Money for Nothing and Bits for Free: 
The Geographies of Bitcoin

by

Adrian Pel

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for the degree of Master of Arts  
Department of Geography and Planning  
University of Toronto

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Adrian Pel

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Department of Geography and Planning
University of Toronto

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Abstract

The digital currency bitcoin is distinguished by a decentralized network architecture and the absence of a physical form. These characteristics have prompted assertions that bitcoin lacks any clear or meaningful geographies, as it exists within the nebulous realm of cyberspace. This thesis fundamentally challenges this notion and provides the first thorough geographical analysis of bitcoin. Using empirical evidence, this research examines bitcoin mining, user procurement of bitcoin, and bitcoin-related startup firms. Each of these aspects is found to have clear links to geographic space as well as marked patterns of physical concentration. This thesis argues that the accumulation of market power by a small group of firms, the concentration of market activity in key places such as financial centres, and the clear territorial aspects of bitcoin make the currency far more possible to govern and regulate than commentators from the fields of law, economics and computer science have previously suggested.
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Chapter 1
Introduction

1.1 Bitcoin: A Brief Introduction

In 2009 an unknown person or group using the pseudonym Satoshi Nakamoto created bitcoin, the world’s first truly decentralized digital currency (Decker & Wattenhofer, 2013). Bitcoin is an Internet-based payment system that uses its own currency, also called bitcoin. This payment system is a peer-to-peer network that enables users to transfer value directly between ‘digital wallets’, without the need for financial intermediaries and with a high degree of anonymity. Bitcoin is revolutionary in that it eschews both an administrator to verify transactions (such as a bank), and an issuer to control the money supply and otherwise regulate the currency (such as a central bank). Instead, bitcoin relies upon a network underpinned by complex cryptography to create what is currently the closest functional equivalent to digital cash (Brito & Castillo, 2013). Bitcoin’s decentralized system architecture (see Chapter 2 for a full explanation of bitcoin) and its promise to obviate financial intermediaries have led to assertions – in both popular and academic literatures – that the currency is a hyperfluid form of money that will lead to a dispersion of financial activity away from financial centres, pose legal and regulatory issues for governments, and quickly supersede existing forms of money and payment systems. Indeed, some argue that bitcoin “detaches money from geography”, because it challenges the delineated boundaries of state-issued currencies and as it lacks a physical form (Bergstra & Leeuw, 2013). This paper provides an analysis of bitcoin through the lens of geography. In doing so, the paper questions the notion that bitcoin is a completely spaceless and placeless phenomenon and challenges the perception that cyberspace lacks links to geographic space.
1.2 Research Objective & Thesis

The objective of this paper is to challenge the assertion that bitcoin ‘lacks geography’ due to its non-material basis and its existence as mere bits and bytes in the nebulous realm of cyberspace. Many observers conclude that bitcoin’s decentralized network architecture will lead to a shift of power away from governments (Owen, 2015) and a dispersion of economic activity (Vigna & Casey, 2015). Two implications are typically drawn from this position. The first is that bitcoin is impossible to regulate effectively due to the lack of large actors. The conjecture is that if bitcoin is being used by millions of consumers, it will become impossible for states to regulate activity and punish wrongdoing (Kaplanov, 2012). The second implication drawn is that because bitcoin lacks any clear geographical basis – through a material form or the backing of a national government - it will prove impossible for states to assert control over bitcoin as the realms of cyberspace and real space do not overlap clearly and territorial sovereignty is muddled (Bergstra & Leeuw, 2013). With such apparently high stakes, bitcoin is undoubtedly deserving of scholarly scrutiny, especially by geographers.

The findings of this paper fundamentally challenge the notion that bitcoin is a decentralized geographic phenomenon, or one lacking any discernable geography. The empirical evidence presented in this paper reveals that bitcoin is rapidly becoming centralized amongst a small group of market actors which themselves demonstrate spatial concentration. Moreover, this research reveals that bitcoin has clear geographical manifestations in 1) the process of ‘mining’, 2) consumers’ procurement of it, and 3) in terms of financial technology companies that are developing hardware, software, and services related to bitcoin. Remarkably, established financial centres such as London and New York City are leaders in the realm of bitcoin finance, challenging the logic that ‘offshore’ financial centres might emerge as important sites for trading and transactions involving bitcoin given that their limited oversight would further
enhance the anonymity of bitcoin. Meanwhile, Silicon Valley has emerged as a key locus of financial and technical innovation related to bitcoin, illustrating that even a decentralized currency without central governance can produce spatial agglomeration. It is argued that the issues of legitimacy, trust, and expert knowledge explain the shift in bitcoin financial activity towards financial centres and Silicon Valley.

The remainder of this chapter consists of a literature review. First, the burgeoning literature concerning bitcoin is reviewed, and the lack of geographical contributions is underscored. The two sections that follow this review of bitcoin literature summarize literature relating to digital currencies and geography, drawing from writings within the disciplines of geography, political science, and international political economy. By summarizing traditional debates about the geographies of money and finance and ‘electronic money’, this section provides a foundation upon which to examine bitcoin.

1.3 Academic Literature About Bitcoin

Strikingly, geographers have yet to examine bitcoin in any significant capacity. Throughout the course of this research, an exhaustive literature review discovered only two publications that might be considered geographical, and neither were written by geographers. One is a study of bitcoin through the lens of complexity theory written by a macroeconomist (Pilkington, 2014), and the other is an analysis of the prospect of using bitcoin as a tool for economic development in one of the UK’s Channel Islands (Connell, 2014). The paucity of geographic writing on bitcoin seems particularly strange given the bold claims being made by scholars and non-academic writers about bitcoin’s lack of geography and the generally large volume of publications about bitcoin. For instance, The Economist reports that more than 200 books were published about bitcoin in 2014 alone (The Economist, 10 January 2015a). In
addition, several hundred journal articles and working papers have been written. And yet, while these writings constitute exhaustive examinations of bitcoin from the perspectives of economics, computer science and law, it is clear that none offered a geographical perspective other than statements about the irrelevance of geography. While these other writers do occasionally discuss geography, this often comes in sweeping statements about geography’s irrelevance.

While geography has been notably absent in discussions of bitcoin, the fields of law, computer science and economics have provided a wealth of analysis to date. For instance, legal scholars have examined issues of jurisdiction, consumer rights, contract enforcement and the possibility and rationality of state regulation (e.g. Kaplanov, 2012; Desan, 2014; Ponsford, 2015, Guadamuz & Usher, 2008). Computer scientists have offered insights related to the degree of anonymity within bitcoin, its degree of network decentralization, user security, and issues relating to its network architecture (e.g. Gervais et al., 2014; Bergstra & Leeuw, 2013; Koshy et al., 2014). Economists have taken a particular interest in bitcoin, examining facets such as transaction costs, market structure, bitcoin’s status as a form of money, whether it can become a valid global currency, market equilibria, market intermediaries, and many others (e.g. Yermack, 2014; Dwyer, 2014; Franco, 2015; Houy, 2014; Luther & White, 2014). To a lesser extent, economic sociologists have also begun to address bitcoin. Sociologists have begun to discuss aspects such as bitcoin’s materiality, its “social life”, and perceptions of legitimacy among citizens and governments (see Dodd, 2014; Karlstrøm, 2014).

While these perspectives are informative, in many cases they conceptualize bitcoin as a phenomenon floating within the ether of cyberspace and devoid of geographical manifestations. This research aims to remedy the clear lack of geographical analysis and question claims made about bitcoin’s geography (and lack thereof) by scholars in other disciplines. Just as economic
sociology offers insights into the social and cultural aspects of bitcoin and as economics provides analyses of transaction costs and currency volatility, geography can also provide important insights. For instance, consider the following questions: Does bitcoin have manifestations in geographic space, or does it exist only in cyberspace? Is bitcoin truly decentralized in geographic space? Will it be possible for states to establish jurisdiction and assert sovereignty over digital currencies such as bitcoin? What is the future of financial centres? This paper does not seek to prognosticate about bitcoin as an agent of globalization or discuss the minutiae of differing national policy responses to bitcoin, although the latter is sometimes mentioned. Instead, this paper seeks to fundamentally challenge the notion that bitcoin is a spaceless/placeless phenomenon and demonstrate that bitcoin has clear and distinct geographies.

1.4 The Geographies of Money and Finance

Although there has been little written by geographers about bitcoin, there is an established subfield of the discipline which can be drawn from, and into which this paper can be situated: the geographies of money and finance. This subfield came into vogue in the 1990s, largely as a response to hyper-globalist accounts prophesying the ‘end of geography’ (O’Brien, 1992) and a ‘borderless world’ (Ohmae, 1990) due to the apparently inexorable forces of globalization, deregulation, and technological change (Martin, 1994). O’Brien’s provocatively titled *The End of Geography* predicted that the forces of regulatory change and technological innovation would soon render geography irrelevant. His analysis was essentially twofold, with the first plank being that states would lose their regulatory power over money and finance due to the complexity of asserting sovereignty over electronic signals and competitive pressures to attract capital flows. His second argument was that the speed of information technology had already become such that the location of economic actors was no longer an important
consideration. O’Brien’s conclusion was that the integration of financial markets through technology and regulatory changes would lead to the decline of regional, and even global financial centres, as conduits of finance capital.

Many geographers writing after O’Brien concurred with his observation that technological change and deregulation were significant, but countered his assertion that geography was becoming redundant. For instance, Martin (1994) argued that ‘globalization’ was leading to a contradictory tendency vis à vis the geography of finance with decentralization and dispersal on one hand, and centralization and concentration on the other. Leyshon and Thrift (1997) went on to provide a series of empirical accounts of these conflicting tendencies. They observed that even in an interconnected and increasingly regulated world, financial activity is continuously extricating itself from national territory so as to escape regulation, but simultaneously re-embedding itself in highly concentrated places such as global financial centres. Drawing from a thorough analysis of the continued dominance of the City of London as a global financial hub, Leyshon and Thrift argued that in a world of electronic finance and limited government intervention, a greater emphasis comes to be placed on trust and social connections. For Leyshon and Thrift, financial centres remain dominant not simply due to their agglomeration economies and human capital advantages, but due to the role they play in communicating and interpreting complex matters. That is to say that financial centres serve as interpreters for financial actors that struggle to ‘make sense’ the complex world of money and finance, putting to use specialized knowledge and wielding ‘cultural authority’ as arbiters of new and confusing financial products (Thrift, 1994). Given bitcoin’s complexity and novelty, as well as its nascent links to global financial centres, the geographies of money and finance provide a helpful framework through which to examine it.
Literature focused on the geographies of money and finance has experienced a renewed interest recent years in the wake of the 2008-9 global financial crisis (Hall, 2012). Much of this writing has been concerned with phenomena such as financialization (e.g. French et al., 2011a), the contagion of the financial crisis (e.g. Marshall et al., 2012; French et al., 2011b), global financial centres and their role in the crisis (Wójcik, 2013), and the interplay between local housing markets and the global capital flows (Immergluck, 2011). However, as discussed in section 1.2, geographers have yet to produce any significant research into bitcoin. This seems perverse given the groundwork that economic geographers laid in the 1990s and 2000s towards understanding financial centres, regulatory arbitrage, and the social aspects of money and finance, among other phenomena. The geographies of money and finance is an ideal framework through which to examine bitcoin, and this paper therefore sets out to examine bitcoin in a thorough manner that integrates both recent empirical evidence and contemporary theoretical understandings developed by other economic geographers.

1.5 Electronic Money

To provide some context, digital currencies are not a new idea or even a new phenomenon. The 1990s saw attempts to create digital currencies, which in turn generated a wave of scholarly interest in what was then termed ‘electronic money’. While this broad category included electronic debit and credit systems as well as value-loaded “smart cards” (essentially pre-paid credit cards), the subject of the greatest interest was unquestionably ‘true digital money’ that existed only on computer systems (Korbin, 1997). Benjamin Cohen, a scholar in the field of International Political Economy argued in 2000 that it was only a matter of time before such digitally indigenous money became a customary means of payment (Cohen, 2000). During the dot-com boom of the late 1990s and early 2000s, several Internet firms attempted to establish internet-based currencies. These currencies were essentially proprietary
units of account that could be used to make online purchases at a select group of merchants. Issues such as credit card fraud, lack of widespread acceptance and complex user interfaces led pioneering forms of electronic money such as Flooz, Digicash and Beenz to collapse in the early 2000s (Guadamuz & Usher, 2008). Following the dot-com crash, however, scholarly and public interest in electronic money/digital currencies subsided.

In a detailed historical account of the international monetary system, political scientist Eric Helleiner illustrates that territorial forms of money and transaction systems have been continuously shaped by technology and the evolving form of the state (Helleiner, 2003). Helleiner (1998) also argues that although electronic forms of money may appear to challenge the national basis of money that currently exists – the so called ‘Westphalian’ model of national currency zones – such digital currencies will struggle given that currencies fundamentally depend upon trust. For Helleiner, even if virtual forms of money evade regulation – perhaps by being based in ‘offshore’ jurisdictions (see Hudson, 1999) – the widespread lack of confidence relating to matters such as fraud, contract enforcement, stable currency value, and legal prosecution stand as roadblocks to footloose or ‘wildcat’ electronic currencies (Helleiner, 2003). Although bitcoin has no issuer, it has a growing body of intermediaries that facilitate systemic liquidity through exchange processes (see Chapter 4). These intermediaries have geographic footprints. Helleiner also notes that although ‘onshore’ financial centres may have more stringent regulation, it is more probable that electronic forms of money will be based in them due to their advantages in human capital, finance capital, political stability, efficient clearing mechanisms, and trust among market participants, all of which will likely make global financial centres such as New York City and the City of London crucial nodes in the affairs of any major form of electronic money (Helleiner, 1998). As Chapters 4 and 5 illustrate, bitcoin appears to be moving towards ‘onshore’ rather than ‘offshore’ financial centres.
There is an important difference between bitcoin and the forms of ‘electronic money’ discussed by social scientists in the 1990s and 2000s. This difference is that bitcoin does not have a straightforward or identifiable ‘issuer’. The idea that financial institutions privately would come to issue their own forms of ‘electronic money’ can be traced to Hayek’s (1976) monograph *The Denationalization of Money*, in which he called for the abolition of state-issued currencies and a return to the 19th century practice of ‘Free Banking’. Hayek supported market competition among currencies, believing that issuers would be pressured towards maintaining currency stability as consumers rationally sought to avoid the eroding force of inflation. Even heterodox accounts such as those from Helleiner (1998) and Cohen (2004) discuss the future of money within the context of ‘electronic money’ issued as general liabilities of the issuer, which would necessarily be a large bank. Korbin (1997) predicted that in order to assuage the concerns of users, early-stage electronic currencies would have to be issued by established financial firms. Korbin wrote that “consumer confidence in the issuer will be key … brand names [will] become critical” (1997: 68). Furthermore, Cohen (2004) posited that, initially at least, consumers would almost certainly demand a promise of full and unrestricted convertibility into more conventional legal tender.

As has been alluded to, bitcoin is not produced or endorsed by any sovereign state, nor is it backed by any kind of institution such as a bank. This lack of a reputable issuer raises important questions about how and why consumers develop sustained confidence in bitcoin. The lack of a centralized issuer would seem to suggest that bitcoin will be extremely difficult to regulate due to the lack of an issuer to whom political pressure, sanctions or regulations can be applied. Given this important difference between the existing orthodoxy on ‘electronic money’ and bitcoin, new research is required.
1.6 Thesis Outline

The remainder of this paper proceeds as follows. Chapter 2 provides a thorough description of bitcoin and its characteristics. Such a detailed explanation is essential in order to understand the complex phenomenon that forms the focus of this research. Chapters 3 through 5 provide the core analysis of this paper, with each chapter examining a particular facet of the geographies of bitcoin. Chapter 3 discusses the process of bitcoin ‘mining’ and the tendency of mining operations to become large-scale, centralized and oligopolistic. Chapter 4 examines the experience of procuring bitcoin by typical bitcoin users, something that is remarkably complicated at present due to poor monetary circulation within the ‘bitcoin economy’ and issues with the model of ‘mining’. Chapter 5 examines the geography of ‘bitcoin firms’, startup companies that have quickly become important and powerful intermediaries within the economic realm of bitcoin. The empirical evidence and theoretical discussion offered in each chapter supports this paper’s thesis that bitcoin has geographical manifestations characterized by intermediaries and a tendency towards organizational and spatial centralization. Chapter 6 concludes this paper by summarizing bitcoin’s distinct geographies, discussing bitcoin as a ‘financial technology’ rather than a currency, and drawing links with the field of Internet Geography.
Chapter 2
Bitcoin: An Overview

2.1 What is Bitcoin?

Bitcoin is perhaps best described as a digital payment system that uses its own currency, also called bitcoin (sometimes represented by the symbol BTC). In order to provide a distinction between the network and the currency, some authors capitalize the network as bitcoin and leave the currency in the lower case bitcoin. For the sake of simplicity, however, this paper follows the Wall Street Journal’s style guide by making all reference to bitcoin in lower case, as in almost every case the context clarifies which of the two is being discussed (Wall Street Journal, 28 February 2014). Bitcoin was first proposed in a white paper published online in October 2008 by an unknown individual or group under the pseudonym Satoshi Nakamoto (Nakamoto, 2008). In January 2009, the bitcoin network came into existence when Nakamoto released the first open-source bitcoin client software and ‘mined’ the first bitcoins. Nakamoto’s objective was to produce a decentralized system that would not require users to trust commercial banks with their deposits or private information for that matter. The fact that bitcoin’s creation coincided with the Global Financial Crisis of 2008 was not a coincidence. One of Nakamoto’s goals was to ensure that bitcoin’s value could not be debased through the printing of money by a central bank. In Nakamoto’s own words:

The root problem with conventional currency is all the trust that's required to make it work. The central bank must be trusted not to debase the currency, but the history of fiat currencies is full of breaches of that trust. Banks must be trusted to hold our money and transfer it electronically, but they lend it out in waves of credit bubbles with barely a fraction in reserve. We have to trust them with our privacy, trust them not to let identity thieves drain our accounts. Their massive overhead costs make micropayments impossible (Nakamoto, 2009).

Bitcoin was the first decentralized digital currency, and has been described as the first practical and popular cryptocurrency, a term reflecting the fact that the bitcoin payment system
is underpinned by complex cryptography (Brito & Castillo, 2013). Bitcoin is not backed by any government or financial institution. It is instead a system through which digital tokens can be transferred from one user to another without intermediaries. Bitcoin has therefore been likened to digital cash, as bitcoins are transferred directly between the ‘digital wallets’ of parties to a transaction, thereby eliminating the need for financial intermediaries such as banks or credit card companies. Bitcoin transactions thus have substantially lower costs than credit or debit card transactions and offer a strong (although not perfect) degree of anonymity, as bitcoin wallets are not registered with any central authority or financial institution. As regulated financial institutions do not mediate bitcoin transactions, the currency is a highly mobile one that can easily skirt capital controls.

Bitcoin’s decentralized payment system does not rely on financial intermediaries to process or validate transactions, nor does it rely on a central authority to clear transactions. Instead, bitcoin is based upon a decentralized peer-to-peer system underpinned by cryptography. Prior to bitcoin’s creation, digital payment systems had struggled to overcome the double-spending problem. This problem was that without a ‘trusted third party’ to maintain a ledger of balances, digital cash was prone to being spent twice as recipients of a transaction had no way of knowing whether or not the previous owner had already spent the same unit of currency (Kroll et al., 2013). Bitcoin solved the double-spending problem through the novel application of a public ledger system underpinned by public key cryptography. This ledger is known as the block chain. The block chain is a distributed database that contains the history of every bitcoin transaction ever made. This innovation solves the double-spending problem by substituting the public ledger for a ‘trusted third party’. Crucially, while the block chain is a master ledger, it is maintained by thousands of computers operating bitcoin node software. Each node maintains a full copy of the ever-growing block chain, which is approximately 30 gigabytes in size as of
June 2015 (Blockchain.info, 2015). These nodes serve to validate transactions and regularly update their copy of the block chain. The validation process involves checking that a transaction does not involve double-spending. Nodes perform this by parsing through the transaction history found within the block chain. When a transaction is initiated, it is first relayed to a small number of nodes. If these nodes determine that the transaction is valid, then it is relayed to other nodes in the network and approved (Franco, 2015). These transactions are periodically codified into a new block that extends the block chain. These blocks are created at an approximate rate of one block every 10 minutes. As the blocks are sequential and overlapping, it is next to impossible to reverse transactions (Kondor et al., 2014).

The process of creating new blocks is a competitive one. Nodes operating ‘mining’ software compete against one another to be the first to solve a complex cryptographic problem. These cryptographic problems have random solutions, so solving a block is best achieved through a brute-force approach (Franco, 2015). Nodes with greater computational power have a greater likelihood of solving the problem first. The design of the bitcoin software is such that while the solution (known as a nonce) to this cryptographic problem is difficult to calculate, it is easy for other nodes to verify it. If a majority of other bitcoin nodes approve of the nonce, then the new block is added to the block chain and nodes shift their attention to the newest batch of transactions (Kroll et al., 2013).

‘Miners’ who compete to create new blocks to extend the block chain are not merely motivated by competitive spirit or libertarian sentiment. Rather, in a highly ingenious incentive structure, new bitcoins are awarded to the miner which succeeds in creating the newest valid block. These bitcoins are created by a sort of network fiat, albeit a highly predictable and stable one. At the moment the reward is 25 BTC, equivalent to approximately $6175 USD as of 15
June 2015. Bitcoin’s source code thus creates an incentive for users to verify transactions and maintain the block chain. As the source code also constantly adjusts the difficulty of the cryptography so that a block is mined approximately every 10 minutes, the money supply is characterized by an almost perfectly constant rate of inflation. While bitcoins are created through a sort of algorithmic fiat, it is impossible to alter the rate of money creation as it is defined by the source code. The reward for mining halves approximately every four years, and will continue to decline until the money supply reaches a limit of 21 million bitcoin in 2140 (Brito & Castillo, 2013). As of June 2015, there are approximately 14.2 million bitcoin in circulation (Blockchain.info, 2015).

In addition to receiving freshly minted bitcoins, miners may also receive a small, and currently rather insignificant, transaction fee. At present, bitcoin transactions are free, but some bitcoin users have already started to include micropayments to miners along with their transactions, as an incentive to process transactions quickly. This is typically only done for large and more complicated transactions as miners can simply choose to delay processing them. At present, transaction fees amount to less than 0.5% of miner revenue (Houy, 2014). However as the block creation reward decreases over time (indeed, eventually bitcoin will cease to be created) and as the transaction complexity may increase, transaction fees will increasingly serve as the main incentive for mining. The extent to which the declining rewards for mining – a process with enormously important positive externalities – will impact bitcoin is impossible to tell, but several economists have suggested that the transaction fee issue demonstrates bitcoin’s need of governance (Kroll et al., 2013; Houy, 2014; Kaskaloglu, 2014).
2.2 Bitcoin and Functions of Money

This section examines bitcoin with reference to theories of money. It begins by discussing bitcoin’s ability to fulfill the three main functions of money: to serve as a store of value, a unit of account and a medium of exchange. It then proceeds to discuss bitcoin with reference to commodity money theory, chartalist theory and creditist theory. It is argued that, at the moment, bitcoin only succeeds as a medium of exchange and that its value comes from 1) speculative investment, and 2) its utility as a payment system. This section will conclude that the convertibility of bitcoin to fiat currencies is essential at present, and is therefore worth examining in detail.

2.2.1 Bitcoin as a Unit of Account

A crucial feature of any currency is that it functions as a unit of account. That is to say, a currency’s unit of measurement must allow its users to meaningfully interpret prices. Bitcoin is currently a poor unit of account for several reasons. The first is that it is not widely accepted. While a number of retailers have begun to accept it after Overstock.com became the first to do so in January 2014, acceptance of bitcoin in transactions remains miniscule compared to established fiat currencies (Weber, 2014). A second key problem is that where purchases can be made using bitcoin, such purchases are almost never priced primarily in bitcoin. Instead, almost all purchases made in bitcoin involve market exchange pricing, whereby the price originally listed in a currency such as the US dollar (USD) is converted to bitcoin at the going market rate (Luther & White, 2014). While this dynamic pricing appears to solve bitcoin’s problem, Yermack (2014) observes that there is diversity in the ‘going market rate’ as online bitcoin exchanges consistently list prices that vary by several percentage points. The volatile value of bitcoin (as discussed next) disincentivizes retailers from pricing their items in bitcoin as they
would be subject to exchange rate swings and transaction costs unless their inputs also became

Another reason that bitcoin has thus far struggled as a unit of account is its questionable
legal status. While many governments have taken a ‘wait and see’ approach to bitcoin before
imposing regulations, bitcoin’s current lack of widespread status as legal tender and its uncertain
legality by jurisdiction no doubt further discourages bitcoin’s adoption as a unit of account in
financial transactions. The final issue with bitcoin as a unit of account is one of consumer
psychology. Due to the enormous value of a single bitcoin – $247 USD per 1 bitcoin as of 15
June 2015 – it is difficult for consumers to meaningfully interpret prices at a glance as most
prices quoted in bitcoin currently come in at least four decimal places (Yermack, 2014). For
instance, at the time of this writing an item costing $10 USD would be priced at approximately
0.0383 BTC. While consumers could eventually adapt to prices with numerous decimal points
and leading zeroes, it seems difficult to imagine that consumers will (en masse) adopt bitcoin as
their default unit of account when interpreting transactions as long as it continues to play a
secondary role to local fiat currencies. To bring all these problems together, bitcoin does not
serve as an effective unit of account since neither retailers nor consumers are willing to price
transactions in bitcoin, and given that its volatility makes comparisons of prices at points in time
complicated. Indeed, the Bank of Canada (2014) has remarked that: “…Bitcoin is not a unit of
measurement that could be used to compare the value of a good or service offered over time or
by different merchants.” Perhaps the only advantage as a unit of account that bitcoin holds over
existing fiat currencies is its degree of divisibility. While the smallest monetary unit of most
 currencies is equal to 1/100th of the basic monetary unit, bitcoins can be divided into units
(known as satoshis) that are equal to one hundred millionth of a bitcoin. This means that after
bitcoin’s monetary expansion eventually stops, the currency can be divided almost endlessly
As such, bitcoin might be able to fill a niche in micropayments because at present exchange rates, a satoshi is worth approximately $0.00000247 USD (BTCSatoshi.com, 2015). Although bitcoin is well-suited to fractional payments, it is not an effective unit of account as it is neither widely or commonly used by either merchants or consumers. This seemingly circular paradox – that bitcoin is a poor unit of account because it is not in widespread use, and that bitcoin is not widely accepted because it is a poor unit of account – illustrates the uphill struggle for the nascent cryptocurrency to become accepted as a form of payment. As Weber (2014) reminds us, bitcoin must be seen as competing with an established (and firmly entrenched) monetary system in which state governments are the dominant actors and in which financial institutions are key intermediaries (Weber, 2014).

2.2.2 Bitcoin as a Store of Value

As has already been mentioned, bitcoin is a poor store of value due to significant volatility in its exchange rate against fiat currencies. While bitcoin does reliably hold some value (greater than zero, that is), this value is highly volatile. The swings in its value in both the short and the long term can only be described as radical. In 2013 bitcoin’s value skyrocketed due to a spike in demand, increasing from $12 to $1151 USD over the course of the year (Blockchain.info, 2015). However, in 2014 bitcoin was the world’s worst performing currency, exhibiting a steady decline towards ~$300 USD, a trend that has continued into 2015, as demand fell while supply inched upwards (Bloomberg, 23 December 2014). This decline is not just limited to bitcoin’s exchange rate against the dollar, as bitcoin’s value has depreciated against every fiat currency with which it is traded. Figure 2.1 presents the value of bitcoin against the dollar over the past five years, averaging the weekly exchange rates available on all online currency exchanges trading between USD and BTC.
Figure 2.1 Bitcoin’s exchange rate against the American dollar. Data smoothed to weekly averages. Figure by the author. Data current as of 15 June 2015. Data from http://www.bitcoinity.org/

Given the dramatic swings in the value of bitcoin, holding bitcoin for even a short period of time is risky. While there is an incentive to hoard bitcoin as the value could spike due to rising demand, the price is also liable to suddenly decline. Although the highly inelastic money supply prevents bitcoin from being debased, volatile demand has thus far made bitcoin’s value much more unstable than that of established fiat currencies. (Luther & White, 2014). Bitcoin is thus less a store of value than a speculative investment with an unpredictable future value. That said, for as long as people wish to acquire bitcoin, it will hold market value. However, a fundamental problem is that bitcoin is not a stable store of value for any length of time, short or long. (Weber, 2014). A glance at bitcoin’s exchange rate against the USD over the previous 100 days from the time of this writing – hardly an unusual or unique period, and in fact one of the most stable periods for bitcoin yet recorded – is indicative of the currency’s volatility. As Figure 2.2 illustrates, bitcoin’s value against the dollar regularly changes by several percentage points in a day. Looking even closer, for instance between early April and early June 2015, it is clear
that although bitcoin’s price was approximately $220 USD at both times, there was significant volatility during this period. This volatility underscores the issue facing prospective bitcoin users: fundamental uncertainty about its future market value.

![Bitcoin's Exchange Rate Volatility (USD)](image)

**Figure 2.2** Bitcoin’s exchange rate with the American dollar between 7 March and 13 June 2015. The values plotted are the average daily exchange rate found on the major online exchanges. The graph illustrates Bitcoin’s day-to-day volatility, which is significant even during a relatively stable period. Data current as of 13 June 2015. Figure by the author. Data from [https://blockchain.info/](https://blockchain.info/)

Even more damningly, the bitcoin-dollar exchange rate exhibits almost no correlation with the exchange rates of other currencies to bitcoin or to the value of gold (Yermack, 2014). Moreover, bitcoin’s daily exchange rate volatility against the dollar is five times more volatile than that of gold and more than 10 times that of the Yen, USD, Swiss Franc and British Pound (ibid).
2.2.3 Bitcoin as a Medium of Exchange

Bitcoin performs best as a medium of exchange since it brings some characteristics of cash to electronic transactions. Unlike credit card payments or bank transfers, payments using bitcoin occur directly between parties to a transaction and thus eliminate the need for a middleman. Transactions typically have no (or low) fees, are rapid (confirmed within 10 minutes) and offer a strong degree of anonymity, which prevails by virtue of the fact that there is no central authority or institution with which bitcoin users are registered. While transactions are publicly logged in the block chain, only the recipient is disclosed, and the disclosure is of bitcoin addresses (strings of letters and numbers) that aren’t linked to a single person or their other financial accounts (Reid & Harridan, 2013). As a medium for facilitating online transactions, bitcoin is ideal as transactions are both highly secure and irreversible due to the design of source code (Barty, 2014).

In conceptualizing bitcoin as a medium of exchange, it is important to consider bitcoin as both a medium of exchange as well as a payment system that facilitates transactions. Through its capacity as a secure, reasonably anonymous and frictionless payment system, bitcoin might be seen as a sort of commodity money (Mittal, 2012). Akin to commodities such as gold, bitcoin is characterized by a high level of scarcity (due to an absolute limit in money supply) and eschews a centralized monetary authority in favour of having an adjustable value. However, bitcoin does not quite fit the bill as a commodity money. While bitcoin engenders both a medium of exchange and a system of payments, it lacks a non-monetary use and has no intrinsic value. Selgin (2013) describes bitcoin as a ‘synthetic commodity money’, noting that while bitcoin is commodity-like due to its absolute scarcity and rising marginal production costs, it is akin to fiat currencies as it lacks non-monetary value or use.
Although bitcoin is a viable medium of exchange in theory, it has yet to become widely accepted or widely used as payment. As such, it does not completely fulfill the function of a medium of exchange. Frederic Mishkin (2004, P.44) contends that a medium of exchange must be “generally accepted in payment for goods or services or in the repayment of debts.” Bitcoin’s level of acceptance is nowhere near mainstream. While a small but growing number of retailers accept bitcoin as payment – ranging from computer retailer Dell to the vacation website Expedia (CoinDesk, 2015) – bitcoin remains a highly uncommon medium of exchange. As Luther and White (2014) remark: “Even [bitcoin’s] greatest enthusiasts do not buy groceries or pay rent with it.”

According to data derived from the block chain, the average number of daily bitcoin transactions is approximately 100,000 worldwide (Blockchain.info, 2015). However, it is widely believed that most of this activity (perhaps as high a figure as 80%) is related to speculative trading rather than transactions involving the purchase of goods and services (Yermack, 2014). Even assuming that all these transactions involve the purchase of goods or services, the figure of 100,000 is negligible when compared to the volumes processed by credit card payment networks such as Visa which processes 150 million transactions per day and the online payment system PayPal which processes approximately 11.5 million transactions per day (PayPal, 2015; Visa, 2015).

Bitcoin’s limited use as a medium of exchange in transactions stems from the evident reluctance of retailers to use it and the difficulty of procuring new bitcoins. While bitcoin reduces transaction costs traditionally borne by retailers, the currency has downsides for merchants. The volatility of bitcoin’s value, its lack of intrinsic or state-backed value, and its unclear legal status all serve as disincentives for retailers to accept bitcoin. For consumers,
bitcoin has one drawback and one severe structural problem. The drawback is that purchases must be made with cash on hand (i.e. bitcoin they possess) as transfers are more akin to debit card transactions than credit card transactions (Yermack, 2014).

Perhaps the more fundamental structural problem with bitcoin as a medium of exchange is that it doesn’t easily circulate amongst users. As consumers are not paid in bitcoin, they must continuously acquire them via the mining process or by purchasing them from others. This systemic issue will be discussed in greater detail in Chapters 3 and 4.

2.3 Bitcoin and Theories of Money

In principle, bitcoin appears to defy classification under the three dominant theories of money: Chartalist Theory, Creditist Theory and Commodity Money Theory.

Chartalist Theory and its contemporary incarnation, Modern Monetary Theory, understands money as being a system of tokens generated by the state that the state uses for spending and accepts back for the payment of taxes or debts (Desan, 2014). Bitcoin does not fit this theory as no government accepts the currency as payment. In fact, and on the contrary, many governments are considering outlawing the possession or use of bitcoin and similar digital currencies. A Chartalist interpretation does not suit bitcoin either, as it does not account for bitcoin’s creation – Chartalists understand money as being legally imposed by a sovereign authority - or explain why market actors accept bitcoin despite the fact that bitcoin cannot be used to pay obligations to the state or serve as legal tender to settle private-sector financial obligations (Pilkington, 2014).

Creditist Theory understands money not as a commodity, but instead as a form of debt. Creditist theory holds that money is an accounting relation based upon debt. While bitcoin is not
a tangible thing or a normal commodity, the creditist theory nonetheless does not describe it adequately. The creditist perspective is predicated on the argument that fiat currencies are forms of credit money (Graeber, 2011). As has been discussed however, bitcoin is more akin to a ‘synthetic commodity’ rather than a fiat currency. The bitcoin protocol does not enable users to issue IOUs; users can only transfer bitcoins they own and cannot extend liabilities. Moreover, bitcoin’s system architecture does not enable the creation of endogenous money, a key feature of Creditist theory. While fiat currencies support the creation of credit through fractional reserve banking, bitcoin’s money supply is predetermined by algorithm and bitcoin credit/debt instruments do not currently exist. This led Greek economist turned Finance Minister Yanis Varoufakis (2014) to describe bitcoin as a “hard-core version of the gold standard” in a 2014 blog post.

As previously discussed, bitcoin exhibits some of the characteristics of a commodity money. Bitcoin is a fungible and liquid medium of exchange adopted by people without the coercion of a government. Moreover, bitcoin has rising marginal production costs as the mining process has grown in difficulty and as mining rewards decrease over time. As such, bitcoin has been likened to a sort of digital gold (The Economist, 13 April 2013). Indeed, the absolute restriction of bitcoin’s supply to 21 million bitcoin and the consistent difficulty of mining are a step beyond traditional commodity monies as supply shocks seem impossible (Selgin, 2013) However, bitcoin is not a normal commodity money as it has no non-monetary value or use. This lack of intrinsic value means that bitcoin has no underling value beyond market participant belief that other participants will accept bitcoin in the future. Clearly, bitcoin is little different from the fiat currencies that it claims to be different from. Indeed, at least holders of paper currency have a physical artifact that they can put to some non-monetary use (say, a bookmark).
2.4 Analysis: What exactly is Bitcoin then?

Bitcoin might best be described as a ‘digital commodity money’ (Jenssen, 2014) and as a ‘speculative commodity’ (Mittal, 2012). As has been discussed, bitcoin has yet to demonstrate itself as an effective or widely accepted unit of account, store of value or medium of exchange. While a shift in social conventions could afford bitcoin the status of money, this seems unlikely due to two issues that undermine the stability of bitcoin’s value. First, in the absence of a sovereign stakeholder or intrinsic value, bitcoin’s value is entirely shaped by the demand exerted by market actors. The fact that bitcoin has any value is dependent on trust that other market actors will accept bitcoin in the future, while the price of bitcoin is a function of market demand. The bitcoin bubble that inflated in 2013 (Figure 2.1) and evidence that most trading is speculative suggests that bitcoin is treated less as a currency by market actors, and more as a liquid asset or speculative commodity (Mittal, 2012; Yermack, 2014). Second, while the supply of bitcoin is limited there is no limit to the number of other cryptocurrencies that could emerge as competitors. According to one website that monitors the market capitalization of cryptocurrencies, as of June 2015 there are 650 cryptocurrencies, although bitcoin’s market capitalization of $3.4 Billion USD is greater than all others combined (Coinmarketcap.com, 2015). As such, while bitcoin is perceived as the most legitimate of these, it is unclear as to whether bitcoin can become the dominant synthetic commodity money in the same way that gold was the hegemonic commodity money among adherents to the metallist theory of money.

As bitcoin has come to be better understood by government regulators and financial institutions, some of them have labeled bitcoin as a type of commodity. In December 2013, for example, the Chinese government defined bitcoin as a special “virtual commodity” that citizens,
but not banks, can possess and use in barter transactions (Library of Congress, 2015). In April 2014, the American Internal Revenue Service took the position that bitcoin is a type of property or commodity rather than a form of digital money (IRS, 2014). In 2014, major financial firms such Citi Group, Goldman Sachs and Bain Venture Capital opined that bitcoin is too volatile to serve as a currency, and instead appears to function as a commodity similar to gold (CoinDesk, 2014a; Forbes, 2014; TechCrunch, 2014).

In the chapters that follow it will be shown that although bitcoin lacks a material basis and a clear territorial currency zone, it nonetheless has clear geographical manifestations. These are evident in the process of bitcoin mining, user procurement of bitcoin, and activity in the nascent field of bitcoin financial technology. Despite the fact that bitcoin is entirely digital, mining must occur on a computer somewhere (Chapter 3), users tend to procure bitcoin through intermediaries such as ‘bitcoin ATMs’ that are geographically fixed (Chapter 4), and investment in startups seeking to profit from bitcoin is overwhelmingly concentrated in the technology hotbed of Silicon Valley (Chapter 5). In short, while bitcoin does not hold a territorial monopoly as a form of money anywhere (de facto or de jure) or have a discernable centre of its network, it is simply not true that bitcoin lacks a discernable geography. Such a stance ignores the unique features of bitcoin as well as the clearly uneven spatial distribution of bitcoin’s production through mining, the acquisition of bitcoin by users, and the activities of ‘bitcoin firms’.
Chapter 3
Bitcoin Mining: A Visit to the Digital Salt Mines

3.1 Overview

As has been discussed in the previous chapter, bitcoin’s money supply is produced through a process of computerized ‘mining’. The process involves computers competing to solve complex cryptographic problems, with the first to correctly solve the problem receiving a reward of freshly minted bitcoin and a small transaction fee. This process is open to any user, as there are no barriers to entry other than ownership of a computer, an Internet connection and the installation of open-source mining software. As there are no ‘transportation costs’ (between mining sites and markets where bitcoin can be sold or utilized in transactions), as well as almost no regulations concerning mining, the process should in theory be a decentralized one. However, in reality, mining has quickly become an astonishingly concentrated activity that appears to be increasingly located in places where input factors - electricity and cooling - are lowest. Due to the economies of scale and the capital-intensive nature of mining, ordinary users have been crowded out by large-scale mining operations. Agglomerations of mining hardware in places with cheap electricity and cool climates offer decisive advantages in a zero-sum competition that has become extremely competitive since the price of bitcoin exploded in 2013.

This section describes the geography of bitcoin mining, with an emphasis on the tendency of miners to establish large-scale mining sites and seek out locations where input costs are the lowest. In doing so this chapter challenges the notion that mining is decentralized and dispersed both across geographic space and among market actors.
3.2 Bitcoin Mines

Although bitcoins only exist on a distributed electronic ledger in the nebulous realm of cyberspace, the mining process is carried by computers that are located in geographic space. Unfortunately, due to the quasi-anonymous nature of the bitcoin software protocol it is difficult to acquire reliable data on mining activities and their geographic distribution (Koshy et al., 2014). As the activity is a competitive one – and one with an uncertain future legal status - secrecy abounds among miners. Nonetheless, empirical analyses of the economics of mining and several documented cases of large-scale mining operations offer insight into the geography of bitcoin mining and the economic forces that are shaping its evolution.

In bitcoin’s early years, mining difficulty was low. Due to the small number of miners and their relatively simple hardware, the probability of a miner successfully solving a block (and thus receiving a reward) was relatively high and the computational power expended was low. In early 2009, for instance, a regular desktop computer would have been a reasonably competitive piece of mining hardware (Vigna & Casey, 2015). However, as bitcoin’s value increased in the years that followed, more and more miners began to participate. Furthermore, miners began to develop complex computers designed specifically for bitcoin mining. Spurred by the prospect of increasingly valuable mining rewards after bitcoin’s exchange rate against fiat currencies began to rise in 2013, miners developed specialized ‘mining rigs’ that use specially designed computer chips rather than normal computer central-processing units (CPUs) to solve the cryptographic problems that mining entails (Kelly, 2015). The prospective rewards from this digital gold panning led to the emergence of a cottage industry of ‘mining rig producers’. In early 2014, this emerging industry brought to market specialized computer chips, known as Application-specific integration circuits (ASICs), that are optimized specifically for the mining process. Figure 3.1 illustrates the increase in bitcoin mining activity since 2010, presenting both the ‘hashrate’, (a
measure of the combined computational activity of all active miners) as well the price of bitcoin. Of particular note is the spike in mining activity since 2013, when the price of bitcoin began its meteoric rise. A cursory calculation based on network hashrate data reveals that between January 2013 and June 2015, the hashrate has increased by a factor of almost 13,000. To provide some measure of context, by January 2015, the combined computational power of all bitcoin miners was over 13,000 times greater than the world’s 500 most powerful supercomputers (Casey, 13 January 2015).

![Figure 3.1](http://www.bitcoinity.org/)  
**Figure 3.1** Bitcoin’s price and network hashrate. Since the price of bitcoin began its meteoric rise in 2013, mining activity has steadily grown, even as the price of bitcoin has tumbled. N.B. network hashrate is plotted on a log scale. Data current as of 15 June 2015. Figure by the author. Data from: [http://www.bitcoinity.org/](http://www.bitcoinity.org/)
Economic analyses of bitcoin mining suggest that typical miners already struggle to profit from the mining process due to a combination of high capital investment and operating expenses, as well a high level of mining difficulty. Wang and Liu (2015) investigated the experience of typical bitcoin users through an empirical economic analysis. They found that the computational arms race that has occurred in bitcoin mining has resulted in a landscape where, since mid-2013, typical users – even those armed with specialized ‘mining rigs’ – have likely not made any significant profits, and have in fact probably lost money. Wang and Liu conclude that the decreasing probability of successfully solving a block combined with the costs of electricity and hardware would have led to negative profits, even though the price of bitcoin steadily rose throughout 2013. A key issue for miners is that even new hardware quickly becomes obsolete, as mining hardware improvements have moved in line with Moore’s Law. The resulting problem is that many miners face impossibly long amortization periods before they can expect to recover their expenditures on hardware. Furthermore, as the price of bitcoin has gradually sunk since its peak in December 2013 the value of bitcoins as measured in USD has flagged. This situation will no doubt be exacerbated in July 2016 when the 25 Bitcoin reward for solving a block will be halved in line with bitcoin’s money supply algorithm (BitcoinClock.com, 2015). Figure 3.2 shows the total daily revenue of all miners on the bitcoin network, including block rewards and transaction fees.
Figure 3.2 Total daily revenue of all bitcoin mining. This figure is the total number of Bitcoins blocks mined per day (approximately 140) multiplied by the current block reward (currently 25 bitcoin) and then multiplied by the then-current market price of bitcoin in USD. Data current as of 15 June 2015. Figure by the author. Data from: [https://blockchain.info/](https://blockchain.info/)

As the number of miners has increased and the difficulty has risen, the price of electricity has become a key production factor in bitcoin mining operations. As bitcoin’s price against fiat currencies skyrocketed in 2013, competitive miners began somewhat of an arms race that has culminated in industrial-scale mining activities modeled after server farms (Dwyer, 2014). Such ‘bitcoin mines’ tend to include thousands of ‘mining rigs’ operating around the clock and are often located in places where electricity is cheap, as the activity is power-intensive. The ‘mining rigs’ also produce significant amounts of heat, which in turn requires air conditioning or other cooling systems.

The rising operational costs of mining have seen mining relocate from the basements of early enthusiasts around the world to warehouses in countries – and indeed, specific regions – where these costs are lower. When the price of bitcoin began to rise in 2013, bitcoin mining quickly became an industrial process approached from a systems engineering perspective.
Taking advantage of economies of scale, reducing production costs, improving processing efficiency and optimizing capital investment strategies have become key aspects of the competitive mining landscape in a short time.

Within the United States, bitcoin mining has already shifted towards low cost regions, namely the Pacific Northwest. The largest known bitcoin mine in North America is located in Washington state (Vigna & Casey, 2015). This is can be readily explained by the fact that this state provides the cheapest electricity for industrial users in the country, averaging 4.30 ¢/kWh as of March 2015. This compares to the Federal average of 12.29 ¢/kWh for residential users and 6.88 ¢/kWh for industrial users, figures that are significantly lower than comparable rates in most industrialized economies (U.S. Energy Information Administration, 2015). This stems from the state of Washington’s significant hydroelectric capacity. Due to this capacity, electricity can cost as low as 2 ¢/kWh for industrial users located in close proximity to hydroelectric dams. A May 2014 article in the Seattle Times reported that multiple bitcoin mines had been established in the region, drawn in there entirely by cheap power (Seattle Times, 10 May 2014). The largest of these is housed in an approximately 20,000 square foot warehouse, and consumes up to 1.4 megawatts of electricity at its peak (Kelly, 2015; CoinDesk, 12 March 2014).

There is also evidence that China hosts numerous large-scale bitcoin mining operations. Akin to the United States, reports by journalists indicate that miners have been drawn to rural areas where electricity is cheap. The Economist reported in that bitcoin mines have proliferated in the northeastern province of Inner Mongolia where a combination of abundant coal, oversupply in generation capacity and lax pollution standards produced a perfect storm of cheap and bountiful electricity (The Economist, 10 January 2015b). A February 2015 article in
Motherboard, an online magazine, revealed a mining operation in the adjoining province of province of Liaoning that spans 6 industrial warehouse sites and reportedly accounted for 3% of the entire bitcoin mining capacity on the bitcoin network as of October 2014 (MotherBoard, 6 February 2015).

Iceland has also emerged as a site of industrial-scale bitcoin mining, although the entrepreneurs involved are reportedly almost all foreigners. A December 2013 New York Times reported that miners such as a British computer programmer formerly working at HSBC have flocked to Iceland in pursuit of cheap geothermal electricity as well as the cold climate (New York Times, 21 December 2013). The latter effectively provides, for free, the industrial scale cooling that is needed to prevent the ‘mining rigs’ from overheating (Kelly, 2015). In large-scale bitcoin mining operations, cooling energy typically increases power consumption by approximately 30-50%, a significant operating cost (Allied Control, 2014). The case of Iceland is notable in that under the strict regime of capital controls imposed after the collapse of Iceland’s 3 largest banks in the wake the 2008 financial crisis, it is illegal for citizens to purchase bitcoin with the Icelandic króna. It is therefore likely that most bitcoins mined at Icelandic facilities are sold to foreign buyers as 1) capital controls do not extend to foreign currencies and, 2) because it is illegal for Icelandic merchants and service providers to accept bitcoin as a form of payment.

3.3 Bitcoin Mining Pools

The rise of industrial-scale mining operations has been accompanied by the development of ‘mining pools’. These pools are online consortia through which miners pool their resources and share the rewards. The advantage of participating in a pool is that miners receive a steady flow of bitcoin (typically a tiny fraction of a single bitcoin) over time. This smoothes the income
of participating miners over time, with miners receiving a steady ‘income’ rather than a random lump sum block reward when (or indeed if ever) they solve a block by themselves. Mining pools have been likened to lottery syndicates since they increase the probability of winning by pooling resources and sharing rewards (Coindesk, 2014b). It is believed that most mining power is channeled through pools. A simple analysis comparing the total number of blocks mined to the known blocks mined by publicly available mining pools reveals that such pools currently account for approximately 65% of mined bitcoins, although this now appears to be a declining figure (Neighbourhood Pool Watch, 2015). Once other privately organized pools are taken into account, mining pools account for at least 86% of the total network hashrate. Figure 3.3 presents the approximate hashrate distribution among mining pools for the month preceding June 12, 2015.

Amongst the group of mining pools, the largest pool changes constantly as switching costs are minimal and since pools tinker with their incentive structures to attract miners. However, one thing that has remained true since 2013 is that a small number of pools hold a significant market share. Throughout this period there have consistently been pools possessing approximately of 30% of the total mining capacity (Kroll et al., 2013).
Figure 3.3 Bitcoin’s hashrate distribution. This chart shows the hashrate attributed to mining pools (both public and private) based upon blocks attributed to them, as determined from analysis of the blockchain. Due to data issues, figures are only approximate. Data covers the 30 day period preceding 15 June 2015. Figure by the author. Data from: http://blockinfo.org/

Given that mining pools are open-access consortia, there may be some tendency to view them as decentralized and collaborative networks through which ordinary miners can compete with large-scale ‘bitcoin mines’. However, this apparent dichotomy of centralized mines and decentralized mining pools is a false one. Almost every large mining pool is a centrally operated private company that charges user fees, typically subtracted from miners’ payouts (Eyal, 2014). Many of these pools provide no contact information to users and do not publish audited financial accounts (Dowd & Hutchinson, 2015). As such, mining pools have also become a concentrated sector in which shadowy outfits can dominate.

While mining pools offer ordinary miners a way to improve their odds and create a consistent revenue stream, enthusiastic miners who seek to mine on a large-scale will likely end up leasing cloud-mining capacity. Cloud mining is akin to other forms of cloud computing.
Consumers lease processing power from firms that operate remote data centres connected to the Internet. Consumers do not need to make heavy capital investments in hardware, and firms can take advantage of economies of scale by serving a large and diversified clientele. Given the economies of scale that benefit cloud-mining firms, as well as lower electricity costs, it seems almost inevitable that cloud mining will continue to diminish the prospects of home-miners. As Kelly (2015) illustrates, the mining capacity that powers such cloud hashing is typically housed in the aforementioned large-scale bitcoin mines. Large-scale mining operations appear to occupy a relatively strong position due to their economies of scale and the desire of bitcoin miners to remain competitive in the mining arms race. Simply put, although mining pools might be envisioned as peer to peer networks, a substantial amount of their capacity likely comes from large warehouses full of specialized computer chips and air-conditioners, a scenario which seems likely to continue.

Evidently then, although mining was originally designed to be a decentralized process that would serve a public good (transaction verification) and reward users’ computational contributions, it has already become a highly centralized affair. While mining pools are undoubtedly a positive development for the bitcoin economy – in that that they reduce the ‘income inequality’ in the mining sphere – they have done little to challenge the emergence of large-scale mining operations. The market dominance and integral role played by mining pools has led Gervais et al. (2014) to contend that they play a role similar to banks within the global financial system.

### 3.4 Analysis & Implications

It seems probable that the now industrial scale of bitcoin mining will continue to erode the profit-making prospects of ordinary bitcoin miners. As the cryptography that mining entails
can only be solved through brute force, there is no advantage for nimble and otherwise innovative miners unless they make significant improvements to mining hardware. This faint-hope scenario seems unlikely due to the capital-intensive nature of computer hardware development and the technical knowledge required. Moreover, the escalation of the bitcoin mining arms race requires constant reinvestment in order to maintain profitability. That is to say that today’s marginally profitable miners will be even less competitive in a matter of months. Given these market conditions, it is conceivable that the mining landscape could soon come to be dominated by a small group of large mining pools run by corporations. Scott (2015) suggests that large-scale bitcoin mining operations have become de facto utilities; they dominate the market and are in a prime position to extract rents from transaction fees as barriers to entry are high (Scott, 2015). Indeed, the growing market share of a small number of mining pools has led Schneider (2015) to contend that mining has already become an oligopoly. This apparent oligopolistic tendency can to some extent be understood in light of the fact that competitive bitcoin mining is more than a capital intensive process. As Dodd (2014) observes, although bitcoin is often treated as a thing without social foundations, bitcoin is produced through a collective human process that involves both expert knowledge and an industrial mining logic on one hand, and apparently irrational miners on the other.

The growing dominance of a handful of large-scale mining operations (pools and bitcoin mines) has led to concerns about the potential for market abuse. The transaction-processing network - operated through the process of mining - relies on a majoritarian principle: if a majority of miners verify a transaction it is deemed valid and is irrevocably processed. While this system has functioned efficiently thus far, the fundamental weakness of the bitcoin network is the ‘51 percent attack’ (Reber & Feuerstein, 2014). The problem is that if a single miner (or more probably a mining pool) were to possess 51 percent of the mining network’s computing
capacity they would be able to spend the same bitcoins twice. Moreover, they would be able to accrue far larger than a 51 percent share of mined bitcoins due to the ability to manipulate the block chain (Dowd & Hutchinson, 2015).

At the same time, the centralization of mining operations and their geographical fixity may transform bitcoin mining operations into prime targets for regulation. Although some observers have argued bitcoin’s decentralized character eliminates the ‘choke points’ such as banks and clearing where regulators can focus their monitoring and regulatory actions, the emergence of a mining oligopoly may in fact lead to the opposite outcome. The high capital costs and fixed geographic location of large-scale mines make them a far easier (and indeed more alluring) target than the suburban basements of everyday bitcoin users mining for themselves. This is a fact that American security researcher Dan Kaminsky underscored at a 2013 conference organized by the non-profit Bitcoin Foundation. Speaking on a discussion panel, Kaminsky noted that “the miners are going to be really nice regulation points”, opining that large-scale bitcoin mining operations are perhaps the best choke point available to regulators (Chapela et al., 2013). Whereas the economies of scale inherent to mining and the competitive advantage conferred by specific locales combine to make bitcoin mining geographically concentrated, these economic forces have also led to a significant amount of mining activity in a small number of clearly defined legal jurisdictions. As such, the regulation of mining appears viable. At the same time however, a laissez-faire approach may win out. Faced with regulating a fast-paced industry that is not entirely understood, it is conceivable that governments may simply choose to eschew the regulation of bitcoin mining. On the other hand, a potentially new source of tax revenue may stoke governments’ interests in the cryptocurrency’s creation.
Chapter 4
The Geographies of Bitcoin Procurement

4.1 Overview

This section builds upon the extensive discussion of bitcoin’s commodity-like nature and makes the case that bitcoin’s utility as a medium of exchange in dependant on its exchange with fiat currencies. It is argued that because typical users struggle to procure bitcoins through mining them and do not earn wages in bitcoin, acquiring bitcoin through exchange is the only viable route for most users. The three processes through which bitcoin exchange occurs are then described: 1) over-the-counter exchanges between market participants 2) recently developed ‘bitcoin ATMs’, and 3) online exchanges. Through describing these processes, it is demonstrated that bitcoin is geographically manifested during such transactions, thus challenging claims that the currency exists only on the Internet and outside of regulatory jurisdiction.

4.2 User Procurement of Bitcoin

A fundamental problem with bitcoin is that it is remarkably difficult for typical users to procure bitcoins. As discussed in Chapter 3, typical users struggle to accrue bitcoin through mining as the field is simply too competitive. Moreover, workers are not paid their wages in bitcoin, except for a few employees working at technology start-ups (CBC, 1 September 2014). This means that bitcoin does not effectively circulate within the economy and that most users must buy bitcoin in order to use it for exchange purposes or to hold it speculatively. The combination of these two issues results in a scenario where the only way to procure bitcoin short of establishing a mining operation or a small business that only accepts bitcoin as payment, is to purchase it. Figure 4.1 provides an illustration of the methods to procure bitcoin, and highlights the difficulty level of each.
**Figure 4.1.** Methods of procuring bitcoin. Exchanging fiat currency for Bitcoin appears to be most viable method for ordinary users to procure Bitcoins. Figure by the author.

### 4.3 Over-the-Counter Transactions

Perhaps the easiest way to procure bitcoins is through over-the-counter transactions that often occur in person. In such transactions, one party possesses bitcoin and exchanges them with a second party in exchange for a fiat currency (often cash), usually at a market rate quoted from an online exchange. Buyers may know a prospective seller in their vicinity, but if not they can easily consult websites that list sellers in their local area (Penrose, 2014). These websites host classifieds that connect buyers and sellers and allow them to negotiate their own transactions rather than serving as market makers. The largest such site, Localbitcoins.com, lists sellers in 7653 cities spread across more than 200 territories (Localbitcoins.com, 2015). These transactions may occur through online payments (e.g. PayPal or credit cards) or through cash payment in person.

Another way to procure bitcoin through over-the-counter exchanges is through physical marketplaces not unlike trading floors. In some cities, local bitcoin enthusiast groups have established regular meet-ups known as ‘Satoshi Squares’ where buyers and sellers convene in person and operate what amount to bitcoin spot markets (Wired, 23 July, 2013). Over-the-
counter transactions that occur in person have two advantages over online exchanges. First, buyers can immediately purchase bitcoins; newly registered users of online exchanges typically have to wait two weeks until they can trade so that their bank account can be verified. Second, in person exchanges enable bitcoin procurement to be more anonymous; buyers can pay cash and thus leave no record of the procurement. The clear trade offs of over-the-counter transactions are risk – via fraud or physical harm – as well as the transaction costs expended in time and effort (Penrose, 2014). Evidently, although bitcoin is easily conceptualized as an ethereal commodity shifting around cyberspace, its exchange with fiat currencies is often done through face-to-face transactions. Although impossible to verify, it seems probable that most in person transactions occur within local urban areas, due to the additional transaction costs imposed by travel.

4.4 Bitcoin ATMs

On October 29th, 2013 a new way to procure bitcoin emerged. On that day, the world’s first publicly available bitcoin ATM opened in a Vancouver coffee shop (CBC, 29 October, 2013). bitcoin ATMs are relatively uncomplicated computers that enable users to exchange cash for bitcoins. This is done by submitting one’s bitcoin address – the code identifying one’s digital wallet on the bitcoin network – into the computer and then inserting banknotes, prompting the machine to quote the current bitcoin price from an online exchange and then transfer bitcoin at the going market exchange rate to one’s address. This convenience comes at a cost though, as fees for both deposits and withdrawals are both approximately 5.5% as of mid-2015 (CoinATMRadar.com, 2015). The term ATM is misleading as the machines are essentially automated bureaux de change rather than machines that facilitate deposits or withdrawals. Some machines can also convert bitcoin back into fiat currencies. Although ATMs are not a
revolutionary innovation, they significantly simplify the exchange of fiat currencies for bitcoin and bring geographical fixity to the process (Molchanova & Solodkocskyy, 2014).

Since the first bitcoin ATM was installed one and a half years ago, hundreds have popped up around the world. According to the website Coinatmradar.com, as of June 15 2015 there are 412 bitcoin ATMs known to exist, spread across 49 countries and territories (Coinatmradar.com, 2015). However, the distribution of the machines among these countries – almost all of which are located in the Global North – is remarkably uneven. For instance, the United States and Canada alone account for almost exactly half of the existing Bitcoin ATMs with 205 out of 412 (see Figure 4.2). Meanwhile, 27 of the 49 countries with Bitcoin ATMs have either 1 or 2 machines.

The United States is by far the leader in Bitcoin ATMs, with just under a third (120) of all known machines. Canada, meanwhile, houses approximately one sixth of the global total, meaning that roughly half of the machines are located in North America. The notable exception to the concentration of machines in the Global North is China and Hong Kong, which house a total of 23 machines.
Figure 4.2 Number of bitcoin ATMs by country. Figure by the Author. The 17 countries that each have 1 bitcoin ATM have been grouped for graphic simplicity. Data current as of 15 June 2015. Figure by the author. Data from: http://www.coinatmradar.com/

While bitcoin ATMs make procuring bitcoin easier, their use brings bitcoin out of the fringes of cyberspace and the black-market like world of over-the-counter transactions and firmly into the purview of state regulation as ATMs are both clearly visible and not mobile. The growing prevalence of bitcoin ATMs could well make bitcoin transactions subject to taxes and government regulation. While bitcoin ATMs simplify the process of procuring bitcoin, they situate transactions within identifiable jurisdictions and thus make regulation easier and more likely (Owen, 2015). Although unregulated in Canada at the moment, bitcoin ATMs are already regulated in the United States under strict federal anti-money laundering laws. Within the United States, state governments have already begun to regulate bitcoin ATMs, with Vermont ordering the closure of the state’s only ATM in February 2015 on the grounds that it lacked a money transmission license (Vermont Public Radio, 17 February 2015).
4.5 Online Bitcoin Exchanges

Bitcoin can also be procured through online currency exchanges. As with other foreign exchange transactions, the exchange rate between bitcoin and fiat currencies on such websites is determined by supply and demand (Mittal, 2012). In order to prevent fraud, online exchanges require users to pay using bank transfers rather than credit cards. This is necessary as bitcoin transactions are irreversible (Yermack, 2014). While bitcoin buyers and sellers can use any online exchanges, two emergent phenomena demonstrate the concentration of trading among exchanges registered in particular jurisdictions.

The first phenomenon is the growing dominance of online exchanges registered in China, and the massive trading volume of Chinese yuan on these exchanges. As of June 15th 2015, 88.3 percent of all online exchange activity is handled by online exchanges registered in either China or Hong Kong (Figure 4.3). While these exchanges offer transactions in numerous

![Bitcoin Trading Volume by Online Exchange](http://www.bitcoinity.org/)

**Figure 4.3** Bitcoin trading volume by online exchange. Bitcoin exchanges based in China and Hong Kong are clearly dominant. Chinese and Hong Kong exchanges are illustrated in red. Data current as of 15 June 2015. Figure by the author. Data from [http://www.bitcoinity.org/](http://www.bitcoinity.org/)
currencies, yuan trading drives an overwhelming majority of exchange activity. Since early 2014, approximately 80 percent of all bitcoin trading volume has been denominated in Chinese Yuan (Figure 4.4).

The explosion in yuan-bitcoin exchange began in mid-2013 when bitcoin’s value began its remarkable appreciation (See Figure 2.1). Between December 2013 and April 2014, the Chinese Central Bank began to restrict the activities of bitcoin exchanges, for instance by limiting the ability of banks and financial institutions to process payments. However, the exchanges found ways to circumvent these regulations and the central bank reversed its course in April 2014 and returned to the laissez-faire stance it had initially taken (Gloudeman, 2014).

Several explanations can be offered to account for the dominance of Chinese-based exchanges and yuan trading. One explanation, although difficult to verify due to the
decentralized nature of bitcoin, is that China is a major hub of bitcoin mining and therefore online exchange activity is driven by miners cashing out their freshly mined bitcoins (Ibid). Another explanation is that bitcoin is seen by Chinese investors as a vehicle for investment outside China’s domestic-focused stock markets and as a hedge against concerns that the Chinese Central Bank will devalue the Yuan to support China’s export competitiveness (Cowen, 2013). In a related vein, it has been hypothesized that investors view bitcoin as a vehicle through which to circumvent China’s strict capital controls and thus transfer their wealth abroad anonymously (ibid). Other factors that appear to have boosted activities on Chinese exchanges are low fees and limited market regulation. Chinese exchanges have consistently had the lowest transaction fees, with several of them slashing fees to 0% in 2014 (CoinTelegraph.com, 2015). The combination of low (or zero) fees and the lack of a market regulator has likely led to inflated trading volumes as users can trade bitcoin between accounts they own, so as to boost market volume and therefore the price of bitcoin. While such ‘wash trading’ is illegal in regulated stock and commodity markets, as bitcoin exchanges are unregulated, they are ripe for manipulation by participants that hold large amounts of bitcoin and engage in automated trading (Wong, 2014). In sum, the case of China’s online exchanges provides an illustration of how, for some, bitcoin serves as a speculative liquid asset rather than just a commodity used in transactions.

The second significant phenomenon that can be observed among online bitcoin exchanges is their concentration in established financial centres. Aside from the large Chinese exchanges that are based in Beijing and Shanghai – BTCChina, OKCoin and Huobi and LakeBTC – many of the major exchanges are based in established financial centres such as London (Coinfloor, Bitstamp), Hong Kong (Bitfinex), New York City (Coinsetter, itBit) and San Francisco (CoinBase, Kraken). Given bitcoin’s decentralized character and its apparent
severance from the sphere of formal finance, this appears to be a curious phenomenon. Furthermore, it seems to beggar belief that bitcoin exchanges would be based in jurisdictions with established and competent regulators given that they could easily be set up in more lightly regulated ‘offshore’ financial centres (Hudson, 1999). While exchanges based in these established financial centres are currently dwarfed by Mainland Chinese exchanges, there are reasons to believe that exchanges based in these established financial centres will continue to grow in trading volume. Although basing bitcoin exchanges in such cities means that activities are firmly situated within national regulatory space (Martin, 1994), there are clear advantages that exchanges seek to yield from basing themselves in global financial centres.

4.6 Analysis

There appear to be two key factors that motivate exchanges to locate in financial centres: a desire for greater oversight and the potential of partnerships with the formal financial sector. Although it appears perverse that exchanges would seek regulation, there are two clear explanations for this. The first reason is that bitcoin exchanges desire regulatory clarity. Although regulation brings costs in terms of compliance, the advantage that exchanges gain from being proactive is that they are not caught out by unexpected regulatory decisions (Frick, 26 March 2014). The second reason is the growing concern about the security and trustworthiness of online exchanges. Since 2011, bitcoin exchanges have become targets of increasingly disastrous hacking attacks (Hern, 18 March 2014). The most significant of these attacks occurred in February 2014 when the Tokyo-based Mt. Gox exchange – then the world’s dominant exchange (see Figure 4.3) – announced that 750,000 bitcoin had been stolen by hackers. The stolen bitcoins comprised approximately 7% of the total bitcoins in circulation and had a value of approximately $480 million USD (Takemoto & Knight, 28 February 2014). The Mt. Gox incident and others like it have catalyzed collaboration between bitcoin exchange
operators and financial regulators, with the hope of setting up regulated exchanges which can bring a greater degree of trust to the currently opaque operation and structure of the exchanges. This process is furthest along in New York, where the state’s Department of Financial Services has been working on a ‘Bitlicense’ since mid-2014 that would implement standards on cyber security and bookkeeping practices (Ember, 17 July 2014). Evidently, there appears to be a symbiotic relationship between financial regulators keen to encourage financial innovation and maintain the hegemony of established financial centres, and exchanges that are keen to implement industry-wide regulation that will restore trust to market participants through consumer protection provisions, provide regulatory clarity and prevent a race to the bottom among exchanges that will imperil the whole online exchange industry.

A second factor that may account for the registration of bitcoin exchanges in established financial centres is a desire to access finance capital, and perhaps to improve perceptions of legitimacy among market participants. Financial centres such as London and New York City contain deep pools of human capital and finance capital that can be used to finance the expansion of exchanges (e.g. through venture capital) as well as provide insurance or banking facilities for exchanges concerned about security risks and currency swings. As such, established financial centres are well suited to fostering financial innovation (Strange, 1997; Wójcik, 2013). However, in the case of bitcoin, it appears that San Francisco – which boasts a well-developed financial services sector as well as the technologists of Silicon Valley – is a particularly prominent base for online bitcoin exchanges. In January 2015, it was announced that Coinbase, a San Francisco based exchange whose early backers included prominent Silicon Valley venture capital firms, had raised $75 million USD in funding. As the Wall St. Journal reported, this was notable as “Investors included banks and the New York Stock Exchange, apparently the first time any traditional financial institutions have taken direct stakes in a
Bitcoin enterprise” (Vigna & Casey, 20 January 2015). Evidently, although bitcoin transactions obviate the necessity of a financial institution to serve as an intermediary, established financial institutions are beginning to establish formal links with bitcoin exchanges. Although such relationships are novel, it does not seem unreasonable to suggest that the prospect of investment or even partnerships with established financial institutions may serve to lead bitcoin exchanges to become concentrated in established financial centres. The concentration of bitcoin exchanges in financial centres adheres to the long observed phenomena that specialized financial firms are often highly spatially concentrated, and that established financial centres have impressive staying power (Martin, 1999). The location of online bitcoin exchanges in established, ‘onshore’ financial centres adheres to Helleiner’s (1998) skepticism about ‘electronic money’ being dominated by shady (and possibly illicit) offshore jurisdictions. Helleiner argued that in addition to the resources that onshore financial centres possess, they also offer political stability, strong legal systems and a sense of trust in market participants and clearing systems. For Helleiner (2003), even if offshore based online bitcoin exchanges emerge, they will struggle due to a fundamental lack of trust – the central foundation upon which money relies, even for a currency modeled on distrust – as well as the ability of powerful governments to both squeeze offshore financial centres through sanctions and to lead international cooperation. As such, there are reasons to believe that online bitcoin exchange will continue to involve global financial centres.
Chapter 5
The Geography of Bitcoin Firms

5.1 Introduction

This chapter presents empirical evidence that supports the argument advanced in previous chapters that economic activity related to bitcoin is geographically concentrated. Under examination here is the distribution of firms involved in commerce relating to bitcoin – hereafter referred to as bitcoin firms for the sake of simplicity – as well as investment in them. The evidence presented consists of all publicly disclosed venture capital (VC) investments in bitcoin firms worldwide. While restricting an analysis to only VC-backed firms obviously leads to a limited perspective, this decision has been undertaken for three reasons. First of all, in a nascent industry characterized by secrecy and competition, public disclosures provide some of the only reliable data. Whereas some private equity firms may let it be known that they have invested in bitcoin, and banks have begun to investigate the uses for bitcoin and acquire startup firms (Bloomberg, 3 March 2015), specific financial details are scant. Second, VC is a common method through which small and young firms with uncertain prospects raise capital. Within the high-technology sector, VC is a standard investment practice, especially where there are asymmetries in understanding between entrepreneurs and investors (Gompers & Lerner, 2001; Florida & Kenney, 1988). Clearly, such a description fits bitcoin firms well. The third and final reason is that the research to date is wanting; there has yet to be any scholarly analysis of bitcoin firms, much less their geography (Pilkington, 2014). As such, even a relatively straightforward examination limited to VC-backed bitcoin firms promises to offer fresh insight.

5.2 Bitcoin Firms

As has been explained, although bitcoin does not require middlemen due to its network architecture, intermediaries have nonetheless proliferated within the ‘bitcoin economy’ (Brito &
Castillo, 2013; Garcia et al., 2014). The ‘bitcoin economy’ is a term used to describe the economic sphere of bitcoin including mining and transaction activity together with the related commerce of other bitcoin firms, these being third parties such as mining hardware vendors and software firms. Bitcoin firms are a heterogeneous group. Most bitcoin firms focus on a specific aspect related to bitcoin such as mining, digital wallet provision, payment processing, currency exchange, or financial services. A small handful of bitcoin firms engage in more than one of these functions, and are known as ‘universal’ bitcoin firms. Even within these subsectors of bitcoin activity there is diversity. For instance, some firms involved in mining focus on cloud mining while others sell hardware. Broadly speaking, bitcoin firms are situated within the burgeoning field of financial technology or ‘fintech’. Fintech firms are typically startup companies that seek to challenge financial sector incumbents such as banks, especially through the utilization of software. In 2014, VC investment in bitcoin totaled $234.17 million USD out of an estimated $12 Billion USD for the entire fintech sector (The Economist, 9 May 2015).

Bitcoin firms vary quite significantly in terms of their market valuations. Some firms have negligible valuations and struggle to attract investment. Other large firms have successfully raised tens of millions of dollars in rounds of VC investment. For example, in early 2015 it was widely reported that following a $75 million USD round of investment, Coinbase, an online bitcoin exchange and ‘digital wallet’ provider based in San Francisco, was valued at over $400 million USD (Bloomberg, 20 January 2015).

5.3 The Geography of Bitcoin Firm Venture Capital

This section presents information about all publicly-disclosed VC funding for bitcoin firms up until 15 June 2015. The information is drawn from a database compiled by CoinDesk, the most trafficked news site that specializes in bitcoin and other digital currencies (Alexa,
The earliest known VC investment in a bitcoin firm is reported to have occurred in January 2013. The short timeline between this date and the present-day (30 months), as well as a relatively small number of data points (171 known rounds of VC funding are known to have occurred), would make a temporal analysis of VC investment in bitcoin firms not particularly worthwhile or insightful. Instead, this paper groups VC-backed bitcoin firms by their home country and calculates the total number of bitcoin firms and the total amount of VC funding received. Based upon a cursory examination of the results and clear regional disparities within the United States, the author decided to treat California’s Silicon Valley region (defined loosely, as will be explained) and New York City as separate entities from rest of the United States. The data are presented in Figure 5.1. In total, bitcoin firms are based in 23 countries spread across 6 continents. However, there are clear disparities within the geographic distribution of bitcoin firms and VC funding. As of June 2015, bitcoin firms headquartered in the United States have received 74.7% of all VC funding, totaling $591.31 million USD out of the global total of $791.28 million USD invested between 2013 and mid-2015. Although Africa and Australia host the headquarters of VC-backed firms, they each host only one relatively small firm (See Figure 5.1). Indeed, a total of 12 out of the 23 countries host only one VC-backed bitcoin firm, and only 4 of these have received more than $1 million USD in VC funding as of June 2015. Figures 5.2 and 5.3 present the geographical distribution of VC-backed bitcoin firms and VC funding.
<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Total Venture Capital Funding ($M USD)</th>
<th>Number of VC-Backed Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon Valley, USA</td>
<td>428.46</td>
<td>32</td>
</tr>
<tr>
<td>USA (excluding New York City and Silicon Valley)</td>
<td>120.48</td>
<td>17</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>42.88</td>
<td>5</td>
</tr>
<tr>
<td>New York City, USA</td>
<td>42.52</td>
<td>9</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>41.28</td>
<td>4</td>
</tr>
<tr>
<td>Sweden</td>
<td>39.85</td>
<td>3</td>
</tr>
<tr>
<td>China (Inc. Hong Kong)</td>
<td>28.05</td>
<td>7</td>
</tr>
<tr>
<td>Israel</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>South Korea</td>
<td>6.9</td>
<td>3</td>
</tr>
<tr>
<td>Canada</td>
<td>5.9</td>
<td>3</td>
</tr>
<tr>
<td>Argentina</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>France</td>
<td>3.75</td>
<td>2</td>
</tr>
<tr>
<td>Singapore</td>
<td>3.41</td>
<td>4</td>
</tr>
<tr>
<td>Japan</td>
<td>2.93</td>
<td>1</td>
</tr>
<tr>
<td>Barbados</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>Mexico</td>
<td>1.24</td>
<td>2</td>
</tr>
<tr>
<td>Kenya</td>
<td>1.1</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>0.94</td>
<td>1</td>
</tr>
<tr>
<td>Panama</td>
<td>0.78</td>
<td>1</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.53</td>
<td>1</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.34</td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>0.25</td>
<td>1</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>0.22</td>
<td>1</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>Australia</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$791.43 Million USD</strong></td>
<td><strong>106</strong></td>
</tr>
</tbody>
</table>

**Figure 5.1** Geographic distribution of venture capital investment in bitcoin firms. Ranking ordered by total funding in each country/region. Data current as of 16 June 2015. Figure by the author. Data from: [http://www.coindesk.com/bitcoin-venture-capital/](http://www.coindesk.com/bitcoin-venture-capital/)
Figure 5.2 Venture capital backed firms by country/region. This figure presents the number of bitcoin firms in each country or region. All countries with less than $1M USD in VC funding are grouped as “Other Countries”. Data current as of 16 June 2015. Figure by the author. Data from: http://www.coindesk.com/bitcoin-venture-capital/

Figure 5.3 Venture capital investment in bitcoin firms by country/region. This graph presents the distribution of venture capital to firms headquartered in the shown countries and regions. The United States, led by Silicon Valley, dominates. All countries with less than $1M USD in VC funding are grouped as “Other Countries”. Data current as of 16 June 2015. Figure by the author. Data from: http://www.coindesk.com/bitcoin-venture-capital/
A closer analysis of American VC-backed bitcoin firms reveals the dominance of Silicon Valley and the somewhat surprising relatively small role played by New York City. Silicon Valley – a geographical area with somewhat blurred boundaries, which for the sake of this analysis includes San Francisco (see Guzman & Stern, 2015) – hosts the headquarters of 32 VC-backed bitcoin firms (30% of the worldwide total) compared to New York’s nine (8%). Silicon Valley-based firms have received an outsized share of worldwide VC funding (54%), as compared to New York City’s disproportionately small share (5.4%). Beyond these two city-regions, no American metropolitan area hosts more than two VC-backed bitcoin firms. Notably, outside of the United States, no countries exceed New York City in terms of firm count and total venture funding.

Comparing the activities of VC-backed firms in New York City and Silicon Valley highlights a disparity in the diversity of their local VC-backed bitcoin firms. On the one hand, New York City-based bitcoin firms are all involved in the financial services and transaction subsectors of the ‘bitcoin economy’. On the other hand, firms based in Silicon Valley operate in every subsector. Figure 5.4 presents a subsector breakdown of VC-backed firms in both regions.

<table>
<thead>
<tr>
<th>Subsector</th>
<th>Silicon Valley</th>
<th>New York City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Services</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Payment Processor</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Exchange</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wallet</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Universal</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mining</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

**Figure 5.4** VC-backed Bitcoin firms in New York City and Silicon Valley by subsector. This table presents the subsector of the ‘bitcoin economy’ into which firms can be classified. It is clear that New York VC-backed bitcoin firms are concentrated in financial services, while firms
based in Silicon Valley are more diverse. Data current as of 16 June 2015. Figure by the author. Data from: http://www.coindesk.com/bitcoin-venture-capital/

Silicon Valley based firms also have the largest average amount of VC funding, at approximately $13.4 million USD. While this figure is arguably skewed by the two largest VC-backed bitcoin firms – 21 Inc. ($121 million) and Coinbase ($106 million USD), both of which are diversified ‘universal’ firms that are active in multiple subsectors - Silicon Valley hosts multiple firms above this average. Figure 5.5 presents the firms with the 15 largest amounts of VC funding. Firms based in San Francisco and Palo Alto occupy three of the top four, and nine of the top fifteen places.

<table>
<thead>
<tr>
<th>Firm</th>
<th>Subsector</th>
<th>Total VC Funding ($M USD)</th>
<th>Headquartered</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 Inc</td>
<td>Universal</td>
<td>121.05</td>
<td>San Francisco, USA</td>
</tr>
<tr>
<td>Coinbase</td>
<td>Universal</td>
<td>106.00</td>
<td>San Francisco, USA</td>
</tr>
<tr>
<td>Circle Internet</td>
<td>Universal</td>
<td>76.00</td>
<td>Boston, USA</td>
</tr>
<tr>
<td>Xapo</td>
<td>Wallet</td>
<td>40.00</td>
<td>Palo Alto, USA</td>
</tr>
<tr>
<td>BitFury</td>
<td>Mining</td>
<td>40.00</td>
<td>Amsterdam, NL</td>
</tr>
<tr>
<td>Ripple Labs</td>
<td>Financial services</td>
<td>37.00</td>
<td>San Francisco, USA</td>
</tr>
<tr>
<td>BitPay</td>
<td>Payment Processor</td>
<td>32.51</td>
<td>Atlanta, USA</td>
</tr>
<tr>
<td>Blockchain</td>
<td>Wallet</td>
<td>30.50</td>
<td>London, UK</td>
</tr>
<tr>
<td>KnCMiner</td>
<td>Mining</td>
<td>29.00</td>
<td>Stockholm, SWE</td>
</tr>
<tr>
<td>itBit</td>
<td>Exchange</td>
<td>28.25</td>
<td>New York, USA</td>
</tr>
<tr>
<td>Blockstream</td>
<td>Infrastructure</td>
<td>21.00</td>
<td>San Francisco, USA</td>
</tr>
<tr>
<td>Bitreserve</td>
<td>Wallet</td>
<td>14.60</td>
<td>San Francisco, USA</td>
</tr>
<tr>
<td>Bitnet</td>
<td>Payment Processor</td>
<td>14.50</td>
<td>San Francisco, USA</td>
</tr>
<tr>
<td>BitGo</td>
<td>Infrastructure</td>
<td>14.00</td>
<td>San Francisco, USA</td>
</tr>
<tr>
<td>Chain</td>
<td>Infrastructure</td>
<td>13.70</td>
<td>San Francisco, USA</td>
</tr>
</tbody>
</table>

Figure 5.5 The top 15 VC-raising bitcoin firms. Data current as of 16 June 2015. Figure by the author. Data from: http://www.coindesk.com/bitcoin-venture-capital/

5.4 Analysis

Venture capital figures obviously do not tell the whole story about bitcoin firms. Not all firms rely upon VC investors for funding. Other sources of funding exist, such as private equity. It is also important to note that not all economic activity relating to bitcoin intermediaries is
limited to bitcoin firms. A number of financial institutions have committed some of their resources projects relating to bitcoin, especially where block chain technology is involved. However, for the purpose of a preliminary investigation into the realm of the ‘bitcoin economy’, analyzing VC investment offers a satisfactory starting point for the reasons set out in section 5.1.

The salient (and arguably most significant) phenomena is the agglomeration of firms and VC funding in Silicon Valley. Given the obvious lack of clear agglomerations of VC-backed firms in other regions, the analysis in this section focuses almost exclusively on Silicon Valley. However, some consideration is given to global financial centres such London and New York City.

The concentration of VC funding and bitcoin firms in San Francisco appears to conform to the orthodox understanding of agglomeration/clustering developed by geographers and economists from the 1970s through the 1990s (e.g. Fujita et al., 2000; Amin & Thrift, 1994; Porter, 1990; Saxenian, 1994). Bitcoin firms located in Silicon Valley undoubtedly benefit from information spillovers, a highly skilled and fluid labour market in which entrepreneurship is an established practice, and a close proximity to successful venture capitalists already specializing in the technology-related ventures.

The Silicon Valley agglomeration also appears to conform to findings from recent analyses of financial firms and to the continuing importance of spatial proximity in the financial sector. Grote (2009) examined the impact of ‘virtualization’ – defined as the rise of information and communication technology – on the banking sector. Grote found that although agglomeration economies have been lessened in some regards, virtualization has clear limitations when it comes to matters involving complex information that requires constant interpretation. A related analysis but broader study of the financial sector found that face-to-face
contact is an important determinant of investment and competitiveness of startup firms, citing the development of trust between market actors as a critical underlying factor (Alessandrin et al., 2009).

The evidence concerning bitcoin firms appears to conform to a conjecture made by Leyshon and Thrift (1997). Discussing the future of financial centres, Leyshon and Thrift suggested that in a world of electronic finance defined by near instantaneous communications and novel technologies, social connectedness and geographical proximity will heighten in importance as the financial system is concurrently ‘disembedded’ from national regulatory spaces. Leyshon and Thrift have contended that global financial centres will remain key places of commercial activity in which face-to-face interaction helps market actors to develop mutual trust, exchange specialized knowledge, and finally to cement relationships formed “in the fragile and symbolic communities of electronic space” (p.306). In light of bitcoin’s complexity – both in terms of the expert knowledge involved in bitcoin firm activities and the difficulty that investors face in appraising novel enterprises related to bitcoin – it hardly seems surprising that firms would agglomerate in a region where ancillary firms are located. For instance, a bitcoin firm specializing in wallet technology (digital or physical) will no doubt benefit from interacting with a payment processing firm as the two are more complementary rather than competitive, and because the emergence of numerous strong firms could help to bring bitcoin into the mainstream by building an extensive ‘ecosystem’ in which consumers can utilize bitcoin. Where bitcoin diverges from Leyshon and Thrift’s conjecture is that San Francisco is not typically regarded as a global or even particularly international financial centre. Nor for that matter is Boston, which is home to the bitcoin firm with the 3rd largest VC funding total (see Figure 5.5). While San Francisco does have a large and diverse financial services sector – ranked 8th in the world as of March 2015 by the Global Financial Centres index (Y/Zen Group, 2015) – it would be facile to
suggest that Silicon Valley’s dominance in bitcoin firms stems solely from the strength of San Francisco’s financial centre. Therefore, whereas bitcoin firm VC funding conforms to Leyshon and Thrift’s vision of concentration, it defies their hypothesis about global financial centre dominance. However, it should be considered that Leyshon and Thrift concerned themselves with long term ascendance rather than innovation in the short term. That is to say that the technologies developed in Silicon Valley could come to be wielded by financial actors in global financial centres in the future.

Although Silicon Valley is currently the clear leader in VC funding for bitcoin firms, it is worth noting that both New York City and London also host some of the largest VC-backed bitcoin firms (see Figure 5.5). It is thus premature to suggest that Silicon Valley will remain the dominant centre of the ‘bitcoin economy’, especially as VC investment only dates back to January 2013. It remains to be seen whether evolving regulatory frameworks will nudge bitcoin firms away from California and towards the laissez-faire regulatory environments that typify global financial centres. Moreover, if bitcoin usage becomes mainstream in the future, it seems probable that global financial institutions, such as those based in New York and London, will step up their efforts to become bitcoin intermediaries due to potential profits as well as the fundamental threat to their current market positions.

This chapter’s discussion of bitcoin firms has illustrated how bitcoin firms are blurring the line between financial firms and technology firms. Although most bitcoin firms are involved in some aspect of bitcoin transactions, there are currently no bitcoin firms that are involved in the extension of loans for the creation of other financial products. For Clark (2005), the key difference between money and finance is that money is transformed into finance through a chain of commodification, pooling and channeling around the world through intermediaries based in financial centres. As bitcoin is both a (pseudo)-currency and a payment system, it is difficult to
prognosticate the future of bitcoin firms. The question that remains is whether bitcoin firms should be thought of as financial services companies or as technology companies. The answer to this question will undoubtedly have important regulatory and governance implications. Furthermore, it is unclear how the current benefits of agglomeration (economies of scale, knowledge spillovers, labour market pools) will be affected if and when the technologies being developed by bitcoin firms mature.

Unfortunately, the dynamics of Silicon Valley’s evidently exceptional cluster are not entirely clear at present. For instance, Silicon Valley’s dominance in VC-funding could to some extent be explained by the tendency of VC firms – of which the region has some of the most established in the high-technology sector – to disproportionately channel their funding towards firms located in close spatial proximity to themselves, a well-documented phenomenon within the VC industry (Martin et al., 2005; Florida & Smith, 1993). On the other hand, some studies have found that such ‘geographic bondage’ can be overcome through investment syndication (Fritsch & Schilder, 2012; Sorenson & Stuart, 2001). As such, VC investment into Silicon Valley-based firms could be driven by local flows, syndicated flows channeled local VC firms, or a combination of the two. Unfortunately, answering this question is beyond the scope of this paper, especially given the relatively limited dataset. That said, the case of Silicon Valley and bitcoin firms is no doubt a phenomenon worthy of further investigation. Nonetheless, this chapter has demonstrated that, like other aspects of bitcoin, intermediaries have a distinctive geography that favours agglomeration rather than decentralization and dispersion. It might therefore be said that while bitcoin has no central bank, there appears to be a centralizing tendency among its bank-like intermediaries in geographic space.

To conclude, it is evident that bitcoin firms exhibit strong geographical patterns. Perhaps not surprisingly, London and New York City are home to groups of firms (albeit small), which
specialize in financial services and currency exchange. Silicon Valley, meanwhile, hosts a large
group of bitcoin firms that are both well-funded and diverse in their operations. The spatial
agglomeration of bitcoin firms conforms to Martin’s (1999) argument that technological and
regulatory change would not decentralize money and finance. Martin observed that although
money, finance and markets are distributed across wide spaces, specialized financial institutions
are invariably much more spatially concentrated. As this section has illustrated, bitcoin firms are
highly specialized and exhibit clear spatial concentration. Where the case of bitcoin diverges
from Martin’s analysis is that bitcoin firms are not moving to ‘offshore’ jurisdictions where
regulatory scrutiny, disclosure requirements and taxes are lower (Pilkington, 2014). Instead,
bitcoin firms are firmly ‘onshore’. As has already been argued, this likely stems from efforts to
increase market participant trust of both bitcoin - an unfamiliar and strange currency – and a
whole new sector of unfamiliar firms, all within the context of potential fraud and regulatory
uncertainty.
Chapter 6
Conclusion: Tales from the Cryptocurrency

6.1 Bitcoin and Geography

The findings of this research can be summarized into three inter-related conclusions. First, bitcoin has clear geographies that are manifest in ‘real’ space. Although bitcoin lacks a material form, the economic processes of mining, procurement and investment all occur within geographic space. Furthermore, bitcoin’s geographies illustrate an attachment to place. Spatial agglomeration is a clear trend vis à vis these economic processes and financial centres are important loci of bitcoin financial activity. In this sense, bitcoin nicely adheres to Garretsen et al.’s (2009, P. 145) position that “Even with capital free to move within or between countries, the bulk of financial transactions is or remains spatially bounded and has a distinct geographical footprint”.

Secondly, although bitcoin obviates the need for financial intermediaries, such middlemen have already emerged as powerful market actors. The bitcoin mining sector
illustrates a tendency towards oligopoly, while the act of procuring bitcoin by almost all users is dependent on intermediaries such as ATMs and online exchanges. As has been discussed, intermediaries in both of these sectors are not randomly or evenly distributed across geographic space. Instead, mining has shifted to places where ‘production costs’ are the lowest, while much of the currency exchange and financial activity related to bitcoin is based in established global financial centres and in Silicon Valley.

Third and finally, bitcoin’s spatial character (especially agglomeration of large firms in ‘onshore’ jurisdictions) and the emergence of large market actors will likely make bitcoin easier to regulate than bitcoin enthusiasts often argue. Although bitcoin may have thousands or even millions of users, the consolidation of market power among a small group of firms makes it far easier for regulators and governments to regulate and intervene. One thing that bears remembering though, is that by no means do all users of bitcoin or bitcoin firms wish to escape regulation. As the movement towards regulated and audited bitcoin exchanges indicates, some see a role for government in supporting the growth of this libertarian-inspired currency.

While these three conclusions point to a set of geographies, it is important not to consider the observations offered by this paper to be final. The evolution of these geographies has taken place largely within the context of laissez-faire government approaches to bitcoin. As such, the impacts upon the geographies described heretofore by future government regulation and/or the widespread adoption of bitcoin are highly unpredictable.

6.2 Internet Geography

In several regards, the findings of this research conform to the findings of scholars within the subfield of Internet Geography. Broadly speaking, research from this subfield has found that the effects of the Internet on geography are often overstated and are sometimes
This research into bitcoin has found that its purported decentralization and spaceless-ness are both overstated, as bitcoin activity is spatially concentrated in several regards. In terms of bitcoin’s contradictory character, it might be said that while bitcoin enables rapid and fluid transfers of value across space, these are usually in turn dependent on place-based actors such bitcoin mines and exchanges that are often concentrated in specific places and always firmly situated in the realm of geographic space, not just the realm of cyberspace. As Internet geographer Mark Graham (2014, p. 99) remarks: “The Internet is not an amorphous, spaceless, and placeless cloud. It is characterized by distinct geographies. Internet users, servers, websites, scripts, and bits of information all exist somewhere”. Given the analysis presented heretofore, Graham’s observation describes bitcoin quite well.

Essentially, while bitcoin is highly fluid due to a combination of low transaction costs, high speed, and its bypassing of established regulatory barriers, place still matters. This is in both in the sense of firms’ relationships with investors and other firms, as well as public perceptions and trustworthiness of firms. As Internet geographers have found, face-to-face contact and familiarity remain highly important in public adoption of new technologies (Leamer & Storper, 2001). The findings concerning venture capital investment into bitcoin firms conform to Zook’s (2005) analysis of the Internet industry. Zook notes that for internet startups, proximity to investors with expertise in specialized fields (so called ‘smart money’) is a commonly deployed strategy. This would help to explain the dominance of Silicon Valley despite the region’s relatively inward-looking financial services sector.
6.3 Bitcoin as FinTech

Given both bitcoin’s problems in functioning as a currency and the rapid emergence of financial intermediaries, a rhetorical question emerges. Is bitcoin best conceptualized as a currency, or is it in effect a sort of financial technology? Bitcoin does not function particularly well as a currency (see Chapter 2) and simply procuring it is complicated and almost inevitably involves middlemen. Instead, bitcoin’s most advantageous characteristic is that it serves as an innovative payment system. While the bitcoin network functions as a closed system, due to systemic circulation issues within the bitcoin economy fuelled by hoarding and procurement issues, financial intermediaries have become a de facto aspect of the bitcoin economy. These intermediaries can be seen as augmenting bitcoin with further technology (e.g. hardware and software) that generally make the experience of using bitcoin far easier. Given bitcoin’s relatively slow adoption to date, it seems likely that it (or other digital currencies) will only come into widespread use when deployed under the aegis of trusted market institutions such as regulated commercial banks. The irony that bitcoin has become a buzzing area of FinTech activity and investment is rich. After all, a currency created and initially fostered by diehard libertarians seeking to obviate the need for middlemen and eschew regulation is now dominated by financial intermediaries. Moreover, although bitcoin was created as radical alternative currency, it appears that it is being increasingly subsumed by the finance industry. Indeed, some large global banks are looking to bitcoin – and especially its blockchain technology - as a way to update their antiquated systems of money transfers (The Economist, 9 May 2015). Conceptualizing bitcoin as a technology is especially helpful in contemplating its future. Technology is prone to innovation, but also obsolescence. Technologies may not succeed in a marketplace despite being the “best” in some regards, especially if they are not user friendly. In the absence of legal restrictions, technologies are prone to be experimented with by a range of
market actors: old and new, large and small. Finally, thinking about bitcoin as a technology reminds us that bitcoin does not enjoy the same privileges that other currencies do, as it lacks the backing of a state or even a large financial institution. Moreover, bitcoin lacks a legal or de facto monopoly of use, and should faith in it evaporate then there is nothing to prevent users from switching to other digital currencies or bank/credit-card online payment systems.

6.4 Concluding Remarks

This paper has endeavored to provide a geographical analysis, and in doing so to respond to assertions made by non-geographers about bitcoin’s geographical character. By taking a broad approach and considering theory relatively heavily, this paper has inevitably economized in some other areas. For example, this paper has not examined the geography of bitcoin transactions. Such an exercise is muddled by the lack of clear data due to bitcoin’s anonymous qualities, and as such might be better approached through an ethnographic lens or through the gathering of primary data from merchants. Nonetheless, this paper challenged the notion that bitcoin ‘lacks geography’ due to its decentralized network architecture and lack of a physical form. As has been shown here, digital currencies are indeed geographical and should be of interest to geographers concerned with the geographies of money and finance, innovation, law, and the Internet. As a final note, the findings of this paper should not be taken as a repudiation of the non-geographic scholarly work on the subject of bitcoin. Rather, the author hopes to complement the insightful research into bitcoin emanating from these other fields with a geographical perspective.
References


Barty, Andrew (2014) *Bitcoins: The Currency of the Future*


Scott, B. (2015) ‘A Dark Knight is better than no Knight at all’, *Kings Review*. Web article. Accessed 9 June 2015. Available at: [http://kingsreview.co.uk/magazine/blog/2015/03/24/a-dark-knight-is-better-than-no-knight-at-all/](http://kingsreview.co.uk/magazine/blog/2015/03/24/a-dark-knight-is-better-than-no-knight-at-all/)


