The relevance of corporate entrepreneurship in share price performance: A mining industry study

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DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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1. COVER LETTER

The journal targeted for this article, is *Business Horizons* published by *Elsevier.* The journal covers a variety of topics within the general field of business, with the intent to provide alternative solutions or view points to current business issues. The topics covered over the past year focused on technological advances in business such as blockchain, data analytics as well as sustainability.

The study conducted, contributes to the discussion around the impact of data discloser by companies relating to corporate entrepreneurship, and the impact it has on share price performance, in a drive to assist with the sustainability of shareholder returns (Burke & Clark, 2016; Clement, 2005; Giones, Brem, & Berger, 2019).

Business Horizons has a 2 rating as awarded by the *Association of Business Schools Academic Journal Quality Guide (ABS).*

The article in question, was written in terms of the author guidelines of Business Horizons, published by Elsevier (refer to Appendix A).

The proposed author sequence is “De Witt and Marks”, with the last author position being that of the supervisor of this study.

2. LITERATURE REVIEW

2.1 Introduction

Corporate entrepreneurship (CE) can be simply understood as creating something new, or optimizing something that already exists (Engelbrecht, 2015). This literature review will aim to expand on this by focusing on the following themes:

- What does CE activities entail;
- Driving forces behind CE activities;
- How CE activities manifest in organisations; and
- The relationships between CE activities and organizational performance.

To complement the above, a view will also be formulated to understand the mechanism at the disposal of mining companies to effectively communicate CE activities to shareholders and other stakeholders. Focus will also be given to the drivers of share price performance and what important factors need to be considered in the valuation of these share prices. This will include a review of work done around the efficient market hypothesis as well as the occurrence of events which impact on share prices.

2.2 Corporate Entrepreneurship

The term “Corporate Entrepreneurship (CE)” has been defined by a number of scholars over the years – the first published in 1977 by Von Hippel (Chrisman & Sharma, 1999). The definition has evolved from a concept dealing mainly with the creation of something new, to one which also includes the process undertaken to change something or to combine things.

For the purpose of this study, the following definition of corporate entrepreneurship will be used: “The process whereby an individual or a group of individuals, in association with an existing organization, create a new organization or instigate renewal or innovation within that organization” (Chrisman & Sharma, 1999, p. 18).

A number of leading companies in various sectors, have acknowledged the important part which its internal environment plays to support creativity/entrepreneurial behaviour within the organisation (Kuratko, Hornsby, & Covin, 2014). Kuratko,

Hornsby, and Covin (2014) go further in identifying the dimensions (described below) which will result in entrepreneurial behaviour being effective within an organization and therefore facilitate corporate entrepreneurship.

Top management support: The perception in the organisation that management is behind all entrepreneurial initiatives and will go the extra mile to promote the expansion of such initiatives within the organisation.

Discretion of work: This focuses on the ability bestowed on employees to make their own choices in executing tasks within organisations, bearing in mind that failure will be more often experienced without the normal negative consequences directed towards employees.

Rewards: Remuneration of employees are done based on entrepreneurial actions undertaken by the relevant employee, considering the relevant risk of the action in question, as well as the success obtained through the action.

Time availability: Organisations ensure that employees have enough time available to pursue entrepreneurial opportunities, without negatively impacting on the normal deliverables expected from employees. Therefore, sufficient time is provisioned to ensure that employees have the ability to look for new opportunities within the organisation.

Organisational boundaries: Employees can work outside their normal work environment to get exposure to different aspects of the organisation but also to look at the functioning of certain aspects of the organisation with a new lens which might bring about more effective processes. Knowledge of employees also increases due to the exposure to other ideas and ways of thinking (Zahra, 2015).

The advantage to companies which aim to embed CE initiatives in their everyday operations, is the perception in the market that these companies are ready to evolve with changing environments, and to capitalize on new opportunities which in turn will have a positive impact on financial performance (Gcaza & Urban, 2015). Studies have also found that organizations which operate in, among others, unstable

environments will be best suited to focus on CE in their strategy formulation and execution (Gcaza & Urban, 2015).

2.2.1 Drivers of Corporate Entrepreneurship

CE is generally associated with an "action" i.e. a conduct displayed by organizations and its employees (Zur & Walega, 2015). Zur and Walega (2015) go further by highlighting three main factors which have been identified by past research to have a direct impact on CE occurrences:

Influences from outside organizations: The markets and general surroundings within which organizations find themselves in, have an impact on the drive within organizations to focus on CE activities, and to ensure that these activities are executed effectively. An example is organizations which operate in highly competitive markets with CE activities resulting in being the differentiator between competitors.

Inherent abilities of organizations: Organizations differ from each other on a number of aspects which will include resources, geographical footprints and size. All these differentiating factors have a direct influence on the CE abilities of organizations. An example is where an organization is regarded as a multi-national with operations across the world. This will give rise to exposure to different cultures and environments which will have a positive impact on new ideas and eventual CE occurrence.

Environment within organizations: This relates to drivers of CE which can be controlled internally. Organizations can introduce policies which they deem supportive to CE activities and therefore influence the level of CE occurrences. A further study on this was performed whereby it was found that internal communication processes within organizations are impacting on the realization of CE activities (Zur & Walega, 2015).

2.2.2 Manifestation of Corporate Entrepreneurship

In defining corporate entrepreneurship, Chrisman & Sharma (1999) have broken down the term into different components to illustrate the type of actions which can be regarded as CE activities. These actions will be discussed briefly below:

- *Innovation:* This is a well-known term which indicate the new application of something which already exists.

- *Strategic Renewal:* This relate to actions undertaken within organizations to change strategies, and also relationships between the organizations and external role players.

- *Internal Corporate Venturing:* This relate to the establishment of new organizations within the current organization. An example can be the creation of a new department.

- *External Corporate Venturing:* This relate to the establishment of new organizations outside of the current organization. An example can be the creation or the acquisition of a new subsidiary.

2.2.3 Corporate Entrepreneurship and Culture

The occurrence of CE activities within organizations are created and implemented by employees i.e. individuals occupying either very senior or very junior roles. Therefore, it is not an activity which is isolated to certain employees. It necessitates the creation of an CE supportive environment which will include all levels of employees in an effort to enhance their contribution to CE activities (Paunovic & Dima, 2014). The overall culture of an organization is therefore relevant in establishing this “ideal” environment.

The creation on an organizational wide culture with CE activities as an objective, has the benefit of installing direction to employees in executing CE activities whereby it is becoming integrated with their day to day activities (Paunovic & Dima, 2014). Less time is therefore spent in directing employees to display preferred characteristics supportive of CE activities.

2.2.4 Corporate Entrepreneurship and Performance

For organizations to focus on CE activities, there should be some benefit. Zahra (1991) performed a study whereby the relationship between profitability and CE activities were established. A similar study was also performed in the agricultural

sector of Iran (Daryani & Karimi, 2017). In both studies a relationship was established between CE activities and the performance of the relevant companies. In addition, studies has also found that entrepreneurial activities within organizations also contribute to increased competitiveness and a better outlook on being sustainable (Gcaza & Urban, 2015).

Kiss & Barr (2015) identified a categorisation scheme consisting of 15 areas which summarised the different types of actions in a organsition.

Marketing	Finance	New Products
Cooperative alliances	Competition/Competitiveness	Top management team changes
Human Resources	Capacity	Internationa
Firm's IPO	Structure	Restructruing
Service	Corporate Social Responsibility	Low cost/pricing

Table 1 – 15 Organisational areas (Kiss & Barr, 2015)

CE activity has also evolved into a key measurement consideration when the performance of companies is determined. Therefore, not only does CE activity have an impact on the performance of a business, the CE activity itself is being regarded as an indicator weather a company performs well or not (Umrani, Kura, & Ahmed, 2018). A reason why this perception holds truth is the fact that CE activity is regarded as a catalyst for innovation to take place in a company (Ahmed, Shah, Qureshi, Shah, & Khuwaja, 2018). Therefore, the presence of high levels of CE activity will result in benefits to the company through innovation occurrences. Comparing that to the mining sector in South Africa, innovation is a key enabler to restore confidence in the South African mining sector over the medium to long term, but also to provide short term benefits which will assist in overall investor confidence.

2.3 Integrated reporting

Integrated Reporting (IR) is a mechanism which companies use to report on a variety of matters to its various stakeholders. This reporting tool will be discussed considering the various areas involved.

2.3.1 Companies and its shareholders

Companies of which shares are being publicly traded are subject to several regulatory requirements when it comes to the communication of information to its shareholders and/or stakeholders. However, these companies have a vested interest in addition to the regulatory requirements: to effectively communicate its business activities, can assist with the creation of a favourable perception in the market, which can translate into a more favourable share price in comparison with competitors.

An important document which assist with this communication is the Integrated Report (IR) which comprises of financial and non-financial information. The purpose of this document is to demonstrate the value created by the company over a period of time, usually one year (Burke & Clark, 2016). Value in this context, does not only relate to value for shareholders, but also value for a wide range of stakeholders which include employees, the environment and the broader society (Dumay, Bernardi, Guthrie, & Demartini, 2016).

According to Burke and Clark (2016), the benefit of Integrated Reporting (IR) is not limited to the external users, but also to the internal understanding of what the company is doing and how it is creating value. Companies with shares traded in the public domain are usually quite large which means that focus on what the real value drivers are in the company might be lacking. Effective integrated reporting can assist with this and, as a result, bring about necessary change i.e. CE activities and innovation.

An added advantage of an effective IR process is the fact that investors with a longer-term view, are more likely to invest if the value proposition of the company is effectively communicated (Serafeim, 2015). Therefore, short term investors will not be tempted to invest as the opportunities to exploit short term gains which might only be realised through detailed analysis of information, is no longer possible due to information being presented clearly and effectively. An added advantage will be share price stability.

Dumay (2016) makes the argument that Integrated Reporting, although a step in the right direction, should focus more on the reporting of intellectual capital (IC) which

companies holds. IC, at its core, is the aggregate of all the information and knowledge which resides within a company. The benefit for companies which incorporates a larger focus on IC reporting, is the advantage to shareholders to better determine the possible performance of the company in future which includes benefits like a more favourable finance terms (Dumay, 2016).

2.3.2 Sustainability

Reporting by companies on their sustainability initiatives, might be seen as a deliberate action to improve the overall appeal of companies in the market as well as to its various stakeholders of which the adoption of IR activities is linked (Lai, Melloni, & Stacchezzini, 2016). However, Lai, Melloni, and Stacchezzini, (2016) further found that companies which adopted IR principles, already scored very high with regards to their sustainability reporting and therefore it cannot be seen as the primary reason for adopting IR practises. This however, is not to say that it is a global phenomenon.

In South Africa and China, a study found that an increase in reporting initiatives aimed at sustainability, the valuations of these companies where positively impacted while other countries such as Denmark did not show the same increase (Ioannou & Serafeim, 2017). In the case of South Africa, the positive impact on firm valuations might be as a result of the socio-economic conditions in South Africa, which includes a very high unemployment rate as well as high levels of inequality (Padayachee, 2019).

2.4 Event studies

The term event study relates to the methodology whereby movements in market indicators, such as the share price of a company, is monitored over a relatively short period from the occurrence of a specific event (MacKinlay, 1997). The period of impact can vary as some studies have even found that a specific event had a noteworthy positive impact up to one year after the specific event occurred (Ammann, Bauer, Fischer, & Müller, 2018).

The initiation of events can be internal, within the company, or in the external environment. Klassen and McLaughlin (1996) did work around this phenomenon

and found that external events such as a positive announcement about a company's environmental performance, had a positive impact on the company's share price.

More recently MTN, a telecommunication company, was subject to this principle of event studies when a fine of $5.2bn was imposed on MTN by the Nigerian government. This resulted in a significant share price decline of 12% after the fine was announced (Crasnic, Kalyanpur, & Newman, 2017). This scenario also confirms work done around negligent behaviour and the positive correlation it has to significant negative impact on the value for shareholders (Clement, 2005).

2.5 Efficient market hypothesis

Shares traded publicly on stock exchanges, such as the JSE, are extremely exposed to the theory of efficient markets (EMH) which dictates that any point in time, the share prices, or other publicly traded instruments, display a value which fully reflect the available information related to the instrument or share price (Fama, 1970; Fama, Fisher, Jensen, & Roll, 1969).

Based on this principle, the chance for outperforming the market is very limited as all the publicly available information is already factored into the share prices. If the market is outperformed, it must be viewed as a "glitch" (Bartos, 2015). This principle is however not proven in all circumstances.

Companies that issue information relating to events dealing with take-overs or dividend announcements, usually have share prices that fully adapt to this new information (Campanella, Mustilli, & D'Agnelo, 2016). It can be argued that the reason for this is due to the fact that these types of events are relatively easy to identify and are usually covered by the relevant media houses due to its high levels of relevance to investors, but also to society.

There are three forms of EMH which will be discussed briefly. The first, *weak efficiency*, accepts that share prices cannot be projected based on information of the past. Secondly, *semi-strong efficiency* takes the view that share prices include all information in the public domain. Lastly, *strong efficiency* assumes that share prices reflect all information in the public domain, together with internal (private) information (Vidal-Tomás & Ibañez, 2018).

In summary, the following conditions were identified as important for markets to function efficiently (Kumar & Jawa, 2017): no cost involved in share trading, information available to all, and a set view of what implications certain events will have on share price movements.

2.6 Conclusion

From the literature review, it is evident that CE is a concept which manifest in organizations in various forms. In addition, the occurrence of CE activities is depended on employees to execute. Lastly, the implementation of CE activities does not only positively impact on performance, but also on sustainability.

2.7 Research Question and Hypotheses

From the literature review, it is evident that CE activities can have a very positive impact on the internal operations of organisations, which in turn will have a positive outcome relating to performance. Therefore, it is a possible solution to ensure that all the problems facing the South African mining sector, are addressed effectively and therefore assist in increasing share prices.

Research Question 1:

What is the nature and role of corporate innovation activity in the SA mining sector?

Research Question 2:

How does CE activity in South African mining companies influence shareholder value, measured by the share price?

The valuation of share prices includes several external factors which companies do not have control over. However, all company related information used in the valuation of share prices, are disclosed by companies and therefore they have control of what gets presented to the external market.

Hypotheses:

There is a positive correlation between the magnitude of CE relating activities reported in Integrated Reports (IR) of mining companies, and the share price performance of these mining companies.

3. RESEARCH METHODOLOGY

3.1 Choice of methodology

The planned research is to be divided into two sections which build on one another. The first section will entail the measurement of CE activity within listed mining organizations. The second part will build on this by comparing the CE activity measured, to the share price performances of the various mining entities selected and to identify any relationships.

The two parts to the planned research, will follow a quantitative, deductive, explanatory, quasi-experimental research analysis. The quantitative methodology was based on the fact that the source information i.e. public communication by listed mining companies in the form of Integrated Reports, and share prices obtained from the JSE, are best suited with a quantitative approach.

From the literature review, the positive impact of CE activities within organizations came out strongly and therefore a deductive approach was deemed to be relevant to test this by focusing on CE information disclosed by listed mining organizations in their Integrated Reports, and the impact it might have on share prices.

A quasi-experimental research design was followed whereby the variables in the study, i.e. CE activity, was controlled and limited to that of listed mining companies and the impact it has on share price performance over a certain period of time.

A longitudinal study type will be applied as data will be collected from two sources, i.e. JSE share data and public data communicated by listed entities in their Integrated Reports, over a certain time period.

3.2 Population

The mining companies in South Africa selected for this research study, are made up of the five largest gold mining companies and three largest platinum mining companies on the Johannesburg Stock Exchange (JSE). Two factors were considered in selecting the relevant companies

3.2.1 Excluding the impact of commodity prices

Commodity prices have a significant influence on the share price performance of mining companies. Therefore, to exclude commodity price impacts, the relative performance of mining companies compared to the other companies in the same mining sector, needs to be determined. For this reason, only mining companies which formed part of the same sector was selected for this study i.e. gold and platinum sectors. To calculate the performance excluding commodity price movements, the average annual movement in share prices of companies in the same sector, was determined and then a deviation percentage from that average was calculated. The deviation percentage was regarded as the performance relative to peers which effectively excluded any commodity price movements.

Once the performance relative to pears were calculated per sector, the performance of all eight companies were compared against each other as the assumption was made that commodity price impacts were excluded; therefore, performance percentages relative to pears were influenced by other factors such as CE activity. These performances were then ranked from 1st to 8th place.

It is also for this reason, why mining companies which does not focus solely on a single commodity or group of commodities, were excluded as the impact of the underlying commodity prices would have skewed the results of the performance relative to peers.

3.2.2 Significance of the companies in the South African mining industry

The mining companies selected was based on the largest companies which have a significant presence on the JSE. For this reason, the five largest gold mining companies and three largest platinum companies were selected based on market capitalisation as at the end of 2018. These companies are the most relevant in their respective sectors and are regarded as the trend setters with regards to new technology, management principles and overall impact on the South African economy.

3.3 Unit of analysis

The unit of analysis for this study, is CE activities as identified from the various Integrated Reports of the mining companies selected, which will be used to determine CE activity. In addition, share price data of the selected mining companies on the JSE will be a second unit of analysis.

3.4 Sampling method and size

Purposive sampling will be applied whereby judgement will be used to determine the companies within the gold and platinum sectors in South Africa which will conform to the set requirement i.e. public available information, share price data and significance.

3.5 Measurement instrument

Two data sets will be included in the measurement activity:

- Occurrences of CE activity as identified from Integrated Reports as disclosed by mining companies; and
- Share price data.

The measurement of CE activity occurrences will be done based on a number of factors identified by Zahra (1991) which relate to predictors of CE activities (refer to Table 2).

External environment	Grand Strategy	Organization
• Dynamism • Hostility • Heterogeneity	• Growth • Stability	• Communication • Scanning • Integration • Differentiation • Control • Values

Table 2 – Predictors of Corporate Entrepreneurship (Zahra, 1991)

Equal weighting was given to the three main categories, and equal weighting was given to the sub categories (measured based on the number of occurrences over the time period covered). To ensure that all significant CE activities are identified in the Integrated Reports reviewed, the synonyms and other related terms was used in

addition to the predictors indicated in Table 2. In addition, Alonso and Bressan (2016) also identified a number of key words associated with innovation which were included in the set of "predictors" used for identifying CE activity (refer to Table 3).

Investment	Improvement	Adapting
Efficiency	Research	Technology
Updating	Develop	Technique
New		

Table 3 – Words associated with innovation (Alonso & Bressan, 2016)

In addition, the CE activities identified above was classified using the 15 categorisation areas as identified by Kiss and Barr (2015).

Share price data for the selected mining companies will be obtained from the JSE and the measurement of data will entail the movement of share prices over the selected periods expressed as an index.

3.6 Data gathering process

Data will be gathered from Integrated Reports as disclosed by listed mining entities in South Africa. This will include the identification of CE activities from the data gathered. The occurrences of CE activity will be identified by making use of *Adobe Acrobat Pro DC* whereby the various Integrated Reports will be searched using the predictors of CE activities. All activities will be highlighted and summarised in an Excel document after which additional reviews will take place to categorise the various items in the 15 categories. In addition, any duplications will also be clearly marked to not distort the total number of CE activities.

In addition, share price information will be obtained from the JSE for the selected mining companies.

Data was gathered across a six-year period. Although the Integrated Reports are formally released at the end of each financial year, the assumption is made that the necessary communication was given to the markets of any significant CE activities which could influence the share price throughout the year. Therefore, the Integrated

Report should influence the share prices over the period which it covers, and no lag period was factored in. The periods of data collections will be as follow:

- Identification of CE activities executed by the relevant mining entities from public available data: Financial Year (FY) 2013 – FY2018
- Obtaining share prices for the relevant mining entities: Start of FY2013 – end of FY2018.

3.7 Analysis approach

The share price performance of the various mining companies was calculated on an annual basis from the start of FY2013 to the end of FY2018. The share price movements will include the impact of changes to commodity prices. Therefore, the performance of mining companies in the same sector will be compared to establish who performed better than their peers. The mining companies will then be ranked from 1st to 8th place for each of the years under review.

The following analysis activities were performed.

3.7.1 Rankings vs number of CE activities

The first test done was to compare the rankings of the various companies in the various financial years, to the number of CE activities which took place in the relevant financial years. A Spearman correlation was done between the rankings of companies and the number of CE activities.

3.7.2 Rankings vs focus of CE activities

The various CE activities per financial year for each company were expressed as a percentage of the total number of CE activities to identify in which areas did the company spend most of their efforts. These focus areas were then correlated with the rankings achieved in each financial year. Again, a Spearman correlation was performed.

3.7.3 Rankings vs focus of CE activities per sector

The aim of this test, similar to the test performed in 3.7.2, was to establish if the focus areas of CE activity for each company, had any relationship with the share price rankings. However, this test was done per sector which meant the rankings were

adjusted to either exclude the companies in the gold sector, or companies in the platinum sector. A Spearman correlation was performed.

3.8 Quality controls

The focus will be on JSE listed companies who are required by the JSE listing requirements to report on several activities within the organization through the Integrated Reporting process. In addition to the listing requirements, companies are also compelled by regulatory structures to report on additional information which need to conform to certain standards and requirements.

3.9 Limitations

A limitation of the research to performed, is the small sample size as the focus will be on listed mining companies on the JSE within the same sector and exposed to a very specific commodity or commodity group, to exclude the impact commodity prices might have on the underlying share price.

In addition, share prices are impacted by several external factors. For this research study, only the impact of commodity prices and CE activities were considered when analysing share price performances.

Lastly, the identification process of CE activities in the various Integrated Reports, was a manual process whereby key words were searched, and the results reviewed as being a CE activity or not. Therefore, the risk remains that not all CE activities might have been correctly classified in the Integrated Reports or that not all CE activities were identified.

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APPENDIX A: AUTHOR GUIDLINES

*The following extract was obtained in its entirety from the Elsevier website (*https://www.elsevier.com/journals/business-horizons/0007-6813/guide-for-authors*).*

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Manuscripts should be prepared consistent with the following guidelines. Manuscripts which do not conform to these guidelines may be returned to the author(s) without review for reformatting.

1. Double-space, use a 12 point font with normal text spacing, and one-inch margins throughout the entire manuscript. Manuscripts should not exceed 25 pages, all-inclusive. We cannot, however, consider notes, briefs, or commentaries. All pages, save the title page, should include pagination. Page numbers should appear centered at the bottom of each page.

2. The first page of the manuscript should include the title of the manuscript and complete contact information for each author with author name, affiliation, full postal mail address, email address, telephone number, and fax number. The corresponding author should be clearly noted in the case of multiple authors.

3. The second page of the manuscript should include the title of the manuscript, an abstract of 150 to 200 words, and four to five key words or short phrases that accurately reflect the content of the manuscript. Abstracts should be designed to provide a comprehensive executive summary of the manuscript in a manner that draws the reader's attention.

4. The body of the text should begin on the third manuscript page. The manuscript text should begin with an introductory heading.

5. Incorporate headings and sub-headings throughout the manuscript to aid readability. First order headings should be centered and all capital letters. Second order headings should be centered and use both upper and lower case letters. Headings should be descriptive and informative, yet not standard academic style. For example, rather than use "Introduction", you might elect to use "Corporate Women: Another Look". The aim is to guide the reader with innovative and lively language.

Business Horizons relies on the APA (American Psychological Association) style of referencing. Authors should carefully document their work while at the same time judiciously select references. A complete list of references cited should appear at the end of the text, and preceding any tables, figures, or graphs. Only works cited in the manuscript should be included in the references section. The references should begin on a new manuscript page, with the heading REFERENCES appearing centered at the top of this page. We do not rely on footnotes or endnotes. Any full or partial with-in text quoted material should include the relevant page number(s) with the source citation (e.g., Author & Author, 2008, p.1). Please also note the use of ampersand for within text citations contained in parentheses. The following are examples of the APA referencing style. Please consult the *Publication Manual of the American Psychological Association,* Fifth Edition, ISBN 1-55798-790-4 or http://www.apastyle.org/elecref.html for further style guidelines.

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APPENDIX B: JOURNAL ARTICLE EXAMPLE

(Refer to next page)

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Fintech: Ecosystem, business models, investment decisions, and challenges

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KEYWORDS
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Online banking;
Real options

Abstract Fintech brings about a new paradigm in which information technology is driving innovation in the financial industry. Fintech is touted as a game changing, disruptive innovation capable of shaking up traditional financial markets. This article introduces a historical view of fintech and discusses the ecosystem of the fintech sector. We then discuss various fintech business models and investment types. This article illustrates the use of real options for fintech investment decisions. Finally, technical and managerial challenges for both fintech startups and traditional financial institutions are discussed.

1. Fintech: An introduction

Financial technology (fintech) is recognized as one of the most important innovations in the financial industry and is evolving at a rapid speed, driven in part by the sharing economy, favorable regulation, and information technology. Fintech promises to reshape the financial industry by cutting costs, improving the quality of financial services, and creating a more diverse and stable financial landscape ('The FinTech Revolution,' 2015). The technological developments in infrastructure, big data, data analytics, and mobile devices allow fintech startups to disintermediate traditional financial firms with unique, niche, and personalized services. According to PwC (2016), 83% of financial institutions believe that various aspects of their business are at risk to fintech startups. Due to fintech companies already having a significant impact on the financial industry, every financial firm needs to build capabilities to leverage and/or invest in fintech in order to stay competitive.

The growth of investment in fintech has been phenomenal. According to Accenture (2016a), global investment in fintech ventures in the first quarter of 2016 reached $5.3 billion, a 67% increase over the same period the previous year, and the percentage of investments going to fintech companies in Europe and the Asia-Pacific nearly doubled to 62%. Much of this increase in investment has come from traditional financial institutions. Traditional financial

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institutions invest in external fintech startups in the form of collaborative fintech ventures, as well as their internal fintech projects in hopes of leapfrogging fintech innovation and gaining a competitive advantage.

According to the annual fintech 100 report published by KPMG (2015), China and the U.S. are leading countries in fintech startups and companies. The fintech 100 companies in 2015 include 25 payments and transactions companies, 22 lending companies, 14 wealth management companies, and 7 insurance companies. Holland FinTech (2015) forecasts that approximately $660 billion in revenue may migrate from traditional financial services to fintech services in the areas of payments, crowdfunding, wealth management, and lending.

It is clear from the evidence that fintech is now well beyond the stage of hype and has become a major player in the financial world. In light of the urgent need to inform financial professionals of the significance of this disruptive innovation, in this article we will discuss the following topics. First, we introduce a historical view of fintech and presents the fintech ecosystem. We then discuss various business models and investment types. We illustrate the use of real options for fintech investment decisions. Finally, we identify and discuss six technical and managerial challenges for fintech startups and traditional financial institutions: investment management, customer management, regulation, technology integration, security and privacy, and risk management.

2. Emergence of fintech

Financial markets worldwide were profoundly affected by the internet revolution in the early 1990s, with one of the major effects being that it lowered costs for financial transactions. Technological advances driven by the internet revolution changed the face of the financial services industry and led to the development of electronic finance (e-finance). E-finance refers to all forms of financial services such as banking, insurance, and stock trading performed through electronic means, including the internet and World Wide Web. E-finance allows individuals or businesses to access accounts, transact business, and obtain information on financial products and services without being in physical contact with financial firms. Many e-finance business models emerged in the 1990s, including online banking, online brokerage services, mobile payment, and mobile banking. As with e-commerce, many of these changes have led to the downsizing and reduction of number in physical locations for banks.

The impact of internet technology has been especially obvious in the banking industry. Information-intensive and time-sensitive in nature, virtually every component of the banking business' value chain benefitted from an innovative utilization of web technologies. From the bank's point of view, potential benefits of online banking include lower operational costs, shorter turnaround time, real-time managerial information, smoother communication within the organization, more convenient interaction with existing as well as prospective customers, and the provision of value-added services such as access to professional knowledge in financial management (Nielsen, 2002; Sathye, 1999). Online stock trading is another example of e-finance. It minimizes its operating costs by processing every stock transaction online. It achieves competitive advantage by providing differentiated services at the lowest feasible transaction fees. Some online stock brokers provide their clients free access to high quality research reports developed by reputed financial research firms.

The growth of the smartphone user base in the mid-2000s facilitated the growth of mobile finance, such as mobile payment and mobile banking, which is an extension of e-finance. Financial institutions have allowed their customers not only to access bank account information, but also to make transactions, such as paying bills and remitting money, via their mobile device.

With the advances in e-finance and mobile technologies for financial firms, fintech innovation emerged after the worldwide financial crisis in 2008 by combining the e-finance, internet technologies, social networking services, social media, artificial intelligence, and big data analytics. Fintech startups differentiated themselves from traditional financial firms with personalized niche services, data-driven solutions, an innovative culture, and a nimble organization. While fintech is generally considered a threat to traditional financial firms, it also provides ample opportunities for these firms to gain a competitive advantage over competitors. Most major financial firms have begun taking fintech seriously and are developing strategies to compete, coexist, and collaborate with fintech startups.

3. Fintech ecosystem

To understand the competitive and collaborative dynamics in fintech innovation, we must first analyze the ecosystem. A stable symbiotic fintech ecosystem is instrumental in the growth of the fintech industry. Diemers, Lamaa, Salamat, and

Steffens (2015) suggested that entrepreneurs, government, and financial institutions are the participants in a fintech ecosystem. We have identified five elements of the fintech ecosystem:

1. Fintech startups (e.g., payment, wealth management, lending, crowdfunding, capital market, and insurance fintech companies);

2. Technology developers (e.g., big data analytics, cloud computing, cryptocurrency, and social media developers);

3. Government (e.g., financial regulators and legislature);

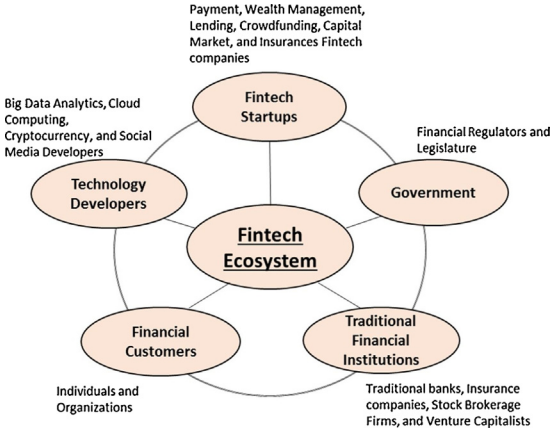
4. Financial customers (e.g., individuals and organizations); and

5. Traditional financial institutions (e.g., traditional banks, insurance companies, stock brokerage firms, and venture capitalists).

These elements symbiotically contribute to the innovation, stimulate economy, facilitate collaboration and competition in the financial industry, and ultimately benefit consumers in the financial industry. Figure 1 shows the five elements of the fintech ecosystem.

At the center of the ecosystem are fintech startups. These companies are mostly entrepreneurial and have driven major innovations in the areas of payment, wealth management, lending, crowdfunding, capital market, and insurances by incurring lower operating costs, targeting more niche markets, and providing more personalized services than traditional financial firms. They are driving the phenomenon of unbundling financial services, which has been highly disruptive for banks (Walchek, 2015). The ability to unbundle services is one of the

Figure 1. The five elements of the fintech ecosystem



major drivers of growth in the fintech sector, as traditional financial institutions are disadvantaged in this situation. Consumers, rather than relying on a single financial institution for their needs, are beginning to pick and choose services they would like from a variety of fintech companies. A consumer may manage his/her loan via SoFi, while using PayPal to manage payments, Rocket Mortgage for his/her mortgage, and Robinhood for stock management. Venture capitalists and private equities are conducive to the creation of fintech startups and the level of investments increased significantly over time as well.

Technology developers provide digital platforms for social media, big data analytics, cloud computing, artificial intelligence, smart phones, and mobile services. Technology developers create a favorable environment for fintech startups to launch innovative services rapidly. Big data analytics can be used to provide unique personalized services to customers and cloud computing may be used for cash-strapped fintech startups to deploy web-based services at a fraction of the cost of in-house infrastructure development. Algorithmic trading strategies can be used as the basis for robo-advisor wealth management services at much lower fees than traditional wealth management services. Social media facilitates the growth of communities in the crowdfunding and person-to-person lending services. The ubiquity of mobile devices supplants the advantages of physical distribution. Mobile network operators are also providing low cost infrastructure for fintech companies' service development, such as mobile payment and mobile banking. In turn, the fintech industry is generating revenue for these technology developers.

Governments have been providing a favorable regulatory environment for fintech since the 2008 financial crisis (Holland FinTech, 2015). Depending on the national economic development plans and economic policies, different governments provide different levels of regulation (e.g., licensing of financial services, relaxation of capital requirements, tax incentives) for fintech startups to stimulate fintech innovation and facilitate global financial competitiveness. For example, Singapore is changing online payment regulations to make the regulation friendlier to payment service providers and spur payment technology growth (Reuters, 2016). On the other hand, since 2008, traditional financial institutions have been subject to more rigorous regulation, capital requirements, and reporting requirements from government regulators. The looser regulatory requirements imposed on fintech startups allow them to provide more customized, inexpensive, and easy-to-access financial

services to consumers than traditional institutions. However, while certain regulations are favorable to fintech startups, they still need to understand how regulations may affect their service provisions. LendUp, a payday loan fintech company, was fined $3.63 million for violations of consumer financial protection laws, including the Truth in Lending Act and the Dodd-Frank Wall Street Reform and Consumer Protection Act (Consumer Financial Protection Bureau, 2016).

Financial customers are the source of revenue generation for fintech companies. While large organizations are important sources of revenue, the predominant revenue source for fintech companies are individual customers and small and medium-sized enterprises (SMEs). A survey found that the use of fintech services is greatest among younger, wealthier customers (Holland FinTech, 2015). Early fintech adopters tend to be tech-savvy, younger, urban, and higher-income individuals. Currently, millennials (people between the age of 18 and 34) constitute a significant portion of fintech consumption in most countries. The future demographic is favorable to fintech companies in that in the next few decades, the tech-savvy millennials will account for the largest part of the population and drive the growth of fintech services.

Traditional financial institutions are also a major driving force in the fintech ecosystem. After realizing the disruptive power of fintech and dwindling window of opportunities to blunt fintech's impact on the market, traditional financial institutions have been reevaluating their existing business models and developing strategies to embrace fintech innovation. Traditional financial institutions have competitive advantages in economies of scale and financial resources over fintech startups. However, traditional financial institutions tend to focus on bundled services, providing one-stop comprehensive financial products and services to consumers rather than unbundled specialized products and services. While traditional financial institutions initially treated these fast-growing fintech companies as threats, they have shifted their focus to collaborating with fintech startups with various funding provisions. In exchange for providing funding, they are able to draw on the insights of these startup companies in order to stay on the forefront of the technology (Yang, 2015).

4. Fintech business models

According to a recent report by Accenture (2016a), more than $50 billion has been invested in almost 2,500 companies since 2010, as these fintechs redefine the ways in which people store, save, borrow, invest, move, spend, and protect money. We identify six fintech business models implemented by the ever growing number of fintech startups: payment, wealth management, crowdfunding, lending, capital market, and insurance services. Their value propositions, operating mechanisms, and major fintech companies in each business model are discussed below.

4.1. Payment business model

Payments are relatively simple compared to other financial products and services. Fintech companies focusing on payments are able to acquire customers rapidly at lower costs, and are one of the fastest moving in terms of innovation and adoption of new payment capabilities. The two markets of payment fintechs are (1) consumer and retail payment and (2) wholesale and corporate payment. Payments are one of the most used retail financial services on a day-to-day basis, as well as one of the least regulated financial services. According to BNY Mellon (2015), consumer and retail payment fintechs include mobile wallets, peer-to-peer (P2P) mobile payments, foreign exchange and remittances, real-time payments, and digital currency solutions. These services improve the experience for customers who look for a streamlined payments experience in terms of speed, convenience, and multi-channel accessibility.

Mobile payment services that can be conveniently and securely used on mobile devices are a popular business model. Approaches to mobile payments include but are not limited to: charging to a phone bill, near field communication (NFC), barcode or QR code, a credit card on mobile websites, a mobile phone card reader, and direct mobile payment without using credit card companies (Li, 2016). The most widely known NFC-based mobile payment applications are Google Wallet, Apple Pay, and Samsung Pay. Another popular payment business model is P2P payment services. Users are now able to reimburse each other with apps such as PayPal and Venmo for free.

4.2. Wealth management business model

One of the more popular wealth management fintech business models is automated wealth managers (robo-advisors) that provide financial advice for a fraction of the price of a real-life adviser. These robo-advisors use algorithms to suggest a mix of assets to invest in based on a customer's investment preferences and characteristics ('Ask the Algorithm,' 2015). This business model benefits

from changing demographics and consumer behavior that favor automated and passive investment strategies, a simple and transparent fee structure, and attractive unit economics that allow low or no investment minimums (Holland FinTech, 2015). A survey by the CFA Institute in April 2016 found the majority of survey participants to be most concerned about the disruptive characteristics these fintech companies would have in the wealth management sector (Sanicola, 2016). Wealth management fintechs include Betterment, Wealthfront, Motif, and Folio.

4.3. Crowdfunding business model

Crowdfunding fintechs empower networks of people to control the creation of new products, media, and ideas and are raising funds for charity or venture capital (International Trade Administration, n.d.). Crowdfunding involves three parties: the project initiator or entrepreneur who needs funding, the contributors who may be interested in supporting the cause or project, and the moderating organization that facilitates the engagement between the contributors and the initiator. The moderating organization enables the contributors to access information about the different initiatives and funding opportunities for the development of products/services.

Rewards-based crowdfunding, donation-based crowdfunding, and equity-based crowdfunding are the most popular crowdfunding business models. Rewards-based crowdfunding has been an attractive fundraising option for thousands of small businesses and creative projects. In the event that there is any interest to be charged on the amount of the rewards-based crowdfunding, the borrower sets the interest rate that they are comfortable with and can guarantee a refund within the stipulated time period (Mollick, 2014). In return for a fund from supporters of a project, the business typically gives some type of rewards. Donation-based crowdfunding is a way to source money for a charity project by asking donators to contribute money to it. In a donation-based crowdfunding, the funder receives nothing at all other than some form of non-monetary recognitions. Equity-based crowdfunding is an appealing option for small and medium-sized companies (SMEs) as increased capital ratio requirements on traditional banks make lending to SMEs less prioritized by the traditional banks. Equity-based crowdfunding allows entrepreneurs to reach investors interested in acquiring equity in their startup or other privately held small business.

The essential difference between equity-based crowdfunding and other crowdfunding types is that in equity-based crowdfunding, fund-seeking entrepreneurs give up a portion of the ownership in exchange for the funds. Examples of reward-based crowdfunding companies include Kickstarter, Indiegogo, CrowdFunder, and RocketHub. Donation-based crowdfunding companies aimed at fundraising for charitable causes include GoFundMe, GiveForward, and FirstGiving. Equity-based crowdfunding companies include AngelList, Early Shares, and Crowdcube.

4.4. Lending business model

P2P consumer lending and P2P business lending is another big trend in fintech. P2P lending fintechs allow individuals and businesses to lend and borrow between each other. With their efficient structure, P2P lending fintechs are able to offer low interest rates and an improved lending process for lenders and borrowers. A subtle but significant distinction from a bank is that these fintechs are technically not involved in the lending themselves, as they are simply matching lenders with borrowers, and collecting fees off of users. Because of this distinction, P2P lending fintechs currently do not need to meet the capital requirements that influence the total amount of lending, while banks have become more and more limited in the lending they are engaged in (Williams-Grut, 2016).

The fintech innovation in lending manifests itself in the use of alternative credit models, online data sources, data analytics to price risks, rapid lending processes, and lower operating costs. However, the success or failure of this business model is largely dependent on how interest rates behave, something that firms do not have any control over. P2P lending and crowdfunding are different in purpose. While the primary purpose of crowdfunding is funding for projects, the primary purpose of P2P lending is debt consolidation and credit card refinancing (Zhu, Dholakia, Chen, & Algesheimer, 2012). Lending fintechs include Lending Club, Prosper, SoFi, Zopa, and RateSetter.

4.5. Capital market business model

New fintech business models take hold across a full spectrum of capital market areas such as investment, foreign exchange, trading, risk management, and research. One area of promising capital market fintech is trading. Trading fintechs allow investors and traders to connect with each other to discuss and share knowledge, place orders to buy and sell commodities and stocks, and monitor risks in real time. Another area of capital market fintech business models is foreign currency transactions. Foreign currency transactions have been a service

dominated by financial institutions. Fintechs lower barriers and costs for individuals and SMEs engaging in foreign currency transactions all around the world. Users are able to see live pricing and send/receive funds in various currencies securely in real time, all via their mobile device. Fintechs offering this service are able to do so at a much lower cost, via payment methods that are much more familiar to individual clients or businesses. Capital market fintechs include Robinhood, eToro, Magna, Estimize, and Xoom.

4.6. Insurance services business model

In insurance fintech business models, fintechs work to enable a more direct relationship between the insurer and the customer. They use data analytics to calculate and match risk, and as the pool of potential customers broadens, customers are offered products to meet their needs (e.g., car, life, healthcare, or causality insurance). They also streamline healthcare billing processes. The insurance fintech business model seems to be the most well-embraced by traditional insurance providers. The technology allows insurers to expand their data collection to non-traditional sources to supplement their traditional models, improving their risk analysis. Insurance services fintechs that are disrupting the insurance industry include Censio, CoverFox, The Zebra, Sureify Labs, and Ladder.

5. Investment decisions for fintech projects and real options

On June 30, 2016, J.P. Morgan's Corporate & Investment Bank announced the launch of the In-Residence Program for fintech startups to work side-by-side with its employees in order to develop innovations that enable banks to operate faster, safer, and at a lower cost. This type of incubator program is one of many approaches to fintech developments by financial institutions. Our brief survey reveals that traditional financial institutions are investing in fintech in a variety of ways, including (1) partnering with fintechs or technology companies, (2) outsourcing fintech services from fintechs, (3) providing venture capital to fintechs, (4) incubating/accelerating fintech startups, (5) acquiring/buying fintechs, and (6) developing internal fintechs. In general, financial institutions are going to take an immediate investment or a wait-and-see approach to the above-mentioned investment options based on the volatility and project duration of the specific fintechs.

In order to grow businesses and secure venture capital, fintech startups can choose to compete with the traditional financial institutions or to collaborate with them. According to Accenture (2016b), overall U.S. fintech investment favors collaborative ventures, with the volume of collaborative investment increasing from 21% in 2010 to 35% in 2015. On the other hand, in Europe, investment in collaborative fintech declined from 38% of deals in 2010 to 14% of deals in 2015. These opposite trends may be attributable to the different banking regulations in these regions. When the regulation is favorable for new startups to establish their business, they tend to be less collaborative with established institutions.

6. A real options approach

To value the technology projects more appropriately, a real options approach has been suggested. In this section, we discuss how real option valuation can be used to develop traditional financial institutions' fintech projects. A real option approach with an option to wait for technology project investment was explained by Lee and Lee (2015). While traditional net present value (NPV) without real options thinking has been widely used, it ignores flexibility in investment such as deferment and expansion in the investment horizon. Therefore, NPV tends to undervalue a project's worth with a higher discount rate, and is not suitable for highly uncertain, risky technology projects. Since many fintech projects are experimental and being developed in highly fluid economic and regulatory environments, real options may be an appropriate evaluation method.

Similar to financial options, real options are the right, but not the obligation, to take an action such as 'wait,' 'expand,' and 'abandon' during a period of time or by an expiration date. There are characteristics that make real options an appropriate application for fintech projects. Fintech projects inherently carry technical as well as economic and regulatory uncertainties. The potential regulatory intervention is a big factor in the growth rate of the fintechs. Real options applicable to fintech projects include: (1) option to defer, which gives management the option to wait/learn more to see if a project will be profitable; (2) option to expand, which gives management the option to invest more in a project that is profitable; (3) option to abandon, which gives management the option to abandon a project that is operating at a loss and sell or redeploy the assets; and (4) option to contract, which gives management the option to scale

back a project that is operating at a loss. For example, if a fintech market test suggests that customers are far more receptive to a new fintech service than expected, the firm can use the pilot fintech service as a basis for expanding the scale of the service.

Values of real options for projects can be calculated using the Black-Scholes model (Black & Scholes, 1973) and the binomial option pricing model (Cox, Ross, & Rubinstein, 1979) if the estimates of the underlying asset's value and variance are obtained. However, the use of these financial option pricing models is usually not possible for fintech projects due to the lack of reliable market data and possibly one-of-a-kind project nature that is not traded. Furthermore, for financial options, the buyer and the seller of the option are different entities. For example, a European call option is traded in the options market between a seller and a buyer of the option. A buyer pays the value of the option as an option price (or as an option premium) in exchange for the right to exercise the call option on the expiration data. The price of the option is for risk protection and it is difficult for an option buyer to make any extra return (e.g., profit) over the expected market return. While some type of real options such as patent and license to drill oil wells may involve sellers and buyers, for real options for internal development—such as R&D and technology development projects—the option buyer and seller are the same entity. When the same entity plays the role of both the seller and buyer of the real option, any returns accrued from the investment belong to the investor.

For real options, using decision trees is recommended, as it allows the ability to set up the possibilities of the project according to what management believes it to be or data obtained from simulations. Furthermore, decision trees are more intuitive to decision makers, and solutions can be framed flexibly and realistically without confined assumptions of other real option pricing models. Smith and Nau (1995) studied decision tree analysis and standard binomial lattice-based option pricing methods and showed that the two methods yield the same results, as long as the risk level is correctly specified throughout the decision tree.

Using decision trees to calculate the value of projects, one can stage the possible values a project can take, exercise the option at the optimal time/value of the project, and discount backwards in order to find the value of the option. In the following, we give an example of using the decision tree with a 2-period expansion option. In a decision tree, we begin with the starting value today, S_0, and move forward 1 period. The value can either increase to S_u, or decrease to S_d. We can use the risk-free rate, r, and determine the probability of success/move-up (p) and failure/move-down (1-p). An early example of this type of binomial decision tree approach was a binomial lattice model developed by Cox et al. (1979), which depicts two possible changes in value for a stock in each time period, a move up by a factor *u* or a move down by a factor *d*. These factors, *u* and *d*, and move up probability and move down probability are derived in closed-form solutions.

6.1. A real options decision tree example

For example, one bank is looking to invest in a new P2P lending fintech project that will add additional revenue and increase profits. To value the expansion options, as suggested by Copeland and Antikarov (2003), we use the present value of the project without options as the underlying asset for the options. Management assumes the following for the investment evaluation without real options:

1. The fintech project will generate a cash flow of \$100 million at T_0.

2. The initial investment for the fintech project is \$330 million at T_0. The initial investment will be sufficient for the maximum market growth potential of the project.

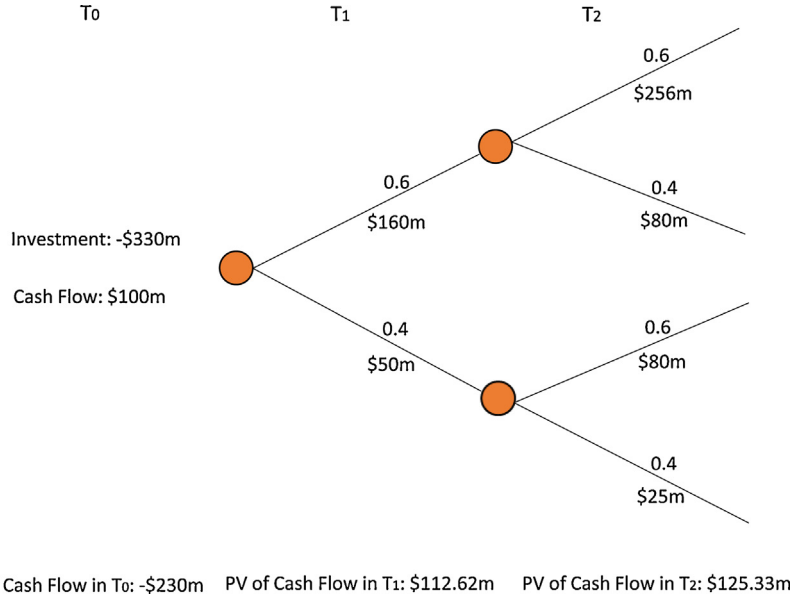
3. The expected annual growth rate is 16%. At each period, the cash flow will go up by 60% with a probability of 0.6 and the cash flow will go down by 50% with a probability of 0.4.

4. The annual discount rate is 3%. For simplicity and comparison purposes, we assume discount rates with real options and without real options are same. In reality, the risk-free discount rate for real options should be much lower than the discount rate for a project without real options.

5. There are two periods (T_1 and T_2) in the decision horizon for this project. After the project expires at the end of T_2, the project does not have any value and a new fintech project will take over.

Figure 2 shows a decision tree without real options and Table 1 shows the summary of the present values generated from the investment evaluation. From a simple NPV calculation, the value of the project is \$7.95 million, which the standard NPV would accept. However, for the bank, many proj-

Figure 2. A decision tree without real options



ects compete for a limited budget and therefore a positive NPV does not guarantee the acceptance of the investment plan. Next, we explore a real options approach to evaluate this investment as an expansion option. The option to expand is set up as follows:

1. At the beginning, there is a $110 million investment for the initial cash flow of $100 million.

2. If the first period has up to $200 million in cash flow, $110 million is invested to expand. If the cash flow is below $100 million, no option to expand is exercised.

3. If the second period has up to $300 million in cash flow, $110 million is invested to expand. If the cash flow is below $200 million, no option to expand is exercised.

Figure 3 shows a decision tree with real options. Table 2 shows that the net present value of the investment with real options is $126.54 million. However, note that value of option is $118.59 million, since the bank needs to take into consideration the NPV of the investment without real options (i.e., $126.54 million−$7.95 million). In this example, we did not consider extra cost which might occur to incorporate flexibility for expansion. As long as the extra cost for flexibility for incremental expansion is less than $118.59 million, the real option investment approach would be beneficial for the bank.

In the fintech industry, some external variables, such as government regulations and technology development, are quite uncertain and their changes will have significant impact on the growth and profitability of fintechs. Currently, national regulations are very favorable for fintech startups, in part because governments do not want their fintech sector to get behind in the global financial market. However, if fintechs threaten the health of domestic and global financial markets, strong regulations will be introduced and the profits of fintechs will decline significantly.

The decision tree-based real option model requires estimates for the parameters. These estimates can be obtained from experts and various Delphi methods can be used to obtain the

Table 1. Net present value without real options

	Expected Cash Inflow in Present Value	Investment without Real Options (Cash Outflow)	Net Present Value
Period 0	$100m	$330m	
Period 1	$112.62m [i.e., ($160m * 0.6 + $50m * 0.4)/1.03]		
Period 2	$125.33m [i.e., ($256m * 0.36 + $80m * 0.24 + $80m * 0.24 + $25m * 0.16)/(1.03 * 1.03)]		
Total Period	$337.95m	$330m	$7.95m

Figure 3. A decision tree with real options

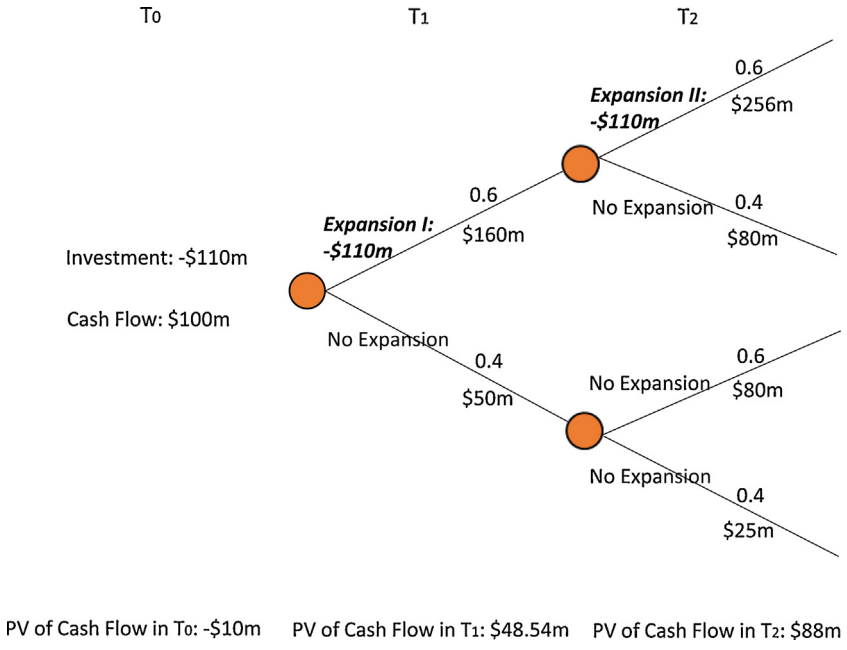


Table 2. Net present value with real options

	Expected Cash Inflow in Present Value	Investment with Real Options (Cash Outflow)	Net Present Value
Period 0	$100m	$110m	
Period 1	$112.62m [i.e., ($160m * 0.6 + $50m * 0.4)/1.03]	$64.08m [i.e., ($110m * 0.6)/1.03]	
Period 2	$125.33m [i.e., ($256m * 0.36 + $80m * 0.24 + $80m * 0.24 + $25m * 0.16)/(1.03 * 1.03)]	$37.33m [i.e., ($110m * 0.36)/(1.03 * 1.03)]	
Total Period	$337.95m	$211.41m	$126.54m

estimates. While this example was simplified for readers who are not in finance area, more complicated scenarios can be analyzed with the same principles. Our example highlights the value of the real option approach to fintech projects.

7. Challenges facing the fintech sector

Currently, the financial industry is experiencing unprecedented change. A wide range of traditional banking products from payments to investment advice are being challenged by innovative fintech products. Blockchain technology is revolutionizing many traditional banking services with better transaction security and faster exchanges of money at lower costs domestically and globally. Fintech innovation has the ability to shake up the entire financial landscape in the coming years. As with any disruptive innovation, the disruptive power of fintech innovations will manifest themselves clearly as the market evolves. This section discusses six challenges facing both fintech startups and traditional financial institutions in this time of disruptive innovation: investment management, customer management, regulation, technology integration, security and privacy, and risk management.

7.1. Fintech investment management challenge

The ability to assess the value of projects accurately will be critical in an increasingly competitive business environment. Without a proper portfolio management of fintech projects, financial firms can get easily swamped in the plethora of fintech technologies. The selection of promising fintech projects is challenging. It is still early to predict the best portfolio of fintech projects that will deliver the most competitive and profitable outcomes. Financial institutions may choose to invest in internal fintech projects in competition with fintech startups. Alternatively, financial institutions can use collaborative investments with fintech startups as

a means of remaining on the cutting edge of the technology without requiring internal innovation. For example, a fintech startup may invest in a robo-advisor fintech. The fintech startup can benefit from the financial institution's expertise in modeling and analysis, while the financial institution can gain insight into what kind of fintech services clients are looking for, as well as the cost structure and revenue streams.

7.2. Customer management challenge

As competition is high for customer acquisition and retention, customer management is crucial. Many customers use multiple services from different fintech firms for different needs. For example, customers may use PayPal for paying businesses online, while using Venmo for paying friends. Fintechs need to understand the niche they are in and strive to provide the best possible service in that niche. High responsiveness and care to customer concerns is paramount, as word-of-mouth recommendations can be crucial for the success of a fintech startup in this fast-paced environment.

Robo-advisors are designed to provide more personalized 24/7 service to a greater number of people with low fees. However, the human element is still important in investment services. Providing a personalized experience without a significant cost increase is challenging, but critical for customer acquisition and retention. As the clients from Generations X and Y are more tech-savvy, fintechs need to better address customer needs by offering enhanced accessibility, convenience, and tailored products. It will be more important to have an integrated client service management due to the addition of fintech-based channels.

7.3. Regulation challenge

Both traditional financial institutions and fintech startups face regulatory challenges in capital requirements, anti-money laundering, and privacy and security. For traditional financial institutions, the cost to meet regulatory requirements and compete against fintech startups can be significant. Traditional financial institutions and fintech startups face different regulatory requirements based on the type of financial services they provide. For example, most banks operate on some form of fractional-reserve banking system. There are strict and complex guidelines for what kind of lending can be done based on the capital held by a traditional financial institution that may not apply to a lending fintech startup that does not technically lend (e.g., a P2P lending firm). As regulatory changes lag behind the innovation of the industry, fintech firms need to be aware of potential changes that may impact them and find ways to handle those changes.

7.4. Technology integration challenge

Technology integration is essential in providing seamless customers service. Many fintechs are based on new technologies, and it is challenging to integrate the fintech applications with existing legacy systems. In addition to the internal development of fintechs, banks need to create partnerships and joint ventures with fintech startups via corporate venture funds and incubator programs (Drummer, Jerenz, Siebelt, & Thaten, 2016). These partnerships and joint ventures will allow traditional financial institutions to have a stake in an external source that will focus on new fintech technology. However, without a sound integration plan and experience, traditional banking processes in many areas may become incompatible with new technology and business models that the financial institutions are interested in utilizing.

7.5. Security and privacy challenge

In March 2016, the Consumer Financial Protection Bureau (CFPB) settled its first data security enforcement action against Dwolla, a Des Moines-based online payment processing company. The CFPB found the company's representations to customers about its cybersecurity misleading. Dwolla agreed to pay a $100,000 penalty and take certain steps to improve its data security practices for the next 5 years as part of a consent order that the CFPB issued (Hayashi, 2016). Other government regulators that have been involved in privacy and security action include the Securities and Exchange Commission (SEC), the Department of Justice (DOJ), the Financial Industry Regulatory Authority (FINRA), Commodities Futures Trading Commission (CFTC), and state attorney generals.

For fintech applications, critical information may be stored on mobile devices that oftentimes get lost or stolen. Security of mobile devices can also be compromised through payment applications such as Google Wallet and MasterCard PayPass. As consumers can easily file complaints related to data security and privacy breaches to regulatory agencies, fintech companies need to develop appropriate measures to protect sensitive consumer data from unauthorized access. Furthermore, as trust plays an important role in the adoption of new technologies, it is in the fintech's best interest to maintain security and privacy as one of its top priorities. It is expected that regulatory agencies, consumer

protection organizations, and fintechs keep working together to make fintech services a secure and value-adding experience for consumers.

7.6. Risk management challenge

There are many risks for fintech startups to deal with, including financial risk as well as regulatory risk, as mentioned above. The financial risk can vary based on what exactly the fintech specializes in. For example, a fintech offering financial services for student loans or mortgages may face counterparty risk that can be absorbed by a financial institution with large amounts of capital that a smaller startup would not be able to cover. Deploying robo-advisors for the wealth management of bonds, treasury bills, and stocks may expose customers to financial risk and the fintechs may have to take potentially serious responsibilities for any loss due to the algorithmic failure of the robo-advisors. Recent lawsuits and a number of settlements arising from the faulty sales of derivative products by top-tier banks indicate that fintechs will not be immune to the liability arising from robo-advisors' faulty investment advices.

Overall, it is crucial for fintechs to have a focus on risk management in addition to the technology management of the firm. As many fintechs were created after the 2008 financial crisis, they need to fully understand their exposure to liquidity risk, as well their interest rate risk. The present lending environment is vastly different from before due to the current ultra-low interest rate environment in the financial market, so it is important for fintechs that are involved in lending to recognize how the current lending environment will impact them.

8. Summary

Because fintech is such a recent development, there is still a paucity of studies on the social, regulatory, technological, and managerial aspects of fintech. This makes it very challenging for financial firms to make informed decisions in regard to the investment in fintech projects. This article is one of the first studies to develop a high-level architectural view of the fintech sector. We presented five elements of the Fintech ecosystem and discussed six fintech business models before explaining the real options approach. Finally, six challenges facing the fintech sector were discussed.

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