

Dynamic Roles of Digital Currency

An Exploration from Interactive Processes: Difference, Time, and Perspective

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DYNAMIC ROLES OF DIGITAL CURRENCY - AN EXPLORATION FROM INTERACTIVE PROCESSES: DIFFERENCE, TIME, AND PERSPECTIVE

PhD Series 33.2022

Xiaochun Guo

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AN EXPLORATION FROM INTERACTIVE PROCESSES: DIFFERENCE,
TIME, AND PERSPECTIVE

Department of Management, Politics and Philosophy

PhD Series 33.2022

CBS  COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

Dynamic Roles of Digital Currency

- An Exploration from Interactive Processes: Difference, Time, and Perspective

PhD Dissertation

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Acknowledgment

I have to start with an old saying, that time flies so fast. It is not just one sentence, but a true feeling after I have been through all these years of my PhD time, accompanied by the changing world after the shock of COVID-19. During these years, I have been through many unforgettable moments. The time I spent in Copenhagen Business School was not long, but this experience does have very persistent and deep impact on my life.

I would like to thank greatly to my supervisor Professor Lars Bo Kaspersen. We had many interesting discussions and inspiring talks. He has opened a new research territory for me- a more sociological and political angle to observe the phenomenon. This is a new lens for me to understand the unknowns and observe the world. And you have been all the time very encouraging and motivating, which gave me so much confidence when I was in doubt about myself. Moreover, you also gave me plenty of support during the time I was alone in Copenhagen. Without this help, I would encounter so many more difficulties that I probably could not be able to solve.

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I would also thank my friends who have shared the moment with me during these years. Life would be so dull without you. You are the “painters” of my life to lit up interesting and exciting memories. Many friends have shared their happiness and sadness with me, and we have been supporting each other along the way. Hope we can see each other often in the future, just like when we were young.

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Guo Xiaochun

Nanchang, China

March 27, 2022

Abstract

Digital currency has emerged as a new phenomenon that brought about many technological innovations and social-economic implications. In the last decades, the growing popularity of digital currency, particularly cryptocurrency, has attracted attention from various parties. The multiple facets of cryptocurrency induce controversial debates. So far, there is no mutual agreement on how to perceive, use and govern digital currencies globally, and there are huge divergences in ways of treating them. This new emerging phenomenon is gradually mixing and eroding the existing mechanisms. Meanwhile, the existing system is experiencing incremental changes to adapt to the newness brought forward by digital currencies. In order to understand such dynamic and complex processes of digital currency growth, this dissertation investigates the different roles of digital currency, particularly cryptocurrency, during its development path through the interactions with existing systems. This thesis aims to follow the development of (crypto)currency from the past to the present and extend the present development into future projection to explore the relationships between the existing mechanism and (crypto)currency.

In this dissertation, I draw upon various theories of money to analyze digital currency and applied both qualitative and quantitative methods to explore the dynamic roles of digital currency. First, this thesis uses rich archive data to give a thick description of the evolution path of cryptocurrency through horizontal comparisons between the Western world¹ and China. Second, this thesis combines second-hand and first-hand data to conduct vertical analysis, which integrates the past, present, and future standing points to consider the relationships and interactions between the internal fundamentals and external environments of digital currency. Additionally, empirical data have also been employed to explore the patterns and market dynamics of cryptocurrency evolutions.

In this thesis, I describe and analyze the different roles of digital currency, particularly cryptocurrency over time through the interactive process through various lenses. The roles of

¹ “The Western World” is no longer a self-evident term. In e.g. security-policy, NATO members are the “Western World”, When it comes to monetary and currency we regard the Bretton Woods countries (USA and Western Europe) as the “Western World”.

digital currency experienced from an alternative payment method of monopolized money, to financial assets in the financial market, and to the instrument of the state as a new medium of exchange. The roles of cryptocurrency show great complexities due to its diverse dimensions of design and applications, which have also been evolving gradually. Cryptocurrency encompasses many different dimensions. Some of them create tensions, but others bring opportunities for innovation. In order to explore the maximum potential of cryptocurrency, actors tried to co-evolve with the changes and balance risks and opportunities through dynamic interactions. The way to exploit and govern cryptocurrency show great divergences in different regions.

This dissertation has made the following contributions. First, contribution on a novel research perspective. This thesis provides a holistic description and comparison of cryptocurrency evolution both vertically and horizontally from multi-dimensional actors and time angles. The analysis not only offers understanding of how and why cryptocurrency emerges in different contexts, but also shows the divergences in considering, managing, and governing cryptocurrencies in different backgrounds. Second, theoretically, this thesis contributes to the existing literature of cryptocurrency. Through detailed analyses of the interactions between cryptocurrency and the external environment, this thesis enriches the understanding of cryptocurrency development, governance, and interrelationships with other actors. Third, as for empirical contributions, this research provides new evidence to understand the market dynamics of cryptocurrency in different periods, which helps to better explore the roles of cryptocurrency as a financial instrument. Fourth, for methodology contribution, this thesis breaks the limitation of most existing cryptocurrency research with one single method in this field. The thesis combines quantitative and qualitative research methodologies, including empirical studies, case studies, and theoretical analysis. Mix method offers this research wider knowledge foundations and different dimensional understandings.

Dansk Abstrakt

Fremkomsten og udviklingen af de “nye” digitale valutaer er dels resultatet af teknologiske innovationer og dels producerer de digitale valutaer selv nye teknologiske innovationer men også en række socio-økonomiske konsekvenser, hvoraf størstedelen er utilsigtede.

I de sidste to årtier ser vi en stærkt stigende interesse for digitale valutaer – her især krypto-valutaer – og denne interesse kommer fra mange forskellige sider (den almindelig befolkning, den finansielle sektor, valutaspekulanter, staten, de statsejede virksomheder m.fl.). Krypto-valutaens radikalitet og mange facetter har ført til en række kontroversielle diskussioner i Kina. Der findes ingen gensidig eller fælles forståelse eller tolkning af krypto-valuta-fænomenet og dermed heller ikke en fælles forståelse for hvordan vi skal opfatte, anvende, producere og styre digitale valutaer nationalt og især globalt. Vi er vidner til, hvordan dette nye fænomen udvikler sig ved at benytte sig af eksisterende praktikker og mekanismer men også ved at innovere og konstant optage nye ideer og erfaringer, som utilsigtet nedbryder det grundlag og de eksistensbetingelser, der var grundlaget for at krypto-valutaerne kunne udvikle sig 'in the first place'. Men kompleksiteten er næsten ustyrlig, da der samtidig sker en inkrementel forandringsproces, som medfører at de radikale valutaer også formår at tilpasse sig de eksisterende strukturer. For at få en lidt dybere indsigt i disse meget dynamiske og komplekse processer skabt af den pludselige vækst i krypto-valutater undersøger denne afhandling en række af de udfordringer, som de digitale valutaer møder på sin udviklingssti i interaktion med og møder med det eksisterende system af især reguleringsmekanismer. Afhandlingen sigter på at følge udviklingen af krypto-valuta frem til i dag og afslutningsvis antyde nogle fremtidsperspektiver ved at undersøge forholdet mellem de eksisterende reguleringsmekanismer og krypto-valutaen.

中文摘要

在近十几年中，随着全球金融科技的迅速发展，数字货币逐渐走入大众视野，带来了技术创新和社会经济变革，同时也在多个维度引起了具有争议性的讨论。目前在全球范围内尚未对数字货币的使用方式、治理方案、管理途径等方面达成共识，各国对待数字货币的态度也存在一定分歧。现存系统和数字货币的关系是动态的、是相辅相成的。数字货币的出现逐渐影响着当下体系，包括金融系统、治理结构、社会关系等。同时，现有体系也在逐渐通过边际调整去适应数字货币所带来的变化。为了探究数字货币演变中动态和复杂的过程，本论文从多个视角研究了数字货币发展过程中的不同角色，以及与现有体系之间的相互作用。论文旨在跟踪（数字）货币的演变历史，并将其发展趋势延伸到对未来的预测中，探索现有体系与数字货币之间的动态关系。

论文以多种货币理论为基础，结合定量和定性的方法对数字货币的动态角色变化进行研究。首先，论文利用丰富的档案数据，详尽的横向比较了欧洲和中国数字货币的演化路径。其次，结合现有资料及一手数据，通过纵向分析整合数字货币的过去、现在和未来，从其自身特性和外部环境的影响变化出发，研究了数字货币与现存系统之间的关系及治理。最后，文章采用实证数据来探索数字货币的实际角色演变和金融市场动态变化。

本论文探究了数字货币多个维度的动态角色。数字货币经历了从垄断货币的替代支付方式，到金融市场中的金融资产，再到作为新的交易媒介、国家治理工具等角色变化。数字货币的角色由于其设计和应用的不同，以及其与外界的新交互模式，表现出极大的复杂性，并且一直在不断发展变化。数字货币的多面性给现存系统带来了巨大的风险和挑战，同时也带来了新兴机遇和技术创新。现存系统中的各个参与者通过不断地动态调节变化与数字货币发展共同演化，进而来权衡数字货币发展中的风险与机遇，探索数字货币的创新潜力。

本文的创新点主要体现在四个方面。首先，在研究视角上，本文从多维差异、视角和时间层面对数字货币纵向和横向的演变进行了整体描述和对比分析。该分析不仅对数字货币在不同背景下出现的方式和原因进行了阐释，而且突出了数字货币在治理和使用中的多面性。第二，在理论上，本文为数字货币治理研究提供了新的理论基础。通过理论分析和案例研究，论文详细分析了数字货币与外部环境的相互作用关系，并提出了相应的治理框架。第

三，在实证上，本文丰富了数字货币在金融市场中的动态变化认识，进一步对更好发挥数字货币的金融属性提供了基础。第四，在方法上，本文突破了现有文献单一研究范式的局限，采用多种研究方法，包括定量和定性的方法，结合实证、案例和理论分析，对数字货币的角色演化进行了判断、分析及机制研究。

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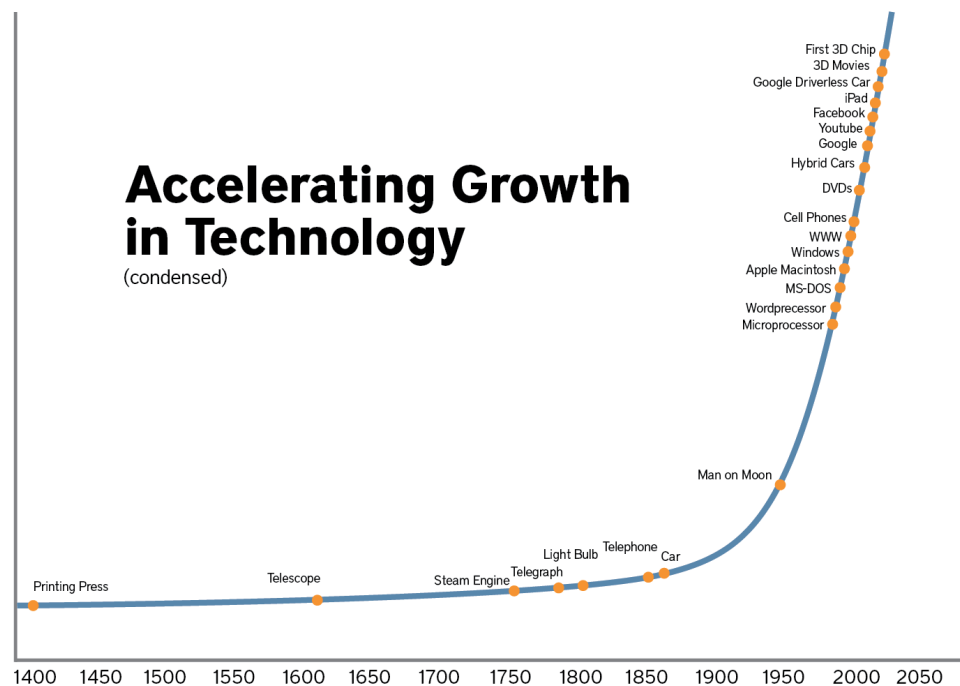
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Chapter 1 Introduction

1 Introduction

1.1 Research Background

Gorden E. Moore (1965) observed that the number of transistors on integrated circuits has doubled the amount almost every second year from 1959 to 1965, and he projected the trend will remain nearly constant for at least 10 years. Not only what he said about the number of integrated circuits has been proved to be true, but also the pace of technological advancement has experienced exponential growth in the past few decades. If we look back at the technology development in the last 100 years, the law of Moore's is still valid (see Figure 1).



Sources: www.asgard.vc

Figure 1. Accelerating Growth in Technology (From 1400 to 2050)

Among all the technology development, computing power and the Internet are the tipping points for the advancement of modern society. Mass adoption of the Internet pushes the coevolution of almost everything that we are familiar with, such as the place we purchase goods, the channel we acquire information, and the way we communicate. The most distinctive transformations that the Internet brings to us can be concluded as from under control to out of control, from bureaucratic to flat, and from governance to autonomous. We can see the “change” has become the “norm” rather than the “new”.

Then how come some few institutions do not change in an otherwise rapidly developing world? I thought that one of these few stable institutions was money. The money here, I mean the mechanism of how money is entitled and endowed with the ability to have value and works as a medium of exchange. The most important object in the monetary system is currency. Money or more precisely a currency has been tied to a particular nation-state for more than a century. The states monopolized the minting of currency and regulated and controlled financial institutions. It is just what Kevin Kelly (2017) said, “nearly every aspect of modern civilization has been flattening down except one: money. Minting money is one of the last jobs left for a central government that most political parties agree is legitimate.”

The emergence of digital currency, particularly cryptocurrency, started to push this unchangeable institution into a new direction. There is no congruence definition for digital currency, and it contains a broad set of money. In this thesis, digital currency mostly refers to the non-governmental issued digital form of money with the use of distributed ledgers (BIS, 2015) (the detailed definitions see Chapter 3 Section 3.1). It is argued that they have challenged the monetary sovereignty, which can be simply understood as the state’s ability to issue and regulate their own currency (Tymoigne, 2020; Murau and van’t Klooster, 2020). In traditional monetary systems, currency is backstopped by the nation-state in one way or another, no matter in the form of digital or physical. Cryptocurrencies, however, are not necessarily endorsed by state authorities. They function fine by being privately issued and distributed. Taking Bitcoin as an example, it is

produced by computer algorithms, distributed by networks and exchanges, and governed by decentralized groups through online communities.

Financial systems have been refreshed and transformed by the introduction of the new money concept. The existing mechanism is considered as antiquated, exclusive, centralized, and monopolistic (Tapscott and Tapscott, 2016), where the infrastructures are legacy technology, and the intermediaries belong to monopoly business. New technology innovation of cryptocurrencies facilitated new ways of moving, storing, lending, exchanging, authenticating, and accounting value (Tapscott and Tapscott, 2016). From the user perspective, financial transactions experience better anonymity, faster settlement speed, cheaper transaction fee, and more secure records. From the issuer perspective, in most cases, state governments do not enjoy this new kind of money-cryptocurrency, since a change of their roles in the whole process of transactions left less benefit than a monopoly business as such. The elimination of intermediaries of financial institutions put them at risk. New intermediaries in the digital currency ecosystem, such as exchanges, crypto wallets, network providers etc., have arisen to take care of the issuance, circulation, governance, and most importantly, make money in the cycle of digital currency transactions.

Besides, the rise of cryptocurrency changes the ideation of money perceived by different actors in many fields, such as technological, financial, social, and political aspects. How Bitcoin is perceived might be similar to what gold has been through in the 1930s - full of controversies and debates. Jamie Dimon, CEO of JP Morgan, once claimed that Bitcoin is a fraud but later started to invest in Bitcoin; Joseph Stiglitz, an Economic Nobel Prize winner, said that Bitcoin should be put down, because it does not provide any value to society. There are also proponents with positive opinions. Elon Musk strongly supports Bitcoin. He considers money as a form of data, and so do Bitcoin and Ethereum (Musk, 2021), which means they possess similar functions as fiat currency. Ray Dalio, the founder of the world's largest hedge fund Bridgewater Associates, considers Bitcoin as an alternative store-hold of wealth that can fulfill the growing need of people in the investment field (Dalio and Patterson, 2021).

Up to the level of states, who have been in charge of money for centuries, and who are officially the ones responsible for guarding the legitimacy of money, different reactions and attitudes seem to be placed on cryptocurrency. Some countries gradually regulate cryptocurrency and put it into existing regulatory frameworks, considering it as an innovative force. Some doubt its capabilities to be a currency and try to use different regulations to set barriers to cryptocurrency development. Others try to adapt and integrate the new elements created by cryptocurrency, and start to look at this new disruption as a new political instrument to maintain state power position (Campbell-Verduyn, 2018b), such as introducing central bank digital currency. In general, cryptocurrency consists of both risks and opportunities.

Why did I decide to write my thesis on this topic? Cryptocurrency has fascinated me for some time. It is an intriguing and exciting phenomenon. During these years, I observed the transition of how the world hate and love cryptocurrencies from an early time, and all those sudden changes in the process that push cryptocurrency into the position of what it is nowadays. The whole transition process is a fascinating social phenomenon that exhibits a rare opportunity to observe and record the radical but also subtle changes of such an old institution- money. PhD study not only offers me a great chance to follow these interesting events in the digital currency area, but also asks me to work on it with curiosity, with scientific methods, and with a sociological engine. Therefore, I believe that this dissertation is a small part of the journey to uncover these observations and findings, which brings about all the questions and queries together along the time, from past, to present, and to the future.

1.2 Research Questions and Aims

When it comes to digital currencies, we face a phenomenon that is perceived, used, and governed in multiple ways worldwide. I shall argue throughout this dissertation that the digital currency phenomenon contributes to complex and dynamic development, both in terms of its impacts on nation-states, and in terms of its own special characteristics. Here I place my primary focus on cryptocurrency. With the growth of cryptocurrency, we can see that the existing system is

experiencing incremental changes to adapt to the new situation and shifting attitudes from “indifferent”, to “wait and see”, and finally to “focus”.

So why has cryptocurrency caused such attention and divergent opinions globally? I assume that those divergences and transformations are connected to the multiple roles of cryptocurrency. The character and the number of these different roles were gradually revealed when different actors started to examine it from various perspectives. For example, nation-states consider cryptocurrency as a big challenge toward fiat money, some investment institutions regard cryptocurrency as a new financial asset, and certain individuals use it as a payment method.

Considering the emergence and development of cryptocurrency as a social phenomenon, two angles can be sorted out to consider the back story of such a complex phenomenon. The first angle derives from the internal side of cryptocurrency, which refers to the fundamentals of cryptocurrency design and how it functions. They are the new features and characteristics of cryptocurrency as a new thing, product, or technology. While another angle can be viewed from the external environment, meaning the relations, impacts, and changes of cryptocurrency with established settings of existing systems. To understand such a social phenomenon, it is difficult to examine solely the design and features of cryptocurrency without taking into account the external environment. Therefore, the research integrates two dimensions to investigate *the roles of digital currency and its interactions with existing systems*.

After looking into the different aspects of digital currency, particularly cryptocurrency, I decided to work on the issue through three lenses. They are “difference”, “perspective”, and “time”. These three words define the research questions from different angles. First, about “difference”. There are many controversies about cryptocurrency, partly due to the differences of how cryptocurrency operates in contrast to existing mechanisms. This dissertation understands the word “difference” in two ways. On the one hand, it is about the distinctions between digital currency and existing money in terms of features and designs. On the other hand, the new designs and features make cryptocurrency work differently in the established environment. We can interpret it as the different impacts on and interactions with other actors. This dimension emphasises on the

interaction between cryptocurrency itself and its consequences and impacts on its development. Second, about “perspective”. Just as the prob says, “every coin has two sides”. So does cryptocurrency. The good and the bad depend on the perspective of looking at the same phenomenon under various backgrounds and applications. This research aims to compare the processes and consequences primarily from the angle of states, that how states perceive digital currencies from different perspectives, and that how digital currencies have been impacted by states. But different states also stand at different positions. Third, about “time”. Time can depict two dimensions in this context. One is the development of money, which contains the past and present descriptions of the rising digital currency from historical analysis, and also includes an attempt to project the future directions of digital currency. Simply to say, this dimension tries to understand the development of digital currency. Another dimension refers to changes. It means this thesis is not just a static description of digital currency development, but also combines a dynamic view to consider changes in the comprehensive environment, and how digital currency brings changes to other actors.

Integrating all the aspects, this thesis develops the following sub-questions:

- 1) What are the differences between cryptocurrency and existing money?
- 2) Whether different actors perceive cryptocurrency differently?
- 3) How and why cryptocurrency has emerged and developed?

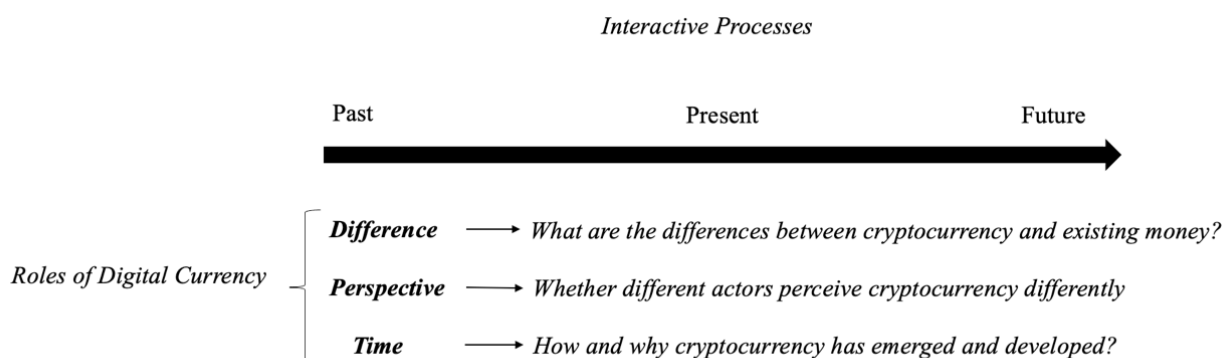


Figure 2. Research Questions

The main research question and the sub-questions demonstrate that this thesis will apply a holistic as well as an interactive lens to investigate digital currency. This thesis offers thick descriptions and analysis of the changes and developments of cryptocurrency. It is an ambition that these guiding research questions will be answered in the four papers which are the core of the thesis. Each paper will not necessarily answer one particular question. The questions are interrelated and, therefore, the answers are also mutually connected. To draw a whole picture, four papers collectively construct the pixels and concretes of the research.

1.3 Research Methodology

The research methodology encompasses three fundamental elements: philosophical assumptions, research design, and specific methods which include data collection (Creswell and Kelly, 2014). Philosophical assumptions are discussed among the philosophy of science scholars, and these scholars focus on the different conceptions of “object of investigation” held by different traditions. Moreover, they look into what follows from particular conceptions of their object of investigation. If they assume that there is a world “out there”, they assume that the starting point is the existence of an ontology. Thus, they often ask: how do we extract knowledge about this ontology? This is an epistemological question. Different starting points can be the assumption that no entities exist prior to the processes in which we speak about the phenomena in question. There are other positions and starting points for studying human or natural phenomena and in some traditions these different positions are called “worldviews” (Mannheim, 2013) or “paradigms” (Kuhn, 1974). Before conducting research, it is important for researchers to reflect upon the particular philosophy of science that the researcher subscribes to and intends to follow when they will produce scientific knowledge. There must be a logical coherence between the philosophy of science, the research question, the research processes and the research methods.

The existing literatures usually look into two types of assumptions when discussing these philosophy of science issues: issues related to ontological and epistemological assumptions. Ontological questions are related to problems of being or the nature of our object of investigation (Bryman, 2012: 32). Ontological positions can be either objectivistic or constructivist.

Objectivism, as indicated before, claims that social reality and social phenomena exist independently of humans and human interaction. While constructionism asserts that social phenomena and their meanings are continually being produced and reproduced by social practices and by meanings produced by our use of language (Bryman, 2012: 33).

Epistemology concerns the questions of the origin and the form of representation of the knowledge, and how we extract knowledge about our object of investigation (Mingers, 2003). The most common positions are positivism and interpretivism (also called hermeneutics) which represent two different epistemologies. In positivism, the world is an object of investigation that exists prior to the analysis and it operates independently of the social actors. Positivism holds the view that the social world is similar to the natural world, thus social science should be studied in the same manner as natural science (Usher, 1996: 12). Positivism has the intention to test the theory through empirical evidence (Orlikowski and Baroudi, 1991). Interpretivism considers humans and institutions as subjectivistic and human beings and their institutions are influenced by their experiences, knowledge, and beliefs. Social science should take into account that each human being experienced the world in a subjective way, the social scientist has to interpret the different meanings and different explanations provided by the subjectivistic.

The whole thesis takes historical and comparative views to investigate the research questions combining ontology and epistemology. This research aims to understand the different roles of (crypto)currency and the interactions between different actors in relation to cryptocurrency. It entails both the researcher's understanding of the other actors, institutions, behaviors, attitudes and the independent features of what exactly constitutes the cryptocurrency phenomenon. This is a complex and open process, involving hypothesis testing, context setting, interpretation, and future projection. Therefore, rather than taking a single perspective, this thesis aims at integrating different forms of philosophy of sciences, including different types of ontology and epistemology. Consequently, the researcher avoids falling into a trap and remains on track with a more holistic and balanced view, which eventually will show to be the most nuanced and convincing.

As for research design, this thesis tries to use mixed methodologies to provide a more comprehensive perspective with more solid and stronger arguments. A qualitative method can better answer the question regarding “what” and “how”. The thick descriptions overcome the problem of abstraction of quantitative studies (Yin, 2017), which helps this research to understand the process of cryptocurrency emergence, changes, interactions, and also the social meanings of the phenomena. While quantitative research methods are employed to investigate larger populations and statistical data. It allows the study to have a comparably more objective judgment based on the facts and scientific procedures, instead of the interpretations solely by the understandings of the researcher. Those results exhibit better generalization power than individual case studies and minimize the bias of the researcher as a social actor.

The thesis consists of four papers which together form the descriptions and illustrations of the role transitions and interactions of cryptocurrency with existing mechanisms. The differences lie in the philosophy and research methods for analyzing cryptocurrency. There is a clear distinction in “relationships” between actors and cryptocurrency. I call it unidirectional relation and interactive relation. As a result, I can also distinguish slightly different research objects in different papers.

Objectivism and positivism are employed to explore the patterns and structures in the process of cryptocurrency development. In Paper 1 and Paper 4, I try to apply natural science methods to social science research and show the historical footprint and role transition of cryptocurrency from empirical data. In Paper 1, by understanding the patterns of cryptocurrency research focus, I try to employ objectivism and positivism primarily to demonstrate the emergence and development of cryptocurrency research, and how cryptocurrency has been discussed and perceived by different actors along the time. In Paper 4, I try to find out the financial features of cryptocurrency by using numeric market data. From this standing point, it is assumed that the previous patterns showed in the past data are reparative in the future to a certain degree. This is an inductive process that tries to understand the role of cryptocurrency from empirical results. The results reflected in

the numeric evidence of the past offer a relatively more independent answer, which is free from subjective bias and manipulations of the researcher.

The constructivist and interpretivist paradigm fit to explain the ongoing processes of my research interests to track the development trajectories of (crypto)currency from evolutionary and comparative perspectives (Paper 2 and Paper 3). The reasons for the emergence and development of cryptocurrency can be seen as the results of continuous negotiations and constructions of social actors in certain environments. Furthermore, how cryptocurrency has been perceived by different participants relies on the interpretations of existing actors. It is not about a static definition of what cryptocurrency is supposed to be, but a dynamic process that has taken into account the interactions between social actors and the consequences of what it brings to the world. In order to understand the complexities of this process, it requires researchers to integrate their own understandings to interpret the history and event by understanding the considerations of different actors. These involve the intentions, beliefs, desires, values, and purpose of the human being and society. Using interpretivism is a way that we can understand why and how the processes have happened. Paper 2 and Paper 3 are more than pure descriptions, but are also pieces that combine the selection of facts and understandings by the researcher.

In sum, this dissertation employs different paradigms and research methods to provide an answer to the research question. The philosophies seem to contradict each other, however, this is just what Salomon (1991) argues, “two paradigms under consideration address different issues, yielding different kinds of knowledge, they ought to be seen as complementing and enriching each other, rather than ruling each other out.” The selection of paradigm should not be a constraint to what it considered ought to be by certain traditions, but it is more of whether the researcher adopts an analytic approach to understand the numbers and assumptions, or a systemic approach to understand various variables that cannot be easily quantified in a complex environment.

1.4 Data collection

This dissertation is inspired by different traditions and integrates multiple research methods. As for the qualitative research method part, this dissertation uses historical analysis and literature analysis to construct an evolution trajectory of (crypto)currency. This process involved large amounts of firsthand and secondary data. The historical analysis requires me to read tons of retrospective materials of (crypto)currency development and dive into the archive of state formation. Investigating the currency and cryptocurrency from past, present to future is the process to have a clear comparison between the oldness and the newness. This process helps to understand the emergence and transformation of (crypto)currency together with its social background and the interactions with social actors.

Due to the convenience of the special education background, I took advantage of the access and ability to read both Chinese and English materials to conduct the research. This thesis employed Europe and China as exemplary cases to illustrate and compare the different perceptions and trajectories of (crypto)currency in various social settings. I got lots of official documents, statistics, policy analyzing reports and attitudes reports² as data to start my analysis of the (crypto)currency development in different regions and the interactive process between multiple actors.

Apart from that, I was very lucky to have an opportunity to work with *Central Bank Digital Currency Research Institutions* for a few months. This was a very valuable experience and rare resource for any researcher to be “in the shoes” to acquire deeper understandings from the state level. During that time, I got lots of chances to discuss opinions with relevant people and participate in relevant activities. This experience helps me to understand cryptocurrency from a more macro and strategic level in the scenario of China and has inspired me in developing thoughts on the meanings of digital currency and its relations with governmental institutions, particularly in the Chinese context. Due to the confidentiality policy, detailed discussion and meeting content will not be publicized. However, this knowledge has become part of the implicit

² Here I will not give an endless list of all the documents that I have read during the research. Many data have been directly pointed out in the following independent papers.

understanding when interpreting the research findings. I believe that this knowledge has contributed to my thesis tangibly in the analysis.

Besides, I have participated in the cryptocurrency network as an observer and investor. To conduct research, it is important to understand the dynamics between different cryptocurrency groups, which include developers, miners, communities, investors, and traders etc. Over the years, I have followed many cryptocurrency activities, including working and talking with different crypto-related companies in China and Denmark. Those experiences might not be directly relevant to a particular paper but they do contribute to understanding the diverse considerations of digital currency under different contexts. Furthermore, the experiences also make me believe even more that many characteristics of cryptocurrency require both qualitative and quantitative analyses to find patterns and get a holistic picture.

I have listed some of the interviews, meetings, and visiting in Table 1.

Table 1 Data Collection List

	Date	Subject	Person	Title	Content	Location	Duration
Interviews							
1	2019.08.29	Interview cryptocurrency startup ARYZE	Carl Jenster	Community Manager	Digital payment and the future development of digital currency in the context of Aryze	Copenhagen, Denmark	49min
2	2020.09	Online Interview with PBoC's officials	As required, the persons need to be anonymous	-	Opinion about cryptocurrency and CBDC potentials	Beijing, China	20min
Forum							
1	2021.04.18	Boao Forum For Asia 2021 Sub-Forum: Digital Payment and Digital Currency	Li Bo and Zhou Xiaochuan	Member of the Party committee of the people's Bank of China and vice president of the International Monetary Fund	Opinion about Bitcoin and crypto assets	Hainan, China Participate online	84min
2	2021.06.11	13th Lujiazui Forum 2021 Sub-Forum: Digital Transformation of	Mu Changchun	Director of the digital currency Research Institute of the people's	Six key points of CBDC	Shanghai, China Participate online	9min

	Date	Subject	Person	Title	Content	Location	Duration
		Economy and Finance		Bank of China			
3	2021.10.20	2021 Financial Street Forum	Zhou Xiaochuan	Vice Chairman of the Boao Forum for Asia and China's Chief Representative to the Boao Forum; the governor of the People's Bank of China (PBoC) from 2002 to 2018.	The two-tier system of digital RMB and cross-border payment issues	Beijing, China Participate online	37min
Participation							
1	2020.10-2020.12	Central Bank Digital Currency Research Institute	-	-	Acquire knowledge and opinion about DC/EP, e-CNY, and global CBDC development	Internship	3 months
2	2021.03.31	China Numismatic Museum	-	-	Monetary development in China	Visit	1 day

As for quantitative research sections (Paper 1 and Paper 4), the data collection process was focused on acquiring numeric data from databases³. I use empirical data to conduct model analysis. Paper 1 uses bibliometrics method and network analysis. The original data is cryptocurrency research information, which I obtained from Web of Science and Scopus. As for Paper 4, data related to cryptocurrency markets and other financial markets come from financial databases. The detailed collection and methods are described in the paper. Here I would like to emphasize that when we try to interpret the understandings of the new emerging technology and the existing forms of (crypto)currency, these interpretations are based on our own knowledge and social background. Social science is also able to discover “what” and “how” through patterns and features. Quantitative methods allow the research to have more objective and independent angles in investigating those features illustrated by the aggregate facts. Therefore, this dissertation uses quantitative methods as another angle to show cryptocurrency development and interactions in a more micro-context.

1.5 Structure of the Dissertation

This section provides readers with a guideline toward the dissertation. It helps to understand the purpose of each chapter and clarify the logic of the whole thesis.

Chapter 1 (this chapter) encompasses four sections. The first section presents the research background of the whole thesis, which includes the inspirations and reasons that raised my interest in pursuing the topic of digital currency. It also includes the *Research Questions and Aims* section to clarify the purpose of the dissertation. The *Research Methodology* section contains the philosophy of science, research design, and data collection of the research. The introduction chapter provides both an overview of this dissertation, and an instruction for the following chapters under the research aims.

Chapter 2 elaborates the theoretical foundations of this dissertation. I started the analysis of digital currency by investigating the concepts of money in different theories or under different

³ The detailed data base please refer to the methodology section of Paper 1 and Paper 4.

views, including money in orthodox economics, in state theory, in social relations, as a generalized symbolic medium, and in the context of currency competitions. This section connects the different understandings of money and foreshadows the multiple perspectives of money considerations. The following papers in the dissertation applied those concepts of money to understand the way of digital currency development and its differences and interactions with existing mechanisms.

Chapter 3 is the literature review of the thesis. This session summarizes the relevant existing literatures and sets the foundation for the following research. It provides fundamental knowledge about digital currency, including concepts, taxonomies, and distinctions and relations with blockchain. This part enables readers to have enough understanding toward the research content. In addition, the chapter also discusses the challenges of cryptocurrency, its relations with public authority, and how global actors put in efforts to manage and govern this new emerging technology. This is a good starting point to understand the multi-facets of cryptocurrency, as well as the tensions and debates created by cryptocurrency. With that knowledge, the thesis can better analyze digital currency emergence and development, and further interpret the roles and interactions of cryptocurrency from past to present and maybe for the future.

Chapter 4 contains findings, summaries, contributions, and conclusions of each paper. Readers can understand the main content and conclusion of the individual paper from this section.

Chapter 5 is the discussion and conclusion of the whole thesis. This chapter revisits the research question and summarizes the overall contributions and conclusions of this PhD project. It also includes a brief discussion about possible future research directions.

Chapter 2 Theoretical Foundation

2 Theoretical Foundation

2.1 Money in Orthodox Economy

Traditional monetary theory originates from commodity money theory. The emergence of money starts with the problem of “double coincidence of wants” in barter economy. The emergence of money transforms the substance economy, or say natural economy, into the exchange economy (Smith, 1937). The later usage of commodity currency forms the metallic school of money. Precious metals, such as silver and gold, were proved to be the fittest commodity currency for the past few centuries. The exchange ratio is defined either by markets or by public laws. For commodity money, the purchasing power is independent of the nominal designations, but decided by the intrinsic value of the metal. With the evolution of currency, paper and credit currency came into our sight. At first, paper money is convertible and pegged to bullion. Then, the credit monetary system emerges after the collapse of the Bretton Wood System. From there on, money becomes the pure credit of governments, which is also called fiat currency.

In modern economies, money is an essential part of life. Modern money is just a special form of “I owe you (IOU)”, or in the language of economic accounts, a financial asset. It is a social institution providing a special kind of IOU that everyone in the economy trusts (McLeay et al., 2014). There are different currencies in the market. The primary sources of money include central bank currency, bank deposits, reserves, and probably in the near future the central bank digital currency.

In orthodox economic theories, the evolution of money comes from the market economy. The inconvenience of barter for “double coincidence of wants” and the aim to minimize high transaction costs drive the rise of money. Markets are formed as a result of the natural disposition of exchange. Money is derived in the market exchange. This means that the orthodox concept of

money emphasizes the monetary attributes of currency as a medium of exchange to lubricate the market.

Orthodox money theory is closely connected with the Quantity Theory of Money and metallic views, which means that it focuses on the supply side of money. Together considered “the quantity of money” and “commodity back-up”, fiat currency only has nominal value but no real value. When there is too much money chasing too few goods, inflation arises. As for digital currency, we can refer these theories to the supply of digital currency and use them to explain and discuss the value formation and inflation of digital currency. For example, the value of Bitcoin in relation to its limited amount of supply.

2.2 State Theory of Money

Georg Friedrich Knapp (1924) developed the state theory of money, which is also called Chartalist view of money. This proposal challenges the metallic money theory, which argues the value of currency comes from the value of precious metals. In Knapp’s understanding, the value of money is derived in a metaphysical sense from the sovereign authority of the state. Money is not bound to any specific material (Knapp, 1924: 8–25). The physical material of a currency is not of primary importance to determine the value of money. This theory places nation-states in the center of money creation, recognizing the power of states over economic exchange. Lerner (1947) believes that money is something we use to pay for things and money is the creature of the state. The validity of money comes from the proclaimed willingness of states to receive such item as a payment method for tax and other obligations.

Under the Chartalist view, money can be acceptable without the precondition of a market. Because the state has the capability to empower almost everything to be generally acceptable as long as the proposed money is acknowledged in tax and other obligations enforced by the state (Lerner, 1947). The value of money does not derive from the intrinsic value of the materials in the commodity, but from the promise to pay in the transactional relations (Ingham, 2002; Simmel, 1991). From this perspective, money is produced by non-market agencies and does not obey the

economic laws of production and exchange of commodities (Wray, 2014). State money is independent of the acknowledgment of market participants, as the validity originates from the proclamation of the state.

In modern monetary systems, the State Theory of Money is still dominant. Keynes describes that “the age of Chartalist or state money was reached when the state claimed the right to declare what thing should answer as money to the current money-of-account-- when it claimed the right not only to enforce the dictionary but also to write the dictionary. Today all civilized money is, beyond the possibility of dispute, Chartalist.” (Keynes, 1930: 4).

Fiduciary money was introduced to play the best interpretation of the state theory of money. Fiduciary money, also called fiat currency, is primarily issued by the state, and has no intrinsic value for its materials. The value derives from the legitimacy offered by the state. The concept of “legal tender” is usually applied to represent such enforcement. The concept of legal tender emphasizes the relations between money and contract, which implicitly requires that the state currency must be accepted (Wray, 2014). It means that the state imposes certain object, in this case is money, to be used in measuring obligations.

This understanding also explains why in modern banking systems certain “privately issued” money is also considered as valuable, such as banknotes, bank reserves, third-payment money etc. In Knapp’s understanding, the value of money does not originate from its utility for exchange but from the acceptance by the “public pay community”, which is the state. The legality of those currencies to be considered as an official payment derives from the state’s acceptance for levies and obligations. Such acknowledgment includes a series of actions empowered by the state, that the state announces them to be acceptable for obligations in the monetary system, and at the same time, they hold equal ability to claim the rights as strict legal tender. It is not the definition of legal tender which justifies the money, but the accepted payment by the state justifies the money.

On the one hand, this theory puts emphasis on the properties of unit of account. Keynes (1930) has been inspired by the state theory of money. He emphasizes the importance of money-of-

account, which comes from the debt and price relations to hold purchasing powers. It is argued that people barely use money as means of payment as the sole source in the modern economy, but the importance of involving contract and deferred payment increases (Hicks, 1989). On the other hand, under this theory, money also has another role - an instrument which can be used to perform governance and readjustment functions in capital markets and economies. Money is a certain kind of “dictionary” written by the state. Effective governance to mobilize resources, creating demand for money, and facilitating liability payment become important tasks that states need to consider.

2.3 Money in Social Relations

Continuing with the state theory of money, the concept of money can be integrated with social constructivist perspectives. Ingham (2002) illustrates how money is considered as a social relation from three aspects. First, he claims that money is a social institution. The process of money creation generates a series of complex social structures between different actors, including money issuers, money exchangers, merchants etc. Any kind of transaction or exchange consists of multilateral relations. Second, monetary exchange is closely connected to social relations and is different from pure exchange theory, which means the barter economy. Money carries the economic exchange process that characterizes the relationships between people who use the money and the institutions that offer the money with value. The value of money derives not from the thing that called is money but depends on the claim within an “economic community” (Simmel, 1991: 176). In the understanding of the state theory of money, this means the relation established between economically active individuals who use such currency, and the state governments who issue and guarantee such currency. Third, modern money is nothing more than a symbol or signifier of states' and banks' promises to pay. This refers to fiduciary money in modern systems. Commodity currency has value by itself to be accepted by people as a medium of exchange. However, the credit currency has no intrinsic value, while the willingness for individuals lies in the social system endorsement guaranteed by the state.

In modern economies, fiduciary currency reflects the new social relations between the market and the state. Credit money has no intrinsic value by itself, but is under state endorsement. The

distinctions between credit money and barter economy lie in the public confidence in issuers, say the government in fiat cases, and the confidence that money can be spent again at the same value (Simmel, 1991: 177). The relation between objects and money is the relationship between economically active individuals and the central power which issues and guarantees the currency (Simmel, 1991:176). The credit and debt relations also imply the relations between the money issuer and money holder. There are triangular relations between the two contracting agents and the issuer of money (Ingham, 2012: 128). Within this relation, the utilization of money requires trust within social relations and the trust of social institutions. Schapiro (1987) points out that credit currency has value because of impersonal trust. This kind of trust is embedded within the social system, and indifferent to individuals. During transactions, the state authorities entail the money of two unknown persons to have formal validity and legitimacy regardless of the differences between the two persons, such as appearance, occupation, and personal interests.

In the case of digital currency, new social relations have been built. The value of such currency can be partly explained under newly constructed relations between states, holders, and issuers. The trust of social institutions in digital currency moves from a traditional state agency and contracting parties to a new form of interpersonal trust in technology that facilitates the operation of digital currencies and online communities, who conduct such exchange activities with the currency. This new type of social relations makes digital currency possible to be free from physical constraints of territory and geographical barriers.

2.4 Money as Generalized Symbolic Media

I draw upon the concept of generalized symbolic medium from Talcott Parson (1963) into the thesis to improve the understanding of the role of money in society and how money works in the relationships between money issuers and money users. This helps us better interpret the money and state relation from a comparative and historical view, and further complement the money function as a medium of exchange.

Any language contains two aspects, 1) the meaningful “message”; and 2) the person who has the “code” to unpack the meanings, meaning he or she knows the language and understands it. Contrary to rational economic theory, money is a measure of value and a standardized unit of account, Parson considers money as a kind of language in economic relations, which carries the “code” and “message” of transactions between two parties.

The symbol has the prerequisites of use, which Parson calls the “definition of the situation”. There are four components of the situation: first, a category of value, which means the value of utility. Unlike commodity money, paper money, and fiat currency, digital currency does not have any intrinsic value. However, it has utility value because it can work as a symbol to represent the value during the transaction process, which means it carries value in use. Money symbolizes what is not present at the moment, but a potential economic relation for exchange. It “can evoke control of relations with them in the special kind of process of social interaction we call economic exchange” (Parsons, 1963). Second, a category of interests, which defines what the generalized symbolic medium can do. “Interest in objects” means that the actors are willing to acquire control over the subject so that it can be used. In terms of money, it is the representation of the possibility of a potential transactional action, such as consuming or spending. Third, a definition of the situation, which is the implementation of such interests. It contains the process of conducting the monetary transaction in terms of how, when, and where. Fourth, a normative framework. This refers to the rules of the condition of this reciprocal relation happening in the economic exchange. It formulates the basis for mutual acceptance of money to function as a medium, which defines the legitimacy of the object in the transaction.

With a generalized symbol, say money, in economic relations, one acquires more flexibility and freedom in the marketplace. This is what is distinguished from the barter economy in the definition of a situation. Whatever form of the money, either paper money or digital currency, once it is considered as a generalized symbolic medium, it can free traders with specific “coincide of wants” and provide actors with more opportunities to choose and select a wider variety source of products and services. It provides extra possibilities in economic relations, in terms of sources

of supply, terms of exchange, and time conditions (Parson, 1963). However, those freedoms are gained at a risk. For example, the risk that a symbol might never be returned to the products or services. In the case of money, we can refer to the concept of inflation or hyperinflation in rational economic theory, which denotes the situation in which the worth of money diminishes in comparison to when we acquire those symbols. Or in extreme cases, certain types of money disappear.

The core idea of the generalized symbolic medium stands at social relationships. Generalized medium involves a particular mode of communication or transaction. In this model, the form of money, say paper money, commodity, or digital currency, is the symbolic token that works as an objective to mediate the relation. It is argued that generalized medium is the linkage in social relations, operating as a feedback system that connects individual actors and systemic structures. Money makes the buy-and-sell relationships become a standardized paradigm in each subsystem and offers those relationships an equivalent measurement during the exchange (Chernilo, 2002). With the emergence of such generalized symbolic media, new possibilities for the expansion of transaction capacity and the development of monetary systems become available in terms of economic relations.

2.5 Competing Currencies

Except for the dominating state theory of money and other related theories, one alternative perspective argues that the free competition of currency will allow people to choose the best money in the market. It means that the monopoly of currency by the government should be abolished, and private sectors should be granted the right to issue their own currency to compete with each other. I call these arguments competing currency theory.

Hayek believes that the exclusive rights of governments to issue and regulate money do not give better currency than free-market competition would otherwise do (Hayek, 1990: 32). The legal tender is considered as a “legal device to force people to accept in fulfillment of a contracting

something they never intended when they made the contract” (Hayek, 1990: 38–39). Under this concept, currency is an instrument that helps governments in gaining and retaining political power.

Supporters of competing currency theory usually argue that the state monopoly of currency has certain problems. First, it is believed that the monopoly of currency by nation-states causes abuse of monetary power. The most evident phenomenon is the inflation problem. Hayek writes “I do not think it an exaggeration to say that history is largely a history of inflation, and usually of inflations engineered by governments and for the gain of governments” (Hayek, 1990: 33). The second problem is the lack of incentives. The monopoly entails that people do not have free choice to other alternatives, even when dissatisfaction has overtaken the advantages of a currency. Competition is considered as a more effective way than the constraint of monopoly, which will force issuing institutions to maintain the stability of the value of such currency. Competition makes each institution responsible for the functioning of its own currency so that the best player wins out from the choice of users.

There are two main approaches to achieving currency competition. The first one is called free banking. The free banking consideration stands on the point that government monopoly will restrict the money market, and more money should be issued under private banks (Hayek, 1990: 14). The banks are allowed to issue notes, however, with certain established national currency. The rights to currency issuance are still under the control of the state. Banks only have limited functions in issuing redeemable notes denominated in the base money. This way does not form real currency competition. It is still a single type of currency circulated in a convenient region. The second approach involves free currency competition. The key focus of this approach is to maintain the purchasing power of money. Private sectors issue different kinds of currencies, rather than a single nation-state currency. In the commodity currency period and the time when paper money was still backed up by commodities, different currencies represent different quantities of the same metal (Hayek, 1990: 32). In fact, what Hayek proposed is a floating exchange rate system between competing currencies, but a fixed price mechanism bond with a basket or certain commodities. In this approach, such a mechanism can be achieved through competitions between

other currencies, because people will always choose the best performing one and, as a result, the overinflated issuing banks will lose their business.

To move one step further, a new form of currency competition is formed with technological development. Kroszner (2003) proposed a new method to divide the function of money in terms of medium of exchange and unit of account. He considers the new private monetary competition a “sophisticated barter system”. The distinction between a normal financial asset and a so-called currency becomes blurry. If we take the concept of Kroszner’s in digital era, an algorithm-automated executed system explains the idea. In digital currency mechanisms, as long as two financial assets can be exchanged, it is possible to engage in transactions. People do not need to worry about the use of different currencies in the digital system, because the unit of account of different currencies will be calculated by the machine, then the coexistence of multiple units of account will be available.

2.6 Concluding Remarks

This chapter compares different theoretical lenses of money and currency, including orthodox theory of money, state theory of money, social constructivist view of money, the generalized symbolic medium view, and competing currency view. The different theories and understandings of currency are interrelated.

In this research, it is difficult to understand digital currency from only one single theory. The newness and disruptive nature of digital currencies, particularly cryptocurrency, have led to controversies in the debate. The argument for whether cryptocurrency is regarded as real money usually focuses on three primary basic functions of money, which are medium of exchange, unit of account, and store of value. If we consider the supply of some cryptocurrencies, they are limited in amount, which refers back to the orthodox theory of money. In the meantime, when state authorities claim cryptocurrency is posing great threats to money sovereignty, they take for granted that money should be the monopoly of nation-states. This reflects the Chartalist view of money. It is difficult to determine whether cryptocurrency has value, because if we consider the

social constructivist view of money, many tend to argue that social relations make it valuable. No matter the market exchange or the usage in payment, the value derives from the new relations connected through cryptocurrency. The existence of cryptocurrency facilitates the communication of online communities through exchanges and collaborative efforts, which makes it a new generalized symbolic medium in the digital era. The special technological features of digital currency further add to the discussion. The reason that digital currency enjoys lots of praise is partly due to the technological innovation associated with it. And when we agree that all agencies should have the rights to issue money, cryptocurrencies can be considered as a preliminary prototype of free competing currency.

This thesis takes a multi-dimensional perspective to examine digital currency. The theoretical section helps to consider digital currency, this new “currency” and “technology”, from various lenses. Regardless of different standards in determining whether cryptocurrency is real money, it has multiple facets when seen from the perspectives of different actors, such as states, financial institutions, and individuals. It can play the role of a medium of exchange, payment method, financial asset, social institution etc. The shifting roles of cryptocurrency reflect changes in economic, social, and political relationships. When analyzing and interpreting the actions and reactions of different actors, different theoretical lenses offer me wider perspectives.

Throughout the dissertation, different theories of money have been used in different sections comprehensively. In paper 2, I discuss the evolution of how money has been developed in Europe and China. This paper takes the view of the state theory of money to consider the role of modern currency, and the impacts and interrelations of states in the development of money. The generalized medium of exchange concept has also been used to evaluate the formation of money economies and the newly emerging role of digital currency. Paper 3 discusses the rising concern of cryptocurrency to the state. Examinations of the relationship between money, state, and society are offered. The detailed analysis integrates understandings of currency competition and the state theory of money. In paper 4, it is argued that the elaboration of cryptocurrency as a new financial asset is the result of exchange activities in market economies. It is argued that digital currency

might be difficult to become real money, however, the market exchange, trading and derivative activities achieve one step further to recognize cryptocurrency as a financial asset. This is a new phenomenon in modern complex financial systems.

The integration of different theories of money helps to explain the rich aspects of cryptocurrency in its development path and its interactions with multiple actors, which offers the research with fruitful understandings in terms of changes, differences, and perspectives during its evolution process. Moreover, taking the traditional theories of money, the dissertation also bridges the “old” theories in money with the “new” understandings of digital money. This is an attempt to interpret the role of cryptocurrency within our established understandings, in the meantime, to create a novel lens through the exploration of this new phenomenon. The integration of different concepts and facets of money is essential in furthering the academic discussion.

Chapter 3 Literature Review

3 Literature Review

3.1 The Fundamentals of Digital Currency

3.1.1 Definition and Classification

Currently, there are more than 5,000 different digital currencies circulating in the market (CoinMarketCap, 2022), but there is still no unified definition and classification for them. With the flourishing of digital currencies, various scholars and research institutions have tried to define and classify them according to their understandings based on different standards.

Broadly speaking, all electronic forms of currency can be called digital currencies, including commercial bank deposits, such as Alipay and WeChat wallets, etc, particularly digital fiat currency. In a narrower sense, digital currencies are those digital substances that do not require a physical carrier as a medium of exchange (Yao and Chen, 2018: 3). The typical example is cryptocurrency.

The International Monetary Fund (IMF) (Adrian and Mancini-Griffoli, 2019) released a report *The Rise of Digital Money* in 2019, which offers a comprehensive taxonomy of digital currencies. The report highlights four attributes of means of payment: type, value, backstops, and technology. Type refers to whether the payment is a claim or an object. Object-based transactions do not need to verify the information of both parties, such as cash payment, while claim-based transactions require complex financial infrastructures to confirm the ownership of the currency. The value of a digital currency can be divided into two types: fixed value and variable value. Fixed-value currency uses face value as a prerequisite for both parties' transactions, while variable-value currency is based on market value, similar to bonds and stocks. Backstops refer to whether the issuance of the currency is endorsed by a government. Based on backstop differences, digital money can be distinguished into private and public. Technology refers to the infrastructures of

the payment, that whether it is centralized permissioned networks or decentralized permissionless networks.

According to the above four important attributes, digital currencies are divided into five categories. The first is central bank money, including cash and legal tender. The second is called b-money, which is claim-based money, redeemed on-demand at face value. This type of digital currency is endorsed by the government, such as commercial bank deposits. The third taxonomy is e-money. It is similar to b-money, except without government backstops. Many familiar examples fall into this category, such as WeChat Pay, M-Pesa, stable coins, and fiat token. Electronic money is always related to online payment, whereas the European Union gives a more formal definition closely connected to payment. It is an electronic store of monetary value on a technical device that may be widely used for making payments to entities other than the e-money issuer (Whyte, 2003). Governments demand strict limitations for the institutions that are allowed to issue and manage that money. Even though electronic money is not directly issued by a government, it is bound to fiat currency and thereby legally recognized (BIS, 2018; Rahmatian, 2019). The next category of digital currency is sometimes also called virtual currency. Virtual currencies are not money that is recognized by law. They are digital representations of value, not issued by a central bank, credit institution or e-money institution, but by private parties and denominated in their own unit of account (European Central Bank, 2015; He et al., 2016). It means virtual currencies are not necessarily attached to fiat currency, but can be backed by gold, assets, and credit (Europe Central Bank, 2012; He et al., 2016). The fourth type is i-money, which is similar to e-money, but with variable values for redemption. A few examples are Libra and Digital Swiss Gold. And the last type is cryptocurrency. Cryptocurrency is denominated in its own unit of account and usually relies on blockchain technologies, such as Bitcoin and Ether (Adrian and Mancini-Griffoli, 2019). Bank of International Settlement (BIS, 2015) defines cryptocurrencies as assets whose value is determined by supply and demand yet has zero intrinsic value, run on distributed ledgers to allow peer-to-peer exchanges, and are not operated by any specific individual or institution.

Under the category of cryptocurrency, it is distinguished into two separate forms, which are native coins and crypto tokens. Native coins represent a general-purpose medium of exchange for the universal accessibility to the network (Houben and Snyers, 2018). Tokens are “digital vouchers” (Tasca, 2019), providing extra functionalities and coexisting with the platform. Tokens can be the representation of assets, claims, or equity to be transferred through cryptocurrency exchanges without involving scrutiny by authorities (Buterin, 2014; Chen, 2018). The Swiss Financial Market Supervisory Authority (FINMA) (2018) provides guideline categories for tokens. Based on the economic function of the token, it is classified as payment tokens, utility tokens, and asset tokens. Payment tokens mainly work as mediums of exchange. The primary purpose is to acquire goods and services. Utility tokens provide digital access for certain applications and usually rely on blockchain-based infrastructure. Asset tokens are claims for debt or equity as well as physical goods. Holding the token claims a portion of the asset or a full set of the asset.

The reviews are selected from various sources of existing literatures. In this dissertation, when discussing digital currencies, it refers to a broad sense of digital money, including digital fiat currency, third-party digital money, and cryptocurrency. This research clarifies the concept of digital currency into fairly simple categories, which are government issued and non-government/private-issued digital currency. Among the classification of non-governmental digital currencies, there are also digital tokens that are controlled by authorities, such as normal third-party currency, and there are also technological cryptocurrencies that are not fully controlled by the state (see Figure 3). Cryptocurrency is a word denominating a certain kind of crypto asset, which is not issued by state authorities, and which states cannot have full control over, and mostly they are supported by blockchain or distributed technologies. It is not just a purely digital representation.

I take a more general understanding of the terminology for cryptocurrency, because, on the one hand, the dissertation covers many different forms of digital currencies, and the frequently changing terms can confuse readers and make the article more difficult to understand. On the other hand, there is no agreed-upon definition for digital currency or cryptocurrency. The aim of

this dissertation is not to clarify the definition, but to use generally understandable terms to represent those non-governmental issued currencies in modern times.

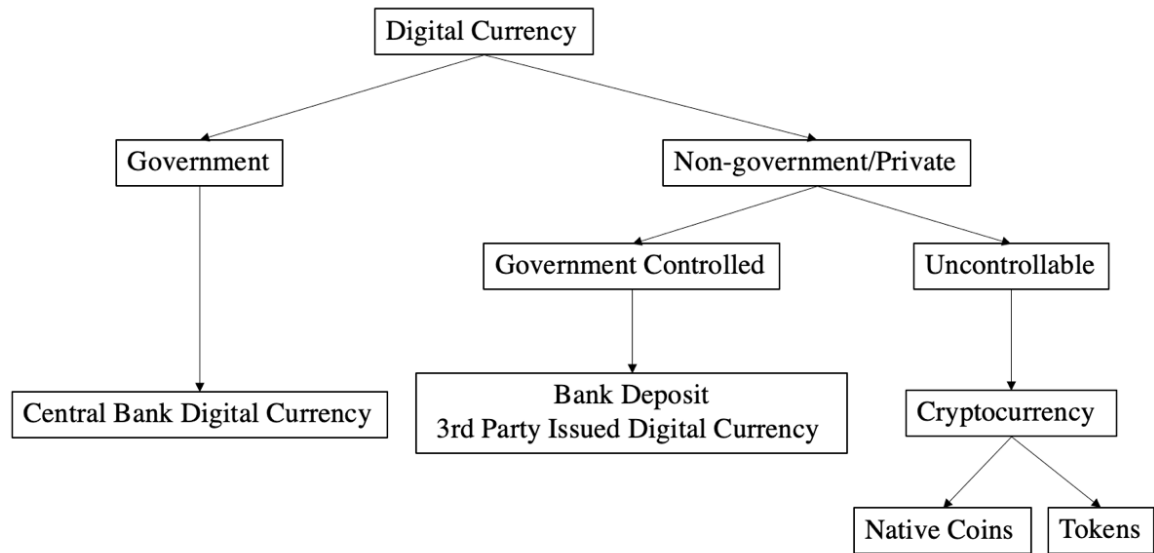


Figure 3. The Classification of Digital Currency

3.1.2 Cryptocurrency and Blockchain

This section elaborates the relationships between cryptocurrency and blockchain, which aims to help readers understand the basic concepts, intertwined linkages, fundamental features of cryptocurrency, and related concepts. Cryptocurrencies, which are mostly facilitated by blockchain, are embedded with technology nature. The benefits of Bitcoin and other cryptocurrencies that have been widely discussed by scholars are also primarily the results of using blockchain technology. In the early research, many have referred to the two concepts in the same sentence interchangeably (eg. Böhme et al., 2015; Grinberg, 2012). And when talking about blockchain 1.0, authors always refer to cryptocurrency and currency functionality, especially Bitcoin (Antonopoulos, 2014; Bodkhe et al., 2020).

Blockchain is primarily a type of distributed ledger technology. Blockchain is a sequence of blocks, which holds a complete list of transaction records like conventional public ledgers (Chuen,

2015). There are three types of blockchains-public, consortium, and private blockchains (Buterin, 2015). A public blockchain is an open ledger, which means anyone can read, write and participate in this blockchain network. It is important to know that public blockchains are fully decentralized and any single person or organization with power cannot control or change them. The primary examples of public blockchains are Bitcoin, Ethereum, Monero, and Dash. As for consortium blockchains, only selected nodes are allowed to participate in the network activities. A consortium blockchain is not fully decentralized, but it is partially decentralized (Lin and Liao, 2017; Zheng et al., 2018). As for private blockchains, only one organization determines the consensus of the blockchain. Therefore, private blockchains are centralized (Zheng et al., 2018).

It is necessary to understand the basic features of blockchain to understand the controversial debates of the challenges for state governance and the formation of new economic institutions of blockchain and cryptocurrency (Atzori, 2017; Davidson et al., 2016, 2018). The key features of blockchains are the following. First, decentralization (Sultan et al., 2018; Zheng et al., 2017). Consisting of algorithms and private and public keys, blockchain does not need a central server or node. Consensus mechanisms are used to maintain data consistency in distributed networks. This feature allows cryptocurrency issuance without authorities and central backups. Second, immutability (Sultan et al., 2018; Witzig and Salomon, 2019) . The data recorded on the blockchain are permanent as long as the participants continue to maintain the network. This feature means that transactions are irreversible. Apart from the agreement between the counterparties, there is no third party, such as financial institutions who can block or withdraw the transaction. Third, transparency. Any record on the blockchain can be reached by the approved members in permissioned blockchains and by everyone in public blockchains. This feature enhances information sharing and guarantees a trusted workflow. Forth, security. A blockchain provides individuals with exclusive ownership. For the overall system, the blockchain prevents information manipulation, counterfeiting, and double spending problems (Drescher, 2017).

Many have claimed a preference for blockchain rather than cryptocurrency. Cryptocurrency is believed to be only one of the blockchain applications, while blockchain contains a variety of

applications, extending to artificial intelligence, Internet of Things, supply chain etc. It is believed that blockchain does not necessarily need cryptocurrency to function. With the development of cryptocurrency, blockchain gradually goes beyond currency functions, representing a disruptive innovation of other potential applications. Just as the book *Blockchain Revolution* said, it is “an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value” (Tapscott and Tapscott, 2016).

However, others argue that this is a false dichotomy. From the blockchain side, originally derived from Bitcoin, it is the fundamental technology to solve the double-spending issue without a trusted third party (Nakamoto, 2008). Furthermore, coins are fundamental for blockchains to provide economic incentives, particularly for public blockchains and decentralized groups (Hunt, 2018; Silverstein and Cadigan, 2018). From cryptocurrency side, many characteristics of cryptocurrency, such as anonymity, transparency, and decentralization, are actually empowered by the design of blockchain technology. Cryptocurrency is primarily a digital currency or a medium of exchange, which could either work as a coin or a token in an ecosystem. But when talking about cryptocurrency, its usage is always related to the system constructed by its network. For example, in the mining process, Bitcoin works as an incentive to maintain mining activities; in the transaction process, cryptocurrencies can achieve payment when both parties accept the value existence. Both processes rely on the social relations that build by cryptocurrencies and cannot be independently reviewed without blockchain networks.

As the two concepts become more and more mature, cryptocurrency and blockchain seem to have more differences, however still difficult to fully detach one from another. The relationships between cryptocurrency and blockchain are subtle, and one can hardly deliberately cut off the linkages between the two concepts. When we analyze cryptocurrency, sometimes we are also talking about how blockchain empowers a new money economy and how blockchain has been motivated and empowered by cryptocurrency.

3.2 Emergence of Cryptocurrency

Dating back to the history of cryptocurrency, it can be traced to the electronic cash (eCash) system proposed by David Chaum in 1983. This system using blind signatures not only solved the problem of double spending on the Internet but also provided anonymity to users (Chaum, 1983). In 1989, he created DigiCash to provide online payment for businesses. However, the idea failed due to the lack of support by business users and inconvenience to individual users (Narayanan et al., 2016).

In 1998, Wei Dai proposed b-money, and in 2005, Nick Szabo proposed Bitgold. These two digital currencies were created through mathematical calculations and used peer-to-peer networks to record ledger information (Dai, 1998; Szabo, 2005). These two proposals stopped at the concept stage without moving forward.

Under the financial crisis and the repeated failure of the global financial system, trust levels toward banks and financial institutions declined sharply, and even a generic unknown individual became more trustworthy than those institutions (Guiso, 2010). People looked for an alternative that could complement and substitute existing ones (Grinberg, 2012; Redshaw, 2017). Cryptocurrency emerged as needed. At the end of 2008, Satoshi Nakamoto launched the whitepaper of Bitcoin, proposing a peer-to-peer electronic cash system, which allows any two willing parties to transact directly with each other without the need for a trusted third party (Nakamoto, 2008).

Taking Bitcoin as the representative of early-stage cryptocurrency, it has brought various innovations. The first innovation is a decentralized form of currency. Bitcoin entails distributed ledger technology and uses proof-of-work mechanisms to achieve money production and management. The mechanism avoids excessive concentration of power, so that no single person or organization can manipulate the transactions. This provides a currency with the possibility to be “censorship-resistant” to government oversight (Werbach, 2018). Second, the creation of Bitcoin gives rise to the idea of alternative currencies. It is denominated as a unique unit of account

and operates in a parallel mechanism of existing fiat currency. The Bitcoin project is a signpost to character this “social sovereignty” (Bauwens and Kostakis, 2013), which strays outside of the existing framework and works as a competing currency to promote scarcity and currency competition. It proves that the existence and growth of alternative currencies besides the state’s fiat currency is possible. The competition between Bitcoin and fiat currency extent to the field of e-commerce, micropayment, financial inclusion etc (Grinberg, 2012; Scott, 2016). Third, the technology architecture. Blockchain, called the trust machine, allows people who have no particular confidence in each other to collaborate without having to go through a neutral central authority (The Economist, 2015). Not only Bitcoin and other cryptocurrencies are new disruptions for the world, but also the technology of blockchain is believed to be another revolution to transform peoples’ relations and business cooperation.

The function of cryptocurrency is expanding and changing. But the early understanding of cryptocurrency for the wider public seems to be more negative than positive. People had the most impressions of its illegal abuse from media sources in the beginning. Many condemned it as a tool for crime, such as illegal purchasing and money laundering. And there were also many severe hack events in the early exchanges, where a large number of coins were stolen from centralized exchanges. People questioned its existence thousands of times.

However, due to the scarcity and decentralized features of cryptocurrency, people started to consider cryptocurrency as an alternative currency. In 2013, when IMF and Cyprus’ government announced the Cyprus Bank bailout, depositors were struggling to take out their money from banks. People turned to Bitcoin to test out this decentralized currency. The Bitcoin price soon increased by 87% after the Cyprus Crisis. In 2017, when Venezuela experienced hyperinflation in its fiat currency, Bitcoin became very popular as an alternative currency to keep the value of assets. At this moment, Bitcoin plays a better function than certain fiat currencies to store value. The credit currency system of fiat money is based on the validity of national governments, and their willingness to pay out deposits and stabilize the value.

Similarly, in recent years when the world economy started to show hints of turbulence, the price of Bitcoin rose, and the market has become relatively more active. Many scholars compare Bitcoin with real gold, trying to determine whether Bitcoin can play the role of a safe asset. The results show that Bitcoin has some safe heaven properties, which can reduce the portfolio risk as a counterfeit in terms of oil price and stock market (Bouri et al., 2017; Dyhrberg, 2016; Selmi et al., 2018; Shahzad et al., 2019). Since Ethereum successfully raised \$19 million in a short time through a process called initial coin offering (ICO), ICOs started to catch the eye of the public. ICO is a financial innovation that plays the role of traditional venture capital to raise money for start-ups. The startups or project teams offer investors crypto tokens in exchange for the initial capital to grow. By using the crypto tokens, investors have the possibility to experience huge future capital appreciations, and enjoy the application of such tokens in the business ecosystems. In 2020, COVID-19 hits the global economy and financial market. Cryptocurrencies and related assets again drew international attention, even from large financial institutions, multi-national companies and famous celebrities. It is regarded as another safe haven similar to gold for the global turmoil (Mariana et al., 2021). In the meantime, new crypto-related concepts and institutions emerged. More decentralized autonomous organizations (DAO) and decentralized finance (DeFi) applications were born to compete with centralized organizations. Cryptocurrencies not only interfere with the macro economy through payment networks and market transactions, but also steps into the micro-level business environment to create niches for new opportunities.

With the concept of cryptocurrency becoming widely promoted, different forms of cryptocurrencies emerged. In the beginning, Bitcoin is the representation of all cryptocurrencies. Other new cryptocurrencies, such as Litecoin and Z-cash, are called altcoins. Most of them barely make new technological and conceptualized breakthroughs (Hileman Dr and Rauchs, 2017). Altcoins just slightly modified the original protocols of Bitcoin in certain aspects for optimization purposes, such as easier mining processes and more flexible supply. Later, with new technological innovations, some cryptocurrency platforms with new infrastructure designs and new features arise. Ethereum is one of them, as it provides a platform for building decentralized applications

and writing smart contracts through the use of Ether (Buterin, 2013). Cryptocurrencies evolve from purely digital currency to the fuel for technology platforms to empower users with decentralized structures to participate in creative activities. With the popularity of ICO and DeFi, new forms of cryptocurrency and tokens start to be appreciated by many actors. Tokens create new ways for fundraising for enterprises and engage multiple stakeholders (Chen, 2018). The process for converting the rights of assets or a claim into tokens is called tokenization (Narayan and Tidström, 2020). The token is an innovation under the category of cryptocurrency to facilitate the technology platform applications, and provides incentives for the growth of its ecosystem (Catalini, 2017). In recent years, there are many voices supporting the creation and development of stable coins. It is argued that one of the reasons for the failure of Bitcoin adoption is that the fluctuating values challenge the users through high uncertainties (Woodside et al., 2017). Stable coins provide consistent exchange value as well as higher legitimacy in most cases. It requires a stabilization mechanism by the accountable organization to ensure their value (Bullmann et al., 2019), such as fiat currency reserves and traditional assets. The widely discussed digital currencies in current days, including Libra (now changed its name to Diem) and central bank digital currency all belong to the category of stable coins.

The development of cryptocurrency is full of controversies and debates. Though there are still many unresolved issues in the development path of cryptocurrency, we can see that states, enterprises, and individuals attach more importance to cryptocurrency. In the near future, digital currencies will probably perform more and more vital roles in society, or at least, inspire more and more innovations for social change.

3.3 Challenges of Cryptocurrency

The birth of cryptocurrency is the result of mature modern technologies and coming problems of the global financial system. The fast-paced development of cryptocurrency is out our expectations, and it is deemed as a radical and disruptive innovation. Accompanied by new distributed technology, decentralized ecosystems, and unlimited potentials of cryptocurrency, a set of unique

and new challenges arise. The challenges posed by cryptocurrency include a range of social, economic, financial, political, and technical issues.

Cryptocurrency activities lack legitimate supervision that is easy to be used under ulterior motives. One of the first trading activities using Bitcoin showing up in mainstream media is the dark web “Silk Road”, which used Bitcoin as a major exchange medium to serve illegal markets for drugs. According to research, Silk Road-related trades made up approximately 4.5% to 9% of all Bitcoin exchange trades. This was a non-negligible share of the Bitcoin economy at the time (Christin, 2013). Lee et. al (2019) collected 5440 addresses to analyze cryptocurrency abuse in dark webs, where more than 80% of the address were identified as potential illicit addresses. In the past ten years, 46% of Bitcoin transactions involved illegal activities, which is equivalent to 24 million participants illegally achieving an amount of \$72 billion dollars per year (Foley et al., 2019). Under cryptocurrency investment, new forms of fund-raising, particularly ICO, have emerged as a popular way to bypass supervision and complex processes of existing funding methods. Many of them turned out to be Ponzi schemes, which make up approximately 150 million USD (Lee et al., 2019). Ponzi scheme is defined as investment fraud that involves payment of purported returns to existing investors from funds contributed by new investors (Security and Exchange Commission, 2013). It is argued that cryptocurrency platforms have created new places for these activities. These Ponzi schemes are highly concealed by trustworthy features by claiming to be blockchain projects that provide anonymity, unmodifiable transactions, and algorithm trust (Bartoletti et al., 2020). Farrugia et al (2020) use quantitative models to identify illegal activities in Ethereum networks. They show that many Ponzi schemes are masked as smart contracts, where those anomaly transactions have higher turnover days and higher transaction amounts compared to the normal account address. In addition, cryptocurrency is seen as a preferable tool for money laundering compared to existing financial instruments and services. The payment process without intermediaries, irrecoverable transactions, convenient international transfers, instantaneous transactions, and low transaction fees are all positive incentives for money laundering criminality (Brenig et al., 2015). Most perpetrators get involved with cryptocurrency activities using exchanges to launder their money. It is possible to trace a few steps for fund moving, but it would

be difficult for regulatory bodies to confirm the identity and final destination of the capital flow (Lee et al., 2019). Due to the lack of regulatory frameworks, digital currencies can achieve almost unconstrained cross-border flows and capital flight (Liu and Yuan, 2019).

From a financial perspective, cryptocurrencies are also exposed to high financial risk and market uncertainties because of their special features and market relations. Compared with traditional financial markets, the value foundation of cryptocurrency is different from traditional financial assets, which are primarily based on underlying assets, such as companies' profitability, industry outlook, and physical products. The valuation of cryptocurrency is more controversial and abstract. Some scholars claim that Bitcoin does not have any fundamental value or intrinsic value (Cheah and Fry, 2015), because the cryptocurrency cannot perform certain functions of a real currency, namely, being the medium of exchange, store of value, and the unit of account (Yermack, 2015). Kristoufek (2015) explored the price driver of Bitcoin through wavelet coherence analysis. The research shows that Bitcoin value formation is composed of three fundamental sources--cryptocurrency usage, technological factors, and speculative factors. Furthermore, cryptocurrency also has its own features that are different from traditional assets. It is particularly sensitive to market sentiment, including public interests (Liu and Tsyvinski, 2018; Urquhart, 2018), google search (Kristoufek, 2013), social media (Naeem et al., 2021), and policy and uncertainty in the world, such as geopolitical conflicts and international political events (Al Mamun et al., 2020; Aysan et al., 2019; Katsiampa, 2019; Wang et al., 2020). Kyriazs et al. (2020) summarized the digital currency price literatures and found that Bitcoin seems to have been in a bubble stage since June 2015; at the same time, since September 2015, Ethereum, NEM, Stellar, Ripple, Litecoin, and Dash are also considered to have bubble-like characteristics. The overall market risks of cryptocurrency are higher than the risks of existing financial markets (Troster et al., 2019).

3.4 Cryptocurrency and Public Authorities

Bitcoin bypasses trusted third parties, allows people to directly conduct transactions, and does not back up by any authorities or state. Such a decentralized form of currency rebuilds the concept of

money and power relations with public authorities, which has led to a number of questions related to fiat currency, regulations, and public power.

Banks and governments safely steered the wheel of currency until the birth of cryptocurrency. Bitcoin is decentralized, free from government interference and manipulation, and represents freedom (Bohr and Bashir, 2014; Filippi, 2014; Nian and Chuen, 2015). The ideology of Bitcoin criticizes financial intermediaries for playing roles in the distortion of market governance by abusing market power and state hierarchies (Weber and B., 2015). The concept soon won great popularity under the collapse of financial institution trust in the global financial crisis time, 2008. The emergence and prosperity of cryptocurrency were by no means a coincidence, but it is the result of complex dynamics at the right time, with the right method and the right opportunity.

As for the initial concepts of cryptocurrency, the idea is that currency should be fully decentralized, and that no one has absolute power to manage the currency (Narayanan et al., 2016: 230). The free participation in networks by any willing individuals guarantees that decentralized cryptocurrency cannot be taken over by any single party alone. The existence of millions of stakeholders makes it so difficult to manipulate that even states, possessing major power over governance, have no way to be the single ruler. One argument for this is cryptocurrency's legal status. In our understanding beforehand, currency should be acknowledged as legal tenders by official governments, even the issuer is independent. "Legal tender" is the terminology for fiat money. Hayek defined legal tender as "simply a legal device to force people to accept in fulfillment of a contract something they never intended when they made the contract". It implies a reluctant fact that people accept fiat money, not on the principle of voluntarism and the selection of mutual benefits, but due to compulsory obligation imposed by the state. Cryptocurrency goes beyond compulsory obligation, breaking the acquiesced contract between people and state (Bjerg, 2016).

The new characteristics of cryptocurrency create competing relations with fiat currency. However, the idea of competing currencies was not new. It was early proposed by Hayek in 1974. In Hayek's proposal, private enterprises should be allowed to issue currencies competing with government

fiat money, thereby free banking delimitates instability of purchasing power (Hayek, 1990). This notion is contradictory to the mainstream monetary system and theory, in which currency should be issued by the state or a single monopoly governmental agency.

Furthermore, the decentralized infrastructures make the control over “new capital” very difficult, that data and information have been defined as new capitalism in the 21st century (West, 2019; Zuboff, 2015). Traditionally, the major financial data are under the control of financial institutions within the reach of public authorities. However, in the case of decentralized cryptocurrency, relative information, such as capital flow, names of users, and usage of the capital are all beyond the knowledge and governance of the state. Crypto assets could be acquired, exchanged, and used without proper custody under state power. People are empowered with more freedom to bargain with the state. For example, to receive donations supporting activities that might not be known by the authorities. Such usage of cryptocurrency makes it very difficult for states to monitor and govern, causing the missing role of public authorities in the middle of transactions. Just as Dread Pirate Roberts said, “The people now can control the flow and distribution of information and the flow of money. Sector by sector the state is being cut out of the equation and power is being returned to the individuals.”

Under strong regulatory control over money, the struggle to survive has always been a problem for cryptocurrency. However, the emergence of cryptocurrency changed people’s mindset that competing currencies can exist, and better currency functions can exist. Bitcoin is called the “commodity money without gold, fiat money without a state, and credit money without debt” (Bjerg, 2016). These new characteristics of Bitcoin money signal a disruption of conventional money, which has been generally accepted by the public that governments hold a monopoly of money. The possibility that “individuals may use different kinds of money to hold (as liquidity reserves), to make contracts for deferred payments, or to keep their accounts in” (Hayek, 1990: 161) became positive. Decentralization, anonymous communication, and algorithmic production features characterize Bitcoin as a new proxy to defeat the governmental control and monopoly on the economy of the money supply. New formations could potentially disrupt the existing forms

of exploitation, risks, and violence embedded within the currency (Bjerg, 2016), however, it is impossible to free money and social ties from modern economies from a material embeddedness point of view (Karlstrøm, 2014). Therefore, how far cryptocurrency can move forward depends on whether cryptocurrencies can grow big enough to build their own momentum.

It is envisaged that the emergence of cryptocurrency could potentially cause a paradigm shift. Not necessarily covered by solely negative impacts, the new attributes of cryptocurrency can also contribute to the positive reconstruction and redefinition of interrelationships between governments, people, and institutions. From the point of view of state authorities, the governance model of cryptocurrency and blockchain technology is not necessarily an absolute threat to existing actors, because the usage of such technology may empower established centralized actors and processes (Campbell-Verduyn, 2018b). As a response to emerging threats by various cryptocurrencies from both decentralized and centralized sources, states have initiated the strategy of central bank digital currency (CBDC). For developing countries, the existing financial infrastructure is relatively defective, and the government hopes to issue CBDC to increase payment efficiency, facilitate financial inclusion, and improve the efficiency of monetary policy transmission (Boar et al., 2020). While developed countries are motivated to issue CBDC to improve payment security and financial stability, and promote the transformation of a cash society into a cashless society (Barotini and Holden, 2019). Meanwhile, currency digitization provides traceability to currency circulation and capital flows, which can help developing countries fight financial crimes. For example, by using cryptocurrencies, it will be easier for governments to track illegal transactions, supervise tax evasion, and predefine the usage of contingency usage (Barotini and Holden, 2019). The choice of CBDC research, design, and implementation become a strategic level consideration for the future governance in the digital currency and cryptocurrency fields

3.5 Governing Emerging Technologies

The relationships between digital technology and state governance are long-term protracted and intertwined processes. This is a complex and evolutionary dynamic marathon between

“innovation thrill” and “risk panic”. The new technologies require enough space to go through trial and failure stages, inspiring innovation in a free environment. Simultaneously, the unknown risks and uncertainties could challenge the existing framework of social and economic orders (Campbell-Verduyn, 2018b; Mandel, 2013; Scott, 2016).

For states, the essential problem is to develop the capabilities to deal with the heterogeneity of the knowledge and the risks of emerging technologies. In the entire governance process of digital technology, the state has a very important role, as it is responsible for the top-level design of the entire governance-structure, and has great power in setting the direction for governance, laws and regulations, and institutional innovation (Wang, 2015). The governance for digital technologies is not to impose one-size-fits-all command or control, but to design a flexible mechanism that can respond to changing knowledge and environments, properly balancing the benefits and risks that the new technologies bring to society (Mandel, 2009). Meanwhile, the purpose of state governance is to maintain the political order, which means that public authorities should allocate value in a sustainable and stable manner (Peng, 2021). In this process, the state has the authority to define how power should be used, how decisions should be made, and how standards of accountability can be implemented and developed for such technologies (Saner, 2013).

Political institutions are required to pursue a flexible way to balance the risks and benefits they are faced with by emerging technologies. Linkov et. al (2018) take the risk angle toward the governance of emerging technologies. The research proposes a comprehensive approach in the governance process, which takes into account the collaborative nature of multiple stakeholders, the limitations of currency’s quantitative orientation for measuring and analyzing risks, and the diverse criteria of risks, costs, benefits, and social implications. The approach can be taken based on the willingness of public and private actors, knowledge-based adaptive assessment, and decision-making processes. Under this governance dynamic, how states act and react to emerging technology changes also requires experimentation and feedback from earlier decisions. Some argue that the precautionary strategy will lead to the suspension of the ongoing processes, especially for those necessary to call for a stop to further development, for example, biotech research with

ethical issues (Hoffman et al., 2012). The precaution can be understood as an attitude of public authorities for scrutinizing instead of standard-setting to direct the action (Wolff, 2014). Whitford (2020) offers an integrative logic for emerging technology governance. It is claimed that we should focus on two dimensions. The first is the nature of the regulatory target, which is the object of governance. The object-oriented perspective focuses on value efficiency in allocation and the attributes of the good itself. The second dimension is the nature of the process that the state advocates for in governing the target. This implies a process-oriented consideration, which emphasizes a broader set of values, such as participant stability and legitimacy. The two dimensions interact with each other and should be combined in governance strategy. When states adopt emerging technologies, it is important to take proactive and adaptive approaches (Peng, 2021).

It is argued that we will never be able to fully understand the whole risk before the emerging technology develops further (Mandel, 2013). In reality, neither technologies nor risks are exclusively objective or factual phenomena, but they are socially constructed, depending on the subjective attitudes, understandings, values, and cultures of the actors and environments (Abbott, 2013). How to choose and balance different governance strategies should also consider the context of different states, the nature of the emerging technology, the acceptance level for citizens, and the adaptation capabilities of the government agents.

Here I believe that governance is about stewardship, collaboration, and incentives to act on common interests (Tapscott and Tapscott, 2016). Governance should extend beyond methods for controlling emerging technologies, especially where those technologies are changing faster than regulatory agencies can foresee or adapt, and where they raise difficult ethical issues (Saner, 2013). It is important that the governance of emerging technology does not halt the innovation, but establishes conditions for scrutiny that can guide the emerging technology on the way to success (Kaebnick et al., 2016).

3.6 Cryptocurrency and Global Efforts

When taking a closer look at the theory, implementation, and stages of governance for cryptocurrency specifically, we can see divergences in global governance, but also collective efforts and directions by central states.

Cryptocurrency governance faces lots of challenges due to its unique nature. A variety of digital currencies, led by Bitcoin, have a super-sovereign nature, and offer new characteristics compared to traditional fiat currency. It is argued that there is a possibility that people will adopt new digital currency after the repeated failures of fiat currencies, such as hyperinflation and financial crisis (Weber and Bear. 2015). The recent threat to fiat currency was the announcement of Libra (now Libra has changed its name into Diem), a cryptocurrency governed by the Libra association, which is consist of many tech giants, and also includes Facebook itself. From a macro perspective, the development of digital currencies may bring risks to financial instability, touching upon many aspects in terms of transaction payments and international settlement, such as exchange rate changes, currency liquidity, and system design, which can cause turbulence in the financial system (Zhao 2020). Furthermore, blockchain and crypto assets rely less on physical artifacts and intermediaries to achieve innovation dissemination, which is considered as immaterial and decentralized in the process. These types of digital technology are characterized by their non-proprietary and open-source nature, which makes it difficult for regulatory bodies to implement control over (Beaumier et al., 2020).

The multiple facets of cryptocurrency make governance very difficult to balance, and the arguments for how to manage it are diverse. In North America, the state holds a relatively positive and liberal attitude toward cryptocurrency. Most governance has been focused on the administrative and agency level, with the Securities and Exchange Commission (SEC), Financial Crimes Enforcement Network (FinCEN), and Commodities and Futures Trading Commission (CFTC) leading the engagement (Deway and LLP, 2019). There is no unified definition for cryptocurrency to clarify its property as virtual currency, property, or digital assets. For the usage of cryptocurrency, it must follow relevant anti-money laundry laws and require a license for

conducting relevant activities. In general, it is considered as taking a permissive governance strategy for cryptocurrency (Chohan, 2017). In Asia, the regulations for cryptocurrency are comparably more conservative. China adopted a prudent enthusiastic attitude towards cryptocurrency at an early stage, that balanced the risks and opportunities of cryptocurrency with a middle-ground approach (Zhang and Jia, 2017). However, later, the People's Bank of China (PBoC) banned ICO activities and trading exchange activities for cryptocurrency. As for South Korea, there is no clear prohibition for institutions to use cryptocurrency and the registration for investment funds. It requires identity verification for cryptocurrency exchange and banned margin trading in 2017. Japan is the first country to have enacted a law defining "crypto-assets" in a legal term, and there is a legal definition for cryptocurrency by the "Payment Service Act". Businesses registered by local agencies are allowed to conduct cryptocurrency-related activities. The governance for cryptocurrency is under the regime of prudent permission, where Japan tries to protect users and control unknown risks. In Europe, the governance strategies for cryptocurrency are comparably looser. Taking Switzerland for example, there is no compulsory prohibition towards any cryptocurrency activities, and no specific license is required to conduct crypto activities. Both the government and the Swiss Financial Market Supervisory Authority (FINMA) hold positive attitudes toward cryptocurrency, considering cryptocurrency as a new force of innovation. The open environment attracts a group of world-leading blockchain/cryptocurrency companies clustered in Zug of Switzerland, forming an acknowledged Crypto-Valley. In the European Union, crypto asset regulation has transformed from a niche discussion into a priority agenda within the highest political institutions, such as European Central Bank (ECB). Many countries have not yet adopted any particular strategy. But EU countries tend to have tolerant and open attitudes toward cryptocurrency. In September 2020, European Commission put up a proposal for "Markets in Crypto-assets". This proposal covered the previously neglected category of crypto assets. This document provides governance guidance for the European Unions with the aim of defining legal certainty, supporting innovation, instilling appropriate levels of consumer and investor protection and market integrity, and ensuring financial stability (Houben and Snyers, 2018).

Regulatory responses to cryptocurrency in different jurisdictions are emerging and are subject to changes as time passes by and the development of cryptocurrency goes into different stages. In the current state, there are still huge differences in regulatory attitudes and governance methods of digital currencies around the world, and there is no unified standard and coordinated regulatory cooperation (Zhao 2020). The governance of cryptocurrency or crypto assets is subject to changes in the international environment and depends on the interaction between state actors and non-state actors. It is also influenced by competition, collaboration, and conflict amongst different actors across international regimes. This is by no means a one-way or unidirectional relationship (Campbell-Verduyn, 2018b). States must realize that the new role in governing blockchain and cryptocurrency with its decentralized nature is different from the role of governing traditional financial institutions with a centralized nature. It requires the authority agencies to tolerate and even welcome the innovation that could potentially push the boundaries (Tapscott and Tapscott, 2016) and achieve long-term global cooperation and public-private cooperation to build international dynamics for the success of cryptocurrency governance (Beaumier et al., 2020).

3.7 Concluding Remarks

Different layers of cryptocurrencies create unique features. The technology aspect is closely connected with blockchain technology, which has the potential to “reshape the world of business and transform the old order of human affairs for the better” (Tapscott and Tapscott, 2016). At the same time, cryptocurrency not only redefines the concept of currency and ushers in a new era of currency competition, but also turns out to be a new financial tool in the market for hedging, trading, and speculation.

However, the special features and new orders created by cryptocurrencies also generate concerns. On the one hand, we can see that the development of cryptocurrency brings about various kinds of risks, including illegal activities, financial market risks, and social and political uncertainties. On the other hand, as for states, cryptocurrency also brings new challenges to public authorities, including money monopoly, rights for control, and importantly, the mindset transformation in the money concept.

The governance of cryptocurrency has become a key issue to be discussed by states. It is not a simple “one-size-fits-all” choice but requires different governmental agencies to strike balances between risk and innovation. In these processes, we can see that there are divergences in attitude, action, development road, and governance method. But there are also collective efforts and similar governance directions by central states, that they are willing to use digital currency as a tool to strengthen the existing mechanism to certain degrees.

Chapter 4 Summary and Contribution of Each Paper

4 Summary and Contribution of Each Paper

4.1 Paper 1: Bibliometrics and Network Analysis of Cryptocurrency Research

The thesis starts the analysis with Paper 1 to create *an overview of the development path of cryptocurrency and cryptocurrency research*. By analyzing their evolutionary paths, this paper also provides a descriptive answer to the question of *whether cryptocurrency has been perceived differently by different actors*, which helps to clarify the changing roles of cryptocurrency vertically and horizontally.

This study collects a total of 833 publications from Web of Science Core Collection and Scopus in the period of January 2008 to June 2018. I examine the descriptive features, countries' research interests and collaboration networks, author collaboration networks, and reference co-citation networks to identify factors with significant influence in this field. In each country, cryptocurrency research has different focuses which reflect the nation-states' interests in understanding cryptocurrency. The intellectual bases of the cryptocurrency domain rest on the early-year literatures that provide fundamental knowledge for cryptocurrency area, and those bridge the understanding of cryptocurrency from different angles. In addition, this paper also draws a crude evolution path of the role of cryptocurrency in the past ten years. As time passes, the research focus shifted from threat talks to technological fundamentals and to new market features. The potential functions and roles of cryptocurrency have been gradually uncovered by the public.

Researchers have been very familiar with the bibliometric method to conduct systematic reviews for a research domain. However, seldom has scholars thought about taking this perspective as a way to examine social phenomena. I find out that bibliometric analysis of the cryptocurrency domain not only provides us with knowledge about the intellectual basis of the research field, but also opens a new angle to consider how cryptocurrency has been perceived and considered by different actors across time and geographical locations. In many cases, research interests are

concerned with practical discussions in the society, therefore, looking through the countries' focus, research trends, and key clusters of intellectual bases will help us to understand the evolution and primary concerns of the debates. This paper aims at giving a description of the development and evolution of cryptocurrency as well as a systematic analysis to complement the literature reviews.

4.2 Paper 2: How Money Became a Symbolic Medium of Exchange – Comparing the Trajectories of the Western and Chinese Currencies

In the core session of the thesis, I start with a historical analysis of (crypto)currency as a symbolic medium of exchange in both Europe and China. This paper assesses the evolution trajectories of how currency gradually developed and led to the rise of cryptocurrency. The whole process tells us some stories about *the interactive process between (crypto)currency and the state*. This paper also re-investigates the *conventional role of currency as a medium of exchange in the economy*. I consider cryptocurrency as a continuation of traditional currency. In order to understand the modern technological currency (cryptocurrency), it is important to look back and examine the nature and sources of currency emergence and its interrelationships with the important actor- the nation-states. History is a good teacher. Taking a historical view to rethink the meanings and roles of cryptocurrency in the modern world helps us to better understand the main conflicts and debates in different regions. The emergence of cryptocurrency is a natural process under the advancement of technology and innovation.

Paper 2 also partly answers the research question of *how and why does cryptocurrency emerge and develop?* Starting from the discussion of “modernization paradigm”, this research conduct a thorough analysis of monetary development trajectories in Europe and China. Europe and most of the western world experienced monetary development from commodity currency to paper currency, and to fiduciary currency. However, China experienced special trajectories with recursive cycles of commodity currency and paper money. Finally, the fiduciary currency arrives in the late 19th and early 20th century in China. The differences and the complexity of the two different paths derive from the differences between Europe and China in terms of military

structure, perceptions of money and institutional arrangements. Those differences further contribute to the modern economic and political relations between the two regions.

In addition, this section also gives an answer to the question that *whether cryptocurrency has been perceived differently by different actors? And what are those differences?* I consider that the roles of cryptocurrency in the two regions are influenced by their historical inheritance. Cryptocurrency is an alternative to existing mechanisms and a new medium to connect people around the world. Additionally, the paper assesses cryptocurrency systems based on the historical characteristics of the two regions. It is argued in this paper that the emergence of the digital currency will not change current “similar but also diverging” roads of monetary development in the West and China. The coexistence and coevolution of the two mechanisms is more likely to happen in the future.

This paper focuses on the *past* in the timeline of this thesis, and builds a connection between traditional currency and modern digital currency. It draws on conceptions of money from different theories, and challenges the traditional modernization paradigm concept from a comparative angle. Seldom has attention been given to the comparison of monetary system development between the West and China in the research. The paper takes the case of monetary development to compare the different social-political relations between the West and China. Further, this paper combines historical context with modern views, which offers a new angle to connect the traditional currency with the new emerging digital currency. Considering the differences between the West and China in terms of the perception, institutional arrangements, and historical influences for money, we can better understand the different actions and reactions towards the rise of cryptocurrency in the two regions. It contributes to the understanding of digital currency development, its distinctive roles in different regimes, and also the differences with traditional currency.

4.3 Paper 3: Cryptocurrency on the Rise – A New Challenge to the Territorial State?

This paper answers the research question about the *differences between cryptocurrency and existing money, and the shifting position of cryptocurrency*. The paper place more importance on the *present* discussion and position of cryptocurrency. It is the continuation of Paper 2 and seeks

to describe the new challenges and development trajectories of modern digital currency. This piece contains *detailed analyses of interactive processes between the Chinese state and cryptocurrency*, and we can also draw some conclusions from this process to answer *why states cryptocurrency with special caution*.

This paper starts with a discussion on whether the economy is an autonomous force or a concept that is closely connected to politics. In the conventional understanding, the state possesses the monopoly on the legitimate means of violence, taxation and currency. As the economy increasingly became an autonomous social force, it is getting more and more difficult for the political power to govern and control the direction of economic changes. In the meantime, some others claim that economics is subjected to politics. The economy serves the state as an instrument and is closely connected to politics. Over time, cryptocurrency is affiliated with certain actions that are considered as “out of control”. With more and more symbolic meanings attached to cryptocurrency, states started to notice the potential disruptions toward the traditional system. Consequently, due to the decentralized designs and the disruptive innovations of crypto-related activities, digital currency has gradually turned into a potential risk for the state as well as a new instrument for states to strengthen their power.

Through a detailed interactive analysis, the emergence and development of cryptocurrency in China have been divided into four phases based on different policies and regulations. The research observes a shift in attitude and governance strategies by the Chinese state when faced with different types of risks and uncertainties in different development stages. Such changes of cryptocurrency development in China can be interpreted as the actions and reactions of the state in responding to the different roles of cryptocurrency in recent years.

The research in this chapter also reflects the process of the state's interactions with cryptocurrency and its conflicting interests in balancing risks and opportunities. Another key question here is whether the development of the latest digital technologies will undermine the key capacities of the state to control, regulate and monitor its own territory. This paper identifies three key factors for the Chinese state when balancing different sides of cryptocurrencies. They are the risk of

capital flight, the risk to impede social stabilities, and the risk of cryptocurrency as a competing currency. The balance between technology innovation and proper governance becomes a major concern for states *at the present*.

This paper further presents four different governance strategies according to risk tolerance and major driving forces of different states. They are 1) laissez-fair governance model; 2) stewardship governance model; 3) precautionary governance model; 4) prohibitive governance model. Based on the proposed framework, I summarize the changing governance strategies of the Chinese government. In the end, a final discussion about how China started to consider digital currency as a potential new national governance instrument has been presented.

This paper illustrates the changing roles of cryptocurrency in the context of China. It contributes to the understanding of how cryptocurrency has been developed in China through detailed case studies, which helps researchers to better understand the divergences of cryptocurrency development in different regions. Moreover, this research makes contributions to the theoretical foundation in the field of digital technologies governance. Based on the case of China and existing literatures, a new governance framework has been proposed to further the understanding of digital governance from the state level.

4.4 Exploring the Bitcoin Dynamics Before and After COVID-19 Shocks-An Investigation of Major Global Events

Taken from the previous studies, cryptocurrency has become a major concern to the state. Apart from the reasons analyzed above, one of the other reasons derives from its market activities. It is less likely that cryptocurrency can really pose threats to the fiat currency at the present moment (Partington and Kollwe, 2017), however, the potential to become a new asset class in the financial market is more promising. The global trading mechanisms and special market features of cryptocurrency make its market activities full of risks and out of the scrutiny of the state's control.

Paper 4 answers the questions of *how and why cryptocurrency emerges and develops*, and *demonstrates the new possible roles for cryptocurrency*. This paper places emphasis on *the market features of cryptocurrency in its financial development pathway* and shows *how cryptocurrency has been interrelated but also different from the other assets*. The study investigates the *roles of cryptocurrency over time from a more micro-level- financial dimension*. Furthermore, the fourth paper also aims to *project the future roles of cryptocurrency*, as the role of cryptocurrency to be a financial instrument starts to dominate its usage.

The COVID-19 pandemic is a watershed that has disrupted the order of the world, including the patterns in the financial markets. This paper uses both quantitative and qualitative methods to explore the market risk contagion effect between Bitcoin and other assets to show the role changes of cryptocurrency before and after COVID-19. The empirical results show that Bitcoin has some resilience to risks, but cryptocurrency is more connected to the other market after COVID-19. The impacts from developed countries became relatively stronger. This paper also identifies a few events to explain the new market dynamics of cryptocurrencies. Those events include global political incidence, geopolitical affairs, and regulations and policies related to the cryptocurrency field. The changing roles of cryptocurrency in the market also involve complex and unpredictable external factors, especially with nation-states. The finding shows that China still has some impact on cryptocurrency markets, but its impact is waning. In most cases, Bitcoin is not a safe haven when nation-states exert influence. However, Bitcoin can work as an alternative payment method during extreme turmoils, such as the Russian and Ukraine conflict. This reflects the threats that are posed by cryptocurrency to existing monetary systems, as well as a growing trust in non-governmental currencies.

This financial angle to investigate the emergence and changing roles of cryptocurrency offer readers new insights from the meso-level. This paper also provides extra evidence to observe the shift and competition between states and non-governmental organizations in terms of cryptocurrency. This is very important not only to investors but also to nation-states to understand the role of cryptocurrency in the market. The financial relations between Bitcoin and the other

markets show dynamic changes in cryptocurrency's role in different periods. We can regard market behaviour as a clear reflection of people's changing attitudes and perceptions of its functional shifts over time. Having enough knowledge about cryptocurrency at the market level will help governments to make better decisions on exploring the potentials of digital currency and launch rational policies to navigate its development.

Chapter 5 Conclusion of the Dissertation

5 Conclusion

5.1 Revisit Research Question

This dissertation intends to investigate the *different roles of digital currency, particularly cryptocurrency, along its development path and its interactions with existing systems*. Three words- “difference”, “perspective”, and “time”-have been put up to provide different research hierarchies. Three sub-questions have been proposed. They are: 1) *What are the differences between cryptocurrency and existing money?* 2) *Whether different actors perceive cryptocurrency differently?* 3) *How and why cryptocurrency has emerged and developed?*

This dissertation answers the research questions together with four articles. It is not necessarily that one single paper answers one research question, but the four papers try to collectively give a coherent and comprehensive answer to the research question.

5.2 Theoretical Contributions

Digital currency is a nascent research field that emerged approximately a decade ago. In this regime, there are lots of unknowns waiting to be found. This thesis combines various standpoints to investigate digital currency development and its relationships with different actors over time. The whole dissertation creates a comprehensive and holistic picture of cryptocurrency development and its ecosystem, which helps to enrich the understanding of existing cryptocurrency literatures.

The first contribution of this project is a holistic description and comparison of digital currency’s evolution both vertically and horizontally. Digital currency is a global phenomenon, and different regions have their own specific approaches and considerations when dealing with emerging issues. However, rarely has research analyzed digital currency from different perspectives. Paper 1 illustrates the cryptocurrency development and role changing from an indirect analysis of

cryptocurrency research. The transformation of the research trend and different research focus in various regions reflect different perceptions and focuses of cryptocurrency across the world. Moreover, in Paper 2 and Paper 3, I take Europe and China as exemplary cases to illustrate the emergence and development of (crypto)currency from a historical lens. The comparison not only offers complementary understandings of how and why cryptocurrency emerges in different contexts, but also shows the divergences in considering, managing, and governing cryptocurrencies in different backgrounds.

Second, the contribution to the governance of digital currency. Current digital currency governance for cryptocurrency primarily focuses on the discussion of legal issues (eg. Campbell-Verduyn 2018; Sapovadia 2015) or on the decentralized governance of cryptocurrency mechanisms (eg. Spithoven 2019; Trump et al. 2018). This dissertation analyses the interactions between the states and cryptocurrency through theoretical analyses and detailed case studies (Paper 2 and Paper 3). I describe the process of relational changes between the states and cryptocurrency and propose different governance strategies for states to integrate risk appetite and driving forces of the nation. The detailed analysis of the dynamic interactions offers important knowledge to help states balance the risks and opportunities of digital currency under different governance frameworks.

Third, this thesis contributes to the empirical understanding of cryptocurrency dynamics. This thesis has employed quantifiable data to explore the roles of cryptocurrency in different contexts and time periods. In Paper 1, the evolutionary path of cryptocurrency research reflects the key focus changes in society, and what are the fundamentals that contribute to the distinctive features of cryptocurrency from the research angle. Paper 4 provides new evidence for understanding the roles and interactions of cryptocurrency with traditional assets in the market context during different periods, particularly after the COVID-19 pandemic shocks. The results enrich the understanding of cryptocurrency's property as a hedge, diversifier, and safe haven in the financial market.

Forth, apart from the new understanding of cryptocurrency studies, *this thesis provides a novel research perspective, which challenges the existing exclusionary thinking*. There are theories, such as the modernization paradigm and the discussion about whether economy and politics are independent driving forces, either fall into exclusionary thinking or fall into certain dichotomy thinking. This thesis considers the relationships are not exclusionary but they are interactive and dynamic. The cases of cryptocurrency development in the West and China illustrate such differences and also show the complexities behind the phenomenon. Multi-dimensional research angles have been applied to the study, therefore, allowing the investigation to take into consideration of specific contexts and distinctive methods when dealing with cryptocurrency development. The analysis complements traditional understandings and offers a novel angle to conduct research.

Last, methodological, this thesis also makes contributions to existing research paradigms. Many argue that there is a gulf between qualitative and quantitative research with each belonging to distinctively different paradigms (Layder, 1988). I consider two seemingly contrasting paradigms that complement each other, which offer researchers both a relatively objective view and an interactive view to consider the research question. This dissertation combines quantitative and qualitative research methodologies, including empirical studies, case studies and theoretical analysis. Mix method offers the research with wider knowledge foundations and different dimensional understandings, which breaks the limitation of most existing research with a single methodology in this field. Paper 1 and Paper 4 employed positivism to investigate the role of cryptocurrency from empirical evidence. The results offer more objective and repeatable generalizations in terms of patterns, features and characteristics. Paper 2 and Paper 3 use interpretivism to demonstrate and explain the interrelationships between social actors and digital currency. The application of mixed methods allows this research to develop more comprehensive considerations in understanding the phenomenon of the rising cryptocurrency.

In sum, this PhD project integrates a mixed research paradigm and multi-dimensional research angle to conduct cryptocurrency analysis, which helps this nascent field to further understand its development, governance, market dynamics, and its interaction with existing mechanisms.

5.3 Practical Implications

From government perspective, this thesis contributes to the decision-making process of the state and governmental policymakers. Cryptocurrency is a combination of innovations and potential risks. For state authorities, taking the reactions of other players in the market and the goal of governing digital currency into consideration are essential factors when making decisions. When governing digital currency, states need to strike the balance between technological innovations and potential threats. The policies should neither hamper innovations nor eliminate opportunities. This research has uncovered the differences between historical economic-political relations and modern practical considerations of currency and digital currency in different regions. Therefore, each nation-state should consider its own preferences and special issues when facing the challenges brought by digital currency. There is no single solution for all territories. If states take the best use of digital currencies, it is possible that they can become a new instrument for state governance and a new financial asset for market governing in digital era. Apart from the efforts of a single state, international collaboration and global consensus are also necessary for combating illicit usage of digital currency.

The detailed analysis of the dynamic roles and the interactions between different actors helps institutional players to better project the future development of digital currencies. For firms involving businesses related to the ecosystem of digital currency, closely following the state policies and innovation trends help enterprises to prevent unexpected political risks, to exploit the benefits of the policies, and to gain competitive advantages. Particularly for those aspects that could have great impacts on their usage of digital currency, such as policy and regulation trends, cryptocurrency potentials, and technology applications. For financial institutions, this thesis helps them to understand the dynamics of cryptocurrency in both market environment and institutional environment.

For individuals, this dissertation helps them to understand the development of cryptocurrency from different perspectives. Individuals also play very vital roles in pushing the development path of digital currency. It is important for individuals to have some knowledge about the potentials and risks of cryptocurrency. It seems that society changes slowly and gradually, but it is marginally changing all the time toward a direction of being more technological and digital advance. Digital currency is definitely one of the advancements and new disruptions that can potentially change our life.

5.4 Concluding Remarks and Future Research

This research investigates the roles of digital currency, particularly cryptocurrency, and its interactions with multiple actors from different angles. This dissertation encompasses four articles. The first paper uses cryptocurrency research to examine the overall changes of cryptocurrency since its emergence and complement the literature reviews of cryptocurrency research field. The second paper compares the monetary development trajectories in Europe and China from a historical view, and analyzes the new distinctive features of digital currency as a symbolic medium of exchange. The third paper analyzes the interactive process between the Chinese state and digital currency in recent years and proposes a digital currency governance framework for nation-states. The fourth paper analyzes the market dynamics of cryptocurrency in the financial area through empirical evidence and also explains such dynamics by identifying possible influential global events.

The overall analysis illustrates the dynamic roles of cryptocurrency from its 1) development path; 2) differences with traditional currency; 3) interactive processes with multiple actors; and 4) treatment by states. This research integrates both ontological and epistemological philosophy to answer the research questions and uses both qualitative and quantitative research methods to conduct the analysis. It is a comprehensive piece to understand the different facets of digital currency from multi-dimensional angles.

From the four articles, this dissertation has drawn certain conclusions. *First, the emergence and development of cryptocurrency have been together impacted by many factors, including the intentions, aims, and actions of both states and individual participants.* Different states have different considerations related to cryptocurrency governance. Among all factors, the policies and regulations of states can largely affect the trajectory of digital currency development. The roles of digital currency experienced from alternative payment methods of monopolized money to speculative assets in financial markets, to technological innovation, to tools for illicit activities, and to the instrument of state governance. However, we should also notice that the changing roles of cryptocurrency do not follow a single direction designed by states or individuals. Different roles co-exist at the same time depending on the perceptions and the purposes of the user. Many players who participated in the markets influence the development path in one way or another. That is to say, no single actor is able to define digital currency development, even for the state, but it is an unintended consequence of the interactions between different actors, including states, institutional players, and individuals.

Second, apart from the technology fundamentals of cryptocurrency, the primary difference lies in the role of nation-states in the two monetary mechanisms. States have played an important part in monetary development for hundreds of years and created unique political and socio-economic relations in their territories. To some extent, it was the state and the needs of the state that influenced how money has been developed. However, cryptocurrencies manage to somehow survive and evolve independently from the interference of states. In contrast with fiat currency, digital currency lives beyond boundaries as a new generalized medium of exchange and can grow without the backstop of states. People tend to believe digital currency is an alternative to existing mechanisms and attach it with supranational tags. The absence of state control and the potential risks of using cryptocurrency makes it a major concern for governments, which also causes a series of interactions and negotiations between cryptocurrency and states in the long run.

Third, the interactive processes between digital currency and other actors are dynamic and complex. There are proactive actions to protect the existing mechanisms and participated

individuals, and there are also defensive reactions to restrict and control certain roles of cryptocurrency. The actions and reactions between states and cryptocurrency were not constant, but are dynamically changing with the shifting roles and the new emerging risks and uncertainties of digital currency. The process is not linear or unidirectional, but it is a winding path involved with the command of political and economic power, and a balance of unwanted risks and wanted opportunities. There is a game-play process between the state and private participants, and each has its own focus and demand for digital currency. During this process, it is important that the actors have the flexibility to adjust to the changes of digital currency, the capability to select a desirable way to interact with digital currency, and a dynamic strategy to strike the balance for different consequences.

Forth, there are divergent ways to perceive, use, and govern digital currency by different actors, and this tendency might persist in the future. On the one side is the full acceptance of cryptocurrency, and on the other side is the full prohibition of cryptocurrency. However, the divergences are not standing at the two ends, but it is a dynamic process that might be subjected to changes over time, and it is the consequences that are deliberately selected to benefit and fit the interests of the state. The case of (crypto)currency development in Europe and China demonstrates such divergence. The differences are justified by the distinctive economic and political relations and dominant driving forces of each region, where the historical monetary and state development has great impacts. Through the interactions, it is shown that there is no superior way to treat digital currency, but there are suitable ways for each region to chase its own priorities and development path. Therefore, divergences might still exist in the near future. Even though collective efforts are required from different regions, a global consensus would be difficult to reach under the different goals and aims of different regimes.

In sum, this thesis provides a clear description of the dynamic roles of digital currency from various time dimensions and actor standing points. Digital currency was regarded as a payment method for users who turned to alternatives in the beginning. With more and more actors participating in the cryptocurrency markets, digital currency started to play different roles in

different fields. The birth of cryptocurrency transformed traditional currency from the instrument of states into a new medium of exchange to connect people and exert bigger influences in the digital universe with new ideologies. On the other side, the state wants to unbundle the currency function and technology function of cryptocurrency and further explore its potential of being a new instrument for state power (eg. CBDC). In financial areas, in the long run, digital currency might not continue to work as traditional money. Instead, it is rising as a new asset class in the market. The roles of digital currency are multi-faceted and have always been evolving. It encompasses technological, financial, political dimensions etc. Some of the features create tensions, but others bring opportunities for innovation. Though there are differences in attitudes, governance, and usage of digital currency in different territories, most actors try to co-evolve with the new development and adapt to the changes by balancing risks and opportunities in their own way.

Based on the findings of this thesis, I believe that digital technology is changing rapidly and will gradually transform our life habits and behaviours. The traditional currency and monetary system will exist for long under proper governance by the efforts of states. However, the two systems will adapt to each other marginally and gradually. There is still a long way to go for both to fully integrate the complexities and dynamics of each other.

This thesis opens some avenues for future research. First, cryptocurrency is a new thing that emerged approximately a decade ago. It is an extremely interesting phenomenon that combines different elements that previously have not been associated with each other, such as technology and money. This thesis is just an early attempt to integrate various aspects of digital currency. Further research could try to select two related but also contrasting facets of digital currency to analyze their impacts and interrelations. Second, just as what I found in this dissertation, the role of digital currency and the interactions between digital currency and other actors are dynamically changing. This will cause new relations and new future stories. Therefore, more attention can be paid to how different actors balance the risks and opportunities in their actions, including how digital currency coexists with legal tender and the impact of different events on digital currency.

Third, while I try to explore the development path of digital currency, one of the major issues in terms of understanding the interactions is to understand the pain points in the governance process. I believe that a more comprehensive governance framework to ease the concerns, and a way to balance the risks and opportunities of digital currency in specific contexts are worthwhile topics to investigate further.

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Paper 1

Bibliometrics and Network Analysis of Cryptocurrency Research

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Abstract

Cryptocurrency, as an emerging social phenomenon, has attracted great research attention and has started to form a new research area in the past decade. A thorough review of the existing cryptocurrency literatures helps us to understand the status-quo and the promising research future of this emerging field. This paper provides a systematic review of the cryptocurrency literatures by employing bibliometrics and network analysis methods. A total of 833 publications from Web of Science Core Collection and Scopus have been collected in the time period from January 2008 to June 2018. We examine the descriptive features, countries' contributions and collaboration networks, author collaboration networks, and reference co-citation networks to identify actors with significant influences in this field. The results show that cryptocurrency research is experiencing an exponential growth, but scientific collaborations between different countries and authors are still insufficient. The intellectual bases of the cryptocurrency domain rest on the early-year literatures that provide fundamental understandings of cryptocurrency, and that bridge different research fields. The analysis indicates that the current research trend focuses on cryptocurrency market analysis incorporating market behaviours and trading characteristics.

1 Introduction

Not so long ago, the term currency has been mostly related to a physical concept, such as commodity and fiat money. They have held historic importance for economic activities of the people and the country. Throughout time, fiat money has been mostly governed by the monetary systems of sovereign governments. Nowadays, currency classification seems to contain yet another type of money called cryptocurrency. By definition, cryptocurrency is a digital currency used as a medium of exchange that is based on cryptographic technology, which helps to secure transactions, control distributed amounts, and verify the transfer of assets (Chohan, 2017). The creation of the first cryptocurrency dated back to 2008 when the whitepaper of Bitcoin was introduced to the world. Among all cryptocurrencies, the most well-known name is Bitcoin. It is the first popular decentralized cryptocurrency that is not backed up by any government or legal entity. Most research projects about cryptocurrency only started shortly after the creation of Bitcoin. The birth of decentralized currency has revolutionized public perceptions about money, financial systems, and technology. The anonymous, decentralized, trustless, and highly secured cryptographic features of cryptocurrency become more and more acceptable to the mass public. It is regarded as a disruptor to established systems, coming with both new opportunities and challenges. The technology behind Bitcoin, called blockchain, has also come into the awareness of different industries as a potentially powerful tool to bring organizational efficiency, collaborative benefits, and technological leapfrogging.

Bitcoin is made possible by blockchain technology. However, Bitcoin and blockchain can be also viewed as two separate entities - Bitcoin is one of the cryptocurrencies, which is a social institution. While blockchain is one type of protocol architecture, which owns its special technological characteristics. Cryptocurrency and blockchain demonstrate two interrelated but also very different underlying concepts of the system.

Even though cryptocurrency research and blockchain research share some similarities, the research direction and focus can be distinctive from each other. Many scholars have conducted thorough reviews of blockchain research (Holub and Johnson, 2018; Maddox et al., 2016; Miao

and Yang, 2018; Seebacher and Schüritz, 2017; Yli-Huumo et al., 2016). Some of them emphasize the technical aspects, such as protocol design and optimization of blockchain technology (e.g. Seebacher and Schüritz 2017; Yli-Huumo et al. 2016). Others do not notice the diverse focus of blockchain research and cryptocurrency research, (e.g. Holub and Johnson 2018; Maddox et al. 2016; Miao and Yang 2018), treating all of them as blockchain research in a general sense.

The relatively short history of cryptocurrency has resulted in many gaps within this research domain, hence leaving great possibilities for scholars to expand and deepen the knowledge base and research collaboration in the future. However, there is a lack of thorough understanding of this newly emerging field. This paper conducts a systematic review of cryptocurrency research by employing bibliometrics method and network analysis to analyze the status-quo of this research domain. This paper aims at identifying actors with significant influences contributing to the intellectual base of the research field from macro to micro-level, namely from country level to individual author and paper level. Furthermore, from the shifting topics and trends of those intellectual bases, this paper further illustrates the transformation of the roles and focuses of cryptocurrency itself. It is important to say that this study does not discuss the pure technology conundrum, protocol design, and other technical issues of the blockchain. This paper limits the research scope to cryptocurrency research, namely non-technological aspects, emphasizing human interactions and socio-economic aspects. Topics related to social science, business, economics, finance, cross-discipline, and areas belonging to computer science and engineering but focusing on human interactions and intentions are under the consideration of the overall dataset.

The rest of the paper is organized as follows: The *Literature Review* section briefly introduces the background and existing literatures about cryptocurrency. The data sources and methodology of the paper are explained in the *Methodology* part. The bibliometrics results are presented in the *Results and Discussion* section. In the *Publication Statistics* part, descriptive statistical analysis for the collected data is conducted. In the *Country Collaborations and Impacts* section, visualizations of country collaboration networks and timeline view clusters are illustrated. Next, in the *Author Collaborations and Impacts* section, we identify important authors and collaboration

networks in the field. The *Co-citation Networks* section shows the intellectual bases. In the *Research Trend* section, we employ the business and keywords timeline cluster to map the evolutionary trajectory of this research field. In the end, the *Conclusion* part summarizes the findings of this paper and proposes the future research direction.

2 Literature Review

Digital currencies are electronically issued currency that the transferability of them into fiat currency is not guaranteed by the state. Cryptocurrency is one certain type of digital currency enabled by blockchain, which is a distributed ledger currently being employed in governing cryptocurrency systems. The fundamental technology of cryptography starts as early as 1980 with David Chaum who is famous for developing e-cash systems and applications aiming at preserving the anonymity of users. Later on, other researchers, such as Back (2002) with his research on the proof of the work concept, and Haber and Stornetta (1997) with their research on data structure predecessors, set the foundations for the creation of cryptocurrency.

Cryptocurrency builds a system that can not only exchange online, but also has the following six features (Lansky, 2018). 1) It does not require a central authority, distributed achieve consensus on its state; 2) It keeps an overview of cryptocurrency units and their ownership; 3) It defines whether new cryptocurrency units can be created. If new cryptocurrency units can be created, the system defines the circumstances of their origin and the ownership of these new units; 4) Ownership of cryptocurrency units can be proved exclusively in cryptograph; 5) It allows transactions to be performed in which ownership of the cryptographic units is changed. A transaction statement can only be issued by an entity proving the current ownership of these units; 6) If two different instructions for changing the ownership of the same cryptographic units are simultaneously entered, the system performs only one of them. With those features to guarantee the functionality of cryptocurrency, cryptocurrency can be used as a new medium of exchange to obtain goods and services (European Banking Authority, 2014).

Bitcoin, the first decentralized cryptocurrency, was officially created by a person or a group of people using the pseudonym Satoshi Nakamoto on the 3rd January 2009. One of the earliest

appearances of Bitcoin in the mainstream media was when the dark net Silk Road was accused of providing a market for drug trade. Bitcoin has been used inside this market to execute transactions between buyers and sellers. At that time, public awareness of Bitcoin was at a preliminary stage and people had little understanding of what it is. After Bitcoin gained more popularity in 2013, more people became interested in the topic. Some started to trade and speculate it through exchanges, some used it as an innovative method of fundraising, and others considered it as a potential tool for financial inclusion (Clegg, 2014).

As the popularity and activity towards cryptocurrency increased among citizens, debates related to various classifications and attributes of Bitcoin also started to rise. Some scholars point out that Bitcoin does not have the attributes of real money and has zero intrinsic value. It is regarded as a purely speculative investment (Cheah and Fry, 2015; Yermack, 2015). Others, such as Van Alstyne (2014) believes that the Bitcoin technology itself-the low transaction fee, improved fraud detection systems, and people's adoption-gives Bitcoin value. In addition, Bitcoin's characteristic of bypassing trusted third parties and enabling people to transact directly with each other (Nakamoto, 2008) also creates tensions between the financial system and government control. Bjerg (2016) claims that cryptocurrency ideologically challenges the conventional forms of money, since it exposes the inherent risks and exploitations within the existing fiat money system. Hegadekatti (2016) believes that a paradigm shift among government, people, and institutions is taking place, where the power of taxation and capital movement will be infringed by cryptocurrency and military power will be substituted by computing power. At the same time, we cannot deny the potential positive changes that technology has and could bring to the world. Cryptocurrency allows merchants in developing countries to have access to international payment systems so that they are able to sell products abroad (Scott, 2016). Moreover, cryptocurrency is regarded as a good diversifier, hedge, and safe haven (Bouri et al., 2017; Briere et al., 2015; Dyhrberg, 2016). However, this technology can also be used for harmful activities. The anonymous feature is challenging for regulatory bodies and governments to scrutinize illegal transactions and criminal activities. Central authorities are at the cusp to create a set of regulatory

frameworks that not only protect the common good, but also do not hamper the innovative development of cryptocurrency (Reyes, 2016).

3 Methodology

3.1 Data Collection

We first consider reliable databases to retrieve the original records. Web of Science Core Collection and Scopus are selected, since these two databases are the two largest databases including multidiscipline scientific literatures. The Web of Science and Scopus database have the most different coverage in Natural Science and Engineering and Arts and Humanities, and a relatively low general coverage rate for Social Science and Arts and Humanities (Mongeon and Paul-Hus, 2016). Therefore, employing the resources from both databases can ensure better coverage for this research purpose.

When selecting the keywords for search query, we take into consideration how people use different words to represent cryptocurrency from inception. In the beginning, there were only limited cryptocurrencies circulating in the market. People showed great interest in discussing Bitcoin. The word “Bitcoin” represented the most focus in news, articles, and papers. Gradually, the word “cryptocurrency” emerged to name the new type of cryptograph-based currency in different contexts. Therefore, “cryptocurrency”, “crypto currency” and “Bitcoin” are used as keywords in searching the topic (including title, keywords and abstracts) in the two databases selected for this study. The time span of the collected data ranges from 2008 to 30th June 2018. In Web of Science Core Collection, the initial search excludes categories of “computer science theory method”, “computer science software engineering” and “computer science hardware architecture”. In Scopus, no category is excluded, since the literatures in each category cannot be clearly defined as non-related content for this paper. As a result, the initial search returns 375 records in Web of Science Core Collection and 1379 records in Scopus. After the preliminary query, a data cleaning process is conducted. The authors manually read the titles and abstracts of all the 1754 downloaded records to ensure that the retained bibliometrics data meet the research

scope. After screening out the out-of-scope data and removing duplicated records, the remaining 833 papers are used for further analysis.

3.2 Data Analysis

This study employs three analytical tools-Excel, Gephi and Citespace. Excel is used to clean the data and generate descriptive statistics. Gephi is used to produce collaboration networks. Its calculation tool and graph function provide visualizations with high readability and understandability. The remaining visualizations in this paper are generated by Citespace.

Since there are some embedded functions and algorithms in Citespace that are not generally known, we briefly introduce the functions employed by this article. Citespace is a freely available tool for interactive and exploratory analysis of the evolution in a scientific domain (Chen, 2018). This study uses four main additional functions of Citespace in network visualizations, including 1) labeling cluster; 2) burstiness detection; 3) identifying pivotal points; 4) timeliness of visualization. In Citespace, a cluster is identified and labeled according to a hierarchy of key terms in articles that cite the cluster (Tibély et al., 2013), which are automatically generated by the software. References compositing the cluster are the intellectual bases of certain underlying specialties. Burst detection is a useful approach to identify emerging terms regardless of the citing times by the host paper (Chen, 2006). Kleinberg's (2003) algorithm is adapted to the software to detect burstiness objects. In the picture, nodes with burstiness characteristics are highlighted in red color. The pivot point is defined as the node that connects two different clusters exclusively. These nodes have betweenness centrality over 0.1 and are highlighted with purple rings in the network. The timeline view of the network cluster is the practical visualization of a group of articles cited in a fixed and time-invariant group of base articles (Morris et al., 2003). Combining the approaches above, Citespace is a functional tool to track and visualize the footprint as well as to detect the evolutionary research trend of scientific literature and intellectual base for this study. The size of the radius in the graph represents the number of publications or the number of citations according to the original graph. The different color rings transiting from dark to light demonstrate the years of time.

4 Results and Discussion

4.1 Descriptive Statistics

This section illustrates the results of the descriptive analysis, including publication statistics, and publication sources.

4.1.1 Publication Statistics

Figure 4 illustrates the annual publication numbers, total publication numbers, and annual publication growth rate of new publications in the cryptocurrency domain. The chart shows that cryptocurrency research starts in 2011 and that the total number of publications has been growing at an exponential rate. The exponential growth indicates that cryptocurrency research is an emerging and developing topic that has gradually shaped a new research field (Guan and Ma, 2007). Annual publication numbers are also increasing rapidly at the beginning. But in 2016, there is a slowdown in annual publication numbers. This may be due to the instability of a new field at the initial stage.

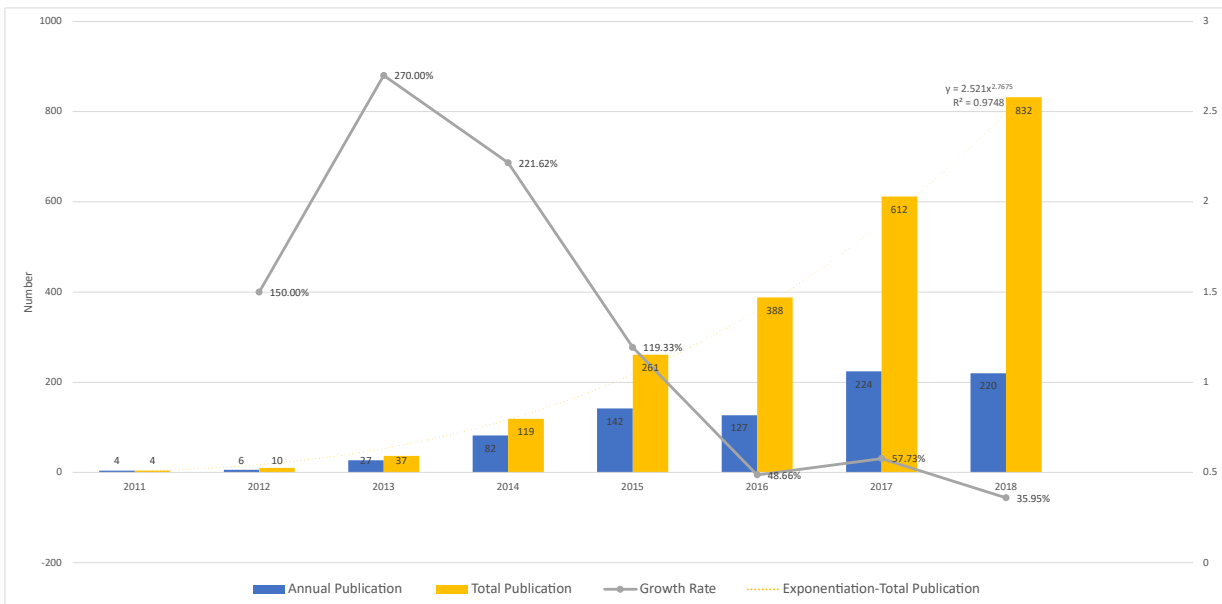


Figure 4. Publication Numbers and Growth Rate of Cryptocurrency Research

Figure 5 depicts the publication type of collected data. Among all the available records, 50.66% (421) of them are articles and 28.64% (238) are conference papers. The rest of papers are published as books (1.68%, 14) or book chapters (6.98%, 58), editorial (4.09%, 34), review (3.37%, 28), note (1.81%, 15), letter (1.2%, 10) and other sources (1.57%,13). Editorial refers to media articles, newsletters, comments, and interviews. The note represents a paper that is mentioned or remarked on a published paper on a specific subject (Web of Science, 2019).

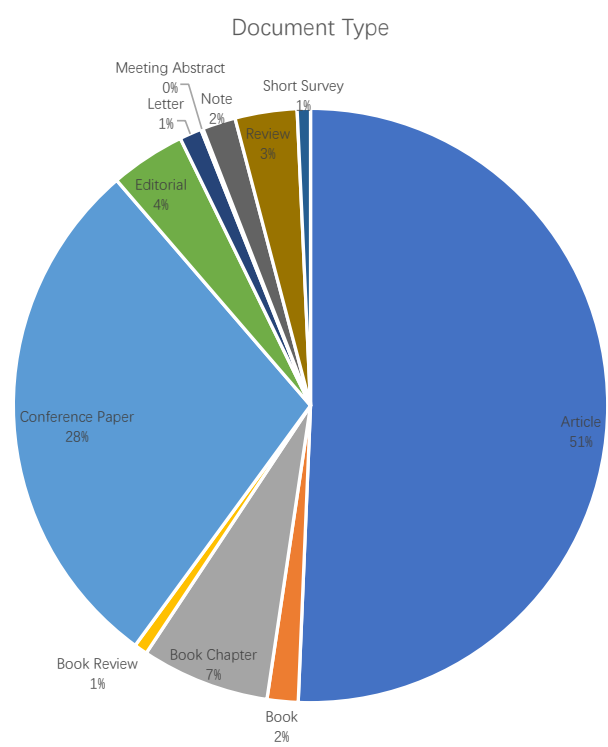


Figure 5. Publication Type of Cryptocurrency Research

4.1.2 Publication Sources

Table 1 lists the top 10 publication sources of cryptocurrency research (the last three journals are tied for number ten). Even though “article” is the most frequently found document type, Table 1 shows that the top 3 publications are Lecture Notes in Computer Science (57), Handbook of Cryptocurrency (28) and Economists (23), which are conference proceeding, book, and magazine respectively. The academic journal with the highest publication number is Finance Research Letter (19), followed by Economic Letter (18) and New Scientists (18). The top 10 publication

sources are diversified in their disciplines, which include not only just computer science, economics, and finance, but also natural science, business and management, and multi-discipline publications. In the chart below, H-index is also listed. Some of the influential journals also rank within the top list of cryptocurrency research publication sources, such as Nature, which means that this research domain has already drawn wide attention from the academic world, and it probably has or will have great impacts on the current and future life of the public. Here we also consider magazines with a high reputation as valuable sources of supply. Because peer-reviewed journals usually take a longer time to process literature from reception, magazines have faster publication cycles to respond to the newly emerging field.

Table 2 Publication Sources and Journal Information

Journals	Number	Type	Country	Field	H-index
Others	597	-	-	-	-
Unknow	12	-	-	-	-
Lecture Notes in Computer Science	57	Conference Proceeding	Germany	Computer Science; Mathematics	296
Handbook of Digital Currency: Bitcoin, Innovation, Financial Instruments, and Big Data	28	Book	-	-	-
Finance Research Letters	19	Journal	United States	Economics, Econometrics and Finance	21

Journals	Number	Type	Country	Field	H-index
Economics Letters	18	Journal	Netherland	Economics, Econometrics and Finance	77
New Scientist	18	Magazine	England	Multidisciplinary	16
Technology Review	15	Journal	United States	Multidisciplinary	12
PLoS ONE	12	Journal	United States	Agricultural and Biological Sciences; Biochemistry, Genetics and Molecular Biology; Medicine	241
Nature	10	Journal	England	Multidisciplinary	1052
IEEE ACCESS	8	Journal	United States	Computer Science; Engineering; Materials Science	36
IEEE SPECTRUM	8	Magazine	United States	Engineering	57

Journals	Number	Type	Country	Field	H-index
Physica A: Statistical Mechanics and its Applications	8	Journal	Netherland	Mathematics; Physics and Astronomy	133
Total	833				

4.2 Country Collaborations and Impacts

Cryptocurrency is an emerging technology, and its development can have great impacts on the global financial mechanism, business practices, and technology applications. Hence, many authors from different countries are interested in researching the topic from their own angles and lenses. Nonetheless, it is important to know the current ranking and interests of different countries, which will enable scientists to better reflect on the development of the research position of this newly emerging field. For this purpose, the study first constructs a country collaboration network analysis and then uses a timeline view to visualize and cluster emerging research interests of different countries.

Figure 6 depicts the country collaboration network of our dataset. The size of the node represents node degree, which means the number of publications of a country in this setting. The red color indicates a high centrality of a country in the network, while the lighter color means that it has relatively less centrality. The final model identifies 67 countries in the network. America and Europe take the lead in the cryptocurrency research area, where the United States has the largest number of publications (205 times) among all. United Kingdom, Germany, Italy, and France are the most productive countries in publications with 88 releases, 60 releases, 38 releases, and 35 releases respectively. Asia also expresses strong interest in cryptocurrency research, with China (50 releases) leading the publication numbers, with India, South Korea, and Singapore followed by. Moreover, the United States and the United Kingdom also rank first and second in centrality

with 0.52 and 0.38 respectively. Other prominent countries with high centrality are France (0.31), Italy (0.19), India (0.12), Russia (0.12) and Spain (0.11). India aligns the research collaborations between the Middle East and Europe, while Russia is the hub connecting Eastern Europe and Central Asia. The United States, the United Kingdom, and France are the top three countries achieving the most scientific collaborations with other regions. On average, every country has 4.7 collaboration parties to conduct research with, which indicates insufficient academic communications in this nascent field. The results suggest that countries with more publications do not necessarily occupy a hub position, this may be due to their limited academic exchange with other regions and relatively isolated research interests. Therefore, combining the research interests with different countries and establishing efficient communication and collaboration networks with other regions are more effective methods to increase the influence of a country's publication than producing large amounts of papers.

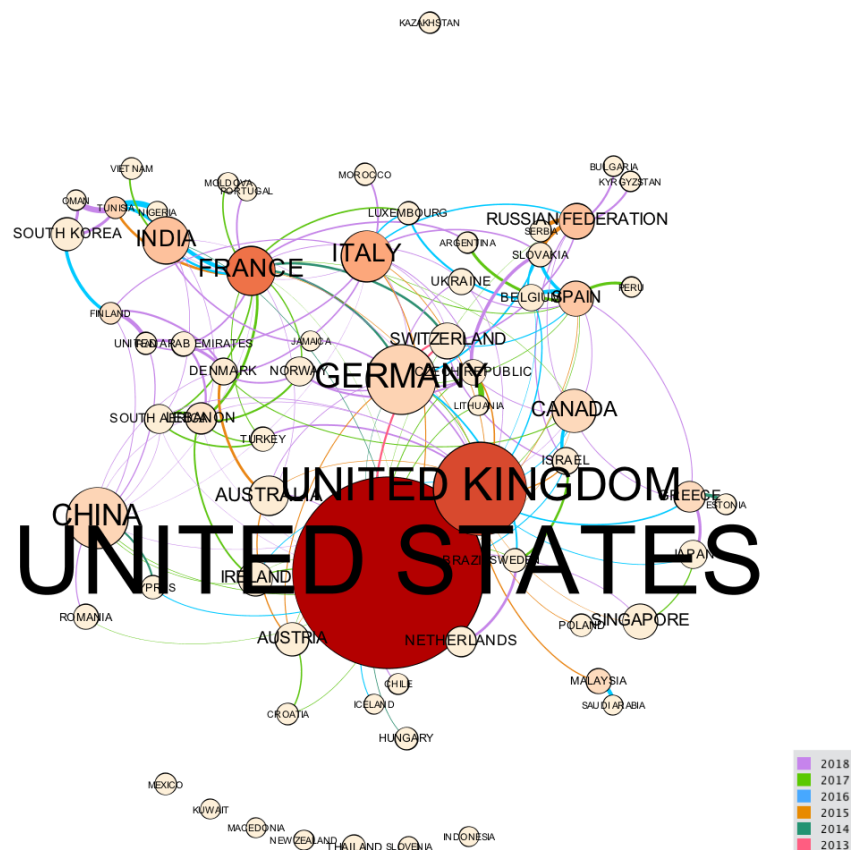


Figure 6. Country Collaboration Networks

From the timeline view (Figure 7), we can see that the various research conducted by different countries are grouped into 5 main clusters. Cluster #0 with the biggest size of actors is labeled as “information transmission”. In this cluster, papers focus on using financial and economic models to explore the cryptocurrency price, volatility, and returns. India, France, South Korea, South Africa, and Lebanon are the major contributors. This cluster started in 2014, and it is the newest cluster among the five. Cluster #1, named “Bitcoin network”, was started by Ireland in 2011. It is one of the earliest research focuses of the cryptocurrency domain. In this cluster, many countries have influential articles on anonymity, privacy, transaction flows of Bitcoin, cryptography, and network system (Androulaki et al., 2013; Eyal and Sirer, 2018; Reid and Harrigan, 2013). The United States and Germany lie on this line. The United States established the first Bitcoin future exchange in the world. The strong background in technology innovation and computer science enables the United States to have early insights into this field. Germany is one of the hubs of blockchain startups in Europe. Some influential projects, such as the DAO, and digital currencies, such as IOTA, were initiated by Germany-based participants. In the meantime, Germany has a very friendly regulation environment for cryptocurrency development. It is the first government to recognize Bitcoin as private money and financial instrument (Khairuddin et al., 2016). Besides, there is no tax on cryptocurrency. More developed infrastructures for cryptocurrency make these two countries have the highest active Bitcoin nodes within the Bitcoin network (by 2019), implying their strong interest in connection with real adoption and application within the country. Cluster #2 starts with Israel and Switzerland in 2012 and 2013. It focuses on the applications of cryptocurrency, especially in energy consumption and smart grid infrastructure area. Cluster #3 is labeled as “political economy”. The papers mainly focus on the discussion of legal considerations and governance issues of cryptocurrency in this cluster. The United Kingdom began to explore the research topic in 2012 and Asian countries, such as Malaysia, Japan, and Singapore, soon followed the trend. In many Asia countries, the widespread cryptocurrencies have raised intensive regulatory considerations, which might be because Asian countries, compared to most European and North American countries, have stronger regulation orientation and stricter market control for capital flow. Cluster #4 is labeled as “new digital currency”. In this cluster, countries place emphasis on how cryptocurrencies have disrupted the trust system within

governmental authorities, and how cryptocurrencies have facilitated business operations and global payment. China has experienced rapid growth in digital payment in recent years. The number of customers and transaction value of digital payment has reached the highest number in the world, and the Fintech coverage has a wide range of services, including payment, wealth management, financing, etc (Chen, 2016). That might be the reasons that China has more focus on this research topic.

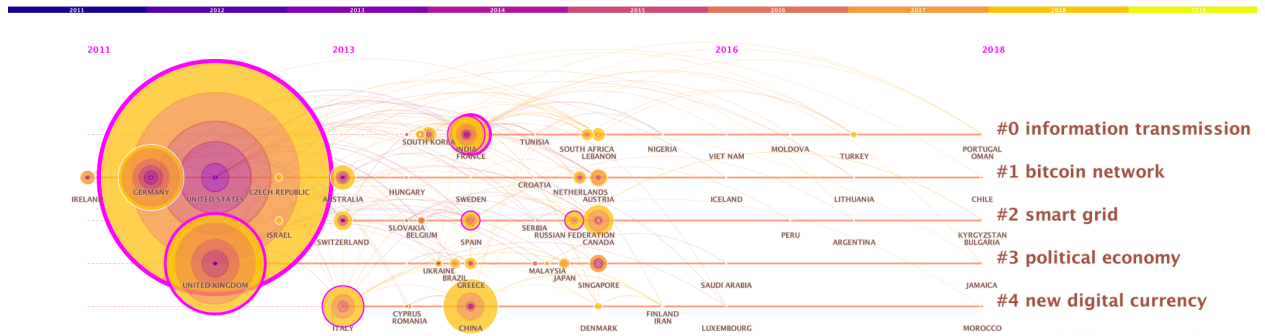


Figure 7. Country Research Interests Timeline View

It is interesting to see that countries focus on diverse topics. The reasons why certain countries have stronger interests in a specific topic than other countries can derive from societal, technological, historical, economic, and cultural aspects. The research interests partly reflect current trends and developments in the area, and also partly due to the research heritage of the country, such as influential universities, stronger academic abilities in certain research domains, and intensive focus on a specific dimension of cryptocurrency. These differences in topic show that cryptocurrency has been considered from divergent angles, and partly suggest a tendency for the primary concerns of the state or people in those areas.

4.3 Author Collaborations and Impacts

In order to have a more thorough understanding of authors who have significant roles in this field, this section evaluates author productivity, number of citations and collaboration networks. It has been argued that merely judging from the total number of publications is arguably an insufficient method to assess research quality (Fanelli, 2010). Productivity and active collaboration networks cannot guarantee the author's authority and the impact of their work. In order to avoid the “publish

or perish” phenomenon, citation count is an important criterion to measure their impacts. It is assumed that significant publications will have higher citation counts to reflect the advanced knowledge of the researcher (Carpenter et al., 2014). Figure 8 illustrates the author collaboration networks. Table 3 shows the top productive authors and the ones with high citations. All the statistic numbers are based on the research data. While some authors may have more articles and higher citations in wider scopes of publications, the results of this study are limited to the collected data used in the analysis.

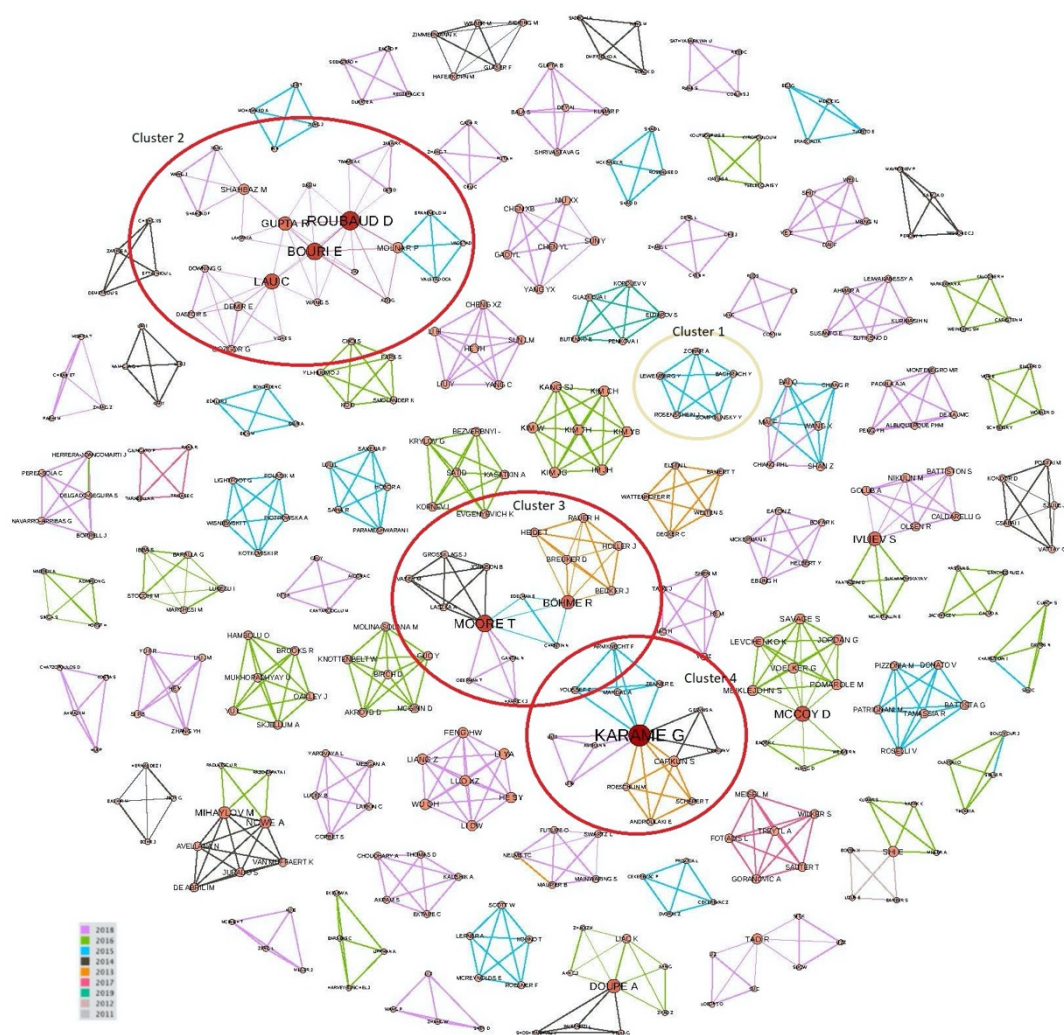


Figure 8. Author Collaboration Networks of Cryptocurrency Research

Figure 8 demonstrates the author collaboration networks. The node size represents the degree of each author in the network, which is determined by the number of his/her collaborations with other authors. The darker the node is, the more publications of this author. Edges are marked by different colors according to different years of publication. The network diagram in Figure 8 has been filtered by the degree of the author, who has a value of more than 2. The individuals and networks of only two people are screened out, which makes the network more meaningful to examine.

From Figure 8 we can see that the overall visualization of the network is very sparse and does not exhibit dense clusters. Many subgroups demonstrate a clique characteristic, meaning the group members interact with all the other individuals within a small group. These are obvious networks of one-paper collaboration. For example, sub-cluster 1 in Figure 8 illustrates that these five authors together produced one paper- *Bitcoin mining pools: A cooperative game-theoretic analysis*. Currently, scholars tend to collaborate in very close networks and very few researchers have successfully expanded collaborations more than one time. The average degree of the unreduced network of the overall dataset is 2.7, meaning that every author has collaborated with two to three other distinctive researchers in one cryptocurrency research on average. Therefore, widespread collaborations have not yet formed in this research domain. By calculating the degree of the authors, we identify three authors that have more than ten collaborations. Ghassan Karame has the highest degree of 13, meaning that he has 13 different collaborations with other researchers. Followed by David Roubaud with 12 co-authorships, and Elie Bouri with 11 co-authorships. Moreover, we highlighted the three prominent sub-networks which exhibit the most complicated and widespread collaborations. The biggest sub-network (Cluster 2 in Figure 8) contains the most productive authors- Elie Bouri, Ghassan Roubaud and Rangan Gupta. They started their collaborations in 2017, but the big sub-network is eventually formed in 2018. This biggest sub-network consists of researchers from different regions, including Lebanon, South Africa, France, Norway, China, the United Kingdom, Turkey and India. The diverse background contributes to the wider collaboration networks. While the second biggest sub-network (Cluster 3 in Figure 8) contains Rainer Bohme and Tyler Moore. They each have an ego network doing research on

cryptocurrency. Their mutual interests in cybercrime and cryptocurrency governance drew their networks together with Ben Edelman and Nicolas Christin in 2015. Ghassan Karame is a hub of the third biggest sub-network (Cluster 4 in Figure 8). He is the chief researcher of NEC Labs in Germany and has done his research and study at ETH Zurich and Carnegie Mellon University. The hub position may be due to his rich personal research experiences obtained across the world. The four networks connected by him had been initiated from the collaborations at NEC and ETH in Europe. The overall network shows that bigger collaboration networks started to form in 2018 and tended to be connected by authors with larger numbers of publications. This fact indicates that researchers have started to collaborate more actively than before and the leading positions in this emerging field began to come into shape. Authors with more active collaborations tend to have a greater number of papers comparably. Even though publication numbers cannot guarantee significant influences on a specific individual work, they can help scholars to expand the collaboration networks to certain extent.

As for productivity, Elie Bouri is the most productive author with 11 papers co-authored. He comes from the USEK Business School at the Holy Spirit University of Kaslik, Lebanon. His research interests are financials and the economics of Bitcoin. Roubaud David has 9 papers in the cryptocurrency research domain, ranking as the second most productive author. He comes from Montpellier Business School in France. However, his work is always associated with Elie Bouri, which is also visible from the analysis of this paper (see Figure 8). Besides, Rainer Bohme and Michele Marchesi have 7 papers each, also Rangan Gupta and William J. Luther have 6 papers each. Ladislav Kristoufek, an associate professor from the Charles University of Czech Republic at the time, has the highest citations of 114 times. He is the first scholar to demonstrate the strong correlations between Bitcoin price and search queries in Google Trend and Wikipedia, and a causal relationship between the price level and search terms (Kristoufek, 2013). His work inspired many other researchers to compare cryptocurrency prices with other benchmarks. The author with the second-highest citations of 93 times is Fergal Reid. He comes from Ireland and is one of the earliest researchers in this field. He has only one paper, where he explored the Bitcoin address cluster in order to evaluate the anonymity of the Bitcoin system (Reid and Harrigan, 2013).

Similarly, Sarah Meiklejohn (2013) and Dorit Ron (2013) also investigated Bitcoin address clusters and transaction graphs to analyze the activities within Bitcoin systems. Additionally, Ittay Eyal and Emin Gun Sirer (2018) broke the conventional perception that Bitcoin mining is safe. They pointed out that Bitcoin protocol is not incentive-compatible, and self-mining is encouraged for any feasible group. David Yermack (2015) is one of the earliest scholars to discuss the currency function of Bitcoin. He represents a great number of researchers who hold the opinion that Bitcoin does not have fundamental value. William J. Luther is also a highly cited author who studies the economics of cryptocurrency, including switching costs, exchange risks and political evaluation of Bitcoin. Besides, Rainer Bohme and Tyler Moore are closely collaborating authors (see Figure 8) with high citation counts, and their research focus is on cybercrime and the governance of cryptocurrency.

Table 3 Author Productivity and Citation

Authors	Productivity	Citation
Elie Bouri	11	38
Roubaud David	9	0
Rainer Böhme	7	65
Michele Marchesi	7	5
Rangan Gupta	7	0
William J. Luther	6	2
Tyler Moore	6	65
Ladislav Kristoufek	5	59
Ittay Eyal	4	114
Bill Maurer	3	73

Authors	Productivity	Citation
Sarah Meiklejohn	3	59
David Yermack	2	86
Fergal Reid	2	60
Reuben Grinberg	1	93
Dorit Ron	1	84

It is surprising to see that authors with high citation counts are usually not the ones with high publication numbers. Instead, works with high citations either represent new research directions in the cryptocurrency area or embrace novel ideas that are potentially controversial. However, with more publication efforts, the ones with high publication numbers show important positions in collaboration networks. Many hold positions in companies or government institutions where they also work on digital currency projects. The research interests and working environment provide them with more possibilities to take the hub position. They are the bridges to include more authors in the field. It is also worth noticing that when counting citations, this paper uses the lead author method, so the second and the third authors are ignored in the citation counts. Roubaud David, Michele Marchesi and Rangan Gupta have many co-authored articles, but they are always the second or the third co-author, which helps to explain their high productivity but low citation counts.

4.4 Co-citation Networks

In this part, the paper aims to identify the main clusters formed by important references and intellectual bases across time periods. This is done by analyzing co-citation networks. The silhouette number is the measurement for the homogeneity of the cluster, ranging from -1 to 1. Silhouette over 0.5 indicates the convincing clustering result (Chen, 2004).

Table 4 High Co-citation Clusters

Cluster ID	Number	Silhouette	Tag
0	44	0.927	Bitcoin return
1	34	0.876	Research Landscape
2	26	0.839	Price Fluctuation
3	23	0.951	Blockchain Technology
4	22	0.809	Mining Pool
5	18	0.933	Regulating Blockchain Transaction
6	15	1	Payment System

Figure 9 shows the main references co-citation network. The whole network was divided into 28 different clusters. In order to optimize the visualization and bring more meaningful results to the network, we filtered the small-size clusters dispersed in the picture and left the six main clusters. The results are shown in Table 4. The color continuum on the top of Figure 9 represents the time exhibited by corresponding colors. The brighter the edges are, the newer the research topic is. Cluster #0 labeled as “Bitcoin return” is the newest research focus and Cluster #1 labeled as “Research landscape” is the oldest one.

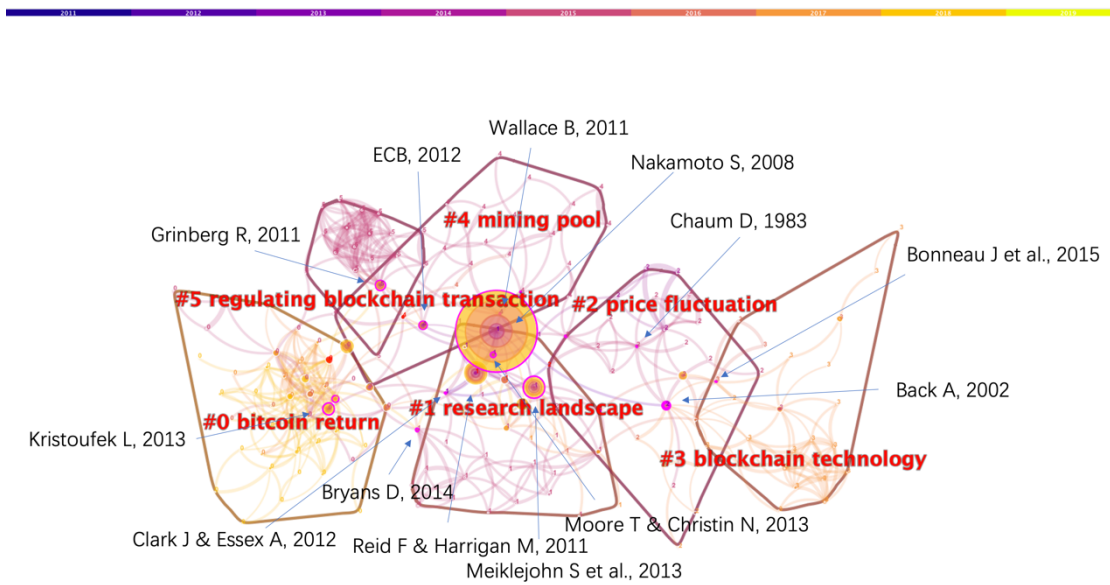


Figure 9. Main Reference Co-citation Network

Table 5 lists the top 10 highly cited references and the top 10 nodes with high centrality (pivot points). There is a noticeable node with the highest citations and the biggest radius. This refers to the paper *Bitcoin: A Peer-to-Peer Electronic Cash System* by Satoshi Nakamoto (2008), who is wildly acknowledged as the “father of blockchain and cryptocurrency”. It is a whitepaper that introduced a peer-to-peer network to solve the double-spending problem without central third parties. This paper is regarded as the birth of Bitcoin and modern cryptocurrency. Therefore, it holds an irreplaceable position.

In the top ten highly cited papers, there are four articles that used the Bitcoin address cluster to visualize and analyze transactions in order to evaluate the anonymity, privacy, criminal activities, and transaction flow within the Bitcoin system (Meiklejohn et al., 2013; Reid and Harrigan, 2013; Ron and Shamir, 2013). These papers showed up in the early period of cryptocurrency research (Cluster #1), representing an important entry field of cryptocurrency research at the beginning. Among them, Meiklejohn’s (2013) paper also has high centrality. This paper used heuristic methods to gather the Bitcoin address of illegal or criminal activities. The results illustrate challenges and barriers for those who want to conduct criminal or fraudulent activities at scale. This paper has also been regarded as one of the pivotal points in this field. These facts indicate

that graph analysis has a significant role, and potentially bridges the different aspects of cryptocurrency research.

Table 5 Highly Cited Papers and Pivot Points

Author	Publication	Centrality	Citations	Cluster ID
Top 10 Highly Cited Paper				
Nakamoto S, 2008	Bitcoin: A Peer-to-Peer Electronic Cash System	0.10	258	1
Reid F, 2012	An Analysis of anonymity in the Bitcoin System	0.09	84	1
Meiklejohn S, 2013	A fistful of bitcoins: characterizing payments among men with no names	0.13	70	1
Böhme R, 2015	Bitcoin: Economics, technology, and governance	0.01	49	0
88	Quantitative Analysis of the Full Bitcoin Transaction Graph	0.05	45	1
Kristoufek L, 2013	BitCoin meets Google Trends and Wikipedia: Quantifying the relationship	0.12	38	0

Author	Publication	Centrality	Citations	Cluster ID
	between phenomena of the Internet era			
Eyal I, 2013	Majority is not enough: Bitcoin Mining is Vulnerable	0.02	35	2
Grinberg R, 2011	Bitcoin: An Innovative Alternative Digital Currency	0.17	34	5
Kristoufek L, 2015	What are the main drivers of the Bitcoin price? Evidence from wavelet coherence analysis	0.03	34	0
Ober M, 2013	Structure and anonymity of the bitcoin transaction graph	0.01	33	1
Top 10 Pivot Points				
Back A, 2002	Hashcash-a denial of service counter-measure	0.30	22	2
Wallace B, 2011	The rise and fall of Bitcoin	0.19	10	4
Grinberg R, 2011	Bitcoin: An Innovative Alternative Digital Currency	0.17	34	5

Author	Publication	Centrality	Citations	Cluster ID
ECB, 2012	Virtual Currency Scheme	0.17	32	4
Chaum D, 1983	Blind signatures for untraceable payments	0.16	7	2
Moore T, 2013	Beware the middleman: Empirical analysis of Bitcoin-exchange risk	0.15	25	1
Meiklejohn S, 2013	A fistful of bitcoins: characterizing payments among men with no names	0.13	70	1
Bonneau J, 2015	Sok: Research perspectives and challenges for bitcoin and cryptocurrencies	0.13	6	3
Clark J, 2012	Commitcoin: Carbon dating commitments with bitcoin	0.13	4	1
Kristoufek L, 2013	Quantifying the relationship between phenomena of the Internet era	0.12	38	0

Among the highly cited papers, 3 articles are located in the biggest Cluster #0. Böhme et al. (2015) analyzed the Bitcoin system comprehensively. They described the Bitcoin system and its ecosystem, highlighted potential risks and regulation directions, and proposed some future

applications of Bitcoin. In addition, Kristoufek (2013) first investigated the correlation between Bitcoin price and search queries in Google and Wikipedia. In 2015, he used a wavelet framework to identify the drivers of Bitcoin price. The study showed that Bitcoin price is formed by fundamental factors, such as usage in trade, money supply and price level, technical reasons, and speculative motivations (Kristoufek, 2015). Among three of them, two of the papers belong to Kristoufek, which also resonates with the fact that he is the author with the highest number of citations.

Cryptocurrency is a relatively new research topic. So, it is worth noticing that two references are more than 10 years old in the top ten pivot points, which are *Hashcash-a denial of service counter-measure* (Back, 2002) and *Blind signatures for untraceable payments* (Chaum, 1983). These two papers are related to the technical fundamentals of cryptography and storage of Bitcoin. When articles explain how cryptocurrency works, they tend to cite these papers. Therefore, it is reasonable to explain their high centrality among all references. Even though cryptocurrency is a new topic, certain intellectual bases are decades old.


The other three articles with high centrality (pivot points) in the top five share a common attribute. They all contain relatively wide content of digital currency in the early stage of this research field. Wallace (2011) described how Bitcoin was born and how it functions, then he reviewed a few key moments and pointed out some skepticism from the public in the early stage of Bitcoin development. As for Grinberg (2012), he gave a short introduction to Bitcoin and described its ecosystem. He also compared Bitcoin with its competitors, including internet payment methods and gold-backed currencies. Combined with technological considerations and regulation issues, Grinberg (2012) discussed the sustainability question of Bitcoin. He was argumentatively confident about Bitcoin but also warned users to be aware of the risks of the young truth. In 2012, the first official report on virtual currency was published by the European Central Bank (ECB). Three types of digital currency have been classified in the report, and a definition for virtual currency has been given. As stated in the report, virtual currency is a type of unregulated, digital money, which is issued and controlled by the developers, and used and accepted among the members of a specific virtual community (Europe Central Bank, 2012). This scheme is different






from electronic money schemes. ECB acknowledged that this new type of virtual bidirectional flow currency has no physical counterpart with legal tender status (Europe Central Bank, 2012). Bitcoin and Second Life’s virtual currency have been demonstrated as case studies in the report. This official and authoritative report of the ECB has objectively evaluated both the positive aspects and entailed risks of a virtual currency.

5 Research Trend

In this part, the study aims to identify research trends across the timeline in order to provide indications for future research work within the domain. The burstiness of co-citation references and keywords timeline visualization has been employed to explore emerging trends. Table 6 shows the references with high burstiness in different time spans and Figure 10 depicts keyword changes in a timeline view. The burst rate implies an article’s sharp increase of citations in a certain time period (Chen, 2006). The higher the strength of the burst reference, the higher attention the article drew from this research domain.

Table 6 Papers with High Burstiness

Reference	Source	Strength	Begin	End	2011-2019
Reid & Harrigan, 2011	Privacy, Security, Risk and Trust （PASSAT） and IEEE Third International Conference on Social Computing （SocialCom）	4.9281	2011	2014	

Chaum D, 1990	Workshop on the Theory and Application of Cryptographic Techniques	2.8585	2011	2015	
Ober et al., 2013	Future Internet	2.5379	2014	2016	
Babaioff et al., 2012	Proceedings of the 13th ACM conference on electronic commerce	2.5853	2015	2016	
Van Alstyne, 2014	Communication of ACM	2.8224	2015	2016	
Ciaian et al., 2016	Applied Economic	5.2214	2017	2019	

5.1 Early Research Trend

In Table 6, the first three intellectual bases with high bustiness are all related to the Bitcoin network and transactional graph analysis. In the meantime, the earliest keyword that emerged in Figure 10 is classified as “Bitcoin transaction graph”. The majority of the keywords with a high frequency, such as Bitcoin, cryptocurrency, blockchain and electronic money, all lie on this line. It coincides with the burst reference of Reid (2013) and Chaum (1983), which discussed the bitcoin address cluster and early signature design respectively. It also resonates with the co-citation graph in Figure 6, where cluster #4 “mining pool” is a dominant topic. Therefore, Bitcoin graph analysis was identified as a popular topic in the early stage of cryptocurrency analysis. This topic line is concerned with embedded technology characteristics and the design of cryptocurrency. Researchers tend to use the public data of Bitcoin or other cryptocurrency addresses to cluster, track and analyze the activities within the network. The graph analysis potentially bridges the research topic in the technical field with a research focus on protocol and

design and social aspects with a research focus on criminology and social impact. However, the peak of the topic stopped in 2017.

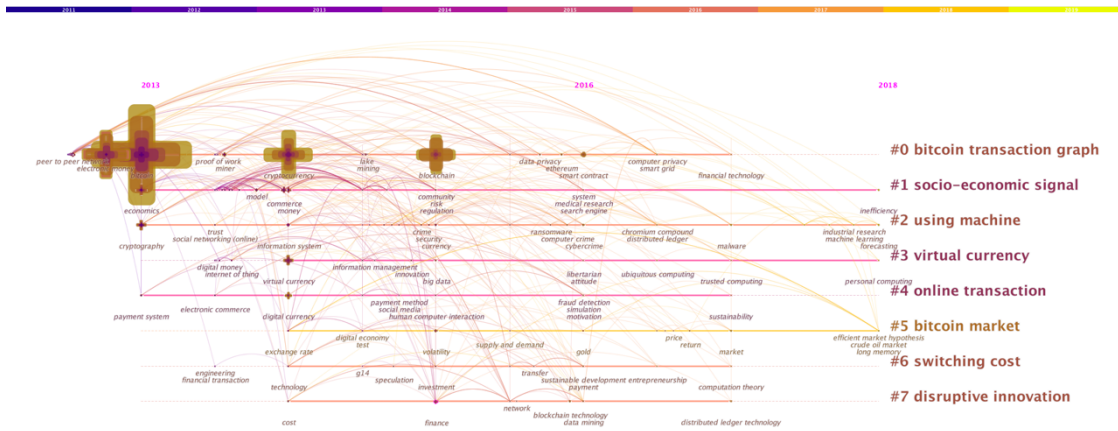


Figure 10. Keywords Timeline View

5.2 Current Research Focus

Moreover, all research topics started in 2013 and 2014, but only four of them are still trendy in 2018. Among the remaining research interests, the most recent research area is the “Bitcoin market”, which has the lightest color. The newest burst paper is Ciaian’s (2016) -*The Economics of Bitcoin Price Formation*. The paper adopted Barro’s model for gold standards and built a Bitcoin price attractiveness model using time-series analysis. The result shows that supply and demand, new information arrival, and investor speculations are the main price drivers. This paper was the first one to put both traditional price determinants and digital currency-specific factors into Bitcoin price formations. This high burstiness literature also reflects the same truth that high research interests stay at cryptocurrency markets analysis.

From all the timelines, we can see those topics #1, #2, #3 and #5 have continued from early on. Keywords, such as forecast, inefficiency, long memory, and machine learning, show up currently, implying one of the research frontiers of cryptocurrency. This topic is not new, however, it has strong vitality and sustainability. In the beginning, the market analysis of cryptocurrency focuses on answering the “yes or no” question about value, hedge function and volatility (Sapuric and Kokkinaki, 2014; Van Alstyne, 2014; Yermack, 2015). Later on, some scholars started to

investigate the cryptocurrency value formation, price driver and the correlation with other market assets (Bouri et al., 2017; Ciaian et al., 2016; Dyhrberg, 2016; Kristoufek, 2015). The new keywords indicate that adopting economic and financial models and computer science methodology to forecast market price, explore market behaviours, and examine trading characteristics are the newly emerging research frontiers. The popular methods include econometrics, machine learning, and data mining (Bouri et al., 2019; Snihovyi et al., 2018). For example, Phillips and Gorse (2017) employed online social media data to predict the price of cryptocurrency. The result shows bubble-like behaviour in the cryptocurrency market. Stosic et al. (2018) analyzed cross-correlations between price changes of different cryptocurrencies, where they find that some contrast predictions exhibited in cryptocurrency markets than other financial markets and collective behaviors exist in the cryptocurrency market as well. This new trend may has affected by the heat wave and new highs of cryptocurrency market prices in late 2017 and early 2018. The market reactions of cryptocurrencies broke many traditional understandings about the stock market and wildly refreshed people's ideas for the definition of currency. Since cryptocurrency research remains at early stage, many interesting and unknown factors behind the cryptocurrency market are still waiting to be uncovered.

6 Conclusion

This paper conducted a bibliometrics review on cryptocurrency studies based on 833 documents retrieved from Web of Science Core Collection and Scopus from January 2008 to June 2018. The study attempts to shed some light on identifying actors with great influences in this research domain, as well as visualizing the collaboration networks and evolution trends of cryptocurrency research. From this analysis, this paper also intends to examine the role of cryptocurrency change and development in different space and time dimensions. The results of the research give an honest description of cryptocurrency research, which is a mirror to reflect the various roles of cryptocurrency from analytical angles.

Some valuable conclusions were drawn as follows:

First, the descriptive analysis shows that cryptocurrency has drawn gradual attention since 2011 when the number of publications increased at an exponential rate. Moreover, cryptocurrency is a domain of strong interest by different journals and conferences from multi-disciplines. This indicates that cryptocurrency has multiple facets and those different facets have already been caught by researchers and probably by more people.

Second, the country and author networks depict the collaborations between different actors. The United States is identified as the most influential country, followed by the United Kingdom. In general, North America and Europe have played leading roles in the research field. Asian countries, such as China, India, South Korea, and Singapore, also demonstrate strong interests in the field. The findings show that more and more countries start to pay attention to cryptocurrency, where the developed countries take the lead, and the new emerging economies followed the trend.

Third, the paper identifies authors who have potential impacts in the cryptocurrency field. Ellie Bouri is the most productive author, while Ladislav Kristoufek is the author with the highest citations. Both of them primarily focus on the economics and financials of cryptocurrency. Authors started to collaborate more from 2017 and 2018, but current collaborations are limited to small network circles, thus improving efficient scientific collaboration across different disciplines and regions is necessary. It means that cryptocurrency has started to catch wider attention since 2017, and financial aspects of cryptocurrency are some of the most concerning dimensions.

Fourth, the co-citation networks and cluster analysis extract a few significant intellectual bases. These intellectual bases are all early research with significant contributions in understanding the technology, history, and constitutions of the cryptocurrency system. Some of them are among the first researchers that pioneered a new research direction in the cryptocurrency field. They have provided many fundamental insights on Bitcoin and cryptocurrency and brought inspirations for future studies.

Finally, the paper evaluates the evolution of the research trend and emphasizes some research frontiers for the future. Analyzing Bitcoin graphs and transaction analyses have been the most popular topic in the early years. Gradually, the trend shifts to socio-economic disruption, such as

payment methods and regulations, and finally to cryptocurrency markets. The research trend reflects the major attention of the cryptocurrency field. We can project the role changing of cryptocurrency, and the tension rising process between state and cryptocurrency through the analysis.

From the above analysis, we can see that many researchers are mostly concerned with technical analysis, such as graph and transaction activities, and socio-economic analysis in the cryptocurrency area, such as payment systems and financial institutions. However, no influential papers, keywords or clusters are identified within the business and management field in relation to cryptocurrency. Therefore, a promising research direction could be done in the business aspects and organizational consideration of cryptocurrency application and impact. On the micro-level, almost no research exists on how cryptocurrency can change organizations. One of the cases where cryptocurrency is used in the business is initial coin offerings, which has already innovated the way small and medium sized enterprises raise capital (European Commission, 2018). These applications of cryptocurrency have already exhibited many new phenomena in the management field.

7 References

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Paper 2

How Money Became a Symbolic Medium of Exchange- Comparing the Trajectories of the Western and Chinese Currencies

Xiaochun Guo and Lars Bo Kaspersen

Abstract

The concept of the modernization paradigm has been generally accepted by the public. This paper describes the currency development trajectories of European states and China and compares the distinctive differences between the Western dominant system and Chinese alternatives to show an exception of such concept. From a historical view and comparative analysis, the divergences in the development path could contribute to the differences in the future development of different regions. With the advancement of technological developments, traditional currency gradually evolves into digital currency. Therefore, we further take digital currency into consideration as the case of modern monetary mechanism. Having compared the different monetary development trajectories of Europe and China, this paper argues that each system has its own priorities and benefits to fit the political, economic, and social relationships in the society. The historical political and economic relations still impact how each state reacts, and the divergence will remain in different systems. We need to accept the truth that China will probably not converge to what the Western world is. As digital currency rises as a new generalized symbolic medium of exchange, divergent responses co-exist in the two regions.

1 Introduction

During the last 30 to 40 years, China has demonstrated high growth rates and increasing prosperity. Poverty has not entirely disappeared, but the country has been through a social development hardly seen before in history. Many China experts have argued that China has managed to “catch up” faster than any other developing country. They are “catching up” because they had “fallen behind” the advanced industrial societies in the West for a long time and many observers expect that China will “overtake” the other formers or present superpowers. Many commentators, in particular from the western societies but not exclusively from there, cannot help thinking about development as a fast-moving and forward-going linear process, which for centuries has been led by the west. This way of thinking rests on a number of assumptions that are closely affiliated with the so-called “modernization paradigm” which dominated the development and the Third World debate in the 50s, 60s, and 70s in the United Nation, International Monetary Fund, the World Bank etc. It seems to be a common assumption that finally China will adapt to capitalism and private ownership, and become integrated into the world market, and following from here the modern contract-based market will spread into more areas of Chinese business.

Apparently, the modernization paradigm is layered in minds of the political elite, and it still (despite 30 years of fierce criticism) influences many decision-makers. This is unfortunate because it ignores important insights which could help us understand China and its further development. In this paper, we will engage in this debate. Our purpose is to show how China and Western Europe take two different trajectories in the development of a money system. Both took different ways to develop a monetary system with money as a “symbolic medium of exchange” – a device that facilitated the exchange of goods and commodities across time and space. Most often, economists and other social scientists argue that during the 1990s the Chinese monetary system surrendered to the global monetary system undergirded by the United States. This happens as a part of the process of integrating China into the world trading system. We shall argue, however, that despite the integration into the global trading system, the Chinese monetary system remains different from the western.

2 The Structure of the Paper

The structure of the paper is the following. First, we provide a set of concepts to help analyze the two different lines of development. Admittedly, these concepts are taken from Western thinking about money and currency mainly from Keynes and Knapp – two authoritative sources. Despite the danger of reinforcing the Eurocentric view, we shall argue that our analysis drawing upon these concepts contributes to escape the modernization inclination. The next section of the paper provides an overview of the development of the monetary system in the western world and in the following section, we concentrate on Chinese development. In the fourth section, we compare and discuss the two trajectories. Before the concluding part, we point to some examples clearly demonstrating that even today in the age of “globalization” there are distinctive differences between the Western-dominated and the Chinese financial system.

3 Oikos, Economics, Money, Currency - Some Introductory Remarks

Before we move on to present the development of the monetary system in Europe, we shall clarify some concepts which frame this historical analysis.

When most people hear about money and a monetary system, they tend to think that we now focus on “economics”. Unfortunately, the differentiation of society, the increasing division of labour, and the strong specialization within science and other related developments have detached economics from other areas (e.g., politics, religion, and culture). Economics has become an autonomous sphere with its own logic and driven by its own laws. It is important to remember that economics was closely interdependent with politics, culture, military matters, and ideology. Thus, our hypothesis is that the production and exchange of commodities was as much a political act as it was an economic act. When hunters and gathers began to exchange commodities, it could be seen as a gift relation (Mauss, 2002). This gift relation was not only an exchange of a commodity, but it was also a political act. Because by exchanging gifts the two parties demonstrated mutual recognition. When you give a gift to someone, you demonstrate that you recognize “the other” and your social group respect this other group and its territory. Over time,

we tend to forget that the exchange of commodities is not only an economic relation but also a political one. In particular, after the introduction of coins/money as a symbolic media of exchange, laymen and laywomen, and scholars as well, often ignored the political dimension.

In our exposition and analysis of the rise of a monetary system in Europe as well as in China, we will point to how politics and economics are interdependent processes, but we shall not unfold the whole complexity of the politic-economic relationship. It is useful to remember that the origin of the concept of economics goes back to the Greek word “oikos” which means household. An oikos is not a free-floating entity. On the contrary, the oikos is tied into a political structure (a polis – a city-state) providing protection and the conditions of existence of the oikos.

In the following, we will look into how a monetary system developed and how the European states went through a dual process in which they increasingly ruled and controlled a demarcated territory and also monopolized the minting process and the monetary system. Thus, they develop symbolic means of communication in relation to exchanging commodities and property. Throughout this process, they have experienced a barter economy, a money economy, and a digitalized economy.

Archaeological sources provide evidence for different forms of barter economies over time, in which people lived as hunters and gathers, also in the Neolithic period. We are also aware of the existence of coins in Lydia approx. 800 B.C. and in the Roman Empire, there was widespread use of coins (Galbraith, 1976: 16). The existence of coins did not automatically lead to a money economy. A money economy emerges gradually in the late medieval period. But how do we define a money economy?

A useful starting point of this analysis is Keynes' *A Treatise on Money*. Keynes provides us with some useful concepts to understand the developments of a money economy. The first concept - money-of-account - refers to money as a material unit in which debts, prices, and general purchasing power are expressed (Keynes, 1930: 3). Money-of-account, which essentially is a name (Pound Sterling, livre tournaies, crown, Mark, etc.), came into existence together with debts, price lists, and taxes which can only be expressed in terms of a money-of-account. Money itself - or money proper - is the money by which delivery of debt contracts and price contracts are

discharged and in the shape of which a store of general purchasing power is held. Money proper derives its character from its relationship to the money-of-account (since debts and prices must first be expressed in terms of the latter) (Keynes, 1930: 3).

Another important concept is fiat (or fiduciary) money. This refers to money which today is often made of paper, created, and issued by the state, but which “is not convertible by law into anything other than itself, and has no fixed value in terms of an objective standard. Moreover, the intrinsic value of the material substance is divorced from its monetary face value” (Keynes, 1930: 7).

If something is just used as a means of exchange on the spot and holds a general purchasing power it is not money proper, and in Keynes’ terms, it cannot be recognized as a part of a money economy. Money has been used in this way throughout history, but this money system still must be considered as a barter economy. Money proper in Keynes’ sense of the term can only exist in relation to money-of-account. When a relationship between these two concepts appears, the barter economy is succeeded by “the age of money” (Keynes, 1930: 4). The important difference between the barter and the money economy concerns precisely the relationship between money-of-account and money proper. Money-of-account as a description or title of the money can remain the same, while the thing (money proper) can change. A French livre tournaïis can be used to describe the coins in circulation while the thing - e.g. a coin - can change content. For example, the gram of silver or gold contained in the coin can change, while the description “one livre tournaïis” will remain the same (ibid.; Braudel & Spooner 1967:379).

The money economy is interrelated with another concept which Keynes and Knapp (Knapp 1924) call “state money” because the state is the only authority with the power to enforce payment of things that correspond to the name or description in a contract and, moreover, the state claims the right to determine and declare what thing corresponds to the name (Keynes, 1930: 4). Various “states” or “polities” have made this claim for thousands of years, but they never fully succeed before the rise of the nation-state in the years after the French revolution. However, during this period (1500-1660), some of the states in Western Europe began to control a certain area in terms of minting and claimed a “national” currency. A monopoly on minting and a real national currency was still to come.

Keynes correctly points out that different forms of states with economies based on money proper and money-of-account attempting to claim a monopoly on minting have existed for several hundred, maybe thousands of years (Keynes, 1930: 11–15). However, no states or economies have had a true money economy based on the relationship between money-of-account and money proper, the existence of important fiat money and a predominance of state money. This did not begin to take place until the 16th and 17th centuries.

4 Monetary System Development in Europe

A whole set of interrelated changes with consequences for states and the monetary system took place. The enormous bullion flow stemming from the silver mining industry in South Germany from the mid-15th century, and even more important the bullion imported from the New World by Spain and Portugal, contributed to the widespread use of money instead of payment in kind (Miskimin, 1977: 156; Wallerstein, 1974). All prices, all accounting systems, and all contracts were formulated in terms of an accounting unit. The use of money-of-account made possible classification of prices and created a continuous accounting procedure (Braudel and Spooner, 1967: 378–379).

The consequences of the increased bullion flow must be related to other changes. Technological changes (not least in the military sector, but also in the means of transportation and communication), organizational changes in military and state bureaucracies and in the industrial structure, the burgeoning activity of international trade on a world scale, population growth with increased output of goods and services, and in some regions urbanization involving a further specialization - all changes that generated a higher demand for transaction in cash, which again “placed heavier demands on the money supply and consequently stimulated the desire to alleviate monetary insufficiencies by devising alternative credit mechanisms” (Miskimin, 1977: 158). Thus, there was pressure to make the money supply more flexible and to expand the use of credit. In particular, the states themselves, in order to strengthen their defence and to meet the increasing cost of warfare and military-commercial activities, had an “interest in an expansion of money supply and the opportunity to borrow at reasonable rates of interests” (Miskimin, 1977: 158). The

states themselves were responsible for gradually freeing the money supply from dependence on bullion stocks through the introduction of a fiat currency (Braudel and Spooner, 1967: 386; Miskimin, 1977: 158).

In the 16th century, economies began to function after different principles. The principles of state money, money-of-account, money proper, and fiat money became more dominating in economies with a more extended international trade and a growing financial sector with merchant bankers and moneylenders (Bonney, 1991: 429).

Increasingly, it became possible to distinguish between a domestic “national” economy (or more precisely a “territorialized” economy) and an international economy. One particular form of survival unit was in the long run better capable of creating a legitimate currency. That was the emerging modern state. State-issued or certified currency achieved greater and greater legitimacy within a territory. The state offered a guarantee for the coin/currency because it accepted taxes to be paid in the state-issued currency. Thus, it became obvious to the population that the state confirmed the value of the coin. The taxation served as a guarantor of the circulating value of the currency. The public accepted the coin at par. The extensive process of taxation, which took place in most Western European states that were linked to military development, was broad and deep enough to touch a significant number of people who, therefore, were confronted with the currency. The high level of taxation “acted as a guarantee for the integrity of the par value of the coinage which finally broke the direct link between the money supply and the bullion supply” (Miskimin, 1977: 159). Because of this acceptance of a “national” currency, domestic trade and business used it, and even though foreign currencies still were found in for example France and its civil society, the state-issued currency became more prominent.

At the international level where the amount of bullion in the coins was decisive, the “national” currencies and their face value were not accepted unconditionally. Thus, international trade was made possible through merchant bankers who compared the amount of bullion in different currencies. It became crucial for the state to collect bullion because this functioned as the international currency. In order to extract bullion from its own domain of sovereignty (besides taxation), the state often debased the money-of-account (Braudel and Spooner, 1967: 383; Højrup,

1995: 180). The face value of the money remained the same, but the amount of gold or silver was reduced and kept by the state as savings. This process could only take place among those forms of states where the internal circulation was based on the same currency, which was made compulsory, by the “sovereign”. In the long run, it required a state with a certain level of centralization and territorialization, something that occurred in some Western European areas during this period. This is exactly what we find in the forms of states we call territorial (and nation-) states.

International trade increased dramatically after 1500. Partly, the great “discoveries” and the expanding trade with the new world boosted internal trade. In addition, the demand for mercenaries involved a massive flow of money into the international system. States lending money and buying troops at the international market reinforced the development of international trade and financial systems, which again generated pressure for more flexibility in the money supplies of the states and contributed to the development of the monetary system.

This development of the first “national” economies with money-of-account, money proper, and fiat money must be seen in close relation to the development of certain state forms. The city-states in Italy, the city-leagues like the Hanseatic League and the stände-staat, especially in the centralized version like the French, all played a part in this development. They all had an interest in the emergence of this monetary system, but for different reasons. The city-states and city-leagues could benefit financially either as money lenders or traders, while a state like France could use the domestic economy, based mainly on its own currency, to extract resources to buy the troops necessary for the defence. The international market was not only used as a market for buying soldiers, food, etc. (which all state forms were forced to do) but also as a financial market to obtain loans to pay for the mercenaries. This reinforced the development of finance capital, bankers, and moneylenders.

Since the use of mercenaries became crucial for the defence in this period, this economic system favoured states that could afford to buy armies on the international market. These states obtained their resources from taxation, loans, or debasement of the currency. States without access to money were left to extract resources directly from their own society by raising conscripted armies

and developing their own production of necessities (weapons, horses, food, clothes, etc.). This happened largely in Sweden. States without access to resources declined.

The new monetary system contributed to the development of a new type of “society” - civil society. For the first time in history, state and civil society separated into two spheres. Before the Renaissance, all states extracted resources for military and defence purposes directly from “products” produced in a state. More precisely, it was impossible to distinguish the organization of the “particular unit” from the organization of “society”. One example is the feudal state where the king could raise an army by ordering the vassals to fulfill their military obligations. The ties of loyalty between lord and vassal made it possible to mobilize an army, and furthermore the army - mainly a cavalry - had to equip itself, because the king did not possess the resources to provide equipment, food, horses, etc. From the Renaissance onwards, states only had indirect access to resources. In order to maintain its goals, the state had to buy the means in a market - either the domestic or the international market. Money is the medium that separates the state from society. Only through money as a medium can the state purchase the resources necessary for its operations.

After 1500, a defence and an army could almost only be raised with money as a medium. The possession of money - bullion - became a dominating feature of the state forms during this period, and consequently, mercantilism became the dominant economic policy and philosophy (Mann, 1988: 473). Export of goods and thus conversion of goods into bullion equaled savings, while import meant the opposite - conversion of bullion into goods equaled consumption. The strength of the state depended on the amount of money/bullion that could be raised to mobilize an army. Consequently, it was of utmost importance to limit imports and promote export. Only this step could secure sufficient savings to buy mercenaries and other goods necessary for the defence.

In sum, during the 16th and 17th centuries, a new money economy developed in Western Europe. It was interrelated with the coexistence of certain forms of states. The gradually internationalized trade encouraged the emergence of new money that are easy to mobilize. In the meantime, the state benefits from fiat to acquire resources in the international market. One important aspect of this development was the military changes with new defence structures based on a new expensive

type of fortifications, gunpowder, and mercenaries forcing the states to extract many resources for warfare. This stimulated the development of a new monetary system.

A detailed examination of the relationship between the rise of civil society and new forms of states is beyond the scope of this chapter. It is sufficient to point out that the enormous demand for money and military equipment contributed to the development of this new monetary system and following from this a separation of some particular states, most notably the emerging modern state and civil society. Thus, two interdependent but still separated spheres characterize all modern forms of states: one dominated by a set of institutions with locus in which politics are developed and decided, and another sphere dominated by economics and economic processes preconditioned by political goals and decisions.

Thus, when it comes to the emerging modern state –which did not mature until the late 19th century- the state -civil society separation does not lead to a civil society independent of the state. On the contrary, the state is still a precondition for civil society. The state confers rights, privileges, and obligations on the actors in civil society, be the different estates, assemblies, towns, guilds, individuals, the Church or other associations. When this conferment has taken place, these actors can become real actors with the power to act. The state no matter what form or shape it takes is the only entity that can provide the foundation for a civil society. All economic actions within trade, industry, agriculture, etc. are dependent on a legal order developed, determined, and approved by the state. The privileges to trade and do commerce, to own land, or to set up production are completely dependent on approval from the state.

5 Monetary System Development in China

Eastern Asia had an exceptional development path. Turning to the evolution of the monetary system in China, we open another facet of socio-economic development and state formation from an Eastern- historical perspective. The trajectories tell us not only how money development happened differently between China and Europe, but also how the role of nation-states and governmental agencies have been shaped through the monetary system in different ways.

In the prehistoric era, natural products, such as livestock and grains, were exchanged for different purposes. That was the time of the barter economy. As productivity started to increase, commodity money emerges as the general medium of exchange. In the early Shang and Zhou dynasties (1660-770BC), cowries were used as the medium of exchange. The metal coinage started in Spring and Autumn period (770-476BC) and the Warring State period (475-221BC). The cultural, economic, and social development had reached a new time for its glory and prosperity. Various forms of money proper were used in different regions, including many different metal coins, gold, and cowries. It is argued that the monetary economy at that time was close to the ideal situation of currency competition proposed by Hayek (Kakinuma, 2014). Though there is evidence that those different money props were able to be exchanged in different regions, the coexistence of multiple currencies still caused great inconveniences and demarcations for business and trading activities.

The Qin dynasty (221-207BC), which was the first acknowledged unified empire in China, made a series of currency revolutions after unifying the country. The first emperor of Qin unified the currency material, shape, and standard unit of account. Qin no longer considered cowries as currency and created a standardized metal coin Ban Liang. Though there is no direct evidence to point out that Qin monopolized money production in the historical material, scholars infer that private minting has been prohibited (Peng, 2020: 76). It is argued that the monetary system was designed to be part of architecture for national unification (Mayhew, 2012). Giving one standard to multi-currencies of all other perishable small states was one of the essential means to maintain centralized power to unite people previously from different nations and prevent rebellions of the remnants from the old empires. This is the first time we can call those coins “state money”.

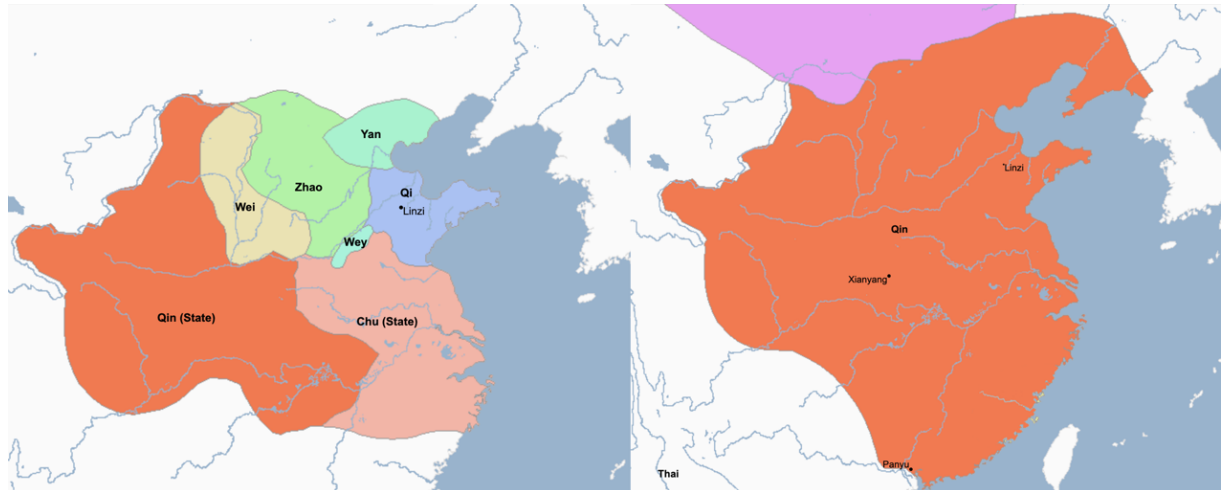
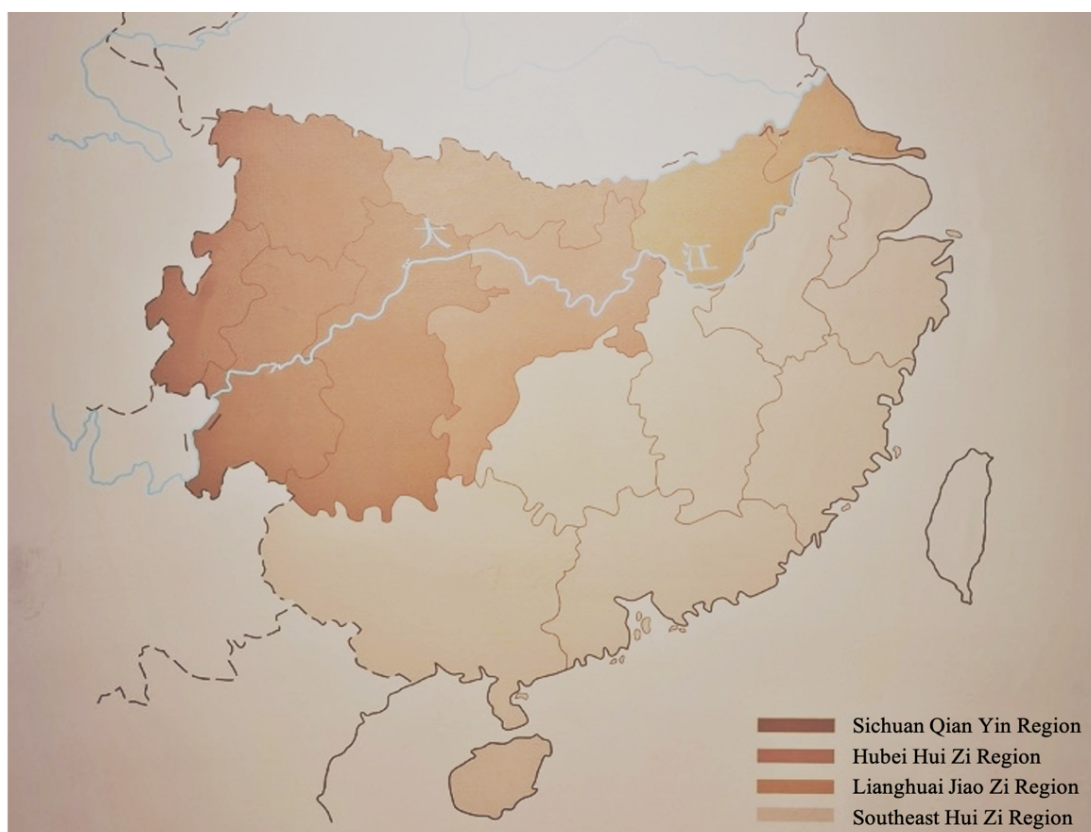


Figure 11. Waring Period (225BC) and Qin Dynasty (208BC)

The commodity continues to be the major money until the Song dynasty (960-1279), when the first paper money, Jiao Zi, came into the world. Later, Qian Yin and Hui Zi (the name of certain types of money) emerged. After over 50 years of separatism in Five Dynasties and Ten Kingdoms period, the currency system of the Northern Song dynasty was strongly demarcated and very complex. Iron coins, bronze coins, paper currency, silver, and gold were all used at the same time in different regions. However, this did not impede economic and cultural development (Peng, 2020: 457). The economy, culture, and technology of the Song dynasty were highly developed. Merchants and businesses were booming (Horesh, 2012). Due to the insufficient supply of metals, widely spread private casting, and the inconvenience of the metallic coins, paper money emerged as needed for its cheap and sufficient supply of original materials and the ease to carry for business. Paper money started with private issuance, with big merchants issuing their own paper deposits to allow businessmen to exchange the same amount of currency in remote areas. Later, paper money came into central governmental management, which defined standards for its design, including setting maximum issuance amounts, deposits, fixed face values, and qualified issuers (Horesh, 2012).



Sources: Edited version of the original picture from China Numismatic Museum

Figure 12. Southern Song Dynasty Paper Money Circulation

Those paper currencies were the medium of exchange, stores of value, and means of payment during that time. Song and other external regions had active economic exchanges with the surrounding nation-states, for example, Japan, and Jin (Akiyama, 1941: 158; Xu, 1408). At this point, Song's currency became a generalized medium of exchange in the surrounding regions, regardless of the format of money proper. Only when currency is not bound to a specific form can it help to develop active cross-border exchanges.

The linkage between money-of-account and money proper had been built in a way. However, the multiple currency coexistence phenomena form a relation that the money-of-account was well-defined in the society, and money proper was flexible in substance. Though different money proper existed, things were usually priced in "qian". Before the hyperinflation at the end of the Song dynasty, the price level was stable. A standard unit of account for products and services was able to be reached in the economic exchange process under the management of the state. Money-

of-account is the standard for individuals to measure the value of different products beyond subjective pairs in accordance with the needs of two transactional parties. This is an essential element of multilateral exchange in the market economy (Ingham, 2002).

If we analyse the monetary development from a numismatics perspective, the numbers of circulated currencies in the Song dynasty were very high, which can be regarded as a very high level of a money economy in feudal ancient China (Peng, 2020: 455). However, if we take Keynes' concept of the money economy, that in the money economy, the state needs to monopolize the currency minting, set standard value, and control the unification of a certain type of currency in a territory, we cannot conclude that the Song dynasty has a standard generalized symbolic medium of exchange. But this can be regarded as the primary stage for moving towards a money economy.

In the early Yuan dynasty (1271-1378), the principal currency in the market was still paper money. Yuan dynasty issued four different kinds of paper money with indefinite circulation without demarcation and a regular redemption mechanism. It considered paper money as an important means to acquire seigniorage. In history, Yuan had expanded its territory from East Asia to Europe. Large military and fiscal expenditures were required to support the continuous wars, and huge amounts of rewards were granted to the ministers in order to maintain the governance of state operations (Guan, 2016). Unlike commodities, paper money became the creature of the state to conduct those activities without high costs. As a result, all paper money ended up with decreasing value and hyperinflation (Peng, 2020).

The earliest emergence of paper money had been prevailing in the market from the Song dynasty until the early Ming dynasty (1368-1644), lasting for around 400 years. It is argued that the dissociation of money-of-account and means of payment was of critical importance in providing the conditions for the emergence of merchants' private bank money (Ingham, 2002). However, this precondition for developing a money economy did not continue as Europe did. The paper money attempts all ended up with failures, which made people turn back to commodity currency. This was not the willingness imposed by the state, but the choice of the market (Xu, 2017: 152). When the paper currency encountered hyperinflation, even though silver was prohibited by the

state to be a legal payment, it was largely accepted by the public as a medium of exchange. In the meantime, the banking system emerged, and fiat currency came into the stage in Europe.

After the Ming dynasty, silver became the medium of exchange for trade with the western world. Though silver was considered as official money acknowledged by the state, silver itself is still a commodity with value. The value of metallic money did not derive from the backstops of the state, but from the value of the metal itself. Instead of being reinforced by state public laws, the relation between the money-of-account and money proper has been detached. Therefore, to a certain extent, we can say that the progress of currency moving towards a generalized symbolic medium had been halted since the declination of paper money in ancient China. The power of the state in currency governance was also reduced in economic activities.

The Qing dynasty (1636-1912) was the last imperial dynasty in China. In the early Qing, the monetary system continued to be similar to the Ming dynasty's, with casted coins and silver as a medium of exchange. In the late Qing dynasty, the country became a semi-colonial and semi-feudal state. The introduction of the western monetary system impacted how currency had been developed in China. At the end of the Qing, money entered into a period of complete chaos with all kinds of money circulating in the market (Peng, 2020: 867). There was no unified benchmark exchange rate for commodity money, and people used all types of money proper to trade with different merchants, including silver, foreign coins, bronze coins, banknotes, and private currencies. Money had strong regional features without the monopoly of the state. There was a lack of currency monopoly ideation for the empire (Xu, 2017: 216–220).

In the early 20th century, the Chinese modern state emerged, and banks started to emerge in China as well. The weight-scaled currency was substituted by the money-of-account, meaning that the use of standard coins took place the commodity features of money. But at that time, different notes were circulated in the market, and the whole monetary system still relied on the silver standard. Not until 1935, the fiat currency finally replaced the silver standard under the background of the devaluation of silver and the global money revolution impacted by the Great Depression.

6 Comparison of Two Trajectories

Stepping into the world of globalization, money has become one of the most important objects in economic relations. After Bretton Wood System collapsed in 1947, a new monetary system, a floating exchange rate mechanism, has been introduced to the world. The paper money evolves to be the fiat currency, which is the government legal tender that is backed up by the state. This marked an important step to liberalize currency for a more market-driven mechanism.

In the mainstream, it is held that Europe has been leading the world in the modernization process, and other countries follow the trajectories of the west. In the economic sphere, it is generally accepted that the European states have been at the front of the race to create a modern banking system, currency standards, and monetary mechanism. It is true if we look back to the 18th and 19th centuries afterward, that the emergence of the modern state has provided the cradle for the fiat currency system and new international monetary order. As we dated back history, the European currency trajectory went through gift, commodity, and paper money. However, when we investigate the trajectory of Chinese currency development, a different route has been developed. The currency experienced the gift, commodity, paper money and return to commodity currency again, and finally converges with the global trend towards fiduciary money in the 20th century.

Here, we take the sentence from Kemal Derviş (2012) to describe the future monetary development, that the world economy moves towards “convergence, interdependence, and divergence”. One of the convergences is the modern monetary system taking place since the 20th century. As the globalization process has reached new highs in the last decade, particularly economic activities have become more and more interdependent. One company starts its design of products in the west, places the manufacturing in developing countries, and distributed the products all over the world. For economic developments, money is an essential element pushing forward the process. Many western voices tend to have the idea that what happened in the west should be universally applied and China will finally converge with the western system under such global influences. However, divergence not only happens to the wealth distribution (Derviş, 2012),

but also in the differences in the international order. Therefore, taking both the history and modern stories of the West and China, we project that the differences in monetary development will continue in the west and the east.

From the 16th century, Europe gradually transformed into a money economy. While China experienced the sprout of early industrialization, but with the failure of paper currency, China turned back to a more conservative commodity economy. The emergence of fiduciary currency did not continue to formulate trust institutions and drive the Chinese economy to develop a market economy. There were different times that China made attempts or even advanced progress toward developing a money market, such as the Song dynasty and Ming dynasty. However, they never succeeded. The feudal China early achieved territorial unification and had the attempt to monopolize minting since the Qin dynasty. But they seldomly took full control over the currency power. Either private minting prevailed, or the state abused the trust in money issuance. Therefore, the winding development path has not helped China to achieve a money economy earlier than Europe, and the country only started to have a monopoly on its currency after the convergence of the modern monetary system and the People's Republic of China has regained public confidence in currency issuance.

From the above historical description, we can see that the development of the money economy in China has been way more complex and dynamic. The case of the monetary system very well characterizes the differences of Chinese and European people in understanding the relations between money and the state. There are several reasons that contribute to such disparities.

First, the different military structures. Since the 16th century, the domestic supply of vassal resources was not enough to defend and expand the territory. Mercenaries became crucial resources for Kings of Europe's states to defend their own territories. To hire those mercenaries, the king needs capital to finance the army. Money was required to be the medium, on the one hand, to acquire resources for military activities; on the other hand, to distinguish the state from society in a sense of the international market. In China, troops were under the control of a set of military institutions, where the emperor retained the highest power in political and military affairs (Zhang, 2015). It means that emperors had their own armies and did not need to hire mercenaries

to fight for the state. Generally, people who were citizens of China became soldiers to defend their own territories. Being a soldier is more of a job or a born destiny under the system of hereditary conscription. Besides, under the unification of China, the territory of China was big enough that made the emperor did not need to rely on outside resources to support military activities. These differences in military activities resulted in China not having the need to develop a system to acquire external resources, which disadvantaged the development of the money economy.

Second, the different perceptions of money. Currency is an important part of state formation in terms of resources and economic power for European states, where it is a mean to acquire resources through economic activities. For example, in Italy, the state governors ran loans and businesses, and paid mercenaries to get military resources. Money, or more precisely, capital is a driving force for state development in European countries. As for China, money is not the mean to access resources or build connections with business, but more of an instrument to strengthen political power. No matter ancient China or modern China, a popular acknowledgment is that money should serve the purpose of political goals, instead of the priority for the economy, though business and trade were once very active in Chinese history, even the “earliest sprouts of capitalism” occurred in China instead of other areas. Nevertheless, business was not considered as a vital and essential part of society. Long has ancient Chinese literati proposed the state governance strategy to strengthen the central political power and pointed out that merchant activities should be suppressed. The ranking order for the perceived value was government officials, peasants, workers, and businessmen. Therefore, money, as the most important part of business, was just considered as a tool to serve the dynasty, rather than an independent driving force integrated into the state development as European society did. But one should also not misunderstand that money and economic power are not important in China. Currency works as a tool to represent the legitimacy of the sovereign regime, strengthen the state power, and ensure solidarity governance for the region, which carries less economic meaning than political implications.

Third, the different institutional relations. The separatism of different small states means that Europe can hardly achieve currency unification like a few centuries ago. The capacity to defend

and attack relies on the state's ability to access resources. If we take Europe as a whole, different states within Europe have competing relationships. The monetary system of each state, therefore, also competes with each other. Currency has not been monopolized until the emergence of the modern state in the 18th century. Resources flow to the territory where one can gain more benefits than the others. This was quite similar to the Spring and Autumn and Warring State period in China. However, since the Qin dynasty, China had experienced several attempts at unification. Theoretically, most dynasties prohibited private minting. Here we discuss the official act towards currency, thus ignoring the fact that the ancient Chinese government had hardly fully had control over private minting. Therefore, particularly for low-cost paper money, the Chinese state started to monopolize the issuance of currency since 1024, and private paper money was forbidden ever since (Chen et al., 1995). After the Song dynasty took over the control of paper money from the private sector, currency issuance relied fully on the credit of the government. On the monopoly of currency rights, there is another side of risk, which is power abuse in money creation. Under such an institutional arrangement, states-controlled currency usage, amount, and exchange process, and in the meantime also limited the freedom of currency development through market-driven forces.

Taking a closer look at the modern monetary system between Europe and China, we can also identify many different elements that could potentially cause the divergence of the development. Europe advocates free-market policy and believes that money is an autonomous force of production and the economy is an independent driving force to social changes (Ingham, 1999, 2002). Government involvement makes decision-making focus more on political motivation instead of value maximization, which will reduce the capital allocation efficiency (Wurgler, 2000). Inherited from history, China has more special economic and political relationships and institutional arrangements compared to other countries. The Chinese government has control over a large proportion of resources and intentionally intervenes in economic and social development. For example, the National People's Congress (NPC) and the Chinese People's Political Consultative Conference (CPPCC) National Committee annual session proposed the fourteenth five-year plan to guide economic and social development in the next five years. This plan will

decide the direction of major national construction projects, labor distribution, and the national economy. By intervening in activities, the state is able to fulfill social responsibilities and gain political advantages.

A typical example is state-owned enterprises (SOEs). The government maintains control by holding enterprise shares and appointing top executives. SOEs have dual roles in operating the business, including the general economic purpose of enterprises to achieve profits, and the special political social responsibility to strengthen the ideological requirements of the states in accordance with the major strategies and policies (Zhang and Tang, 2018). According to the statistics of the State-owned Assets Supervision and Administration Commission of the State Council (SASAC), the assets of Chinese SOEs reached 94 trillion yuan (not including financial enterprises) by the end of 2020 (about 14 trillion USD). Lots of large projects, especially those related to natural resources, infrastructure, and national strategy, are conducted through SOEs, such as electronic supply, crude oil, fundamental agricultural products, aerospace research and development etc. Another more direct example is the institutional setting of central banks. In western monetary institutional settings, central banks should be independent of state governments, which means the monetary policies focus on economic goals rather than political priorities. However, in China, the central bank is not designed to be an independent institution, but a governmental agent under the control of the State Council. This means that the economic power is by no means beholden to political interference, and it constitutes part of the state's political power.

Having compared the currency development trajectories of Europe and China, and some differences between the modern systems, the more important thing to draw from here is not that one system is performing better than the other. Rather, the two mechanisms have long inherited histories to keep the differences towards the understanding of economic and political relations. Even in the modern world, the seemingly same system has differences underneath implicit knowledge stemming from history. Those two aspects are interdependent, and the dominance of the one also requires the support from another to function well. Either force has exhibited its own advantages, such as the formation of modern markets by economic force, and the unification of the territory by political force. Each region has its own preferences and advantages in economic

and political development. The monetary system is one as such. Those differences give the possibility that the west and China will adopt their own way of development, therefore, the convergence of one single system may not be necessary.

7 New Challenges: Digital Symbolic Medium of Exchange

Dating back history, we have seen a divergent road of monetary system development in Western Europe and China. But in recent decades, with globalization and gradually opening markets, two regions are following along the same path of fiat currency. Since fiat currency does not require any physical commodity to support its value, it is subjected to the issuers to determine the value in practical usage. On the one hand, fiat currency allows cheap production as well as flexible monetary governance for the issuer. On the other hand, it is subjected to the manipulation of the issuer. For any generalized symbolic medium, a problem faced by the interactive actors is just what Parson (1963) said, “in relinquishing control of objects of ‘real’ utility for money, one risks never gaining an equivalent in return and being ‘stuck’ with the symbol”. It means that the object could fail to be store-of-value and to perform the function as a medium to be accepted in exchange for other products or services. Particularly, fiat money, backed up by the credit of the government having no intrinsic value at all, could easily turn to be “thin-air” which is worth nothing.

In recent years, it seems that what has been through the history in the development of currency history of China has started to somehow replay in the modern economy. States are largely overprinting at present. In modern monetary theory, some academics claim that “the issuer of a currency faces no financial constraints” (Mitchell et al., 2019: 13). To put it simply, it means the government can print as much money as they want to solve any type of problem. This theory began to become very popular after the 2008 financial crisis and the practice of such theory has reached a climax under the shock of the COVID-19 crisis, that many countries have adopted quantitative easing policy to stimulate the economy and business. However, this claim also draws lots of skepticism. If we turn back the history of the Song and Yuan dynasties when paper money was wildly used in ancient China, such action had serious consequences, for example, currency depreciation, and the loss of public confidence in fiat currency.

Under the background of the global financial crisis and high inflation, the voice of building an alternative monetary system arise and the demand for safe-haven assets also increased. Cryptocurrency was designed to fit this purpose in certain ways. In late 2008, Satoshi Nakamoto (a pseudo) launched Bitcoin whitepaper, proposing a peer-to-peer electronic cash system, which allows any two willing parties to transact directly with each other without the need for a trusted third party (Nakamoto, 2008). Bitcoin is a decentralized currency system that helps to solve the problem of double-spending issues without the interference of centralized systems, such as banks, financial institutions, and governments. It is governed by online open communities, and transactions are verified through decentralized networks of computers. The new concepts of Bitcoin criticized financial intermediaries' role in the distortion of market governance by abusing market power and state hierarchies (Weber and B., 2015). Bitcoin is decentralized, free from government interference and manipulation, and represents freedom (Bohr and Bashir, 2014). Cryptocurrency exhibits advantages in transaction speed, expense, security, and transparency. Scholars call it "alternative currency" (Grinberg, 2012) or "distributed capitalism" (Kostakis and Bauwens, 2014), claiming its potential to substitute fiat currency and posing great threats to state power.

Globalization makes the world interconnected, facilitating the peer-to-peer network. People are not necessarily to be grouped together based on geographical location, rather, they can choose to be with people who share common values and common beliefs. This can be done fairly easy on the Internet. Digital currency, represented by Bitcoin, is a product produced through international collaboration by individuals with similar interests across borders. Parson (1963) argues that the generalized symbolic medium has to operate in a set of norms and rules that are institutionally anchored in a system. In the case of money, there are many different types of notes and coins or fiat currency, but they are legalized to use in a certain normative world, say in a certain country or state. States form the system wherein the currency is acceptable to the transaction parties. However, digital currencies are circulated beyond the boundaries of existing segmented money forms in different countries. Cryptocurrency enjoys the nature of the supranational and was initially designed to transact without a third party, mostly meaning financial institutions and

governmental agencies. As the trend grows, Bitcoin and cryptocurrency become a symbol to signify the disruption of existing financial mechanisms and construct another freer decentralized monarch in the virtual kingdom. It makes money to be even more “generalized” to allow a wider context of interaction on the Internet.

8 Further Discussion

Currently, we cannot deny that “go-crypto” is an inevitable trend for the globe, and that globalization makes trade, financial, and economic activities more and more interconnected. As the new generalized symbolic medium, digital currency develops fast. And these algorithm-based, privately issued semi-decentralized currencies bring numbers of new potentials. Many believe that the currency development trajectories will finally converge, continuing toward the existing western version of monetary systems. However, the road of digital currency development is controversial. The doubts about its value formation, speculative bubbles, and potential threats to the states make this phenomenon full of risks and uncertainties.

The question continued from the last section again is whether digital currency is a new watershed for the world monetary system to continue the convergence in digital or crypto format and finally comes with a global solution? Or is it another start to mark a new divergence, leading the west and China to explore two distinctive currency mechanisms? An answer to the question requires the consideration of several facts. We open the discussion in this section and argue that different regions have their own understandings of cryptocurrency, and therefore, probably will have various solutions for the challenges brought by it.

If we take the concept of “state money” from Knapp (1924), each state is facing the issue that cryptocurrency has disrupted the established order of the current monetary system. First, it challenges the state power of currency monopoly. Private sectors are able to issue so-called digital currency without many barriers, and potentially anyone in the world can get such currency for their own usage. Cryptocurrency offers people new alternatives to get away from the unsatisfactory financial system and form competition with existing fiat currency. Second, this new type of currency is not legalized or supported by the state. Money has essentially no intrinsic value.

The value of money should derive from the institutional surroundings of the states (Knapp, 1924). However, cryptocurrency is valid by decentralized peers and governed decentrally by blockchain technology through codes and communities online. The new form of value validation escapes the state and diminishes the fundamental roles of the state within the money concept. Third, the emergence of cryptocurrency makes it impossible for nation-states to maintain the same control over economic “territory”. People are free to choose digital currencies for multiple purposes, including payment, store of value, speculation, or just purely to accept the idea of cryptocurrency. Among all those possible activities, some of them are not preferred by any states, such as using Bitcoin in illicit activities, tax evasion, and capital flight.

The objective challenges posed by cryptocurrencies for each state are similar. However, taking into consideration of different settings and perceptions, the reactions toward cryptocurrency exhibit disparities. Drawing upon the currency history of monetary systems, the understandings and historical impacts of currency have great distinctions between Europe and China. Particularly, the relations between money and states are different in the two regions. As a result, after Bitcoin rises, the reactions of the west and China also have great differences. The European Union adopts a more laissez-faire approach towards cryptocurrency, which means the major driving force relies on the market, and the governments are open to the new disruptions of cryptocurrency. Most European countries did not launch strict policies and regulations to stop cryptocurrency from being circulated in the market. Rather, many states started to revise existing laws and regulations to try to put cryptocurrency into the legal framework, which also means protection is given by the states to participants. For example, Switzerland built a friendly environment and many infrastructures for crypto-related startups and formed the world crypto valley in Zug. This is an indication of the acceptance of the new relation between new forms of “currency” and the states.

On the contrary, China adopts relatively harsh measures toward cryptocurrency. There are bans on financial institutions, businesses, and exchanges to be involved with cryptocurrency activities. The state put lots of effort in cracking down the cryptocurrency trading, exchanges, and payment activities, however, many active individuals are still participating in the game. Meanwhile, China considers digital currency as a new instrument to strengthen the governance and control over

money in the future, thereby fast pushing forward the central bank digital currency research and development process. China rejects these new emerging cryptocurrency relations by not offering participants proper legal security, instead, China takes advantage of digital currency to further improve the existing mechanism beyond the power of taxation and seigniorage rights. Central bank digital currency is an extended power instrument to reach new information control over spending, capital flow, and financial privacy in the digital era. And it is also argued to be an alternative to challenge the dollar hegemony and a new opportunity to redefine the global currency order (Konowicz, 2018; Raymaekers, 2015; Taskinsoy, 2018).

The system might enjoy some similarities even with the rise of cryptocurrency, since we can see a trend for the growing popularity and importance of central bank digital currency on a global scale, and we can also notify that it is impossible for any single state to stop cryptocurrency from being circulated or traded within a specific region completely. However, the process of governing cryptocurrency is a reflection of the different understandings underneath and relations between money and state in the West and China. For Europe, it is considered as part of the market forces to drive the monetary system with new possibilities, while in China, the government started to steer the direction of what should be done and what should not be done.

All of this support coexistence and coevolution of the two similar, but also different mechanism in the west and China, that each could go along its own path. It is by no means that one way is better than another. Either state-led or market-led money economies and digital economies have historical and practical implications. In the future, the different reactions by the two regional states could make those two regions face different challenges in governing digital currencies and potentially lead to different trajectories of currency development in the long run.

9 Conclusion

The thinking of modernization paradigm has influenced the world for a few decades. People tend to take for granted that the Western mode of development has been leading and will still lead the world trend. However, that might not be the case. From a historical view and comparative analysis, the divergences in the historical understandings of political and economic relations could

contribute to the future differences of many regions. The diversities remain in the world's political and economic spheres. This paper takes monetary development as an example to engage the discussion and to elaborate the idea. We describe the currency development trajectories of European states and China and compare the distinctive differences between the Western dominant system and the Chinese alternative. With the advancement of technological developments, we further take digital currency into consideration as “one step further” of existing modern mechanisms. Having compared the different trajectories of Europe and China in monetary development, this paper argues that each system has its own priorities and benefits to fit the economic, political, and socio-economic relationships in the society, and the divergence will remain in different systems. We need to accept the truth that China will probably not converge to what exactly the Western world is. Even when facing digital currencies, dual responses exist in two regions.

For Europe, money has experienced the trajectory of commodity currency, paper currency, and fiduciary currency. In the 16th and 17th centuries, the money economy gradually formed. It has been accompanied by the emergence of paper money and fiduciary money, which is closely related to the rising of the modern state in Europe. The urging need for states to acquire resources and organize military activities in Europe pushed forward international trade and active development of capital mobility. As for China, the development trajectory went through commodity currency, paper money, and turned back to commodity again. Not until the late 19th and early 20th century did paper money and fiduciary currency come back to the stage again. There were various attempts to develop a money market in ancient China, however, all failed in the end. The Chinese state has long tried to monopolize money sovereignty. The successful monopoly without proper institutional arrangements finally lead to the abuse of currency production, which is particularly evident during the paper currency phase.

When it comes to modern markets, the development of the monetary system also characterizes differences and will still go along their own path in a similar but also distinctive way. Considering the different monetary development trajectories of Europe and China, the different military structures, perception of money for the state, and institutional arrangements and relations

contributed to such differences. Even in the modern world, the gradual interdependence does not transform China to converge the Western manner. China still has its own special features in economic and political relations. Economic forces can never be independent of political interference, and they serve part of the political purpose. There is no superiority of one system over another. The coexistence and coevolution of the two mechanisms are more likely to happen in the future.

Under the financial crisis and the COVID-19 shock, the imperfection of modern monetary mechanisms was gradually exposed to the world, which give birth to digital currency, particularly cryptocurrency. Digital currency become a new symbolic medium to reshape the money concept and break the geographical boundary of traditional money. For digital currencies, Europe and China also have different attitudes and reactions. Taking the historical trajectories and modern developments of monetary systems into consideration, this paper still believes that the West and China will face different challenges in competing and developing digital currency. We try to give an answer at the current stage in the discussion, however, more should be left for future research to make more projections. Because this is an ongoing process and definitely not close to the end.

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Paper 3

Cryptocurrency on the Rise – A New Challenge to the Territorial State?

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Abstract

Starting from the discussion on whether the economy is an autonomous force or a concept that is closely connected to politics, this paper chooses cryptocurrency development in China as the case to illustrate such complex and interrelated relationships. First, this paper investigates the reciprocal actions and reactions between the Chinese government and cryptocurrency ecosystems and further divides the development of cryptocurrency in China into four distinctive phases. Second, in order to understand the development path of cryptocurrency in China, this paper conducts a deep analysis of the primary concerns of cryptocurrency in China. Third, based on the interactions between China and cryptocurrency and existing literatures, this paper further reinterprets digital technology governance and proposed a governance framework that incorporates the lenses of risk dimension and major social driving force. After balancing risks and opportunities, China chooses a strategy to unbundle the technology and currency side of digital currency and tries to extract a new “instrument” from it for state governance.

1 Introduction

A central aspect of human history concerns the development of different forms of political organization⁴. When we look into world history, we encounter, among others, tribes, bands, agrarian empires, city-states, feudal state forms, the *Stände staat*, and the territorial state. In particular, the territorial sovereign state has proved itself important because it outcompeted the other forms of political organizations. The territorial sovereign state emerged in the 16th century and during the next centuries, it became the form of political organization, that all other states imitated, first in Europe and later in the rest of the world. Thus, from the mid-20th century, it became the dominant form. The organizational power in the territorial state not only increased the control with the means of violence and the ability to prevent other states from encroaching on the territory of the state, but also fortified the ability to monopolize taxation and the control of mining and currency. The German sociologist Norbert Elias called the phenomenon “the monopoly mechanism” and these two monopolies were seen as interdependent. The state needed fiscal control to produce resources in order to defend its territory, and the monopoly of the means of violence was necessary partly to secure the fiscal control and partly to defend the sovereign and the territory (Elias, 1978: 302–311). One particular feature of any political organization was, according to Weber, the territory. Only the territorial state, however, controlled a demarcated territory by the use of an administration, which upheld the claim to the legitimate use of physical force.

The processes of territorialization lasted a long time although they varied from state to state. The French state went through an almost thousand years’ process with a point of departure in the 10th century and ending with a strong and coherent territorial state in the 19th century. However, it was far from a linear process. On the contrary, now and again the French state lost control and

⁴ The term “political organization” comes from Max Weber (see Weber, 1978:54-55). A “ruling organization” will be called “political” insofar as its existence and order is continuously safeguarded within a given *territorial* area by the threat and application of physical force on the part of the administrative staff. A compulsory political organization with continuous operations will be called a “state” insofar as its administrative staff successfully upholds the claim to the *monopoly of the legitimate* use of physical force in the enforcement of its order (Weber, 1978: 54).

processes of deterritorialization emerged (Kaspersen, 2020). However, in the long run, it can be characterized as a two-step forward and a one-step back process⁵.

Other states/political organizations such as China had a bumpier road with many setbacks, including several collapses of various empires/dynasties. Centuries before the territorial state appeared in Europe, some of the earlier Chinese empires/dynasties had strongly demarcated territories and almost monopolized the means of violence and taxation processes. Eventually, China went through several centuries with civil war, internal division, and occupation and therefore no demarcated territory and territorial control. First, when the Chinese Communist Party (CCP) tied mainland China together, a huge territorial state emerged. The Chinese territorial state also controls the monopoly of the means of violence, taxation, and currency. Today several political commentators argue that the one-party state China is one of the strongest territorial states with an unusually high level of despotic as well as infrastructural power⁶. This unusual power structure facilitates that China has developed into a large-scale territorial state with a huge population. Despite the geographical space and the number of people, the Chinese state has been able to develop strong control and also legitimacy.

During the last four to five centuries, the territorial sovereign state developed and consolidated in Europe, and this process intertwined with other processes, in particular, the development of the modern market economy. The rise of market economies and later the rise of capitalism turned out to be of major significance for the development of wealth and prosperity. Intellectual friends and foes such as Adam Smith, Adam Ferguson, G.W.F. Hegel and Karl Marx agreed that the modern market and capitalism were dynamic forces and, apart from Hegel, these thinkers argued that the economy increasingly became an autonomous force. In other words, it became more and more difficult to govern and control the economic forces. Thus, some economists argued that “the

⁵ We have to remember that there is no “telos” in history. No one anticipated or was able to predict the territorial state becoming the dominant form of political organization in the 20th century.

⁶ Michael Mann distinguishes between despotic power and infrastructural power in relation to the “autonomous power of the state”. Despotic power refers to the range of actions the state elite is empowered to undertake without routine, institutionalized negotiation with civil society groups. The Chinese Emperor, as the Son of Heaven, owned the whole of China and could do as he wished with any individual or group within his domain. The second kind of state power Mann terms ‘infrastructural’ power, which is the capacity of the state to actually penetrate civil society, and to implement logistically political decisions throughout the realm. (Mann, 1988: 1–5).

economy” was no longer always subjugated directly to politics and the state. Economics became a social force of its own and the task of politicians was more to adjust various policies according to the opportunities and constraints provided by the economic development. Political decisions could not change the direction of the economy, but clever politicians could reduce the speed and implications of economic changes. Production, trade, finances, and other market forces contributed to processes of social differentiation, an increasing division of labour, an intensified functional differentiation, and separation of society into “sub-systems” such as economics, law, education, religion etc. Most economists and sociologists have argued that these processes continued, and this has made the ability and capacity to govern and regulate economic activities even more difficult and more complex.

Despite these developments within economics and the changing relationship between politics and economics in the 19th century, a particular tradition – German Political Realism or German Political Economy – has continued to argue that economics are subjected to politics⁷. From a political-economy perspective, the economy serves the state as an instrument. Economic actions and economic policy are never oriented to merely economic ends. According to Max Weber, economic actions and economic organizations served the nation in order to survive in the struggle between states. “The science of political economy is a political science” (Weber, 1994: 16). Weber argued this position in the late 19th century in a specific historical context. However, despite its ideological character, we can extract an analytical position from this statement. The state or any other political organization must regard the economy as well as other activities as instruments in order to survive.

This variant of political economy has always been contested and even more during the last 30-40 years of increasing “globalization” where most (neoclassical) economists have argued that this kind of political economy has no validity. Partly, states do not compete, only firms do. Moreover, they have argued that the global economy makes it impossible to govern “national economies”

⁷ German Political Realism/German Political Economy is a heterogeneous group of scholars who mainly published their key works in the 19th and early 20th century such as F. List (1841), M. Weber (1895), and F. Oppenheimer (1975). This grew out of the Historical School of Political Economy with a long list of German economists and historians.

because the flows of capital, investments, commodities, and labour move across all types of borders and barriers. The market forces are undermining the power of the territorial (nation-) state.

Whether you are convinced that the internationalized economy makes governance at the state level almost impossible – at least more difficult – or not, then we have to accept that the rise of the East Asian national economies has changed the world economy. Some of the leading forces in the development of an even stronger international economy are some of the strongest territorial nation-states in the world: China, Japan, and Korea⁸. It seems to be a contradiction claiming that some states are becoming stronger territorial states while the economic flows of capital, commodities, labour, and foreign direct investments become more transnational. It is not a contradiction – it is rather a paradox (Rodrik 2011). In other words, states – at least some of them – have been able to maintain the ability to govern and regulate a territory while the economy has developed into a globalized, transnational network economy (Castells 2000). The question is: will the state continue to claim the monopoly of the territory and continue to regulate within its borders? Or will the most recent technological developments finally undermine key capacities of the state to control, regulate, and monitor its own territory?

The purpose of this paper is to investigate whether a fairly strong territorial state (China) is responding to the latest digital technologies and if the state is reacting to these new innovations, how and why is this taking place?

Before we move into an analysis of the reaction of the Chinese government to new technologies it is important to emphasize that it is far from all new digital technologies which pose unique regulatory challenges for the state (Beaumier et al., 2020). Usually, digital technologies are seen as transnational and fast moving and therefore these technologies are seen as incompatible with the relatively slow and territorially bounded public regulatory processes. Beaumier et al. (2020), however, develop a typology of digital technologies that demonstrates how different artifacts affect different global distribution of power. Some technologies can extend the capacity of the

⁸ By strongest we here mean strong cultural, historical, identical attachment to a territory, a strong state, (clear decision making), control of territory and a common acceptance that preservation of the nation-state has absolute priority. The market and businesses are just instruments for the state and people.

state to regulate globally while others can limit their capacity. A typology based upon two dimensions, the level of centralization and (im)material nature leads to 4 different typologies. Typology 4 which is the seemingly most immaterial and the most decentralized is exemplified by Blockchain technology and digital currency (Bitcoin). This seems to be the most difficult to conceive and regulate. Beaumier et al. (2020) sum up the challenges of blockchain technologies:

“In short, blockchain technologies draw upon multiple technical innovations, including most notable encryption and time-stamping, to allow the safe transfer of value without trusted third parties (Campbell-Verduyn, 2018). This can take the form of exchange of money (e.g. Bitcoin), but also of contractual rights or other valuable information. The non-proprietary and open-source nature of the blockchain protocol actually mean that anyone can use them to process any types of economic transactions. Participants’ transactions are then validated by a distributed network of computers that solve complex mathematical puzzles and saved as ‘blocks of data’ in public ledgers. The security and immutability of the information results both from the impossibility to change one transaction information without changing the entire chain of blocks, which would require immense computing powers, and the fact that the data is held by all participants. In other words, no single entity could in theory change the data saved in a blockchain without the consensus of the other members of a given blockchain network. The absence of a single validation authority, such as a bank or another financial intermediary, is one reason why public authorities are puzzled or even hostile towards blockchain technologies. In effect, a network of countless entities distributed around the world does not fall easily under their control and there are obvious risks that private actors try to circumvent their legal obligations. The relatively immaterial nature of the computer code and data behind blockchains mean that it can be hard for public regulators to assert their authority over them”.

Since cryptocurrency (Bitcoin), as one of the major applications of blockchain, seems to be the most difficult to monitor, control, and regulate, we have chosen exactly this new phenomenon to look into why and how the Chinese state responds to these new technologies.

2 The Challenges

Cryptocurrency and its supporters represented a different view than what a centralized state would prefer. Many cryptocurrencies, such as Bitcoin, Ether, and Dash, are running on algorithm protocols, which are usually governed by decentralized communities. In the case of cryptocurrency, decentralization and anonymous feature allows individuals to pursue individual liberty in the digital economy. In the online world, the virtual presence is able to disconnect from the real-life identity under the anonymous mask of cryptocurrency. The digital anonymity and freedom of financial speech are what they call “the last tool left in the dwindling garrisons of liberty” (Bitcoin Dark Wallet | Indiegogo, 2014). Traditionally, tax regimes, global trade systems, reserve currency disputes, and control of currency are important attributes of state power (Taylor Owen, 2015). However, with cryptocurrency, many core functions once controlled by the state are challenged by the new cryptocurrency entities. Regulatory supervision becomes difficult with unrevealed identity and unknown capital flow, which could induce illegal activities. Cryptocurrency is deemed as a product to get rid of the state intervention, which is a tool for overriding the rule of thumb of Chinese society.

The purpose of this paper is not to investigate to what extent some of these cryptocurrencies *are a real threat* to the modern states⁹. Rather, we will examine if the Chinese state regards cryptocurrency *as a potential threat* to Chinese sovereignty and the Chinese capacity to control its own territory.

It is crucial to the type of polity we call the territorial state to control its currency. If a number of cryptocurrencies emerge, then the states have to find ways to handle these new currencies because they can potentially lead to a loss of trust in the state and the ability of the state to guarantee the value of the national currency. Also, if the state cannot control the monetary policy within its territory, it can lead to a loss of income for the state and make it more difficult to govern and therefore, take away certain policy instruments with unpredictable consequences.

⁹ They might in the short run be a problem but in a longer perspective other new technology might be in favour of the state and the state will no longer have to see these currencies as a threat.

In this paper, we focus on how and why the Chinese state copes with the newness of cryptocurrencies. We have chosen China because one may assume that China is one of the states in the world with the strongest capacity to control currencies and we may assume that the Chinese state regards this issue as very important and therefore, has allocated resources to develop the right policy measures and instruments to respond to this challenge in an appropriate way.

The Structure of this Paper is the Following:

First, we provide an account of the emergence and developments of cryptocurrencies in China. The development of cryptocurrency in China is studied through an analysis of how, on the one hand, various form of actors moves forward advocating in favour of cryptocurrency in China and then, on the other hand, how the state responds in different ways to these moves. We have divided the period from the emergence of the first cryptocurrency up to the present tense into four phases related to different government policy papers and new forms of regulation. We go through the four phases. The first one runs from 2008 – the year in which Bitcoin appeared - to 2013. December 2013 is characterized by a policy paper including some regulations. This sparks off phase two which runs from December 2013 to September 2017 in which a notice was issued by the People’s Bank of China (PBoC). The third phase runs from late 2017 to September 2021, when an even harsher policy has been issued. The fourth phase lasts from September 2021 to the present day.

In the next section, we discuss various risks brought by cryptocurrencies including speculation, social unrest, and currency competition. Then follows a presentation of different strategies for digital currency governance. We move into a final discussion about the Central Bank Digital Currency (CBDC) because it illustrates in a way how subtle the relationship is between digital currency and the government.

Lastly, we conclude.

3 Major Actors and Evolution of Cryptocurrency in China

In this section, we shall look into the emergence and development of cryptocurrency in China, including presenting key actors pushing forward and shaping the crypto-related industries in China. We shall analyse the relationship between the Chinese government and the actors advocating for cryptocurrency, and how this relationship is shaped in different ways over time. The character of the relationship between the government and the proponent of cryptocurrency determines how the “ecosystem” of cryptocurrency develops from approximately 2010 and onwards.

In the following, we have chosen to present cryptocurrency and its development by taking our point of departure in the various form of regulation (governance strategies) appearing to regulate the area. In China, the authorities have issued three sets of official pieces of regulation. First, in 2013, *Notice of Preventing Bitcoin Risk (hereafter Notice 1)* was issued, emphasizing that financial institutions were not allowed to participate in cryptocurrency-related business and trade. The second piece is named *Announcement on Preventing Risks relating to Fundraising through Token Offer (hereafter Announcement)*. It was a ban to prohibit initial coin offerings (ICO) in China. The third one came just recently in September 2021. It is called *Notice on Further Preventing and Resolving the Risks of Virtual Currency Trading and Speculation (hereafter Notice 2)*. These three legal documents reflect that the Chinese authorities have developed policies to meet various challenges in the development of cryptocurrency. The governance goals and strategies change over time as the purpose of cryptocurrency usage dynamically changes. Initially, the purpose lies in the currency function of cryptocurrency. Later we observe a shift, which involves a stronger focus on the investment features, and, then most recently, the technological dimension, particularly blockchain technology and distributed ledger, has come to the forefront. China operates with four phases in the development of cryptocurrencies and attempts to regulate the area.

Phase One (2008-2013.11)

We count Phase One from the birth of Bitcoin in 2008 to the time when the government issued *Notice 1* on 3 December 2013. At the inception of Bitcoin, Nakamoto (2008) defines it as “a peer-to-peer electronic cash system”, which aims to allow any two willing parties to transact directly with each other without the need for a trusted third party. In the beginning, cryptocurrency was considered as an alternative currency to the existing system. Many of the discussions were centered on how this new object will function as a currency or a payment tool.

This new product, Bitcoin, soon raised the interest of some Chinese people. Even the vice governor of the People's Bank of China at that time had once expressed his own personal interest in Bitcoin in 2013. He said, “Bitcoin is very distinctive and enlightening. I will personally follow its long-term development.” In this phase, China was the cradle of cryptocurrency ecosystem. There was not much regulatory intervention regarding how the state should control and monitor cryptocurrency development. Everything was bred in the enthusiasm of the entrepreneurs and the forerunners. The first Chinese cryptocurrency exchange (BTC China) was established in June 2011, which became the largest exchange soon after Mt. Gox was bankrupted¹⁰. Apart from cryptocurrency exchanges, the laissez-fair governance of cryptocurrency left plenty of spaces for new entrants and established firms to exploit the new opportunities. For example, one of the first Bitcoin ASIC miners (Avalon) in the world was developed in January 2013 by Canaan Inc in Hangzhou China. Soon Bitmain, one of the biggest mining firms in the world, was established in the same year. One Foundation, a charitable organization initiated by Jet Li, received hundreds of Bitcoins as a donation for Lushan Earthquake in 2013. Meanwhile, more and more China-based multinational BigTech companies claim the acceptance of Bitcoin for purchasing, such as Baidu and Alibaba.

In this phase, the market force was the main driver of the development of cryptocurrency and related industries. There was hardly any interference from state authorities. The Chinese government adopted a laissez-faire approach to meet cryptocurrency in the first round. No obvious conflicts played out between regulatory bodies, enterprises, and individuals. At that time, China

¹⁰ Mt.Gox was a Bitcoin exchange based in Shibuya Tokyo, which by 2013, into 2014 was handling over 70% of all Bitcoin (BTC), and it went bankrupt in 2014 due to a series of security flaws.

could be considered as the land of opportunities for this new phenomenon. Optimistic atmospheres and ecosystems were constructed by the collective efforts of entrepreneurs under the acquiescence of the state. Even though official institutions noticed Bitcoin and started to take a closer look at its development, it was too early to intervene. First, the government needed an “observation period” to find the right angle and lens to lead the way, instead of making decisions blindly. Second, the cryptocurrency audience was very limited. The ordinary Chinese barely knew the existence and usage of Bitcoin. The impacts were too little. The government still needed to take some time to observe how Bitcoin could be developed, or it may die out before it had any impact. Third, during this period, there was high tolerance for digital products and services, particularly for digital infrastructures. Enterprises and industrial participants played positive roles in building and improving digital infrastructures and digital technology in China, especially in the digital payment area. It is reasonable to believe that government agencies were willing to wait and see whether Bitcoin can bring positive changes to digital infrastructures, particularly, those who did research in mining, digital currency wallets, and cryptography applications.

In phase one, Bitcoin was still considered as an alternative currency by the majority of users. For example, the currency properties of Bitcoin made it possible to function as a donation and payment acceptance. Therefore, we define this period as an “utopian currency stage with market-driven dominance” stage.

Phase Two (5 December 2013-4 September 2017)

In China, the free market environment of cryptocurrencies ended when the Chinese authorities launched the first set of regulations on 5 December 2013. The PBoC issued the so-called *Notice 1*. *Notice 1* points out that Bitcoin does not hold currency properties and legality as fiat money, therefore cannot be and should not be used as currency in the market. This regulation also prohibited established financial institutions and payment service providers to be involved with cryptocurrency directly, including receiving Bitcoin as payment and providing cryptocurrency investment and asset management services. The state authorities have been aware of the money laundry and illegal usage of Bitcoin in the marketplace and call for identity verification and anti-money laundry procedures for those who provide trading and exchange services.

At this stage, the Chinese government has already raised concerns about payment usage and the illegal application of the currency. *Notice 1* was one of the measurements to prevent such foreseeable events to expand and become an overwhelming phenomenon. That was successful. Immediately after the launch of *Notice 1*, not only financial service-related companies but also other firms that previously accepted Bitcoin announced the suspension of cryptocurrency usages, such as BigTechs and charitable foundations. The intensive and extensive use of Bitcoin as a medium of exchange decreased enormously.

Through this act, the government removed the currency potential of Bitcoin, and clarified the position of digital currency in China. However, relevant authorities underestimated the enthusiasm of the Chinese public toward cryptocurrency speculation. The small crevice in the first regulation rejuvenated the passion of Chinese entrepreneurs and investors. Numbers of startups position themselves as innovative platforms for digital infrastructures. *Notice 1* defines Bitcoin as a “virtual commodity” and emphasizes “rational investment”. The general public interpreted the warning for investment risks as a permission for investment. It is understood by people that this notice is an implicit permission for individuals to participate in investment activities at their own risk. Naming Bitcoin as “commodity” and highlighting the “investment risks” means that Bitcoin trading is regarded as some sort of commodity exchange and purchasing behaviour on the Internet.

Coupled with the fast development of cryptocurrency trading and exchange facilities in China, more and more people jumped into this new promising investment asset- cryptocurrency. The speculative features gradually dominated the role of cryptocurrency in the market. According to statistics, China ranked number one in cryptocurrency activity in the world in 2015 and 2016. 70% supply of Bitcoin was circulating within China domestically through various activities, including Bitcoin mining, ICO¹¹, and trading activities (Economist, 2017). By December 2016, a few well-

¹¹ A typical ICO is that firms use digital token to raise money for ongoing projects. The token can either provide access to the services and products in the project or can represent certain equity or asset of the organization. Due to its lack of supervision, ICO is easily subjected to scams and high risks.

known Chinese cryptocurrency exchanges, such as BTCChina, Huobi, and OkCoin, constituted more than 90% of all Bitcoin exchange activities.

The heat wave of cryptocurrency has been pushed to a new high by the innovative forms of cryptocurrency products and services in 2017. However, opportunities always come along with risks. For example, ICO, an unregulated method of blockchain crowdfunding, could turn out to be a scam project. Not to mention that there were a number of Chinese participants who lacked basic financial literacy, even for professionals, it would be extremely difficult to exercise due diligence because of the asymmetry of information in cryptocurrency projects. Most “investors” did not know the full exposure before putting money inside. Besides, some of them tended to use leverage and play with complicated financial derivatives to bet on higher returns, which put them in a position that was beyond their risk appetite and affordance level.

In mid-2017, the growing enthusiasm to participate in cryptocurrency activities has drawn closer attention to Chinese governments. The authorities first issued a warning to remind investors to be aware of the Ponzi scheme¹² for illegal fund-raising in the name of “virtual currency” and “blockchain”. However, this warning did not weaken the popularity of cryptocurrency activities. The interest in investing in digital currencies continued to grow, which led the Bitcoin price to reach new highs almost every day.

In general, Chinese people were less interested in the special attributes of Bitcoin that are different from the fiat, such as privacy and decentralization benefits. The major focus for cryptocurrency was still centered on investment and speculation. Changjia, the founder of 8btc, said “If you call Bitcoin a peer-to-peer digital currency, 95% of the people in China will feel confused. If you call it Gold 2.0, however, most of them are suddenly enlightened”. Whatever had a chance to make money, people crowded in that area. According to the statistics, over a hundred thousand people had participated in ICO, which raised funds equivalent to 2.6 billion RMB in the first half-year of 2017 in China (National Committee of Experts on Internet Financial Security Technology, 2017).

¹² Ponzi Scheme is defined by the Security and Exchange Commission of US as an investment scam that involves the payment of purported returns to existing investors from funds contributed by new investors.

Meanwhile, even for physical products, such as ASIC miners, the Bitcoin mining equipment, also showed a highly speculative market. The market price of miners roared up five times more than the listed price globally, which created arbitrage opportunities in the miner market. The ASIC miner manufacturer Bitmain took up over 70% of the mining pool and mining equipment globally in 2017. Due to the strong demand for Bitcoin miners, there was not enough supply of miners in the market. Chinese investors took advantage of the direct access to Bitcoin mining equipment to exploit the price differences in global markets. Everything related to cryptocurrency seemed like wonderful investment opportunities and was full of speculative bubbles.

On 4 September 2017, China issued a new piece of regulation called the *Announcement*. The *Announcement* defines ICO as an illegal fundraising activity. It also emphasizes that “all financial institutions and non-bank payment institutions shall not conduct business related to token issuance and financing transactions” and “any trading and exchange platforms are not allowed to engage in the exchange between legal tender, token, and virtual currency”. Compared to the previous *Notice 1*, the *Announcement* further limited the activities that financial institutions can do. *Notice 1* only banned institutions from directly using, investing, and managing Bitcoin, but the new one indicated a full prohibition for all cryptocurrency-related services. It means all the financial intermediary services, such as opening bank accounts and providing settlement services for payment, also had to stop. The *Announcement* gave cryptocurrency-related businesses a heavy blow.

The Chinese authorities decided to further stop cryptocurrency activities. In the following year, regulatory bodies consecutively issued two new policies to follow up and reinforce the *Announcement*, which are *Notice on Carrying out Self-Inspection and Rectification Work for Providing Payment Services for Illegal Virtual Currency Transactions (Notice 3)* and *Warnings on Preventing the Risks of Overseas ICO and "Virtual Currency" Transactions (Warning)*. Zhou Xiaochuan, the governor of PBoC at the time, pointed out that financial products and financial services must serve the real economy, and cryptocurrency transactions are not in line with the overall policy in China. Therefore, China treats virtual asset transactions with caution.

Phase Two was the time that the Chinese government shifted its attitude from tolerance to contentiousness. But this is also a gradual process. What the Chinese government did at the beginning was to prevent cryptocurrency to become a payment method by limiting institutional players, thus eliminating the possibility of threats to the fiat currency position. As things went unexpectedly with speculation and financing activities, the Chinese government went for a harsher policy. The governance purpose was by no means to prohibit everything. It was a moderate level of management and supervision over risky activities. On the one hand, it is a defensive strategy. These policies are the reactions towards unwanted activities. Stopping cryptocurrency from being used and stopping crypto projects from being issued are the most direct and simple ways to defend the established system. On the other hand, it is also a proactive approach. Because such action can prevent the consequences of the risky activities before they really happen and really bring damage to the public interests. This method curbs the booming activities straying outside the law frame. We conclude this phase as “the shift from market force to state power”.

Phase Three (4 September 2017- 23 September 2021)

In this period, the primary focus became the backbone technology blockchain and the extended application of cryptocurrency in the shape of CBDC. If China wants to exploit the advantages of cryptocurrency, it is important for China to unbundle the digital currency and Bitcoin, and build a boundary between cryptocurrency and blockchain (Yao, 2017).

In October 2019, President Xi Jinping said in a speech that “We must take blockchain as an important breakthrough for independent innovation of core technologies”, addressing the importance to seize the opportunities posed by this cryptocurrency fundamental technology-- blockchain. In December 2019, China initiated the pilot project of Fintech innovation. Nine regions were granted special licenses to attract firms exploring emerging technologies in financial innovation. The aims are to take advantage of blockchain technology in practical applications and empower financial institutions to improve service efficiency and quality. The actions aim to reduce speculative risks and stop illegal fundraising, at the same time, to increase the possibilities of the state to lead financial and technological innovation.

Meanwhile, the state draws the blueprint of the CBDC strategy. For China, the digital currency should be understood as more than private coins, but can be raised to the strategic level as a tool to strengthen state power (Yao, 2017). CBDC competition becomes the battlefield for the sovereign state to claim the power on digital economy and currency fabrication. The movement by China to adopt CBDC is just to transit challenges posed by private actors into an opportunity and devise a tool for national governance. Therefore, China fastens the speed of research and development of Digital Currency Electronic Payment (DC/EP) together with commercial banks and business partners. It is one of the first central banks that were well prepared for CBDC implementation. By mid-2021, China had successfully rolled out multiple times of digital red pocket pilot trials¹³ in selected regions. In June 2021, DC/EP has officially launched for public usage. People are able to use DC/EP as long as they register in certain designated Apps and exchange deposits from their bank account into e-CNY in CBDC wallet. So far, though DE/CP is still in the test phase, and it is not acceptable by all vendors, the potential for China to use DE/CP as a new capital governance tool is at stake.

For other private digital currencies, phase three intensified the regulation and the survival space for them became very small. After these strict measures were introduced, China sealed all possibilities for new digital currency issuance and their development. However, individuals are still permitted to hold and trade cryptocurrency as long as they could manage to find a way. Bitcoin and other cryptocurrencies were still considered as virtual commodity. In the Bitcoin mining field, it was once classified as an industry that should be “eliminated” by National Development and Reform Commission (NDRC). But soon it was taken out from the scrap list. The shares of world Bitcoin mining hash power dropped from over 70% to 65% by the end of April 2020. However, surprisingly, big mining companies are actually enjoying the support from the government for integrated circuits research and development, but of course not for running mining activities.

¹³ PBoC distributed the CBDC in the pilot program through free airdrop of CBDC to the participants in the beginning. People can register on the PBoC designated platform to participate the pilot tests, and the program picked up the lucky participants to get free CBDCs to spend in the market. Chinese people called this process of acquiring CBDCs as opening up the “red pocket”.

In the third phase, the Chinese government already clarified its inclination and preference for different sides of digital currency. It downplayed the investment potentials and financial aspects of cryptocurrency, but supported the blockchain technology development in many applicable areas, and, in the meantime, went all-in to research and develop CBDC. We could actually see that China goes further and faster in the CBDC project. Though the country chose a “one-size-fits-all” approach to crack down on private currency at the peak of its boom, China did not adopt a similar strategy to stop everything originating from cryptocurrency, that is to say, blockchain technology. The governance strategy reflects an old Chinese idiom, that “take the essence, and discard the gregs”. In this phase, China achieved to unbundle the currency function and blockchain technology from Bitcoin and leverage the angle to use them at the key aspects. This phase is led by state power.

Phase Four (24 September 2021 Onward)

Under the background of COVID-19, the global monetary systems started quantitative easing monetary policies to stimulate the economy. Storing value of money becomes a core issue. At this time, cryptocurrency regained the preferences of many people. The price of cryptocurrencies and the active level of market exchange activities reached another high. Even though there are strict restrictions in China, this trend has extended to China as well. Cryptocurrency has begun to attract more attention long after the ban from the last policy. People started to manage to find a way to go beyond the restrictions and participate in trading activities through overseas exchanges. Many Chinese-originated exchanges are still operating abroad providing trading and exchange services to Chinese citizens, therefore, giving access to cryptocurrency activities under strict restrictions.

When cryptocurrency became popular again, it immediately drew the attention of the Chinese government. On 24 September 2021, PBoC and the other nine governmental departments together launched the *Notice on Further Preventing and Resolving the Risks of Virtual Currency Trading and Speculation (Notice 2)*. This is the “death sentence” of all cryptocurrency activities in China. *Notice 2* declares, “virtual currency-related activities are illegal financial activities”, and “such activities are unlawful and strictly prohibited by law and shall be forcibly banned in accordance with the law”. The main difference between this notice and the previous ones is that the previously

unclear activities, such as cryptocurrency trading and investment and the usage of overseas service providers, have been defined to be illegal. There are no grey areas anymore. It is worth noticing that the Supreme People's Court and the Supreme People's Procuratorate of China have first been the co-issuers of such notice, which highlight the resolution of China to entirely prohibit all crypto-related activities, including mining, trading, coin/token offering etc.

From now on, China steps into a time when all virtual currency activities are not allowed. After the issuance of *Notice 2*, local governments of China started another round of rectifying virtual currency mining activities. Mining is now considered as an illegal, and energy-consuming activity that is not in line with the national development goal of “carbon peaking and carbon neutrality”. Though the ban on cryptocurrency exchange has been executed for 4 years, the previous Chinese exchange moved abroad and continued to provide services to Chinese citizens. There is never a complete removal of cryptocurrency exchange activities in reality. The new notice put further pressure on exchanges and forced them to stop offering services to Chinese citizens because such activities are illegal in accordance with the new policy. Therefore, the Chinese-originating exchanges, including Binance, Huobi, Okex, started to clear out Chinese users. The only space left for people is the right to hold cryptocurrencies in their own pockets, probably.

In this phase, we can see an overwhelming degree of political power over economic autonomous force. The Chinese state executed its political power to stop all market forces in terms of cryptocurrency activities. China chooses to entirely leave the market and adopt CBDC as the “pearl” of digital currency. When we look parallelly to the other side of the world, digital currency has been acknowledged by different laws as private property/money (eg. Germany, Japan) and relative financial instruments (eg. Bitcoin ETF in the United States). These represent different attitudes, approaches, and directions of states to govern cryptocurrency. Probably, this is also the watershed that cryptocurrency will go separate routes in China and some other countries. It is hard to give a conclusion on which way is better and which way is right, at least at this moment.

4 Hidden Risks Behind Cryptocurrency Development

In this section, we try to analyze the reasons why China and cryptocurrency experiences such interactions.

4.1 The First Nerve: Going under the Shade

One of the major concerns of cryptocurrency for the state rests on capital control and preventing illicit activities. Many cryptocurrencies enjoy anonymous characteristics, which allow users to eliminate the prospect of government censorship and circumvent regulatory control. The lack of centralized processes impaired the collective efforts of anti-money laundry between different national governments. The decentralized infrastructures reverse the traditional transaction logic of centralized mechanism from “parties known and transactions unknown” to “transactions known and parties unknown”. Moreover, for Bitcoin users, one of the key motivations to adopt it lies at the core of its political dimension that it is outside the control of the government. As a result, the proportion of illegal activities occupied a considerable amount of trading activities. Foley et al (2019) show that almost half of the Bitcoin transactions are associated with illicit activities, which account for around 24 million participants with \$72 billion of equivalent number of transactions.

Capital flight is deemed as a very covert activity that is difficult to be detected and distinguished. The capital flight from China has different motives. The purpose of capital flight is to surpass the regulatory bodies for capital control, tax evasion, money laundering, and illegal activities. For example, wealthy individuals purchase properties abroad; corrupted officials search for alternative money-laundering methods to avoid prison time; companies may like to move capital abroad to avoid tax payment and supervision. Particularly after the anti-corruption campaign has been launched by the Chinese government, it reveals that a large amount of money has been embezzled and illegally abused. The capital control became even tighter. Before cryptocurrency was available, the popular method was “ant moving”, which means large sums of money were transferred out in a high frequency and small amounts. However, this strategy is relatively

complicated and time-consuming. It had been detected and started to be cracked down by the Chinese State Administration of Foreign Exchange (SAFE) in the past years.

The emergence of Bitcoin makes the capital control policy porous. Due to the anonymous characteristics and early loosen policy, Bitcoin and other cryptocurrencies were used to avoid regulatory control and achieve capital flight. Early in 2015, a company, named Easton international trading co., Ltd, tried to use Bitcoin to laundry illegal income abroad. The company borrowed numbers of future accounts to conduct future trading. They use high-frequency buy and sell self-trading order, which is considered as illegal activities in the financial market, to make profits over 2 billion yuan. Due to the strict capital control policy in China, they were not able to move out the profit from China. The company then offered BTCChina, a cryptocurrency trading platform in China, a deal to buy 10,000 BTC per month to conduct the transaction. However, BTCChina declined the deal, because the company could not provide proper proof of legal income to purchase Bitcoin. Later, BTCChina reported the case. Easton International Trading Co. was arrested, and by that time this company was using shadow banks to transfer money outside of China.

However, in most cases, capital flight through Bitcoin is more secretive and cannot be captured in person but only showed through numbers. In the balance sheet of a country, the net error and omission (NEO) of the balance of payment can capture the residual component of the currency account that does not match the capital account and financial account. This gap reflected the calculated omission, duplication, and capital outflow. Researchers use NEO to analyze the currency flow hidden behind the current account, which indicate a certain level of capital flight from underground channels (David Keohane, 2015).

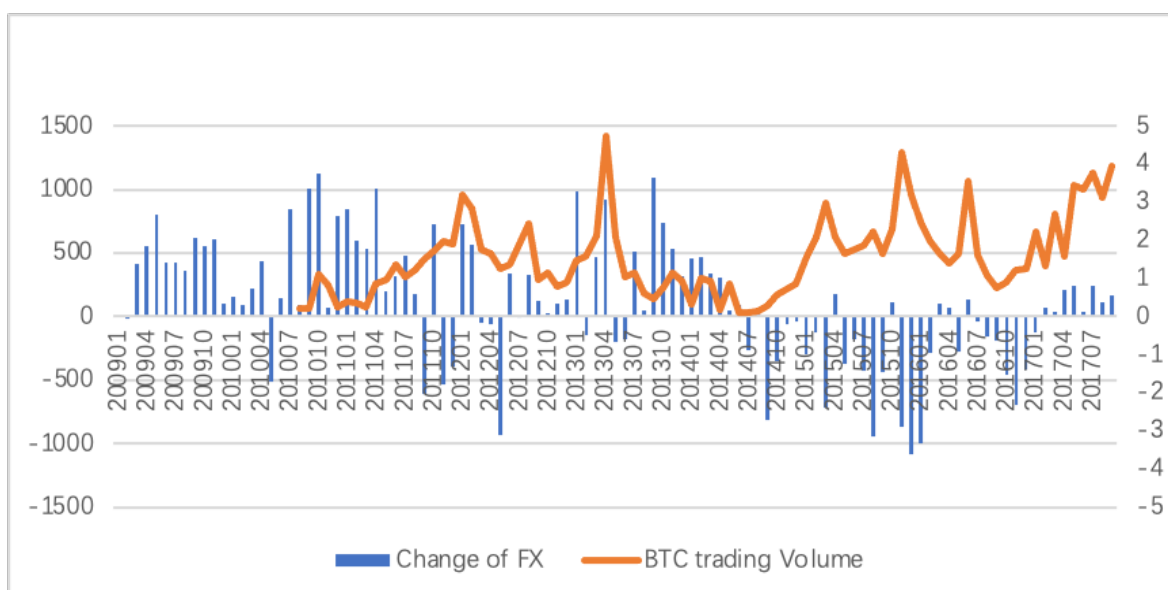


Figure 13. Change of Foreign Exchange Reserve and BTC Trading Volume (2009-2017.08)

Figure 13 shows the change in the foreign exchange reserve of China and the total Bitcoin trading volume in the world from 2019 to August 2017 before the harsh policy was introduced. There was a peak in Bitcoin trading volume in 2013. Though there are many reasons contributing to the decrease in foreign exchange reserves, Ju et. al (2016) find strong evidence of capital flight from the Chinese RMB to the US dollar through Bitcoin before *Notice 1* was issued by PBoC in December 2013. Besides, a clear negative change in the volume of NEO since mid-2014 has been identified. Coinciding with the biggest negative change in foreign exchange reserves at the end of 2015, Bitcoin trading volume reached a high level. The statistic shows that China was the most active region in global Bitcoin trading activity during 2015-2016. And by the end of 2016, Chinese exchanges constituted more than 90% of all Bitcoin exchange activities (Economist, 2017). It is difficult to attribute all the capital outflow of China to Bitcoin, but the highly accidental coincidences somewhat disclose the scene behind the phenomenon.

“The Mundellian trilemma” of the monetary policy states that it is not feasible to achieve a fixed exchange rate, full capital mobility, and monetary policy independence at the same time. Only two of the three may coexist. That is to say, the state has to choose to give up one dimension to strike the balance (Rey, 2016). This is very important for developing economies to avoid volatile

movements of exchange rates from speculation and hot money. Under this concept, once the balance has been broken, the domestic inflation rate, purchasing power, stability of price, and export completeness could be damaged. The consequences are tremendous, possibly leading to a financial crisis (Baliño and Ubide, 1999). We can refer to the cases of hyperinflation in Argentina and Venezuela in recent years and the Asia financial crisis in the late 90s.

The reasons behind the gradually harsher steps towards cryptocurrency reflect two layers behind the scenes. First, for China, cryptocurrency is not only considered as an innovation in terms of technology and currency, but also a potential source of threats to the established order of society and represents a leeway for illegal activities. Second, the control of cryptocurrency also has the consideration of stabilizing economic balances, such as foreign exchange reserves and exchange rates. However, we never know whether the proportion of potential capital flight can have serious consequences. The Chinese government inherited the prudential attitude towards the new sphere and prioritizes economic stability over the new potentials of the financial market.

4.2 Unmatched Risk Appetite: Speculation vs Social Stability

In Chinese political logic, one important goal is to maintain financial and social stability. Authoritarian governments require high social stability to keep power centered and manage resistance. Early in 1989, when China was facing economic reform, Deng Xiaoping pointed out, “For China, the overriding need is stability. Without a stable environment nothing can be done, and what has been achieved will be lost.” In recent years, the Chinese government has repeatedly addressed the importance of stability maintenance. The growing emphasis on stability indicates the attitude of the Chinese government in response to events and policy implementation. Therefore, the risk appetite of the Chinese government strongly follows the trajectory of incremental and minor changes, instead of radical and disruptive shifts.

However, contrary to what the state expected, Chinese people enjoy a high risk-taking attitude, especially on financial decisions (Fan and Xiao, 2006; Weber and Hsee, 1999). Research shows that Chinese people have lower risk tolerance in social decision-making, however, higher risk tolerance in financial decision-making (Fan and Xiao, 2006). Moreover, recently, there is a strong

tendency for profit-seeking mentality in China. This mentality casts light on the development of cryptocurrency market activities. People do not care about the natural properties of cryptocurrency as long as it can make money. Bitcoin and blockchain became investment ventures. The gambler's mentality for quick money makes lots of people take higher risks than what they can accept. Many of them took loans from banks, overdraft through credit cards cash-out, and even sold their house to bet on the market.

Unlike mature products, cryptocurrency fell into a grey area where no regulations were applicable. The wild growth of the cryptocurrency market brings potential risks to both individual investors and the stability of the state. China has banned institutions to participate in the game early in 2013, which make systematic risks for the financial market unlikely to happen, but most investments in the market were personal disposals from individual investors. Over hundred thousand people had participated in ICOs. Once these ICO projects failed, individual wealth would be damaged, especially for those investing with leverage.

The reasons that the Chinese government changed its attitude to cryptocurrency match with the financial stability requirement changes in China. When Bitcoin first came out, it was also the least regulated period for Internet finance in China. Simultaneously, it was also the high growth time for peer-to-peer (P2P) lending platforms¹⁴, mobile payment, and online shopping in China. The friendly environment towards digital infrastructure development allowed organizations to innovate digital finance and meet the new demand of consumers. However, as digital finance became more and more common, many regulatory blind spots started to show negative impacts. In 2015, 2016, and 2017, the number of P2P platform crashes was 1003, 1397, and 886 respectively. These platforms have raised trillions of money (denote in CNY), causing thousands of families to lose their life savings. As a result, victims gathered to protest at local government and central governmental institutions, asking to get their money back.

¹⁴ Peer-to-peer (P2P) lending platform was first introduced to China in 2006, and then started to boom in 2012, reached its high in 2015 and 2016, and finally exist in Chinese market completely in 2020. The initial aim for P2P platform was to solve the financing problem of small-medium size enterprise and individual business, but low lending threshold and lack of regulatory supervision turning the industry to be high risks field with a mix of fraud, scam, and speculation.

The time when cryptocurrency projects flourished coincided with the high time of peer-to-peer financial platform collapse in China. Bitcoin and the project alike, as another product that came out of digital finance, share the same credit risks for default. The default risk of cryptocurrency projects is very high. Many cryptocurrencies are decentralized, and if the program is a scam or maybe it is just lack of proper management, the disappearance of such coins might happen. Specifically, crypto projects only work with more complexities. The return on investment for those projects is high enough, which can reach thousands of times in a short time in some extreme cases, making people ignore the risks of these unfamiliar new financial instruments. If an ICO crash happens, especially in the meantime of P2P platform crash, the financial stabilities of the Chinese market could be shaken, and the social stability of the population would be impacted by the anger and desperateness in protest activities and social media.

Cryptocurrency, as a new emerging financial innovation, brings lots of risks and uncertainties to the financial market and challenges to the existing monetary system. The risk appetite of participants to chase the new high of the cryptocurrency market conflicts with the inherent governance ideology of the Chinese state. Cryptocurrency is a nerve that could trigger unknown and uncontrollable risks for Chinese society. Particularly, when financial literacy in China is absent, but the public intends to speculate in the market. Governance for China means not creating chaos, but sustaining and keeping things in order. As a big government, protecting, reconstructing, and creating the market by institutionalized policy becomes a natural reaction to guard the national priority as well as to prevent innocent bystanders from being exposed to risks.

4.3 Alternatives: Competing Currency

Cryptocurrency provides an alternative for the public to compete with fiat currency. It is arguably to be considered as a creature for the state. Upper to the state level, the risk to leave cryptocurrency to grow without proper control is at stake in the core interests of the Chinese state, and that currency will not be able to serve the purpose of public interests under the control of state governance.

It has been widely argued that cryptocurrency is considered as a competing currency with fiat money. In the field of cryptocurrency, the state is not the only player dealing with currency. New institutions, such as BigTech companies and private participants have crowded the playground. If the public substitutes national currency with other alternative cryptocurrencies, such as private digital currency and foreign CBDCs, China will face gradually lose its controllability over monetary matters (Brunnermeier et al., 2019).

When we take the example of Libra (On December 1st, 2020, “Libra” change its name to “Diem”), and the series of reactions by the global governments, it is not difficult to understand the threats of a potential competing currency. The initial mission for Facebook Libra was to supersede the borderline to provide an international currency and payment method. However, the progress of Libra was slowed down by the harsh regulatory interrogation by many countries. The major debates for states focus on the potential disruption of the established order of financial systems and the concern over Libra becoming a “sovereign currency” that can compete with state currencies. It is concerned that digital currency as Libra imposes huge challenges to the existing legal and regulatory framework, national controllability of important data, and the international position of sovereign currency (Guo and Wang, 2020). There are other potential risks in the usage of a large portion of competing currency, such as monetary policy and financial stability. When there are competing currencies circulated in the markets, privately issued currencies can impair monetary policy by increasing the amount of private currency supply to pursue profit maximization (Fernández-Villaverde and Sanches, 2019).

The result is that going through a protracted process of negotiation between the Libra association and every relevant jurisdiction, Libra launched the second version of the whitepaper in April 2020. The revised version is under the approval of regulatory authorities and adds compliance rules to adapt to the applicable laws and regulations, which makes Libra less likely to compete with national currencies in major states.

The Libra case in different jurisdictions can be somehow compared to the cryptocurrency case in China. Once a privately issued digital currency becomes material in existence and threatens the

state's power to control the monetary system, it is believed that this digital currency will not be allowed. Particularly for China, state power and political power are important forces to drive the development of society.

5 Different Strategies for Cryptocurrency Governance

The development of digital currency is not static, and the different opportunities and risks encountered at various stages are constantly changing. The governance model of each country on cryptocurrency is not always constant but is dynamically adjusted to the development of market changes and the suitability of cryptocurrency to society.

The existing literatures have identified that the interactive relationship between digital technologies and the state is a long-standing issue. New products can bring about innovation disruptions, business opportunities, and new dynamics for industries. For cryptocurrency, blockchain technology is considered as the second generation of digital revolutions “bringing us the Internet of value: a new, distributed platform that can help us reshape the world of business and transform the old order of human affairs for the better” (Tapscott and Tapscott, 2016). Meanwhile, for currency functions, it redefined the concepts of money, which brought about a new era of currency competition.

Different regimes adopt different strategies to cope with cryptocurrency. Jia and Zhang (2017) propose three progressive governance strategies. The first strategy is prohibitive approach, the second is prudential enthusiasm, and the third is liberalized approach. Further, they use Russia, China, and the United States as exemplary cases to illustrate how different states react to the new cryptocurrency technology respectively. Linkov et al (2018) also place emphasis on the governance strategies in terms of digitalization. Linkov et al (2018) identify three different strategies such as a laissez-faire approach, a more precautionary and preemptive strategy, and finally a stewardship approach. The laissez-fair approach relies on the industry-driven force with limited government intervention in the marketplace. A precautionary and preemptive strategy aims to prevent irreversible risks and mitigate risks to avoid negative forces that could endanger

the power of the state. Whereas in governance by stewardship, governments tend to actively surveil digital systems and build response capacity for future and emerging threats.

The existing governance strategy concludes the methods and direction of a state that could deal with emerging technologies. It is basically involved in every field that can also potentially bring changes and challenges at the same time. Bosso (2012) points out that society must balance the potential benefits of technological innovation and risks in the economic, social, and personal spheres. Whereas the benefits are sometimes near-term and tangible, risks appear to be distant and intangible. Most pieces of literature ignore the risk dimensions of governance strategies. In reality, neither technologies nor risks are exclusively objective and factual phenomena, but they are socially constructed, depending on the subjective attitudes, understandings, values, and cultures of the actors and environments (Abbott, 2013).

Combined with the discussion of political and economic forces in the previous section and existing literatures, we proposed four different governance dimensions which add on risk elements and driving force considerations to better illustrate how cryptocurrency has been governed by the state in the long-term dynamic process. It is important that governance strategy for emerging technologies incorporate the lenses of normative risk understandings and different positions of state in governance, particularly the case of cryptocurrency in this paper. The reasons for the state to adopt diverging strategies lie at the fundamental angles that the risk appetite and risk tolerance for the domestic market and the roles of governments played in society. It is important for the state to balance the risks and benefits for governance decision-making.

According to the degree of supervision and management and the risk tolerance for emerging technology/products by states, this paper re-interprets four different governance models, namely: 1) laissez-fair governance model; 2) stewardship governance model; 3) precautionary governance model; 4) prohibitive governance model. These four governance strategy typologies reflect how states cope with digital currencies in different countries at different time points, and also reflect the transformation of national governance models under different risk exposures. The attitude of individuals and the private sector in the jurisdiction towards digital currencies is not within the framework of consideration to analyze the cryptocurrency case. Different strategies not only

exhibit the regulatory differences but also reflect the risk exposure and dominant driving power of different territories.

In the laissez-fair approach, the main driving forces are market demand and market supply, while government supervision and leadership are not the dominant factors. The risks of a new emerging digital technology or product are usually not fully understood at the beginning. Under the laissez-fair approach, it is usually considered that the emerging technologies and the attendant risks are not different from previous ones (Mandel, 2013). However, newer and broader risks could be divergent. Individuals and companies have a high degree of freedom in this governance environment, but at the same time, they also need to actively adjust their strategies according to market opportunities and challenges (Linkov et al., 2018). This governance model is a bottom-up governance approach. The government holds an open and inclusive attitude, but this does not mean that the country will allow digital currency to develop arbitrarily. Instead, it will introduce policies to standardize where necessary. To promote the development of the market, the introduction of regulation is mainly to meet the regulatory needs demanded by the market. Under this governance model, it is not necessary to be normatively positive, the country needs to bear the social impact of the abuses brought about by emerging things (Linkov et al., 2018). Governments that take this strategy tend to have a high-risk tolerance for emerging technologies.

In the stewardship governance model, the government aims to provide a friendly development environment for digital currency through an active management model. The introduction of relevant policies will not be accomplished for once, but will be a more gradual process; and will not cause major directional shifts in the digital currencies development. The policy orientation is to lead new emerging technologies to a more positive development path, rather than directly prohibit it or set barriers. The new digital technology or product in this environment will be better protected by policies, and, at the same time, have certain degrees of freedom. Compared with the laissez-fair governance approach, the stewardship governance model has adopted a more proactive method, instead of “going with the flow”, the state usually adopts more active intervention to promote its development and counterfeits the risks, such as sovereignty threats with genuinely global cryptocurrency. Therefore, the market risks faced by the market actors will be

guided by national policies, which help to avoid and prevent potential risks. Under this governance strategy, the risk tolerance is weaker than that of a country with laissez-fair approach. The risk exposure is moderate. The risk control measurements rely on the state's ability to lead the innovation. If the state is good at using policies to guide the direction of industry development, the best practice for new emerging products and services could be formed by the collaboration between industry participants, individuals, and governmental agencies.

In a precautionary governance model, the government will take a relatively binding and cautious policy to hold the new technologies under control, and it may focus more on risks rather than opportunities. Therefore, under a precautionary governance model, the country has a higher possibility to adopt a radical approach to avoid risks to ensure that the original system is not challenged by emerging technologies. Compared with the stewardship governance model, this governance approach is more conservative. It is more robust to the original power. The stewardship method aims to direct and supervise the innovation, while the precautionary method aims to protect existing mechanisms, thereby may leash and control the innovation to a certain extent. States choosing this method are usually unwilling to take too high risks and rashly accept new things. The more conservative choice will ensure that the traditional system is not endangered by the unwanted risks. However, it may also hamper innovations due to too strong political intervention. Entities still enjoy certain market opportunities, but they may also expose to higher policy risks in this environment. This method does not completely prohibit new things but leaves some possibility for further adjustment as things develop.

Under the prohibitive approach, the state will adopt the most direct plan to prohibit the development of new things, choosing completely to protect its own existing system. In the case of digital currencies, it can be interpreted as to be illegal to conduct crypto activities. This governance model will be most likely to restrict opportunities. The state is strongly risk-averse, and in the short term, hardly affected by any new risks directly posed by the technologies. In the long run, however, in order to keep up with the pace of global trends and use international services and infrastructures, the states might be forced to adapt to the new circumstances and accept the international order in the newly emerging field with less flexibility and negotiation ability. This

governance strategy will help the state to guard the established orders, thus leaving the new risks and uncertainties brought by emerging technology tightly under control. When the new market order has been established from the other regimes through integrating new innovations into mechanisms, the state can choose the follower strategy to imitate and adjust the existing measurements. Therefore, this strategy is suitable for countries that have low-risk tolerance and weak risk management capabilities.

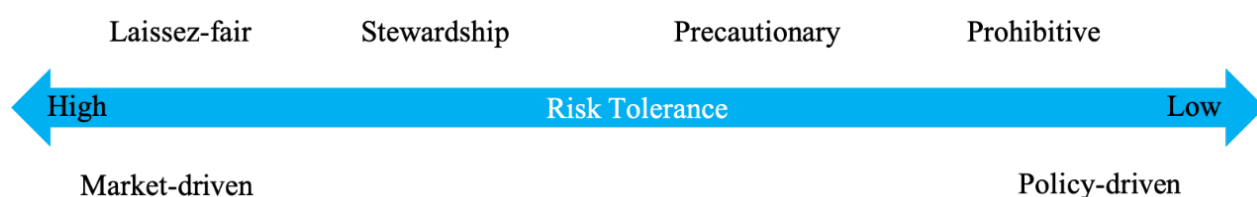


Figure 14. Cryptocurrency Governance Strategy

These four different governance models are neither in sequential order nor developed as a gradual process (Table 7). Mandel (2013) voiced a major issue for current emerging technology governance is that how regulatory oversight arrangements can keep pace with scientific and technological innovation. Technological development is on an exponential pathway, where regulations might lag behind the happening process of innovation (Marchant and Wallach, 2013). The characteristics of the four strategic choices can be distinguished, but the transition process might not be likely to happen in a processual manner. In particular, those countries with stronger political power can turn from one end to another in terms of governance strategy. Each governance strategy is not a definite end for a nation-state to last forever, which means that the change of attitudes by the state, the introduction of new policies, and the outbreak of new events may always expose the governance strategy to shift from one to another. Therefore, the governance strategy choice is not a static result, but a dynamic process. In addition, in real applications, different governance models may coexist. The existence of one governance model will not be compatible with another model theoretically. However, as we identified earlier in the article, cryptocurrencies encompass multi-facets, such as technical level, currency level, financial market level etc. For the diverging dimensions, the state can choose to adopt different governance strategies. They can

coexist to demonstrate the different risk appetites and regulatory attitudes towards multi-dimensions of different layers.

Table 7 Cryptocurrency Development in China with Different Governance Model

	Phase one	Phase two	Phase three	Phase four
Time	2008-2013.11	2013.12-2017.09	2017.09-2021.09	2021.09 onward
Government	Laissez-faire approach Keep an eye on its development	Stewardship approach Prudent in trading activities and participants	Precautionary approach to cryptocurrency Stewardship approach to blockchain Unbundle cryptocurrency and blockchain	Prohibitive approach to cryptocurrency activities
Industry	Established firms, financial institutions, emerging groups all participants in the industry Early entrants start to build infrastructure for cryptocurrency activities.	Established firms and financial institutions left market New entrants form new industry ecosystem The most active market in the world	Exchanges and ICOs are banned Support blockchain technology and related industries	Mining and trading activities are banned

	Phase one	Phase two	Phase three	Phase four
Time	2008-2013.11	2013.12-2017.09	2017.09-2021.09	2021.09 onward
		Infrastructure's dominance		
		Product innovation		
		Wider population	Allow to hold cryptocurrency but barely any access to other cryptocurrency activities	Illegal to trade
Individual	Small group of enthusiasts Minor impact	participate in investment and speculation activities		Only allow to hold cryptocurrency
Focus	Payment and ecosystem construction	Speculation	Technology	CBDC

6 What's more? Pushing for a New Currency Era- China's CBDC

With the fast-changing international financial environment and domestic digital payment trend, new currency become a mandate for the new era. At the state level, CBDC is a tool to help states win out the combat in modern society.

As the concept of CBDC says, it is a digital form of central bank money that is different from balances in traditional reserve or settlement accounts (CPMI-MC, 2018). Strictly speaking, CBDC is the direct liability of the central bank, a digital payment instrument denominated in the national unit of account (Bank of International Settlements, 2020). The purpose of launching CBDCs is primarily focused on the payment related considerations, including increasing payment diversity,

improving cross-border payment, and supporting more resilient payment systems. In addition to that, financial inclusion, public privacy, monetary policy, and innovations are also key drivers for central banks to issue CBDC (Bank of International Settlements, 2020).

China and digital currency have very subtle relationships. On the one hand, China has banned almost all cryptocurrency-related activities, including trading, exchange, and payment. On the other hand, China has expressed great interest in developing its own central bank digital currency. From a very early stage, the government has established particular research groups and has pushed to launch CBDC in a remarkable leading progress. The key differences between those two types of digital currencies mainly lie in the issuer, which means that cryptocurrency is a private or an unauthorized digital currency, while CBDC is still a state currency subjected to government control.

It is a strategic choice to step forward when facing external challenges and internal demand. DC/EP, China's national digital currency project, was born to strengthen the fiat currency position, to compete with cryptocurrency, and to protect state power over monetary matters. The DC/EP adopted the two-tier synthetic architecture, which means the PBoC will engage in the issuance of digital currency, however, still require financial intermediaries, including commercial banks and non-bank financial intermediaries, to provide financial services. DC/EP is the operating mechanism, while under this mechanism, it is encouraged to have competitive, multi-plan and dynamic projects (Zhou 2020). The e-CNY is one of the payment products so far. E-CNY is the liability of financial service providers instead of the central bank's. The major responsibility of PBoC is to maintain the stability of e-CNY, construct the settlement and clearing infrastructure, facilitate interoperability between different payment products, and prepare contingent and alternative emergency plans (Zhou 2020). The DC/EP system adopts a controllable anonymous feature to balance individual privacy and required compliance. Information between two transactional parties remains anonymous, but when it comes to the state level, governmental agencies still have control over the flow of capital and individual identity. It is claimed that controllable anonymity will contribute to the investigation of compliance issues, such as anti-money laundry.

Instead of giving up everything related to digital currency, China adopts a differentiation strategy to unbind the technology development and currency features of cryptocurrency. For the wild cryptocurrency speculation market, China issued strong bans. However, we can interpret that China acknowledges the development of digital currency and use the concept and technology to develop a tool for their own governance. With proper selective features for the CBDC plan, China further improves the controllability over currency in terms of issuance, usage, traceability, and supervision. Apart from that, China also made a very smart choice for the future digital currency plan. The multi-plan and dynamic open-end project offer financial institutions with more possibility to achieve certain degrees of financial innovations within the framework of applicable laws and regulations. The state senses the transformation signal of currency revolution and immediately participates in the race. The DC/EP is a swift response to combat back with the private and non-authorized cryptocurrency. It is a payment method to fit the trend of digital world, however, it is also an instrument for the state to further strengthen the power over the monetary regime.

7 Conclusion

It has been interesting to follow and investigate the acts, actions, and reciprocal actions of the Chinese government during the years of the development of new digital currencies (in particular Bitcoin in this paper) starting in 2008. To observe and register every reaction from the Chinese authorities towards new digital currencies is impossible. Therefore, it has been necessary to use fairly simple methods with high validity and reliability, and which can be used to demonstrate that the state is responding to exactly the new digital currencies (Bitcoin). We decided to use the three highest official pieces of regulation addressing new digital currencies. In other words, we have securitized governmental decisions, new laws, directives etc. In order to find all possible attempts to constrain the cryptocurrency. Laws, regulations, official documents, and authority statements in the media, interviews with key persons from the state administration and ministers could have been relevant, but resources are limited. If an activity or event has led to official pieces of regulation, it must reflect the importance of the area/event/ or practice in question.

In 2013, 2017, and 2021 the Chinese government acted in relation to the new digital currencies but in different ways. We divided the years from 2008 to now into four phases. The four phases appeared when the Chinese authorities issued three pieces of regulations first in 2013 (*Notice 1*), in 2017 (*Announcement*), and in 2021 (*Notice 2*). The three pieces shaped the paper into four phases (2008-2013.11, 2013.11-2017.09, 2017.09-2021.09, and 2021.09 onwards). In the first phase, the structure of the cryptocurrency system was constituted. The government developed a laissez-faire policy towards the new currency which seemed to be regarded as an alternative currency. The government seemed to be more curious than frightened, and the Chinese authorities were themselves interested in the new currency. Phase Two was the time that the Chinese authorities changed their attitude from tolerant to contentious. When the authorities published *Notice 1* it became clear that the development of a free market of cryptocurrencies had come to an end. The government realized that a cryptocurrency market maybe not serve the interest of the state as much as they thought. The clear indication of the non-currency property for cryptocurrency pushed Chinese people into a maze of investment and speculation. Phase Three has focused on the backbone technology blockchain and the extended application of cryptocurrency (for example CBDC). The Chinese government has been aware that if they want to exploit some of the advantages of cryptocurrency, it is important to build a boundary between cryptocurrency and blockchain. Phase Four is straightforward. China has gone into a time that divides governmental and non-governmental controlled digital currency. A clear line lies behind all the cryptocurrencies and state currencies. China will focus on the development and promotion of DC/EP.

Further, this paper analyzes the reasons why China and cryptocurrency experience such interactions. Three main factors have been identified, including the illegal activities provided by cryptocurrency, particularly focusing on capital flight discussion, the conflicts between the social stability demand and the speculation needs by citizens, and the threats of a competing currency to the monopoly of monetary power and existing financial systems. Moreover, this paper summarizes four governance strategies based on the risk appetite and driving forces of society. They are laissez-fair governance model, stewardship governance model, precautionary

governance model, and prohibitive governance model. States with higher risk tolerance and stronger market-driven force can adopt relatively more flexible and high-risk governance methods. Those states who tend to protect existing mechanisms can choose to lead by policy-driven dominant strategies. In the case of China, the governance for cryptocurrency is not a linear process, the governance approach went through all four methods. These changes demonstrated a shift in attitude to cryptocurrency and partly that this phenomenon was more complex than first realized.

The analysis of the relationship between the territorial state and the rising cryptocurrency market demonstrates clearly that the Chinese state is aware of (some of) the dangers and challenges of the new digital technology. However, most of the time it is a response and a reaction reacting to the rapid technological development. Therefore, we can conclude that the modern Chinese territorial state interprets the situation with new digital technologies as a challenge to the sovereign Chinese state, and we can read the three pieces of regulation (*the Notice 1, the Announcement, and the Notice 2*) as clear examples of an attempt to defend the territorial state.

It is important to add that the self-perception of the Chinese state is not just a weak and passive entity adapting to the environment. It also can be considered as a strategy considering the risks and uncertainties with the opportunities. After the first couple of years with a huge expansion of the Bitcoin market, the risk exposures are beyond the tolerance level of the state and citizens. The response to cryptocurrency is a protection both for the established system and for the future uncertainties faced by the states. In the long run, the government realizes that the cryptocurrency field existing outside the state might not be in favour of the state. Therefore, the Chinese state puts up restrictions by introducing regulations to ban many aspects of cryptocurrency applications while also looking for opportunities to get the upper hand in the power game with global economic actors, such as central bank digital currency. It seems that this is the new “instrument” for the states to combine the newness and the oldness in searching for a way out in an even more complex global world.

The paradox is that the Chinese state will find it difficult to exploit opportunities (e.g. new form of the token economy), because they have put limits to the transactions which appear to be

counterproductive, as it only pushes these intermediaries towards expatriation and ends up limiting their capacity to monitor and influence the future development of the new technology. That being said, working with national private intermediaries will not be enough. To ensure that these technologies remain an opportunity for positive economic transformation, “greater global cooperation will once again be needed” (Beaumier et al., 2020). We believe that divergent roads of governance strategy towards cryptocurrency will co-exist in different parts of the world. No matter which strategy has been chosen, the state will continue to fight for its survival for central control and a balance of power in the middle of the clash of modern technological disruption.

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Paper 4

Exploring the Bitcoin Dynamics Before and After COVID-19 Shocks-An Investigation of Major Global Events

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Abstract

This paper takes COVID-19 as a watershed to examine the contagion effect and the dynamic roles of cryptocurrency in relation to the other eight major markets globally, particularly after the COVID-19 period. This research employs Diebold and Yilmaz's (2012) method to explore the static and dynamic spillover of the selected variables and also identifies a few global major events, including crypto-specific affairs, state policy, and geopolitical conflict to explain the new market dynamics of Bitcoin with network analysis. The findings show that Bitcoin has some resilience to risks before the pandemic. But after the pandemic, it is more likely to have extreme returns and became more connected to the other markets. The contagion effect between Bitcoin and most markets has also changed after COVID-19, and these changes seem to be very persistent and might not be able to revert to the previous level. The contagion effects from/to other markets are asymmetry. Bitcoin receives more spillovers than transmits to others. The impacts from developed countries became relatively stronger. China still has some impacts on cryptocurrency markets, but the impacts are waning. Bitcoin cannot be a safe haven under the shock of major global events.

1 Introduction

COVID-19 is probably the biggest black swan in recent decades. After experiencing the hit of the pandemic on the global economy, supply chain, labor market etc., some might say that life will never be the same. So does the financial market. The economic and financial impacts of COVID-19 are long-lasting and complex. With the dissemination of increasing cases globally, financial market risks have reached a high level long after the financial crisis. Commodity, particularly crude oil has experienced extreme highs and lows and spiked to crisis level. United States (US) equity market fused four times in ten days at the beginning of COVID-19 and then reached new highs all the time in the following years. As for cryptocurrency market, in the beginning, Bitcoin lost half of its value in two days and back to over \$10,000. In November 2021, Bitcoin price hit over \$68,000 for the new record.

On the one hand, the pandemic shock is more quickly and deeper than any other economic downturn. It draws many economies into recession in a very short time. The repeated spikes in COVID-19 cases make the recovery pace unexpectedly slow and challenging. Even though some countries declare that COVID-19 is no longer a “socially critical disease”, its impact on the economy and society is long-lasting. On the other hand, global markets became more closely connected and also more fragile to external shocks (OECD, 2020). Understanding the changes in market dynamics calls for a comparison before and after the pandemic, and especially an urge for a detailed analysis of post-pandemic interactions. The contagion phenomenon reflects the changes in the fundamental linkages between different markets (Yarovaya et al., 2016, 2020), where negative returns of one market directly have effects on the return of the other markets (Acharya and Pedersen, 2005; Guo et al., 2011). The contagion effect depicts the risk and information transmission and interaction mechanism.

In the financial area, the markets evolve and start to exhibit certain new features. There are some existing research about the cryptocurrency market during the early time of COVID-19. Global markets have experienced dramatic movement. The risk levels have increased substantially in response to the pandemic, and the markets also became more volatile and unpredictable (Zhang

et al., 2020). Cryptocurrencies were identified to have mixed performances. Research finds that cryptocurrencies are the riskiest in the long term, with more than a 50% decline in value coupled with high degrees of persistence during the pandemic (Yarovaya et al., 2022). And it is argued to be even more likely to increase portfolio risk during the market turmoil (Conlon et al., 2020; Conlon and McGee, 2020). Meanwhile, other research shows certain degrees of hedge, diversifier, and safe haven properties of Bitcoin. Bitcoin has safe-haven properties for NASDAQ, EUROSTOXX, and short-run safe-haven properties for NSE50. (Kumar and Padakandla, 2022). And if we take a longer period rather than just focusing on the shock of the early pandemic, it is found that the returns for Bitcoin recovered by April 2020 and remained resistant to further COVID-19 panic shocks. But equity markets were vulnerable to COVID-19 panic throughout the timeframe to June 2021 (Marobhe, 2022). Cryptocurrency is considered as a safer choice after COVID-19 (Karamti and Belhassine, 2022).

COVID-19 has changed our life in many aspects and also exerted great influences on the world economy and financial markets. Understanding the changes of market dynamics calls for a detailed investigation of post-pandemic interactions. Contagion phenomenon reflects the changes in the fundamental linkages between different markets (Yarovaya et al., 2016, 2020) where negative returns of one market directly has effects on the return of the other markets (Acharya and Pedersen, 2005; Guo et al., 2011). The contagion effect depicts the risk and information transmission and interaction mechanism. The purpose of this paper is to use empirical results to explore the dynamic roles of Bitcoin, specifically after the COVID-19 shock, and try to identify a few global events to describe and explain such changing dynamics. First, this paper conducts the analysis of the contagion effects in financial markets and its interrelationships with Bitcoin by Diebold and Yilmaz's (2012) model. Further, this paper uses network analysis and identifies a few events to explain such dynamics. The paper considers crypto-related and global political and economic events together held account for some of the dynamics of Bitcoin.

Contributions are from the following three aspects. First, this research contributes to understanding cryptocurrency and its relationships with other global markets in the post-COVID

period. Extensive literatures have discussed the Bitcoin and other financial markets' reaction immediately after the COVID-19 shocks, but few have extended the data sample to a longer period to examine the up-to-date phenomenon. A long-term analysis of Bitcoin relationships with other markets after the COVID-19 crisis provides more comprehensive performances of the cryptocurrency market and also up-to-date knowledge to existing literatures. Second, the analysis of the paper also contributes to the understanding of the changing roles of cryptocurrency as a financial asset. The study places more emphasis on the post-pandemic period, but also compares the evidence with the pre-pandemic to show such changes. Bitcoin, as a new emerging financial asset, has experienced global-scale shock for the first time. Examining the performance before and after COVID-19 is important to understand its financial properties, especially the potential ability to work as a safe-haven, hedge, and diversifier when uncertainty occurs. Third, this paper offers the reasons contributing to the change of such dynamics. The purpose is not only just to show the differences, but also to explain such differences. Under the shock of COVID-19, the world economy and relations have also changed. It is important to take into consideration of emerging events to explain the cryptocurrency market behavior. The article further adopts network analysis to identify a few global events to explain the above changes. Particularly, I focus on three representative periods of Bitcoin market and relevant global events after the pandemic shocks.

2 Methodology

2.1 Contagion Measurements

In this paper, the contagion effect is measured by the framework proposed by Diebold and Yilmaz (2012). Based on this method, we use dynamic and conditional spillover to investigate the evolution of the Bitcoin contagion effect, as well as two time period unconditional spillover index to compare the contagion between Bitcoin and other financial markets. This method generates directional results under a generalized VAR framework, which solves the order dependency issue of Cholesky factorization in variance decompositions (Diebold and Yilmaz, 2009, 2012).

The moving average process for VAR(p) is represented by

$$y_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \quad (1)$$

where A_i is $N \times N$ coefficient matrix in the recursive pattern.

The model calculates the H-step-ahead forecast error variance decompositions by $\theta_{ij}^g(H)$, for $H = 1, 2, 3 \dots$, there is

$$\theta_{i \leftarrow j}^g(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i A_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (e_i A_h \Sigma A_h' e_i)} \quad (2)$$

where $\theta_{i \leftarrow j}^g(H)$ represents the risk spillover from asset j to asset i . Σ is the variance matrix for the error vector ε , σ_{jj} is the standard deviation of the error term of asset j . e_i and e_j are $N \times 1$ selection vectors with one as the i th element and zeros otherwise. The shocks to each variable are not orthogonalized, so the sum of the element contribution in each row is not necessarily equal to one. In order to facilitate comparison, the normalized variance decomposition matrix is given

$$\tilde{\theta}_{i \leftarrow j}^g(H) = \frac{\theta_{ij}^g(H)}{\sum_{j=1}^N \theta_{ij}^g(H)} \quad (3)$$

where, $\sum_{i,j=1}^N \tilde{\theta}_{ij}^g(H) = N$ and $\sum_{j=1}^N \tilde{\theta}_{ij}^g(H) = 1$.

Directional spillover from market i to market j is denote by

$$S_{i \rightarrow j}^g(H) = \frac{\sum_{j=1, i \neq j}^N \tilde{\theta}_{ji}^g(H)}{\sum_{i,j=1}^N \tilde{\theta}_{ji}^g(H)} \times 100 = \frac{\sum_{j=1, i \neq j}^N \tilde{\theta}_{ji}^g(H)}{N} \times 100 \quad (4)$$

The spillover to market i from market j is denote by

$$S_{i \leftarrow j}^g(H) = \frac{\sum_{j=1, i \neq j}^N \tilde{\theta}_{ij}^g(H)}{\sum_{i,j=1}^N \tilde{\theta}_{ij}^g(H)} \times 100 = \frac{\sum_{j=1, i \neq j}^N \tilde{\theta}_{ij}^g(H)}{N} \times 100 \quad (5)$$

Then the net spillover is equal to

$$S_i^g(H) = S_{\cdot i}^g(H) - S_{i \cdot}^g(H). \quad (6)$$

This paper uses net pairwise spillover to build contagion networks to illustrate the relations between different assets. The net pairwise spillover describes the net contagion contribution of two markets or two assets.

The net pairwise spillover is

$$S_{ij}^g(H) = \left(\frac{\tilde{\theta}_{ji}^g(H)}{\sum_{i,k=1}^H \tilde{\theta}_{ik}^g(H)} - \frac{\tilde{\theta}_{ij}^g(H)}{\sum_{j,k=1}^H \tilde{\theta}_{jk}^g(H)} \right) \times 100 = \left(\frac{\tilde{\theta}_{ji}^g(H) - \tilde{\theta}_{ij}^g(H)}{N} \right) \times 100 \quad (7)$$

2.2 Network Analysis

Network theory has been widely used in researches of financial contagion and market connectedness (Diebold et al. 2014; Gai and Kapadia 2010; Georg 2013; Martínez-Jaramillo et al. 2010). This paper further uses network analysis to visualize the contagion path and the interrelationships between different assets.

In financial contagion network analysis, each financial institution represents a node and the interconnection between different institutions use links to define. These links are directed and weighted, reflecting the exposure of each institution (Gai and Kapadia, 2010). The degree measurements are employed to build the network. The degree of the node, which is the number of links to other nodes,

$$d_i = \sum_{j=1}^n a_{ij} = \sum_{j=1}^n a_{ji} \quad (8)$$

In-degree measures the number of links that point into the node,

$$d_{in}(i) = \sum_{j=1}^n a_{ij} \quad (9)$$

Out-degree is the number of links that point out from the node,

$$d_{out}(i) = \sum_{j=1}^n a_{ji} \quad (10)$$

3 Data

This paper together selects nine variables to examine their interrelationships. They are Bitcoin, the United States market, the European market, the Chinese market, the US dollar, Gold, Commodity Market, the Bond market, and market fear. MSCI USA, MSCI EUROPE, Shanghai composite index, US dollar index, COMEX gold future price, GSCI, Vanguard Total Bond Market Index Fund Admiral Shares, and VIX are used representatively. In the following figures and tables, “btc”, “usa”, “eu”, “cn”, “usd”, “gold”, “gsci”, “vix”, “bond” are used to represent Bitcoin, US market, European market, Chinese market, US dollar, gold, commodity market, VIX and bond market respectively. GSCI and bond data are collected from investing.com, other data is collected from Wind database.

Daily frequency data has been used in this paper. The full sample period starts from January 1, 2018, to February 28, 2022. I extended the dataset to both earlier times and later times. Longer and newer data periods show relatively more stable results of the variables and can offer up-to-date knowledge of how market dynamic changes over time. Further, the full sample is divided into two sub-periods, which are pre-COVID-19 and post-COVID-19 periods. World Health Organization (WHO) received the first coronavirus case reported on 31 December 2019. Therefore, data of pre-COVID-19 crisis covers the year 2018 and 2019. Though the pandemic has been spread for more than 2 years and some countries have lifted all restrictions, its impacts have not come to an end. Data of post-COVID-19 ranges from 1 January 2020 to 28 February 2022. This paper uses the rate of change for VIX data, and log return for the rest of the markets in further analysis. I delete the missing data due to holiday differences.

4 Empirical Results

4.1 Descriptive Statistical

Table 8 depicts the descriptive statistics result of the full sample and each sub-period. Many financial assets have changed the basic features before and after the COVID-19 shocks. Guo et. al (2021) research shows that all assets exhibit higher volatility and negative change for average return during the COVID-19 crisis. However, from the newer and longer sample data analysis, the results show that most assets became more volatile after COVID-19 except the Chinese market, and if looking at a longer period, the average return of most assets has returned back to positive again. It is the same for Bitcoin. The volatility of Bitcoin is only slightly higher than before. However, the skewness and kurtosis results show that it is more likely to have extreme returns and fat tail features after COVID-19.

Table 8 Descriptive Statistics for (Log) Return, nine asset classes

Panel A: Full Sample					
	Mean	Std. Dev.	Skew	Kurtosis	ADF test
btc	0.000457	0.0211	-0.9183	10.3621	-9.2847***
usa	0.000212	0.0059	-1.0533	17.3308	-9.3254***
eu	0.000051	0.0048	-1.6014	19.6021	-9.0488***
cn	0.000014	0.0050	-0.5859	4.9274	-9.6358***
gold	0.000022	0.0016	0.2331	2.3625	-10.7440***
usd	0.000161	0.0041	-0.2664	5.5385	-10.6560***
gsci	0.000119	0.0066	-1.5812	12.7877	-8.6955***
vix	0.000486	0.0388	1.5620	8.1721	-11.0070***
bond	0.000003	0.0011	-0.5760	6.4348	-9.9134***
Panel B: Before COVID-19					
	Mean	Std. Dev.	Skew	Kurtosis	ADF test
btc	-0.000656	0.0202	-0.3086	3.3806	-6.8448***

usa	0.000162	0.0041	-0.6274	3.6914	-7.0418***
eu	0.000040	0.0033	-0.7049	2.0883	-7.2453***
cn	-0.000083	0.0052	-0.3621	3.2473	-6.2799***
gold	0.000044	0.0015	0.2811	1.4360	-7.7418***
usd	0.000127	0.0030	0.3410	2.3019	-7.5132***
gsci	0.000011	0.0051	-0.1075	4.9950	-7.341***
vix	0.000307	0.0388	1.8643	11.8122	-8.1660***
bond	0.000027	0.0009	-0.0716	1.5416	-6.1949***

Panel C: After COVID-19

	Mean	Std. Dev.	Skew	Kurtosis	ADF test
btc	0.001494	0.0218	-1.3915	15.3002	-6.4230***
usa	0.000259	0.0072	-1.0343	14.3192	-6.3928***
eu	0.000061	0.0059	-1.5763	16.0014	-6.2578***
cn	0.000106	0.0048	-0.8349	6.9497	-7.3466***
gold	0.000002	0.0017	0.2099	2.6586	-7.5243***
usd	0.000192	0.0050	-0.3831	4.3260	-7.5988***
gsci	0.000219	0.0078	-1.8803	11.7464	-6.0480***
vix	0.000653	0.0389	1.2773	4.7723	-7.2755***
bond	-0.000020	0.0013	-0.6587	6.0313	-7.7518***

Note: Lag selection in ADF test is based on Akaike Information Criteria (AIC). *** denotes 1% level of significance.

4.2 Average Contagion Level for Full Sample Period

In order to have an overall understanding of the dynamic evolution and contagion effects of various assets, this section offers an average contagion level analysis for the full sample period. The analysis uses 100 days rolling window and 10 day forecast horizon in the analysis to smooth the result and reflect the fast response in price for highly liquid markets (Longstaff, 2010). Other parameters with shorter rolling windows offer a less smooth pattern, but the result still has the

same trend and features. Other forecast horizons also show similar patterns. In general, reasonable changes to the parameters do not impact the outcome and conclusion of this research. The results are based on VAR model and the method described in the Methodology section. Based on Schwarz Criterion (SC) and Hannan Quinn (HQ) criteria, lag of 1 is suggested.

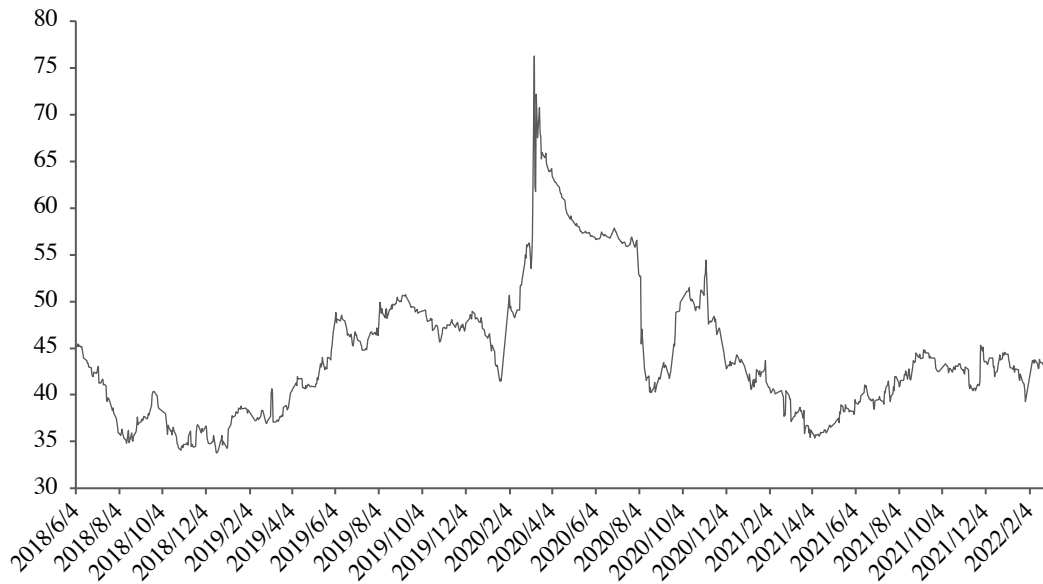


Figure 15. Average Contagion Level, nine asset classes

Figure 15 illustrates the average return contagion behavior of all variables for the full sample period. The y-axis represents the total percentage of contagion level of all assets, which has been detailed described in the Methodology section. Based on the full sample dynamic contagion results, I defined four different intervals to better illustrate the risk level, thus explaining the interrelationships between different assets and Bitcoin. When the contagion level is below 40 percent, the risk transmission stays at a low level. When the contagion level is between 40 to 50 percent, I define it as medium level of spillover. If the contagion level becomes over 50, it is considered to be high. Numbers over 60 are considered as very high. Markets usually have strong interconnections with each other during that time.

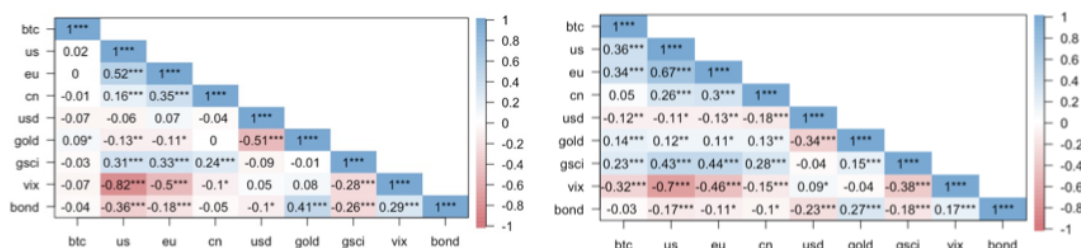


Figure 16. Correlation Matrices, nine asset classes

Before the COVID-19 outbreak, the impacts of one asset on another ranged approximately from 30 to 50 percent, and the average contagion level is 34.88 percent (see Table 9). The correlation matrices (Figure 16) also demonstrate that fewer assets are significantly correlated with the other assets. Bitcoin only shows significant correlations with gold. All equity markets became closely correlated. GSCI and USD are not significantly correlated, and gold and VIX are not significantly correlated. The geopolitics and insufficient supply of natural resources caused the commodity markets to have large price volatility after the pandemic, and VIX represents the market fear itself. These imply the potential hedging roles of the US dollar and gold after the pandemic. As for Bitcoin, it is not significantly correlated with the Chinese market and bond market after the pandemic. The correlations with other assets became significant, which indicates a less independent role of Bitcoin after the COVID-19 shocks.

Though the results of the sub-sample of the post-COVID-19 show an average level of 40.04 percent (see Table 10), it is obvious that overall impacts and transmissions between all variables experienced spikes and crashes (see Figure 15). The spillover between different assets started to rise since February 2020, when COVID-19 spread in more and more regions. Then it spiked in the middle March 2020, when WHO announced the world pandemic of COVID-19 on 11 March 2020, American stock markets fused four times in ten days, and geopolitical conflicts caused the crude oil price to crash and the oil future price to drop below zero for the first time. Those different factors drove an increasing level of interconnections between all assets. The extremely high level of contagion lasted for approximately one month, but it remained high until the end of July of 2020.

Table 9 Contagion Before COVID-19

	btc	us	eu	cn	usd	gold	gsci	vix	bond	FROM
btc	97.36	0.08	0.02	0.18	0.48	1.07	0.14	0.58	0.09	2.64
us	0.25	44.07	13.55	1.20	0.25	1.06	3.96	29.65	6.01	55.93
eu	0.57	17.43	51.44	5.52	0.59	0.93	5.02	16.28	2.22	100
cn	0.19	7.31	11.42	70.02	0.64	0.19	3.76	5.55	0.91	18.55
usd	0.46	0.57	0.57	0.20	75.67	20.61	0.52	0.30	1.11	24.34
gold	0.68	1.03	2.05	0.04	17.91	66.21	0.22	0.54	11.32	33.79
gsci	1.62	6.99	6.81	3.49	0.87	0.51	69.90	5.05	4.76	30.1
vix	0.52	31.03	12.71	0.76	0.27	0.55	3.51	46.17	4.48	53.83
bond	0.09	8.01	2.81	0.35	1.41	12.28	4.47	5.37	65.21	34.79
TO	4.38	72.45	89.96	11.74	22.42	37.2	21.6	63.32	30.9	34.88

Table 10 Contagion After COVID-19

	btc	us	eu	cn	usd	gold	gsci	vix	bond	FROM
btc	68.21	9.59	7.96	0.23	1.47	1.75	3.67	7.11	0.01	31.79
us	6.23	39.43	21.91	3.44	1.48	0.57	7.18	18.48	1.26	60.55
eu	5.03	24.01	44.40	3.81	0.80	0.53	9.24	11.58	0.61	55.61
cn	1.02	6.93	6.02	70.01	2.39	1.87	6.19	4.22	1.35	29.99
usd	2.61	9.00	5.36	1.37	62.85	7.81	2.92	3.65	4.43	37.15
gold	2.22	1.19	1.21	0.92	8.97	75.84	1.91	1.02	6.72	24.16
gsci	3.19	11.04	11.59	4.51	0.28	1.27	57.52	8.76	1.85	42.49
vix	5.24	24.21	12.07	1.57	1.27	0.12	7.10	47.27	1.14	52.72
bond	0.64	4.83	4.18	2.88	1.95	5.53	3.71	2.21	74.07	25.93
TO	26.18	90.8	70.3	18.73	18.61	19.45	41.92	57.03	17.37	40.04

4.3 Dynamics of Bitcoin

As for Bitcoin, Figure 17 and Figure 18 shows the average contagion effect of Bitcoin from and to other markets over the full sample period. Before COVID-19, Bitcoin has the lowest contagion level compared to the other eight assets (see Table 9). On average, 97.36 percent of the return changes can be explained by cryptocurrency-related activities. The spillover both from and to other assets ranges from 0 to 4 percent. It is the asset that is least likely to be influenced by the other markets. After the outbreak of COVID-19, Bitcoin became more connected to other markets. Only 68.21 percent of the changes remain unimpacted by other markets. Both from and to directional spillover no longer ranks last among all nine assets. This indicates dynamic changing relations between Bitcoin and the other markets. The role of Bitcoin cannot be regarded as a safe haven after the pandemic shock. The result is in line with the findings of some previous research (Conlon et al., 2020; Yarovaya et al., 2022).

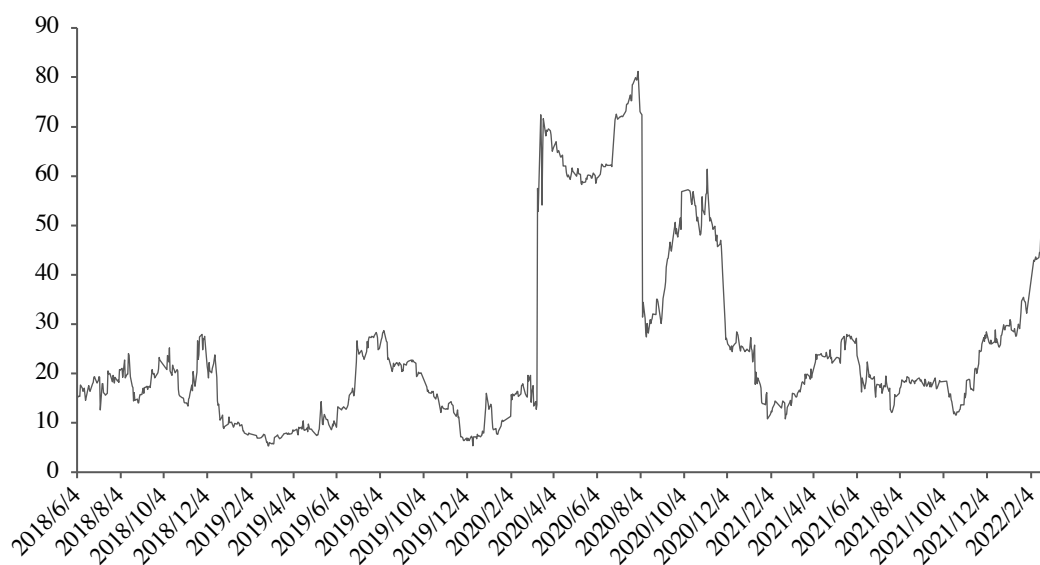


Figure 17. Contagion from Bitcoin to Other Markets

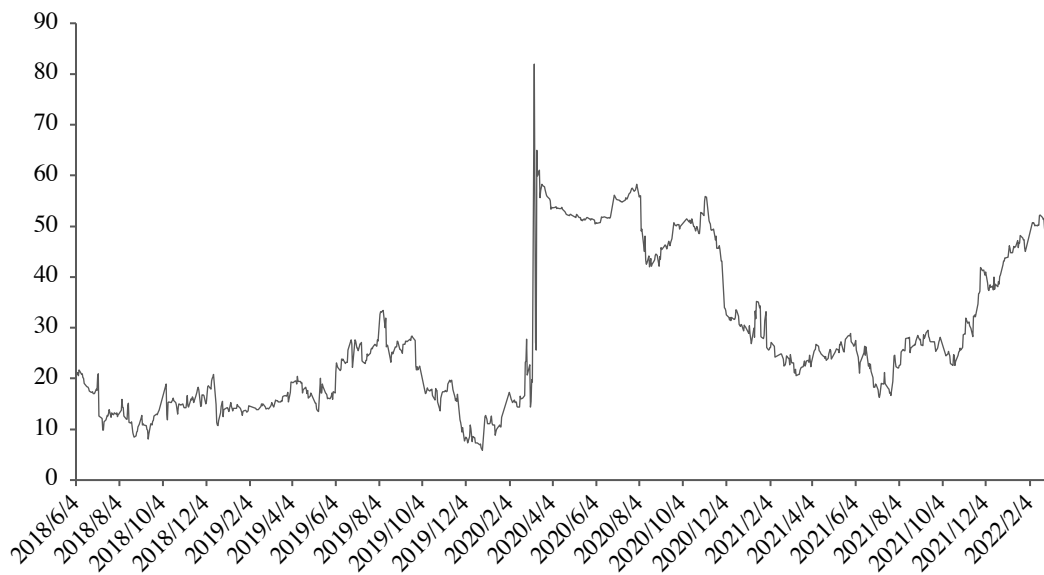
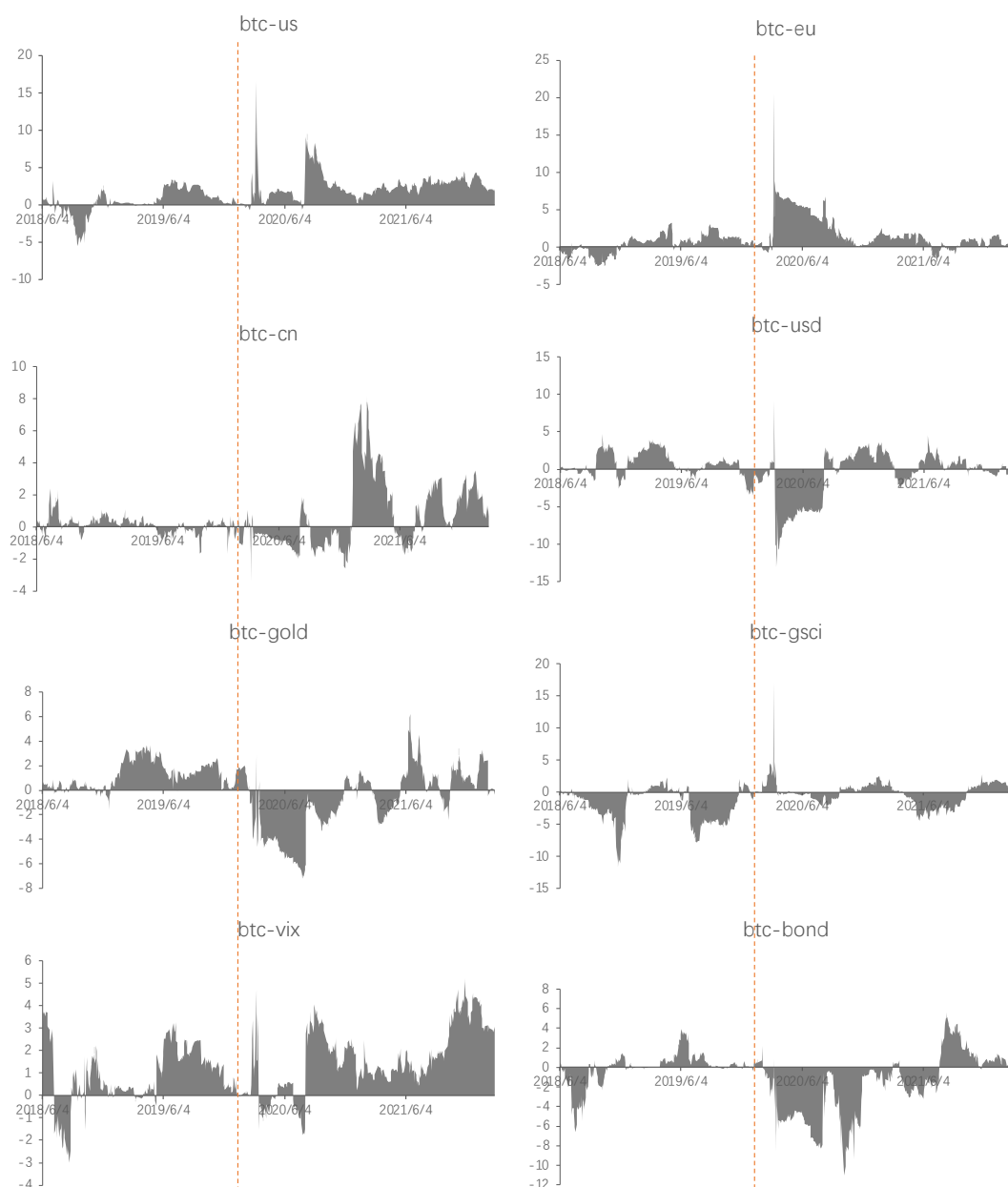


Figure 18. Contagion from Other Markets to Bitcoin

Figure 19 describes the net pairwise contagion from other assets to Bitcoin. The grey shadow on the positive side means the asset transmits risk to Bitcoin, and the negative percentage represents the asset receiving net contagion from Bitcoin. In general, there are some immediate dynamics during the COVID-19 shocks, but there are also persistent changes in the contagion effects before and after COVID-19. The dynamic contagions between Bitcoin and the other markets are getting stronger, which is in line with the findings of static results showed in Table 10. For the US market and the EU market, since the shock of the pandemic, they became the net transmitters of risk and information of Bitcoin, and the effect between these markets increased. This is in line with the results of Guo et. al (2021). A reason for that is that the developed economy employed the Quantitative Easing (QE) method to stimulate the economy during the pandemic recession. QE generates more money in the market and increases the financial market liquidity (Christensen and Gillan, 2017). The market of cryptocurrencies attracted another round of attention. It is argued that people turn to Bitcoin as an alternative, on the one hand, to bet on its diversifier function in the global crisis; on the other hand, to invest in cryptocurrency to make profits. Therefore, more capital from developed economies entered Bitcoin market. In later 2020, the Chinese market became one of the major transmitters of Bitcoin. During the COVID-19 shocks, the US dollar, gold and bond receive the risks from Bitcoin. It can be explained that the more liquid assets have

faster speed in price discovery (Longstaff, 2010). Bitcoin has higher liquidity compared to bonds and the US dollar, therefore, when the shocks came, Bitcoin reacted first and then transmitted risk to them. US dollar and bonds are also considered to have safe haven properties in some cases (Das et al., 2020; Flavin et al., 2014; Schuknecht et al., 2009), and gold is always considered as the final safe haven for global turmoil (Coudert and Raymond, 2011; Selmi et al., 2018). The relationships between Bitcoin and commodity markets does not change much before and after the COVID-19 water shade. Bitcoin receives more spillover from VIX, which might be explained by the reason that VIX and US market has close relationships (see Figure 16). When the Bitcoin market is impacted more by the US market, VIX is also an indicator of such changes.

We can see that the contagion effects of Bitcoin to and from the other assets experience dynamic changes before and after COVID-19 and do not exactly follow the same trend as the overall average contagion level of the other assets (see Figure 15). First, the spillover effect of Bitcoin drops to a lower level, however, it seems to start another round of growing contagion levels from and to other assets since 2022. In contrast, the average contagion level of all variables became relatively stable after April 2021. Even though there are growing effects from time to time, it stays between 40 percent to 50 percent. Second, the contagion effects from/to other markets are not symmetry. It seems that Bitcoin is more impacted by other markets than it to other markets. Third, focusing on the interrelationships between different assets, it is found that the contagion effect between Bitcoin and most markets has changed, such as the US, Europe and Chinese markets, and these changes seem to be very persistent and might not be able to revert to the previous level.



Note: the orange line marks the time before and after COVID-19 outbreak.

Figure 19. Net Pairwise Contagion

4.4 Analysis of Global Events

Those Bitcoin dynamics are difficult to explain when just looking at the data and figures. There must be different events or situations driving the fluctuation and dynamic of Bitcoin. This paper tries to find out the reasons behind to explain such spillover effects and the changing roles of

Bitcoin. In this section, the study tries to identify some events that can partly explain such differences, including crypto-specific events, nation-state policy, and political events.

This paper uses network method to depict the contagion networks of all variables when those events happened. Nine assets are denoted by nine nodes, and the size of the node is the out-degree of the net contagion effect of each asset. Bigger nodes mean this asset has more spillover receivers. The thickness and color of the edge are denoted by the amount of net contagion from node asset to other assets. The darkness and thickness of the line denote the degree of net contagion effects.

4.4.1 September-November 2020: Institutional Players and United States Presidential Election

In Figure 17 and Figure 18, there is another spike following the pandemic shock. An important driver for the rising price is the entry of institutional players. One of the most important moments remarks the major trend of Bitcoin investment is the launch of BTC ETFs. After a long struggling process, the United States Securities and Exchange Commission (SEC) approved the first Bitcoin ETF (ProShares Bitcoin Strategy Fund (BITO)) on 6 October 2020. On the first opening day, the trading volume soon became the second-largest ETF compared to all issued ETFs. 23,103 million shares have been traded on the first day, which worth \$950 million during the first session. Moreover, more and more institutional players join the Bitcoin market, such as Grayscale, MicroStrategy, and Square. They bought huge amounts of Bitcoin in their asset portfolios. The participation of institutional players activated the cryptocurrency market and improve the practical usage of Bitcoin as a diversifier and hedge as a financial instrument, thus increasing the contagion effect from equity markets to Bitcoin.

Apart from the specific crypto-related events, the impact of the United States presidential election cannot be ignored. The election started in August and lasted until November 2020. On 7 November 2020, by counting the votes, Joseph Biden won out Donald Trump and became the 46th president of the United States. Since the first voting day of 3 November 2020, the global financial markets started to react strongly to the news. Before there is a clear result of the presidential

election, the markets can be considered as exposed to political uncertainties. In this situation, the overall market tends to have a lower risk appetite, and the capital usually goes for safer assets, such as bonds and gold (Bilgin et al., 2018). The historical data shows that the probability of a declining market is high during the election period. But once the election has a final result, the investors start to react. This explains why the US market, US dollars and Bitcoin are the main net transmitters during the period, and the bond market became the net receiver.

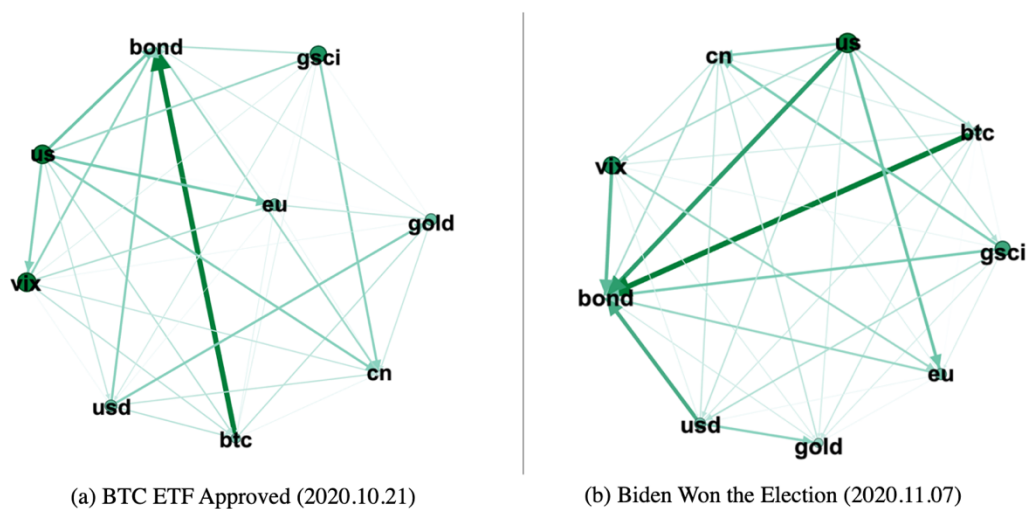


Figure 20. Net Contagion Network-1

4.4.2 May to September 2021: Chinese Policy

China has new regulations towards crypto assets during this time. Previous research has identified that Bitcoin and cryptocurrency markets are very sensitive to political risks and regulations (Aysan et al., 2019; Wang et al., 2020), particularly to the uncertainties of Chinese policy (Borri and Shakhnov, 2019; Cheng and Yen, 2020). To better analyze such subtle relationships, this paper selects two events that can represent the recent actions of the Chinese government. They are, 1) Chinese Financial Stability and Development Committee under the State Council (FSDC) announced crackdown on Bitcoin mining and trading activities on 21 May 2021; and 2) China issued a regulation on 24 September 2021. The regulation is called *Notice on Further Preventing*

and *Resolving the Risks of Virtual Currency Trading and Speculation*. This notice points out that all trading and speculative activities are considered illegal.

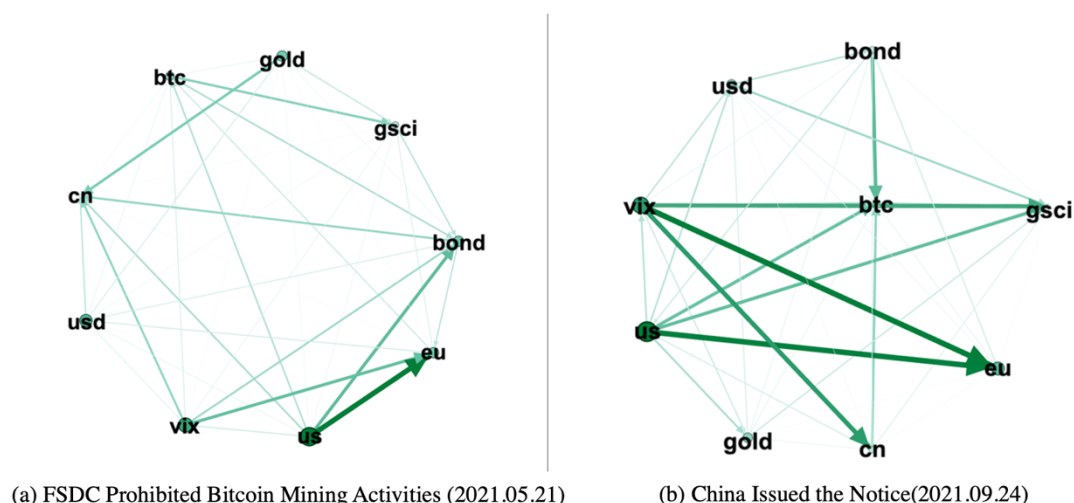


Figure 21. Net Contagion Network-2

Once the news of FSDC was released, Bitcoin price plummeted, dropped by 4% in 10 minutes. When China issued the *Notice* and claimed that services related to virtual currency settlement and provision of trader information are completely prohibited, Bitcoin price again dropped approximately 6% in an hour. And it is obvious that the contagion effect between different assets became more active (see Figure 21). In two cases, the risk and information spillover of Bitcoin remains at the level of over 70% explained by itself. From the net contagion networks, the results show that the risk of Bitcoin primarily transmitted to the commodity and bond markets, and commodity and gold markets in the two scenarios respectively. The other markets are less affected by Bitcoin. The receiving assets are traditional diversifiers and safe haven assets during market turbulence. However, we can see that the overall from and to contagion level stays at a low level, which is below 40 percent. Chinese government probably started to have fewer impacts on the cryptocurrency market than before, which has been tested by other research as well (Panagiotidis et al., 2019). The news intervened the market, but the impacts are milder and last shorter. Since China has mostly banned all activities related to cryptocurrency, it is reasonable to expect that the cryptocurrency market will gradually not react to the response of Chinese regulation and policy.

4.4.3 November 2021 to February 2022: Federal Reserve Actions and Russian and Ukraine Conflict

In the end, this paper selects the recent global events to explain the growing spillover level by the end of the dataset. This paper believes that two international events have had big impacts on the Bitcoin market during the period.

The first one is the Fed's interest rate hike. Previous research found that currency-based digital assets experience idiosyncratic spillovers in response to US Federal Funds interest rate and QE announcements (Corbet et al., 2020). Due to the shocks of COVID-19, Fed started another round of QE to stimulate the economy since March 2020. The huge amount of money issuance together with the consequences of COVID-19, such as supply chain bottlenecks, frangibility of labor markets, and economic uncertainties etc, caused an increasing level of inflation. The current inflation number reached a three-decade high. In January 2022, the FOMC minutes signaled a strong rate hike as soon as March, that “ we are prepared to use our tools to assure that higher inflation does not become entrenched” (Powell, 2021). Bitcoin and other global markets all experience a stronger spillover effect and market volatility (see Figure 22). On the one hand, the announcement indicates a contraction of monetary policy, which means a global retrenchment in capital flows, a fall in global stock markets, and a decrease in risk appetite. As a risky and global asset, Bitcoin also suffers to some extent. On the other hand, the Federal funds rate hiking will reduce Bitcoin's role as an inflation hedge during the QE period (Blau et al., 2021), causing more intense spillovers between Bitcoin and the other markets.

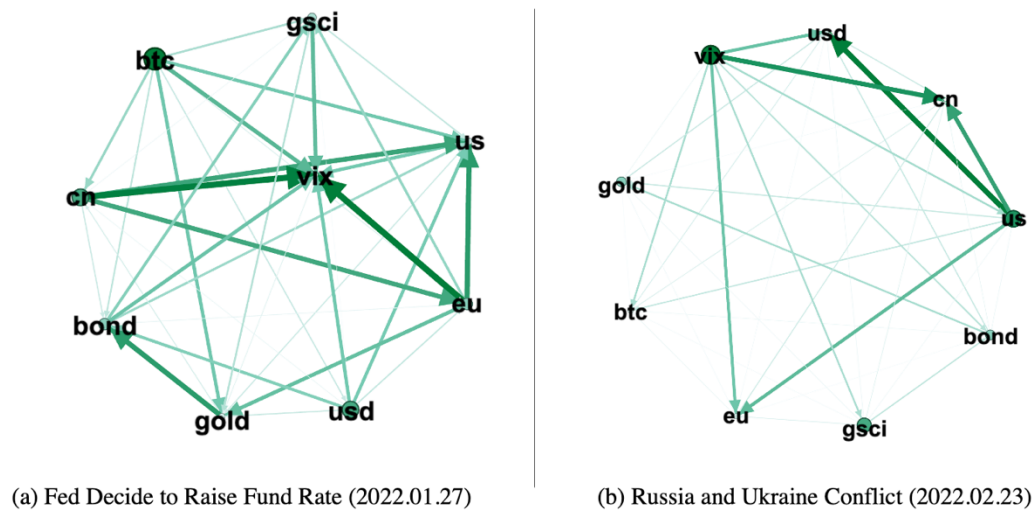


Figure 22. Net Contagion Network-3

The second event is the Russian and Ukraine conflict. Even though there are no Russian and Ukraine markets in the sample data set, the impacts of such a global event should not be ignored. Because Bitcoin and cryptocurrency are global markets, which could be potentially influenced by many international phenomena. The direct participants are Russian and Ukraine, however, the United States and Europe also play key roles in the situation. The war reduced global risk appetite. As a result, capital runs to the US dollar and Chinese CNY for safer choices (Karamti and Belhassine, 2022). These explain why the US market and VIX transmit major risks to European markets, US dollar, and Chinese market.

But it is also worth noticing there is relatively low net contagion between Bitcoin and other assets, which indicates that Bitcoin might be a diversifier during this period. This resonates with the research that Bitcoin shows relatively low risks during the Russian and NATO tension (Selmi et al., 2022). Bitcoin price surged 15% in a week since the outbreak of the Russian and Ukraine conflicts, while the price of the US market and European markets dropped. After Russia was hit by a series of new sanctions, the trading volume between rubles and cryptocurrencies spiked on Binance according to Arcane Research (2022). For Russians, probably Bitcoin is one of the safe havens. Many people in Russia started to use Bitcoin as an alternative payment. Meanwhile, the Russia and Ukraine conflict brings lots of uncertainties and risks to Bitcoin as well. The adoption

of Bitcoin in Russia attracted the attention of nation-states. The Group of Seven (G7) countries issued a joint statement stating that they “will ensure that the Russian state and elites, proxies and oligarchs cannot leverage digital assets as a means of evading or offsetting the impact of international sanctions (Whitehouse, 2022)”. This might make different countries further reconsider the role of cryptocurrency and its development. By the end of the dataset, the spillovers between Bitcoin and other markets still remain relatively high.

5 Conclusion

Focusing on the meso level of cryptocurrency, this paper places attention on the financial attributes to examine the roles and interactive relationships between Bitcoin and the other markets after COVID-19. A comparison of pre and post-pandemic contagion effects has also been given, but more detailed analysis has been conducted in the post-pandemic period. First, this paper examined the full period average static and dynamic contagion level of all selected data using Diebold and Yilmaz’s (2012) method. Second, the focus shifted to the dynamics between Bitcoin and the other markets using the same method. Third, to further explain the above findings, this paper identified a few specific events to elaborate the differences between Bitcoin and the other markets, including crypto-related issues, major economic activities, and geopolitical events.

The results of this paper explain some interesting facts within the data sample period. The findings show that the contagion level experienced one immediate spike followed by a second-round spike after the outbreak of COVID-19. But when taking a longer perspective, the overall contagion level of all variables has turned back to the previous level. However, the contagion effects between Bitcoin and most markets have changed, such as the US, Europe, and Chinese markets, and these changes seem to be very persistent and might not be able to revert to the previous level. Bitcoin became more closely related to other assets and is more likely to have extreme returns compared with that of the pre-pandemic period. Under different situations, Bitcoin exhibits different characters. Immediately after the COVID-19 shock, financial markets experienced huge turbulence, and so did Bitcoin, but the spillover effects of Bitcoin last longer than average level. The contagion effects from/to other markets are asymmetry. Bitcoin gets more impacted by other

markets than it to other markets. The impacts from developed countries became relatively stronger, including major policies and actions taken by the regions. China still has some impacts on cryptocurrency markets, but it is getting out of the market. Bitcoin cannot be a safe haven under the shock of major global events.

In sum, we can see a clear trend that cryptocurrency is gradually taking its new role as a financial asset. Market behavior is another side to reflect people's changing attitudes and perceptions of the functional shifts of cryptocurrency over time. For governments, it is also important to have enough knowledge about cryptocurrency at the market level to facilitate decision-making and policymaking. The relative changing roles also make the governance of cryptocurrency very difficult. Balancing different facets of cryptocurrency is crucial when examining its overall development and governance.

It is also necessary to know that the reasons for the formation of such dynamics are very complex. It involves the complexities of cryptocurrency and its interrelationships with external actors. The aftermath impacts of COVID-19 are persistent, and many changes are also intertwined with other factors around the world, especially with nation-states. They all contribute to the dynamics of Bitcoin. The events selected in this paper can only contribute to part of the explanations. There are probably many other factors that can affect market sentiment, capital flow, trading behaviour etc. Cryptocurrency field is still nascent, and many unknown and interesting facts about cryptocurrency are waiting for scholars to explore.

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