [1] has a statistically insignificant negative effect on financial stability as gauged by the bank *z-score*, whereas the coefficient on the volume of digital capital raising as a share of GDP in column [2] is positive and statistically highly significant. In other words, an increase in digital lending is associated with a reduction the bank *z-score* and thereby an increase in the risk of financial instability. On the other hand, an increase in digital capital raising is associated with strengthening financial stability—with a greater magnitude compared to digital lending. The overall impact of fintech including all instruments in column [3], however, appears to be negative and statistically insignificant because of the overwhelming share of digital lending in the total amount of fintech instruments. These findings suggest that lending activity facilitated by fintech platforms may involve greater financial risk due to concentration and over-reliance on data-driven algorithms, while capital raising opportunities provided by fintech institutions help decentralize and diversify risk in the financial system.

For robustness and to obtain a better understanding of how the level of economic development influences the impact of fintech on financial stability, I estimate the model separately for different

[4] The results remain broadly unchanged when I estimate the model using the volume of digital lending or capital raising on a per capita basis.

income groups—advanced economies (in Table 3) and developing countries (in Table 4).[5] This disaggregation reveals striking differences in how fintech developments affect financial stability in advanced and developing economies. First, the impact of fintech on the bank *z-score* becomes statistically insignificant across all specifications when the model is estimated for country subsamples, which have lower number of observations. Second, the impact of digital lending on financial stability is negative in both advanced and developing countries. Third, the impact of digital capital raising on the *z-score* is positive in advanced economies, but negative in developing countries. As a result, the overall effect of fintech (including all instruments) becomes positive in advanced economies, but still remains negative in developing countries, albeit still statistically insignificant. In other words, capital raising facilitated by fintech platforms does not appear to strengthen financial stability through decentralization and diversification risks in developing countries.

Table 2. Fintech and Financial Stability: All Countries

	[1]	[2]	[3]
Digital lending	-0.071		
	[0.041]		
Digital capital raising		1.433***	
		[0.436]	
Total fintech			-0.052
			[0.073]
Real GDP per capita	-0.116***	-0.080***	-0.074***
	[0.026]	[0.016]	[0.018]
Real GDP growth	0.010***	0.007	0.007
	[0.004]	[0.006]	[0.005]
Inflation	-0.012***	-0.001***	-0.001***
	[0.002]	[0.000]	[0.000]
Trade openness	0.000	0.001	0.001
	[0.001]	[0.000]	[0.000]
Domestic credit to the private sector	0.004***	0.003***	0.002***
	[0.000]	[0.000]	[0.000]
Government stability	0.025***	0.025***	0.025***
	[0.009]	[0.010]	[0.009]
Bureacratic quality	0.147***	0.092***	0.087***
	[0.052]	[0.013]	[0.013]
Number of observations	496	778	796
Number of countries	98	116	116
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
R^2	0.15	0.19	0.18

Note: The dependent variable is financial stability as measured by the country-level bank z-score. Driscoll-Kraay standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Source: Author's estimations.

[5] As an additional robustness check, I estimate the model for the pre-pandemic period and obtain similar results, which are available upon request.

With regards to control variables, I obtain consistent and intuitive estimation results. The level of real GDP per capita is inversely correlated with the bank *z-score*, suggesting that the level of financial stability tends to be lower in higher income countries. However, disaggregated estimations show that the coefficient on real GDP per capita is positive in advanced economies, but negative in developing countries. In other words, the relationship between income and financial stability is complex as economies develop over time. This is consistent with the stabilizing effect of real GDP growth across all countries, while inflation is found to have a significant negative impact on financial stability. Trade openness—a measure of international economic integration and development—does not appear to have statistically significant effect on the bank *z-score*, except in the case of advanced economies where it has a marginal positive impact. The overall level of financial development as measured by domestic credit to the private sector as a share of GDP is an important factor in determining cross-country differences in financial stability. The coefficient on financial development indicates a strong and statistically

Table 3. Fintech and Financial Stability: Advanced Economies

	[1]	[2]	[3]
Digital lending	-0.347		
	[0.132]		
Digital capital raising		3.483	
		[2.232]	
Total fintech			0.211
			[0.203]
Real GDP per capita	0.203	0.318***	0.296**
	[0.148]	[0.074]	[0.102]
Real GDP growth	0.007	0.008	0.002
	[0.003]	[0.007]	[0.008]
Inflation	-0.038	-0.122***	-0.100***
	[0.036]	[0.038]	[0.021]
Trade openness	0.000*	0.001*	0.001*
	[0.000]	[0.000]	[0.001]
Domestic credit to the private sector	0.003***	0.003***	0.002**
	[0.001]	[0.001]	[0.001]
Government stability	0.021	0.019	0.002
	[0.019]	[0.028]	[0.020]
Bureacratic quality	0.154	0.020	0.032
	[0.062]	[0.044]	[0.028]
Number of observations	216	258	268
Number of countries	33	34	34
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
R^2	0.28	0.18	0.14

Note: The dependent variable is financial stability as measured by the country-level bank z-score. Driscoll-Kraay standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Source: Author's estimations.

significant positive relationship with the *z-score* across all countries. Finally, I introduce a series of institutional and political variables, which have the expected effects on financial stability. Both measures of government stability and bureaucratic quality strengthen financial stability, with greater statistical significance in developing countries.

Table 4. Fintech and Financial Stability: Developing Countries

	[1]	[2]	[3]
Digital lending	-0.029		
	[0.049]		
Digital capital raising		-5.468	
		[5.424]	
Total fintech			-0.063
			[0.042]
Real GDP per capita	-0.124*	-0.048***	-0.043
	[0.045]	[0.014]	[0.022]
Real GDP growth	0.006	0.006	0.008
	[0.004]	[0.007]	[0.007]
Inflation	-0.015***	-0.001***	-0.001***
	[0.004]	[0.000]	[0.000]
Trade openness	0.001	0.001	0.001
	[0.001]	[0.001]	[0.001]
Domestic credit to the private sector	0.003***	0.003***	0.003***
	[0.000]	[0.001]	[0.001]
Government stability	0.047***	0.027	0.021
	[0.015]	[0.014]	[0.013]
Bureacratic quality	0.103***	0.127***	0.120
	[0.028]	[0.014]	[0.026]
Number of observations	280	520	528
Number of countries	65	82	82
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
R^2	0.09	0.07	0.07

Note: The dependent variable is financial stability as measured by the country-level bank z-score. Driscoll-Kraay standard errors are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Source: Author's estimations.

IV. Conclusion

Rapid advances in digital technology are undoubtedly transforming the financial landscape, with a global surge in products and companies that employ innovative technologies to improve and automate traditional financial services. The total value of investments into fintech—financial technology—worldwide increased from US$1 billion in 2008 to US$247 billion in the first half of 2023. This unabating rise of fintech is creating new opportunities and challenges for the financial sector—from consumers to financial institutions and regulators. It has the transformative potential to make financial systems more efficient and competitive and broaden financial inclusion to the under-served populations. However, with greater technological complexity and

exposure to cybersecurity threats, fintech also poses significant potential system-wide risks to financial stability and integrity. In this context, policymakers need to proactively assess the adequacy of regulatory frameworks for fintech to harness its benefits while mitigating risks to financial stability.

Fintech is still small compared to traditional financial institutions in many countries, but developing fast, especially in riskier business segments. There is a scarce but growing literature on fintech and its implications for financial stability, with mixed results on whether it is a threat or opportunity. On the one hand, fintech could mitigate risks to financial stability by enhancing decentralization and diversification, deepening financial markets, and enhancing efficiency and transparency in the delivery of financial services. On the other hand, fintech could become vulnerable to cybersecurity risks, amplify market volatility, increase risk-taking and contagious behavior among both consumers and financial institutions, and thereby undermine financial stability. This ambiguity in the relationship between fintech and financial stability is consistent with the findings of a broader literature on how financial innovation affects macro-financial stability.

In this paper, I use a novel cross-country dataset to trace the development of fintech (excluding cryptocurrencies) and conduct an analysis to empirically identify its impact on financial stability in a panel of 198 countries over the period 2012–2020. The analysis provides interesting insights into how fintech correlates with financial stability as gauged by the bank *z-score*. First, the impact magnitude and statistical significance of fintech on financial stability depends on the type of instrument (digital lending *vs*. digital capital raising). While digital lending as a share of GDP has a statistically insignificant negative effect on the *z-score*, digital capital raising as a share of GDP has a large and statistically significant positive effect on financial stability. Second, the impact of all fintech instruments altogether turns out to be negative because of the overwhelming share of digital lending in total, albeit statistically insignificant at conventional levels. Third, while digital capital raising is estimated to have a positive effect on financial stability in advanced economies, its effect remains negative among developing countries. These findings suggest that lending activity facilitated by fintech platforms may involve greater financial risk due to concentration and over-reliance on data-driven algorithms, while capital raising opportunities provided by fintech institutions help decentralize and diversify risk in the financial system, at least in advanced economies. It is also important to take into account that new financial technologies with complex network structures, especially on the lending front, are yet to be tested in economic downturns.

Altogether, the analysis presented in this paper finds that fintech—even at its infancy—could have significant effects on financial stability. While the magnitude and direction of this impact depends on the type of fintech instrument, the overall effect still appears to be statistically insignificant, since the average volume of fintech instruments amounts to 0.1 percent of GDP during the period 2012–2020, compared to 55 percent of GDP in domestic credit to the private sector. Looking forward, however, fast-growing fintech will have a greater effect on financial stability and consequently important policy implications, especially with increasing adaptation by

large established institutions and big-tech companies.[6] Not only do fintech firms tend to take on more risks themselves, but they also exert pressure on traditional financial institutions to engage in riskier operations and transactions.

As shown by recent developments, systemic financial risks can arise from institutions that individually are not systemically important for the financial system. Maintaining financial stability and integrity requires strong regulatory institutions, better use of technology in regulation, extensive cross-border coordination and appropriately calibrated prudential regulations for a level playing field and effective monitoring and supervision of traditional and emerging financial institutions. Therefore, policymakers across the world must consider modernizing legal principles and macroprudential policies, as well as expanding the scope of existing regulations, in order to prevent a build-up of systemic risks in the financial sector by fast-growing fintech. Furthermore, given the international nature of fintech, effective supervision requires greater collaboration and coordination in developing common standards and regulatory principles.

[6] The entry of big-tech firms into the financial sector, especially at a global scale, may require more entity-based regulation (Crisanto, Ehrentraud, and Fabian, 2021; Restoy, 2021).

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