

Is Bitcoin a Real Currency?

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Abstract: Motivated by Bitcoin's rapid appreciation in recent weeks, I examine its historical trading behavior to see whether it behaves like a traditional sovereign currency. Bitcoin has exchange rate volatility an order of magnitude higher than the volatilities of widely used currencies, undermining Bitcoin's usefulness as a unit of account or a store of value. Bitcoin's daily exchange rates exhibit virtually zero correlation with bona fide currencies, making Bitcoin useless for risk management purposes and exceedingly difficult for its owners to hedge. Bitcoin also lacks access to a banking system with deposit insurance, and it is not used to denominate consumer credit or loan contracts. Bitcoin appears to behave more like a speculative investment than like a currency.

Late 2013 became an auspicious time for Bitcoin, a "virtual currency" launched five years earlier by computer hobbyists. During the month of November 2013, the U.S. Dollar exchange rate for one Bitcoin rose more than fivefold, and the value of one Bitcoin, which had begun trading at less than five cents in 2010, exceeded \$1,200.00. Two days of hearings were held by the U.S. Senate Committee on Homeland Security and Governmental Affairs, at which government regulators testified that virtual, stateless currencies like Bitcoin had the potential to

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play useful roles in the commercial payment system. Stories appeared in the media about travelers subsisting for lengthy periods by spending only Bitcoin, and various businesses – including Richard Branson’s Virgin Galactic space travel startup – attracted publicity by agreeing to accept Bitcoin as payment. With approximately 12 million Bitcoins circulating, the worldwide value of the currency exceeded \$14 billion, equal to the market capitalization of a mid-range S&P500 company. Figure 1 shows the daily closing Dollar-Bitcoin exchange rate on the Mt. Gox exchange, with the data plotted on a log scale necessitated by the meteoric rise in Bitcoin’s value.

In this research note, I argue that Bitcoin does not behave like a currency at all. Instead it resembles a speculative investment similar to the Internet stocks of the late 1990s.

Money is typically defined by economists as having three characteristics: it functions as a medium of exchange, a unit of account, and a store of value. Bitcoin increasingly satisfies the first of these three criteria, because a growing number of merchants, especially in online markets, appear willing to accept it as a form of payment. However, I argue in the sections below that Bitcoin performs poorly as a unit of account and as a store of value. The currency exhibits very high time series volatility, which tends to undermine any useful role for Bitcoin as a unit of account. A currency should have only negligible volatility in order to be a reliable store of value. Bitcoin’s daily exchange rate with the U.S. Dollar has virtually zero correlation with the Dollar’s exchange rates against other prominent currencies such as the Euro, Yen, Swiss Franc, or British Pound. Therefore Bitcoin’s value is almost completely untethered to that of other currencies, which makes its risk nearly impossible to hedge for businesses and customers and renders it more or less useless as a tool for risk management.

Bitcoin lacks additional characteristics that are usually associated with currencies in modern economies. Bitcoin cannot be deposited in a bank, and instead it must be possessed through a system of “digital wallets” that have proved vulnerable to hackers. No form of insurance has been developed for owners of Bitcoin comparable to the deposit insurance relied on consumers in most economies. No lenders use Bitcoin as the unit of account for standard consumer finance credit, auto loans, and mortgages, and no credit or debit cards have been denominated in Bitcoin. Bitcoin cannot be sold short, and financial derivatives such as forward contracts and swaps that are routine for other currencies do not exist for Bitcoin. The absence of these types of contracts seems to be the most straightforward explanation for the astronomical rise in Bitcoin’s value in November 2013. Since currency investors have no easy way to bet against Bitcoin’s appreciation, skeptics can only watch as optimists trade the currency among themselves at ever-rising prices.

History and background of Bitcoin

Until the 20th century, most of the world’s successful currencies were convertible into fixed amounts of gold or other precious metals. This promise of convertibility, secured by sovereign inventories of gold such as the Fort Knox depository in the U.S., created public confidence in a currency’s value. The gold standard collapsed in most economies between the 1920s and 1970s, partly due to the pressures of financing two World Wars, but also because worldwide production of gold did not keep pace with economic growth. Since then, nearly every major economy has issued paper fiat currency, the value of which relies on public belief that a nation’s government or central bank will not increase the supply of new notes too rapidly.

Multinational consortia have issued fiat currency like the Euro on similar terms. Fiat currencies have circulated for thousands of years, and sooner or later nearly all of them have been inflated down to worthlessness by governments confronted by strained public finances. Bitcoin attempts to overcome the weaknesses of gold-based and fiat currencies, presenting itself as an “algorithmic currency” with a deterministic supply and growth rate that are tied to the rigor of mathematics. No government or other central authority can manipulate the supply of Bitcoin. Instead the currency is governed by cryptographic rules that are enforced by transparent computer code in a decentralized manner.

Bitcoin originated using a scheme outlined in Nakamoto (2008), a nine page proposal for a “peer-to-peer electronic cash system.” The author or authors of this document have not been identified, but their system was designed in a way that gave them no royalties or residual property rights to benefit from Bitcoin’s adoption. According to the algorithms proposed by “Nakamoto,” new Bitcoins are created and awarded to computer users who solve pre-specified mathematical problems. A transparent, decentralized registry tracks the ownership and subsequent transfers of every Bitcoin after it is “mined” by its initial owners. The algorithm limits the rate at which new Bitcoins can be created, and it fixes an ultimate limit of 21 million Bitcoins that will be reached in the year 2140. All of these quantities and growth rates are known with certainty by the public, so Bitcoin’s circulation cannot be affected by monetary policy in the way that the Federal Reserve controls the public supply of U.S. Dollars.

Wallace (2011) reviews the early history of Bitcoin and states that “Nakamoto” introduced the first 50 Bitcoins into circulation in 2009, essentially to demonstrate the mining method to online enthusiasts who were attracted to the concept of an algorithmic currency.

Bitcoin's circulation at first took place among online volunteers and enthusiasts, and interest grew to the point that Bitcoin began to trade on a Japanese-based online exchange, Mt. Gox, in July 2010. On the first day of trading, 20 Bitcoins changed hands at a price of 4.951 cents, for total volume of slightly less than one U.S. Dollar.

The first purchase of goods and services using Bitcoin is said by Wells (2011) and other sources to have been a pizza procured at a cost of 10,000 Bitcoin in 2009. The pizza parlor did not accept Bitcoin directly, and instead a third-party broker was enlisted who agree to procure the pizza using a credit card (based on a real currency) and accept Bitcoin as consideration. Much of the commerce involving Bitcoin continues to take place using middlemen who facilitate immediate exchanges of Bitcoin into more widely used currencies.

The Silk Road marketplace, an Internet portal for the sale of illegal narcotics which accepted only Bitcoin for payment, was sometimes reported to account for as much as half of the early Bitcoin transaction volume. This association helped give Bitcoin an early reputation for lawlessness. The cachet as an outlaw currency may not have harmed the appeal of Bitcoin at all, and its usage spread into the bricks-and-mortar economy. Silk Road was shuttered by U.S. authorities after they arrested its operator in San Francisco in October 2013, but the event generated publicity for Bitcoin and seemed to have little impact on Bitcoin's value or trading volume. Later that month, the first Bitcoin ATM was installed in a Vancouver coffee shop.

Trading of Bitcoin grew rapidly on the Mt. Gox exchange, and Figure 2 shows the daily volume in U.S. Dollars, calculated by multiplying each day's midnight exchange rate by the unit volume over the prior 24 hours. Other online exchanges have opened to trade Bitcoin and additional virtual currencies that sprang up as rivals. These exchanges generally operate around-

the-clock. Some have proved vulnerable to hackers; Mt. Gox in April 2013 reported three denial of service attacks that sharply reduced trading volume on various dates, though in each case the exchange appeared to recover in a matter of hours. A number of investment funds have opened to cater to Bitcoin speculators, including one registered with the Securities and Exchange Commission in July 2013 by the Winklevoss twins, who became famous in the world of online commerce due to their legal battles over the ownership of Facebook.

Bitcoin appeals to two distinct clienteles. One group consists of technology enthusiasts who embrace Bitcoin for purposes of online commerce. As more and more routine business transactions migrate online, these users believe Bitcoin's value should increase due to transaction demand. A separate group finds Bitcoin attractive due its lack of connection to any sovereign government. Bitcoin's introduction in 2008-09 coincided with the very bottom of the global financial crisis, and Bitcoin has found adherents among persons who lack confidence in the world financial system or have strong Libertarian beliefs. The daily transaction flow of Bitcoin trades suggests that the large majority of worldwide demand originates in two countries, the U.S. and China.

The benign attitude of U.S. regulators toward Bitcoin, as revealed in the November 2013 Senate hearings, may stem from the existence of a universal online audit trail for Bitcoin transactions. Although many services exist on the Internet that purport to cloak Bitcoin transfers in anonymity, confidence in the security of these protocols appears to be naive. The arrest of Silk Road's operator in October 2013, which took place amid widespread publicity of online data monitoring by the U.S. National Security Agency, disabused many about the possibility of keeping any information anonymous on the Internet. Tax evasion, money laundering, purchases

of contraband, and other illicit activities using online transfers become far more difficult when the use of a virtual currency like Bitcoin can be reconstructed by governments that have sufficient technical skills.

Bitcoin's weaknesses as a currency

This section presents analysis of ways in which Bitcoin fails to conform to the classical properties of a currency. A successful currency typically functions as a medium of exchange, a unit of account, and a store of value. While it is difficult to benchmark the size of the merchant network that accepts Bitcoin, copious evidence suggests that Bitcoin has made significant inroads as a medium of exchange. However, Bitcoin does not seem to have established itself as a unit of account or a store of value. Bitcoin imposes large risks on its owners, because it has excessive volatility and fails to exhibit correlation with the behavior of other currencies.

Figure 3 shows the year-to-date volatility of the Bitcoin-Dollar exchange rate, calculated using daily data from January 1 - November 29, 2013. For comparison purposes the graph shows the volatilities of the exchange rates of the Euro, Yen, British Pound, and Swiss Franc as well as the London price of gold, with all volatilities annualized. Bitcoin's exchange rate volatility since the start of 2013 has been 133%, an order of magnitude higher than the exchange rate volatilities of the other currencies, which fall between 8% and 12%. Gold, which is a plausible alternative to these currencies as a store of value, has had volatility of 22% since the start of 2013. For comparison purposes, most widely traded stocks have volatilities in the range of 20% to 30%, and even very risky stocks rarely exhibit volatility as high as 100%. From Figure 3, one must conclude that holding Bitcoin even for a short period is quite risky, which is

inconsistent with a currency acting as a store of value and which greatly undermines the ability of a currency to function as a unit of account.

I study the movement of Bitcoin compared to the other currencies and to gold in the correlation matrix shown in Table 1. The table is based on the daily changes in the London gold price and each currency's exchange rate against the U.S. dollar, using daily data from July 2010 (the inception of trading on the Mt. Gox exchange) up to the present. As shown in the table, the three European currencies tend to exhibit strong positive correlation, with the Euro having 0.60 correlation with the Swiss Franc and 0.65 correlation with the British Pound, and the Pound and Franc having 0.42 correlation. The Yen's exchange rate is also positively correlated with those of the other currencies, albeit at a somewhat reduced level. The same is true of the price of gold. In contrast, the Bitcoin-Dollar exchange rate exhibits almost zero correlation with the exchange rates of any of the four currencies or with the price of gold.

Bitcoin's complete separation from other prominent international currencies and from gold seems telling. Macroeconomic events that cause similar impacts on the value of various currencies do not seem to affect Bitcoin either positively or negatively. The data imply that Bitcoin is completely ineffective as a tool of risk management, which is a common use for currencies, and conversely, that it is very difficult to hedge any risks that might affect Bitcoin itself. I examined the trading histories of all U.S. stocks in 2011-12 to see whether Bitcoin could be hedged by selling short individual equities. Using monthly returns from the 2011-12 time period, I found that Bitcoin was most closely correlated with Vitamin Shoppe, a retail growth stock with a market capitalization of just under \$2 billion (Vitamin Shoppe does not appear to accept Bitcoin for transactions on its website). Therefore, to best limit exposure to Bitcoin, one

would have succeeded up to now by selling short the shares Vitamin Shoppe.

Obstacles faced by Bitcoin

For Bitcoin to become more than a curiosity and establish itself as a bona fide currency, its daily value will need to become more stable so that it can reliably serve as a store of value and as a unit of account in commercial markets. The excessive volatility shown in Figure 3 is more consistent with the behavior of a speculative investment than a currency.

Moreover, Bitcoin's legitimacy as a currency should also hinge on its integration into the web of international payments and risk management transactions. Even though it is not issued by a sovereign state, Bitcoin imparts risk to any business that accepts it for transactions, just like any other currency. All major companies that deal in more than one currency, such as multinationals, attempt to hedge themselves against risks related to changes in those currencies' values. Data shown in Table 1 suggest that no effective way exists to hedge Bitcoin against the value of other currencies, and the absence of any swap, forward, or other derivative markets for Bitcoin exacerbates this problem.

Bitcoin appears to suffer by being disconnected from the banking and payment systems of the U.S. and other countries. Most currencies are held and transferred through bank accounts, which in turn are protected by layers of regulation, deposit insurance, and international treaties. Without access to this infrastructure, Bitcoin would seem vulnerable to fraud, theft, and subversion by skilled computer hackers. However, adherents of Bitcoin may argue that Bitcoin bypasses the well-known flaws in standard financial security systems, which have spawned epidemics of identity theft and related problems for ordinary customers of mainstream

businesses.

Finally, Bitcoin faces a structural economic problem related to the absolute limit of 21 million units that can ever be issued, with no expansion possible of the Bitcoin supply possible after the year 2140. If Bitcoin becomes wildly successful and displaces sovereign fiat currencies, it would exert a deflationary force on the economy since the money supply would not increase in concert with economic growth. This situation would require most workers to accept pay cuts every year, for instance, likely leading to political protests against the currency similar to those experienced in the U.S. during the Populist movement at the end of the 19th century. One can imagine a revival of William Jennings Bryan's 1896 "cross of gold" speech in the next century, updated with futuristic rhetoric about the economic tyranny of an uber-currency with an inflexible supply.

References

Nakamoto, Satoshi, 2008, "Bitcoin: A Peer-to-Peer Electronic Cash System," unpublished manuscript, retrieved at <http://pdos.csail.mit.edu/6.824/papers/bitcoin.pdf>.

Wallace, Benjamin, 2011, "The Rise and Fall of Bitcoin," *Wired*, November 23.

Data sources

<http://bitcoincharts.com/charts/mtgoxUSD> (Bitcoin).

<http://oanda.com/currency/historical-rates/> (currencies)

<https://research.stlouisfed.org/fred2/> (gold)

Figure 1

Value of one Bitcoin in U.S. Dollars

The figure shows the value of the Bitcoin-Dollar exchange rate, recorded daily at midnight on the Mt. Gox Exchange in Japan from July 17, 2010, to November 29, 2013.

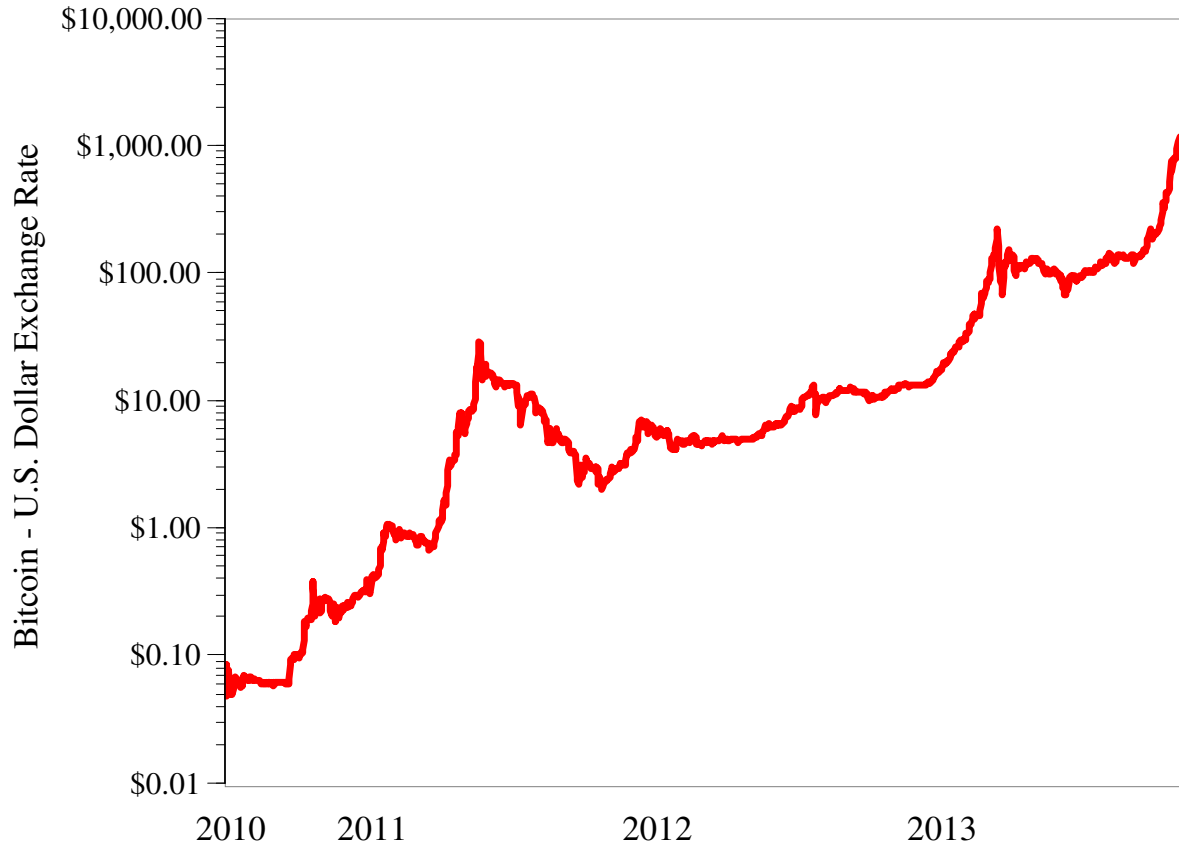


Figure 2

Daily Bitcoin trading volume on the Mt. Gox Exchange

The figure shows the daily volume of Bitcoin trading on the Mt. Gox Exchange from July 17, 2010, up to November 29, 2013. Volume is calculated by multiplying the midnight price by the number of units traded each day.

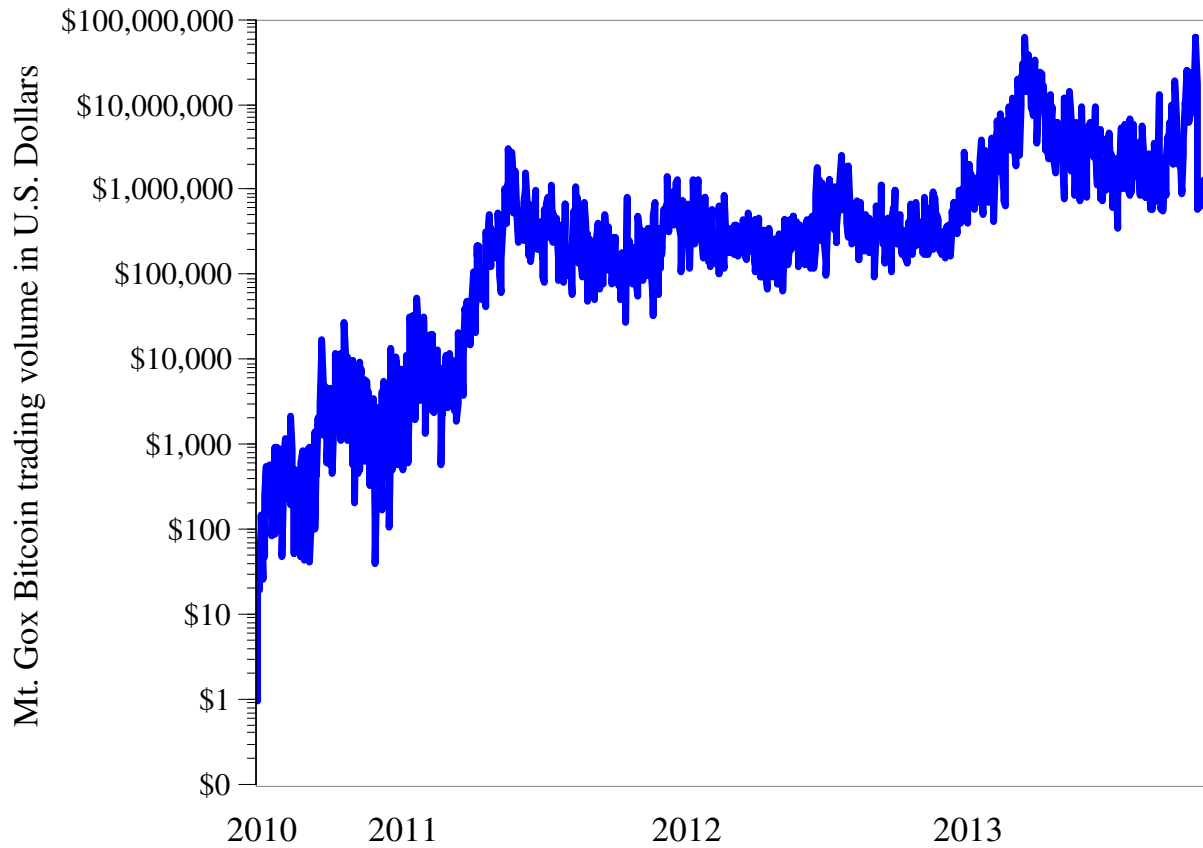


Figure 3
Volatility of Bitcoin compared to major currencies

The figure shows the annualized volatility of the percentage change in daily exchange rates for four major currencies, gold, and Bitcoin, all measured against the U.S. dollar. Volatilities are calculated for the period January 1, 2013 up to November 29, 2013.

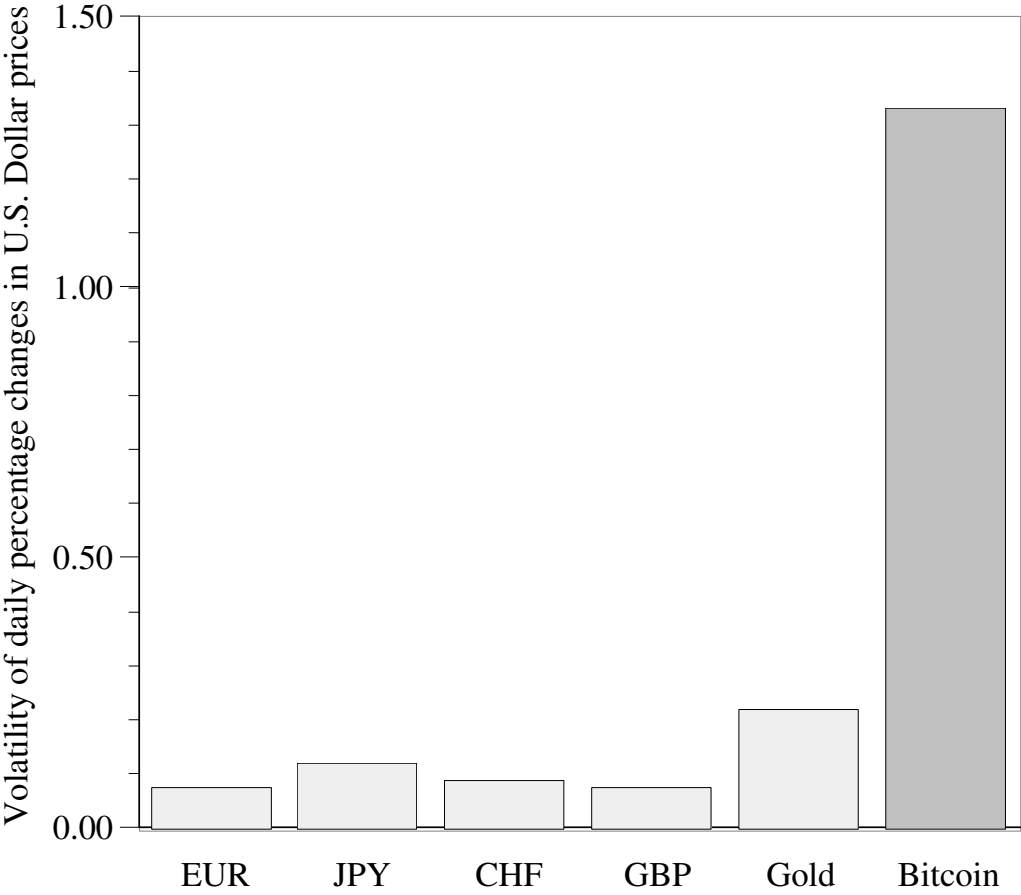


Table 1**Correlation matrix of daily changes in exchange rates, Bitcoin, and gold**

The table shows simple correlations of the percentage changes in daily exchange rates for pairs of currencies, with all exchange rates measured against the U.S. Dollar. In addition, the table shows correlations between each currency and the percentage change in the daily London gold price as measured in U.S. Dollars at 3 p.m. Correlations are calculated for the period from July 19, 2010 up to November 29, 2013.

| | EUR | JPY | CHF | GBP | Gold | Bitcoin |
|---------|------|------|------|------|------|---------|
| EUR | 1.00 | 0.19 | 0.60 | 0.65 | 0.21 | 0.05 |
| JPY | | 1.00 | 0.33 | 0.21 | 0.08 | -0.02 |
| CHF | | | 1.00 | 0.42 | 0.20 | 0.04 |
| GBP | | | | 1.00 | 0.21 | 0.02 |
| Gold | | | | | 1.00 | 0.06 |
| Bitcoin | | | | | | 1.00 |