

**The emergence of the fintech industry in China: An evolutionary
economic geography perspective**

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Summary

Over the last decade, the global economy has rapidly becoming digitized. Digital technologies have transformed the economy and society, affecting all sectors of activity around the world. Among them, the financial sector is one of the most digitalized sectors, and the term ‘fintech’ is coined to describe the digitalization of the financial sector. Although the global fintech landscape is currently geographically concentrated in the United States and Europe, the pace of China’s fintech development has been dramatically accelerated. However, it is quite surprising that there is hardly any study that investigates fintech in China from a subnational scale. To fill this gap, this dissertation conducts a city-level analysis of the emergence of the fintech industry in China.

Theoretically, I position this dissertation within the broad literature on evolutionary economic geography (EEG), which has emerged as one of the main paradigms in economic geography. This dissertation aims to provide a comprehensive understanding of the emergence of the new industry in regions. Conventional wisdom in EEG posits that new industry in regions tends to grow out of technologically related pre-existing industries. However, this conventional understanding is somewhat technology-centric. In response, this dissertation extends the scholarly work from technology-centric to embrace the role of the demand-side market and institutional logic in the emergence of the new industry in regions. This dissertation proposes that not only supply-side technology but also demand-side market and institutional logics matter for the emergence of the new industry in regions. Moreover, this dissertation ascribes the underlying logic of how technology, market, and institutional logics matter to the agentic processes of asset modification, particularly redeploying pre-existing assets and creating new assets. In other words, the emergence of the new industry in regions results from relevant regional actors’ purposeful actions in terms of modifying technological, market, and institutional assets.

Methodologically, there is a dualism in evolutionary economic geography research between qualitative and quantitative work. To seek a methodology integration, this dissertation proposes

the mixed-method that is composed of four concrete approaches, namely the triangulation approach, the embedded approach, the sequential exploratory approach, and the sequential explanatory approach. Among these concrete approaches, the embedded approach is utilized in the empirical work. The embedded approach in this dissertation refers to the embedding of the qualitative case study (which deals with the ‘how’ questions) into quantitative research (which deals with the ‘whether and to what extent’ questions).

Empirically, this dissertation first examines the emergence of fintech industry in China’s cities based on the quantitative regression analysis (mainly dealing with the ‘whether and to what extent’ questions) and then zooms in on the city of Shenzhen, which is the largest fintech hub in southern China, based on the qualitative case study (mainly dealing with the ‘how’ questions). The findings are as follows. (1) Based on a unique dataset from 2003 – 2019, this dissertation provides a city-level analysis of the fintech industry in China. The econometric results show that fintech industries tend to emerge in cities that have more fintech-related technologies, particularly in the fields of finance, e-commerce, data sciences, and security. This confirms the principle of technological relatedness. Moreover, it finds a positive relationship between the development of the fintech industry and the demand for fintech services. To the best of my knowledge, this is the first systematic evidence of the significant positive role of the demand-side market in the emergence of the new industry in regions. (2) In order to uncover the underlying processes (the question of ‘how’) that lead to the above significant positive effect, this dissertation resorts to the qualitative case study. The case study shows that the rise of Shenzhen’s fintech industry mainly grows out of Shenzhen’s pre-existing internet and financial industry. By systematically comparing the processes that internet and financial industry diversify into the fintech industry, it finds that the emergence of the fintech industry in Shenzhen result from internet and financial firms’ purposeful actions in terms of redeploying their pre-existing technologies, market, and institutional logics, as well as creating the new ones that are necessary for fintech but are missing for the internet or financial firms. In other words, it is the processes of asset modification, particularly redeploying pre-existing assets and creating new assets, that give rise to the birth of the fintech industry, leading to the positive

relationships found in the quantitative regression analysis.

Practically, the dissertation offers valuable policy implications for nurturing a new regional industry. Evolutionary economic geographers suggest regions enter into new industries that are related to their pre-existing industries because these pre-existing industries provide assets that can be redeployed to form the new industries. However, due to the prevailing concept of technological relatedness, evolutionary economic geography so far has mainly focused on technological assets. This dissertation proposes that the creation of new industries in regions should move beyond the narrowly technological assets and draw on a broad set of pre-existing assets, consisting of technology, market, and institutional logics. Moreover, the nurturing of new industries in regions should not only draw on pre-existing assets but also rely on creating new assets that are necessary for the new industries but are currently missing.

Zusammenfassung

Im letzten Jahrzehnt hat sich die Weltwirtschaft rasant digitalisiert. Digitale Technologien haben die Wirtschaft und die Gesellschaft verändert und wirken sich auf alle Wirtschaftszweige auf der ganzen Welt aus. Unter ihnen ist der Finanzsektor einer der am stärksten digitalisierten Sektoren, und der Begriff "Fintech" wurde geprägt, um die Digitalisierung des Finanzsektors zu beschreiben. Obwohl sich die globale Fintech-Landschaft derzeit geografisch auf die Vereinigten Staaten und Europa konzentriert, hat sich das Tempo der Fintech-Entwicklung in China dramatisch beschleunigt. Es ist jedoch überraschend, dass es kaum eine Studie gibt, die Fintechs in China auf subnationaler Ebene untersucht. Um diese Lücke zu füllen, führt diese Dissertation eine Analyse der Entstehung der Fintech-Branche in China auf Stadtebene durch.

Theoretisch positioniere ich diese Dissertation innerhalb der breiten Literatur zur evolutionären Wirtschaftsgeographie (EEG), die sich als eines der wichtigsten Paradigmen der Wirtschaftsgeographie herausgebildet hat. Ziel dieser Dissertation ist es, ein umfassendes Verständnis für die Entstehung der neuen Industrie in Regionen zu schaffen. Konventionelle Weisheit in der EEG postuliert, dass neue Industrie in Regionen dazu tendiert, aus technologisch verwandten, bereits existierenden Industrien herauszuwachsen. Dieses konventionelle Verständnis ist jedoch etwas technologiezentriert. Als Antwort darauf erweitert diese Dissertation die wissenschaftliche Arbeit von der Technologiezentrierung auf die Rolle des nachfrageseitigen Marktes und der institutionellen Logik bei der Entstehung der neuen Industrie in Regionen. Es wird vorgeschlagen, dass nicht nur die angebotsseitige Technologie, sondern auch die nachfrageseitigen Markt- und institutionellen Logiken für die Entstehung der neuen Industrie in Regionen von Bedeutung sind. Darüber hinaus wird in dieser Dissertation die zugrundeliegende Logik der Bedeutung von Technologie, Markt und institutioneller Logik für die agenturischen Prozesse der Vermögensmodifikation, insbesondere der Umschichtung von bereits vorhandenen Vermögenswerten und der Schaffung neuer Vermögenswerte, aufgezeigt. Mit anderen Worten: Die Entstehung der neuen Industrie in Regionen resultiert aus

den zielgerichteten Handlungen relevanter regionaler Akteure in Bezug auf die Modifikation von technologischen, marktlichen und institutionellen Vermögenswerten.

Methodisch gibt es in der evolutionären wirtschaftsgeographischen Forschung einen Dualismus zwischen qualitativer und quantitativer Arbeit. Um eine methodische Integration anzustreben, wird in dieser Dissertation ein Methodenmix vorgeschlagen, der sich aus vier konkreten Ansätzen zusammensetzt, nämlich dem Triangulationsansatz, dem eingebetteten Ansatz, dem sequentiellen explorativen Ansatz und dem sequentiellen erklärenden Ansatz. Von diesen konkreten Ansätzen wird in unserer empirischen Arbeit der eingebettete Ansatz verwendet. Der eingebettete Ansatz bezieht sich in dieser Dissertation auf die Einbettung der qualitativen Fallstudie (die sich mit den "Wie"-Fragen beschäftigt) in die quantitative Forschung (die sich mit den "Ob und in welchem Ausmaß"-Fragen beschäftigt).

Empirisch untersucht diese Dissertation zunächst die Entstehung von Fintech-Industrien in Chinas Städten anhand der quantitativen Regressionsanalyse (die sich hauptsächlich mit den Fragen des "ob und in welchem Ausmaß" befasst) und zoomt dann anhand der qualitativen Fallstudie (die sich hauptsächlich mit den Fragen des "wie" befasst) auf die Stadt Shenzhen, die das größte Fintech-Zentrum in Südchina ist. Die Ergebnisse sind wie folgt. (1) Basierend auf einem einzigartigen Datensatz von 2003 bis 2019 bietet diese Dissertation eine Analyse der Fintech-Branche in China auf Stadtebene. Unsere ökonometrischen Ergebnisse zeigen, dass Fintech-Industrien tendenziell in Städten entstehen, die mehr Fintech-bezogene Technologien haben, insbesondere in den Bereichen Finanzen, E-Commerce, Datenwissenschaften und Sicherheit. Dies bestätigt das Prinzip der technologischen Verwandtschaft. Darüber hinaus finde ich eine positive Beziehung zwischen der Entwicklung der Fintech-Industrie und der Nachfrage nach Fintech-Dienstleistungen. Nach unserem Kenntnisstand ist dies der erste systematische Nachweis für die signifikante positive Rolle des Nachfragemarktes bei der Entstehung der neuen Industrie in Regionen. (2) Um die zugrundeliegenden Prozesse (die Frage nach dem "Wie") aufzudecken, die zu dem oben genannten signifikant positiven Effekt führen, greift diese Dissertation auf die qualitative Fallstudie zurück. Unsere Fallstudie zeigt, dass der Aufstieg der Fintech-Industrie in Shenzhen hauptsächlich aus der bereits existierenden

Internet- und Finanzindustrie in Shenzhen erwächst. Durch den systematischen Vergleich der Prozesse, die die Internet- und Finanzindustrie in die Fintech-Industrie diversifizieren, stelle ich fest, dass die Entstehung der Fintech-Industrie in Shenzhen aus den zielgerichteten Handlungen der Internet- und Finanzunternehmen resultiert, die ihre bereits existierenden Technologien, Märkte und institutionellen Logiken neu einsetzen und neue schaffen, die für Fintech notwendig sind, aber den Internet- oder Finanzunternehmen fehlen. Mit anderen Worten, es sind die Prozesse der Vermögensmodifikation, insbesondere die Umschichtung von bereits existierenden Vermögenswerten und die Schaffung von neuen Vermögenswerten, die zur Entstehung der Fintech-Branche führen, was zu den positiven Beziehungen führt, die in der quantitativen Regressionsanalyse gefunden wurden.

In der Praxis bietet die Dissertation wertvolle politische Implikationen für die Förderung neuer regionaler Industrien. Evolutionäre Wirtschaftsgeographen schlagen Regionen vor, in neue Industrien einzusteigen, die mit ihren bereits existierenden Industrien verwandt sind, da diese bereits existierenden Industrien Vermögenswerte bereitstellen, die für die Bildung der neuen Industrien umgewidmet werden können. Aufgrund des vorherrschenden Konzepts der technologischen Verwandtschaft hat sich die evolutionäre Wirtschaftsgeographie bisher jedoch hauptsächlich auf technologische Vermögenswerte konzentriert. In dieser Dissertation wird vorgeschlagen, dass die Schaffung neuer Industrien in Regionen über die eng gefassten technologischen Vermögenswerte hinausgehen und auf ein breites Set von bereits existierenden Vermögenswerten, bestehend aus Technologie, Markt und Institutionen, zurückgreifen sollte. Darüber hinaus sollte die Förderung neuer Industrien in Regionen nicht nur auf bereits existierende Vermögenswerte zurückgreifen, sondern sich auch auf die Schaffung neuer Vermögenswerte stützen, die für die neuen Industrien notwendig sind, derzeit aber fehlen.

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Chapter 1: Introduction

This chapter starts with the introduction of the practical background of this dissertation. It is followed by the literature review leading to identifying four research gaps. Finally, the structure of this dissertation is presented.

1.1 Practical background

1.1.1 Digitalization across the world

The 4th industrial revolution is currently underway, using digital technologies to connect things, processes, and people in real-time (Schwab, 2016). Over the last few years, the global economy has rapidly become digital. It witnesses that digital technologies have transformed the economy and society, affecting all sectors of activity around the world. On the supply side, many sectors are seeing the introduction of digital technologies to reshape the whole value chain from R&D, through development and manufacture, to marketing, sales, and distribution. On the demand side, consumer behaviors are increasingly enabled and empowered by mobile networks and data, which in turn forces the supply-side companies to adapt the way they design, market, and deliver products and services.

Against this backdrop, digitalization¹ is high on the international agenda. In Europe, digitalization is one of the six European Commission priorities for 2019-2024 which aims to empower people with a new generation of technologies. Since 2010, the European Commission has launched several digitalization initiatives. In the context of the Europe 2020 Strategy, European Commission in 2010 launched the ‘A Digital Agenda for Europe’, which aimed to ‘deliver sustainable economic and social benefits from a digital single market based on fast and ultra-fast internet and interoperable applications’ (European Commission, 2010, p3). In 2015,

¹ Digitalisation refers to the use of digital technologies and data as well as interconnection that results in new or changes to existing activities (OECD, 2019). In contrast, digitisation is the conversion of analogue data and processes into a machine-readable format.

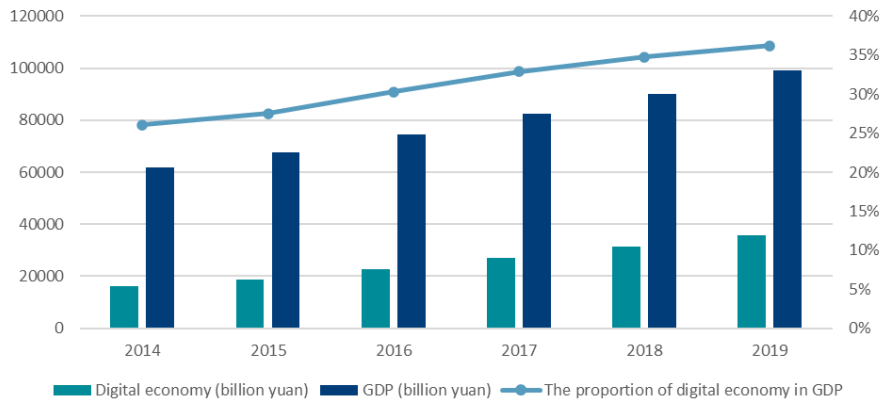
the European Commission further launched its strategy to achieve a Digital Single Market (DSM) (European Commission, 2015). One year later, the European Commission went one step further to launch the ‘Digitising European Industry’ (DEI) initiative as part of the DSM strategy (European Commission, 2016). At the beginning of 2020, the European Commission published the ‘White Paper on Artificial Intelligence: a European approach to excellence and trust’ and ‘The European data strategy’, which together aimed to make the EU a leader in a data-driven society (European Commission, 2020a, 2020b).

In China, the large-scale initiatives of digitalization took off since China’s Premier Li Keqiang brought up the concept of ‘Internet Plus’ and designated it as the national strategy in his Report on the Work of the Government in 2015. Premier Li said in the report (2015, p20): ‘I will develop the Internet Plus action plan to integrate the mobile Internet, cloud computing, big data, and the Internet of Things with modern manufacturing, to encourage the healthy development of e-commerce, industrial networks, and Internet banking, and to guide Internet-based companies to increase their presence in the international market.’ Later on, Internet-based new industries became a sustained driving force within the 13th Five-Year Plan period from 2016-2020. By the end of the 13th Five-Year Plan period, China launched the ‘Cloud – Big Data – AI-driven New Economy Implementation Strategy’ in 2020. It aimed to further implement the digital economy strategy, accelerate digitalization, and foster the development of a new economy (National Development and Reform Commission, 2020a). At the same time, China launched a ‘New Infrastructure’ campaign to offset the economic impact of the Covid-19 pandemic and boost sustainable growth. The new infrastructure focuses on three areas: 1) increased investments in basic science and innovative capabilities; 2) the development of cutting-edge technologies, including 5G, big data, and artificial intelligence; and 3) the integration of traditional sectors such as manufacture, transportation, and finance with advanced technology (National Development and Reform Commission, 2020b).

On the global scale, China’s overall digitalization lagged behind other countries in advanced economies. In 2018, the digital economy stood at about 34% of GDP, compared to around 60% in the UK, the United States, and Germany (CAICT, 2019). However, due to the favorable

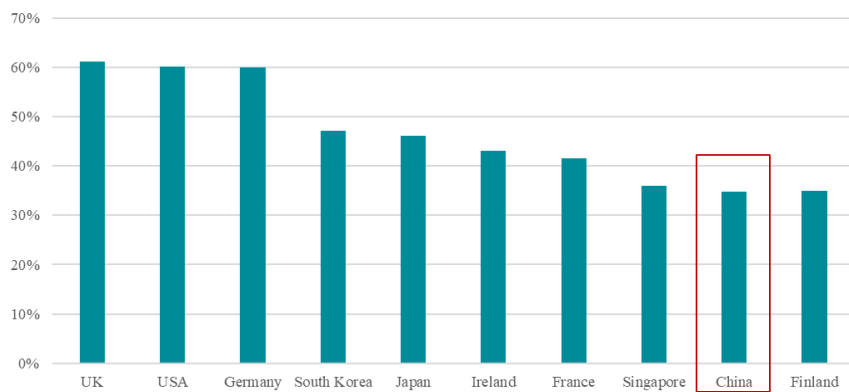
external environment, the digital economy has rapidly increased in the past few years. According to the report released by the China Academy of Information and Communications Technology (CAICT) in 2020, the proportion of China’s digital economy to the whole GDP increased from 26.1% in 2014 to 36.2% in 2019 (CAICT, 2020).

Figure 1. 1 The proportion of the digital economy in GDP in China.



Source: Author based on data from the China Academy of Information and Communications Technology (2020).

Figure 1. 2 The proportion of the digital economy in GDP in 2018 (Top 10 countries)

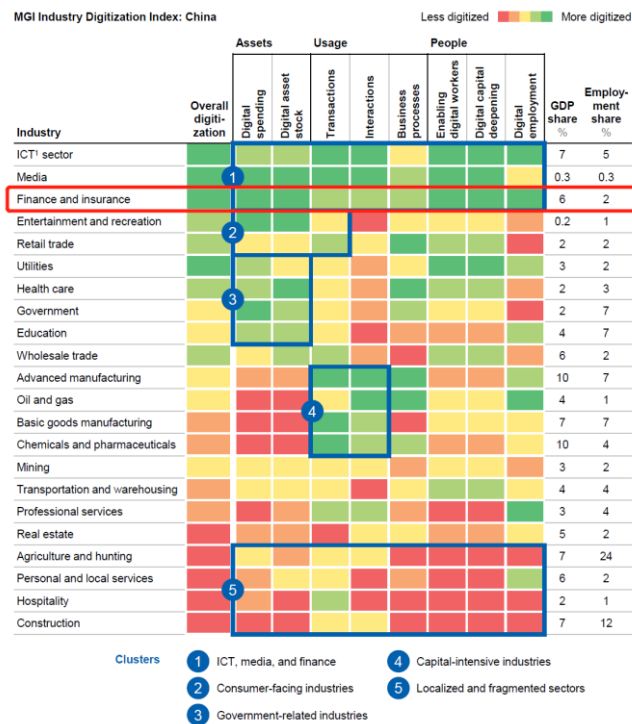


Source: Author based on data from the China Academy of Information and Communications Technology (2019).

1.1.2 Fintech as one of the most digitized industries

Since different sectors develop and adopt different digital technologies at differing rates, the states of digitization are different across the sectors. To date, international organizations and consulting companies have made efforts to measure the degree of digitalization across sectors. According to the McKinsey Global Institute (MGI) report that measures the degree of digitalization across sectors, examples of high digital-intensity sectors include ICT, media, professional services, and finance (MGI, 2017). Among them, the financial sector is one of the most digitized industries, in which financial products and services have deeply involved the combination of artificial intelligence (AI), blockchains, cryptography, and mobile access internet (He et al., 2017). Recently, this process is depicted by the term ‘fintech’ (a short-hand for ‘financial technology’) which is defined as ‘a set of innovations and an economic sector that focus on the application of recently developed digital technologies to financial services’ (Wójcik, Forthcoming, p3).

Figure 1. 3 MGI Industry Digitization Index in the world.



Source: MGI (2017).

Fintech is not an inherently novel development for the financial services industry. Arner et al. (2015) trace the origins of fintech back to the 19th century and distinguish three main eras of FinTech evolution. The first era is named Fintech 1.0, which started from 1866 - 1967. In this era, financial companies adopted telegraph technology to facilitate the rapid transmission of financial information, transactions, and payment around the world (Arner et al., 2015). The second era is named Fintech 2.0, which started from 1967 - 2008. In this era, financial companies adopted communications, processing, and internet technology to establish the ATM, digital payment system, and online bank (Arner et al., 2015). Since the global financial crisis in 2008, the development of fintech entered into a new era, which is named Fintech 3.0 (Arner et al., 2015).

Fintech 3.0 witnesses several new features compared to the previous eras. (1) While innovation in finance is not new, Fintech 3.0 witnesses the increasing adoption of a set of cutting-edge technologies, such as digital identification, mobile applications, cloud computing, big data analytics, artificial intelligence, blockchain, and distributed ledger technologies (He et al., 2017). (2) Another visible feature of Fintech 3.0 is that financial incumbents are no longer the single players that used technology to provide financial products and services. Fintech 3.0 witnesses the new entrants from tech giants and innovative start-ups which offer fintech solutions ranging from mobile payments and automated investment advice to cryptocurrencies and crowdfunding platforms (Chen et al. 2019; Haddad & Hornuf 2019; Cojoianu et al, 2020).

1.1.3 Global fintech landscape

In 2020, Findexable, a real-time fintech data company, launched the Global Fintech Index City Rankings 2020 Report, the first ranking of all cities with a fintech cluster (Findexable, 2020). This ranking is calculated from multiple indicators comprised of a combination of three metrics, that is, quantity (e.g., size of the fintech ecosystem, number of fintech firms, co-working spaces, and accelerators), quality (e.g., number of fintech unicorns, international collaboration, and website ranking), and environment (e.g., ease of doing business, critical mass, and regulatory environment). According to this report, the global fintech landscape is dominated by cities in

the United States (e.g., San Francisco Bay, New York, Los Angeles, and Boston), Europe (e.g., London, Berlin, and Paris). Within the Asia Pacific region, Singapore City ranked 1st and Bangalore is the next. Concerning China, Hong Kong is in the top 1 within China and ranked 11th in the world. However, no mainland China city enters into the top 20 global fintech hubs.

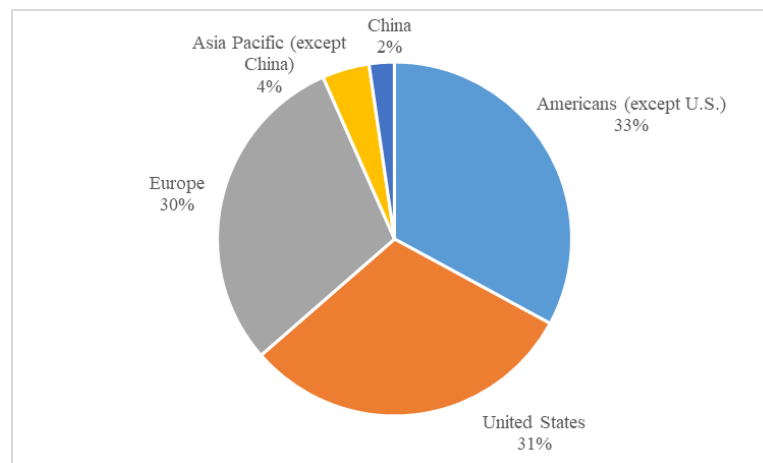
Figure 1. 4 Top 20 global fintech hubs in 2020

FINTECH RANK	City	Total Score
1	San Francisco Bay	80.136
2	London	54.888
3	New York	36.889
4	Singapore City	23.621
5	Sao Paulo	18.805
6	Los Angeles	17.867
7	Bangalore	16.093
8	Boston	15.795
9	Berlin	15.616
10	Mumbai	15.063
11	Hong Kong	14.778
12	Toronto	14.616
13	Sydney	14.470
14	Chicago	14.419
15	Paris	14.293
16	New Delhi	13.958
17	Tokyo	13.783
18	Tel Aviv	13.628
19	Atlanta	13.150
20	Miami	13.097

Source: Findexable (2020).

These dominant roles of the United States and Europe in the global fintech landscape are also revealed by the report Pulse of Fintech H2 2019 published by KPMG, a consultant company. In terms of the amount of M&A, private equity (PE), and venture capital (VC) deals, the KPMG's report shows that approximately 62% of the global fintech investment in 2019 was concentrated in the United States and Europe. Concerning the Asia Pacific and China, the whole Asia Pacific region accounted for approximately 6% of the global fintech investment in 2019. Among them, 2% of the fintech investment has occurred in China.

Figure 1. 5 The geographical breakdown of the fintech investment activity (M&A, PE, and VC) in 2019.

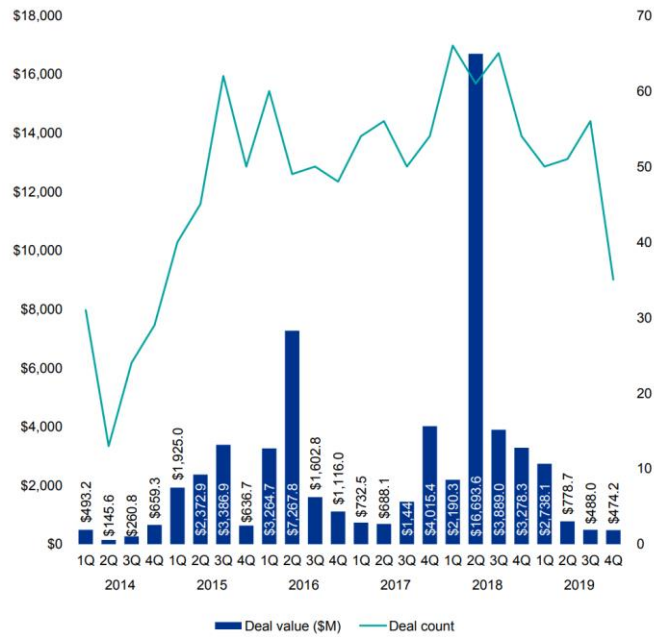


Source: Author based on data from the KPMG (2019).

Briefly, the global fintech landscape is geographically concentrated in the United States and Europe. China in particular and Asia Pacific region, in general, are still lagging.

However, if zooming in on China itself, China's fintech industry grew relatively rapidly in the past few years. In terms of the total investment (VC, PE, and M&A) in fintech, the amount of investment increased from \$1.5 billion in 2014 (\$31.3 billion in the USA, and \$14.7 billion in Europe) to \$4 billion in 2019 (\$59.7 billion in the USA, and \$58 billion in Europe), with a compound annual growth rate of 21% (14% in the USA, and 31% in Europe) (KPMG, 2019). Moreover, IPRdaily, an intellectual property cooperation platform, launched a report which zooms in on the specific corporations that applied for such fintech patents (IPRdaily, 2019). It shows that the 3 out of the top 10 fintech applicants in 2018 are Chinese companies, that is, Shenzhen-based Ping AN (Number of patents application: 1205), Hangzhou-based Alibaba (1147), and Shenzhen-based Tencent (393).

Figure 1. 6 Total investment activity (VC, PE, and M&A) in fintech in China, 2014-2019.



Source: KPMG (2019).

Table 1. 1 Top 20 fintech patent applicants in 2018

Ranking	Company	Country	The number of fintech patents application in 2018
1	Ping AN	China	1205
2	Alibaba	China	1147
3	MasterCard	United States	1002
4	IBM	United States	469
5	Google	United States	447
6	Walmart	United States	427
7	Tencent	China	393
8	Samsung	South Korea	345
9	VISA	United States	279
10	Toshiba	Japan	271

Sources: Author based on data from the IPRdaily (2019).

1.1.4 Interim summary of the practical background

As outlined above, I position this dissertation in the context of the 4th Industrial Revolution, in which the pace of digitalization has been dramatically accelerated worldwide. More specifically, digitalization has profoundly influenced many sectors, of which the financial

sector is one of the most digitalized sectors, and the term ‘fintech’ is coined to describe the digitalization of the financial sector. Currently, the global fintech landscape is geographically concentrated in the United States and Europe. Asia Pacific region in general and China, in particular, are still lagging. However, in the past few years, the pace of fintech development in China has been dramatically accelerated. China thus gradually becomes one of the key playgrounds in global fintech development. Against this background, the geography of China’s fintech industry is an interesting empirical question. The next subsection will elaborate on the related theoretical issues.

1.2 Theoretical literature review

Since 2014 when the term ‘fintech’ was used by global consultancy firms in industry reports (Lai & Samers, 2020), scholars with different theoretical perspectives have brought their lenses to investigate the phenomenon of fintech. Indeed, the Social Sciences Research Network reports that fintech-related research is now the fastest emerging research topic on the platform (David, 2018). Among them, finance and management are two key theoretical perspectives. Scholars in the field of finance tend to explore the blockchain protocol (Biais et al., 2019), blockchain-based settlement (Chiu & Koepl, 2019), smart contracts (Cong & He, 2019), and the performance of fintech adopters (Chen et al., 2019; D’Acunto et al., 2019). At the same time, studies in the field of management prefer the topics concerning the interrelation between fintech start-ups and financial incumbent (Fuster et al., 2019; Vallee & Zeng, 2019), and the factors that facilitated the rise of fintech (Haddad & Hornuf, 2018; Cumming & Schwienbacher, 2018).

1.2.1 The economic geography of fintech

Although the above literature has enhanced the understanding of fintech, it is surprisingly silent on one noteworthy perspective – namely, the economic geographical perspective. Indeed, the rise and development of fintech should not be understood as geographically ubiquitous. They rather have to be characterized as unevenly spatial distribution. Against this backdrop,

economic geographers recently call for the need to theorize the economic geographies of fintech (Haberly et al., 2019; Hendrikse et al., 2019; Lai & Samers, 2020). By theorizing fintech in economic geography, it means considering ‘how the intersections of financial products and services, technologies, and institutions are reshaping economic activities and their uneven outcomes’ (Lai & Samers, 2020, p5). Put simply, theorizing fintech in economic geography aims to examine and explain the emergence and growth of fintech from a geographic lens. To date, three theoretical approaches to fintech in economic geography are identified.

The first approach relies on the concepts of agglomeration and cluster. The seminal work is Marshall (1920), which highlights three distinct drivers of agglomeration (i.e., knowledge spillovers, input-output linkages, and labor market pooling). In the context of fintech, researchers adopting this approach stress the important role of region-specific assets in facilitating the rise of fintech in regions. For example, through analyzing almost 1000 fintech start-ups in France, Gazel & Schwienbacher (2020) find that the location of new fintech start-ups is positively related to the size of the cities and the presence of incubators. Another study explores the role of regional IT and financial sectors in fintech development (Cojoianu et al., 2020). Through investigating the emergence of fintech start-ups across 21 OECD countries, 226 regions, and over the 2007–2014 period, Cojoianu et al. (2020) find that the creation of regional fintech is positively related to regional IT as well as financial sectors. A similar positive relationship is also found when examines the association between country-level assets and the rise of fintech. For example, Dunshnitsky et al. (2016) find that the main drivers of crowdfunding platform creation in the EU-15 countries are the size of the national population, national entrepreneurial rates, and the presence of platforms operated by incumbent financial organizations. Similarly, Haddad & Hornuf (2019) find that fintech start-up formations occur more frequently in countries where the latest technology and supporting infrastructure are readily available. Moreover, Laidroo & Avarmaa (2019) find that fintech formation intensity is greater in countries with stronger financial and ICT services, based on the analysis of a country-level dataset covering the period of 2007–2017 and 107 countries.

The second approach builds on the network perspective which moves beyond the analysis of

simple attribute properties in regions and thus embraces a network model (Beaverstock et al., 2001; Faulconbridge, 2004). Specifically, the recent scholarly work draws on the notion of global financial networks (GFNs) which is defined as networks of the financial and business services firms, and their activities linking financial centers, offshore jurisdictions, and the rest of the world (Coe et al., 2014). With the rapid development of fintech, technology firms are playing increasingly important roles together with finance and business service firms (Lai, forthcoming). In this context, recent GFNs work extends the geographical network from the international financial centers and offshore jurisdictions and to the data centers and high-tech clusters (Haberly et al., 2019). As such, global fintech networks refer to networks of the financial, business services firms, tech firms, and their activities linking financial centers, offshore jurisdictions, data centers, high-tech clusters, and the rest of the world.

The third is a political economy approach which stresses the role of the state, the state-firm relationship as well as the regulatory environments in shaping the geography of the financial industry (Hall, 2018; Töpfer, 2018). It thus ‘calls for greater consideration of state actors and regulators in not only enabling FinTech growth through regulatory adjustments and risk management but also strengthening IFC competitiveness in entrepreneurial ways’ (Lai & Samers, 2020, p8). For example, Shim & Shin (2016) contend that the growth of FinTech is enabled by China’s government that makes use of a techno-nationalist strategy to create ‘national champions’ and shield domestically-owned firms from foreign companies, while also using a techno-globalist strategy to improve the global competitiveness of FinTech firms. Similarly, Gruin & Knaack (2020) find that the rise of the fintech sector in China mainly results from the Chinese state’s support because fintech not only support the real economy and improve financial inclusiveness but also support the activities of the ‘new economy’ which is a key pillar under the broader program of supply-side structural reform and economic rebalancing. Regarding Europe, Hendrikse et al. (2019) point out that the rise of the fintech industry in Brussels resulting from the strategic coupling of big financial institutions with small tech start-ups through specific actions of Belgian entrepreneurs and state actors. In addition to the above qualitative researches that focusing on the role of the state and the state-firm

relationship in the rise of fintech, several quantitative studies examine the role of regulatory environments in shaping the rise of the fintech industry. One early work conducted by Cumming & Schwienbacher (2018) find that fintech venture capital investments are relatively more common in countries with weaker regulatory enforcement because weaker labor regulation reduces failure costs of start-ups and the costs for employees to find a new job (Saxenian, 2002); the reduction or abolishment of minimum capital requirements increased entrepreneurship activities and thus ultimately risk-taking by entrepreneurs (Braun et al., 2013); weaker regulation enables tailored regulation that needed to encourage fintech (Hornuf & Schwienbacher, 2017); and regulations that create extra incentive effects encourage innovation (Blind, 2012). Similarly, through investigating the crowdfunding platforms worldwide, Rau (2019) shows that the introduction of explicit legal regulation appears to significantly increase crowdfunding volume. Moreover, Haddad & Hornuf (2019) find that fintech start-ups are more frequent in countries with a more benevolent regulation and a larger labor market.

Although the above existing approaches provide valuable insights to investigate the geography of the fintech industry, research on fintech might require a more dynamic and evolutionary analytical framework because fintech is a newly emerging subsector in the financial sector (Lai & Samers, 2020). From a temporal perspective, the emergence of a new industry mainly includes the pre-founding stage (the new industry has not yet been founded) and the post-founding stage (the new industry begins to emerge and develop) (Forbes & Kirsch, 2011; Martin, 2010). According to this category, the geography of the emergence of a new industry in regions should understand the transition from the pre-founding stage and the post-founding stage, that is, how regional industries at the pre-founding stage condition the emergence of the new industry in regions at the post-founding stage.

In order to establish a more dynamic and evolutionary analytical framework, it is necessary to incorporate the EEG (Lai & Samers, 2020). First, comparing with the existing three mainstream frameworks, EEG is more explicitly dynamic and has a reasonably clear framework building on the concepts, such as technological relatedness, related variety, and path dependence (Martin & Sunley, 2006; Frenken et al., 2007; Neffke et al., 2011). Moreover, EEG has emphasized the

role of institutional environments by integrating with the insights from institutional and political-economic geography (Boschma & Frenken, 2006; Boschma, 2015; Hassink et al., 2019). The next subsection, therefore, is to elaborate on the status quo of EEG.

1.2.2 The status quo of evolutionary economic geography

‘Put broadly, I can say that the basic concern of evolutionary economic geography is with the processes by which the economic landscape—the spatial organization of economic production, distribution, and consumption—is transformed over time’ (Boschma & Martin, 2007, p539). Thus evolutionary economic geography is quintessentially concerned with ‘*the spatialities of economic novelty* (innovations, new firms, new industries), with how the spatial structures of the economy emerge from the micro-behaviors of economic agents (individuals, firms, institutions); with how, in the absence of central coordination or direction, the economic landscape exhibits self-organization; and with how the processes of path creation and path dependence interact to shape geographies of economic development and transformation, and why and how such processes are themselves place dependent’ (Boschma & Martin, 2007, p540). Among others, ‘the question of how new regional growth paths emerge has repeatedly been raised by leading economic geographers ... as one of the most intriguing and challenging issues in the field of economic geography’ (Neffke et al., 2011, p241).

‘EEG has drawn on a range of theoretical influences both within and beyond evolutionary economics, EEG itself should be seen as something of a broad church’ (Coe, 2011, p84). In what follows I briefly sketch two strands of literature that have proven to be powerful approaches in this regard, namely, literature on regional diversification and literature on ‘path as a process’.

Regional diversification literature

Regional diversification literature can trace back to the seminal work of Boschma & Frenken in 2006. Boschma & Frenken (2006, p273) proposes the EEG is an emerging paradigm in economic geography which occurs ‘at the interface between neoclassical and evolutionary

theory (especially in modeling) and at the interface between institutional and evolutionary theory (especially in ‘appreciative theorizing’). The main question that regional diversification literature deals with is what kinds of new industries are more likely to emerge in regions.

One most influential claim in regional diversification literature is that regions are more likely to develop new industries that are technologically related to their pre-existing industries (Frenken & Boschma, 2007; Neffke et al., 2011). This process of pre-existing regional industry diversifies into the new technologically related industry is named as related regional diversification or regional branching. So far, systematic evidence shows that, no matter what kinds of regions, related regional diversification serves as a common rule. For example, systematic evidence on related regional diversification has been found in different regions, such as the Swedish regions (Neffke et al., 2011), Spanish regions (Boschma et al., 2013), US metropolitan regions (Essletzbichler, 2015), NUTS-2 regions in the EU (Cortinovis et al., 2017), and China’s prefectures (He & Zhu, 2019). It mainly builds on the concepts of proximity and relatedness. Work on proximity argues that too little cognitive distance increases the risk of lock-in, while too much cognitive distance is detrimental to communication (Nooteboom, 2000). Consequently, to make innovation properly, it requires some degree of cognitive proximity, but not too much. Scholars, therefore, propose that regions tend to create a new industry that is technologically related to regional industrial structure because the new industry could benefit from pre-existing regional industries when they are cognitive proximity. In parallel, work on relatedness also supports the above claim of the regional diversification literature. Technological relatedness refers to the situation in which two activities require similar technologies (Boschma, 2017; Hidalgo et al., 2018). As such, regions tend to diversify into a new industry that is related to the pre-existing regional industries because such pre-existing regional industries could provide technologies that new industry could build on, and therefore, reduce the cost of developing new industry (Boschma, 2018; Balland et al., 2019).

In addition to related regional diversification which the new industry is technologically related to regional pre-existing industries, scholars recently highlight the need to explore unrelated regional diversification (Boschma, 2017; Neffke et al., 2018). As the name suggests, unrelated

diversification refers to entering into a new industry that is less dependent on pre-existing regional industries and capabilities (Boschma, 2018). Unlike related regional diversification that has found evidence in different types of regions, unrelated regional diversification happens now and then, and only occurs in some particular regions. Specifically, scholarly work finds that unrelated diversification tends to occur in regions with high levels of economic development (Boschma & Capone, 2015), regions that possessed key enabling technologies (Montresor & Quatraro, 2017), regions with excellent research and innovation infrastructure (Xiao et al., 2018), and regions where the industrial structure is characterized by unrelated variety (Castaldi et al., 2015).

Yet, the above analysis mainly takes a technology-centric view (Boschma et al. 2017; Hassink et al. 2019). In fact, regions not only possess technology endowments but are also embedded in multi-scalar institutional environments (Martin, 2000; Hassink et al. 2019; MacKinnon et al., 2019a). Recently, scholars examine the role of institutions (at national and/or regional scale) in regional diversification, while the findings are contingent. At the national level, following the Varieties of Capitalism literature (Hall & Soskice 2001), Boschma & Capone (2015) find evidence that institutions associated with so-called ‘liberal market economies’ (i.e., institutions that regulate less tightly labor, capital, and product markets) are more likely to induce unrelated diversification because this kind of institutions gives countries more freedom to diversify. In contrast, institutions are known as ‘coordinated market economies’ (i.e., institutions that regulate more tightly labor, capital, and product markets) are more likely to induce related diversification because these kinds of institutions make countries stick more closely to what they have been doing in the past. At the regional level, through studying 118 European regions in the period 2004-2012, Cortinovis et al. (2017) find evidence that regional diversification (without zooming in on (un)related regional diversification) is more likely to occur in regions with bridging social capital which bridges different social groups and enables the creation of new combinations of different strands of knowledge. More recently, Santoalha & Boschma (2020) examine the role of both national and regional institutions (in terms of political supports) in the development of green technologies in 95 European regions in the period of 2000-2012.

They find that regional political supports tend to strengthen the role of relatedness in green technologies development, while national political supports tend to moderate the role of relatedness.

In addition to moving beyond the technology-driven view to exploring the role of the institution, another recent extension is moving from regional fetishism to consider both endogenous and exogenous factors (Dawley 2014; Binz et al. 2016; Boschma et al. 2017; Hassink et al. 2019; MacKinnon et al. 2019a). Recent studies find systematic evidence on the positive relationship between extra-regional linkage and regional diversification (without zooming in on (un)related diversification). For example, Neffke et al. (2018) find that non-local entrepreneurs and firms are more likely to induce unrelated diversification in regions because non-local actors can develop activities that rely on resources that do not exist in the host region. Similarly, Santoalha (2018) posits that cooperation across regions boosts regional diversification in Europe. Recently, Whittle et al. (2020) find that inter-regional inventor collaboration networks have a positive effect on related regional diversification in Europe, especially when external knowledge sourcing is done in a diverse set of regions. More recently, Balland & Boschma (2020) examine the role of inter-regional linkages in terms of relatedness in regional diversification. They find that what matters is not being connected to other regions *per se* but being connected to regions that provide complementary capabilities. That is to say, complementary inter-regional linkages increase the probability of regions in Europe to develop a technologically related new industry.

Finally, recent studies embrace the shift from the meso-level view of regional capabilities to the micro-level view of the regional actor (Boschma 2017; Boschma et al. 2017). Scholarly work finds that diversification and entrepreneurial spin-offs play a key role in related regional diversification (Klepper, 2007; Boschma & Frenken, 2011; Tanner, 2014). Evidence is shown by several studies, such as the automobile industry in Detroit (Klepper, 2007), the automobile industry in the UK (Boschma & Wenting, 2007), and the fuel cell industry in Europe (Tanner, 2014). In contrast, regional unrelated diversification tends to rely on the non-local actor. For example, by examining Swedish regions between 1994 and 2010, Neffke et al., (2018) find that

new subsidiaries that are established by large firms in other regions play a key role in regional unrelated diversification because they could rely on resources that do not exist in the host region (Neffke et al., 2018). Similarly, through investigating the manufacturing sectors in 67 Hungarian regions between 2000 and 2009, Elekes et al. (2019) find that foreign-owned firms tend to show a higher deviation from the regional assets and therefore are more likely to induce unrelated diversification in regions.

In terms of methodology, the regional diversification strand of EEG literature mainly follows the quantitative method (see, e.g., Neffke et al., 2011; Boschma, 2013; Feldman, et al., 2015; Rigby, 2015; Boschma, Martin, & Minondo, 2017; Montresor & Quatraro, 2017; Zhu et al., 2017; Xiao et al., 2018; Balland et al., 2019; Balland & Boschma, 2020). It has theorized with ‘tightly defining conceptual categories; specifying and theorizing their relationships; articulating and testing formal hypotheses; developing robust methods, research designs, and data sources; and measuring and mapping the incidence of associations, patterns, and regularities of evolutionary change across space and time’ (Pike et al., 2016, p133). Put simply, the quantitative work in evolutionary economic geography aims to examine the relationship between a set of independent variables (e.g., regional capability, regional institutions, and inter-regional linkage) and the dependent variable, particularly the emergence of a new industry. For example, the regional diversification literature examines the relationship between regional capability and the emergence of a new industry, and finds that related diversification is more likely to occur in regions where the regional pre-existing capabilities are technologically related to that new industry (Neffke et al., 2011; Boschma et al., 2013; Feldman, et al., 2015; Rigby, 2015; Zhu et al., 2017; Balland et al., 2019).

In terms of empirical work, the regional diversification literature has dealt with several technologies, like ecotechnologies in European regions (Van den Berge & Weterings, 2014), fuel cell technology in European regions (Tanner, 2016), nano-technologies in European regions (Colombelli et al. 2014), biotechnologies across world cities (Boschma et al., 2014), rDNA technology across US metropolitan areas (Feldman et al. 2015), and green technologies in European regions (Santoalha & Boschma, 2020).

'Path as a process' literature²

Since the early 1990s, it witnesses an increasing body of work in economic geography that seeks to explain the path-dependent growth of regional economy, particularly old industrial regions (e.g., Grabher, 1993; Bathelt & Boggs, 2003; Hassink, 2005). By path dependence, it means 'a path-dependent process or system is one whose outcome evolves as a consequence of the process's or system's own history' (Martin & Sunley, 2006, p399). Such regional path-dependent process is usually underpinned by a range of sources, such as sunk costs of local assets and infrastructures; natural resource basis of the economy; local external economies of industrial specialization; regional technological 'lock-in'; economies of agglomeration; region-specific institutions, social forms, and cultural traditions; and interregional linkages and interdependencies (Martin & Sunley, 2006). In the seminal work of Martin & Sunley (2006), they posit the need to shift attention from path dependence to path development and creation. In response, Martin & Sunley (2006, p. 408) propose a 'path as process' approach, 'wherein the process of economic evolution must be understood as an ongoing, neverending interplay of path dependence, path creation and path destruction that occurs as actors in different arenas reproduce, mindfully deviate from, and transform existing socio-economic-technological structures, socio-economic practices and development paths.' In brief, it suggests that 'processes of path destruction and new path creation are always latent in the process of path dependence' (Martin & Sunley, 2006, p. 408).

A key point of departure for discussing regional path development or regional industrial path development is Martin's (2010) alternative path-dependent model of local industrial evolution which criticizes the canonical path-dependent model of local industrial evolution set out by David (1985) and Arthur (1988). According to the canonical model, the rise of a new industry in a region is resulted from 'historical accident' and 'exogenous shock' (David, 1985; Arthur, 1988). Martin (2010) criticized that the original of a new local industry may not be due to

² This subsection is mainly based on the manuscript currently submitted and under review in *Regional Studies*, as Chen, Y. Rethinking asset modification in regional industrial path development: Toward a conceptual framework.

‘historical accident’ but enabled by pre-existing regional assets, and the emergence of a new local industry may not be due to unpredictable ‘exogenous shock’ but enabled by regional actors’ purposive experimentation. In response, Martin’s (2010) model distinguishes a first preformation phase constituted by the pre-existing regional conditions, a second path creation phase wherein actors leverage the inherited conditions to create a new path, a third path development phase wherein increasing returns assist path development and a final phase that may evolve dynamically or become locked in. Taking this framework as the starting point, new regional industrial path development in this dissertation concerns with the first and second phases, that is, how a new regional industrial path in the region at the second ‘path creation’ phase emerges from pre-existing regional preconditions in the first ‘preformation phase. More specifically, how regional actors, enabled through or constrained by regional preconditions in the first ‘preformation phase, develop a new regional industrial path in the second ‘path creation’ phase.

The regional precondition in the first ‘preformation’ phase reflects the outcome of previous rounds of regional industrial development (MacKinnon et al., 2019a; Grillitsch & Sotarauta, 2020). It offers a precondition that enables or constrains regional actors to generate a new regional industrial path in the second ‘path creation’ phase (Maskell & Malmberg, 1999; Boschma, 2017; MacKinnon et al., 2019a; Grillitsch & Sotarauta, 2020). In the literature on path development (creation), the regional precondition is often described by several largely synonymous terms, e.g., regional assets (MacKinnon et al., 2019a), regional capabilities (Boschma, 2017), and regional resources (Binz et al., 2016). They all represent a combination of the region’s technology, institution, natural assets, infrastructure, built environment, etc. (Maskell & Malmberg, 1999; MacKinnon et al., 2019a).

In order to generate a new regional industrial path in the second ‘path creation’ phase, regional assets in the first ‘preformation’ phase need to be modified by regional actors in terms of de-locking mechanisms (Martin & Sunley, 2006; Martin, 2010; Mackinnon et al. 2019a) or asset modification processes (Trippel et al., 2020). First, strongly inspired by the seminal work by Martin & Sunley (2006), recent research particularly focuses on four de-locking mechanisms

in harnessing regional assets to generate a new regional industrial path, that is, upgrading, diversification, transplantation, and indigenous creation (Isaksen & Trippel, 2016; Grillitsch et al., 2018; MacKinnon et al. 2019a). Specifically, upgrading presents the process of enhancing the region's pre-existing industry by infusing new technologies. Diversification describes the process that core technologies in one pre-existing regional industry are redeployed to provide the basis of another new industry in regions. Transplantation refers to importing new industry or technology from elsewhere. Indigenous creation means leveraging a new technological paradigm to establish new industries without local technological antecedents. Second and more recently, scholars suggest that there are three forms of asset modification that play a crucial role in manipulating regional assets to facilitate regional industrial path development, that is, reusing (redeploying and recombining) pre-existing regional assets, creating new regional assets, and destructing pre-existing regional assets (Trippel et al., 2020).

Arguably, such assets modification processes are largely analogous and can be adapted to refer to the de-locking mechanisms. Specifically, diversification evokes the process of reusing (redeploying) pre-existing regional assets. Indigenous innovation and transplantation can be understood as creating new regional assets that are new-to-the-world and new-to-the-region but have existed elsewhere, respectively. Upgrading also involves creating new regional assets which in turn can enhance the pre-existing industry. In what follows, I use the notion of asset modification, because the de-locking mechanisms (upgrading, diversification, importation) easily confuse with the typology of regional industrial path development that I will discuss later (path upgrading, path diversification, path importation).

Drawing on the asset modification processes, a region can experience different types of regional industrial path development (i.e., path extension, path upgrading, path diversification, path transplantation, and new path creation) (Martin & Sunley, 2006; Isaksen & Trippel, 2016; Grillitsch et al., 2018). Such regional industrial development paths are defined concerning the relationship with the pre-existing regional industrial path. The first is path extension which refers to the continuation of the pre-existing regional industrial path. It mainly relies on preserving pre-existing assets without asset modification (Isaksen & Trippel, 2016; Grillitsch et

al., 2018). The second is path upgrading which refers to the rise of a new direction within the pre-existing regional industry. This new direction results from adopting newly created regional assets to upgrade the pre-existing industry (Martin & Sunley, 2006; Isaksen & Trippel, 2016; Grillitsch et al., 2018). Unlike path extension and upgrading that occur within the pre-existing regional industry, the others point to the rise of a new industry. The third is path diversification which refers to the rise of a new industry that is related to the pre-existing regional industry. In principle, two industries are related when they require similar assets (Hidalgo et al., 2018). Consequently, pre-existing regional industries provide assets that the new industry can build on (Boschma, 2017, 2018; Hidalgo et al., 2018). In this sense, path diversification results from reusing (redeploying) pre-existing regional assets (Martin & Sunley, 2006; Isaksen & Trippel, 2016; Grillitsch et al., 2018). The last two types are path importation and new path creation which refer to the rise of a new industry that is less related to the pre-existing regional industry. Due to the lack of relatedness, these two types of paths mainly stem from creating new regional assets instead of reusing (redeploying) pre-existing regional assets like path diversification. The difference between these two paths is the degree of innovation of the newly created assets. Specifically, the asset modification process underpinning path importation is creating new-to-the-region assets through transplanting from other regions, whereas new path creation results from creating new regional assets that are not only new-to-the-region but also new-to-the-world (Martin & Sunley, 2006; Isaksen & Trippel, 2016; Boschma, 2017; Grillitsch et al., 2018).

In line with the above framework, several scholars have developed extensions. The first zoom in on differentiated regional preconditions and investigates regional industrial path development in different types of regions. Grillitsch & Trippel (2016), and Isaksen & Trippel (2016) adopt the notion of the regional innovation system (RIS) to present different types of regional preconditions. Distinguishing between organizationally thin and thick versus specialized and diversified, three types of RISs are identified (Tödtling & Trippel, 2005; Isaksen & Trippel, 2016). The first type of RIS, described as an organizationally thin RIS, often has a few weak organizations, either firms or non-firm actors. It thus exhibits a lack of critical mass in any specific industry, let alone a diverse regional industrial structure. Typical regions are

rural or peripheral areas. The second type is the organizationally thick and specialized RIS, such as old industrial areas and specialized clusters. It is characterized by the presence of strong organizations that concentrate on one sector, leading to a specialized regional industrial structure. The last type is the organizationally thick and diversified RIS. It is usually well endowed with a set of strong organizations as well as diversified industries rather than featuring specialization. Such RISs are often found in metropolitan areas and innovation hubs.

How does the above differentiated regional precondition condition the probability for new path development in regions? First, the organizationally thick and diversified RISs offer favorable conditions for path upgrading, path diversification, and new path creation, because this type of RIS hosts a variety of new knowledge. The latter may be used to modernize the existing industry for path upgrading, recombined with existing knowledge for path diversification, and facilitated radical innovation for new path creation (Isaksen & Trippl, 2016; Grillitsch et al., 2018). Second, concerning the thick and specialized RISs and thin RISs, they tend to be more difficult to develop a new path, as the local preconditions offer few new resources (Tödting & Trippl, 2005; Isaksen & Trippl, 2016; Boschma, 2015). Instead of nurturing a new path, the thick and specialized RISs and thin RISs often experience path extension resulting from incremental innovation, which is based on the use of existing technology and limited new knowledge (Isaksen & Trippl, 2016; Grillitsch et al., 2018). In order to develop other paths (e.g., path upgrading, diversification, and importation), the thick and specialized RISs and thin RISs have to rely on the extra-regional assets. For example, the thin RISs can access extra-regional assets to upgrade their small and under-developed industry into a well-developed one (Humphrey & Schmitz, 2002; Montresor & Quatraro, 2017). Similarly, thin RISs are likely to rely on the arrival of extra-regional actors to foster path importation (Nam, 2015). Path diversification is more difficult for thin RISs, as it requires substantial firms and R&D organizations in at least one industry, which the thin RISs cannot offer (Grillitsch & Trippl, 2016). Moreover, thin RISs have a lower capacity to attract and absorb knowledge from elsewhere (Trippl et al., 2018). In contrast, in thick and specialized RISs, it has at least one well-developed sector that offers favorable conditions for path diversification (Chen & Hassink,

2020). Moreover, the thick and specialized RISs have a relatively higher capability to attract knowledge from other regions (Trippel et al., 2018). Concerning path upgrading and path importation, they are feasible in thin RISs, let alone thick and diversified RISs and thick and specialized RISs, which possess better endowments (Chen & Hassink, 2020).

Another extension takes into account how institutional agents and institutional environments at multi-scale (particularly at the regional and national level) influence the regional industrial path development (Gong & Hassink, 2019). As Martin & Sunley (2006, p. 412) remind us, ‘paths in a region may be shaped by...reliance on financial institutions elsewhere; and influence exerted by economic and regulatory policies pursued in other regions and at the national level (or even beyond)’. In the empirical work, Dawley (2014) investigates the rise of offshore wind paths in the peripheral region of North East England. They find that the industry emerged from an episode of entrepreneurial activity, subsequently developed catalyzed by a decade of strategic and contextual regional policy intervention, and recently a radical restructuring of economic development governance in the United Kingdom created a policy vacuum for the path’s development. Similarly, MacKinnon et al. (2019b) examine the rise of offshore wind paths in various countries in Europe. They illustrate the significant role of nation-states and institutional environment at different spatial scales in mediating the strategic coupling of assets to mechanisms of new regional industrial path development.

In terms of methodology, the ‘path as process’ strand of EEG literature is more qualitatively focused (see, e.g., Dawley, 2014; Binz et al. 2016; Steen & Hansen, 2018; MacKinnon et al., 2019a; Trippel et al., 2020). It has theorized with ‘looser and less tightly defined concepts; undertaken comparative analysis between different geographic settings; provided rich empirical studies capturing the diversity, variety, and heterogeneity of evolutionary change; and sought to identify explanatory causal relations, mechanisms, and processes’ (Pike et al., 2016, p133). Put simply, the qualitative work aims to unravel causal relations, mechanisms, and processes that give rise to the emergence of a new industry. For example, Martin (2010) developed an alternative path-dependent model of local industrial evolution model that distinguishes a first preformation phase constituted by the pre-existing regional conditions, a

second path creation phase wherein actors leverage the inherited conditions to create a new path, a third path development phase wherein increasing returns assist path development and a final phase that may evolve dynamically or become locked in. According to this framework, the original of a new local industry results from the interplay between pre-existing regional assets as well as regional actors' purposive experimentation. Recently, inspired by the literature on technological innovation systems. Similarly, Trippl et al. (2020) claim that regional industrial path development results from the interplay between regional preconditions (i.e., pre-existing industrial structures, organizational support structures, institutional set-ups, and natural assets) as well as agentic processes of asset modification (i.e., re-use, creation/transplantation and destruction of assets).

In terms of empirical work, the 'path as process' literature has dealt with several technologies, like fuel cell technology in European regions (Tanner, 2014), on-site water recycling in Beijing (Binz et al., 2016), electronics and software industry in Arendal–Grimstad in southeastern Norway (Isaksen & Trippl, 2017), the software industry in Mühlviertel in Upper Austria (Isaksen & Trippl, 2017), offshore wind power industry in North East England (Dawley, 2014), offshore wind power industry in Norway (Steen & Hansen, 2018), and offshore wind power industry in Germany (MacKinnon et al., 2019b).

1.3 Identifying the research gaps

Based on the above discussion, this subsection leads to the theoretical, methodological, and empirical gaps.

Theoretical gaps

(1) It is fair to say that extant literature has not yet fully understood the role of the demand-side market in the emergence of the new industry in regions, although a handful of studies have claimed that the prevailing technology-centric view should be extended with a demand-side perspective (MacKinnon et al., 2019a; Martin et al., 2019). For example, MacKinnon et al. (2019a) claim that market construction (together with regional and extra-regional assets, actors,

mechanisms, and institutional environments) is one of the five key elements in the emergence of a new industry. Specifically, the market construction is ‘principally concerned with how “economic agents create and shape ... market structures” through their “actor-specific practices” (Coe and Yeung 2015, 96)’ (MacKinnon et al., 2019a, p12-13). However, their work does not mention what the ‘actor-specific practices’ are and how those practices influence the emergence of a new industry. The work by Martin et al. (2019) differentiates various types of consumers and their needs (e.g., anonymous consumer, sophisticated buyer, active co-developer, public procurer, and norm and value setter), and further links these multiple demands with different types of new industrial development (e.g., path extension, path upgrading, path diversification, path importation, and new path creation). Compared with the work by MacKinnon et al. (2019a), this work goes one step further by zooming in on multiple customers and their needs. However, this work does not explicitly explore ‘actor-specific practices. In other words, it has not yet known how regional actors (i.e., firms and multiple customers) take action (in terms of asset modification) to foster the emergence of the new industry in regions. Consequently, I would like to know:

- ① Does the demand-side market influence the emergence of a new industry in regions, and if so, how? Particularly, how do regional actors modify the demand-side market to foster the emergence of the new industry in regions

(2) In addition to the demand-side market, extant literature has not yet fully understood the role of the institutional logic in the emergence of the new industry in regions. So far, the scholarly work mainly focuses on regulative institutions, such as policy intervention (Dawley, 2014), labor market regulation (Boschma & Capone, 2015), and political support (Santoalha & Boschma, 2020). Yet, what these studies do not account for is the role of institutional logic in the emergence of a new industry in regions. Institutional logics are defined as ‘a set of material practices and symbolic constructions which constitutes its organizing principles and which is available to organizations and individuals to elaborate’ (Friedland & Alford, 1991, p248). In other words, institutional logics are taken-for-granted belief systems guiding the behavior of field-level actors and related decision-making that predominate in an organizational field

(Thornton & Ocasio, 1999; Suddaby & Greenwood, 2005; Battilana & Dorado, 2010; Edvardsson et al., 2014). Taking the field of the banking sector as an example, the dominant institutional logics are that ‘required profits sufficient to support ongoing operations and fulfill fiduciary obligations’ (Battilana & Dorado, 2010, p1419). In recent literature on evolutionary economic geography, a handful of scholars have started to pay attention to the role of institutional logics in the new industrial emergence and development (see Isaksen et al. 2020a, 2020b). For example, Isaksen et al. (2020a, 2020b) investigated the digital transformation of regional industries in Norway, in which they found that the digital transformation might challenge firms’ pre-existing mindset and firms should get rid of the outdated mindsets for coming up with the new ones that adapting to digitalization. However, the extant literature has not yet systematically dealt with the specific strategies that regional actors modify their pre-existing institutional logics to adapt and support the new industry. Consequently, this thesis would like to know:

- ② Do institutional logics influence the emergence of a new industry in regions, and if so, how? Particularly, how do regional actors modify the institutional logics to foster the emergence of the new industry in regions?

Methodological gaps

As discussed above, there is a dualism in evolutionary economic geography research between qualitative and quantitative work (Coe, 2011; Pike et al., 2016). Yet, it is ironic that the original purpose of EEG is to seek a methodology integration. As the seminal work by Boschma & Frenken (2006, p292) put it: ‘Evolutionary Economic Geography makes use of formal theorizing grounded in more realistic assumptions (like bounded rationality), but it also conducts case-study approaches that analyze regional specificities from a dynamic perspective. In short, evolutionary scholars favor methodological pluralism.’ However, so far, ‘nearly all of the extant literature is either qualitative or quantitative – very few if any pieces operated in, and connected, both realms’ (Coe, 2011, p87).

In fact, quantitative and qualitative approaches should not be viewed as rigid, distinct

categories, opposites, or dichotomies. Instead, they represent different ends on a continuum (Newman et al., 1998). In response to the dualism in evolutionary research between qualitative and quantitative research, recent scholars emphasize the need to bring quantitative and qualitative approaches together to learn from each other in joint research (Coe, 2011; Neffke et al., 2011; Pike et al., 2016). As Coe (2010, p87) puts it, ‘one area of apparent agreement is in the domain of methodology. All participants see room for, and the necessity of, both quantitative and qualitative approaches.’ In response, Pike et al. (2016) propose the mixed-method as a potential approach, as Pike et al. (2016, p135) put it: ‘foster mixed-method approaches—from discourse, textual analysis, and ethnography to surveys and statistical analysis—to benefit from complementary expertise and focus on common empirical concerns and the creation of spaces for joint working and learning.’ Consequently, I would like to know:

- ③ How to apply the mixed-method to integrate qualitative and quantitative research in evolutionary economic geography?

Empirical gaps

In terms of empirical work, this thesis concerns the literature on both evolutionary economic geography and financial geography.

First, concerning the literature on evolutionary economic geography, it so far has examined the biotechnologies (Boschma et al., 2014), nano-technologies (Colombelli et al. 2014), fuel cell industry (Tanner, 2014), eco-technologies (Van den Berge & Weterings, 2014), rDNA technology (Feldman et al. 2015), on-site water recycling industry (Binz et al., 2016), software industry (Isaksen & Trippel, 2017), and offshore wind power industry (Steen & Hansen, 2018; MacKinnon et al., 2019b). Yet, there is hardly any study that analyses the emergence of the fintech industry from the perspective of evolutionary economic geography.

Second, concerning the literature on financial geography, (i) most empirical work to date has been conducted at the national level. For example, Dushnitsky et al. (2016) investigated the crowdfunding platform in 15 European countries, Cumming & Schwienbacher (2018) examined the volume of fintech investments in fintech across 63 countries, Haddad & Hornuf,

(2018) analyzed the emergence of the global fintech industry covering 107 countries, Laidroo & Avarmaa (2019) examined the geography of fintech formation in 107 countries, and Rau (2019) investigated the crowdfunding volume across 93 countries. (ii) So far, there are very few studies on the geography of fintech were conducted at the subnational level (Wójcik, 2020). Even though a few studies concern a regional-level analysis, their sample does not cover China's cities. For example, Cojoianu et al. (2020) deal with 21 countries and 226 regions, yet their sample does not cover China's cities. Similarly, Gazel & Schwienbacher (2020) only deal with the cities in France. (iii) Although the literature on the financial industry in cities in China is abundant, there is hardly any literature dealing with fintech. For example, Yeung (2009) analyzed the banking industry in China; Lai (2012) examined the roles of Shanghai, Beijing, and Hong Kong in China's financial center network; Pan et al., (2016) investigated the rise of venture capital centers in China; Li & Wang (2019) investigated the securities industry in China. Consequently, from the empirical point of view, this dissertation would like to explore:

- ④ What does the emergence of the fintech industry across China look like? How does evolutionary economic geography explain the emergence of the fintech industry in China?

1.4 Structure of the dissertation

To solve the above four gaps, the dissertation consists of six chapters and is organized as follows (see Figure 1.7).

Chapter 1 begins with a brief introduction to the development of the fintech industry, leading to an empirical question of 'the geography of the fintech industry in China'. It then presents a review of recent literature on fintech research as well as evolutionary economic geography. After that, four theoretical, empirical, or methodological research gaps are identified.

Chapter 2 introduces a historical and evolutionary analysis of fintech in China in general and in Shenzhen in particular. Specifically, I pay attention to the role of three types of players (i.e., governments, tech firms, and financial incumbents) in shaping the evolution of the fintech industry in China.

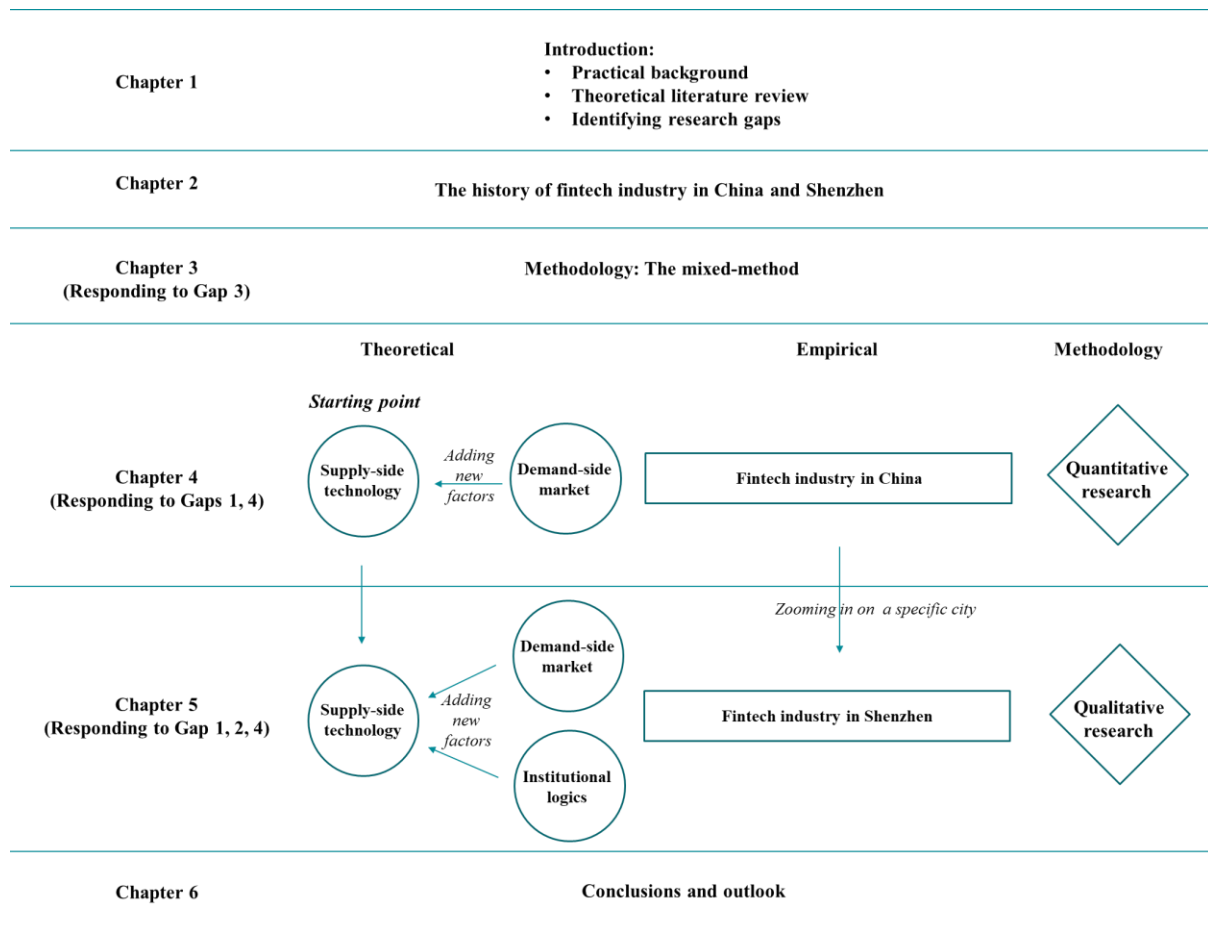
Chapter 3 concerns the methodology I use in this dissertation (Responding to gap-3). This chapter begins with a brief introduction of the mixed-method that integrates the otherwise separate qualitative and quantitative research in evolutionary economic geography. Specifically, four concrete ways of integrating qualitative and quantitative methods are presented. Finally, I present how I apply this mixed-method to guide the research in this dissertation.

Chapter 4 examines the geography of China's fintech industry. So far, EEG has not yet been applied to examine the fintech industry. This chapter thus extends the empirical work of EEG into the fintech industry (Responding to gap-4). Specifically, this chapter empirically examines whether the principle of technological relatedness can be generalized into the fintech industry. Theoretically, this chapter moves beyond the supply-side technological relatedness and takes into account the role of the demand-side market. Specifically, this chapter applies the quantitative regression analysis to examine whether market demands do matter for the emergence of the fintech industry across China (Responding to gap-1).

Chapter 5 conducts a qualitative case study to examine the rise of fintech in Shenzhen. Empirically, compared with chapter 4 which deals with the whole of China, chapter 5 zooms in on one particular city, Shenzhen (Responding to gap-4). Theoretically, in line with the quantitative research in chapter 4, chapter 5 also takes into account the role of the demand-side market but is based on qualitative research (Responding to gap-1). Moreover, chapter 5 further adds a new factor, namely institutional logics, as well as examines the role of the institutional logics in the emergence of a new industry (Responding to gap-2).

Chapter 6 summarizes the key findings of this whole dissertation. Theoretical, empirical, and methodological contributions to the evolutionary economic geography are identified. Policy recommendations on fintech development are presented. Limitations and suggestions for future research are also provided.

Figure 1. 7 Research Process Flowchart



Source: Author (2020).

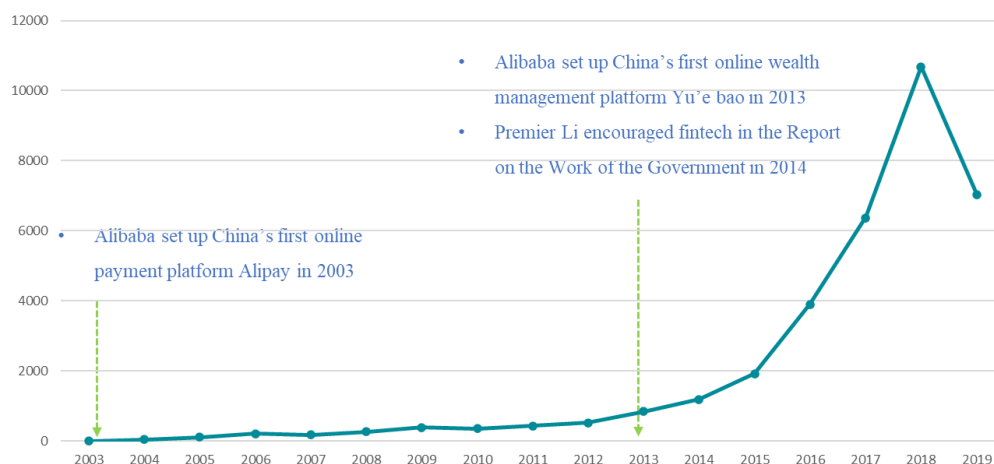
Chapter 2: History of the fintech development in China and Shenzhen

This chapter provides a retrospective overview of the history of fintech development in China and Shenzhen. More importantly, it provides a context for the analysis in Chapter 4 which examines the geography of the fintech industry in China and Chapter 5 which examines the rise of the fintech industry in Shenzhen. This chapter includes four subsections, namely, the evolution of the fintech industry in China, the geographical distribution of the fintech industry in China, the evolution of the fintech industry in Shenzhen, and the summary.

2.1 The evolution of the fintech industry in China

The fintech industry in China has evolved from stage 1 (before 2003) through stage 2 (2003-2012) and now to stage 3 (2013-2019). The periodization of fintech depends on the collected fintech-related patent data, key events, and key players (i.e., the governments, financial incumbents, and tech companies) in China's fintech history. Specifically, the fintech-related patents include two IPC codes G06Q20 (payment) and G06Q40 (banking, insurance, exchange investment). The patent data was extracted from China's National Intellectual Property Administration (NIPA).

Figure 2. 1 The periodization of fintech development in terms of the patent in G06Q20 and G06Q40



Sources: Author based on data from the NIPA (2020).

Stage 1: the infant stage (Before 2003)

China's fintech industry experienced an infant stage of development before 2003. As shown in Figure 2.1, there are very few fintech patents before 2003. In this stage, financial companies gradually adopted information technology to automatize their internal operations. However, most of the important hardware and software came from foreign companies (Shim & Shin, 2016; Van Rijn, 2017). For example, business software was generally purchased from Oracle and SAP, servers from IBM and HP, and storage hardware from IBM and Hitachi Data Storage (Nolan, 2014).

A more important event in this stage was the digitalization of the domestic payment system, which aimed to reduce technological barriers to financial transactions (Lovelock & Ure, 2002). The key players were states and financial incumbents. The central government and the Ministry of Industry and Information Technology launched the 'Golden Card Project' in 1995 (Shim & Shin, 2016). This project was designed to create a nationwide electronic transition network, particularly the ATM network (Lovelock & Ure, 2002). Under this project, the government established the bankcard association, China UnionPay Network in Shanghai in 2002, to process and clear interbank payments in China (Wang, 2015). In addition, financial companies have also used internet technology to offer online financial services since the 1990s. For example, Shenzhen-based China Merchant Bank introduced China's first online banking services with the functions of payment and asset management in 1997 (Kurnia et al., 2010). Subsequently, other banks introduced similar products, such as the Bank of China in 1999 and China Construction Bank in 1999 (Ibid.).

Stage 2: the development stage (2003-2013)

The launch of Alipay, an internet payment platform, in 2003 marked the beginning of the second stage of fintech development in China. Since then, increasing interaction between finance and internet technology has been observed. The number of fintech patents in China has increased from almost zero in 2003 to more than 1000 in 2013 (see Figure 2.1). The most visible feature of the fintech movement during this stage was the rise of tech companies that

entered the fintech industry (Shim & Shin, 2016). Consequently, the development of the fintech industry in stage 2 was not only driven by states and financial companies, but also by the new player, namely, tech companies.

During this stage, the central government continued its effort to modernize the online payment system (Shim & Shin, 2016). In this sense, several policies were enacted by the central government. In April 2005, the People's Bank of China issued 'Some Opinions on Promoting the Bankcard Industry.' This created a favorable policy environment for the further development of bankcards (People's Bank of China, et al., 2005). The year 2010 was another key time. The People's Bank of China promulgated a regulation on third-party payment that allowed nonbank firms to offer online payment services. Under this regulation, more than 200 companies were formally licensed (People's Bank of China, 2010).

The most visible feature in this stage was the rise of tech companies that offered solutions ranging from online payments to online lending platforms (Arner et al., 2015). Concerning online payment, China's e-commerce giant Alibaba, launched the Alipay platform, an internet payment service for its e-commerce platform, in Hangzhou in 2003 (Shim & Shin, 2016). Shortly after, in 2005, Shenzhen-based Tencent, China's social media and online giant launched its Tenpay platform (Shim & Shin, 2016). Concerning online lending, China's first peer-to-peer online lending platform, PPD AI Group, was established in Shanghai in 2007 (Association of Chartered Certified Accountants, 2015). Thereafter, the growth of the online peer-to-peer lending industry accelerated with the addition of approximately 800 platforms by the end of 2013 (WDZJ, 2014). In addition, Alibaba set up two micro-lending companies in Hangzhou and Chongqing in 2010 and 2011, respectively (Arner et al., 2015).

Moreover, financial incumbents accelerated the integration of information technology with financial services. For example, Beijing-based Industrial and Commercial Bank of China and Beijing-based China Construction Bank collaborated with Hangzhou-based Alibaba in 2009 to facilitate lending to domestic small business customers in China (Shim & Shin, 2016). Similarly, Shanghai-based UnionPay partnered with the Beijing-based China Mobile to

announce a new payment service in 2012 to facilitate the use of mobile devices for remote payment services (Xinhua, 2013).

Stage-3: the booming stage (2013-2019)

Although the states, financial incumbents, and tech companies remained the key players, as in stage 2, stage 3 witnessed the explosive pace of fintech development. As shown in Figure 2.1, the average annual number of fintech patents in China was more than 2,000 during 2013-2019. This latest wave of financial innovations was powered by a favorable regulatory environment (Shim & Shin, 2016).

Since the 18th Central Committee meeting in November 2013, the necessity of a vibrant and growth-facilitating financial system that serves the changing real economy has been broadly recognized among economic policymakers (Gruin, 2019). For this reason, fintech has become an important element in increasing financial inclusion and assisting with deeper structural economic rebalancing (Gruin & Knaack, 2020). In 2014, Premier Li Keqiang encouraged the development of fintech in the Report on the Work of the Government, stating that Internet-based finance has swiftly risen to prominence and that the healthy development of Internet finance will be promoted (Li, 2014). Such a positive attitude and freedom from regulation fostered the rapid growth of the fintech industry because the encouragement and tolerance from authorities provided great space for companies to participate in fintech innovation (Liu, 2014; Gruin, 2019). However, the lack of regulation gave rise to fraud. For instance, the Ponzi scheme conducted by the peer-to-peer lending platform Ezubao, which raised more than 1.5 billion yuan, was the largest financial fraud case in China (Buchanan & Cao, 2017). Consequently, the regulatory environment started to become more sophisticated, and more emphasis was placed on healthy development and risk management. In late 2015, the first formal regulatory framework for fintech was developed by the People's Bank of China and the other nine ministries. It clarified the responsibilities of the main financial regulators in supervising internet finance, encouraged financial innovation, and promoted the healthy development of internet finance (People's Bank of China et al., 2015). More recently, in 2019, People's Bank

of China announced its fintech development plan for 2019 to 2021 to encourage the adoption of cutting-edge technology (e.g., artificial intelligence, blockchain, cloud computing, big data, and Internet of Things) in financial service, on the one hand, and to curb financial risks, on the other hand (People's Bank of China, 2019).

In this stage, the tech companies also entered a new phase. Their scope was no longer limited to online payment and lending. One of the most notable new features was the emergence of online wealth management platforms and internet-based private banking (Arner et al., 2015; Shim, & Shin, 2016). The first online wealth management platform, namely Yu'e Bao, was launched by Hangzhou-based Alibaba in 2013 (Zhu, 2018). Only four years later, Yu'e bao became the world's largest money market fund (Financial Times, 2017). Inspired by Alibaba's success, Shenzhen-based Tencent entered the online wealth management market by launching an investment platform called LiCaiTong in 2014, which was an online money market fund similar to Alibaba's Yu'e bao (Swanson, 2014). Concerning internet-based private banking, the central government launched a pilot project to establish five new banks, wholly owned by private investors in Shanghai, Tianjin, Zhejiang, and Guangdong in 2014 (Financial Times, 2014). Among them, two new private banks are online-only banks with no brick-and-mortar branches. The first privately-owned internet-based bank, namely WeBank, was founded by Tencent in Shenzhen in 2015 (Lu, 2016). Following WeBank, Alibaba launched its online-only bank, namely MyBank in Hangzhou in 2015 (Reuters, 2015). Later, China Citic Bank Corp and search engine giant Baidu launched a direct online bank, AiBank, in Beijing in 2017 (Reuters, 2017).

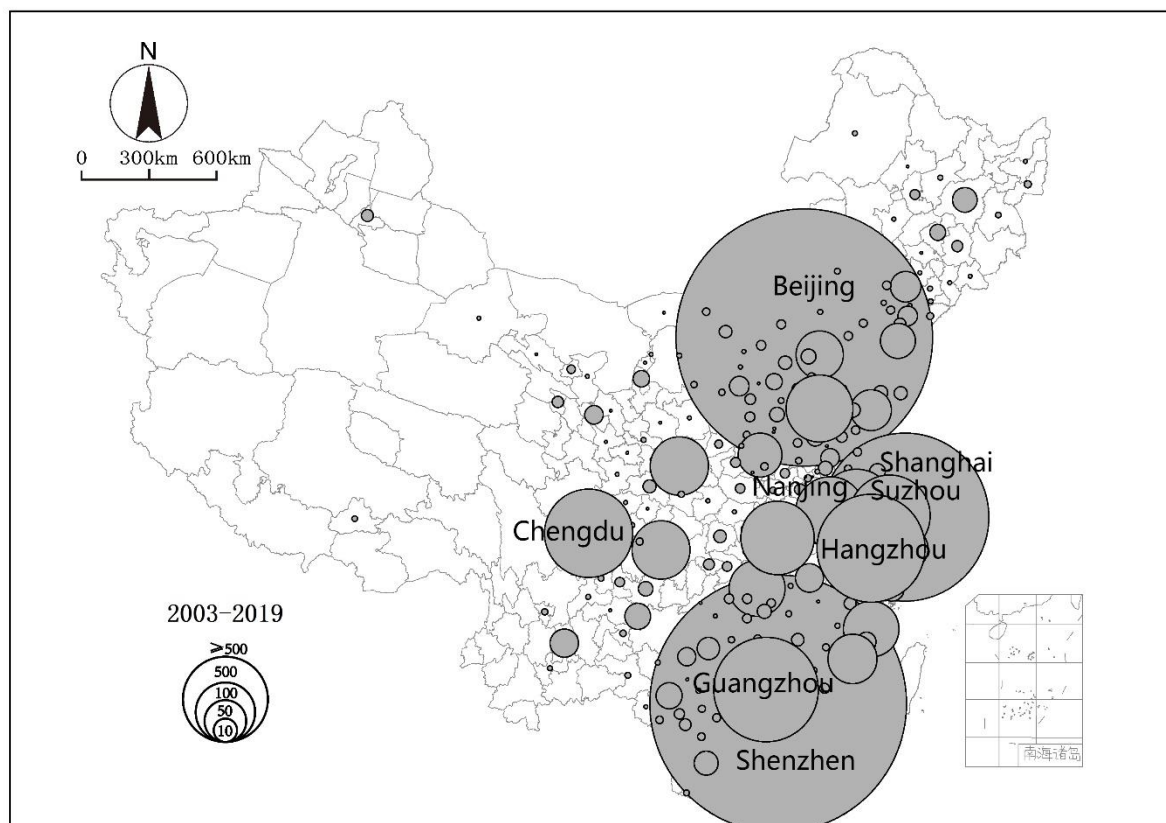
To compete with the tech giants, particularly Alibaba and Tencent, financial incumbents responded by launching online services and competitive online products (Shim & Shin, 2016). For instance, in 2015, Beijing-based Industrial and Commercial Bank of China was the first commercial bank to launch an Internet finance brand called 'e-ICBC', which creates an integrated online and offline financial system and enhances big data applications in financing and payment services. (Chen et al., 2017). In parallel with this trend, several banks further developed their fintech subsidiaries to apply cutting-edge technologies to financial services

(Institute of International Finance, 2018). For example, the Bank of China launched the Bank of China Fintech Company in the Pudong New District of Shanghai, which became the first fintech subsidiary established by a financial incumbent (China Banking News, 2019a). The Industrial and Commercial Bank of China launched its own wholly invested fintech subsidiary in the Xiong'an New District of Hebei Province, close to Beijing (Ibid.).

2.2 The geographical distribution of the fintech industry in China

In terms of the number of fintech patents, the geographical distribution of the fintech industry in China was dominated by three prominent eastern coastal cities, namely, Beijing, Shenzhen, and Shanghai (see Figure 2.2). This makes sense because most of the key events mentioned in subsection 2.1 took place in these three important cities.

Figure 2. 2 The development of the fintech industry during 2003-2019



Sources: Author based on data from the NIPA (2020).

The dominant roles of Beijing, Shenzhen, and Shanghai in China's fintech landscape are consistent with the geographical distribution of China's financial and internet industry. Specifically, Beijing, Shanghai, and Shenzhen are the three leading financial centers and high-tech centers in China. Concerning financial centers, Beijing is the regulatory center and acts as the national financial decision-maker (Lai, 2012; Zhao et al., 2013). Moreover, Beijing is strong in terms of domestic banks, insurance markets, and venture capital (Zhao et al., 2013; Pan et al., 2016). Shanghai is the hub of securities companies and foreign banks (Lai, 2012; Zhao et al., 2013). Shenzhen is an important venture capital center in China (Zhao et al., 2013; Pan et al., 2016). Concerning high-tech centers, Beijing is the dominant center of elite universities and research institutes in China (Chen, & Kenney, 2007; Zhou, 2008). Moreover, Beijing has China's first and largest science park, namely ZGC Science Park (Zhang, 2013). In addition, Beijing is home to tech giants, such as Baidu and Tiktok. Shanghai is the second-best national center of advanced education and talent in China and is home to the Zhangjiang High-tech Park (Zhang, 2013). Shenzhen is another high-tech center in China where most of the R&D capabilities are concentrated within companies rather than universities or research institutes, as they are in Beijing and Shanghai (Chen & Kenney, 2007). Moreover, Shenzhen is home to tech giants, such as Huawei and Tencent.

In sum, as three leading financial centers and high-tech centers in China, Beijing, Shanghai, and Shenzhen possess more capabilities necessary for fintech development (i.e., fintech is the combination between finance and technology), enabling great development of the fintech industry within their jurisdictions.

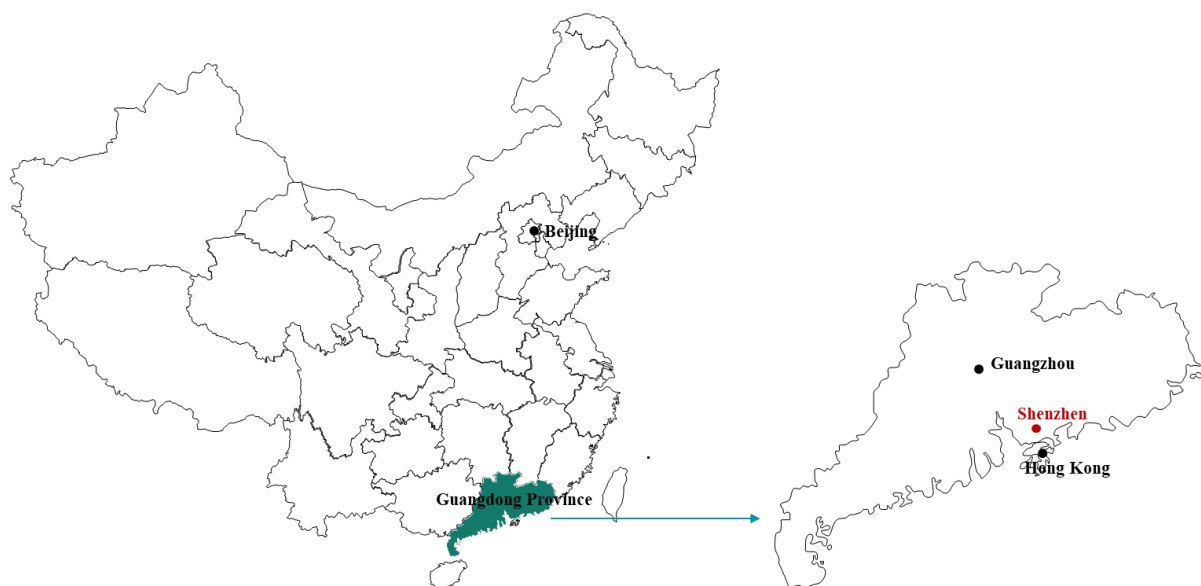
2.3 The evolution of the fintech industry in Shenzhen

The selection of the fintech industry in Shenzhen

Shenzhen is a city located north of Hong Kong and sits in the Guangdong province of southern China. There are two reasons why this thesis selects fintech in Shenzhen as the case study in Chapter 5. First, Shenzhen is the largest fintech hub in southern China and the 2nd largest in

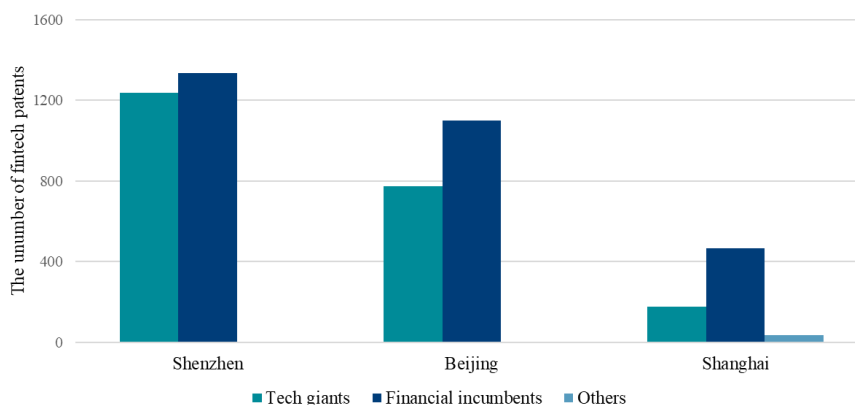
China (see Figure 2.2). Second and more importantly, the recent fintech revolution is no longer dominated by financial incumbents but is witnessed by the new entrants from tech giants (Chen et al. 2019; Haddad & Hornuf 2019; Cojoianu et al, 2020). Shenzhen is therefore the most appropriate case in China to study how tech giants and financial incumbents are entering the fintech industry. As shown in Figure 2.4, the top 20 fintech owners in Shenzhen hold more fintech patents, comparing with Beijing and Shanghai. More importantly, the top 20 fintech owners in Shenzhen keep the best balance between tech giants and financial incumbents. In contrast to Shenzhen, the key fintech owners in Beijing and Shanghai are dominated by financial incumbents.

Figure 2. 3 The location of Shenzhen in China



Sources: Author (2020).

Figure 2. 4 Types of the top 20 fintech owners in Beijing, Shenzhen, and Shanghai



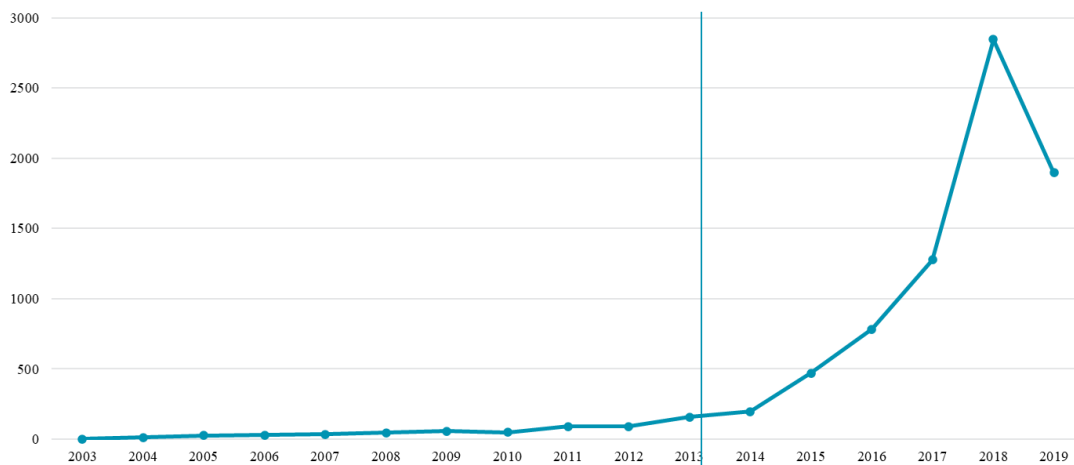
Sources: Author based on data from the NIPA (2020).

The history of the fintech industry in Shenzhen

Shenzhen has a favorable regional precondition (i.e., financial centers and hi-tech centers) to enter and develop the fintech industry. Shenzhen is traditionally known as the city powered by advances in financial and hi-tech sectors. First, Shenzhen is one of the top three financial centers in China along with Beijing and Shanghai (Zhao et al., 2013). It is home to China's financial conglomerate Ping An, China's first share-holding commercial bank China Merchant Bank, and the Shenzhen Stock Exchange. Second, Shenzhen currently commits more than 4% of its gross domestic product to R&D (Shenzhen Municipal Statistic Bureau, 2019). As a high-tech center, it is home to many hi-tech firms such as China's largest social network and gaming giant Tencent Holdings, and the world's largest telecoms equipment supplier Huawei Technologies.

The fintech industry in Shenzhen has so far evolved, from the embryonic stage (the 1990s - 2012) to the booming stage (2013-2019) (see Figure 2.5). Comparing to the history of the fintech industry in China, which has evolved from stage 1 (before 2003) through stage 2 (2003-2012) to stage 3 (2013-2019), I condense stages 1 and 2 together in the context of Shenzhen.

Figure 2. 5 The number of fintech patent in Shenzhen



Sources: Author based on data from the NIPA (2020).

The embryonic stage (the 1990s - 2012)

It was the dot-com boom in the late 1990s that set the embryonic stage of the emergence of the fintech industry in Shenzhen. This stage observed some early seeds of fintech. First, financial incumbents gradually adopted internet technology to transform their offline services from online. One notable event was that China Merchant Bank introduced China's first online banking in 1997. Second, tech giants began to incorporate fintech services into their existing products to respond to users' needs and preferences. For example, Tencent launched the Tenpay platform, which is an internet payment service for their gaming and e-commerce platform. Though it witnessed some pioneers of fintech, the overall development is relatively weak with less than 100 fintech-related patent applications per year.

The booming stage (2013-2019)

The year 2014 is widely recognized as the onset of the boom of Fintech in Shenzhen. At the national level, Premier Li Keqiang encouraged the development of fintech in the Report on the Work of the Government in 2014, stating that fintech (or Internet finance the term used by Premier Li Keqiang) has swiftly risen to prominence and that the healthy development of fintech will be further promoted. Given the positive attitudes at the national level, local authorities followed up and developed specific guidelines for fintech development. In 2014,

Shenzhen municipality promulgated the ‘Guiding Opinions on Supporting the Innovation and Development of Internet Finance’ (Shenzhen Municipal Financial Regulatory Bureau, 2014). These guiding opinions facilitated (1) the transformation and upgrading of the financial industry by integrating with internet technology, as well as (2) promoted internet companies to enter the financial sector. In 2019, the central government unveiled the Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area (National Development and Reform Commission, 2019). This Plan positions Shenzhen as a special economic zone, a national core economic city, and a national innovation hub, of which fintech is one of the major growth points. Specifically, the Plan supports Shenzhen in launching fintech pilot projects and boosting the development of fintech.

This favorable institutional environment enabled both tech giants and financial incumbents to quickly enter into the fintech business. Concerning the tech giants, one of the most remarkable events is that Tencent launched the WeChat Pay’s³ red packets campaign in the Lunar New Year and the wealth management platform Licitong in 2014. Later, Tencent jointly launched China’s first online-only private bank in 2014 and its first-ever loan was initiated by Chinese Premier Li Keqiang who pressed the ‘Enter’ key on a WeBank’s computer terminal. Aside from tech giants, financial incumbents also launched their digitalization strategy to transform into fintech. For example, China Merchant Bank repositioned itself as a fintech bank in 2017, at the same time, Ping An China officially adopted the ‘finance plus technology’ strategical transformation plan in 2017. In short, the booming stage was reflected in the soaring number of fintech-related patents, which have increased tenfold from less than 100 per year in the embryonic stage to more than 1000 per year in the booming stage. Specifically, Ping An (financial incumbent) and Tencent (tech giant) rank 1st and 7th in the world in 2018, with 1205 and 393 fintech patents, respectively (IPRdaily, 2019).

³ WeChat Pay is the mobile extension of the older payment platform TenPay.

2.4 Interim summary

This chapter has provided an overview of the evolution and spatial distribution of the fintech industry in China. I find that the development of the fintech industry in China has accelerated rapidly since 2013. More importantly, it reveals a highly uneven geographical distribution of the fintech industry in China. China's fintech landscape is dominated by three leading eastern coastal cities, namely, Beijing, Shenzhen, and Shanghai. So, how can this uneven geographical distribution be explained? What are the underlying impact factors? It will be responded to in Chapter 4.

Among the top three fintech hubs, Shenzhen is probably the most interesting one. First, Shenzhen is the largest fintech hub in southern China and the 2nd largest in China (see Figure 2.3). Second and more importantly, unlike Beijing and Shanghai where the fintech industry is relatively dominated by financial incumbents (see Figure 2.5), Shenzhen keeps a relative balance between financial incumbents and tech giants. So, how do Shenzhen's financial incumbents and tech giants diversify into the fintech sector, resulting in Shenzhen becoming a major fintech hub in China? What are the similarities and differences between financial incumbents and tech giants diversifying into fintech? It will be responded to in Chapter 5. After introducing the history of the fintech development in China and Shenzhen, the next Chapter 3 is to elaborate on the methodological issues that are important for scientific research.

Chapter 3: Methodology

This chapter elaborates on the methodological issues used in this study. It responds to the following question, i.e., how can the mixed-method be applied to integrate the otherwise separate qualitative and quantitative research in evolutionary economic geography (see the Gap-3 in Chapter 1 for detail)? Specifically, this chapter starts with a brief introduction of the mixed-method. Then, I will apply the mixed-method to integrate the qualitative and quantitative research in evolutionary economic geography. Finally, I will present the specific mixed-method used in this dissertation.

Here, it is important to note that this chapter deals with the mixed-method that is used to integrate quantitative and qualitative research. Concerning the specific research methods that are used in the empirical studies (i.e., quantitative regression analysis and qualitative case study method), they will be presented in chapters 4 and 5, respectively.

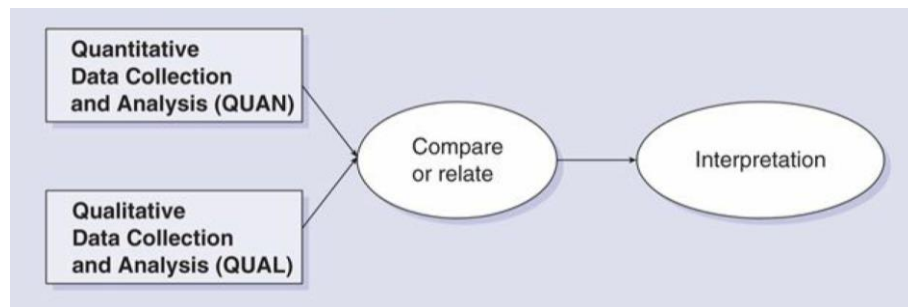
3.1 The brief introduction of the mixed-method

The term ‘mixed-method’ refers to a research methodology that advances the systematic integration of the otherwise separate quantitative and qualitative research (Creswell & Clark, 2017). The mixed-method draws on the logic of pragmatism (Tashakkori & Teddlie, 1998; Johnson & Onwuegbuzie, 2004; Creswell & Clark, 2017). Pragmatists posit that neither quantitative nor qualitative methods alone are sufficient to develop a complete analysis. Instead, researchers should use whatever methods to obtain the optimum results. Consequently, quantitative and qualitative methods must be used in combination, so that they can complement each other. Concerning the concrete ways to integrate qualitative and quantitative methods, I build on the work by Creswell & Clark (2017) and proposed four avenues, namely the triangulation approach, the embedded approach, the sequential exploratory approach, and the sequential explanatory approach.

Triangulation approach

The most common and well-known approach to mixed-method is the triangulation approach (Creswell & Clark, 2017). The triangulation approach aims to decrease the deficiencies and biases that come from any single method. It draws on the concept of methodological triangulation, that is, the use of both qualitative and quantitative research to conduct a study (Denzin, 1978). Specifically, researchers adopt both qualitative and quantitative research and then compares the two results to determine if there is convergence, differences, or some combination (see Figure 3.1). The advantage is that it brings together the strengths and weaknesses of quantitative methods (large sample size, generalization) with those of qualitative methods (small N, in-depth) (Patton, 1990). Briefly, this design is used when a researcher wants to compare quantitative results with qualitative findings (Creswell & Clark, 2007).

Figure 3. 1 Triangulation approach



Sources: Creswell & Clark (2017).

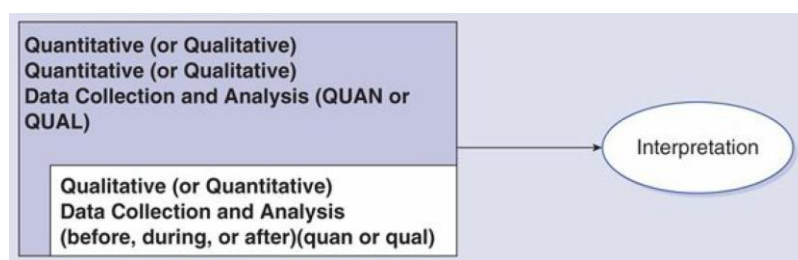
Embedded approach

The embedded approach refers to the design that embeds one type of research (qualitative or quantitative) within another type of research (quantitative or qualitative) (Creswell & Clark, 2017). The premise of this embedded approach is that different questions need to be answered and that each type of question requires different types of research methods (Creswell & Clark, 2007).

Practically, there are two types of embedded approaches. (1) The first type is that quantitative research is embedded in qualitative research. The typical scenario is that qualitative design can

include some quantitative data to enrich the description of the case (Morse, 1991). (2) The second type is that qualitative research is embedded in quantitative research. It includes two scenarios. (2-1) The first scenario is that qualitative research can compensate for data limitations in quantitative research. Specifically, Morse (1991) noted that qualitative research could be used to describe an aspect of a quantitative study that cannot be quantified. Moreover, qualitative research is especially useful when quantitative research is limited by a lack of resources for data collection (Creswell & Clark, 2017). (2-2) The second scenario is that quantitative research and qualitative research addresses questions at a different level of analysis (Tashakkori & Teddlie, 1998; Creswell & Clark, 2017). Put simply, quantitative research is good at questions concerning understanding the ‘relationship’ between variables (i.e., what is the relationship between event A and event B), while qualitative research focuses on the questions of ‘how’ and ‘why’ (i.e., why and how entities and their actions A cause the outcome B). In other words, the quantitative method examines correlations between events, while qualitative methods uncover evidence on the mechanisms that generate the events we observe (Sayer, 1992).

Figure 3. 2 Embedded approach



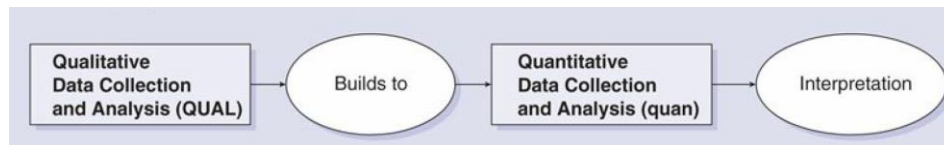
Sources: Creswell & Clark (2017).

Sequential exploratory approach

The sequential exploratory approach is characterized by conducting qualitative research in the first phase, followed by quantitative research in the second phase that builds on the results of the initial qualitative results (Creswell & Clark, 2017) (see Figure 3.3). The premise of this approach is that first-phase qualitative research is necessary for several reasons: ‘measures or instruments are not available, the variables are unknown, or there is no guiding framework or

theory' (Creswell & Clark, 2007, p75). This practice of this approach is as follows, that is, the qualitative study is used to generate hypotheses in the first stage of an entire research process, while quantitative research is used to test the hypotheses and generalize the qualitative findings (Morgan, 1998).

Figure 3. 3 Sequential exploratory approach

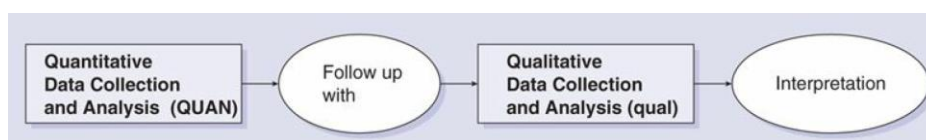


Sources: Creswell & Clark (2017).

Sequential explanatory approach

The sequential explanatory approach is characterized by conducting quantitative research in the first phase, followed by qualitative research in the second phase that builds on the results of the initial quantitative results (Creswell & Clark, 2017). A sequential explanatory design is typically used in two scenarios. First, quantitative results in the first phase enable the case selection of qualitative study in the second phase (Creswell & Clark, 2017). Second, it also can be especially useful when unexpected results arise from a quantitative study (Morse, 1991). In this case, the qualitative research in the second stage can be used to explore these surprising results in more detail.

Figure 3. 4 Sequential explanatory approach



Sources: Creswell & Clark (2017).

3.2 Applying the mixed-method into the evolutionary economic geography

In this subsection, I elaborate on how to apply different types of mixed-method to integrate the

qualitative and quantitative research in evolutionary economic geography, particularly the quantitative-centric regional diversification literature and the qualitative-centric path as process literature.

Table 3. 1 Utilizing the mixed-method to the evolutionary economic geography

The mixed-method	Utilizing the mixed-method to the evolutionary economic geography
Triangulation approach	<ul style="list-style-type: none"> Comparing the results between the quantitative and the qualitative research to detect whether the findings based on different methods are convergence or differences.
Embedded approach	<ul style="list-style-type: none"> Embedding quantitative data to enrich the description of the qualitative case. Embedding qualitative research into quantitative research occurs when some indicators cannot be quantified or the data are unavailable, and when quantitative research and qualitative research addresses questions at a different level of analysis.
Sequential exploratory approach	<ul style="list-style-type: none"> Using the qualitative case study in the first phase to generate hypotheses which then be tested in the second quantitative research.
Sequential explanatory approach	<ul style="list-style-type: none"> Using the quantitative results in the first phase to select the qualitative case study in the second phase. Using the qualitative case study in the second phase to explain the unexpected results arise from a quantitative study in the first phase.

Sources: Author based on Creswell & Clark (2017).

Triangulation approach

In the context of evolutionary economic geography, the triangulation approach can be used to compares the results from the regional diversification literature, which uses the quantitative method, and the path as process literature, which uses the qualitative method. Such a comparison would allow us to determine whether the findings based on different methods are convergent or different. If the findings are converged, then it can result in well-validated and justified results. If the findings are different, then it may be necessary to improve and advance the previous theoretical framework.

One interesting example is the exploration of the role of extra-region linkages in the emergence of the new industry in regions. In this specific question, the regional diversification literature finds that new subsidiaries established by foreign-owned firms are more likely to induce

unrelated diversification in regions (Neffke et al., 2018; Elekes et al., 2019). Similarly, path as process literature finds that the arrival of non-local actors is crucial for new path development in the thin RISs and the thick and specialized RISs (Dawley et al., 2014; Trippel et al., 2018). Consequently, both strands of literature confirm the important role of non-local actors in regional industrial development.

Embedded approach

The first type of embedded approach is the embedding of quantitative research in qualitative research. Practically, it usually refers to embedding some quantitative data to enrich the description of the case (Morse, 1991). In the context of evolutionary economic geography, Pike et al., (2016, p134) also argue that ‘backward extension of available quantitative data and *its integration with* historic qualitative analysis of secondary sources and in-depth engagement with relevant actors from the past and present can assist following the path methods’.

The second type of embedded approach is to embed qualitative research into quantitative research. In section 3.1, it has mentioned that it includes two scenarios.

The first scenario of embedding qualitative research in quantitative research occurs when some indicators cannot be quantified or the data are unavailable. It is common in research on evolutionary economic geography. For example, Santoalha & Boschma (2020) examined whether national or regional political support is relevant for regional diversification into green technologies. They ‘made use of a unique data set (Manifesto Project Database) that allowed one to regionalize the political support for environmental policy, and to make a distinction between national and regional support’ (Santoalha & Boschma, 2020, p11). Yet, ‘this indicator does not take up the direct impact of environmental policy: I had no information on whether the political support resulted in the implementation of environmentally friendly policies and practices in the region’ (Santoalha & Boschma, 2020, p11). Consequently, it is useful to apply the embedded approach. That is to say, a qualitative case study could be conducted to investigate the implementation of environmentally-friendly policies and how such policies influence regional diversification into green technologies.

The second scenario of embedding qualitative research in quantitative research is that quantitative research and qualitative research addresses questions at a different level of analysis (Tashakkori & Teddlie, 1998; Creswell & Clark, 2017). In other words, the quantitative method examines correlations between events, while qualitative methods uncover evidence on the mechanisms that generate the events we observe (Sayer, 1992). This need to embed qualitative research (exploring mechanism) into quantitative research (finding the correlation between variables) has been emphasized by several quantitative works on evolutionary economic geography, although practical actions of integration are lagging behind advocates. For example, Neffke et al. (2011) find a positive relationship between the entry probability of an industry in a region and the closeness (or technologically related) of the new industry to the region's portfolio. In the conclusion section, they propose that 'there is a strong need to determine *mechanisms* through which the process of regional branching operates' (Neffke et al., 2011, p261-262). Another case is the work of Santoalha & Boschma (2020), they find strong evidence of a negative effect of dirty technologies on the probability of a region developing new green technologies. In the conclusion section, they emphasize that 'exactly through which *mechanisms* this negative effect of dirty technologies works is still unclear' (Santoalha & Boschma, 2020, p12).

Sequential exploratory approach

The sequential explanatory approach refers to using the qualitative case study in the first phase to generate hypotheses that are then tested in the second quantitative research (Creswell & Clark, 2017). In the context of evolutionary economic geography, Pike et al. (2016, p134) echo this idea and argue that 'systematic review of qualitative studies can help distill taxonomies and general propositions to inform hypothesis-building for formal quantitative treatment'. An early attempt to adopt a sequential exploratory approach to evolutionary economic geography is the work of Boschma & Capone (2016). To examine the previously neglected role of institutions in determining the direction of industrial diversification, Boschma & Capone (2016) draws on the qualitative findings from the Varieties of Capitalism literature to generate hypotheses, which are then followed by the use of quantitative data to test such hypotheses.

They find evidence that institutions associated with so-called ‘liberal market economies’ are more likely to induce unrelated diversification, while institutions associated with so-called ‘coordinated market economies’ are more likely to induce related diversification. Another example is the role of non-local linkages in the emergence of the new industry in regions. Qualitative case studies suggest that non-local linkages might be crucial for the emergence of the new industry in regions, especially in peripheral regions where local assets are rare and weak (Isaksen, 2014; Tripl et al. 2018). To find systematic evidence and test the role of non-local linkages in new regional industrial development, Neffke et al., (2018) investigate Swedish regions between 1994 and 2010. Their econometric result shows that non-local firms are more likely to induce the emergence of technologically related new industries (Neffke et al., 2018; Elekes et al., 2019).

Sequential explanatory approach

The sequential explanatory approach is typically used in two scenarios. The first is to use the quantitative results in the first phase to select the qualitative case study in the second phase (Creswell & Clark, 2017). In the context of evolutionary economic geography, for instance, Neffke et al. (2011, 260) explicitly recognize that ‘a visual analysis of industry space (*quantitative research*) can help localize likely hot spots of inter-industry interaction in the structural transformation of a region that merits closer scrutiny by *qualitative research methods* . . . knowledge of which industries are strongly linked to the protagonists of structural change in a specific region can help sharpen the *focus and delimit the scope of a case study design*’ (Italic by the authors).

The second refers to using a qualitative case study in the second phase to explain the unexpected results that arise from a quantitative study in the first phase (Morse, 1991). In the context of evolutionary economic geography, for example, Santoalha & Boschma (2020) examine whether national or regional political support is relevant for regional diversification into green technologies. Although they expect that new specializations in green technologies are more likely to occur in regions with political support, quantitative analysis shows surprising

results, that is, neither national nor regional political support has a significant influence on regional diversification into green technologies. In terms of the sequential explanatory approach, future research could conduct qualitative research to explore why national and regional political support does not have a significant impact on regional diversification into green technologies.

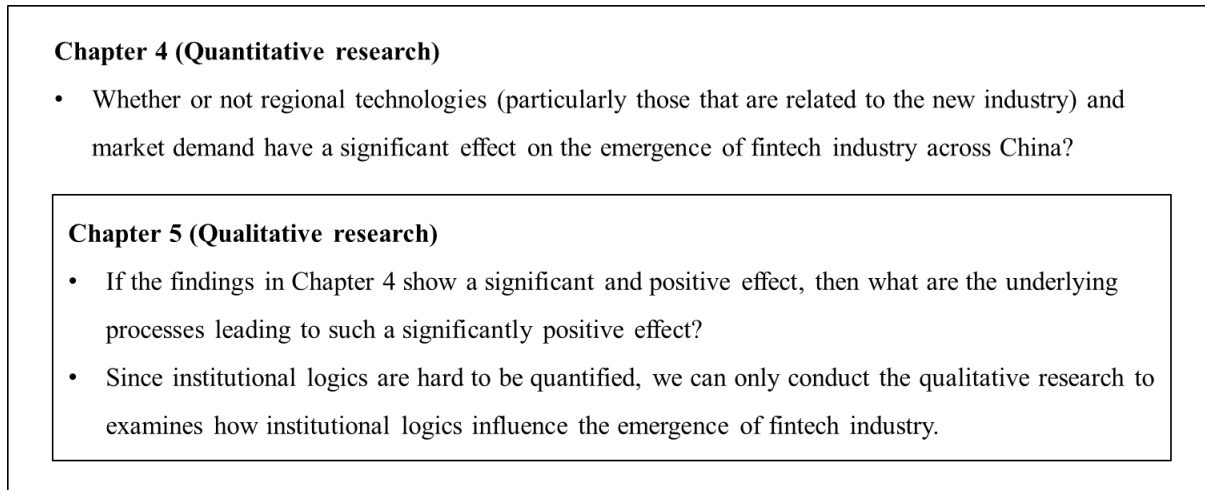
3.3 The selection of the embedded approach in this study

I use the embedded approach in this work. The reasons and detailed strategies are as follows.

First, I embed the qualitative case study within quantitative research because quantitative and qualitative research addresses questions at a different level of analysis (Tashakkori & Teddlie, 1998; Creswell & Clark, 2017). Practically, this embedded approach includes two levels. The first level (see the quantitative research in Chapter 4) deals with the question of whether the supply-side technologies (particularly those that are related to the new industry) and the demand-side market have a significantly positive effect on the emergence of the fintech industry across China (Responding to Gap-1 and 4). The second level (see the qualitative research in Chapter 5) deals with the question of how such a positive effect happens, i.e., how the supply-side technologies (particularly those that are related to the new industry) and the demand-side market foster the emergence of the fintech industry in Shenzhen (Responding to Gap-1 and 4). In other words, the second level conducts a case study to investigate the underlying logic leading to the positive effect on the emergence of the fintech industry that is revealed in the first level.

Second, I embed the qualitative case study into the quantitative research because some indicators (i.e., institutional logics) cannot be quantified (Creswell & Clark, 2017). To compensate for the data limitation, Chapter 5 conducts the case study to analyze whether and how institutional logics influence the emergence of the fintech industry (Responding to Gap-2 and 4).

Figure 3. 5 The usage of the embedded approach in this dissertation



Sources: Author (2020).

Chapter 4: Exploring the role of supply-side technology and demand-side market in the rise of the fintech industry: A quantitative regression analysis of China's city-level patenting

This chapter (specifically section 4.2-4.3) is mainly based on the manuscript currently submitted and under review in *Growth and Change*, as Dai, D. & Chen, Y. The geography of the fintech industry in China: An analysis of China's city-level patenting.

4.1 Introduction

Theoretically, the extant literature on EEG has shown that new industry tends to emerge in regions where the new industry is technologically related to the pre-existing industries (Frenken & Boschma, 2007; Neffke et al., 2011; Boschma, 2017). However, the role of the demand-side market in the emergence of the new industry in regions has not yet been fully understood (see Gap-1 in Chapter 1 for details). Empirically, Chapter 2 has shown that the emergence of the fintech industry in China is not geographically ubiquitous but rather needs to be characterized as spatially uneven distribution. However, the empirical work of the EEG has not yet extended to the fintech industry (see Gap-4 in Chapter 1 for details). In sum, this chapter conducts quantitative research to examine whether the supply-side technologies (especially those related to the new industry) and the demand-side market in regions have a significant impact on the emergence of the fintech industry in China.

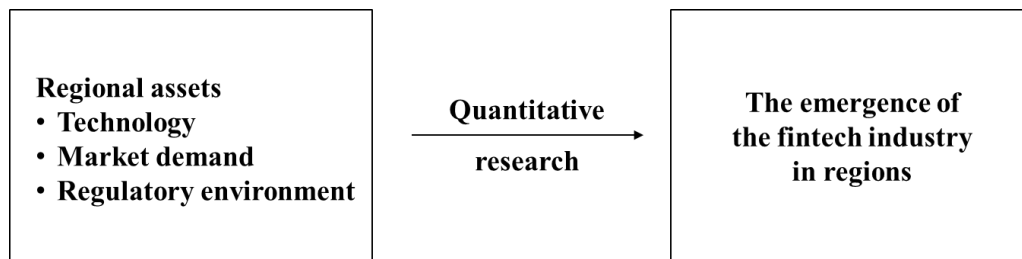
The rest of this chapter is organized as follows. It first reviews the literature and proposes hypotheses. Then, it presents the data and the econometric model. This is followed by the presentation of the econometric results and the discussion. The final is the summary.

4.2 Analytical framework

Given that fintech is a relatively new phenomenon, there are only a handful of quantitative papers that examine the drivers that facilitate the growth of fintech (Dushnitsky et al., 2016; Claessens et al., 2018; Cumming & Schwienbacher, 2018; Haddad & Hornuf, 2018; Laidroo

& Avarmaa, 2019; Rau, 2019; Cojoianu et al., 2020; Gazel & Schwienbacher, 2020; Hornuf et al., 2020). In the quantitative literature on fintech, the rise of fintech is regarded as the outcome of the interactions between IT technology (supply-side), market demand for fintech services (demand-side), and the regulatory environment (institution-side). Likewise, the literature on evolutionary economic geography also emphasizes the role of technology, market, and the regulatory environment in the emergence of new industries in regions (Neffke et al., 2011; Boschma, 2017; Martin et al., 2019). Below, I review the literature and propose the hypotheses.

Figure 4. 1 The comprehensive model of the emergence of the new industry in regions



Source: Author (2020).

Technology

Technology is the crucial driving factor for the emergence of new industries in regions (Neffke et al., 2011; Boschma, 2017; He & Zhu, 2019). In the context of fintech research, the literature proposes that countries/cities with greater information technology endowments are more likely to foster fintech industries. For instance, Haddad & Hornuf (2018) found that the formation of fintech startups occurs more frequently in countries that have the latest technology such as artificial intelligence, big data, and near-field communication. Similarly, Laidroo & Avarmaa (2019) found that fintech startups formation occurs with greater frequency in countries with stronger ICT service clusters. Recently, Cojoianu et al. (2020), by studying cities across 21 OECD countries, showed that the number of regional IT patent applications is positively related to the number of new fintech startups. Gazel & Schwienbacher (2020) showed that cities in France with more engineering schools and technology incubators are more likely to nurture the fintech industry. However, extant studies have not yet investigated the specific technologies underlying fintech and how they influence the rise of fintech. This question is important

because not every information technology has a positive impact on the rise of fintech. In contrast, there are a handful of specific technologies that can really facilitate the rise of fintech. For example, technology in data science and encryption contributes strongly to fintech development. However, technology in online gaming plays a less important role in the fintech industry.

To provide a detailed analysis of information technology, I introduce the concept of technological relatedness. Technological relatedness refers to the situation in which two technological activities require similar knowledge (Boschma, 2017; Hidalgo et al., 2018). Based on the concept of technological relatedness, scholars argue that new technology tends to develop in regions where the existing technology base is related to the new technology (Neffke et al., 2011). Theoretically, the concept of technological relatedness works as follows. The starting point is the current technology that a particular city has. As the current technology becomes outdated, obsolete, and devalued over time, the city has to develop the new technology to survive. Generally, there is a negative relationship between the existing technology and the cost of developing the new technology. That is, the cost of developing the new technology rises rapidly around the boundaries of existing technology (Boschma, 2005). To reduce the cost and develop the new technology effectively, cities tend to diversify into new technologies that are related to the existing regional technology and thus provides capabilities on which the new technology could build on. To date, evidence of technological relatedness has been found in China, Europe, and the U.S. (Neffke et al., 2011; Feldman et al., 2015; Rigby, 2015; Boschma, 2017; Hu, 2017; Zhu, He, & Zhou, 2017; He & Zhu, 2019). Briefly, based on the concept of technological relatedness, the following hypothesis is therefore expected:

Hypothesis 1: Cities with more technologies that are related to fintech are more likely to develop a fintech industry.

Demand for fintech services

In addition to supply-side technology, recent scholarly work claims that market demand may play a crucial role in the emergence of new industries in regions (Martin et al., 2019). Generally,

demand for fintech services comes from two customers segments. The first type of customers is retail customers, particularly individuals and SMEs who have financially underserved (Wójcik & Cojoianu, 2018; Cojoianu et al., 2020). To meet the financial demands of these retail customers, fintech firms provide them with affordable and Internet-based financial services (e.g., online payments, online investment, and online financing). For example, Huang (2018) found evidence that the large financial needs of individuals and SMEs contributed to the rapid rise of P2P lending platforms in China. Similarly, Dushnitsky et al. (2016) found that crowdfunding platform creation in Europe is greater in countries with more individuals willing to use crowdfunding services either as participants or crowdfunders. Based on the above analysis, I hypothesize the following:

Hypothesis 2-1: Cities with more retail customers for fintech services are more likely to develop a fintech industry.

The second type of customer in need of fintech services is financial institutions (Wójcik & Cojoianu, 2018; Cojoianu et al., 2020). In order to secure a competitive advantage in the age of digitalization, financial institutions have a strong need to digitalize their products and services and upgrade their legacy IT systems (Hornuf et al., 2020). Fintech firms are therefore seizing this opportunity to offer advanced and customized technology solutions (e.g., big data risk management, distributed ledger technology, financial services cloud) (Wójcik & Cojoianu, 2018) to incumbent financial institutions. For example, Hornuf et al. (2020) analyzed the largest banks in Canada, France, Germany, and the United Kingdom. They found that incumbent financial institutions that have a well-defined digital strategy are more likely to access new technology solutions by forming alliances with external fintech companies. Based on the above analysis, I hypothesize the following:

Hypothesis 2-2: Cities with a higher presence of financial institutions are more likely to develop a fintech industry.

Demand for fintech services

In addition to supply-side technology, recent scholarly work claims that market demand might

play a crucial role in the emergence of new industries in regions (Martin et al., 2019). Generally, demand for fintech services comes from two customer segments. The first type of customer is retail customers, especially individuals and SMEs who have been financially underserved (Wójcik & Cojoianu, 2018; Cojoianu et al., 2020). To meet the financial needs of these retail customers, fintech companies provide them with affordable and internet-based financial services (e.g., online payments, online investment, and online financing). For example, Huang (2018) found evidence that individuals' and SMEs' great financial needs contributed to the rapid increase of P2P lending in China. Similarly, Dushnitsky et al. (2016) found that crowdfunding platform creation in Europe is greater in countries with more individuals who are willing to use crowdfunding services as either participants or crowdfunders. Based on the above analysis, the hypothesis is as follows:

Hypothesis 2-1: Cities with more retail customers for fintech services are more likely to develop a fintech industry.

The second type of customer who has a demand for fintech services is financial institutions (Wójcik & Cojoianu, 2018; Cojoianu et al., 2020). In order to secure a competitive advantage in the era of digitalization, financial institutions have a strong need to digitalize their products/services and modernize their legacy IT systems (Hornuf et al., 2020). Fintech companies are therefore seizing the opportunity to offer incumbent financial institutions advanced and customized technology solutions (e.g., big data risk management, distributed ledger technology, financial services cloud) (Wójcik & Cojoianu, 2018). For example, Hornuf et al. (2020) analyzed the largest banks in Canada, France, Germany, and the United Kingdom. They found that, when pursuing a well-defined digital strategy, incumbent financial institutions are more likely to access new technology solutions through forming alliances with external fintech companies. Based on the above analysis, the hypothesis is as follows:

Hypothesis 2-2: Cities with a higher presence of financial institutions are more likely to develop a fintech industry.

Regulation

The presence of a favorable regulatory environment is important for the emergence of the new industry in regions (He & Zhu, 2019). In the context of fintech, favorable regulation may take three forms. First, governments can adopt a directly supportive regulatory regime that attracts fintech entrepreneurs and facilitates fintech innovation (Pan & Brooker, 2014; Lai & Samers, 2020), because supportive regulations create extra incentives to encourage innovation (Blind, 2012). For example, Haddad & Hornuf (2018) found evidence that fintech startups are more numerous in countries with more favorable regulations that exercise less control over interest rates, allow for a flexible labor market, and impose fewer administrative burdens. Second, the introduction of explicit regulation also facilitates fintech innovation, as explicit regulation can reduce information asymmetry and transaction costs for start-ups (Williamson, 1985). For example, based on an investigation of 2,200 crowdfunding platforms worldwide, Rau (2019) showed that the introduction of explicit legal regulation appears to significantly increase crowdfunding volume. Third, less stringent regulation can reduce compliance costs and thus incentivize fintech innovation (Claessens et al., 2018; Cumming & Schwienbacher, 2018). By examining fintech development in 63 countries, Cumming & Schwienbacher (2018) found that investment in fintech is more likely to take place in countries with weaker regulatory enforcement. Similarly, Claessens et al. (2018) found that fintech credit volumes are greater in countries with less stringent banking regulations. Since regulations can be introduced by either national or city governments, I hypothesize the following:

Hypothesis 3-1: Cities in a favorable national regulatory environment are more likely to develop a fintech industry.

Hypothesis 3-2: Cities with a favorable local regulatory environment are more likely to develop a fintech industry.

4.3 Data and quantitative method

Dependent variable

In this chapter, the development of the fintech industry is measured by patent data. To identify patents in the fintech sector, it uses the International Patent Classification (IPC) system, a category system developed by the World Intellectual Property Organization (WIPO) to classify patents. In doing so, it measures fintech patents using two IPC codes: G06Q20 (payment) and G06Q40 (banking, insurance, exchange, and investment). Specifically, G06Q20 refers to patents that relate to the procedure by which a payment is made between a merchant, a bank, a user, and sometimes a third party, and the procedure typically includes verification and authentication of all parties involved. G06Q40 refers to the patents used in banking (e.g., for providing interest calculations, credit approvals, mortgage services, home banking services, or online banking services), insurance (e.g., risk analysis or pensions), in exchange (e.g., stocks, commodity, derivatives or currency exchanges), and investment (e.g., financial instrument development, portfolio management, or fund management). The patent data extract from China's National Intellectual Property Administration (NIPA). Since the granting process usually takes a long time, the application year is closer to the time when the invention is developed (Albino et al., 2014; Ardito et al., 2018). Fintech patents that are applied in 294 Chinese cities at the prefecture level or above were collected. The dataset includes more than 34,000 patents. It shows that fintech patent applications in China started in 2003, and therefore, the analysis focuses on the period 2003–2019. Moreover, it finds that 32 out of 294 cities do not host any fintech patents, while the remaining 262 cities have at least one fintech patent. Among the 262 cities, there are 210 cities with an extremely low proportion (less than 0.1%) of the nation's fintech patent. Consequently, this chapter restricts its analysis to a sample of 52 key Chinese cities in which each city's fintech patents account for more than 0.1% of the nation's fintech patents, and totally account for approximately 95% of the nation's fintech patents. To examine whether the local or non-local source is the main driver of fintech innovation in a given city, the inter-city fintech patent linkages base on the co-inventors

residing in multiple cities were calculated, which follow other studies using patent data (Balland & Boschma, 2020; Le Gallo & Plunket 2020; Whittle et al. 2020). The result shows that fintech innovation mainly occurs at the local scale. The sample (G06Q20 and G06Q40) includes about 34,000 patent documents. Among them, approximately 98% (95%+3%) of the patents are invented within cities, while only 2% of the patents have inter-city linkages.

Independent variables

To measure a set of technology fields that appear to be related to fintech, the method based on the co-occurrence of technology classes in a patent document was applied (Teece et al., 1994; Feldman et al., 2015; Rigby, 2015). A patent document often includes more than one IPC code, reflecting every technology field the patent covers. If two technology fields (IPC codes) are mentioned on the same patent document, they are technologically related. Using this method, there are 570 IPC codes are co-occurred with the fintech patent code G06Q20, and 199 IPC-codes are co-occurred with the fintech patent code G06Q40. However, some IPC codes only appear a few times. Therefore, to simplify the analysis, the IPC codes with a share of more than 2% of the total co-occurrence patents were selected. Table 4.1 describes the technology that is related to fintech in terms of G06Q20 and G06Q40. For each IPC code, the patent data from the NIPA was collected.

Table 4. 1 Technologies that underpins the fintech in terms of G06Q20 and G06Q40

G06Q20			G06Q40		
IPC-Codes	Description	Share*	IPC-Codes	Description	Share*
G06Q30	Commerce, e.g. shopping or e-commerce.	13.5%	G06Q20	Payment architectures, schemes or protocols.	16.6%
H04L29	Communication processing and transmission control procedure.	8.7%	G06Q10	Administration and management.	15.1%
G06Q40	Banking, insurance, exchange investment.	8.6%	G06Q30	Commerce, e.g. shopping or e-commerce.	10.8%
G06F21	Security arrangements for protecting computers against unauthorized activity.	5.8%	G06F16	Information retrieval, data cleaning, design and maintenance of databases.	9.1%
H04L9	Arrangements for secure communication based on encryption technology.	5.1%	H04L29	Communication processing and transmission control procedure.	6.9%
G06Q50	Systems or methods specially adapted for specific business sectors, e.g. utilities or tourism.	4.8%	G06F17	Data processing for specific functions such as solving equations, Fourier transformations, and matrix computation.	6.6%
G06Q10	Administration and management.	3.8%	G06F21	Security arrangements for protecting computers against unauthorized activity.	5.4%
G07G1	Registering the receipt of cash.	3.3%	G06Q50	Systems or methods specially adapted for specific business sectors, e.g. utilities or tourism.	4.9%
G06K9	Methods for recognizing printed or human characters such as fingerprint, iris, and voice.	2.8%	G06K9	Methods for recognizing printed or human characters such as fingerprint, iris, and voice.	4.4%
G07B15	Payment system relating to toll, entrance fee or fare collection.	2.5%	H04L9	Arrangements for secure communication based on encryption technology.	2.6%
G07F17	Coin-freed apparatus for hiring articles.	2.4%	G06N3	Computer systems based on neural network models, genetic model and other biology model.	2.0%
H04W4	Wireless communication networks.	2.1%			
G07F7	Mechanisms actuated by objects other than coins to free or to actuate vending, hiring, coin or paper currency dispensing or refunding apparatus.	2.0%			

*: The share indicates how large a proportion of the total co-occurrence belongs to the specific knowledge field.

Source: authors (2020)

To measure the demand for fintech services, it divides into the retail and financial institutions market demand. It uses the Internet subscribers (IS), the per capita disposable income (PCDI), and the financial industry GDP (FGDP) as the proxies. First, IS and PCDI are used as proxies for retail customers of fintech services, following the studies by Dushnitsky et al. (2016), Laidroo & Avarmaa (2019), and Gazel & Schwienbacher (2020). Second, the FGDP is used as a proxy for financial institutions. Finally, to dampen potential endogeneity issues, the variables of IS, PCDI, and FGDP are lagged by one period, denoted by t-1 (Wooldridge, 2006). Data were retrieved from statistical yearbooks in each city.

To consider the regulatory environment at the national level, it inserts a dummy variable National Regulation (NR) that equals 1 starting from the year 2014 in which Premier Li Keqiang encouraged fintech development in the Report on the Work of the Government 2014, and 0 otherwise. The adoption of a dummy variable to measure regulation follows the work of Dushnitsky et al. (2016) and Rau (2018). Moreover, to consider the regulatory environment at the city level, the data concerning the year in which a specific regulation on fintech entered into force in the specific city was collected. It also inserts a dummy variable local regulation (LR) that equals 1 starting from the year in which the city government introduced explicit regulations to cultivate fintech, and 0 otherwise. Data were retrieved from the municipal financial office in each city.

In addition, the measure of R&D expenditure (R&D) and the number of college students (CS) are added as the control variables, as it is assumed that fintech companies tend to emerge in regions with more advanced technology infrastructures. The usage of R&D expenditure as a control variable follows the scholarly work by Cojoianu et al. (2020) and Laidroo & Avarmaa (2019). The usage of the indicator of the number of college students follows the studies of Laidroo & Avarmaa (2019), and Gazel & Schwienbacher (2020). Data were retrieved from statistical yearbooks in each city.

Table 4.2 presents all the variables with the fintech patent G06Q20 in a correlation matrix. All variables show positive correlations. Some fintech patents have high correlation coefficients

(>0.90). Variance inflation factors (VIFs) are calculated to estimate the potential effect of multicollinearity. The VIF reveals four variables with value>10 (which is the standard threshold indicating multicollinearity): G06Q50 (VIF=26.74), G06Q10 (VIF=28.29), H04W4 (VIF=10.94), and G07F7 (VIF=10.27). Therefore, these variables are dropped. Similarly, Table 4.3 presents the variables with the fintech patent G06Q40 in a correlation matrix. All variables show positive correlations. The VIF showed three variables with values>10, G06Q10 (VIF=40.23), G06Q50 (VIF=34.84), and H04L9 (VIF=13.05). Consequently, these variables are dropped.

Table 4. 2 The fintech and fintech-related variables (G06Q20): correlation statistics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1 G06Q20	1.00																					
2 G06Q30	0.96	1.00																				
3 H04I29	0.83	0.83	1.00																			
4 G06q40	0.92	0.86	0.66	1.00																		
5 G06F21	0.92	0.90	0.91	0.79	1.00																	
6 H04L9	0.74	0.75	0.82	0.61	0.78	1.00																
7 G06Q50	0.87	0.93	0.81	0.73	0.88	0.74	1.00															
8 G06Q10	0.92	0.97	0.81	0.83	0.89	0.77	0.98	1.00														
9 G07G1	0.79	0.75	0.75	0.68	0.75	0.74	0.70	0.74	1.00													
10 G06K9	0.93	0.94	0.77	0.88	0.88	0.72	0.93	0.96	0.72	1.00												
11 G07B15	0.83	0.81	0.79	0.69	0.80	0.69	0.78	0.79	0.78	0.80	1.00											
12 G07F17	0.85	0.85	0.67	0.76	0.72	0.63	0.77	0.81	0.77	0.80	0.80	1.00										
13 H04W4	0.79	0.76	0.92	0.63	0.86	0.72	0.72	0.73	0.73	0.72	0.75	0.63	1.00									
14 G07F7	0.50	0.48	0.63	0.43	0.52	0.60	0.43	0.46	0.61	0.44	0.51	0.46	0.64	1.00								
15 PCDI	0.44	0.45	0.40	0.34	0.44	0.41	0.52	0.50	0.47	0.49	0.45	0.50	0.40	0.28	1.00							
16 IS	0.10	0.10	0.09	0.07	0.08	0.09	0.12	0.11	0.11	0.10	0.10	0.11	0.09	0.09	0.16	1.00						
17 FGDP	0.39	0.39	0.38	0.29	0.37	0.34	0.40	0.39	0.38	0.36	0.34	0.32	0.37	0.29	0.30	0.08	1.00					
18 NR	0.28	0.29	0.21	0.20	0.28	0.19	0.37	0.34	0.27	0.32	0.33	0.36	0.21	0.09	0.75	0.12	0.18	1.00				
19 LR	0.33	0.33	0.22	0.27	0.29	0.22	0.39	0.38	0.31	0.39	0.33	0.44	0.24	0.13	0.63	0.08	0.21	0.63	1.00			
20 CS	0.03	0.05	0.04	0.01	0.04	0.02	0.12	0.09	0.06	0.08	0.09	0.05	0.01	0.04	0.12	0.06	0.03	0.11	0.13	1.00		
21 R&D	0.80	0.81	0.84	0.69	0.84	0.77	0.81	0.82	0.76	0.80	0.72	0.66	0.77	0.60	0.52	0.12	0.51	0.29	0.29	0.02	1.00	

Note: All correlations are significant $p < 0.001$.

Table 4. 3 The fintech and fintech-related variables (G06Q40): correlation statistics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1 G06Q40	1.00																			
2 G06Q20	0.92	1.00																		
3 G06Q10	0.83	0.92	1.00																	
4 G06Q30	0.86	0.96	0.97	1.00																
5 G06F16	0.84	0.72	0.74	0.70	1.00															
6 H04L29	0.66	0.83	0.81	0.83	0.47	1.00														
7 G06F17	0.59	0.79	0.85	0.85	0.40	0.92	1.00													
8 G06F21	0.79	0.92	0.89	0.90	0.63	0.91	0.89	1.00												
9 G06Q50	0.73	0.87	0.98	0.93	0.67	0.81	0.88	0.88	1.00											
10 G06K9	0.88	0.93	0.96	0.94	0.84	0.77	0.77	0.88	0.93	1.00										
11 H04L9	0.61	0.74	0.77	0.75	0.50	0.82	0.78	0.78	0.74	0.72	1.00									
12 G06N3	0.80	0.82	0.91	0.85	0.88	0.63	0.65	0.74	0.87	0.95	0.62	1.00								
13 PCDI	0.34	0.44	0.50	0.45	0.33	0.40	0.40	0.44	0.52	0.49	0.41	0.46	1.00							
14 IS	0.07	0.10	0.11	0.10	0.07	0.09	0.10	0.08	0.12	0.10	0.09	0.10	0.16	1.00						
15 FGDP	0.29	0.39	0.39	0.39	0.22	0.38	0.39	0.37	0.40	0.36	0.34	0.31	0.30	0.08	1.00					
16 NR	0.20	0.28	0.34	0.29	0.19	0.21	0.25	0.28	0.37	0.32	0.19	0.30	0.75	0.12	0.18	1.00				
17 LR	0.27	0.33	0.38	0.33	0.29	0.22	0.23	0.29	0.39	0.39	0.22	0.39	0.63	0.08	0.21	0.63	1.00			
18 CS	0.01	0.03	0.09	0.05	0.03	0.04	0.07	0.04	0.12	0.08	0.02	0.09	0.12	0.06	0.03	0.11	0.13	1.00		
19 R&D	0.69	0.80	0.82	0.81	0.59	0.84	0.83	0.84	0.81	0.80	0.77	0.71	0.52	0.12	0.51	0.29	0.29	0.02	1.00	

Note: All correlations are significant $p < 0.001$.

The model

The analysis is performed on a balanced panel data set comprising data from the years 2003-2019 and 52 cities in China. The fintech patents with G06Q20 and G06Q40 as the dependent variables are limited dependent count variables, indicating that the appropriate model is a count model such as negative binomial or Poisson. As the variance of the dependent variables (G06Q20 and G06Q40) is greater than their mean (see Table 4.4), it cannot satisfy the requirement of the Poisson model, which requires that the variance of the dependent variable to equal to its mean. Therefore, the negative binomial regression model that allows for heterogeneity to the mean was adopted. To determine the specific model, the Hausman test was conducted (see Table 4.5 and 4.6). The result confirms the choice of fixed over random effects. Each variable is measured for each year in the period from 2003-2019 for each of the 52 cities; hence, $n=17 \text{ years} * 52 \text{ cities}=884$ (see Table 4.4).

Table 4. 4 The fintech and fintech-related variables: descriptive statistics

List of variables	Nbr. Obs	Mean	SD	Minimum	Maximum
Payment (G06Q20)	884	18.54	72.58	0	947
Commerce (G06Q30)	884	48.29	179.56	0	2377
Communication processing (H04L29)	884	180.07	556.28	0	5704
Banking, insurance, and investment (G06Q40)	884	18.53	110.15	0	1899
Security arrangements (G06F21)	884	45.81	160.36	0	1843
Data retrie Encryption technology (H04L9)	884	33.56	96.73	0	931
Registering the receipt (G07G1)	884	3.60	8.93	0	90
Recognizing fingerprint and voice (G06K9)	884	106.71	372.25	0	5312
Toll payment system (G07B15)	884	5.02	14.85	0	183
Coin-freed apparatus (G07F17)	884	7.36	23.94	0	264
Data retrieval and cleaning (G06F16)	884	41.16	286.84	0	5223
Data processing for math functions (G06F17)	884	184.37	599.10	0	7844
Neural network models (G06N3)	884	35.87	147.98	0	2092
Per capita disposable income (PCDI)	884	27661.64	13932.17	1884	73615
Number of internet subscribers (IS)	884	207.25	890.72	6.16	26109
Financial industry GDP (FGDP)	884	466.77	1734.57	4.22	47625
National regulation (NR)	884	0.35	0.48	0	1
Local regulation (LR)	884	0.19	0.40	0	1
Number of college students (CS)	884	443.11	394.89	19.45	7111.89
R&D expenditure (R&D)	884	117.53	211.41	7955.81	2180.00

Consequently, the fixed effects negative binomial (FENB) model is as follows:

$$P_r(y_{i1}, y_{i2}, y_{i3}, \dots, y_{it}) = F(x_{i1}, x_{i2}, x_{i3}, \dots, x_{it}) = \exp [\alpha + X'_{it}\beta + \mu_i + \varepsilon_{it}]$$

where y is the number of the fintech patents of dependent variables in city i and t year and F represents a negative binomial distribution function (Baltagi, 2008). x is the independent variable, X'_{it} is the $1 \times K$ matrix, β is the $K \times 1$ matrix, α is the intercept, μ_t is the individual effect, and ε_{it} is the random disturbance.

For G06Q20 as the dependent variable, the following FENB model is used:

$$\begin{aligned} G06Q20_{it} = \exp [\alpha + \beta_1 \ln(G06Q30_{it}) + \beta_2 \ln(H04L29_{it}) \\ + \beta_3 \ln(G06Q40_{it}) + \beta_4 \ln(G06F21_{it}) \\ + \beta_5 \ln(H04L9_{it}) + \beta_6 \ln(G07G1_{it}) + \beta_7 \ln(G06K9_{it}) \\ + \beta_8 \ln(G07B15_{it}) + \beta_9 \ln(G07F17_{it}) + \beta_{10} \ln(PCDI_{it}) + \beta_{11} \ln(IS_{it}) \\ + \beta_{12} \ln(FGDP_{it}) + \beta_{13} \ln(NR_{it}) + \beta_{14} \ln(LR_{it}) + \beta_{15} \ln(CS_{it}) \\ + \beta_{16} \ln(R\&D_{it}) + \mu_i + \varepsilon_{it}] \end{aligned}$$

For G06Q40 as the dependent variable, the following FENB model is used:

$$\begin{aligned} G06Q40_{it} = \exp [\alpha + \beta_1 \ln(G06Q20_{it}) + \beta_2 \ln(G06Q30_{it}) \\ + \beta_3 \ln(G06F16_{it}) + \beta_4 \ln(H04L29_{it}) \\ + \beta_5 \ln(G06F17_{it}) + \beta_6 \ln(G06F21_{it}) + \beta_7 \ln(G06K9_{it}) \\ + \beta_8 \ln(G06N3_{it}) + \beta_9 \ln(PCDI_{it}) + \beta_{10} \ln(IS_{it}) + \beta_{11} \ln(FGDP_{it}) \\ + \beta_{12} \ln(NR_{it}) + \beta_{13} \ln(LR_{it}) + \beta_{14} \ln(CS_{it}) + \beta_{15} \ln(R\&D_{it}) + \mu_i + \varepsilon_{it}] \end{aligned}$$

4.4 Results

Table 4.5 presents the results for the FENB model with G06Q20 as the dependent variable. And Table 4.6 presents the results for the FENB model with G06Q40 as the dependent variable. For each dependent variable (i.e., G06Q20 and G06Q40), it runs five models that have focal points. Models 1 and 6 include the independent variables representing the demand for fintech and regulation. Models 2 and 7 include the independent variables representing fintech-related

technologies. To further examine the role of fintech-related technology, this chapter divides the fintech-related technologies into two subsets, each representing approximately 50%. Models 3 and 8 focus on a set of fintech-related technologies with a share of more than 50% of the total co-occurrence patents. Models 4 and 9 represent the set of fintech-related technologies with a share of less than 50% of the total co-occurrence patents. Finally, Models 4 and 9 include all the independent variables.

Table 4. 5 Regression results of panel negative binomial estimations (G06Q20)

	(1)	(2)	(3)	(4)	(5)
Ln (G06Q30) Commerce		0.506(0.051) ***	0.501(0.049) ***		0.440(0.054) ***
Ln (H04L29) Communication processing		0.088(0.052) *	0.128(0.057) **		0.058(0.057)
Ln (G06Q40) Banking, insurance, and investment		0.054(0.031) *	0.103(0.030) ***		0.065 (0.031) **
Ln (G06F21) Security arrangements		0.115(0.045) **	0.064(0.051)		0.028(0.052)
Ln (H04L9) Encryption technology		0.095(0.050) *	0.158(0.052) ***		0.2001(0.053) ***
Ln (G07G01) Registering the receipt		0.099(0.028) ***		0.222(0.034) ***	0.161(0.030) ***
Ln (G06K9) Recognizing fingerprint and voice		0.161(0.043) ***		0.362(0.052) ***	0.026(0.054)
Ln (G07B15) Toll payment system		0.109(0.034) ***		0.175(0.039) ***	0.082(0.034) **
Ln (G07F17) Coin-freed apparatus		-0.022(0.029)		0.148(0.035) ***	-0.016(0.031)
Ln(PCDI) _{t-1} Per capita disposable income	1.061(0.201) ***		0.345(0.142) **	0.506(0.185) ***	0.387(0.148) ***
Ln(IS) _{t-1} Number of internet subscribers	-0.046(0.080)		0.081(0.058)	0.097(0.065)	0.068(0.057)
Ln (FGDP) _{t-1} Financial industry GDP	0.155(0.061) ***		0.012(0.039)	-0.017(0.054)	-0.007(0.038)
NR (National regulation)	0.740(0.108) ***		0.330(0.077) ***	0.465(0.090) ***	0.374(0.074) ***
LR (Local regulation)	0.318(0.067) ***		0.031(0.047)	-0.102(0.062)	0.023(0.051)
Ln (CS) Number of College students	0.152(0.072) **		0.045(0.061)	0.149(0.063) **	0.071(0.059)
Ln (R&D) R&D expenditure	0.454(0.100) ***		-0.084(0.097)	-0.061(0.101)	-0.056(0.103)
Constant	-18.648(1.793) ***	-1.995(0.141) ***	-4.747(1.377) ***	-6.724(1.788) ***	-5.238(1.491) ***
	Fixed effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect
Hausman test	(Prob>chi2 = 0.0012)	(Prob>chi2 = 0.0000)	(Prob>chi2 = 0.0000)	(Prob>chi2 = 0.0036)	(Prob>chi2 = 0.0001)
Wald chi ²	1489.26***	6568.6***	5078.35***	3584.84***	5740.46***
Log likelihood	-1591.657	-1447.959	-1399.658	-1449.898	-1378.074
AIC	3199.314	2915.918	2825.316	2923.795	2790.147
BIC	3236.588	2963.763	2885.887	2979.707	2869.355
Observations	884	884	884	884	884

Note: standard errors in parentheses, *** p<0.001, ** p<0.05, * p<0. 1.

Table 4. 6 Regression results of panel negative binomial estimations (G06Q40)

	(6)	(7)	(8)	(9)	(10)
Ln (G06Q20) Payment		0.304(0.068) ***	0.267(0.068) ***		0.291(0.068) ***
Ln (G06Q30) Commerce		0.252(0.077) ***	0.345(0.074) ***		0.222(0.080) ***
Ln (G06F16) Data retrieval and cleaning		0.045(0.020) **	0.161(0.017) ***		0.060(0.023) ***
Ln (H04L29) Communication processing		-0.011(0.071)	-0.023(0.060)		0.012(0.081)
Ln (G06F17) Data processing for math functions		-0.065(0.069)		0.044(0.057)	-0.061(0.076)
Ln (G06F21) Security arrangements		-0.017(0.067)		0.194(0.070) ***	-0.003(0.075)
Ln (G06K9) Recognizing fingerprint and voice		0.164(0.083) ***		0.197(0.099) **	0.072(0.096)
Ln (G06N3) Neural network models		0.315(0.059) ***		0.482(0.050) ***	0.321(0.062) ***
Ln (PCDI) _{t-1} Per capita disposable income	1.561(0.254) ***		0.063(0.244)	0.004(0.263)	-0.135(0.256)
Ln (IS) _{t-1} Number of internet subscribers	-0.157 (0.099)		0.083(0.067)	0.076(0.092)	0.145(0.084)
Ln (FGDP) _{t-1} Financial industry GDP	0.250 (0.091) ***		0.142(0.084)*	0.153(0.076)**	0.113(0.063)**
NR (National regulation)	0.537(0.134) ***		0.506(0.137) ***	0.402(0.131) ***	0.341(0.139) **
LR (Local regulation)	0.595(0.079) ***		0.069(0.077)	0.094(0.075)	0.014(0.074)
Ln (CS) Number of College students	0.246(0.085) ***		0.315(0.092) ***	0.106(0.132) *	0.211(0.091) **
Ln (R&D) R&D expenditure	0.139 (0.116) **		-0.139(0.121)	-0.459(0.089)	-0.294(0.126)
Constant	-20.461(2.296) ***	-2.066(0.167) ***	-3.386(2.185)	1.944(2.529)	0.972(2.362)
	Fixed effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect
Hausman test	(Prob>chi2 = 0.0027)	(Prob>chi2 = 0.0000)	(Prob>chi2 = 0.0000)	(Prob>chi2 = 0.0000)	(Prob>chi2 = 0.0000)
Wald chi ²	891.95 ***	3171.7 ***	2339.72 ***	1982.11 ***	2627.33 ***
Log likelihood	-1397.130	-1312.439	-1283.520	-1298.367	-1264.904
AIC	2810.26	2642.878	2591.041	2620.733	2561.807
BIC	2847.535	2685.938	2646.952	2676.645	2636.356
Observations	884	884	884	884	884

Note: standard errors in parentheses, ***p<0.001, **p<0.05, *p<0. 1.

Technology in G06Q20

All the models in Table 5 display a significant positive relationship between fintech patents (in G06Q20) and the five technology areas at the city level, that is, G06Q30 (transactions in shopping and e-commerce), G06Q40 (banking, insurance, investment), H04L9 (arrangements for secure communication based on encryption technology), G07G01 (registering the receipt of cash), and G07B15 (payment system relating to toll, entrance fee or fare collection). The reason could be as follows. First, G06Q20, G06Q30 and G06Q40 all belong to the same patent subclass G06Q (Data processing in administrative, commercial, financial, and others). It thus indicates that they are technological relatedness. Specifically, G06Q30 handles buying, selling, or leasing transactions as well as billing in commercial activities, and G06Q40 deals with activities in banking, insurance, exchange, and investment. Both are related to G06Q20 and thus could facilitate the understanding and absorption of G06Q20. Second, information transmission and data security are prerequisites for conducting online financial services. H04L9 applies encryption technology to secure transmission and communication. Third, both G07G01 and G07B15 deal with payment processes and thus are cognitively close to G06Q20. Therefore, G07B15 and G07G01 could facilitate the understanding and absorption of G06Q20.

Table 5 also shows four technologies that only have a significant positive relationship in some models. Specifically, these include H04L29 in models 2 and 3 (communication processing and transmission control procedure), G06K9 in models 2 and 4 (methods for recognizing printed or human characters), G06F21 in model 2 (security arrangements for protecting computers against unauthorized activity), and G07F17 in model 4 (coin-freed apparatus). The reason could be as follows. First, H04L29 has a significant positive effect in models 2 and 3 but lacks statistical significance in model 5. This is probably because H04L29 is a relatively generic character and thus not narrowly associated with fintech. Second, G06K9 and G06F21 refer to the technology that is used to verify customers' identities. It is the core process in the financial sector because financial institutions have to conduct customer due diligence to satisfy their obligation to verify the identity of their clients. The lack of statistical significance in model 5

is probably because these technologies have just been applied to the field of fintech recently. Finally, although G07F17 concerns the process of payment when purchasing optical devices, musical instruments, and games, it might not be sufficiently closely related to the core payment process based on point-of-sale devices, cards, and electronic wallets. Therefore, its role in fintech is relatively weak.

Technology in G06Q40

All models in Table 6 suggest a positive relationship between fintech patents (in G06Q40) and the four technology fields, that is, G06Q20 (payment), G06Q30 (transactions in shopping and e-commerce), G06F16 (information retrieval, data cleaning, design, and maintenance of databases), and G06N3 (computer systems based on neural network models, genetic models, and other biological models). The reason could be as follows. First, as discussed above, G06Q20, G06Q30, and G06Q40 all belong to the same patent subclass and thus are technologically related. Second, concerning G06F16 and G06N3, the reason for the positive relationship could be that they are the two key fundamental processes in financial services. Recently, financial services have become increasingly data-oriented, and thus, financial institutions require technology to handle the data. It is G06F16 that provides technology to acquire, clear, and maintain data. Similarly, G06N3 is the technology that can be used to analyze the data. Taking online lending activity as an example, financial institutions can apply a neural network model to analyze big data and thus predict the likelihood that borrowers will repay a loan.

Table 6 also demonstrates four technologies that only have a significant positive relationship in some models. Specifically, G06K9 (methods for recognizing printed or human characters such as fingerprints, irises, and voices) has a significant positive relationship with fintech patents (in G06Q40) in models 7 and 9 but does not seem to play a role in model 10. G06F21 (security arrangements for protecting computers against unauthorized activity) is only significant in model 9. Similar to the G06Q20, the lack of statistical significance in model 5 is probably because these technologies have been applied to the field of fintech only very recently.

However, H04L29 (communication processing and transmission control procedures) and G06F17 (data processing for specific functions such as solving equations, Fourier transformations, and matrix computations) seem not to play a role in the fintech patent (in G06Q40). This could be due to the generic character of the knowledge, that is, both are technologies with a very broad range of applications outside of the narrow field of fintech.

Demand for fintech in G06Q20 and G06Q40

Concerning fintech patent G06Q20 (payment), all the models in Table 5 show a significant positive relationship between PCDI (per capita disposable income) and G06Q20. This is because PCDI is the prerequisite for online payment, that is, the more disposable income that retail customer has, the more money that is available to spend on housing, food, clothing, utilities, and transportation, leading to the demand for online payment. Concerning G06Q40 (banking, insurance, investment), all the models in Table 6 demonstrate a significant positive effect of FGDP (financial industry GDP). It displays that financial incumbents (e.g., banks, insurance companies, and investment firms) have great demand for financial technology solutions to digitize their products and services and upgrade their legacy IT systems. For example, Bank of China, Industrial and Commercial Bank of China, and China Merchants Bank have heavily invested in fintech-related cloud computing, big data, blockchain, and AI for digitalizing their products and services.

Regulation in G06Q20 and G06Q40

All models in G06Q20 and G06Q40 show a significant positive relationship between NR (national regulation) and fintech development. Nevertheless, LR (local regulation) is only significant in model 1 concerning G06Q20 and model 6 concerning G06Q40. This reveals that national regulation plays a more important role than local regulation. This might be a result of the financial regulatory system in China which is designed as a top-down model. Specifically, the top-down decision-making process refers to policymaking at the national level (e.g., People's Bank of China, China Banking and Insurance Regulatory Commission, and China Security Regulatory Commission), and subsequent policy implementation at the local and city

level.

Control variables

Models 1 and 6 (without the fintech-related patents) show that the control variables of the number of college students (CS) and R&D expenditure (R&D) have a significant positive effect on both G06Q20 (payment) and G06Q40 (banking, insurance, exchange, and investment). However, when adding the fintech-related patents into the models (see models 2-5 in G06Q20 and models 7-10 in G06Q40), CS and R&D are only significant in some specific models. This indicates that fintech-related patents play a more important role in fintech development compared with CS and R&D. This result echoes the core claim of evolutionary economic geography, that is, instead of technology overall, only a handful of specific technologies that are related to the new technology can facilitate the rise of new technology (Neffke et al., 2011; Boschma, 2017).

In summary, the study finds that the emerging fintech industry develops in cities with technologically related competencies, particularly in the fields of finance, e-commerce, data sciences, and security (confirming hypothesis 1). Second, cities with more retail customers and financial institutions who have a demand for fintech services are more likely to develop the fintech industry (confirming hypotheses 2.1 and 2.2). Third, national regulation plays a crucial role in the emergence of the fintech industry in cities (confirming hypothesis 3.1). Finally, it finds that local regulations play a positive role in the emergence of the fintech industry in cities (confirming hypothesis 3.2), yet their role is less important than that of the national regulations.

4.5 Interim summary

This chapter examines the emergence of the fintech industry in China based on the analysis of China's city-level patenting. The findings are as follows. First, the study finds that the fintech industry emerges in cities with technologically related competencies, particularly in the fields of finance, e-commerce, data sciences, and security (confirming hypothesis 1). Second, the fintech industry tends to emerge in cities with more retail customers for fintech services

(confirming hypothesis 2.1). Third, the role of demand from financial incumbents is weak. However, hypothesis 2.2 cannot be rejected, as providing financial technology solutions to financial incumbents is an emerging phenomenon since the end of 2018. It thus requires more research in the future. Fourth, national regulation plays a crucial role in the emergence of the fintech industry in cities (confirming hypothesis 3.1). Fifth, it finds that local regulations play their role in the emergence of the fintech industry in cities (confirming hypothesis 3.2), yet their role is less important than that of the national regulations.

In response to the main questions that are posed in the introduction section, (1) the findings reveal that the fintech industry develops in cities with technologically related competencies. It thus implies that the principle of technological relatedness can be generalized into the fintech industry (Responding to Gap-4). (2) To the best of my knowledge, this is the first paper to systematically investigate the role of market demand in the emergence of the new industry in cities. It thus echoes recent scholarly work calling for a shift from the supply-side technology-centric view to the demand-side views, highlighting the important role of market demand in developing a new industry in cities (Responding to Gap-1).

The analysis in this chapter is not without limitations. The econometric models reveal generalizable regularities in the significant positive relationships between the emergence of fintech in cities and the supply-side technology, and the demand-side market. However, it has not yet been known how such a positive relationship occurs, or in other words, what are the specific processes underlying such positive relationships. This is because the quantitative method is good at revealing the generalizable regularities rather than the underlying process and mechanism (Yin, 2018). In contrast, the qualitative method, particularly case study, is the preferred strategy when ‘how’ or ‘why’ questions are being posed (Yin, 2018). In response, the next chapter focuses on the emergence of the fintech industry in Shenzhen to offer a qualitative and in-depth study.

Chapter 5: Modifying technology, demand, and institutional logics for regional industrial path development: A qualitative case study of the fintech sector in Shenzhen

5.1 Introduction

Chapter 4 finds a significantly positive relationship between the emergence of fintech in regions and the supply-side technology (particularly those that are related to the new industry) and the demand-side market. The unresolved question is what is the underlying logic that results in such positive relationships (Responding to Gap 1). In response, this chapter investigates the underlying logic that leads to such a significantly positive effect. Moreover, this chapter takes into account the role of institutional logics in the emergence of a new industry (Responding to gap-2). As institutional logics are hard to be quantified, I investigate them by a qualitative case study in chapter 5, rather than the quantitative research in chapter 4. In sum, this chapter explores the underlying logic of how supply-side technology, the demand-side market, and institutional logics matter for the rise of the fintech industry. By ascribing the underlying logic to the process of asset modification, this chapter explores how regional actors take action in terms of asset modification to generate the new industry in regions. Specifically, through conducting the case study in Shenzhen's fintech, I investigate and explore how Shenzhen's internet and financial firms modify the supply-side technologies, the demand-side market, and institutional logics to generate the fintech industry.

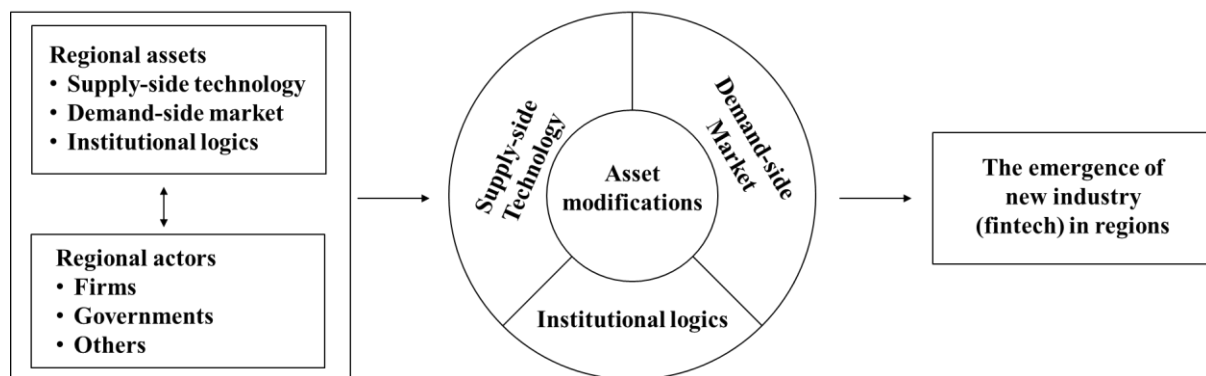
The remainder of this chapter is structured as follows. It first reviews the literature and establishes the theoretical framework. It is followed by introducing the case selection and research methods. After that, empirical results are presented. The final is the conclusion and discussion.

5.2 Theoretical framework

5.2.1 Regional precondition

The departing point of the analysis is Martins' (2010) alternative path-dependent model of local industrial evolution. Martins' (2010) model distinguishes a first preformation phase constituted by the pre-existing regional conditions, a second path creation phase wherein actors leverage the inherited conditions to create a new path, a third path development phase wherein increasing returns assist path development and a final phase that may evolve dynamically or become locked in. Taking this framework as the starting point, new regional industrial path development concerns with the first and second phases, that is, how regional actors, enabled through or constrained by regional preconditions (or regional assets), develop a new regional industrial path through their actions in terms of assets modification (Martin, 2010; Trippel et al., 2020).

Figure 5. 1 The theoretical framework of asset modification



Source: Author (2020).

Regional assets in the first 'preformation' phase reflect the outcome of previous rounds of regional industrial development (MacKinnon et al., 2019a; Grillitsch & Sotarauta, 2020). It offers a precondition that enables or constrains regional actors to generate a new regional industrial path in the second 'path creation' phase (Maskell & Malmberg, 1999; Boschma, 2017; MacKinnon et al., 2019a; Grillitsch & Sotarauta, 2020). Regional assets represent a combination of the region's technology, institution, natural assets, infrastructure, built

environment, etc. (Maskell & Malmberg, 1999; MacKinnon et al., 2019a). Regional assets may facilitate or hamper new regional path development. For example, regions that possessed technologies that are related to the new industry have a higher probability to enter such new industry, as regions offer technologies that new industry could build on, and therefore, reduce the cost of developing new industry (Boschma, 2018; Balland et al., 2019). In contrast, if regions don't possess technologies that are related to the new industry, regional precondition may hinder the rise of the new industry because the new industry has to set up from scratch (Boschma et al., 2017; Boschma, 2018).

Yet, regional precondition is a necessary but insufficient basis for regional industrial development (Martin, 2010; Mackinnon et al. 2019a). In order to generate a new regional industrial path in the second 'path creation' phase, regional actors have to take action in terms of assets modification (Trippel et al., 2020). Scholars suggest that three forms of asset modification play a crucial role in regional industrial path development, namely, reusing pre-existing assets, creating new assets, and destructing pre-existing assets (Trippel et al., 2020).

However, the extant literature on asset modification takes broadly defined assets without zoom in on different types of assets. In fact, the process of asset modification might differ in terms of different types of assets. Below, I will elaborate on asset modification (particularly focusing on redeploying pre-existing assets and creating new assets) in terms of technology, market, and institutions.

5.2.2 Asset modification

Modify technology

Redeploying pre-existing technology

Redeploying pre-existing technology plays a crucial role in developing a new industry, particularly the so-called 'regional branching or related regional diversification' which means that developing a new industry that is technologically related to regional pre-existing industries (Boschma & Frenken, 2011; Neffke et al., 2011; Boschma, 2018). Terminologically,

redeploying pre-existing technology describes the process that core technology in one pre-existing regional industry is reused to provide the basis of another new industry in regions (Martin & Sunley, 2006). Redeploying pre-existing technology is related to the concept of technological relatedness which means that two industries require similar technology (Hidalgo et al., 2018). Whenever both industries are technological relatedness, it means the technology within one industry can be redeployed into another industry. In other words, pre-existing industry provides technological assets on which new industry can build on (Breschi et al., 2003; Boschma, 2018). In contrast, if there is no technological relatedness between the new and pre-existing industries, the new industry has to build from scratch, and thus it is costly (Boschma, 2018). To date, qualitative case studies have provided a detailed analysis of how the new industry draws on the region's pre-existing technologically related industries. For example, Fornahl et al. (2012) examine the process of the shipbuilding industry diversify into the OWP industry in Bremen, Germany. They find that the OWP industry mainly draws on the pre-existing shipbuilding sector's technological assets, particularly welding and assembling large components, electronics in autonomous systems, and maritime logistics. In another case, Steen & Hansen (2018) studied the emergence of the offshore wind power (OWP) industry from the pre-existing offshore oil and gas (O&G) industry in Norway. They find that OWP is built on the machines and technology previously used in the O&G industry.

Creating new technology

However, when developing a specific new industry, relevant regional actors usually do not *ex ante* possess all the necessary technology for the new industry (Balland & Boschma, 2020; Chen & Hassink, 2020). It thus implies that redeploying pre-existing technology alone is not enough to support the new industry. In this case, relevant regional actors usually have to create new technologies that are required for the new industry but are missing in regions (Balland & Boschma, 2020; Chen & Hassink, 2020). Take the OWP industry in Bremen as an example, although the regional pre-existing shipbuilding sector has offered several key technologies for the OWP industry, there have certain technologies that are missing in Bremen and thus have to be newly created based on attracting the arrival of non-local firms, such as the WeserWind

(foundation structures and towers), REpower (turbine production) and Powerblades (blades and rotors) (MacKinnon et al., 2019b).

So, how do regional actors create new technological assets? In the field of economic geography, creating new technological assets has been conventionally analyzed by the buzz-and-pipelines model (Bathelt et al., 2004). Recently, moving beyond this conventional model, Trippel et al. (2009) and Trippel, et al. (2018) provided a comprehensive understanding of creating new technologies. First, new technologies can be created through the exchange of static technology, which means the transfer of pre-existing technology from one actor to another. It usually takes the form of market linkage (e.g., buying components, licenses, consulting, and contract research), and spillovers (e.g., recruiting specialists, the arrival of non-local actors, participating in conferences, and reading scientific literature). The second refers to the exchange of dynamic technology. It bases on interactive learning through formal networks (e.g., R&D collaborations, sharing R&D facilities), and informal networks (mainly based on trust). It often occurs when the target technology has not yet pre-existed, or has pre-existed but is out of relevant actors' search scope (Nelson & Winter, 1982), or has pre-existed but the transfer is costly (Boschma, 2005).

Modify market

The downstream market is one of the latest topics in evolutionary economic geography because scholars claim that the prevailing upstream technology-centric view should be expanded to include a downstream market perspective (MacKinnon et al., 2019a; Martin et al., 2019). The downstream market perspective argues that the exploration of new industrial development should take account of the role of market construction (MacKinnon et al., 2019a) or demand (Martin et al., 2019). Specifically, market construction refers to economic agents to create and shape the market, and sell commodities in markets (MacKinnon et al., 2019a). Demand refers to consumer needs and wants – that is, the desire or preference to acquire a product or service (Martin et al., 2019). Combined both, I define market assets as customers and their needs, and market construction refers to making the products and services to the marketplace which fills

their customers' needs and wants.

Redeploying pre-existing market (customers)

In the field of evolutionary economic geography, related diversification (or regional branching) mainly draws on a technology-centric view, i.e., due to the principle of technological relatedness, regions tend to develop a new industry that is technologically related to regional pre-existing industries (Boschma & Frenken, 2011; Neffke et al., 2011; Boschma, 2018). However, according to the seminal work of related diversification by Penrose (1959) in the field of management, related diversification can take the forms of diversifying into a new product based on a firm's existing technological assets as well as introducing a new product in a firm's existing market. In the latter form, firms sell new products and services to their pre-existing customers for meeting their new needs.

Recently, Byun (2018) and Mawdsley & Somaya (2018) coined the terms 'client-led diversification' which refers to the process that firms diversify into new activities in responding to their existing client's new demands (Byun, 2018; Mawdsley & Somaya, 2018). For example, the manufacturer General Motors (GM) diversified into the financial industry by establishing the General Motors Acceptance Corporation (GMAC) for responding to their existing customers' new demands in car financing (Ye et al., 2012). Similarly, law firms can diversify into new domains for responding to their existing customers' new demands (Mawdsley & Somaya, 2018). The underlying logic of client-led diversification is that both firms and clients get benefits from it. For firms, they may reap the benefits of selling new products and services to the same customer by enjoying the scope economies in consumption (Cottrell & Nault, 2004; Helfat & Eisenhardt, 2004). Specifically, scholarly work shows that it costs five times less to serve an existing customer than to acquire a new one (Rothfeder, 2003). For customers, they may perceive value in buying from the same supplier due to the reduction of shopping cost (Klemperer, 1992; Klemperer & Padilla, 1997) and the saving of time (Ye et al., 2012). Specifically, shopping cost refers to the customer's real and perceived costs of using several suppliers to fulfill multiproduct needs (Klemperer, 1992). In order to reduce the shopping cost,

customers often prefer to concentrate their purchases with a single supplier (Klemperer, 1992; Klemperer & Padilla, 1997). Moreover, consumers might also prefer to purchase products from one supplier because consumers could benefit from the one-stop shopping formats and thus saves their time due to the colocation of goods or services (Messinger & Narasimhan 1997; Ye et al., 2012).

How do translate the process of client-led diversification into the process of asset modification, particularly the process of redeploying pre-existing assets? Client-led diversification means firms diversify into new activities for responding to their existing client's new demands (Byun, 2018; Mawdsley & Somaya, 2018). It thus implies the commonality in the customers between the new and pre-existing industries. That is to say, the same customers have needs and want in both the new and pre-existing industries. From the firms' point of view, the current industry serves pre-existing customers' pre-existing needs, while diversifying into a new industry can serve pre-existing customers' new needs. Due to the share of the same customers with different needs in different industries, firms can redeploy their pre-existing customers in the pre-existing industry into the new industry which serves and satisfies their pre-existing customers' new needs.

Creating new market (customers)

However, when developing the new industry, the pre-existing industry may not necessarily share the same customers with the new industry. Moreover, even there exists commonality in the customers, redeploying pre-existing customers alone might not enough to support the new industry to gain momentum and critical mass. In this case, the successful development of a new industry requires attracting and acquire new customers. In general, there are several tactics to acquire new customers, such as marketing, marketing alliances, and recruiting sales experts. First, companies can acquire new customers through various ways of marketing, such as search engine advertising, mobile advertising, television advertising, direct mail, offline advertising, and more spontaneous referrals based on word-of-mouth (Villanueva, Yoo, & Hanssens, 2008; Lemon & Verhoef, 2016). Second, the marketing alliance refers to the collaboration between

two or more organizations that focuses on downstream market activities (Das, Sen, & Sengupta 1998; Swaminathan & Moorman, 2009). Marketing alliance helps firms to access the new market and customers (Bucklin & Sengupta 1993). For example, by forming an alliance with a retailer or distributor, a firm gains access to the retailer's or distributor's customers (Swaminathan & Moorman, 2009). The third is to recruit top sales experts who can facilitate a good product-clients match by sorting out product value issues with fewer search costs to the consumer as well as minimum communication costs to the clients (Priem, 2007).

Modify institutional logics

Institutional logics are defined as 'a set of material practices and symbolic constructions which constitutes its organizing principles and which is available to organizations and individuals to elaborate' (Friedland & Alford, 1991, p248). In other words, institutional logics are taken-for-granted social prescriptions that represent shared understandings of what constitutes legitimate goals and how they may be pursued in an organizational field (Thornton & Ocasio, 1999; Suddaby & Greenwood, 2005; Battilana & Dorado, 2010; Edvardsson et al., 2014). For example, in the field of the banking sector, the dominant institutional logics are that 'required profits sufficient to support ongoing operations and fulfill fiduciary obligations' (Battilana & Dorado, 2010, p1419). Institutional logics matter for the emergence of the new industry in regions because every economic activity is not isolated from but deeply embedded in institutions (Granovetter, 1985; Nelson 1998; Grillitsch & Sotarauta, 2020). In this sense, actions that are directed towards modifying institutions play a crucial role in developing a new regional industry.

Redeploying pre-existing institutional logics

Institutions are carriers of social practices which pass ingredients of the past into the future (David, 1994; Martin, 2000; Grillitsch & Sotarauta, 2020). That is to say, pre-existing institutions are, to some extent, spontaneously reproduced and redeployed to underpin the new institutions. The underlying logic is that, when institutional entrepreneurs take actions towards modifying institutions, they are not working under the institutional vacuum, rather they are

likely to be carriers of the pre-existing institutions and thus will have preconceived notions as to what new institutions to expect (Bourdieu, 1998; Scott, 2003; Battilana & Dorado, 2010). It also echoes to the concept of institutional hysteresis (Setterfield, 1993). Institutional hysteresis recognizes ‘the importance of current behavior in shaping future institutions, but which at the same time takes account of the extent to which this behavior is constrained by pre-existing institutional structures’ (Martin, 2000, p86). ‘By institutional hysteresis, then, is meant a process in which current institutions influence the nature of current economic activities, which in turn influences subsequent institutional forms’ (Martin, 2000, p86).

In addition to the above relatively spontaneous redeployment, redeploying pre-existing institutions could be purposeful and draws on the notion of ‘institutional relatedness’, that is, ‘the degree to which institutions associated with certain industries or activities can be transposed to provide resources and legitimacy to new industries meaning reusing the institution in one domain to another new one’ (Carvalho & Vale, 2018, p291). Whenever two industries exist institutional relatedness, institutional and relational practices developed within a certain industry can be purposefully redeployed to another industry (Padgett & Powell, 2012; Carvalho & Vale, 2018). For example, relevant regional actors in the Portuguese Centro Region redeployed the institutional norms and practices (e.g., technology-transfer models, incubation, dual management of research labs) previously associated with the IT industry to the biotechnology industry which in turn construct a more amenable institutional environment for the biotechnology development (Carvalho & Vale, 2018).

Create new institutional logics

However, when developing a specific new industry, redeploying pre-existing institutions might not enough to support the new industry. In this case, the emergence of a new industry requires new institutions to support it. The concept of ‘institutional entrepreneurship’ leads us to explore the central role of individual agency in creating new institutions. Following DiMaggio’s (1988) seminal work, institutional entrepreneurship emphasizes the role of actors in creating new institutions, since ‘new institutions arise when organized actors with sufficient resources

(institutional entrepreneurs) see in them an opportunity to realize interests that they value highly' (DiMaggio,1988, p14). In this regard, Battilana et al. (2009, p69) assume that institutional entrepreneurship is embedded in the so-called institutional entrepreneurs who 'initiate divergent changes and actively participate in the implementation of them'.

Although institutional entrepreneurship highlights the crucial role of institutional entrepreneurs, it does not explicitly identify the specific actions in which institutional entrepreneurs work to create new institutions (Lawrence & Suddaby, 2006). So, what are the specific purposive actions or institutional work that could create the new institutions? In order to have more explicit analytical tools for examining institutional change, I introduce Lawrence & Suddaby's (2006) work on institutional work, which elaborates on 'sets of practices through which actors engaged in actions that resulted in the creation of new institutions' (Lawrence & Suddaby, 2006, p220). Lawrence & Suddaby (2006) summarized nine institutional work in creating new institutions, namely advocacy (the mobilization of political and regulatory support through direct and deliberate techniques of social suasion); defining (the construction of rule systems that confer status or identity, define boundaries of membership or create status hierarchies within a field); vesting (the creation of rule structures that confer property rights); constructing identities (defining the relationship between an actor and the field in which that actor operates); changing normative associations (re-making the connections between sets of practices and the moral and cultural foundations for those practices); constructing normative networks (constructing of interorganizational connections through which practices become normatively sanctioned and which form the relevant peer group with respect to compliance, monitoring and evaluation); mimicry (associating new practices with existing sets of taken-for-granted practices, technologies and rules in order to ease adoption), theorizing (the development and specification of abstract categories and the elaboration of chains of cause and effect) and educating (the educating of actors in skills and knowledge necessary to support the new institution).

5.3 Data and qualitative method

Case study method

Methodologically, this chapter adopts the case study method in investigating the emergence of the Shenzhen fintech industry. This method is appropriate for two reasons. First, case studies are particularly powerful in generating in-depth insights when a ‘subject is being encountered for the first time or is being considered in a fundamentally new way’ (Gerring, 2006, p40). It echoes Morse’s (1991) argument that qualitative research may be needed because the topic is new, the subject has never been addressed with a certain sample or group of people, and existing theories do not apply to the particular sample or group under study (Morse, 1991). In this chapter, I focus on the process of modifying market demand and institutions in regional industrial path development that few literatures have considered before. Second, ‘case studies are the preferred strategy when ‘how’ or ‘why’ questions are being posed’ (Yin, 1994, p1). The interest in this paper lies in answering the ‘how’ questions, namely, how do regional actors on the Internet (or financial industry) reuse pre-existing technological (and market) assets by the logic of relatedness as well as create new technological (and market) assets to facilitate the emergence of the fintech industry in Shenzhen?

Case selection

The selection of Shenzhen’s fintech industry relies on ‘theoretical sampling’ which refers to ‘the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes his data and decides what data to collect next and where to find them, to develop his theory as it emerges.’ (Glaser & Strauss, 1967, p45). Put simply, theoretical sampling simply means that cases are selected because they are particularly suitable for extending extant theory and developing a new one. In other words, cases are only sampled for theoretical reasons (Eisenhardt & Graebner, 2007). Based on such a theoretical sampling logic, this research seeks to present a representative case to illustrate the process of modifying technological, market, and institutional assets in regional industrial path development. The rationale behind the selection of the fintech industry in Shenzhen is twofold. First, Shenzhen is one of the top three

fintech hubs in China. Specifically, by the end of 2019, Shenzhen's application of fintech-related patents⁴ reached 8,059 slightly behind Beijing where the number of fintech-related patents was 8,066. Moreover, it witnesses a rapid increase in the number of fintech-related patent applications in the past decade. That is, the number of fintech-related patent applications increased from 58 in 2009 to 1,896 in 2019. In this sense, Shenzhen represents one of the 'best-practice' regions that could be a representative case for investigating the development of the fintech industry. Second, the fintech industry usually emerged from the pre-existing internet industry and/or financial industry (Arner et al., 2015; Cojoianu et al., 2020). In Shenzhen, the fintech industry is diversified from both pre-existing internet and financial industry. In fact, the tech giant Tencent, the financial conglomerate Ping An, and the China Commercial Bank are three key players in Shenzhen's fintech industry. It thus offers a rich empirical case in which I could compare the various process of modifying technological, market, and institutional assets in different pre-existing industries that diversified into the same new industry.

Data collection

This study draws upon two main data sources: 22 semi-structured interviews and a large number of secondary materials. First, semi-structured interviews were adopted as they allowed for a discussion of the questions and topics relevant to the research as well as to pursue related and relevant lines of inquiry that might arise (Yin, 2018). The interviews were conducted over two periods: February to April 2019, and April to June 2020. The interviewees include founders/managers of fintech companies with a background in the internet and financial industry, officials of industrial regulatory authorities, managers of real estate developers that build industrial parks to facilitate the fintech industry, and representative fintech consumers (Table 5.1). Interviewees will be cited in the empirical part according to the abbreviations in Table 5.1. The questions asked dealt with the emergence and development of the fintech industry in Shenzhen. Key questions include (1) what does the emergence of the fintech

⁴ By fintech-related patent, I refer to G06Q20 (i.e., patents in payment architectures, schemes or protocols) and G06Q40 (i.e., patents in banking, insurance, exchange investment).

industry in Shenzhen look like? (2) how do the internet and financial industry diversify into the fintech industry? Specifically, how do the internet and financial industry modify technological, market, and institutional assets to diversify into the fintech industry? (3) how do regulatory authorities and other related organizations facilitate the emergence and development of the fintech industry? The interviews were about 30 to 90 minutes in length and were either recorded by audio recorder or note-taking.

Table 5. 1 Basic Information of interviewees

Interview groups	No. of interviewees	Key topics
Fintech firms with internet background (IT)	7	(1) History and key events of Shenzhen's fintech industry development.
Fintech firms with financial background (FN)	7	(2) The process that financial industry and internet industry diversify into Fintech industry. (3) Key asset modification process (in terms of technology, market demand and institutions) carried out by financial industry and internet industry.
Governmental officials (GO)	3	(1) History and key events of Shenzhen's fintech industry development. (2) Fintech regulations at local and national level.
Industrial experts (IE)	3	(1) History and key events of Shenzhen's fintech industry development. (2) Relevant actors and their roles in developing the industry.
Consumers (CS)	2	(1) History and key events of Shenzhen's fintech industry development. (2) Personal consuming experience in fintech.
Total	22	

Source: Author (2020).

The second part of the qualitative data contains a large number of secondary data. In particular, second-hand qualitative data on companies include the firms' websites, quarterly and annual reports, company conferences as well as articles with interviews with corporate leaders. Moreover, policy documents related to the fintech industry are extracted from the websites of

Shenzhen municipal governments and central governments. Furthermore, I selected four journals and newspapers, including a professional Chinese-language journal that specializes in the fintech industry ('Financial Computerizing'), a leading English-language provider of news and insights on the Chinese finance and fintech sectors ('China Banking News'), and local newspapers that focus on city events in Shenzhen ('Shenzhen Special Zone Daily' and 'Shenzhen Evening News').

Data analysis

The qualitative data analysis proceeds in terms of Miles & Huberman's (1994) three-phase framework. The first phase is data reduction which 'refers to the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written up field notes or transcriptions' (Miles & Huberman, 1994, p10). The data reduction is mainly guided primarily by the need to address study questions, namely, how does Shenzhen's fintech industry emerge and develop? While initial data reduction is shaped by pre-established study questions, I remain open to inducing new meanings from the data available.

The second phase is data display which goes one step beyond data reduction to provide 'an organized, compressed assembly of information that permits conclusion drawing and action. ... The displays ... include many types of matrices, graphs, charts, and networks. All are designed to assemble organized information into an immediately accessible, compact form so that the analyst can see what is happening and either draw justified conclusions or move on to the next step of the analysis the display suggests may be useful' (Miles & Huberman, 1994, p11). In this chapter, I use the matrix to arrange the qualitative data, as well as discern systematic patterns and relationships that are related to the research questions. Specifically, qualitative data was structured by several concept-led and research objective-based categories (see Table 5.2).

Table 5. 2 The concept-led and research objective-based categories

	Pre-existing assets			Newly created assets		
	Technology	Market	Institutions	Technology	Market	Institutions
Internet industry	<ul style="list-style-type: none"> • What are internet industry’s pre-existing technological, market, and institutional assets? • How do internet industry redeploy their pre-existing assets and diversify into the fintech industry? 			<ul style="list-style-type: none"> • What are the key technological, market, and institutional assets that internet industry is missing? • How do the internet industry create its missing assets and diversify into the fintech industry? 		
Financial industry	<ul style="list-style-type: none"> • What are financial industry’s pre-existing technological, market, and institutional assets? • How do financial industry redeploy their pre-existing assets and diversify into the fintech industry? 			<ul style="list-style-type: none"> • What are the key technological, market, and institutional assets that financial industry is missing? • How do the financial industry create its missing assets and diversify into the fintech industry? 		

Source: Author (2020).

The final phase is conclusion drawing and verification. By conclusion, it means to ‘decide what things mean - is noting regularities, patterns, explanations, possible configurations, causal flows, and propositions’ (Miles & Huberman, 1994, p11). In other words, conclusion looks for a ‘mechanism-based explanation’ which underpinning logic is quite simple, that is, ‘at its core, it implies that proper explanations should detail the cogs and wheels of the causal process through which the outcome to be explained was brought about’ (Hedström & Ylikoski, 2010, p50). By mechanism, it ‘consists of entities (with their properties) and the activities that these entities engage in, either by themselves or in concert with other entities. These activities bring about change, and the type of change brought about depends upon the properties of the entities and how the entities are organized spatially and temporally’ (Hedström, 2005, p25). In the field of economic geography, ‘mechanism serves as a necessary relation to connect an initial causal condition with its particular socio-spatial outcomes in context’ (Yeung, 2019, p226). Here, there is an additional point needed to be mentioned, that is, the generalizability of the mechanism. Generalization from case study research is based on thinly rationalistic social mechanisms (Bengtsson & Hertting, 2014). Thin rationality here is understood as the fact that ‘actors in most cases do things for certain reasons’ (Bengtsson & Hertting, 2014, p708). Based on this thin rationality, one expects ‘the same ideal-type mechanisms to be applicable also in

similar actor constellations in other contexts, and thus such mechanisms can be used as a generalizing bridge between contexts' (Ibid.). In sum, generalization from single-case studies builds on expectations about 'similar mechanisms operating in similar contexts' (Bengtsson & Hertting, 2014, p707). With the conclusion, mechanism, and the generalizability of mechanism in mind, I hold some conclusions lightly at first, maintaining openness and skepticism, then analyzed continuously to get an explicit and grounded conclusion (Miles & Huberman, 1994).

'Conclusion drawing, in our view, is only half of a Gemini configuration. Conclusions are also *verified* as the analyst proceeds' (Miles & Huberman, 1994, p11). One key technique to verify the conclusion is triangulation. According to the seminal work by Denzin (1978), there are four basic types of triangulation, that is, data triangulation (the use of multiple data sources in a single study), investigator triangulation (the use of multiple investigators to study a particular phenomenon), theory triangulation (the use of multiple perspectives to interpret the results of a study), and methodological triangulation (the use of multiple methods to conduct a study). In this chapter, the conclusions are verified by the method of data triangulation, that is, I triangulate the interview qualitative data and a large number of secondary materials to draw the conclusions.

5.4 Results

5.4.1 A favorable regional precondition in Shenzhen

Shenzhen is a city located in the Guangdong province of southern China and locating the north of Hong Kong. Shenzhen was designated as the first special economic zones under China's reform and opening-up policies in 1979. Over the past four decades, the GDP annual growth rate in Shenzhen averaged 22% from 1979 until 2019 (Shenzhen Municipal Statistic Bureau, 2019). To date, Shenzhen has become one of the most important financial and hi-tech centers in China.

Figure 5. 2 The location of Shenzhen in China



Sources: Author (2020).

The development of the financial industry in Shenzhen can be dated back to the late 1970s when China implemented the opening and reform policies and, soon later, Shenzhen was selected as the ‘Special Economic Zone’. To support the construction of the Special Economic Zone, Shenzhen reorganized the preexisting state-owned banks (e.g., Agricultural Bank of China, China Contracture Bank, and Bank of China in 1979), attracted foreign banks (e.g., Nanyang Commercial Bank in 1982), and, more important, set up joint-stock financial institutions (e.g., China’s first joint-stock commercial bank China Merchant Bank in 1987; and China’s first joint-stock insurance company Ping An Insurance Group in 1988). To date, Shenzhen is one of the top three financial centers in China along with Beijing and Shanghai (Zhao et al., 2013). According to the ‘Global Financial Centres Index’ (2020) published by the Z/Yen Partners in collaboration with the China Development Institute (CDI), Shenzhen is the 3rd largest financial center in China, just behind Beijing and Shanghai (Z/Yen & CDI., 2020). Over the past four decades, the compound annual growth rate of the financial industry in Shenzhen averaged 28% from 1979 until 2019 (Shenzhen Municipal Statistic Bureau, 2019). Through the rapid development of Shenzhen’s financial industry, the Shenzhen-based Ping An (ranking 29th) and CMB (ranking 188th) have been listed on the Fortune Global 500 List 2019

(Fortune, 2019). Moreover, Shenzhen hosts more than 200 thousand financial employees in 2018 (Shenzhen Municipal Statistic Bureau, 2019). Among others, the number of Chartered Financial Analyst (CFA) candidates in Shenzhen which represents one of the highest levels of recognition for financial professionals reached 800 people in 2019 which ranked 3rd in China in 2017, just behind Beijing and Shanghai (CFA Society Shenzhen, 2019).

The development of the internet industry in Shenzhen took off in 1995 when the Shenzhen municipal government initiated a transformation strategy with high-tech industries to replace the previous low value-added labor-intensive industries. Due to the constant R&D inputs from enterprises, particularly domestic firms, Shenzhen successfully cultivated several internet firms. To date, Shenzhen is one of the five leading internet cities in China, along with Beijing, Shanghai, Guangzhou, and Hangzhou (Zhen et al., 2015). In 2019, the added value of the Shenzhen Internet industry reached 102 billion yuan with a year-over-year growth rate of 23% (Shenzhen Municipal Statistic Bureau, 2029). The number of employees in the internet sector in Shenzhen was 420 thousand in 2018 (Shenzhen Municipal Statistic Bureau, 2019). Shenzhen's internet industry is mainly dominated by the social network giant Tencent. Tencent ranked 2nd among the Chinese Internet Companies according to the report released by China's Ministry of Industry and Informational Technology (MIIT) and the Internet Society of China (ISC) in 2019 (MIIT & ISC, 2019). Moreover, Tencent ranked 237th, according to the Fortune Global 500 List 2019 (Fortune, 2019).

In addition to the competent financial and internet sectors, Shenzhen also has a favorable regional institutional environment by which the internet and financial industries diversify into the fintech industry.

As a young metropolis and the experimental zones for economic reform, Shenzhen has a relatively market-led atmosphere for entrepreneurs to innovate with less direct intervention from central, provincial, and municipal authorities (Chen & Kenney, 2007; Yang, 2015). This market-led innovation was reflected by the so-called 'four 90%'s', that is, 90% of innovative companies are local firms, 90% of R&D personnel employed in firms, 90% of R&D funds from

firms (Yang, 2015). In the field of fintech in the particular and financial industry in general, Shenzhen authorities implemented the ‘small government and big market’ strategy which enables the market forces to promote innovation. As put by He Jie, Director of Shenzhen Local Financial Supervision Administration (2019),

‘The first is to give full play to the decisive role of the market and promote innovation. Shenzhen's financial work has always adhered to the concept of ‘small government, big market’, strives to provide services without interfering in the daily operations of enterprises, and supports more guidance in resource allocation and industry behavior through market rules, market prices, and market competition to keep the financial industry strong Innovation motivation and active innovation atmosphere. ... Shenzhen has always been a ‘small government’. I often say these three sentences. The first sentence is ‘Officials do not disturb the people, and the people do not flatter officials’; the second sentence is ‘The government is like air. To its existence, it is everywhere when you need it’; the third sentence ‘you don’t find me, I don’t find you, come to me when you need me, and I will definitely help you.’

Moreover, this market-led atmosphere in Shenzhen was strengthened by the Chinese national and local authorities’ encouragement and tolerance of the industry. As one interviewee put it (IT-6),

‘Shenzhen has a relaxed attitude towards financial innovation because financial innovation is the global technology frontier and has no first movers to follow. They [regulators] don't know how far it can develop in the future. So, take a look first and decide later, just a wait-and-see or test-and-learn. Moreover, you should consider the temporal and spatial background of this wave of financial innovation. In those years, double innovation [Mass innovation and mass entrepreneurship] was the big trend, and the government held a positive attitude towards innovation.’

In sum, this market-led atmosphere in Shenzhen provided a huge space for private-owned corporations to participate in fintech innovation. According to the fintech patents application during 2003-2019 that I collect based on two IPC codes G06Q20 (payment) and G06Q40

(banking, insurance, exchange investment), it shows that 90% of the patents owned by financial and internet firms.

However, market-led innovation with less government intervention is a relative concept, rather than meaning there are not policy supporting it. In principle, the financial regulatory system in China is designed as a top-down model in which national authorities made policy guidelines and local authorities made relevant local policies in line with such upper national guidelines. As put by He Jie, Director of Shenzhen Local Financial Supervision Administration (2019),

‘The first is to combine the upper national policy. Deeply grasp the national financial policy guidance, and consciously put the development of the local financial industry into the overall financial situation of the country to think and plan.’

This top-down model is illustrated by the following example. In February 2014, Premier Li Keqiang encouraged the development of fintech in the Report on the Work of the Government. The report stated that fintech (or Internet finance the term used by Premier Li Keqiang) has swiftly risen to prominence and that the healthy development of fintech will be further promoted. In line with the encouraging attitude from national authorities, local authorities followed up and made specific policies for fintech development. Immediately, in March 2014, Shenzhen municipality promulgated the ‘Guiding Opinions on Supporting the Innovation and Development of Internet Finance’ which promotes financial incumbents to upgrade by integrating with the internet technology, and promoted Internet companies to enter the financial sector (Shenzhen Municipal Financial Regulatory Bureau, 2014)

In addition to implementing the upper national policy, local authorities made policies that are tailored to the local situations. As put by He Jie, Director of Shenzhen Local Financial Supervision Administration (2019),

‘The second is to combine with the local situation, give play to the decisive role of the market in the allocation of financial resources, properly handle the relationship between the government and the market, improve the market regulation, and improve the efficiency of financial resource allocation.’

Indeed, Shenzhen struggled to create a favorable and conducive environment for fintech firms from three pillars, namely space, capital, and talent. As put by He Jie, Director of Shenzhen Local Financial Supervision Administration (2019),

‘The main practice is to continue to create a good business environment and improve financial service functions. For a long time, Shenzhen has worked hard to create ‘three bests’ for the development of the financial industry: the most favorable policies, the best services, and the best environment. From the aspects of capital, land, and talents, [Shenzhen] built a comprehensive preferential policy system to foster the development of the financial industry.’

This statement echoes the interviewee’s comments (GO-3). She said:

‘Government’s support for the fintech industry is mainly two parts, the first is space, the second is reward.’

One example that illustrating such supports from land and capital is the Nanshan Fintech City that co-developed by Shenzhen Nanshan district local government and property developer China Resource Land. It offers more than a hundred thousand square meters of office space to fintech companies, and gives the tenants attractive incentives in rent costs and rewards. So far, has attracted several leading fintech firms, of which one key tenant is the fintech department of the Bank of Beijing. As one interviewee (GO-2) put it:

‘To improve its industrial ecosystem, the Nanshan government sets Beijing Haidian Central Business District and others as the benchmark, then selects fintech as a development direction. ... [To achieve this aim], the Nanshan government collaborates with China Resources Land to establish this project. ... It leases 70% of the benchmark assessment rent and offers 70 million yuan reward to qualified enterprises. Meanwhile, now and then, it holds events to establish a platform to integrate various companies, such as IT, finance, and third-party institutions. ... [It attracts] key tenants include the fintech department of Bank of Beijing, fintech department of other big banks, and big data risk management firms’

Several supports focus on the capital. For example, in 2017, the Shenzhen Municipal

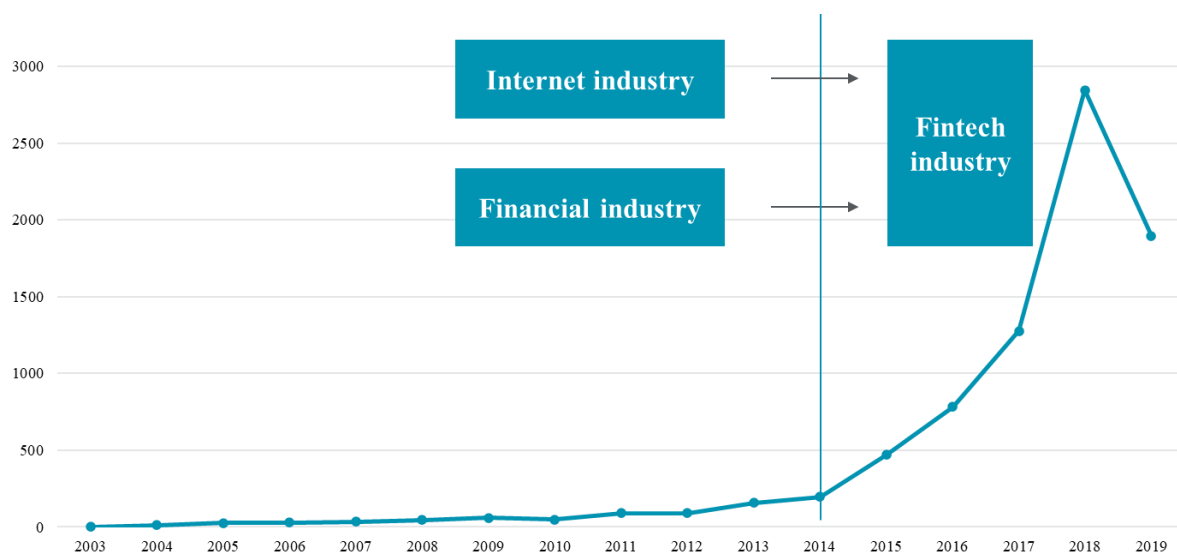
Government incorporated the development of financial technology in the ‘Ten Action Plans’ for special support for major technology industries in the city. More importantly, the Shenzhen Municipal Government sets up China’s first fintech award which rewards 6 million yuan each year for the outstanding and innovative fintech products in Shenzhen and Hong Kong in 2017 (Shenzhen Municipal Financial Regulatory Bureau, 2018). In 2019, Tencent-back WeBank’s federal learning model won the first prize of the Shenzhen Fintech Award. Currently, data is becoming increasingly isolated, that is, large firms have a monopoly over big volumes of data, while small firms only have small data. The federal learning model lies in the distributed mechanism to break the data island (Ma et al., 2020).

The final pillar concerns talents. To create a large pool of highly skilled workforce and educational organizations for the fintech sector, the Shenzhen government set up several programs that offer training specifically designed for fintech occupation. Among others, two programs are eye-catching. First, Shenzhen University teamed up with Tencent-backed fintech WeBank to launch a college, namely Shenzhen University - WeBank Fintech Academy, that offers undergraduate, graduate, and Ph.D. studies in fintech, particularly focusing on financial big data technology applications, blockchain finance, insurance technology, and regulatory technology. This program maintains close ties to industrial practitioners. For example, the college announced the appointment of WeBank’s chief artificial intelligence officer as the chairman of the academic committee. Moreover, WeBank’s chief information officer serves as the supervisor for postdocs and researched the commercialization of distributed technology in the financial industry (Shenzhen University-WeBank Fintech Academy, 2020). Second, in order to train the fintech talents, Shenzhen Municipal Financial Regulatory Bureau cooperated with the Hong Kong Monetary Authority as well as the Monetary Authority of Macao to launch the Shenzhen-Hongkong-Macao Fintech Professional Programme (SHMFTPP) which is akin to Chartered Financial Analyst Program and Financial Risk Manager. This program includes three modules, that is, finance and economics, computer science, and law and norm, which provide three fundamental knowledge about fintech. Such a ‘finance + technology’ program aims to train the compound talents with excellent knowledge in both finance and technology.

The first exam has to be held in 2020, and there have been registered 1,500 people (SHMFTPP, 2020).

In sum, Shenzhen has a favorable precondition for developing the fintech industry, which is characterized by the existence of the competent financial and internet sectors, as well as favorable regional institutions that made an appropriate balance between the free market and government interventions. Indeed, it has witnessed the explosive development of the fintech industry in Shenzhen since 2013 (see Figure 5.3 and the detailed discussion in Chapter 2). In the next two sections, I will elaborate on how do Shenzhen’s internet and financial industry successfully diversify into the fintech industry, particularly during 2013-2019?

Figure 5. 3 The diversification of Shenzhen’s financial and internet industries into the fintech industry



Sources: Author based on data from the NIPA (2020).

5.4.2 Internet industry diversified into fintech

In the section, I elaborate on how the internet industry diversified into the fintech industry from the aspects of technology, market, and institution.

Modifying technology

Redeploying information technology

Fintech is the outcome of the combination of financial skills and information technology (e.g., web technologies, artificial intelligence, big data, distributed system). In this sense, the internet industry could leverage its competitive advantages in information technology to diversify into the fintech industry. For instance, when Tencent set up the WeBank, China's first online banking, was established in 2014. Tencent's IT technology provides great support for the establishment of WeBank. As remarked by one interviewee (IT-3): 'in the early development stage, most of the employees [in WeBank] come from Tencent, especially technology, data analysis, and Internet product developers.' Aside from WeBank, in 2015, Tencent also restructured its business units to set up the Tencent Financial Technology Group (Tencent FiT) which mainly builds on Tenpay that was established in 2005 and works as a platform for Tencent to provide mobile payment and financial services. Besides the above star fintech enterprise, one interviewee from a medium-size online lending company also confirms the crucial role of the internet industry in setting up a new fintech company. He (IT-4) said 'Our founder is previously senior managers in ** [technology company]. Now, many of our company's senior executives are his former colleagues and subordinates, they come together to start this business.'

So, what are the specific IT technologies that internet firms leveraged to diversify into fintech? Web technologies, AI, and distributed databases are some of the key technologies.

Web technologies rely on a set of programming languages, such as HTML, Javascript, PHP, Java, C++. Web technologies are important for fintech services because mobile devices are now portals for accessing a full range of financial services (He et al., 2017). As one of China's leading internet centers, Shenzhen has possessed considerable programming skills and thus greatly supports the development of fintech. Take Tencent as an example, in 2014, it made 470 million lines of code in a single year, wherein the top programming languages were C++ with about 147 million lines, Java with about 45 million lines, Javascript with about 40 million lines, and HTML with about 24 million lines (Tencent, 2014). How these programming skills support the development of fintech services? It relies on the recombination between the programming skills and financial-specific knowledge, particularly customers' financial demand and

preference. As one interviewee explains (IT-4):

‘Like C++, Java, and PHP, these are general-purpose programming technologies. Its value realization needs to be combined with specific scenarios. It may be a financial scenario or a retail or the others. . . In practice, product managers interpret and translate different needs of various industries, then the technical staffs realize these needs through technology’.

Another interviewee gave a more detailed example (IT-5):

‘The development of the mobile fintech service must be based on the users’ financial consumption behavior. Finance, as the name implies, is money and circulation. Users are most concerned about the principal and the risk of return. I [thus] put the number of assets, that users are most concerned about, on the most prominent place on the homepage. Product recommendation, because I are targeting financial novices, I proceed according to the ranking of small risk and high return.’

AI is another key IT technology underpinning the fintech service. For instance, voice authentication and facial recognition enable the process to identify and verify customers. Natural language processing (NLP) underpins the chatbot that serves and interacts with the customers. Shenzhen’s internet industry is competent in AI. For example, Tencent has established three AI labs, namely WeChat AI in 2011, YouTu Lab in 2012, and AI Lab in 2016. They particularly focus on AI-related technologies including facial recognition, speech recognition, natural language processing, and machine learning. So far, Tencent’s AI technology has been applied in several fintech services. For example, as a completely online bank, WeBank has no offline branch to identify and verify customers face to face. Tencent thus leveraged its facial recognition technology to support WeBank’s facial identity authentication. Similarly, Tencent also redeployed its technology in NLP to support the establishment of a customer service robot system in its online asset management platform Licaitong.

It also witnesses the redeployment of previous database technology into fintech services. One influential case is the establishment of Tencent Distributed SQL (TDSQL) which provided digital payment services for Tencent in 2012 and then used as the database management system

for WeBank in 2014. Technically, the establishment of TDSQL mainly depends on reusing Tencent's previous capability in MySQL, an open-source database management system. As remarked by Pan (2015), Technical Director of Tencent's Technology Engineering Group, currently responsible for the development of TDSQL:

'In the aspect of technology, I am more confident in MySQL. Since 2003, our team is basically based on MySQL customized development and has accumulated a lot of relevant experience. ... Therefore, when the TDSQL project was established in 2012...MySQL was directly used as the data storage engine to obtain mature relational data storage and access capabilities'

Creating new financial skills

Since the current rise of fintech is the first time when the internet industry entered into the finance industry and offered financial service (Cojoianu et al., 2020), the internet industry was previously lacking financial knowledge. It echoes Ping An chairman Peter Ma's statements '99% of Internet finance is the new clothes of the emperor. Many Internet finance platforms lack financial risk control technology and experience' (Ma, 2017). To acquire the fundamental yet missing financial knowledge, the internet industry has to recruit financial experts or cooperate with financial institutions that previously monopolized financial knowledge.

The process of recruiting financial experts was witnessed in the establishment of Tencent-backed WeBank. Although Tencent supported the IT technology in WeBank, "financial experts mainly come from Ping An Group" (IT-3). Indeed, several top-level managers were previously working at Ping An, a Shenzhen-based financial group. For example, WeBank's chairman Gu is the former executive director of Ping An, WeBank's president Li is the former secretary of the board of the Ping An Bank, WeBank's Chief Information Officer (CIO) Ma is the former general manager in Ping An Technology, the vice president Liang charged in credit card is the former general manager in Ping An Fintech and also the former general manager of the credit card center in China Merchants Bank, a Shenzhen-based commercial bank. Moreover, WeBank recruited experts from the regulatory authorities. For example, WeBank's Chief Audit Officer

(CAO) Qin was formerly director of the Policy and Regulation Division of Shenzhen Banking Regulatory Bureau, and WeBank's Chief Compliance Officer (CCO) Wan was originally the head of the Payment and Settlement Division of the Shenzhen Branch of the Central Bank.

In addition to WeBank, the rise and development of Tencent's internal Tencent FiT Group are tightly linked to a key person Lai. Lai was from Hong Kong and received a bachelor of science and a master of economics from the Massachusetts Institute of Technology and an MBA degree from Harvard University. Prior to joining Tencent, he worked at Lehman Brothers Investment Bank in the US. Due to the compound education background and working experience, Lai first joined Tencent's QQ team, one of Tencent's social platforms, in 2009. Soon later, he took over as the general manager of Tenpay in 2011, and then the head of Tencent FiT in 2015. During this stage, Lai played a crucial role in Tencent's fintech diversification. As one interviewee (IT-3) put it: '[Lai] seized the opportunity of mobile payment and grabbed the first ship ticket for Tencent to enter technology finance.' Specifically, what the interviewee called 'ship ticket' is the WeChat Pay that developed through the collaboration between WeChat and Tenpay. One of the most influential stories is the launch of the WeChat red envelope in which family and friends send money to each other as a New Year gift, at the 2014 Spring Festival. This battle helped WeChat Pay to catch up to its competitor Alipay, an online payment platform owned by the Hangzhou-based E-commercial giant Alibaba.

However, not every internet company is like WeBank backed by Tencent or Tencent FiT owned by Tencent that can recruit such top-level talents from traditional financial institutions. The small- and medium-size fintech start-ups faced lots of barriers when they looked for top-level talents. It is because the top-level talents might prefer the tech giant rather than small- and medium-sized start-ups, due to better salaries and better career development. However, start-ups from the internet industry have an urgent need for financial skills. As one interviewee (IT-5) said (2019):

'Inter-disciplinary talents who understand both finance and IT are rare. Internet guys generally have no experience in the financial industry, let alone the complex financial knowledge and

regulatory compliance.’

Consequently, small- and medium-size fintech start-ups’ priority is to recruit those financial experts with practical financial skills and those frontline employees with direct interacting experience with clients. As one interviewee (IT-1) said (2019):

‘I [internet finance start-ups] are recruiting financial customer managers; they have financial skills, financial market acumen, and are close customers’ real needs. There are also risk management stalls who understand data, modeling, law, and regulation.’

Aside from recruiting, firm-firm cooperation is another way to acquire the missing financial knowledge. One of the examples of this cooperation was when Tencent opened the wealth management platform LiCaiTong in 2014. This platform allows financial institutions to list their products and services on it. The first round of cooperative financial institutions was four of China’s leading fund management companies, i.e., China Asset Management (Beijing-based), China Universal Asset Management (Shanghai-based), E Fund (Guangzhou-based), and GF Fund (Guangzhou-based). The cooperation model between Tencent and financial institutions is as follows. Tencent is mainly responsible for providing IT technologies, that is, connecting with the systems of multiple financial institutions, providing users with access to services such as financial product information query and transaction ordering, as well as assisting users in doing account opening, buying, and selling, and information query services. While financial institutions are mainly responsible for providing financial knowledge, that is, responsible for the structural design and asset operation of financial products, and provide users with services such as account opening, account registration, product purchase, income distribution, product withdrawal, share inquiry, etc., and in strict accordance with relevant laws and regulations (Wang, 2019). Based on such a complementary partnership, the number of users of LiCaiTong has increased from 0 in 2014 to more than 150 million in 2019, and, in the same period, the asset under management has exceeded 500 billion yuan (Tencent, 2019).

Modifying market (customers)

Redeploying pre-existing market (customers)

Before diversifying into the fintech industry, internet firms usually have specialized in one particular online niche market. For example, customers contact their friends by Tencent's WeChat in China and Facebook in the US, seek information by Baidu in China and Google in the US, and shop by Alibaba's Tmall in China and Amazon in the US. In this sense, internet firms have a large number of existing customers in their businesses before diversifying into fintech services. Therefore, when internet firms diversify into the fintech service, they can easily promote and sell the fintech service to their pre-existing customers, rather than acquiring new customers that are relatively costly.

One typical example in Shenzhen is Tencent, China's largest social network company. Before entering into the fintech industry, Tencent has a large number of social network users. As an interviewee (IE-1) commented:

'Like BATJ [standing for four China's tech giants, Baidu, Alibaba, Tencent, and JD.com], these are all born with their own traffic [customers], and then they started to do finance for their customers' needs.'

Yet, a large number of pre-existing social network users does not necessarily lead to diversifying into fintech services. Why does Tencent can leverage its pre-existing social network-oriented customers to enter into the financial services? It is because Tencent discovered that its customers have an emerging demand for online financial services, particularly in the era that witnesses the increasing penetration of mobile technology into individual's daily lives and every corner of every sector. As Liu, Executive Director of Tencent (2015) explained:

'Tencent has always been engaged in social networking and then doing entertainment and games. Everyone has a clear understanding of this. Why is Tencent engaged in the Internet finance industry now? Obviously, Internet finance has increasingly become the fundamental demand of Internet users. Why would you say so? With the continuous development of the mobile Internet, people spend more and more time on their mobile phones. In addition to previous social behaviors, ordinary people's lives are increasingly focused on the mobile

Internet. With this change, many business models and paths have also begun to transform into mobile Internet... Previously, the development of the mobile Internet has gone through several stages. The first stage is communication and social interaction, and then entertainment and information. Then, people's lives and transactions begin to be closely connected with the mobile Internet. Finally, I see that what follows is financial demand, which is a very natural evolutionary process and the fundamental demand of users.'

So how did Tencent leverage and redeploy its pre-existing customers in social massaging WeChat to diversify into the fintech business? One interviewee (IT-3) mentioned several key events:

'In retrospect, you will find Tencent's fintech development have several decisive points. The first is the WeChat red packet, then collaborating with Didi and Meituan, then Licaitong and Welidai.'

In line with this comment, the detailed development trajectory and the underlying business logics are as follows. The story dates back to the year 2013 when WeChat has nearly 350 million monthly active users but yet not fully engaged in fintech service. In Aug 2013, Tencent launched WeChat Pay which the mobile wallet inside WeChat. To redeploy the WeChat users to the WeChat Pay users, Tencent debuted its virtual red packet in Chinese New Year in 2014, which allows WeChat users to send each other red packets filled with digital cash. Red packet is originated from the traditional Chinese New Year celebrations that people give each other money in red envelopes. Put simply, WeChat Pay's red packets transform the previous offline red packets into online ones. This digital red packet was a remarkable product that attracts numerous WeChat users to use WeChat Pay. During the Lunar New Year's Eve 2014, it witnessed that more than 5 million WeChat users were participated in grabbing WeChat red packets (China Central Television, 2014). If the debut of the WeChat red packet during the Spring Festival in 2014 was the kick-starter for spontaneously transferring its WeChat users into WeChat Pay users, Tencent took a more aggressive action to promote WeChat red packet and WeChat Pay in the Spring Festival of 2015. Specifically, Tencent spent 53.03 million yuan

to bid for the exclusive new media interactive partner of the China Central Television Spring Festival Gala (Wei, 2020), which was the most popular TV program in China during the Lunar New Year with viewers about 800 million people (China Culture News, 2014). In this China Central Television Spring Festival Gala, WeChat cooperated with numerous corporate sponsors to launch a great incentive activity by giving away 500-million-yuan cash and 3 billion yuan of E-coupons for attracting WeChat Pay users (Tencent Technology, 2015a). This Spring Festival Gala attracted approximately 20 million WeChat users to participate in grabbing WeChat red packets, which is 4 times that in 2014 (Tencent Technology, 2015b).

However, rolling out the red packet to incentivize WeChat users to use WeChat Pay just represents the first step of Tencent's diversification into fintech. A more important step is to synergize WeChat Pay with daily services, shopping services, transportation, etc. One interviewee (IT-3) explained the reasons:

‘Doing the payment business, the most critical thing is the scenarios, e.g., shopping, eating, and traveling wherein I buy and pay for the products or services. If a payment tool has no scenarios to pay, it is equivalent to saying that the tool is useless.’

In line with the process of diversifying into fintech services, Tencent, at the same time, has gradually evolved from a social network company into one of the biggest global investors in technology companies. Tencent invested or collaborated with several key players in different lifestyle scenarios, such as taxi-booking Uber-like Didi in 2014, online-to-offline service platform Yelp-like Meituan in 2016, and bicycle sharing Mobike in 2017. All these key players' products and services are showed and bolted on the WeChat app. When the WeChat users use these products and services, they generate the need for payment and transactions. Tencent thus integrated WeChat Pay into these services to meet WeChat users' need for payment which in turn redeploy the WeChat users to the WeChat Pay users. For example, WeChat users can find the services (e.g., tax-booking Didi) in the WeChat app, and pay the fees via WeChat Pay. In fact, during the first month after Didi was bolted on the WeChat app, it witnessed an average of 700 thousand payments per day that WeChat users used WeChat Pay to pay Didi's bills (Li,

2014). In sum, based on the efforts mentioned above, Tencent has redeployed approximately 70% of WeChat users (800 million monthly active users) to the WeChat Pay users (1.16 billion monthly active users) by the end of 2019 (Tencent, 2019).

With the advantage of payment (WeChat Pay), Tencent further rolled out several new fintech products and services to serve WeChat users' new financial demands. Two key products are Licaitong, which is a marketplace for wealth management products offered by the Tencent-owned Tencent FiT and launched in 2014, and Weilidai, which is the online financing products offered by the Tencent-backed WeBank and launched in 2015. Here, I detail to illustrate the process that Tencent redeployed the WeChat users into Weilidai users. First of all, Tencent listed the Weilidai on the WeChat platforms and thus WeChat users can directly and easily touch the Weilidai within the WeChat platform. After showing the Weilidai under the eyes of WeChat users, WeBank adopts the 'one-way white list invitation system' to cross-sell the Weilidai to WeChat users and gradually transferred the WeChat users into Weilidai users (Ma et al., 2020). Especially, among all the WeChat users, Weilidai removes those who are not fit Weilidai's requirements and those who may lead to fraud risks. The rest is the users who meet the credit conditions. Then Weilidai randomly invited a set of qualified WeChat users as the whitelist to use the Weilidai. In the beginning, only a small group of WeChat users receive the invitation. Thereafter, with the continuous improvement of the personal credit data and the Internet's big data of the central bank behind the whitelist, the penetration of the whitelist in WeChat users is also growing. By the end of 2019, there are 200 million Weilidai users out of the 1.16 billion monthly active WeChat users (WeBank, 2019).

In addition to the tech giant like Tencent, numerous small and medium-sized internet firms that specialized in their niche market also leveraged and redeployed their pre-existing customers to the fintech industry. For example, firms A (an online lending platform and anonymous as required because the whole fintech subsection online lending is currently under strict censor by regulatory authorities) was previously focused on B2B e-commerce platforms for a few years. It thus has accumulated a large number of sellers and buyers as well as rich industry experience. Firm B found that both sellers and buyers on the platform require finance, but most

of those demands have unmet yet. As a representative of online lending platforms (IT-7) explained:

‘In our platform, most of the sellers and buyers are small-size enterprises. They have not enough capital or fixed assets to mortgage. They are not a priority for banking. Generally speaking, banking prefers the large enterprise rather than small-and-medium enterprises’

To solve existing customers’ unmet financial demand, firm A diversified from B2B platforms to provide online lending financial services.

Another example is firms B (online lending platforms and anonymous as required because the whole fintech subsection online lending is currently under strict censor by regulatory authorities) which was previously developed software for a work agency that takes charge of hiring blue-collar workers for the company. It seems to be unrelated to fintech. However, those blue-collar workers have large unmet financial demands, and Firm A took advantage of those unmet financial demands to enter into the fintech industry. As a representative of online lending platforms (IT-2) said:

‘I made the payment system for work agencies. At that time, I found a business opportunity. Blue-collar workers usually have not enough money in the first few months after they arrived in the new city. Workers usually need money for renting a new house, buying new clothes, shoes, and others’

Consequently, firm B identified their pre-existing customers’ unmet financial demands as a business opportunity, and thereafter, cooperated with the work agencies to provide the worker with the payday loan which means the loan will be repaid at the borrower’s next payday.

Creating new market (customers)

In addition to redeploying the pre-existing customers, creating new customers is another key action for the internet industry’s diversification into the fintech industry. There is a particularly urgent need for small- and medium-sized firms with fewer pre-existing customers for redeployment. Consequently, small- and medium-size start-ups adopted a flexible multi-

channel marketing strategy, so long as the channel can increase their touchpoints with their potential customers. In the era of mobile internet when everyone spends lots of time on the Internet, the typical marketing channels are the online ones, such as search engines, portal websites, and mobile app stores. As one interviewee (IT-4) who is a marketing manager of online lending platforms said:

‘[Our methods are] buying advertising spaces on portals and keywords on search engines. After you [potential customers] have read these advertisements, if you are interested, you will leave your personal information back. It may be a phone call, loan amount, or investment amount. Then I screen out target customers based on this information, and our marketing and customer service teams will call back for past marketing.’

This multi-channel marketing strategy is also confirmed by another interviewee (IE-1) who was in charge of online lending platforms said:

‘For small loans that are worth several thousand yuan. The methods are similar. You can advertise on various online forums and websites to attract traffic [customers]. Then, like housing debts, car debts, and large credit loans, such as those of 500,000 yuan, they basically get customers offline, post small notes everywhere, send small advertisements, and call text messages. Marketing, the kind of unfamiliar calls you often receive is this way of acquiring customers.’

Modifying institutional logics

Redeploy pre-existing institutional logics

The Internet industry traditionally embraces lean innovation leading to innovation-led and customer-centric institutions. Lean innovation represents such a kind of innovation, that is, innovators first develop the minimum viable product (MVP) based on the idea that 20% of a product’s features will most likely deliver 80% of the benefits sought by customers, then get it into the market quickly, received customers’ feedback, and improve step-by-step (Agan, 2014). In principle, it seems like the so-called bricolage that takes several customer-centric and scale-

up steps with product development (Garud & Karnøe, 2003). In the context of China, lean innovation is described by a short sentence, namely ‘Small-step, fast-running, fast-iteration, and trial-and-error’. The detailed process is explained by Huateng Ma, the co-founder, and CEO of Tencent, that is, though every version of the product is not perfect, but if you insist on finding and fixing one or two small problems every day, you will basically polish the work in less than a year (Wu, 2017).

Indeed, innovation-led and customer-centric thinking has given internet firms a competitive edge because internet firms can make financial services cheaper, faster, more efficient, more affordable, and more accessible. One typical internet firm-led fintech innovation is the debut of online monetary funds in 2013. Comparing with the traditional monetary funds offered by incumbent financial institutions, internet firms offer innovative monetary funds with several new features such as higher liquidity with T+1 subscription and redemption system (T+0 in traditional monetary funds), a higher return than interests on bank deposits, and lower investment threshold with only 1 yuan (50 thousand yuan in traditional monetary funds). The landmark event is Alipay, a mobile payment platform by Alibaba, which started the online money market fund Yu’E Bao in 2013. Following the debut of Yu’E Bao in 2013, Shenzhen-based Tencent launched its online money market fund platform named Licitong in January 2014. Five years later, in 2019, Licitong’s online AUM (asset under management) has reached 500 billion yuan and its user base has surpassed 150 million (Yan, 2019).

Too faster and too many innovations, however, tend to carry risks, particularly in the field of finance. Though MVP might be great for the internet industry, it may carry risks in the field of finance. The reason is that most of the fintech users do not want to use an unfinished product that still needs fast-iteration and trial-and-error, because trial-and-error in the field of finance means lose money and the failure of regulatory compliance. As one interviewee said (FN-1):

‘Internet thinking has been dominated by MVP. So long as a product has just enough success rate, you can go online, but a financial product needs 99.999% (five 9s) ... MVP thinking comes from social products, and it is tolerable when errors occur. But often this

kind of Internet thinking will cause problems in finance because finance has always focused on security. Once a problem occurs, it is generally very serious because it involves money and regulation.'

Moreover, too many innovations may take the risk of violating the basic principles of finance. The online peer-to-peer (P2P) lending platform is a typical example for illustrating that innovation might lead to the violation of regulations as well as cause users to lose their money. The typical operation model of P2P is that the debtor and creditor perform free bidding and finally enter into a debtor-creditor relationship, with a P2P company as the platform. However, in reality, many P2P companies are on the margins of the law and they even break the law. For example, instead of operating as an information platform, P2P companies absorb the investors' capital, set up a capital pool within the companies, and then investing money into the project. It is risky and easily leads to scams. For instance, Ezubao, once the biggest P2P player in China, engaged in a Ponzi scheme that scammed 100 billion yuan from more than 1 million investors (South China Morning Post, 2016).

Creating new institutional logics

Against this background, one of the major challenges faced by the internet industry is to create new institutions characterized by the awareness of financial risk and regulatory compliance.

Defining

Regulator authorities can use their coercive powers to define standardized practices for online lending activity and to punish those who violate regulations. In this sense, internet-diversified fintech firms have increased their awareness of financial risk and make sure their practices are regulatory compliance, otherwise, they will face a high compliance cost and even exit the business.

One typical example is the definition of practice standards about the online lending activity. This defining is initiated by the central and local regulatory authorities to ensure that fintech firms' online lending behavior is legal and compliant. As one interviewee from the local

regulatory authority (GO-3) put it:

‘The entire online lending supervision is a top-down top-level design. The central [regulatory authorities] are responsible for ‘behavior supervision’, and local [regulatory authorities] are responsible for the ‘supervision of institutions’, that is, the inspections of institutions.’

Specifically, ‘behavior supervision’ refers to formulating supervision and management systems, and supervising the daily operations of online lending institutions, and ‘institutional supervision’ refers to conducting standardized guidance, record management, risk prevention, and disposal of online lending institutions within the jurisdiction (CBRC et al., 2016).

After defining the standardized online lending behaviors, the local regulatory authorities then conducted the on-site inspections in each fintech firm involved in online lending activity. As one interviewee from the local regulatory authority (GO-3) put it:

‘In the on-site inspection, I monitor all the processes for assessment, I use a new account to go through all the processes from registration to borrowing.’

According to the inspection results, the local regulatory authority gave some rectification opinions to the fintech firm. Then, the firms change and improve their behavior based on the rectification opinions. Later, the local regulatory authority conducted the second round of on-site inspections for checking, to what extent, the fintech firms’ behaviors are compliant. Finally, if the fintech firms’ behaviors could not comply with the regulations, then they have to exit the online lending business.

The case of online payment is similar. For instance, Tencent received a fine of 1.49 million Yuan for violating China’s payments and settlement management system as well as systems for protecting the rights and interests of financial consumers. After that, Tencent initiated a self-inspection and further strengthen the compliance of financial behaviors following the guidance of regulation (China Banking News, 2019b). Similarly, in 2019, WeBank was also fined 2 million yuan by the CBRC for multiple violations including irregular loan issuance and business undertaking, noncompliance in management appointment, and employee misconduct.

In this sense, internet firms gradually learned the importance of regulatory compliance through the method of learning by doing (Hu & Han, 2019).

Theorizing

Theorizing is important as it helps to understand the role of finance and technology in fintech which then guides the practice. Since the born of fintech in 2013, there has a long-term debate for the essence of fintech, that is, whether technology disrupts and changes the logic of finance.

One influential debate occurred at the ceremony of the Internet Financial Industry Forum at Fudan University in 2013. In this essence of fintech. At that debate, Jack Ma, Founder, and CEO of Alibaba, held a more radical view and emphasized the dominant role of technology.

As remarked by Jack Ma (2013):

‘In principle, I can do all the work that your traditional insurance companies can do, but when will they do well. . . I really can't imagine the complexity of insurance today. . . I need to use technology to solve some complicated things.’

While Huateng Ma, Co-founder, and CEO of Tencent (2013) held a more incremental view and emphasized the need to keep a balance between technology and finance in the fintech industry.

As remarked by Huateng Ma (2013):

‘My understanding is that for traditional industries and certain industries, the Internet represents a kind of ability or external resources or environment to enhance this resource. What was similar to Internet finance before? More appropriate is the emergence of energy or electricity. . . What improvements will be made to each industry after power is available? Is it disruptive or reformative? If you think about it from this perspective, part of it is disruptive, and part of it can be improved. . . I am holding a more optimistic attitude because I think that not all markets will be completely Internet applications, and there are still a lot of vertical specializations to bear.’

This divergent understandings of fintech continued until 2015 when the fintech industry witnessed some risk incidents, such as fraudulent online lending platforms, a flood of runaway

bosses, the Ponzi scheme, and the rising default risks of online lending platforms. These events make the fintech players to re-understand the essence of fintech. As one interviewee (IE-2) commented:

‘The emergence of risk events in those years has sounded the alarm for practitioners in the entire industry.’

To encourage innovation while preventing risks, the People’s Bank of China led the other nine ministries to jointly publish the ‘Guiding Opinion on the Promotion of Healthy Development of Internet Finance Businesses’. The guidance clarified that the role of finance and technology in fintech which gradually become the consensus. Specifically, the guidance states that fintech is still finance in essence, and the advantage of fintech is fintech adopts new technologies to improve the efficiency of financial services to the real economy. As the following quote from the Guiding Opinion (2015),

‘Internet finance still belongs to finance in nature, and it has not changed the hidden, contagious, widespread, and sudden characteristics of financial risks. Strengthening Internet finance supervision is an inherent requirement for promoting the healthy development of Internet finance. At the same time, Internet finance is a new thing and an emerging business format. It is necessary to formulate moderately loose regulatory policies to leave room and space for Internet financial innovation.’

In line with the guidelines, players in the internet industry gradually understand that the essence of fintech is still finance, particularly, fintech has not changed the risk attributes of finance, instead technology improve the efficiency of financial services, on the one hand, and makes the spread of financial risk faster and more severe, on the other hand.

For example, at the 2015 Tencent Financial Partners Summit Forum, Liu, Executive Director of Tencent, explained ‘Why does Tencent do Internet finance? What basis does Tencent have for Internet finance? And how does Tencent do Internet finance?’ As remarked by Liu, Executive Director of Tencent (2015),

‘Tencent has a very respectful heart for finance. With internet finance, many people are discussing whether the internet or finance is more important. Tencent believes that the latter is actually a more important core capability. Tencent knows that finance is a very deep and highly professional industry. ... It may seem simple, but it often takes many years of professional experience to build it.’

Similarly, since the establishment of WeBank, it realized that the essence of Internet banking is banking, and the essence of innovative fintech products is finance. It must follow the inherent laws and rules of banking and finance. As remarked by Li, Chairman of WeBank, when he remembered the time when WeBank just established in 2015 (Li et al., 2018, p75-76),

‘As the first domestic private bank and Internet bank, WeBank was actually a model in the industry at the beginning of its establishment. WeBank’s strategic layout also contains the principle of “unchanging and changing”: what remains unchanged is the essence of commercial banks, and the core remains the same. It lies in the operation and management of risks. ... The difference between traditional banks is that WeBank clearly aims at inclusive finance, uses data technology as the starting point, and does not have physical outlets. All business and risk control connections are completed online.’

Mimicking

After theorizing the nature of fintech as finance, internet players who engaged in the fintech industry mimicked the institutions of regulatory compliance and risk management from the financial industry. In terms of regulatory compliance, internet firms set up the regulatory compliance department for ensuring their behavior to comply with regulations. For instance, WeBank established the Legal Compliance Department and defined it as a shared resource for the whole bank. As a result, employees of the Legal Compliance Department worked as a member of the project team and participated in all the stages of product development to ensure the legal compliance of products. Moreover, internet firms adopted the method of learning by doing to change their institutional logics into regulatory compliance. For instance, Tencent received a fine of 1.49 million Yuan for violating China’s payments and settlement management

system as well as systems for protecting the rights and interests of financial consumers. After that, Tencent initiated a self-inspection and further strengthen the compliance of financial behaviors following the guidance of regulation. In terms of risk management, one interesting example is WeBank. For financial incumbents, risk management is based on several practices including the separation of front, middle and back offices, and the separation of pre-loan review and loan grant (Ma et al., 2020). Due to the efficiency of these traditional practices, WeBank mimicked and improved such practices. Inspired on the internal control framework of the front, middle, and back-office separation, WeBank innovated the project-based triangle, i.e., any project should involve the front-office business manager, the middle-office risk manager, and the back-office IT engineers through the whole process, and these three roles complete due diligence investigation, project initiation, and rollout, and operation jointly (Ma et al., 2020).

Education

Another institutional work is the education that is carried out at both the industry-level and firm-level. Industry-level education is associated with the institutional works of constructing the network. In July 2015, fintech firms together with Shenzhen municipal government and Shenzhen Municipal Government Financial Services Office established the Shenzhen Internet Finance Association (SZIFA). It is the self-regulatory organization that helps the government to regulate the fintech market as well as promote the healthy development of the industry. In the past five years, SZIFA organized more than hundreds of education events including policy interpretation, an industrial forum, training, etc. Amongst these education events, a large portion concerns the topic of financial risk and stability (SZIFA, 2019). For example, in 2015, SZIFA collaborated with the Shenzhen Intermediate People's Court and the Economic Crime Investigation Bureau of the Shenzhen Municipal Public Security Bureau to held a special seminar on 'Combating Illegal Fund Raising'. More recently, the Supreme People's Court, the Supreme People's Procuratorate, the Ministry of Public Security, and the Ministry of Justice jointly issued 4 legal policy documents. Among them, the 'Opinions on Several Issues in Handling Criminal Cases of Illegal Lending' clarified the basis for illegal lending. Under this background, to further enhancing the awareness of member firms to operate in accordance with

laws and regulations, the SZIFA collaborated with law firms to hold a training session on the interpretation of laws and policies in 2019. In addition to these formal educations, SZIFA also held some special education. For example, intending to help fintech companies to enhance awareness of risk and let them know what is the punishment if they violate any rule and regulation, SZIFA together with the Justice Bureau of Shenzhen Municipality as well as Shenzhen Prison organized Internet financial company's executives to enter Shenzhen prisons to attend the 'warning education' with financial risk in 2016 (Liu, 2016). According to the report by ChinaTimes, a newspaper hosted by the State Council Information Office and the State Internet Information Office, after participating in the prison warn education, the fintech company's executive mentioned that 'in any case, it is of educational significance. I am in awe of the law and will learn the law, obey the law, and keep the bottom line' (Jin, 2016).

At the firm level, fintech firms established a set of risk-oriented action templates to educate and increase the awareness of risk. For example, WeBank initiated the 'I strict action' which proposed 'three spirits, six high-voltage lines, 9 etiquettes' to guide employees' practices. Among others, the high-voltage lines mainly educate employees' awareness of risk about strictly forbidding them to participate in illegal fund-raising and strictly prohibiting from leaking customer information. To deepen the understanding of risk, WeBank carried out 18 and nearly 40 training throughout the bank in 2018 and 2019, respectively (WeBank, 2018; 2019).

Aside from the above relative top-down education, fintech firms also involved the relative spontaneous educations by communication between the employees with different industrial backgrounds. The internet-diversified fintech firms consist of not only their pre-existing tech experts but also hiring numerous financial experts. These two groups of people have their path-dependent ideas, and to some extent, are different. In the internet-diversified fintech firms, the previously dominated institution is of course the innovate-led and customer-centric. However, as one interviewee (IT-5) mentioned:

'in terms of customer experience and innovation, there is no doubt that Internet people are very good at it. But if financiers cannot truly participate, a series of financial risks

are prone to appear.’

Consequently, effective communication between the tech experts and financial experts is crucial for the internet-diversified fintech firms to learn the more conservative and risk-oriented financial logics. The importance of communication is confirmed by the following quotes. As one interviewee (IT-5) said:

‘The only way is to acknowledge the conflict between internet background employees and financial background employees. I encourage them to communicate and debate, so long as things can go ahead. Gradually, time will let them understand each other.’

As one interviewee (IT-4) said:

‘In the beginning, there was a battle over routes, whether the Internet or finance is the dominant. The opportunity window appears when I once lost tens of millions due to security issues. . . After the problem appeared, I kept meeting round and round. Summarized the experience and lessons. It is at that time I realize the terrible outcome of financial risk. This accident educated those employees with aggressive ideas and promoted a group of people who had proved to have a financial risk control spirit in the past practice. It is a tough process, but only then did the financial thinking slowly settle down.’

5.4.3 Financial industry diversified into fintech

In the section, I elaborate on how the financial industry diversified into the fintech industry from the aspects of technology, market, and institution.

Modifying technology

Redeploying pre-existing financial skills

By financial skills, it mainly refers to the logic and rules of calculating the risk and return of financial activities (Hebb & Wójcik 2005). In practice, key financial knowledge is presented as the modern portfolio theory, the risk-pricing model, the capital asset pricing model, the Black-Scholes option-pricing theorem, the Sharpe ratio, etc. Since the fintech industry is a

combination of financial skills and information technology, financial incumbents can reuse their pre-existing accumulated financial knowledge to provide fintech services. This process can be observed in the following two typical fintech services, that is, Robo-advisory and online lending.

Robo-advisory is an emerging online wealth management service that provides optimal portfolio choices for investors with different risk appetites. In 2016, China Merchant Bank launched the Robo-advisory service, namely Machine Gene Investment. It aims to help investors to pick the right products from thousands of funds in the Chinese market, according to the investor's risk and return objectives (Yang, 2017). Indeed, the Machine Gene Investment is the 'fund of funds' which is an investment strategy of holding a portfolio of other investment funds. In this sense, the Machine Gene Investment mainly deals with two tasks, that is, selecting the potential funds and making the funds allocation. Concerning selecting the potential funds, CMB has previously accumulated lots of data about funds which provided the basic information for selecting funds. In 2006, CMB launched the new service of recommending fund products for customers and provided a fund selection service, namely, Five Star Selection. Until the debut of Machine Gene Investment in 2016, the Five Star Selection has accumulated a large volume of funds-related data and constructed a comprehensive fund market database, including the data about fund historical performance, fund manager evaluation, the latest news about fund manager, investment institutes' research capabilities, etc. Concerning making the funds allocation, CMB leveraged its accumulated financial knowledge about modern portfolio theory which is used to make funds allocation and construct a portfolio with maximizing potential return while minimizing risk, and then combined the modern portfolio theory with the advantaged AI technology to become Robo-advisory (CMB, 2016). In this process, modern portfolio theory functions as a key financial knowledge that financial incumbent re-uses to design the Robo-advisory (Beketov et al., 2018). By 2018, the Machine Gene Investment has achieved a total sales volume of 12 billion yuan (CMB, 2019).

Another example is online lending which refers to the activity of providing loans to the customer based on the online channel, artificial intelligence, and big data. Although online

lending has incorporated new technologies comparing with offline lending, ‘risk-based pricing is the core financial knowledge underlying the lending, no matter online or offline, is the same’ (FN-3). Risk-based pricing tailors the price and size of a loan to a borrower’s probability of default. For example, ‘it can evaluate the risk of the loan through a series of parameters and algorithms such as income, credit score, turnover, real estate, vehicles, etc.’ (FN-3). As the financial knowledge about risk-based pricing remains unchanged, banks can redeploy their capability in offline lending and risk management that accumulated in the past decades into the online lending service. Aside from customers’ risk, online lending as a new activity for the bank will add new risk in the firm-wide. It thus requires other key financial knowledge, that is, value-at-risk (VaR), which is a method to measure the risk of loss for financial institution’s total portfolio (Guidelines on Market Risk Management for Commercial Banks, 2004). Indeed, since 2004 when the China Banking Regulatory Commission guided the banks to implement the VaR method, banks have accumulated lots of experience and are capable of reusing into the online lending activity. Moreover, financial incumbents have to meet numerous regulations (e.g., the Basel III, the framework of risk-adjusted return on capital, and the International Financial Reporting Standard 9), which each has its standard for risk management. For example, Basel III introduces the requirements on bank’s minimum capital ratios, liquid asset holdings, and funding stability, thereby seeking to mitigate the risk of a run on the bank (Basel Committee on Banking Supervision, 2010).

Redeploying pre-existing information technology

At first glance, the financial industry might not be proficient in information technology. However, information technology is not a novel term for the financial sector. Indeed, the financial industry nationally has been heavily invested in information technology to help its traditional financial services, with total spending of approximately 15 billion yuan in 2013 before the booming of fintech in 2014 (IDC, 2014). This situation is more prominent in Shenzhen. For example, China Merchant Bank spends approximately 3 billion yuan on IT R&D in 2013 (CMB, 2014). Similarly, Ping An has invested approximately 5 billion annually on R&D in finance-related IT and its other business (Ping An, 2017).

A typical banking IT system includes the front-end system that provides a user interface, and the back-end that handles data storage, banking transactions, deposit, loan, and credit processes (Gartner, 2014). Amongst others, the back-end IT system is also known as the core banking system which means is the heart of a bank. Banks' back-end IT system is historically applied to a centralized architecture to organize the servers and databases. The merit of this system is that it can provide robust, stable, and rapid processing power for financial institutions to handle diversified financial services, including payment, transactions, deposits, loans, and credit.

However, with the rise of the mobile Internet in recent years, financial services have evolved from 'low-frequency large amounts' to 'high-frequency small amounts' (IE-1). For example, consumer's financial behaviors may concentrate on some special celebrity day, such as the double eleven shopping festival. In this case, real-time transactions demand the rapid processing of a huge amount of data. To tackle this, the IT system should transform from a centralized architecture to the distributed one which can handle large-scale high-concurrency transactions. However, transforming into a distributed architecture does not mean building from scratch. Due to the technology lock-in and sunk costs, financial incumbents tend to leverage their previous technology accumulated in the centralized architecture to develop the distributed architecture. As a representative of the financial sector said (FN-7):

'Banks are more likely to preserve their core system and reluctant to change due to the sunk costs, on the one hand. On the other hand, the priority of the banking industry is stability and risk aversion. With such a large adjustment, what to do if problems arise.... These core banking systems have existed for more than ten years, they have their rationality because it is high stability and efficiency in handling core financial services.'

Taking China Merchants Bank as an example, its previous core banking system is based on the centralized architecture that adopted the IBM Power AS400 server and IBM DB2 database. Instead of building the distributed system consisting of X86 servers and MySQL that adopted by internet firms from scratch, CMB does innovation based on the current centralized architecture. Specifically, CMB uses the Power AS400 server as a node and applied the

technology of Power Enterprise Pool to implement the resource dynamic adjustment. Through this, CMB transformed its previous centralized architecture into the distributed one. Since the innovation is based on a previous centralized architecture, 80% of the applications can directly reuse in the new architecture without modification or minor modifications (Yang, 2016).

Creating new information technology

Although financial incumbents have accumulated information technology in the core banking system, they usually lack cutting-edge technology in data science, such as artificial intelligence and big data. For the missing technologies, they can be acquired based on recruiting individual actors and collaborating with firms.

Ping An carried out an aggressive recruiting approach for acquiring new information technology. In 2013, Ping An recruited its current co-CEOs, Chief Information Officer (CIO), and Chief Operating Officer (COO), Jessica Tan. Prior to joining Ping An, Jessica Tan was previously served as a global director (partner) at McKinsey & Company. He received a double bachelor's degree in electrical engineering and economics from the Massachusetts Institute of Technology, and a master's degree in electrical engineering and computer science. In addition, Ping An has recruited experts from both local and international Internet companies, such as Alibaba, Tencent, Microsoft, eBay, and Oracle in the past few years (Ping An, 2018). By the end of 2019, Ping An had a technology team of nearly 110 thousand technology business employees, 35 thousand R&D employees, and 2.6 thousand scientists (Ping An, 2019). Amongst others, the technologies in AI and big data are taken in charge by the chief scientist Dr. Xiao Jing who is an expert in China's 1,000 Talents Plan. Dr. Xiao received a Ph.D. degree in computer sciences at Carnegie Mellon University in 1999. After graduation, he first worked in the algorithm team at the Epson Institute and then went to Microsoft with responsibility for the research and development of big data analysis and intelligent algorithms. In 2015, he returned to China and joined Ping An. By the end of 2019, Dr. Xiao helped Ping An to apply for around 700 patents which account for approximately 3% of the total patents in Ping An. In addition to the chief scientist who is mainly responsible for AI and big data, another key expert

is the Chief Software Architect, Mr. Fang, who is one of the earliest practitioners in the field of cloud computing in China. Prior to joining Ping An in 2014, Fang worked in Microsoft as the architect in the department of data center and cloud computing and then became one of the earliest employees of Amazon AWS in China. Based on the talents' efforts, by the end of 2019, Ping An's technology patent applications increased to 21,383. Among these applications, the number of patents in fintech ranked 1st in the world, and the number of patents in digital health tech ranked 1st in the world (Ping An, 2019).

In addition to recruitment, financial incumbents also created new information technology by collaborating with internet companies. For example, CMB mainly cooperated with other firm actors to acquire the necessary AI and distributed technology. In the new digital era, fintech services are characterized by large data volume and large concurrency. In order to meet these new needs, CMB cooperated with Huawei, a Shenzhen-based telecommunications equipment and services company, to build a competitive cloud-oriented distributed database tailored to finance. Under this collaboration, CMB was responsible for providing the practical financial skills, elaborating on the specific requirements for the distributed database, and engaging in design, coding, testing to final production; while Huawei provides the technologies that CMB lacks, such as high-performance distributed transaction processing, computing and storage separation, and remote direct memory access (Tian, 2018). Moreover, in order to modernize and upgrade the bank branches for catering to changing customer expectations in the digital era, CMB cooperated with Shanghai-based YITU, one of the most successful AI unicorns in China, and deployed YITU's facial recognition system into more than 1,500 branches (YITU, 2015).

Modifying market (customers)

Redeploy pre-existing market (customers)

Recently, amid the boom of digitalization in general and fintech in particular, customers' behaviors have shifted from the traditional offline branch-centric channels to the online smartphone-centric channels. Over the past few years, it has witnessed explosive growth in

mobile payments. The transaction volume of mobile payment in 2019 reached 347 trillion yuan, up more than 15 times from 2014 (PBOC, 2014; 2019). Moreover, compared with the traditional offline branch-centric channels, the online smartphone-centric channels are capable of offering financial services more efficiently and accessible. As a representative of the financial sector (FN-3) said:

‘In the past, customers went to the counter to transfer money or others. There is a huge line at the counter, it was time-consuming. Now use mobile banking to do it, move your finger, and it will be completed in a few seconds.’

Consequently, the financial incumbent’s traditional branch-centric channels faced a great challenge. In fact, China’s banking’ off-counter rate has increased from 67.88% in 2014 to 89.77% in 2019 (China Banking Association, 2014; 2019). The off-counter rate refers to the proportion of the business volume processed over the traditional branch counters to the total business volume of the bank. The higher the off-counter rate, the more customers that handle businesses through the Internet, mobile payment, and electronic self-service channels, and the fewer customers that depend on traditional offline branch counters.

As consumers’ financial behaviors were fast-changing and shifting from offline (visiting a branch and purchasing the financial product) to online (opening the app and making purchases), financial incumbents built the mobile APP to offer the online financial service and redeployed their pre-existing customers from offline to online. This can be observed in two leading Shenzhen-based traditional financial firms.

In order to cater to customers’ changing behaviors from offline to online, CMB first introduced the CMB iPhone version in 2010, and then the Android version in 2011. Before 2015, the CMB’s apps mainly functioned as transaction-based APP with bank account inquiry, money transfer, remittance, credit card repayment, etc. (CMB, 2015). Since 2015, the CMB launched the strategy of ‘prioritizing the development of mobile phone applications’ to redeploy its customer services from offline to the online mobile handset. It thus gradually transformed the APP from a transaction-based APP to an operation-based platform with core functions as a real-

time transaction, online lending, robot advisor, online investment, etc. Through almost ten-year development, the functions of APP have covered approximately 98% of functions in the branch counter in 2019, up from around 82% in 2010 (CMB, 2010; 2019). Consequently, it attracted numerous pre-existing cardholders to use the APP, rather than going to the branch. In 2017, 40.35% of our cardholders have already switched to mobile banking, while 81% of transactions were carried out on our mobile platform (CMB, 2017). The pace of online migration accelerated in the next two years. In 2019, the wealth management transaction via the APP amounted to 7.87 trillion yuan, up by 25.72% year-on-year, and accounting for 71.52% of the Bank's wealth management transaction. Wealth management customers using APP amounted to 7.6 million, up by 50.17% year-on-year, and accounted for 89.96% of the Bank's total number of wealth management customers (CMB, 2019).

Similarly, in order to cater to customers' changing behaviors from offline to online, Ping An set up the vision of 'Technology-driven finance and Finance serve life' in 2014. Based on this vision, Ping An introduced several mobile APPs to deploy offline customers online. Amongst them, the two most influential APPs are the Jin Guan Jia APP that is in charge of the online insurance activity, and the Pocket Bank APP that is in charge of online banking activity. In 2019, the MAU in Jin Guan Jia APP and Pocket Bank APP reached 28 million and 21 million, respectively (China International Capital Corporation, 2020). Moreover, Ping An upgraded its Ping An Pay to the Ping An E-wallet which provides customers with transaction solutions, such as accounts, payment, and remittance. In 2018, Ping An E-wallet processed a transaction volume of 5.7 trillion yuan and had over 200 million registered users (Ping An, 2018). In addition to the introduction of mobile APPs, Ping An has launched online fintech platforms through established new subsidiaries. For example, Ping An set up Lufax which is an online wealth management platform in 2011. By the end of 2019, Lufax has provided financing services to over 10 million customers, with 375,006 million yuan in the balance of loans under management (Ping An, 2019). Through the above actions, Ping An successfully migrated its offline customer to online. According to Ping An's annual reports, the percentage of offline customers that use online APP platforms was increased from 13% in 2014 to 84% in 2019 (Ping

An, 2015; 2019).

However, offering online financial products and services alone is not enough to attract and redeploy financial incumbents' preexisting customers in the era of the internet. Compared with financial incumbents that only offer online financial services, internet firms offer numerous products and services that increase the number of customer touchpoints in the customer journey, and thus, improve customer loyalty. For example, Tencent has multiple customer touchpoints in the social network, tax-booking, online-to-offline service, financial services, etc. Due to the multiple touchpoints for customers and the better experience that internet firms provided, financial incumbents lose their customers to internet firms. As a representative of the financial sector (FN-5) said:

‘Our customers use our bank account to received salary. But they immediately transfer to other Internet financial platforms after received their salary. It is a pity. I only have the bank account, but fail to retain the customers. Because I don't have the ecosystem [referring to the integration between multiple services], they [internet firms] have.’

In response, financial incumbents have to mimic what the tech companies do when they diversify into the fintech sector, that is, offering daily life services which increase the number of customer touchpoints, and then synergizing the financial services with those daily life services and guiding the customers to use the financial services.

In fact, Ping An's 2014's vision of 'Technology-driven finance and Finance serve life' has embraced the business of adding daily life services. In 2018, Ping An further refined its vision as 'empowering financial services with technologies, empowering ecosystems with technologies, and empowering financial services with ecosystems' (Ma, 2018).

The 1st step 'empowering financial services with technologies' means applying cutting-edge technologies to upgrade financial services. In terms of upgrading the capability of retaining customers, it is what I have discussed above, that is, establishing the online channel by introducing mobile APPs and other online fintech platforms. The 2nd step is to offer daily needs including 'health, food, housing, transportation, and entertainment'. The 3rd step is to embed

the financial services into online daily life services which in turn stimulate customers' demand for financial services. As explained by Mingzhe Ma, the COE of Ping An, in the half-year press conference in 2018:

'The second step is to apply the new technologies that developed in the fields of finance and medical care to empower the ecosystems. The ecosystems include the five sub-ecosystems including finance, medical care, real estate, automobiles, and smart cities. Through the ecosystems, Ping An is able to integrate into society and thus customer services. In the third step, when the ecosystems are established, Ping An hopes to use ecosystems to empower its own finance. In the past, the traditional financial model was to sell products first, then provide services; the current method is to provide services first, and then provide products.'

To implement the 2nd step of 'empowering ecosystems with technologies', Ping An expanded beyond its core financial services into other four industries consisting of healthcare, automotive, real estate, and smart city. Specifically, in 2014, Ping An set up Ping An Real Estate which strives to become a top-ranking real estate asset management company. At the same time, Ping An found the Ping An Good Doctor which offers a mobile platform for online consultations, hospital referrals and appointments, health management, and wellness interaction services. In 2016, Ping An acquired Autohome Media which is a leading online destination for automobile consumers in China. Later Ping An announced the launch of the Smart City platform in 2018.

Such multiple ecosystems not only increase the number of customer touchpoints (i.e., increasing from previous financial services to embrace the non-financial services) but also are in charge of the 3rd step of 'empowering financial services with ecosystems', that is, embedding financial services into the non-financial services which in turn stimulate customers' demand for financial services. Take the automobile ecosystem as an example, Ping An considered the Autohome as the entry point for financial services because car owners may have to apply for credit cards and buy auto insurance. In fact, the Ping An Auto Owner APP has over 90 million registered users in 2019, within which 49 million of whom were auto insurance customers of Ping An Property & Casualty (Ping An, 2019). Moreover, Ping An Bank actively promoted its

credit card to auto owners. The situation in healthcare is similar. In terms of Ping An Good Doctor, Ping An could guide the users from Ping An Good Doctor to purchase financial services, particularly the health insurance covering varied illnesses and medical services.

It is also observed in the case of CMB. In response to the internet attackers and with the aims of building a non-financial ecosystem for creating a better financial life for users, CMB transforms the previous asset-centric business model into the Internet-based one in 2019. It initiated the new fintech development strategy with the characteristics of featuring ‘building service platforms, connecting to external traffic, and conducting traffic operation’. So how does it work? The key is to embed multiple scenarios into the APP for creating an end-to-end customer journey to enhance the customer experience. Due to the previous experiences and advantages in dealing with the restaurant vouchers and movie tickets, CMB first embedded these two major shopping scenarios into the APPs within which customers could purchase them via mobile phones. For example, the CMB has cooperated with leading partners such as Starbucks, Pacific Coffee, Luckin, KFC, Godiva, Haagen-Dazs, Wanda Cinema. So far, the scenarios of meal tickets and movie tickets have nearly 40 million MAUs in 2019 (CMB, 2019). For the new non-financial scenarios that CMB with less advantage, the CMB expanded these scenarios by collaborating with their partners externally. These collaborations may take the form of alliances and open banking. In terms of the alliance, in 2019, CMB held a partnership conference and initiated the establishment of the “Forerunners’ Alliance” to build a non-financial ecosystem for creating a better financial life for users. In terms of open banking, CMB not only opened the APP platforms internally that all our branches can quickly provide new services by developing applets on the APP but also opened the API (Application Programming Interface) to our partners externally who can use open APIs to build applications and services around the financial institution. Through these strategies, the CMB’s non-financial scenarios have focused on vertical segments such as financial literacy, e-commerce, public transportation, and parking. In terms of financial literacy, CMB collaborated with more than 1,500 financial writers to produce more than 1,000 financial articles per day. These articles teach customers financial literacy. In 2019, the scenario of financial content has nearly 6 million MAUs. In

terms of e-commerce, CMB has 100,000 cooperative merchants in more than 100 cities across the country till the end of 2019 (CMB, 2019). For the rest scenarios, the CMB App has introduced nearly 300 third-party partners, including transportation, travel, shopping, education, financial business, and so on. In sum, these non-financial scenarios are highly attractive for the customers and thus help the CMB to increase its touchpoints with the customers. Specifically, the use rates of the non-financial scenario of the CMB APP and CMB Life APP in 2019 were 69.80% and 73.90%, respectively (CMB, 2019).

Similar to Ping An, the non-financial services will stimulate customers' demand for financial services and thus CMB can guide the customers who use non-financial services to further purchase the CMB's financial services. For example, one customer buys a restaurant voucher or movie ticket on the CMB's APP, he/she usually uses CMB's financial services, such as mobile payment. It is understandable because it is time-saving and convenient for the customer. As one interviewee in the financial sector (FN-2) put it, 'consumers like to purchase multiple services within the same app. It is quick and easy. If you use other apps, you must at least exit this app first, then enter another one, and wait in between.' Similarly, one customer reads the financial article on CMB's APP, he/she may purchase some funds, bonds, or other financial products on CMB's APP. In sum, the non-financial services not only increase the touchpoints with the customers but also stimulated customers to use the financial services. By the end of 2019, the MAU of customers who use the financial and non-financial services simultaneously in CMB APP and CMB Life APP reached 53.59% and 50.11%, respectively (CMB, 2019).

Creating new market (customers)

First, financial incumbents take the form of co-marketing to acquire the new market. Co-marketing gives the firms access to the new market (Bucklin and Sengupta 1993). For financial incumbents, by forming a co-marketing alliance with a partner, the financial incumbents can gain access to the partner's customers. As one interviewee in the financial industry (FN-3) put it: 'Our previous experience (acquisition of customers) was all offline. Now in the Internet era, the entire channel has moved offline. It is difficult for us to adapt at once, and the solution is

to learn and cooperate. I cooperated with the flow party to launch some joint loan products. In this, I provide funds and licenses, and they provide scenarios and traffic.’ In fact, I observe that the CMB has cooperated with multiple internet firms to co-marketing. For example, the CMB has cooperated with several internet enterprises in promoting credit cards by launching a variety of co-branded credit cards, e.g. Momo (social network), Hema Fresh (online-to-offline fresh produce retailing), Tmall Store (E-commerce), Today’s Headline (online news source), Didi Chuxing (Uber-like ride-hailing services platform), etc. Take Didi Chuxing as an example, through co-marketing with Didi Chuxing, the CMB has issued 1.25 million joint-brand credit cards and 1.3 million joint-brand debit cards by the end of 2016 (CMB, 2016).

Second, with the channels shift from offline to online, financial incumbents who would like to acquire new customers should cater to customers’ journeys through online marketing. The first influential online channel is WeChat, a social network platform launched by Tencent in 2013. At that time, CMB quickly recognized the high importance of this emerging channel. CMB thus launched the ‘WeChat Online Banking’ service taking the form of CMB WeChat Official Account in 2013 which is the first of its kind in the industry. This CMB WeChat Official Account integrates product functions with current hot issues to facilitate marketing. By the end of 2019, the WeChat Official Account has approximately 22 million followers (CMB, 2019). Recently, it witnesses the emergence of a new channel based on live streaming. Financial incumbents thus took advantage of this emerging channel to doing marketing and acquiring new customers. For example, in 2019, Ping An collaborated with the big Key Opinion leader to do live streaming marketing in the Ping An Pocket Bank APP, TikTok, and other platforms simultaneously. This live streaming attracted more than 4.4 million users to participate (Bi & Xia, 2020).

Finally, inspired by the internet company’s creation of shopping festivals, such as Alibaba’s ‘Double 11’ shopping day, JD.com 618 festival, and Amazon’s Prime Day and Black Friday, financial incumbents are trying to replicate this success by creating financial shopping festivals of their own. For example, Ping An is the first in the financial industry to introduce the Fortune Festival. Ping An first kicked off the financial carnival named Fortune Festival in 2014. Since

then, the event has evolved from financial product and service sales to brand marketing events, smashing historical records year to year. In the current Fortune Festival from Dec.24.2019 to Jan.29.2020, Ping An launched a set of financial products including insurance, banking, investment, life insurance, pension insurance, health insurance, and other businesses. In sum, the 49-day event saw a cumulative number of purchasers with 510 million, and a sales volume of 2.5 trillion yuan with a year-over-year growth rate of 45% (Xinhuanet, 2019).

Modifying institutional logics

Redeploy pre-existing institutional logics

The financial industry is strongly regulated wherein every activity should comply with the financial regulations and are supervised by regulators consisting of the Financial Stability and Development Committee (FSDC), People's Bank of China (PBOC), China Banking Insurance Regulatory Commission (CBIRC), and China Security Regulatory Commission (CSRC). Due to the tightening regulation, financial incumbents were more conservative, risk-averse, and aware of compliance, comparing their counterpart internet firms. These features were reflected in the pace of launching products and services and what the products and services are. Financial incumbents usually adopted a step-by-step strategy, namely diversifying into the fintech sector by firstly launching the low-risk products and services, and later the high-risk ones. As a representative of the financial sector (FN-3) said:

‘The [digitalization] transformation started probably in 2015. It started from the retail business, including mobile APP, smart counter systems, etc. Retail products and services are standardized. Later, around 2019, it slowly started to do the company business, its requirements for data and risk management were higher.’

Similarly, the aforementioned debate occurred at the ceremony of the Internet Financial Industry Forum at Fudan University in 2013. Mingzhe Ma, the CEO of Ping An, shared a similar idea of incremental strategy by first digitalizing the low-risk standardized products and services and putting off the complicated products and services until later. As remarked by Mingzhe Ma (2013):

‘If you divide the insurance into four, the first is life insurance, the second is pension insurance, the third is health insurance, and the fourth is property insurance. Life insurance is more difficult. This is the most difficult. Short-term accidental health insurance is possible. Long-term life insurance involves people’s financial planning and family planning. Insurance is often negotiated after many discussions. It is not surprising that you talk for an hour. The second is old-age insurance. The objects of old-age insurance are generally large enterprises. The planning of large enterprises, their team situation, and their age are very difficult online. The third is health insurance. Short-term health insurance is possible. Long-term health insurance requires a physical examination, and many questions need to be answered face to face. After the physical examination, a lot of medical history is required. Therefore, it is more difficult to operate on the Internet.

What should be the first to move to the Internet? Property insurance. Because in property insurance, I look at this market, 70% is a personal business, and 30% is corporate business. There is a chance that 50% of personal business can move to the Internet. ... Everything can be connected to the Internet, but maybe a thousand years later.’

However, too much conservative and risk-averse may make the financial incumbents reluctant to make any change for catering customers’ needs that may involve risk. As a representative of the financial sector (FN-1) said:

‘Finance is a highly regulated industry. Any product must meet regulatory requirements. This is like a tight curse. You cannot be as free as an Internet company. Many times, even though these products are technically achievable, I still face barriers from the regulatory perspective. There is also the issue of power and responsibility or the dilemma of innovators. Who will bear the problem of innovation, and who will share the benefits of innovation?’

In addition to the conservative and risk-averse thinking, the failure of catering to customers’ needs also roots in financial incumbents’ mainstream KPI (key performance indicators) of assets under management (AUM). Due to the asset priority strategy, financial incumbents more focus on the assets that a customer has, instead of customers’ real demand. It thus leads to the

‘80/20 rule’, that is, ‘traditional banks focus on the top 20% of large customers and ignore the remaining 80%. This is normal because the cost of serving large and small customers is similar, but the price per customer varies greatly.’ (FN-1). Moreover, the customers’ behavior changed in the era of mobile internet. As one interviewee (IE-1) put it: ‘The mobile Internet is naturally to the side of customers. The mobile phone is held in the hand all day long. Walking. Riding in the car. All keeping the mobile phone in hand. It’s okay to look at the mobile phone and make a shop and payment anytime.’ In sum, due to the ignorance of the rest 80% of customers, and the changing financial behaviors, financial incumbents’ understanding of their customers was lagged.

Creating new institutional logics

Against this background, financial incumbents made efforts to become more innovation-led and customer-centric. Two main strategies are mimicking and education.

Mimicking

In the era of mobile internet, financial services are becoming more and more embedded in customers’ life and business context (King, 2018). Financial incumbents thus have to transform their traditional thinking characterized by asset-centricity and embrace customer-centric thinking for understanding customers’ complete and comprehensive journeys that are not limited to the financial needs but included customers’ non-financial needs. This shift from asset-centricity to customer-centricity was reflected in the CMB’s 2018 press conference (Tian, 2018):

‘I used to be the 20/80 rule, but now I have to focus more on long-tail customers, and I need to invest more energy and resources for long-tail customers. . . . Because in the context of the Internet, it is actually very important to classify customers according to their behaviors. You cannot simply serve customers by AUM [asset under management].’

In order to create user-centered thinking, CMB mimicked the internet company by introducing a new criterion, namely monthly active users (MAU), which is often used by Internet

companies. In contrast with AUM that measures assets, MAU is the metric that reveals the total amount of users who open an app. MAU is the indicator that guides financial institutions to concern customers' needs and becomes use-centered. As the CTO of CMB Chen said (2019):

'How to find a key indicator so that the whole bank can change this kind of thinking? The first is MAU, which is often used by Internet companies. What does MAU stand for? It is not just a number, it represents the frequency of customers coming to the bank, why, when, and what scenarios come, and the interactive cloud on the App accumulates huge data, so it represents the relationship between the bank and the customer.'

In 2018, CMB incorporated the MAU as one of the key KPIs or what they call 'North Star Metric' which means MAU is the brightest KPI and acts as a fixed point from which to navigate other businesses. In order to better promote MAU, CMB has to meet its customers' needs, no matter financial needs or other needs in daily life. Thus, CMB built the 'finance + life' ecosystem which 'connecting the lives, consumption, and finance of millions of people' (CMB, 2019). Specifically, CMB improved the pre-existing financial products and services, on the one hand, and actively expanded a set of daily life scenarios, e.g., content ecosystem, e-commerce, life with the automobile, and other living scenarios, on the other hand. Through the initiation of the 'finance + life' ecosystem, CMB's APP's MAU has increased from approximately 55 million in 2017 to approximately 102 million (CMB, 2019).

Likewise, Ping An transformed asset-centric thinking to customer-centric thinking. For Ping An, the asset-centric thinking is reflected by its previous strategy of 'offering products first, then services' (Ping An, 2016). Here, product refers to financial service, while service refers to the broadly defined services including not only financial service but also non-financial services, e.g., health, food, housing, transportation, and entertainment. As such, 'offering products first, then services' reflects that customers' financial needs have priority over customers' non-financial needs. In 2015, Ping An proactively transformed the previous asset-centric business model to the customer-centric business model, namely 'offering services first, then multiple services, and then multiple products'. This new business model reflected Ping An's customer-

centric thinking, that is, the top priority is to serve customers' Omni-demands, and then the traditional financial needs. As the deputy CEO of Ping An Chen said (2019):

'The idea was to create these platforms where I could draw in customers who would then later buy our financial-services products. This was quite a significant conceptual change for us. Five years ago [2014], I was really learning from what the internet guys were doing: everything was free. They got the users first, and only then started to monetize their offerings by cross-selling and up-selling'

In addition to customer-centric thinking, financial incumbents also have to foster an innovation culture. As the internet firms are known as the full of the innovative gene, financial incumbents learned from and mimicked the tech companies to fill the lack of innovation culture. As Cai, the Special Assistant to the CEO of Ping An Bank put it (2018),

'Fully benchmarking with Internet companies. I often use this analogy. If I score 80 points for new retail e-commerce services, financial services will only have 40 points. ... Compared with Internet companies, although commercial banks have 'hard power' (such as fully functional financial licenses, extensive coverage of offline outlets, mature and stable risk control systems, relatively sufficient self-owned funds, etc.), there is a huge gap in the gene, including the unformed Internet thinking, insufficient organization, the failure of technology applications to lead the business, and the difficulty of replicating online scene traffic. Therefore, the 'soft gene' needs to be filled.'

The lack of innovation gene mainly results from financial incumbents' traditional organizational structure which is fragmented and hierarchical. As different departments have different commitments, directions, and KPIs, different departments have silos in between and thus hinder cooperation and innovations. As the president of CMB Tian put it in the press conference the first half-year of 2020 (2020).

'Breaking silos and removing inherent barriers are easy to understand. In fact, many large organizations have numerous internal silos. I believe that your company may also have this problem. Two departments do not interact with each other. Not to mention the cooperation

and cooperation to act on the market and serve the customers. It is good not to beggar-thy-neighbors. This is a typical manifestation of ‘Big Company Syndromes’. You say ‘customer-centric’. How can you be customer-centric when you have a lot of silos? How can your employees experience it well when the barriers are heavy? The employee experience is not good, how can the customer experience be good?’

In order to break the fragmented and hierarchical organizational structure which hinders innovation, financial incumbents embraced and mimicked the agile transformation from the tech company. As Cai, the Special Assistant to the CEO of Ping An Bank put it (2018),

‘Specific to our approach, the agile team is basically set up in accordance with the organizational structure of the Internet company, without a department structure, popularizing Internet thinking, and de-administrative. The same is true for talents. They are recruited from various functional departments of the bank to form a project-specific team of more than 10 people, equipped with CTO, CPO, and CMO. They have a certain Internet foundation, and they have some understanding and practice of agile, which can play a leading role. effect.’

In order to break the silos arising from different departments with different commitments, Ping An Bank built up multi-department teams that comprise a mix of specialists in product development, IT, and marketing who are otherwise relatively isolated. Rather than guiding by the fragmented commitments, the multidisciplinary teams focused on quickly responding to customers, solving the client’s real needs, and improve client experience. Take the credit card business as an example, the agile transformation has effectively shortened the development and innovation cycle of credit cards from product development to marketing from 69 weeks to 28 weeks with reducing the time by 60% (Cai, 2018).

Likewise, the CMB launched the agile transformation in 2017. Specifically, with the aim of breaking silos, the CMB promoted across-department integration of task-oriented project teams to drive talent flows, break traditional department boundaries, and stimulate the vitality of the organization. In 2018, the CMB has adopted agile development with the integration of the technology department and businesses department in 53 areas (CMB, 2018). In the first half-

year of 2020, the CMB has organized more than 60% of the workforce in the technology department to teamed up with the business department for establishing cross-functional integrated teams (CMB, 2020).

In addition to agile transformation, CMB mimicked the tech company and learned the lean innovation characterized by MVP (Minimum viable product). As remarked by the statement of the president of CMB Tian (2019).

‘It is necessary to transform from empirical thinking and authoritarianism to talking with data. ...Talking with data [refers to] starting from the MVP and continuously optimizing the functions and projects based on market data performance at a low trial and error cost, which has become a widely used in the Internet world.’

How to implement this? Practically, CMB established a fintech innovation incubation platform where entrepreneurial employees can work on their ideas. In addition, the bank held the ‘Small Team Innovation Competition in Fintech’ wherein employees compete for their ideas with each other and the company can thus pick up the best excellent one. To support this campaign and incent employees’ entrepreneurship, it has set up a Fintech Innovation Fund which accounts for 1% of its operating income of the previous year. In 2019, the company received 2260 project proposals. It approved 1611 projects, of which 957 projects have been launched and put in use. As a result, ‘CMB becomes very flexible and agile. Every new thing in the market can be tried. If the outcome is not good, then cut it off’ (FN-6).

Education

Another action used to foster innovation and customer-centricity is education. Education includes both top-down and bottom-up approaches. Here, CMB is an interesting example. In terms of the top-down approach, at the end of 2019, CMB established a set of action codes namely ‘Simple Work Style’. It includes ten work styles, such as ‘Fear not for opposition, fear for silence’, ‘All ideas are equal in the eyes of data’ and ‘Don’t look down on juniors. Don’t kiss up to seniors’ and ‘You are respected for your capacity to create, not for your authority to dictate’ (CMB, 2019). All these work styles are conducive to getting rid of the concept of

hierarchy and cultivate the culture of equality and inclusiveness which in turn foster innovation. In terms of the bottom-up approach, CMB established the ‘Egg Shell’ communication platform which allows the employee to comment on work-related problems. One can directly contact the person who is in charge of that problem. After that, they will discuss how to improve. It thus is a method to improve top-down communication. In 2019, a total of 1,263 opinions and suggestions on the ‘Egg Shell’ platform were adopted, with an adoption rate reaching 29% (CMB, 2019).

Yet, the process of education was not without conflicts because the customer-centric and innovation-led mindsets embedded in the internet industry were relatively new to the previous conservative and risk-averse mindsets embedded in the financial industry. As one interviewee said (FN-2):

‘Internet people focus on user experience and customer-centric. They generally have no previous experience in the financial industry, let alone regulatory compliance. But to do finance is to satisfy risk control and compliance. This creates a contradiction between the ‘light’ of the Internet and the ‘heavy’ of finance. For example, buy insurance online. Internet guys are pursuing the experience of buying with a few clicks, but the financial guy’s thinking is to read the relevant contracts and regulations again and again before buying. At this time, the page [illustrates the contract and regulations] will force the user to read for a certain time before they turn into the next page, which may be 30 seconds or one minute, you have no way to skip. This kind of operation method is unimaginable in the eyes of Internet guys, it is not user-friendly, but there is no way, and this is how finance works....’

So, how to make education (the process of learning innovative and customer-centric thinking) more effective? One relatively smooth strategy is to start the education from the employees with latent proper mindsets who can learn more quickly. As one interviewee (FN-5) explained (2019):

‘The core thinking of the Internet is user thinking and rapid iteration. These banks do not have. How to introduce it? I started from the top-level design, organized a group of people with

relatively Internet thinking to established new departments, and slowly learned and transformed thinking.’

In addition to educating the inside employees, recruiting new employees with latent proper mindsets also played a crucial role in education. As one interviewee (FN-2) said (2019):

‘To smooth the integration between two different guys [with internet backgrounds and financial backgrounds], it needs to plan. Two people, I hire. Those are just graduate. They are fresh and like a white paper, not a predominated idea, easy to learn the new idea. Another is those who work in both sectors before. They are perfect but less.’

Another more coercive strategy to push education is the market selection which forced employees to learn the new mindsets. As one interviewee (FN-5) explained:

‘In this process [of education and learning], naturally, a group of people who adapt and those who do not adapt appear. Because the joint-stock bank has a fully competitive mechanism, those who adapt will stay and those who do not adapt will leave. Repeat this cycle and slowly learn Internet thinking.’

Similarly, another interviewee (FN-4) put it:

‘What’s the glue that holds the internet guys and financial guys together. Two things. The first is the mission. So long as it is positive to the outcome, they are willing to learn. The second is the KPIs. If they don’t work together, they won’t meet their KPIs.’

5.5 Interim summary

Modifying technology

Internet industry diversified into fintech

Recently, fintech services are not exclusively offered by financial incumbents. It witnesses the emergence of new players from the internet industry. As the home to China’s largest social network giant Tencent, Shenzhen’s internet industry is competitive and has *ex ante* possessed

lots of information technologies, such as Web technologies, artificial intelligence, and the distributed databases. Such information technologies are crucial for fintech, which is the combination of financial skills and information technologies. Internet firms can therefore redeploy their pre-existing information technologies, which were previously used in the internet industry, to the fintech industry. However, what internet firms lack are financial skills in designing and operating financial products and services, which mainly comprise knowledge in risk management, asset valuation, portfolio management, as well as financial skills in regulatory compliance. In this case, internet firms have to create such missing financial skills. In this case, Shenzhen's internet firms create such missing financial skills through recruiting financial experts and collaborating with financial institutions.

Financial industry diversified into fintech

With the increasing integration between finance and technology, Shenzhen's financial incumbents have gradually adopted information technologies, particularly artificial intelligence, and big data, to digitalize their financial activities. Shenzhen's financial industry is competent, as it is home to China's financial conglomerate Ping An and China's first shareholding bank China Merchant Bank (CMB). It thus has *ex ante* possessed lots of financial skills, such as modern portfolio theory, the risk-pricing model, the capital asset pricing model, and regulatory compliance. Moreover, financial incumbents have *ex ante* possessed information technologies in the core banking system that deal with data storage, payment, transactions, deposits, loans, and credit processes. This case shows that Shenzhen's financial incumbents redeploy their pre-existing financial skills and information technologies to the fintech. However, information technologies, particularly the cutting-edge technologies in AI and big data, are usually missing for financial incumbents. In this case, Shenzhen's financial incumbents create such missing information technologies through recruiting engineers and collaborating with tech companies.

Modifying market (customers)

Internet industry diversified into fintech

Internet industry has traditionally specialized in a particular online niche market, such as e-commerce, online gaming, and social network. Therefore, internet firms have had numerous existing customers in their businesses before diversifying into fintech services. Based on long-term, frequent, and on-site interaction with the customers, internet firms have efficiently recognized and identified their existing customers' latent or emerging demands in fintech services. For example, customers who shop via the e-commerce platforms or hails a taxi via the online taxi-hailing platforms have a latent demand for online payment and transaction within the same platforms that allow the consumers to stay within the platforms they are in, and thus, save their shopping cost (Klemperer, 1992; Klemperer & Padilla, 1997), time (Ye et al., 2012), and switching costs (Kamakura, 2003; Priem, 2007). As such, in order to respond quickly to their customers' new demand for fintech services, internet firms offered the fintech products and services that meet their pre-existing customers' new needs and then redeploy their pre-existing customers from the previous internet businesses to the fintech industry. In addition, internet firms also acquire new customers who have demands for fintech services through multiple channels advertising so long as those channels can reach their potential customers.

Financial industry diversified into fintech

Financial industry has traditionally offered offline financial services to its customers through branch-centric channels. Recently, with the boom of digitalization of financial activities, customers' behaviors have shifted from offline branch-centric channels to online smartphone-centric channels. In order to cater to customers' changing behaviors from offline to online, financial incumbents established their mobile APPs that provide online financial services to meet their pre-existing customers' new needs, and thus, redeploys their pre-existing customers to the fintech industry. Yet, offering online financial services alone is not enough to attract their pre-existing customers to use mobile APPs. It is because internet firms, the financial incumbents' counterparts, not only offer fintech services to the customers but also their pre-existing businesses. This increases the number of customer touchpoints in the customer journey and improves customer loyalty. More importantly, there exists the so-called 'natural ordering', which refers to the sequential purchase of multiple products or services (Feick, 1987;

Kamakura et al., 1991; Li et al., 2005). In other words, the sequential purchase of multiple products or services exists in the market, where consumers' needs emerge only after some consumptions occur (Kamakura et al., 1991). For instance, a customer is less likely to pay the bill via the platforms *before* shopping via the e-commerce platforms, while a customer is more likely to pay the bill via the platforms *after* shopping in the same platforms. That is to say, due to the existence of natural ordering, internet firms that already offer multiple online businesses (e.g., e-commerce, online gaming, and social network) are more easily and naturally offering fintech services to their pre-existing customers. In order to cater to customers' changing behaviors, to increase the number of customer touchpoints in the customer journey, and to follow the natural ordering, financial incumbents have to mimic their counterpart's tech companies to offer online daily life services, such as e-commercial, online healthcare, and online taxi-hailing, which either self-build up or cooperate with the third-partner. In sum, financial incumbents offer a mix of fintech services and online daily life services that meet their pre-existing customers' new needs and then redeploy their pre-existing customers to the fintech industry. In addition, financial incumbents also acquire new customers who have demands for fintech services through co-marketing with third-party who has the target new customers, and through multiple channels of advertising.

Modifying institutional logics

Internet industry diversified into fintech

Internet industry has traditionally innovation-led and customer-centric, which is embedded in a philosophy of lean innovation. Internet firms have therefore redeployed the innovation-led and customer-centric thinking to the fintech industry, leading them to offer financial products and services more innovative, cheaper, and better meet their customers' needs. However, too many innovations also carry risks, particularly in the field of finance. As such, a crucial challenge for the internet industry is to create awareness of risk and regulatory compliance as new institutional logics. Theorizing is the most important institutional work that creates a new institutional layer. The past few years have witnessed the long-term debate about whether

technology disrupts the logic of finance. Internet players have gradually understood that technology has not changed the risk attributes of finance, instead, technology makes the spread of financial risk faster. Consequently, the next institutional work is to mimic financial incumbents who are characterized by regulatory compliance. Moreover, education acts as another institutional work to enhance internet firms' awareness of risk.

Financial industry diversified into fintech

The financial industry has traditionally been strongly regulated and supervised by regulators. It is thus more conservative, risk-averse, and aware of compliance. These institutional logics are crucial for the fintech industry, as the essence of finance is finance and risk management. Therefore, financial incumbents redeploy pre-existing conservative and compliance thinking to the fintech industry, which is characterized by a step-by-step diversification strategy, namely, rolling out the low-risk products and services first and later the high-risk ones. Although this traditional mindset enables financial incumbents to mitigate the financial risk, being too conservative hinders financial firms' incentive to innovation for catering to customers' up-to-date needs, which may involve risk. In response, Shenzhen's financial industry create a new institutional layer characterized by innovation-led and consumer-centric through mimicking from the internet industry and education. For example, to cultivate innovation-oriented thinking, financial incumbents mimicked internet firms to establish an innovation incubation platform where entrepreneurial employees can work on their ideas and trial-and-error. Moreover, to become more user-centered, financial incumbents introduced the new incentive criterion, namely monthly active users, which is previously used by Internet companies.

Summary

Table 5.3 summarizes the above interim discussion concerning modifying technology, market as well as institutional logics. As shown in Table 5.3, the rise of Shenzhen's fintech industry mainly grows out of Shenzhen's pre-existing internet and financial industry. By comparing the asset modification process that internet and financial industry diversify into the fintech industry, I find that although the internet and financial industry have their unique pre-existing assets in

terms of technology, market, and institutional logics, there exists a consistent pattern, that is, the emergence of the fintech industry in Shenzhen is the outcome that internet and financial firms' purposeful redeploy their pre-existing technologies, market, and institutional logics, as well as create the new ones that are necessary for fintech but are missing for either the internet or financial firms.

Table 5. 3 The exemplification of the theoretical framework with the case of Shenzhen

	Technology		Market		Institutional logics	
	Redeploying pre-existing technology	Creating new technology	Redeploying pre-existing market	Creating new market	Redeploying pre-existing institutional logics	Creating new institutional logics
Internet industry diversified into fintech	Information technologies (e.g., Web technologies, AI, and distributed databases)	Financial skills (e.g., designing and operating financial products, and regulatory compliance)	Pre-existing customers in the internet industry who have latent and emerging demand in fintech services	New customers who have demands for fintech services	Innovation-led and customer-centric thinking	The awareness of financial risk and regulatory compliance
Financial industry diversified into fintech	Financial skills (e.g., modern portfolio theory, regulatory compliance, risk-pricing,) Information technologies (e.g., core banking system)	Information technologies (e.g., AI, big data)	Pre-existing customers in the financial industry who have latent and emerging demand in fintech services	New customers who have demands for fintech services	Conservative, risk-averse, and awareness of regulatory compliance	Innovation-led and customer-centric thinking

Source: Author (2020).

Chapter 6: Conclusions and outlook

This chapter functions as a general conclusion of the entire dissertation. Firstly, a brief overview of the study is discussed, followed by highlighting the key findings that correspond to the research questions proposed in Chapter 1, and then the contributions are summarized. Secondly, I propose some policy implications for the rise of the fintech industry in a given city. Finally, the limitations of the research and directions for future research are discussed.

6.1 Summary of the main findings and contributions of the dissertation

My dissertation aims to contribute to the literature on evolutionary economic geography by providing a comprehensive understanding of the emergence of the new industry in regions that extends from previous technology-centric views to consider the role of the demand-side market and institutional logics in the emergence of the new industry in regions (see chapter 1). To fully understand the role of supply-side technology, demand-side market, and institutional logics in the emergence of the new industry in regions, this dissertation adopts a ‘mixed methodology’ approach (see chapter 3).

First, chapter 4 conducts a quantitative regression analysis to identify the relationship between the supply-side technology and the rise of the fintech industry in a given city, based on the quantitative data covering the fintech development across China during 2003-2019. The econometric results show that fintech industries tend to emerge in cities that have possessed more fintech-related technologies, confirming the principle of technological relatedness. Meanwhile, to go beyond the supply-side technology, chapter 4 also tests the existence of the relationship between the demand-side market and the rise of the fintech industry in the given regions. The econometric results show a positive relationship between the development of the fintech industry and the demand for fintech services.

Second, in line with the above findings from quantitative research in chapter 4, chapter 5 goes one step further to explore the underlying logics of how supply-side technology and the demand-side market actually drive the rise of the fintech industry, leading to positive

relationships. Moreover, chapter 5 explores the role of the institutional logics in the emergence of a new industry, which is hard to be quantified and analyzed through the quantitative research in chapter 4. Based on an in-depth case analysis about the rise of fintech in Shenzhen, I find that the rise of Shenzhen's fintech industry mainly grows out of Shenzhen's pre-existing internet and financial industry. Specifically, internet and financial firms take purposeful actions in terms of redeploying their pre-existing technologies, market, and institutional logics, as well as creating the new ones that are necessary for fintech but are missing for the internet or financial firms. This finding reflects the underlying logic of how supply-side technology, the demand-side market, and institutional logics matter for the rise of the fintech industry, that is, relevant regional actors purposefully modify (i.e., redeploy pre-existing and creating new) technologies, market, and institutional logics to generate a new industry in regions.

Summary of the main findings

In the following, I will highlight the key findings resulting from both theoretical, methodological, and empirical analyses corresponding to the research questions proposed in Chapter 1.

- ① Does the demand-side market influence the emergence of a new industry in regions, and if so, how? Particularly, how do regional actors modify the demand-side market to foster the emergence of the new industry in regions

This dissertation reveals the crucial role of the demand-side market in the emergence of the new industry in regions (the fintech industry in this dissertation). In the field of fintech, the demand for fintech may come from two sources, that is, individual customers' demand for internet-based financial services (e.g., online payments, online investment, and online financing), and incumbent financial institutions' demand for obtaining new technology solutions (e.g., big-data-driven risk management, facial recognition in verifying customers' identity, and encryption technology in ensuring secure online transaction). Based on a unique dataset from 2003 – 2019, the quantitative results show that the fintech industry tends to emerge in regions with a bigger demand for fintech in terms of individual customers' demand for

internet-based financial services (see detail in Chapter 4). Yet, the role of demand in terms of providing financial technology solutions to financial incumbents is relatively weak (see detail in Chapter 4). It is because providing financial technology solutions is an emerging phenomenon since the end of 2018 which requires more investigation in the future.

To further explore the underlying logic that how the individual customers' demand for internet-based financial services actually drives the rise of the fintech industry, I turn to the qualitative data and conduct an in-depth case analysis in the rise of fintech in Shenzhen (see detail in Chapter 5). The qualitative results show that the rise of Shenzhen's fintech industry mainly grows out of Shenzhen's pre-existing internet and financial industry. Looking at the internet industry, before diversifying into the fintech industry, internet firms usually have specialized in one particular online niche market, such as e-commerce, online gaming, and social network. They thus have possessed numerous pre-existing customers in their pre-existing business activities before diversifying into the fintech industry. Since 2013, the internet firms gradually realized that their pre-existing customers have new demands for internet-based financial services which synergize with their pre-existing businesses. To respond to their pre-existing customers' new demand for internet-based financial services, internet firms diversify into the fintech industry which offered products and services to meet their pre-existing customers' new needs and then redeploy their pre-existing customers from the previous internet businesses to the fintech industry. Likewise, before diversifying into the fintech industry, financial incumbents have possessed numerous pre-existing customers. Yet, with the boom of digitalization that affects all sectors of activity around the world, financial incumbents realize that their pre-existing customers' behaviors have shifted from the traditional offline branch-centric channels to the online smartphone-centric channels. To respond to their pre-existing customers' new demand for internet-based financial services, financial incumbents diversify into the fintech industry which offered products and services to meet their pre-existing customers' new needs and then redeploy their pre-existing customers into the fintech industry. In addition to redeploying pre-existing customers, internet firms and financial incumbents also acquire new customers who have demands for internet-based financial services through co-

marketing and advertising.

Briefly, the greater the individual customers' demand for internet-based financial services, the more easily that the internet and financial industry leverage their pre-existing customers' new demand for fintech to redeploy their pre-existing customers to the fintech industry which in turn serves their pre-existing customers' new demands, and the more easily that the internet and financial industry acquire new customers to supplement their pre-existing customers.

- ②Do institutional logics influence the emergence of a new industry in regions, and if so, how? Particularly, how do regional actors modify the institutional logics to foster the emergence of the new industry in regions?

This dissertation reveals the crucial role of institutional logics in the emergence of the new industry in regions (the fintech industry in this dissertation). Since the institutional logics are hard to be quantified, I conduct a qualitative case study to explore whether and how institutional logics matter for the emergence of the fintech industry in Shenzhen (see detail in Chapter 5).

The qualitative case study reveals that institutional logics matter for the emergence of the fintech industry in Shenzhen. Fintech lies at the intersection of finance and technology. It thus internally requires the coexistence of multiple institutional logics, particularly the internet industry's innovation-led and customer-centric institutional logics, and the financial industry's regulatory compliance and risk-averse institutional logics. Moreover, the case shows that both types of institutional logics are necessary and not one less. Specifically, the internet industry is traditionally embedded in innovation-led and customer-centric institutional logics. Yet, too many and too fast innovations may overlook regulatory compliance and lead to financial risk. Likewise, the institutional logics of the financial industry is compliance and conservative. However, being too conservative hinders a financial company's incentive to make innovations.

Moreover, the qualitative case study shows how the institutional logics matter for the rise of the fintech industry, that is, the internet and financial industry redeploy their pre-existing institutional logics and create their missing institutional logics to generate the multiple institutional logics that are required for the fintech industry. Specifically, the pre-existing

institutional logics of the internet industry are innovation-led and customer-centric. Internet firms thus redeploy these pre-existing institutional logics into the fintech industry, which enables the internet firms to offer more efficient, affordable, and accessible financial services. Yet, too much innovation and customer-centric may lead internet firms to overlook the potential financial risk. Internet firms thus have to create an awareness of compliance and risk as new institutional logics. In this case, the new institutional logics characterized by the awareness of compliance and risk are created based on the institutional works of theorizing, mimicking, and education. Concerning the financial industry, it has traditionally embedded the institutional logics characterized by compliance and conservatism. This case shows that financial incumbents purposefully redeploy their pre-existing institutional logics into the fintech industry. For example, the financial incumbents adopted a step-by-step strategy to diversify into the fintech sector by firstly launching low-risk products and services and then the high-risk ones. Although these pre-existing institutional logics can ensure the steady and healthy development of the fintech industry, an overly conservative approach hinders a financial company's incentive to make innovation for catering to customers' up-to-date needs. Financial incumbents thus have to create the new institutional logics characterized by innovation and customer-centricity. In this case, such a financial industry's new institutional logics is created through the institutional works of mimicking and education.

- ③ How to apply the mixed-method to integrate qualitative and quantitative research in evolutionary economic geography?

To seek a methodology integration, chapter 3 proposes the mixed-method, which is composed of four concrete approaches, namely the triangulation approach, the embedded approach, the sequential exploratory approach, and the sequential explanatory approach (see Chapter 3 for detail). Specifically, the triangulation approach can be used to detect whether findings based on different methods are convergent or different. The embedded approach can be used when one embeds quantitative data to enrich the description of the qualitative case. Similarly, the embedded approach can also be used to embed qualitative research into quantitative research. This is usually done when some indicators cannot be quantified or the data are not available,

and when quantitative research and qualitative research addresses questions at a different level of analysis. The sequential exploratory approach is a useful method when one applies the qualitative case study to generate hypotheses which then be tested in the quantitative research. The sequential explanatory approach is applied when one uses the quantitative results to select the qualitative case study, and when one finds some unexpected results arise from a quantitative study and then uses the qualitative case study to explain.

Among these four concrete approaches, the empirical work in this dissertation applies the embedded approach to integrate the otherwise separate quantitative regression analysis and qualitative case study.

First, I embed the qualitative case study into quantitative research because the quantitative and qualitative research addresses questions at a different level of analysis. The first level concerns the quantitative research that deals with the question of ‘whether’, that is, whether the supply-side technologies (particularly those that are related to the new industry) and demand-side market matters for the emergence of the fintech industry across China (see the quantitative research in Chapter 4). The second level concerns the qualitative case study that deals with the question of ‘how’, that is, how do the supply-side technologies (particularly those that are related to the new industry) and demand-side market matters for the emergence of the fintech industry in Shenzhen (see the quantitative research in Chapter 5). Briefly, quantitative research detects ‘whether’ the supply-side technologies and the demand-side market are associated with the emergence of the fintech industry across China. If the quantitative results confirm the existence of the positive relationship, a qualitative case study is used to investigate ‘how’ such a relationship happens, that is, the underlying processes and logics that lead to such a relationship.

Second, I embed the qualitative case study into the quantitative research because the institutional logics are hard to be quantified. In this situation, chapter 5 conducts the case study to explore whether institutional logics matter for the emergence of the fintech industry in Shenzhen and how institutional logics matter in terms of the process of asset modification.

- ④ What does the emergence of the fintech industry across China look like? How does evolutionary economic geography explain the emergence of the fintech industry in China?

The studies reveal a highly uneven geographical distribution of the fintech industry in China. In particular, China's fintech landscape is dominated by three leading eastern coastal cities, namely, Beijing, Shenzhen, and Shanghai. So, how does evolutionary economic geography explain the emergence of the fintech industry in China? Chapter 4 conducts quantitative research which finds that fintech industries tend to emerge in China's cities that have possessed more fintech-related technologies (particularly in the fields of finance, e-commerce, data sciences, and security) and that have more retail customers for fintech services. Moreover, the case study in chapter 5 finds that institutional logics matter for the emergence of the fintech industry.

Moreover, this thesis finds that the conventional understandings of evolutionary economic geography can be generalized into the fintech industry. Evolutionary economic geographers claim that new industry is more likely to occur in regions where the regional pre-existing capabilities are technologically related to that new industry (Neffke et al., 2011; Boschma et al., 2013; Feldman, et al., 2015; Rigby, 2015; Zhu et al., 2017; Balland et al., 2019). Evidence has been found in fuel cell technology in European regions (Tanner, 2016), biotechnologies across world cities (Boschma et al. 2014), and nano-technologies in European regions (Colombelli et al. 2014). Through extending the research to the fintech industry, the quantitative research finds that fintech industries tend to emerge in China's cities that have possessed greater fintech-related technologies, particularly in the fields of finance, e-commerce, data sciences, and security (see detail in Chapter 4). Moreover, the qualitative case study shows that the rise of Shenzhen's fintech industry mainly grows out of Shenzhen's pre-existing internet and financial industry both of which are technologically related to the fintech industry (see detail in Chapter 5). In sum, this dissertation confirms the generalizability of the understanding that the new industry is more likely to occur in regions where the regional pre-existing capabilities are technologically related to that new industry.

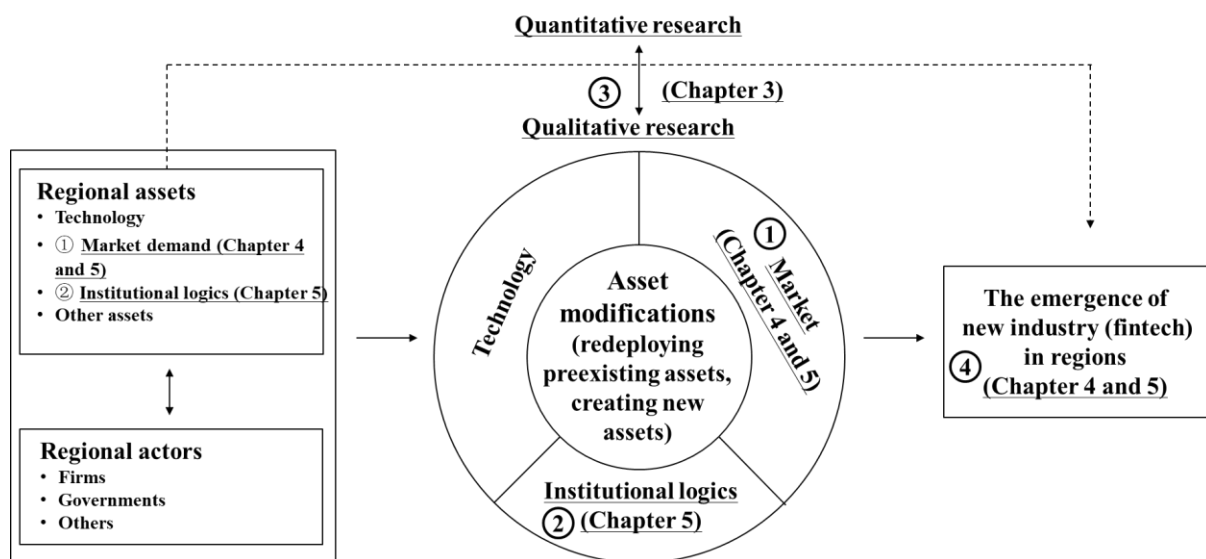
Contributions of the dissertation

Based on the synthesis of the above four main findings, it offers a comprehensive model of the emergence of the new industry in regions (see Figure 6.1).

First, it proposes that regional assets, not only supply-side technology but also demand-side market and institutional logics, matter for the emergence of the new industry in regions (see the dotted arrow line). In terms of the fintech industry, quantitative research shows that fintech industries tend to emerge in cities with more fintech-related technologies and more individual demand for internet-based financial services. Quantitative research does not examine the role of institutional logics because it is hard to be quantified. It is compensated by the qualitative case study which confirms the crucial role of institutional logics.

Second, it unpacks the underlying logic of how do technology, market, and institutional logics matter (see the solid arrow line). The qualitative case study reveals that the rise of Shenzhen's fintech industry results from internet and financial firms' purposeful actions in terms of redeploying their pre-existing technologies, markets, and institutional logics, as well as creating the new ones that are necessary for fintech but are missing for the internet or financial firms.

Figure 6. 1 The comprehensive model of the emergence of the new industry in regions



Source: Author (2020).

This comprehensive framework contributes to the extant literature on evolutionary economic geography in four aspects which respond to the four research gaps identified in chapter 1 (see the circles in the above Figure).

- Theoretically, this dissertation extends the scholarly work from technology-centric to consider the role of the demand-side market and institutional logics in the emergence of the new industry in regions. The results not only confirm the crucial role of technology, market, and institutional logics but also ascribe the underlying logics of how do technology, market, and institutional logics matter to the agentic processes of asset modification, particularly redeploying pre-existing assets and creating new assets (see detail in the above responding-1 and 2, and chapters 4 and 5).
- Methodologically, this dissertation proposes a ‘mixed methodology’ approach to bridge the otherwise dualism in evolutionary research between qualitative and quantitative research (see detail in the above responding 3, and chapter 3).
- Empirically, this dissertation extends the EEG’s empirical work to the fintech industry that has not yet been scrutinized from the perspective of the evolutionary economic geography (see detail in the above responding 4, and chapters 4 and 5).

6.2 Policy implications for nurturing fintech industry in regions

Taking the policymakers in cities as the starting points, policymakers first have to decide whether to nurture the fintech industry or not and if so, how to nurture the development of fintech.

First, to decide whether to nurture the fintech industry or not, policymakers should build on their current competitive advantage in terms of supply-side technologies, demand-side market, and regulative institutional environment, rather than blindly copy best practices from elsewhere. It is because the new industry tends to emerge in cities where the preexisting technological assets are related to fintech, and where there has a greater demand for fintech, and where the institutional environments are favorable for fintech (see the findings of chapter 4 and 5).

Therefore, policymakers should carefully assess and evaluate their competitive assets. For supply-side technologies, if current technologies are related to fintech, it might be reasonable to develop fintech because it represents a low-risk strategy for the city. Otherwise, if fintech is far from the existing knowledge base of the city, its development is risky. For the demand-side market, if the region's existing market/customers have new demand for fintech, then developing fintech is a reasonable strategy because it saves the cost of searching and acquiring new markets/customers. For the institutional environment, if there has already existed a favorable regulative institution at the national level, it might be reasonable for city-level policymakers to take advantage of such a favorable environment to develop fintech. Moreover, policymakers can make more detailed and tailored institutions at the regional level to further facilitate fintech development.

Second, regions often do not *ex ante* possess all the necessary asset the comprises the fintech industry. For the missing assets, policymakers should help regional actors to newly create. Specifically, according to the findings in chapter 5: (i) For the new technology, it could be newly created through the tactics of firm-firm R&D collaborations, firm-university R&D collaborations, recruiting specialists, etc. (ii) For the new market/customer, it could be newly created through the tactics of co-marketing, recruiting top sales, advertising, etc. (iii) For the new institution, it could be newly created through different institutional works, such as mimic, education, defining, and theorizing.

6.3 Limitations of the research and directions for future research

This project also bears some limitations, and several interesting aspects deserve more attention in the future. At this point, I would like to point to five promising avenues for future research in combination with reflecting on the limitations of the research.

The first concerns the relationship between supply-side technology and the demand-side market in regional industrial path development. This dissertation finds that both the Shenzhen financial and internet industry simultaneously redeploy their pre-existing technological assets

and pre-existing market assets to diversify into the fintech sector. In other words, both technological relatedness and market relatedness play their crucial role in regional industrial path development. One promising avenue is to investigate whether technological relatedness and market relatedness can compensate for each other. One interesting question is whether market relatedness could increase the likelihood of entering into a new industry without technological relatedness. For example, it may witness that the pre-existing industry diversifies into a new industry with limited technological knowledge but based on market relatedness. Similarly, one can ask whether technological relatedness could increase the likelihood of entering into a new industry without market relatedness.

The second concerns the relationship between financial industry-led fintech and internet industry-led fintech. Today, financial incumbents are not the exclusive actors that used technology to provide financial products and services. One of the most visible features of the fintech movement is that new entrants (particularly internet firms) have begun to deliver financial products and services. As these new entrants offer many technology-led financial services that are previously exclusively provided by the financial incumbents, they might crowd out some of the business activities of the financial incumbents. On the other hand, it probably witnesses the cooperation between financial incumbents and new entrants. For example, incumbent financial institutions gradually realize the importance of technology, and, thus, tend to cooperate with the new entrants (particularly internet firms) to access new technology. It echoes the recent claims in evolutionary economic geography, that is, moving beyond the single path view (i.e., focusing on one new path development activities in one industrial sector) to incorporate a comprehensive discussion of inter-path dynamics, that is, ‘how multiple paths emerge within a region, how they are related, and which interactions and interdependencies determine their development’ (Frangenheim et al., 2020, p46).

The third concerns the methodology. This dissertation adopts a ‘mixed methodology’ approach to bridge the otherwise dualism in evolutionary research between qualitative and quantitative research. Although there are several potential ways to combine qualitative and quantitative research, this dissertation bases on the logic of pragmatism. Pragmatism claims that neither

quantitative nor qualitative methods alone are sufficient to develop a complete analysis. As a consequence, quantitative and qualitative methods need to be used in combination, so that they can complement each other (Creswell & Clark, 2017). However, pragmatism has not yet resolved the philosophical tensions between quantitative methods (based on positivism) and qualitative ones (mainly based on critical realism). Future research thus could find ways to bring together quantitative and qualitative research at the ontological and philosophical levels. Here, critical realism might offer a rationale for such a combination of quantitative and qualitative methods (Gong & Hassink, 2020). Critical realism assumes a stratified ontology divided into three domains: the empirical (those aspects of reality that can be experienced), the actual (those aspects of reality that occur), and the real (those causal mechanisms that generate phenomena) (Bhaskar 1975, 1986, 1989). According to this stratified ontology, quantitative research mainly focuses on the empirical level and the observable events. The strength of quantitative methods is to develop reliable descriptions and identify patterns and associations that may otherwise be masked. But why do the patterns and associations have happened in the way they did? From a perspective of critical realism, it calls for the so-called retrodution which refers to the moving from the empirical level of observations to the level of real, that is, those causal mechanisms that generate phenomena (Gong & Hassink, 2020). In other words, retrodution means asking why events have happened in the way they did' (Olsen & Morgan, 2004, p25). It is in such a process of retrodution that qualitative research (particularly case study) makes its sense because 'case studies are the preferred strategy when 'how' or 'why' questions are being posed' (Yin, 1994, p1).

Fourth, due to time and resource constraints, this dissertation could only investigate the rise of the fintech industry in Shenzhen, particularly how do pre-existing financial industry and internet industry diversify into the fintech industry. In the future, more empirical research should be carried out in other China's regions as well as other international cities. For example, Hong Kong is probably the most interesting city which is the neighboring city of Shenzhen. Although Hong Kong is one of the most important financial hubs in the world, the rise of fintech mainly results from the cooperation between Hong Kong financial incumbents and

mainland China's fintech giant, such as Fusion Bank (a joint venture between Shenzhen-based Tencent Holdings, Beijing-based Industrial and Commercial Bank of China, Hong Kong Exchanges and Clearing, and others), PingAn OneConnect Bank (an offshoot of the Shenzhen-based Ping An Insurance), and Airstar (a joint venture between Beijing-based Xiaomi Corporation and Hong Kong-based AMTD Group). As shown above, the mode of Shenzhen is endogenous-led diversification based on pre-existing financial and internet industries. While the mode of Hong Kong is the cooperation between the pre-existing Hong Kong-based financial industry and the arrival of mainland China's fintech sector. Against this background, one interesting question is why does the rise of fintech in the different cities has different trajectories? According to the framework, it expects that such different trajectories mainly result from the supply-side technological asset. Shenzhen is one of the most important tech hubs and financial centers in China. It thus *ex ante* possesses a large pool of IT technology and financial skills (although the quality of financial skills may lower than in Hong Kong). In this sense, Shenzhen could leverage its technological relatedness in both IT technology and financial skills to enter into the fintech sector. For Hong Kong, although it is one of the most important international financial hubs and thus *ex ante* possesses a large pool of sophisticated financial skills, it lacks the IT technology which is the foundation for fintech. Due to the lack of IT technology, Hong Kong cooperates with mainland China fintech companies for acquiring their missing IT technology.

The fifth avenue positions in a broader background of digitalization. In the past two decades, digitalization has influenced many industries, particularly the financial industry (the rise of fintech) and the retail industry (the rise of E-commerce). More recently, the outbreak of Covid-19 has accelerated the digitization of the economy. Under this backdrop, future work could pay attention to the digitalization process of other industries. For example, although digitalization is accelerating, the pace of acceleration varies across regions and industries. The above fourth avenue concerns the comparison of the fintech industry in different regions. Other research could compare the digitalization of different industries (for example, fintech and E-commerce) in one region (for example, Shenzhen). Relevant questions include: how does the rise of fintech

and E-commerce industries look like in Shenzhen? What are the similarity and differences between the trajectories of the rise of fintech and E-commerce industries in Shenzhen? How to explain such similarities and differences between the trajectories of the rise of fintech and E-commerce industries in Shenzhen?

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Appendix A. Interview guide

Shenzhen fintech industry Interview guide

Name of company:

Date of interview:

Function of respondent:

Part 1. General opinion on Shenzhen fintech industry development

1. Could you talk about the development process and phases of the Shenzhen fintech industry in general? How do you measure the phases?
2. What significant historical events do you know that have happened in the past decades in Shenzhen or China? How do these events influence the development of the fintech industry in Shenzhen?
3. What are the regional endowments and competitiveness that enable Shenzhen to become a fintech hub?
4. What do you know about national and local policies related to fintech development which have been conducted in the past decade? Do local and national governments support or curb the development of the fintech industry in Shenzhen, and if so how?
5. Who are the key players in the Shenzhen fintech industry? What are the competitive products and services that such key players rolled out?

Part 2. Internet firms or financial incumbents diversify into fintech

1. When was the company founded? Could you briefly talk about the history of the company?
2. What are the key events that your company engaged in? What are the fintech products and services that your company rolls out?
3. What are the pre-existing technological, market, and institutional assets that your company has before diversifies into the fintech industry?

4. How does your company redeploy the pre-existing assets to diversify into the fintech industry? Could you give me some examples?
5. What are critical technological, market, and institutional assets that are necessary for fintech development but are missing for your company?
6. How does your company create such missing assets to diversify into the fintech industry? Could you give me some examples?
7. What's the plan or blueprint for the future development of your company?

Part 3. Others

Do you have any other interesting insights that you wish to share with me?

Thanks a lot for your time!

DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

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Name: Yijia Chen

Signature:

Place: Kiel

Date: