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The Emergence of the Global Fintech Market: Economic and Technological Determinants

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The Emergence of the Global Fintech Market: Economic and Technological Determinants

Abstract

We investigate the economic and technological determinants inducing entrepreneurs to establish ventures with the purpose of reinventing financial technology (fintech). We find that countries witness more fintech startup formations when the latest technology is readily available and people have more mobile telephone subscriptions. Furthermore, the available labor force has a positive impact on the development of this new market segment. Finally, the more sound the financial system, the lower the number of fintech startups in a country. Overall, the evidence suggests that fintech startup formation need not be left to chance, but active policies can influence the emergence of this new sector.

JEL Classification: L26, K2, O3

Keywords: Fintech, Entrepreneurship, Startups, Financial institutions

1. Introduction

Why do some countries have more startups intended to change the financial industry through innovative services and digitalization than others? For example, in certain economies there has been a large demand for financial technology (fintech) innovations, while other countries have made a more benevolent economic and regulatory environment available. In this paper, we investigate several economic and general technological determinants that have encouraged fintech startup formations in 64 countries. We find that countries witness more fintech startup formations when the latest technology is readily available, capital markets are well-developed, and people possess more mobile telephone subscriptions. Furthermore, we show that the available labor force has a positive impact on the fintech industry. Finally, we find that the more sound the financial system, the lower the number of fintech startups in the respective country.

Prior research on fintech mostly focuses on specific fintech sectors. In the area of crowdlending, scholars have analyzed the geography of investor behavior (Lin and Viswanathan, 2015), the likelihood of loan defaults (Serrano-Cinca et al., 2015; Iyer et al., 2016), and investors' privacy preferences when making an investment decision (Burtch et al., 2015). In equity crowdfunding and reward-based crowdfunding, researchers have investigated the dynamics of success and failure among crowdfunded ventures (Mollick, 2014), the determinants of funding success (Ahlers et al., 2015; Vulkan et al., 2016), and the regulation of equity crowdfunding (Hornuf and Schwienbacher, 2016). More generally, Bernstein et al. (2016) investigate the determinants of early-stage investments on AngelList. They find that the average investor reacts to information about the founding team, but not startup traction or existing lead investors.

Recently, scholars have also investigated platform design principles and risk and regulatory issues related to virtual currencies such as Bitcoin or Ethereum (Böhme et al., 2015; Gandal and Halaburda, 2016). Others have analyzed social trading platforms (Doering et al., 2015), robo-advisors (Fein, 2015), and mobile payment and e-wallet services (Mjølsnes and Rong, 2003; Mallat et al., 2004, Mallat, 2007). To date, only a few studies have investigated the fintech market in its entirety. Dushnitsky et al. (2016) provide a comprehensive overview of the European crowdfunding market and conclude that legal and cultural traits affect crowdfunding platform formation. Cumming and Schwienbacher (2016) examine venture capitalist investments in fintech startups around the world. They attribute venture capital deals in the fintech sector to the differential enforcement of financial institution rules among startups versus large established financial institutions after the financial crisis.

In this paper, we investigate the formation of fintech startups more generally, rather than focusing on one particular fintech business model. In line with the classic value chain of a traditional bank, we categorize the fintech startups into four different types of startups: those that engage in *financing*, *asset management*, *payment*, and *other* business activities. The category financing entails, for example, startups that provide crowdfunding, crowdlending, and factoring solutions. We classify fintech startups as asset management companies if they offer services such as robo-advice, social trading, or personal financial management apps or software. Furthermore, various different business models provide new and innovative payment solutions, such as mobile payment systems, e-wallets, or crypto currencies. Finally, a bulk of fintech startups offer investor education and training, innovative background services (e.g., near-field communication systems, authorization services), white-label solutions for various business models, or other technical advancements classified under other fintech startups.

The remainder of the paper proceeds as follows: Section 2 introduces our hypotheses. In Section 3, we describe the data and introduce the variables used in the quantitative analysis. Section 4 presents the descriptive and multivariate results. Finally, Section 5 summarizes our contribution.

2. Hypotheses

To derive testable hypotheses regarding the drivers of fintech startup formations, we regard fintech innovations and the resulting startups as the outcome of supply and demand for this particular type of entrepreneurship in the economy. The demand for fintech startups is the number of entrepreneurial positions that can be filled by fintech innovations in an economy (Thornton, 1999; Choi and Phan, 2006). If the business model and services provided by the traditional financial industry, for example, are essentially obsolete, there might be a larger demand for new and innovative startups. The supply of fintech startups, in contrast, consists of the entrepreneurs who are ready to undertake self-employment (Choi and Phan, 2006). Such a supply might be driven by a large number of investment bankers who lost their jobs after the financial crises and are now eager to use their finance skills in a related and promising financial sector.

First, we conjecture that the higher the demand for fintech startups, the more developed the traditional capital market is. This hypothesis works through two channels. As in any other startup, fintech startups need sufficient financing to develop and expand their business models. If capital markets are well-developed, entrepreneurs have better excess to the capital required to fund their business. Although small business financing traditionally does not take place through regular capital markets, fintech startups might be eligible to receive funds from incubators or

accelerators established by the traditional financial sector.[1] However, such programs have mostly been established by large players located in well-developed capital markets. Moreover, Black and Gilson (1999) note that active stock markets help venture capital and, thus, entrepreneurship to prosper, because venture capitalists can exit successful portfolio companies through initial public offerings. Active stock markets might therefore have a positive effect on fintech startup formations.

In the case of firms that aim to revolutionize the financial industry, a well-developed capital market might also prompt demand for entrepreneurship simply because a larger financial market also offers greater potential to change existing business models through innovative services and digitalization. If the financial sector is small, not much can be changed through the introduction of innovative business models. Thus, for a well-developed but technically obsolescent financial sector, there are more entrepreneurial positions that can be filled by fintech innovators. We therefore hypothesize the following:

Hypothesis 1: Fintech startup formations occur more frequently in countries with well-developed capital markets.

A second driver of fintech demand is the extent to which the latest technology is available in an economy so that fintech startups can build their business models on these technologies. Technical advancements are among the most important drivers of entrepreneurship (Dosi, 1982; Arend, 1999), because technological revolutions generate opportunities that may be further developed by entrepreneurial firms (Stam and Garnsey, 2007). Technological changes enable new practices and business models to emerge and, in the case of fintech startups, disrupt the traditional financial

[1] See, for example, the Main Incubatur from German Commerzbank AG (https://www.main-incubator.com), the Barclays Accelerator in the UK (http://www.barclaysaccelerator.com), or the US-based J.P. Morgan In-House Incubator (https://www.jpmorgan.com/country/US/en/in-residence).

services sector. Such technology-driven changes have in the past occurred with the move from banking branches to ATM machines and from ATM machines to telephone and online banking (Singh and Komal, 2009). Moreover, modern computer-based technology has widely been used in financial markets through the implementation of trading algorithms (Government Office for Science, 2015). Fintech startups largely rely on advanced new technologies to implement faster payment services, to offer easy operations to their customers, to improve the sharing of information, and generally to cut the costs of banking transactions.

Hypothesis 2: Fintech startup formations occur more frequently in countries where the latest technology is readily available.

A third factor on the demand side of fintech startup formations concerns the soundness of banks. The sudden upsurge of fintech startups can be partly attributed to the 2008 global financial crisis. The financial crisis may have fostered the demand for fintech startups for several reasons. There is a widespread lack of trust in banks after the crisis. Guiso et al. (2013) investigate customers' trust in banks during the financial crisis and find that the lack of trust also led to strategic defaults on mortgatges, possibly initiating a vicious circle of customer distrust, defaults on morgages, even less sound banks, and again more customer distrust. Fintech startups, which largely have a clean record, might benefit from the lack of confidence in traditional banks and break the vicious circle of distrust and reduced financial soundness. In addition, the financial crisis increased the cost of debt for many small firms, and in some cases banks stopped lending money to businesses altogether, forcing them to contend with refusals on credit lines or bank loans (Schindele and Szczesny, 2016). Fintech startups in the area of crowdlending, crowdfunding, and factoring aim to fill this gap. The demand for such startups should be particularly high in countries that have extensively suffered from the financial crises and where the banking sector is less sound. Finally,

some of the fintech business models are based on exemptions from securities regulation and would not work under the somewhat more strict securities regulation that applies to large firms (Hornuf and Schweinbacher, 2016). Stringent financial regulation was the outcome of the spread of systemic risk to the financial system (Brunnermeier et al., 2012). Thus, economies with a more fragile banking sector and stricter regulation should see more fintech startup formations that use the existing exemptions from banking and securities laws.

Hypothesis 3: Fintech startup formations occur more frequently in countries with a more fragile financial sector.

The fourth factor on the demand side concerns the effect of mobile telephone subscriptions on fintech startup formations. The almost inconceivable growth in mobile and smartphone usage is placing digital services in the hands of consumers who previously could not be reached, delivering richer, value-added experiences across the globe. Mobile payment services differ across regions and countries. Many users are registered in developing countries where financial institutions are difficult to access (Ernst & Young, 2014). In emerging countries, mobile money has been used as a replacement to formal financial institutions, and as a result mobile money penetration now outstrips bank accounts in several emerging countries (GSMA, 2015; PricewaterhouseCoopers, 2016). At the same time, new technology has enabled fintech startups in developed countries to disrupt established players and accelerate change. Technologies such as near-field communication, QR codes, and Bluetooth Low Energy are being used for retail point-of-sale and mobile wallet transactions, transit payments, and retailer loyalty schemes (Ernst & Young, 2014). We argue that the higher the number of mobile telephone subscriptions, the higher the supply of fintech startups, as individuals who are seeking entrepreneurial activity based on these technologies have more opportunities to succeed.

Hypothesis 4: Fintech startup formations occur more frequently in countries with more mobile telephone subscriptions.

Fifth, on the supply side we consider the role of labor markets in fintech startup formations. In general, we assume that a rich and varied supply of labor has a positive influence on fintech startup formations. Empirical evidence supports the argument that the population size is a source of entrepreneurial supply, in the sense that countries experiencing population growth have a larger portion of entrepreneurs in their workforce than populations not experiencing growth (International Labour Organization, 1990). To evaluate the influence of the supply of labor on fintech startup formations, we account for the size of the labor force and argue that the larger the labor market, the higher the potential number of entrepreneurs who are ready to undertake self-employment.

Hypothesis 5: Fintech startups are more frequent in countries with a larger labor market.

Sixth, on the supply side we consider the impact of the unemployment rate on fintech startup formations. The decision to become an entrepreneur is mostly based on the income choice (Blau, 1987; Evans and Jovanovic, 1989; Evans and Leighton, 1990; Blanchflower and Meyer, 1994). Economies with a low unemployment rate are associated with a higher mobility between employment and self-employment because entrepreneurial failure will not be punished by unemployment later on (Choi and Phan, 2006).

Hypothesis 6: Fintech startup formations are more frequent in countries with a lower unemployment rate.

3. Data and Method

Our main data source is the CrunchBase database, which contains detailed information on fintech startup formations and their financing. The database is assembled by more than 200,000 company contributors, 2,000 venture partners, and millions of web data points[2] and has recently been used in financial articles (Bernstein et al., 2016; Cumming et al., 2016). We retrieved the data used in our analysis on December 9, 2015. Because CrunchBase might collect some of the information with a time lag, the observation period in our sample ends on December 31, 2014. Overall, we identified 2,849 fintech startups for the relevant sample period. To analyze the economic and technological determinants that influence fintech startup formations, we collapsed the information into a panel dataset that consists of 690 observations given our 10-year observation period from 2005 to 2014 covering 69 countries (see Appendix Table A1 for a list of countries in the dataset).[3]

In our empirical model, we consider five dependent variables: the number of fintech startup formations in a given year and country and the number of fintech startup formations in a given year and country for each of the four categories we identified previously—*financing*, *asset management*, *payment*, and *other* business activities. Because we measure the dependent variable as a count variable and because its unconditional variance suffers from overdispersion, we decided to estimate a negative binomial regression model. In particular, we estimate a random effects negative binomial (RENB) model,[4] which allows us to remove time-invariant

[2] See https://about.crunchbase.com.
[3] Because of data limitations in our explanatory variables and given that we use a lag of one year, our sample reduces to the period from 2006 to 2013. However, this is precisely the period when the fintech market emerged in most countries.
[4] See York and Lenox (2014) or Dushnitzky et al. (2016) on the appropriateness of using the RENB model in a similar context.

heterogeneity from fintech startup formations, such as the existence of large financial centers or startup ecosystems for high-tech innovation (e.g., Silicon Valley in California). In our baseline specification, we estimate the following RENB model:

$$\Pr(y_{i1}, y_{i2}, ..., y_{iT}) = F(GDP\ per\ capita_{i,t-1} + commercial\ bank\ branches_{i,t-1} + VC\ financing_{i,t-1} + latest\ technology_{i,t-1} + internet\ penetration_{i,t-1} + government\ tech\ procurement_{i,t-1} + soundness\ of\ banks_{i,t-1} + investment\ profile_{i,t-1} + mobile\ telephone\ subscriptions_{i,t-1} + labor\ force_{i,t-1} + unemployment\ rate_{i,t-1} + new\ startup\ formation_{i,t-1} + law\ and\ order_{i,t-1} + strength\ of\ legal\ rights_{i,t-1} + cluster\ development_{i,t-1}),$$

where y is the number of fintech startup formations in country i and year t and F(.) represents a negative binomial distribution function as in Baltagi (2008).

For our independent variables, we employ different databases that provide country-year variables to construct a panel. To test hypothesis 1, whether well-developed capital markets positively affect the frequency of fintech startup formations, we include the *GDP per capita*, the number of *commercial bank branches*, and the extent of *VC financing* at the country-year level. Yartey (2008) suggests that income level is a good measure of capital market development. We therefore include the natural logarithm of *GDP per capita*, which came from the World Development Indicators database. To capture the physical presence of banks, which traditionally allow customers to conduct various types of transactions, we employ the variable *commercial bank branches* per 100,000 adult population extracted from the International Monetary Fund Financial Access Survey. Furthermore, to measure the development of the venture capital market, we calculate the variable *VC financing* using the data retrieved from the CrunchBase database. We

construct *VC financing* as the natural logarithm of the total amount of VC funding of all the firms available in the CrunchBase database excluding the fintech startups used in our analysis over the GDP per capita at the country level.[5]

Next, to test hypothesis 2, whether the availability of the latest technology has a positive impact on fintech startup formations, we include the variables *latest technology*, *Internet penetration*, and *government tech procurement*. We retrieved the variable *latest technology* from the World Economic Forum Executive Opinion Survey at the country-year level. It is constructed from responses to the survey question from the Global Competitiveness Report Executive Opinion Survey: "In your country, to what extent are the latest technologies available?" (1 = *not available at all*, 7 = *widely available*). We further account for the *Internet penetration* in the countries studied in our analyses. The data is based on surveys carried out by national statistical offices or estimates based on the number of Internet subscriptions. Internet users refer to people using the Internet from any device, including mobile phones, during the year under review. In our analyses, we use the percentage of Internet penetration at the country-year level retreived from the World Telecommunication/ICT Development report and database. To capture the level of government involvement in technology fostering in a specific country, we use the variable *government tech procurement* retrieved from the World Economic Forum Executive Opinion Survey at the country-year level. The variable is constructed from responses to the survey question from the Global Competitiveness Report Executive Opinion Survey: "In your country, to what extent do government purchasing decisions foster innovation?" (1 = *not at all*, 7 = *to a great extent*).

[5] For the calculation, see Félix et al. (2013).

Furthermore, to test hypothesis 3, whether the soundness of the financial system affects fintech startup formations, we include the variables *soundness of banks* and *investment profile*. We retrieved the data measuring *soundness of banks* from the World Economic Forum Executive Opinion Survey at the country-year level. The variable is constructed from responses to the survey question from the Global Competitiveness Report Executive Opinion Survey: "How do you assess the soundness of banks?" (1 = *extremely low – banks may require recapitalization*, 7 = *extremely high – banks are generally healthy with sound balance sheets*). We retrieved the data measuring *investment profile* from the International Country Risk Guide (ICRG) database at the country-year level. We calculate the *investment profile* variable on the basis of three subcomponents: contract viability, profits repatriation, and payment delays. Each subcomponent ranges from 0 to 4 points. A score of 4 points indicates very low country risk and a score of 0 very high country risk.

To test hypothesis 4, we include *mobile telephone subscriptions* and assess the extent to which more people having access to mobile phones affects fintech startup formations. We retrieved the data from the World Telecommunication/ICT Development report and database at the country-year level. The variable measures the number of mobile telephone subscriptions per 100 adult population. To test hypothesis 5, which investigates the extent to which the size of the labor force affects fintech startup formations, we include the variable *labor force*, which we extracted from the World Development Indicators database. The variable is the natural logarithm of the total labor force, which comprises people ages 15 and older who meet the International Labour Organization definition of the economically active population. To test hypothesis 6, whether the unemployment rate affects fintech startup formations, we use the variable *unemployment rate* as a percentage of the total labor force extracted from the World Development Indicators database.

To control for the entrepreneurial environment in a particular economy, we also control for the total number of *new startup formations*. This variable comes from the CrunchBase database and measures the number of new startups created according to CrunchBase in a given year and country. Furthermore, we use the variables *law and order* from the ICRG database to capture the efficiency of the legal system in a country, which might affect startup formations in general. The index of *law and order* runs from 0 to 6, with higher values indicating better legal systems. To control for the strength of law and institutions, we employ the *strength of legal rights* index, which we collected from the World Bank Doing Business database. The variable measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0 to 12, with higher scores indicating that laws are better designed to expand access to credit. We also control for the state of business *cluster development* using the data retrieved from the World Economic Forum Executive Opinion Survey at the country-year level. The variable is constructed from responses to the survey question from the Global Competitiveness Report Executive Opinion Survey: "In your country, how widespread are well-developed and deep clusters" (geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field) (1 = *nonexistent*, 7 = *widespread in many fields*). Definitions of all variables and their sources appear in detail in Appendix Table A2.

4. Results

4.1. Summary Statistics

Table I presents statistics, by year, except Panel B, which provides a summary by country. Panel A considers the full sample, Panel B the top European countries, Panel C the U.S. sample only, and Panel D the EU-27 sample only.

Panel A of Table I documents statistics of fintech startup formations for the period from 2005 to 2014. Column (1) in Panel A presents statistics on the number of fintech startup formations in a given year. There is a notable upsurge of fintech startups following the financial crisis, as the number of startups founded in 2010 was twice as large as in 2008. In 2014, we observe for the first time a decrease of fintech startup formations compared with the previous year. Column (2) shows the number of financing rounds fintech startup have obtained in that year, which almost reached 1,000 rounds in 2011 and 2012. In Column (3), we show the total amount fintech startups raised each year, which grew until 2011 and then steadily declined. Together with Column (2), this suggests that the average volume per funding round has recently dropped. Column (4) shows the number of fintech startups providing financing services, which constitute almost 54% from all categories, suggesting that the demand for innovation in financing activities was substantial. Column (5) shows statistics of fintech startups providing asset management services, which represents 9% from all categories. Column (6) shows statistics of fintech startups providing payment services, which constitute the second-largest group with 21% from all categories. Column (7) shows fintech startups providing other business activities, which constitutes 16% from all categories. For all categories in columns (4)–(7), we observe an increase

in the number of fintech startups founded, with a slight decrease in the last year (2014), except for payment services, which continued to grow until the end.

To investigate different dynamics in developed and developing countries, we report descriptive statistics for the 10 most relevant European countries in terms of fintech activities, the U.S. sample, and the total EU-27 sample. Panel B of Table I presents statistics by country for the 10 most relevant European countries during the period 2005–2014. The United Kingdom is at the top of the list with regard to new fintech startup formations, followed by Germany and France (Column (1)). A recent study conducted by Ernst & Young (2016) ranked the United Kingdom as the number one place to flourish as a fintech startup. With the supposedly most supportive regulatory regime, effective tax incentives, and London's position as global financial center, the country attracts more talented entrepreneurs willing to engage in fintech activity. Column (3) shows the total amount raised by new fintech startups, with firms located in the United Kingdom having raised by far the highest amount (2.3 billion USD), followed by Germany and the Netherlands. According to a report published in Computer Business Review (2016), the United Kingdom also had the highest volume of deals in 2015 outside the United States and the third-highest total VC investment after the United States and China. Columns (4)–(7) again show fintech startup formations for the four subcategories, which remain in the same order of importance as before.

As the United States has the overall largest market share in our sample, internationally followed by the United Kingdom, Canada, India, and Germany (see Appendix Tables A3 for a ranking), Panel C of Table I presents statistics for the U.S. fintech market only by year. Column (1) shows that the number of fintech startups launched in the United States, which represent almost 60% of the entire sample. Columns (4)–(7) show that fintech startups reforming financing activities

constitute 57% of all fintech startups in the United States, again followed by asset management (9%), payment (19%), and other business activities (15%).

Panel D of Table I provides statistics for the EU-27 by year. Columns (1)–(7) are as described previously but calculated for the EU-27 sample only. Column (1) shows the number of fintech startups founded by year. Note that the EU-27 countries constitute only 20% of the total fintech startups we identified in our sample. The evidence shows that most financing rounds took place in the 10 most relevant EU countries, and the amounts these fintech startups raised there were also considerable, with the remaining 17 countries contributing only a tiny fraction. Fintech startups providing financing services again represent the largest share of all fintech startups in the EU-27 (50% of all fintechs), followed by payment services (23%), other business activities (18%), and asset management (9%). The importance of the fintech subcategories thus persists for all panels in Table I. Appendix Tables A3 and A4 show summary statistics and a correlation table that includes the dependent variables and the main independent variables.

--- Table I About Here ---

4.2. Country-level Determinants of Fintech Startup Formations

To analyze which country-level factors drive the formation of new fintech startups, we use multivariate panel regressions to predict the annual number of fintech startup formations in each country between 2006 and 2013. For the RENB model, we report incident rate ratios, which can conveniently be interpreted as multiplicative effects or semi-elasticities. Table II reports the estimates from the RENB models as outlined in Section 3. Column (1) shows the results on aggregate annual fintech startup formations, and columns (2)–(5) replicate the analyses for annual

formation of fintech startups providing *financing*, *asset management*, *payment*, and *other* business activities. Column 6 provides a robustness analysis using an ordinary least squares (OLS) panel fixed effects model.

The model in column 1 underscores the role of country-level factors in shaping the formation of new fintech startups. We find a significant, positive relationship between *GDP per capita* and fintech startup formations, with a high statistical significance ($p < 0.01$). An increase of one unit in Ln (*GDP per capita*) is associated with a 89% increase in fintech startup formations in the following year. Although we find no evidence for the impact of the number bank branches and VC financing on fintech startup formations, we cannot entirely reject hypothesis 1 that these formations occur more frequently in countries with well-developed capital markets. Moreover, we find a positive relationship between *latest technology* and fintech startup formations. A one-unit increase in the availability of latest technology is associated with a 112% increase in fintech startup formations in the following year. We thus cannot reject hypothesis 2 that fintech startup formations occur more frequently in countries where the latest technology is readily available. However, we find no evidence that Internet penetration and technology procurement by the government have an impact on fintech startup formations.

Furthermore, our results show a negative relationship between *the soundness of banks* and fintech startup formations. A one-unit increase in the *soundness of banks* is associated with a 16.4% decrease in the number of fintech startup formations in the following year. Although the variable *investment profile*, which captures the general risk of investing, is not significant, we cannot reject hypothesis 3 that fintech startup formations occur more frequently in countries with a more fragile financial sector. In line with hypothesis 4, we further find a positive relationship between *mobile telephone subscriptions* and fintech startup formations, with a high statistical significance

($p < 0.01$). We also find that a larger labor market is associated with an increase in fintech startup formations, which is in line with hypothesis 5. However, we do not find any significant relationship between *unemployment rate* and fintech startup formations, and thus we reject hypothesis 6. This finding might stem from the fact that fintech startup formations are not driven by necessity entrepreneurs, who find no employment in the wage sector and therefore engage in entrepreneurial activities, but by opportunity entrepreneurs, who want to implement a new business idea and are also willing to give up their jobs to succeed.

Stand-alone analyses of each fintech category reveal nuanced dynamics. Columns (2)–(5) of Table II highlight commonalities among the factors associated with the formation of fintech startups providing *financing*, *asset management*, *payment*, and *other* business activities. Consistent with Column (1) of Table II, the coefficients of *Ln (GDP per capita)* and *Ln (Labor force)* are positive and statistically significant for all subcategories. Moreover, the variable *strength of legal rights* has a positive and statistically significant effect on the formation of fintech startups for the following three subcategories: *financing*, *asset management* and *payment*. We also find that the coefficient of *latest technology* is positive and statistically significant for *financing*, *payment*, and *other* business activities. Fintech startups providing *asset management* services such as robo-advice, social trading, or personal financial management apps apparently do not require the latest technology for their operations. The variable *soundness of banks* has a negative and statistically significant effect on fintech startup formations only for fintech startups providing *financing*. A one-unit increase in the *soundness of bank* is associated with a 20.5% decrease in the formation of new fintech startups providing *financing* ($p < 0.01$). The results highlight the substitution effect of new fintechs providing financing as a result of the deteriorations in the financial system. The variable *VC financing* has a significant effect on the

formation of new fintech startups providing *payment* services. Last, we observe a positive effect of the variable *mobile telephone subscriptions* on the formation of fintech startups in all subcategories.

As a robustness check, we run a standard OLS fixed effects panel model. Column (6) of Table II reports coefficients for all fintech categories. Consistent with column (1), the variable *soundness of banks* has a negative and statistically significant effect on the formation of fintech startups. A one-unit increase in the *soundness of banks* is associated with a 15.6% decrease in the formation of new fintech startups. Of note, the variable *commercial bank branches* has a negative effect on fintech startup formations. A one-unit increase in *commercial bank branches* is associated with a 0.9% decrease in the formation of new fintech startups. Finally, we find a positive effect of the variable *investment profile* on fintech startup formations. A one-unit increase in general investment risk is associated with a 9.0 % increase in fintech startup formations.

--- Table II About Here ---

In Table III, we run the same regression excluding the U.S. fintech market, because U.S. fintechs constitute almost 60% of the total sample in our analysis. We find the results largely consistent with Table II for our main variables: *Latest technology*, *Ln (labor force)*, *Mobile telephone subscriptions*, and *new startup formation*. Moreover, we no longer find a significant effect for the *soundness of banks* variable except for fintech startups providing *financing*.

--- Table III About Here ---

5. Conclusion

In this paper, we investigate economic and technological determinants that have encouraged fintech startup formations in 64 countries. We find that the United States has the largest fintech market, followed by the United Kingdom, Canada, India, and Germany at a considerable distance. Categorizing fintechs in line with the value chain of a traditional bank—*financing*, *asset management*, *payment*, and *other* business activities—we show that financing is by far the most important segment of the emerging fintech market, followed by payment, other business activities, and asset management. Financing for fintech startup formations might be important for multiple reasons, two of which could be the traditional funding gap that small firms around the globe face (Schindele and Szczesny, 2016) and funding constraints potentially due to more stringent banking regulations in the aftermath of the latest financial crisis (Campello et al., 2010; European Central Bank European Central Bank, 2013; European Banking Authority, 2015).

While our study is exploratory in nature, it yields important insights into the evolution of fintech startups. Although the number of fintech startup formations has steadily grown, this growth and the amount these firms have raised have recently dropped. Moreover, we generally find that countries witness more fintech startup formations when capital markets are well-developed, the latest technology is readily available, and people possess more mobile telephone subscriptions, suggesting that these factors are important drivers of fintech demand. Furthermore, we show that the available labor force has a positive impact on the supply of entrepreneurs in the fintech industry, whereas the unemployment rate does not. Finally, we find that the more sound the financial system, the lower the number of fintech startups in the respective country.

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Table I. Development of the fintech market by year

This table presents summary statistics on the fintech market, by year, except for Panel B, which provides a summary by country. Panel A considers the full sample, Panel B the top 10 European countries, Panel C the U.S. sample, and Panel D the EU-27 sample only. Values reported are based on the CrunchBase database for the period 2005–2014, covering 69 countries around the world.

Panel A: Summary statistics for the full sample, by year

Column (1) reports the number of fintech startups that started operating in a given year. Column (2) reports the number of financing rounds fintech startups have obtained in that year. Column (3) reports the overall amount raised by fintech startups in a given year in USD. Column (4) reports the number of fintech startups providing *financing* services. Column (5) reports the number of fintech startups providing *asset management* services. Column (6) reports the number of fintech startups providing *payment* services. Column (7) provides the number of fintech proving *other* business activities. The last row denoted "All Years" reports the sum across all years.

YEAR	TOTAL SAMPLE						
				CATEGORIES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Nbr. Fintechs Started	Financing Rounds	Amount Raised (Millions $)	Financing	Asset Management	Payment	Other
2005	73	173	1,480	48	9	19	13
2006	96	222	2,500	65	9	19	19
2007	152	356	4,080	100	14	29	31
2008	165	330	2,270	120	19	31	30
2009	210	527	4,030	141	22	45	39
2010	305	660	4,440	199	27	77	65
2011	424	954	6,340	292	37	91	72
2012	484	961	5,190	318	57	116	88
2013	502	893	3,740	327	61	149	98
2014	438	606	1,750	289	58	152	63
All Years	2,849	5,682	35,820	1,899	313	728	518

Panel B: Summary statistics for the 10 most relevant European countries

Columns (1)–(7) are as described in Panel A, but calculated for each country separately.

COUNTRY	TOP 10 EUROPEAN COUNTRIES						
				CATEGORIES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Nbr. Fintechs Started	Financing Rounds	Amount Raised (Millions $)	Financing	Asset Management	Payment	Other
United Kingdom	231	483	2,350	149	23	55	52
Germany	54	118	749	34	12	19	13
France	53	84	265	27	1	19	14
Spain	37	75	152	24	8	5	7
Netherlands	34	66	365	19	6	10	6
Ireland	24	46	203	17	4	8	5
Italy	24	43	68	12	3	8	5
Sweden	19	43	370	12	1	8	1
Denmark	15	21	25	9	0	7	3
Switzerland	15	34	41	12	2	4	4
Total	506	1,013	4,589	315	60	143	110

Panel C: Summary statistics for the U.S. sample by year

Columns (1)–(7) are as described in Panel A, but calculated for the U.S. sample only.

YEAR	U.S. SAMPLE						
				CATEGORIES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Nbr. Fintechs Started	Financing Rounds	Amount Raised (Millions $)	Financing	Asset Management	Payment	Other
2005	45	110	924	34	7	10	6
2006	63	157	1,360	40	5	12	16
2007	100	260	2,960	67	10	17	19
2008	104	214	1,540	81	14	15	15
2009	142	375	3,340	101	17	26	26
2010	185	426	3,220	125	17	43	35
2011	255	619	4,780	180	24	46	43
2012	263	530	3,720	187	25	52	44
2013	273	497	2,530	177	33	77	50
2014	235	315	987	160	33	77	29
All Years	1,665	3,503	25,361	1,152	185	375	283

Panel D: Summary statistics for the EU-27, by year

Columns (1)–(7) are as described in Panel A, but calculated for the European sample only.

YEAR	EUROPEAN SAMPLE						
				CATEGORIES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Nbr. Fintechs Started	Financing Rounds	Amount Raised (Millions $)	Financing	Asset Management	Payment	Other
2005	13	34	201	6	1	5	3
2006	11	17	326	8	1	2	1
2007	30	60	855	17	3	7	11
2008	27	59	349	15	2	7	9
2009	44	111	519	27	3	11	8
2010	63	138	675	39	5	18	17
2011	84	172	495	55	7	23	15
2012	103	205	676	56	12	29	24
2013	103	189	483	71	12	30	23
2014	92	141	169	57	16	28	16
All Years	570	1,126	4,748	351	62	160	127

Table II. Drivers of fintech startup formations, full sample

The dependent variables in column (1) pertain to the number of new fintech startups founded in a given country and year. In columns (1)–(5), we report results for fintech startups providing *financing*, *asset management*, *payment*, and *other* business activities only. The data take panel structure. We report negative binomial regressions for the columns (1)–(5) because the dependent variables are count variables. All variables are defined in Appendix Table A2. Standard errors are clustered at the country level, and the model allows dispersion to vary randomly across clusters. Columns (1)–(5) report incident rate ratios. Significance levels: ** < 5%, and *** < 1%. Column (6) reports an OLS panel fixed effect model, using as the dependent variable the natural logarithm of the number of new fintech startups founded in a given country and year.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Number of startups founded by year and country	Financing	Asset management	Payment	Other	Ln (Number of startups founded by year and country)
L. Ln (GDP per capita)	1.890***	2.142***	3.124***	1.796***	3.156***	0.303
L. Commercial bank branches	0.995	0.995	0.991	0.993	0.995	-0.009**
L. VC financing	1.400	1.491	1.624	2.434***	1.748	-0.055
L. Latest technology	2.124***	2.106***	1.268	2.215***	2.108***	0.191
L. Internet penetration	1.002	1.001	0.998	1.006	0.987	0.008
L. Government tech procurement	0.943	0.917	0.835	0.756	1.111	0.079
L. Soundness of banks	0.836**	0.795***	0.927	0.901	0.935	-0.156**
L. Investment profile	1.017	1.041	0.872	0.961	0.933	0.090**
L. Mobile telephone subscriptions	1.010***	1.009***	1.010**	1.007**	1.010**	0.001
L. Ln (Labor force)	2.108***	2.191***	2.353***	1.732***	2.182***	0.138
L. Unemployment rate	1.008	1.004	1.012	0.995	1.013	-0.013
L. New startup formation * 10^{-3}	1.223***	1.179**	1.376**	1.606***	1.274**	
L. Ln (New startup formation)						0.323***
L. Law and order	0.893	0.840	0.989	0.794	0.918	0.251
L. Strength of legal rights	1.092	1.136**	1.188**	1.140**	1.150	0.033
L. Cluster development	0.924	0.955	1.104	0.945	0.693	0.079
Adjusted R^2	-	-	-	-	-	0.21
Wald χ^2	413.95***	324.57***	182.31***	309.57***	157.92***	-
Log likelihood	-670.35	-549.87	-233.11	-406.40	-325.35	-
Observations	399	399	399	399	399	399

Table III. Drivers of fintech startup formations, excluding U.S. Sample

The dependent variables in column (1) pertain to the number of new fintech startups founded in a given country and year. In columns (1)–(5), we report results for fintech startups providing *financing*, *asset management*, *payment*, and *other* business activities only. The data take panel structure. We report negative binomial regressions for the columns (1)–(5) because the dependent variables are count variables. All variables are defined in Appendix Table A2. Standard errors are clustered at the country level, and the model allows dispersion to vary randomly across clusters. Columns (1)–(5) report incident rate ratios. Significance levels: ** < 5%, and *** < 1%. Column (6) reports an OLS panel fixed effect model, using as the dependent variable the natural logarithm of the number of new fintech startups founded in a given country and year.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Number of startups founded by year and country	Financing	Asset Management	Payment	Other	Ln (Number of startups founded by year and country)
L. Ln (GDP per capita)	1.369	1.522	2.513***	1.715**	2.519***	0.290
L. Commercial bank branches	0.994	0.994	0.986	0.992	0.994	-0.009**
L. VC financing	1.419	1.529	1.646	2.590***	2.099	-0.056
L. Latest technology	1.905***	1.869***	1.104	1.735**	1.635	0.197
L. Internet penetration	1.009	1.005	0.990	1.002	0.991	0.009
L. Government tech procurement	0.812	0.784	0.948	0.860	0.946	0.082
L. Soundness of banks	0.883	0.811***	0.898	0.962	1.094	-0.145**
L. Investment profile	1.096	1.153**	1.002	1.008	0.982	0.089**
L. Mobile telephone subscriptions	1.011***	1.010***	1.014***	1.007***	1.009***	0.001
L. Ln (Labor force)	1.877***	1.874***	1.801***	1.492***	1.747***	0.116
L. Unemployment rate	1.013	1.014	1.036	0.998	1.005	-0.014
L. New startup formation	1.003***	1.004***	1.007***	1.005***	1.005***	
L. Ln (New startup formation)						0.317***
L. Law and order	0.977	0.928	1.161	0.833	0.961	0.242
L. Strength of legal rights	1.034	1.062	1.014	1.079	1.082	0.034
L. Cluster development	0.947	0.977	0.992	0.860	0.658	0.148
Adjusted R^2	-	-	-	-	-	0.20
Wald χ^2	264.64***	204.79***	82.67***	186.64***	115.57***	-
Log likelihood	-623.82	-506.15	-202.97	-374.48	-293.24	-
Observations	391	391	391	391	391	391

Appendix

Table A1. List of countries in the dataset (ranking according to number of fintech startups)

Argentina (15)	Greece (26)	Peru (29)
Australia (9)	Hong Kong SAR	Philippines (22)
Austria (25)	China (14)	Poland (20)
Bahrain (29)	Hungary (27)	Portugal (27)
Belgium (22)	India (4)	Romania (29)
Brazil (11)	Indonesia (24)	Russian Federation (11)
Bulgaria (27)	Ireland (13)	Singapore (7)
Canada (3)	Israel (10)	Slovak Republic (29)
Chile (17)	Italy (13)	South Africa (24)
China (12)	Japan (16)	Spain (8)
Colombia (28)	Jordan (29)	Sweden (15)
Costa Rica (29)	Kenya (28)	Switzerland (18)
Croatia (29)	Korea, Rep. (25)	Thailand (26)
Cyprus (28)	Latvia (27)	Trinidad and Tobago (29)
Czech Republic (26)	Lebanon (27)	Turkey (25)
Denmark (18)	Luxembourg (27)	Uganda (29)
Dominica (29)	Malaysia (28)	Ukraine (23)
Dominican Republic (29)	Mexico (14)	United Arab Emirates (25)
Egypt, Arab Rep. (28)	Netherlands (11)	United Kingdom (2)
Estonia (23)	New Zealand (19)	United States (1)
Finland (21)	Nigeria (27)	Uruguay (28)
France (6)	Norway (26)	Vietnam (29)
Germany (5)	Pakistan (29)	
Ghana (29)	Panama (29)	

Table A2. List of variables

Variable Name	Definition
Dependent variables	
Number of fintech startups founded	The number of fintech startups founded in a given country and year. Source: CrunchBase.
Asset management	The number of new fintech startups providing asset management services founded in a given country and year. Source: CrunchBase.
Financing	The number of new fintech startups providing financing services founded in a given country and year. Source: CrunchBase.
Other business activities	The number of new fintech startups providing other fintech services founded in a given country and year. Source: CrunchBase.
Payment	The number of new fintech startups providing payment services founded in a given country and year. Source: CrunchBase.
Explanatory variables	
Cluster development	Response to the survey question: "In your country, how widespread are well-developed and deep clusters" (geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field). The variable runs from 1 = *nonexistent* to 7 = *widespread in many fields*. Source: World Economic Forum, Global Competitiveness Report, Executive Opinion Survey.
Commercial bank branches	Is the (Number of institutions + number of bank branches) * 100,000 / adult population in the reporting country. Source: International Monetary Fund, Financial Access Survey.
Government tech procurement	Response to the survey question: "In your country, to what extent do government purchasing decisions foster innovation?" The variable runs from 1 = *not at all* to 7 = *to a great extent*. Source: World Economic Forum, Global Competitiveness Report, Executive Opinion Survey.
Internet penetration	Data are based on surveys carried out by national statistical offices or estimated on the basis of the number of Internet subscriptions. Internet users refer to people using the Internet from any device (including mobile phones) during the year under review. We use the percentage of residents using the Internet at the year and country level. Source: World Telecommunication/ICT Development report and database.

Investment profile	Assessment of factors affecting the risk of investment that are not covered by other political, economic, and financial risk components. The index is calculated on the basis of three subcomponents as follows: contract viability, profits repatriation, and payment delays. Each subcomponent ranges from 0 to 4 points; a score of 4 points indicates very low risk, and a score of 0 very high risk. Source: ICRG.
Latest technology	Response to the survey question: "In your country, to what extent are the latest technologies available?" (The variable runs from 1 = *not available* at all to 7 = *widely available.*) Source: World Economic Forum, Global Competitiveness Report, Executive Opinion Survey.
Law and order	Law and order form a single component, but its two elements are assessed separately, with each element being scored from 0 to 3 points. The index of *law and order* runs from 0 to 6, with higher values indicating better legal systems. Source: ICRG.
Ln (GDP per capita)	GDP per capita is the gross domestic product per capita in USD. Source: World Development Indicators database.
Ln (Labor force)	Total labor force comprises people ages 15 and older who meet the International Labour Organization definition of the economically active population: all people who supply labor for the production of goods and services during a specific period. Source: World Development Indicators database.
Mobile telephone subscriptions	A mobile telephone subscription refers to a subscription to a public mobile telephone service that provides access to the public switched telephone network using cellular technology, including the number of pre-paid SIM cards active during the last three months of the year under review. This includes both analog and digital cellular systems (IMT-2000, Third Generation, 3G) and 4G subscriptions, but excludes mobile broadband subscriptions via data cards or USB modems. The variable measures the number of mobile telephone subscriptions per 100 adult population. Source: World Telecommunication/ICT Development report and database.
New startup formation	Annual number of new startups founded in a given year and country. The data were retrieved from the CrunchBase database and measure the number of new startups created according to CrunchBase in a given year and country. Source: CrunchBase and own calculations.
Soundness of banks	Response to the survey question: "In your country, how do you assess the soundness of banks?" (The variable runs from 1 = *extremely low – banks may require recapitalization* to 7 = *extremely high – banks are generally healthy with sound balance sheets*.) World Economic Forum, Global Competitiveness Report, Executive Opinion Survey.

Strength of legal rights	The index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending in a country. The index ranges from 0 to 12, with higher scores indicating that these laws are better designed to expand access to credit. Source: World Bank, Doing Business database.
Unemployment rate	Calculated as the percentage from the total labor force. Source: World Development Indicators database.
VC financing	The natural logarithm of the total amount of VC funding of all the startups available in the CrunchBase database excluding the fintech startups used in our analysis over the GDP per capita at the country level. The variable is constructed using available data in the CrunchBase database. Source: CrunchBase and own calculations.

Table A3. Summary statistics

Variable	Nbr. Obs.	Mean	Median	Std. Dev.	Minimum	Maximum
# Fintech startups founded by year and country	690	4.13	0	22.43	0	273
Ln (# Fintech startups founded by year and country)	690	0.64	0	0.94	0	5.61
# Asset management	690	0.45	0	2.54	0	33
# Financing	690	2.75	0	15.45	0	187
# Other	690	0.75	0	3.85	0	50
# Payment	690	1.06	0	5.45	0	77
Cluster development	606	4.09	4.05	0.70	2.49	5.60
Commercial bank branches	661	26.47	20.34	23.23	0.76	256.26
Government tech procurement	606	3.78	3.75	0.61	2.01	5.53
Internet penetration	672	50.55	51.52	26.11	1.74	96.3
Investment profile	680	9.61	9.50	1.92	4	12
Latest technology	606	5.25	0.91	5.25	2.62	6.87
Law and order	680	4.17	4	1.23	1	6
Ln (GDP per capita)	687	9.43	9.55	1.28	5.77	11.67
Ln (Labor force)	680	16.04	16.02	1.61	12.24	20.51
Mobile telephone subscriptions	672	103.83	108.37	36.4	4.58	239.3
New startup formation	690	52.03	6	291.19	0	3842
Soundness of banks	606	5.49	5.62	0.90	1.44	6.90
Strength of legal rights	679	6.44	6	2.32	1.80	10
Unemployment rate	680	7.51	6.90	4.32	0.70	27.2
VC financing	525	1.74	1.80	0.53	0	3.24

Table A4. Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
# Fintech startups founded by year and country	(1)	1								
Financing	(2)	0.9984	1							
Asset Management	(3)	0.9754	0.9729	1						
Payment	(4)	0.9658	0.9557	0.9694	1					
Other business activities	(5)	0.9816	0.9764	0.9426	0.9318	1				
Ln (# Fintech startups founded by year and country)	(6)	0.6632	0.6568	0.6493	0.6459	0.6763	1			
Ln (GDP per capita)	(7)	0.1513	0.1472	0.1561	0.1515	0.1703	0.2974	1		
Commercial bank branches	(8)	0.0252	0.0247	0.0249	0.0156	0.0278	0.0009	0.3048	1	
VC financing	(9)	0.2073	0.2059	0.196	0.2035	0.2064	0.4132	-0.0345	-0.0982	1
Latest technology	(10)	0.1893	0.1858	0.1805	0.1929	0.2042	0.3522	0.7199	0.0203	0.1665
Internet penetration	(11)	0.1416	0.1367	0.1504	0.1505	0.1559	0.3086	0.8838	0.1966	0.0164
Government tech procurement	(12)	0.1627	0.1638	0.154	0.151	0.1714	0.157	0.4451	-0.0412	0.1485
Soundness of banks	(13)	-0.0437	-0.0444	-0.0488	-0.0359	-0.0345	-0.0021	0.3132	0.0816	0.0365
Investment profile	(14)	0.1671	0.1676	0.1638	0.1584	0.1737	0.1789	0.6519	0.1551	-0.0485
Mobile phone subscriptions	(15)	-0.084	-0.0862	-0.066	-0.0697	-0.077	0.0097	0.4188	0.1276	-0.1628
Ln (Labor force)	(16)	0.269	0.2678	0.2632	0.2554	0.2651	0.3853	-0.4218	-0.1334	0.4496
Unemployment rate	(17)	-0.0059	-0.0065	-0.0058	-0.0146	-0.008	-0.0492	-0.0578	0.1822	-0.1092
New startup formation	(18)	0.9898	0.9902	0.9537	0.9317	0.9814	0.6429	0.1493	0.032	0.206
Law and order	(19)	0.0984	0.0963	0.0974	0.0967	0.1109	0.2252	0.7555	0.095	0.0374
Strength of legal rights	(20)	0.1521	0.1529	0.1391	0.1414	0.1628	0.1818	0.1181	-0.142	0.0341
Cluster development	(21)	0.2387	0.2362	0.2424	0.2398	0.2493	0.4081	0.4866	-0.0502	0.3323

Table A4. continued

		(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Latest technology	(10)	1								
Internet penetration	(11)	0.7355	1							
Government tech procurement	(12)	0.6016	0.4068	1						
Soundness of banks	(13)	0.3906	0.2214	0.4216	1					
Investment profile	(14)	0.559	0.5395	0.5838	0.5948	1				
Mobile phone subscriptions	(15)	0.2214	0.4309	0.1386	0.0486	0.1974	1			
Ln (Labor force)	(16)	-0.2989	-0.4457	-0.1431	-0.1689	-0.2957	-0.4038	1		
Unemployment rate	(17)	-0.0809	-0.0789	-0.3776	-0.3071	-0.2419	-0.0538	-0.091	1	
New startup formation	(18)	0.1885	0.1314	0.1773	-0.0341	0.1715	-0.0996	0.2723	-0.0017	1
Law and order	(19)	0.6728	0.7435	0.4531	0.2047	0.6037	0.1898	-0.3786	-0.1117	0.0989
Strength of legal rights	(20)	0.2156	0.2466	0.2594	0.0426	0.2923	0.0411	-0.143	-0.1284	0.1526
Cluster development	(21)	0.6671	0.4637	0.6069	0.3087	0.4317	0.1388	0.1279	-0.2955	0.238

		(19)	(20)	(21)
Law and order	(19)	1		
Strength of legal rights	(20)	0.2927	1	
Cluster development	(21)	0.4391	0.1097	1

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