Price discovery on Bitcoin exchanges

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A R T I C L E   I N F O

A B S T R A C T

Bitcoin is an open source peer-to-peer electronic money and payment system. It is traded at several exchanges and high-frequency trade data are publicly available. We study the contributions of Bitcoin exchanges to price discovery. Our results show that Mt.Gox and BTC-e are the market leaders with the highest information share. Our analysis further suggests that information share is dynamic and evolves significantly over time.

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1. Introduction

Bitcoin is a decentralized peer-to-peer crypto-currency protocol first outlined in a paper by Nakamoto (2008). Since first going online in 2009, Bitcoin has grown from an experimental commodity traded between enthusiasts, to a booming economy receiving substantial media attention. The Bitcoin user base is becoming increasingly global and diversified, and so is the currency exchanges. The market capitalization of Bitcoin reached USD 10 billion recently, and the transaction volume keeps growing. Bitcoin is traded on a myriad of exchanges that support different currencies and are based in countries all over the globe. The days when a single exchange completely dominated the market are gone, and the question of where the value of Bitcoin is decided emerges. We attempt answering this question.

An introduction to the key concepts of Bitcoin can be found in Becker et al. (2013), Segendorf (2014), Dwyer (2014) or Bitcoin (2015). Discussion of Bitcoin in the context of other alternative monetary systems can be found in Rogojanu and Badea (2014) and Shubik (2014). We therefore introduce Bitcoin only briefly. Unlike fiat currencies, the total amount of Bitcoins which were or will ever created is capped. Bitcoins are created in a process called mining. The economics of Bitcoin mining is analyzed in Kroll et al. (2013). Another specific feature of Bitcoin is that instead of trusting that the central bank is guaranteeing the value of your money, as is common for fiat currencies, you trust that the cryptographic proofs provided by the network is correct. In most western countries lack of trust in the central bank has not traditionally been a problem, but with the recent euro crisis and ongoing financial uncertainty around the world, this started to change. After the Cypriotic bank crisis for instance, Bitcoin gained a lot of publicity and surged in value, see Cox (2013). Because of the decentralized structure, no central authority has direct control over the Bitcoin exchange rate. However, regulatory issues still influence the exchange rate between Bitcoin and other currencies. One example is the process of withdrawing and depositing – the easier and cheaper this process is at a particular exchange, the more users it gains and the price at this exchange changes accordingly. This can lead to different prices at different exchanges, an effect we will discuss later.

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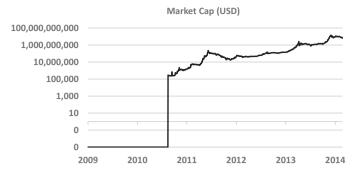
Market Cap (USD)

Fig. 1. Historic market capitalization in USD on logarithmic scale.

The less developed countries with lack of trust in the central bank or government should possibly gain the most by using Bitcoin. However, they do not adopt Bitcoin as fast as more developed countries, see Pekas (2013). One reason for this might be that technological and informational barrier such as lack of IT infrastructure, hinder adoption. However, the success of M-Pesa in Kenya, cf. Hughes and Lonie (2007), suggests that this difficulty can be overcome and we might expect the first widespread adoption of Bitcoin in these countries.

Economic research investigating the phenomenon of Bitcoin has emerged recently with a slight lag to the introduction of Bitcoin itself. Halaburda and Gandal (2014) find that including Bitcoin into a diversified portfolio significantly increases risk-adjusted returns, due to both high average returns and low correlation with other assets. Yermack (2013) concludes that Bitcoin appears to behave more like a speculative investment than a currency, because the value of the currency is very high relatively to the transactions it facilitates. Bouoiyour and Selmi (2014) assess the lead-lag relationship between Bitcoin prices and transactions as well as the relationship between Bitcoin prices and investors' attractiveness and reach the same conclusion. This conclusion is also confirmed by Bouoiyour et al. (2014). Similarly, Ali et al. (2014) conclude that Bitcoin and other cryptocurrencies serve as money only to a limited extent and only for relatively few people, and therefore do not pose a material risk to monetary or financial stability in the United Kingdom. Briere et al. (2013) study the relationship between Bitcoin and other cryptocurrencies and find that during periods when Bitcoin appreciates against USD it also appreciates against other cryptocurrencies.

One of the features of the Bitcoin is that it is traded in many exchanges. Even though the Bitcoin itself is very different from fiat currencies, Bitcoin exchanges are essentially standard privately owned exchanges. However, the only study that briefly address this point is Briere et al. (2013), who note that Bitcoin price vary on different exchanges. The aim of our paper is to investigate this multi-exchange environment further and particularly to study the price discovery at Bitcoin exchanges. Knowing which exchange reacts most quickly to new information and therefore reflects value of Bitcoin most precisely is obviously important. Not surprisingly, this topic has received a lot of attention both among popular media and the Bitcoin community. However, to the best of our knowledge this is the first study of this topic.

The price discovery literature uses primarily two methodologies, the information share method by Hasbrouck (1995) and the permanent-transitory decomposition by Gonzalo and Granger (1995). In this paper we use the method of de Jong et al. (2001). The advantage of this method is that the information share calculated this way is uniquely defined, unlike information share of Hasbrouck (1995), but still takes into account the variance of innovations, unlike Gonzalo and Granger (1995).

The remainder of this paper is organized as follows. Section 2 briefly explains some historic events and characteristics of the Bitcoin exchange market. Section 3 describes the data used and the characteristics of the data. Section 4 describes the model, while Section 5 describes the implementation of this model to Bitcoin data. The results are presented in Section 6. Finally Section 7 draws a conclusion.

2. History

Bitcoin started to exist in January 2009. During its first year in existence it was traded solely privately, as illustrated in Fig. 1. In 2010, the first currency exchanges emerged, with Mt.Gox claiming the position of market leader. Throughout 2010, 2011 and 2012, Mt.Gox kept its position, holding a market share of more than 80%. During the same period most public Bitcoin trading was done in USD.

The Bitcoin has experienced four periods of major price increase within a short time span. As seen in Fig. 2, the price of Bitcoin (on Mt.Gox) reached parity with the US Dollar February 2011, after a surge from USD 0.1 during the latter months of 2010 and January 2011. During the spring of 2011 Bitcoin experienced another surge from $1 to $10 per Bitcoin. The price did not see another boom of this magnitude until the first quarter of 2013, where a similar 10-times surge from $10 to $100 happened. During October and November of 2013, Bitcoin jumped 10-times yet again, roughly from $100 to $1000. The price then hoovered around this milestone until February of 2014, when a series of events led to a dramatic price fall culminating in Mt.Gox declaring bankruptcy at the end of this month.