Technical Analysis in the Virtual World

Philip Daniel

12/7/2011
Technical Analysis is not a new subject by any measure. With its roots stretching back to feudal Japan, much has been done in this field of financial analysis. However, the development of information technologies has changed the world of investment. Technical analysis indicators are now easily calculated and broadly available. Technology has also changed our traditional understanding of value. We now see value and its representative financial markets being virtualized like never before. This paper aspires to test the methods of Technical Analysis in a market for a virtual good.

Technical analysis (TA) is a branch of financial forecasting that uses mathematical and statistical methods in an attempt to predict future price action. The roots of TA reach back to a rice trader in feudal Japan, Sokyo Honma. Honma noticed patterns in the rice market that seemed to repeat themselves. These trading rules became known as, "Honma's rules" and was the first historical record of TA being used. Using these rules Honma became very wealthy, rose to the rank of Samurai, and died at the age of 87; not bad for a rice trader. With the aid of computers TA has grown much from these humble beginnings of simple trade rules. Using statistics, many indexes have been developed to aid traders in hopefully beating the market.

The market where we will be testing TA is the bitcoin market. Bitcoin is a decentralized, digital currency meant to be used like a typical government backed fiat currency. Without any formal backing bitcoin's price has been riding a speculative rollercoaster over the last year. With bitcoin not being representative of another asset, the resulting market is a perfect place to test TA's effectiveness in the virtual world.

---

Bitcoin

"Have you ever encountered something that is so cleverly designed, so profoundly unique, and such a polarizing concept, that when people first hear about it, they either dismiss it as something that could never work, or instantly grasp its immense potential? Bitcoin will trigger one of these reactions in you."

-mrb at blog.zorinaq.com

Bitcoin (BTC) is a digital, peer-to-peer, fiat currency. Breaking that down we understand that bitcoin is an electronic currency, has no central issuing authority and is not backed by any commodity.

Electronic currencies are not new. Flooz was one such currency. The currency and company went bottom up with the internet bubble, but since then numerous electronic currencies have been created; Facebook points, WoW Gold, Eve Isk, Xbox Live points, all of which can be purchased with US dollars and exchanged for goods and services inside of their respective environments. Bitcoin is different from these electronic currencies in a very key way: Bitcoin is not limited to a specific application. Generally electronic currencies are only usable within their respective highly controlled game environment or application, where the issuer is in complete control of the goods and services available. Bitcoin has no such limitations or restrictions. Bitcoin is meant to be used as a real currency like the dollar or the euro.

Fiat currencies are far from new as well. Any major currency is currently not backed by anything that is perceived to have intrinsic value, such as precious metals. In a fiat currency system we have users of the currency collectively agreeing that the currency has value. We can sleep soundly at night knowing that we can purchase goods and services with our dollars tomorrow. That security gives a fiat currency value. Bitcoin functions in the same way. The coins are not redeemable for anything and they only have value because the users believe they do.

---

What is new is the peer-to-peer nature of bitcoin. Bitcoin has no central authority to issue new coins and there are no clearing house or trusted single 3rd parties to verify transactions. Instead, in the bitcoin network, transactions are grouped together into blocks. These blocks are then approved by bitcoin miners. Miners use their computers to perform trial and error math calculations to approve each block. The first miner to approve the block shouts out to the network and is rewarded with 50 newly generated bitcoins. This reward/money supply rate will be halved every 210,000 blocks. The first decline from 50 coins to 25 coins per block is expected near the end of 2012, the next halving is expected to take place during 2017. The result is a money supply following a geometric series, ultimately approaching a maximum of 21 million bitcoins. This geometric series was coded into the bitcoin software by bitcoin’s creator, Satoshi Nakamoto, and cannot be changed except through a change in the entire network’s software.

There is also a difficulty mechanic built into this transaction verification system that is constantly adjusted to make approving blocks harder or easier. The difficulty function keeps the rate at which blocks are approved at about 6 blocks per hour. Since bitcoins have value, this system bundles network
security and the money supply into a powerful incentive system. Meanwhile the difficulty function keeps the money supply close to the predictable curve of the geometric series regardless of how much computer power is used to verify transactions.

Another very attractive feature of bitcoin is the anonymity it provides. Bitcoins are sent using bitcoin addresses and these addresses contain no information about the owner of the address. When sending coins from one person to the other you send coins to an address they provide, and your computer informs the rest of the network. From the outside transactions look like this:

1QLaNtkYtZKRvf15S9vA72jVEX2ewxZUee sends 10 BTC to 1QLaNtkYtZKRvf15S9vA72jVEX2ewxZUee

From the outside this transaction is anonymous, unless users have broadcasted that those addresses belong to them. The network is just aware of coins changing ownership, but not who the coins belong to. Users can also generate as many bitcoin addresses as they desire and can "launder" their money themselves by moving coins between their own addresses.

The intention of bitcoin's creator is uncertain as far as these anonymity features are concerned. When bitcoin was launched, the genesis block was created by Satoshi and included a brief message, "The Times 03/Jan/2009 Chancellor on brink of second bailout for banks". This comment is referencing a Times print headline on that date. This comment serves a dual purpose. It not only provides proof of the genesis block being created on or after January, 3rd 2009 but potentially is also a hint into Satoshi’s views on the modern banking system.

Regardless of the intentions of Satoshi, these features open bitcoin up to numerous illegal uses. Never before has it been possible to send money over the internet without any form of oversight. With bitcoin

---

it is now possible. With an almost untraceable payment system aided by an anonymous routing protocol called 'Tor', a website was created called, "The Silk Road". The Silk Road is a market that connects buyers and sellers of illegal goods, in particular, drugs\(^5\). Drugs can be purchased on the Silk Road using bitcoins and then are vacuumed packed and mailed to the purchaser. The Silk Road created such a stir that Senators Charles Schumer and Joe Manchin wrote a letter to the Attorney General requesting the Silk Road be shutdown\(^6\). While the Silk Road is still small, it shows what kinds of transactions bitcoin enables. Money can now be sent, in any sum, digitally and untraceably to anyone with an internet connection. If the bitcoin economy grows in size this could have major implications on the international black market and current enforcement methods.

The self laundering feature of bitcoin empowers fraudsters. Since your bitcoin wallet is a digital file tied to your computer there is demand for mobile wallet features to enable the spending of your bitcoins from anywhere. These setups were similar to Paypal; you would send your bitcoins to the service and then could login and tell the service where to send bitcoins to pay for goods. However in a system where bitcoins are easily laundered and there is no oversight, a poor incentive structure is established. The only thing keeping the service honest is the prospect of future profits from their service and their goodwill towards their customers. On August 4th 2011, MyBitcoin announced that they had been hacked and lost $250,000 worth of bitcoins\(^7\). On the subsequent days Mtgox, the primary bitcoin exchange, approximately $250k worth of bitcoins were unloaded. Shortly afterwards Gavin Andreson was seen accusing Tom Williams, the operator of MyBitcoins, of stealing the coins himself\(^8\). The bitcoin


\(^8\) Witnessed this on #bitcoin-police on Freenode IRC chat myself.
community is split on whether or not the hack was legitimate or a fraud attempt by the MyBitcoin operators. Unfortunately, due to the design of bitcoin we may never know for sure. Bitcoin's features create many options for fraud and as such users need to be very careful about whom they trust.

Bitcoin has other implications besides the mail order drug trade and fraud; Bitcoin enables international micropayments. The bitcoin network knows no international boundaries and charges only very tiny flat fees for transactions. This is in comparison to wire transfer fees and paypal fees. This allows for nearly painless payments for goods and services on international markets, even in small amounts. While this is potentially a small impact, it creates more tiny links between many international economies and should be noted.

In summary, these features of bitcoin make it a very unique currency whose use is restricted to the internet and whose value is highly speculative. With no government backing, spotty merchant acceptance, questionable uses, and the potential of fraud, bitcoin stands out as a unique data set for testing TA.

**Literature Review**

Bitcoin was launched in January 2009 by Satoshi Nakamoto after he released a white paper titled, "Bitcoin: A Peer-to-Peer Electronic Cash System," outlining how the system would work. Satoshi's main goal is to create a system that solves the problem of double-spending and chargebacks that are possible in electronic payment systems without the use of a trusted third party. In a virtual system it is hard to verify that money is not being duplicated. To get around this problem we have oversight and trusted third parties, such as paypal, that ensure that digital dollars are not be duplicated. In Bitcoin

---


transactions are verified by the whole network through mathematical calculations, rather than a central authority. Satoshi believes the chargeback feature is a double edged sword. One side is, they allow for victims to file claims and reverse fraudulent transactions. The other side is, while some transactions may be fraudulent, some claims may be fraudulent as well. The risk of fraudulent requests for transaction reversals lowers the trust in the electronic payment system. As a merchant offering a non-reversible service, the risk of having funds seized after the performance of the service is a very serious concern. Moreover, the work needed to be done to investigate fraudulent claims, on either side, increases the transaction cost of the system. Satoshi argues that this scenario will eventually result in micropayments being eliminated and transaction fees increasing. To address this issue Satoshi created bitcoin, that uses computation proof of work and cryptography to make non-reversible trustworthy transactions.

While bitcoin does solve the problem of double spending without a 3rd party, it has an interesting economic feature that sets it apart from other modern currencies. As a currency, bitcoin is inherently deflationary. Designed into the system is a geometric series dictating the rate at which the money supply increases, with a limit of 21 million total bitcoins. In an interview with the head programmer of the bitcoin project, Gavin Andreson, Russ Roberts makes a hypothesis about the end result of the deflationary bitcoin system: "That means that way into the future--8, 12, 16 years from now--the amount will be relatively stable, which means that if the dollars are not--if the Fed is behaving such that the money supply is growing rapidly, and the prices of things measured in dollars is going up at a steady, fast, maybe increasing rate, that bitcoins would get increasingly valuable." If the price of the dollar falls relative to bitcoins or the bitcoin economy grows faster than the supply of bitcoins, deflation will take place. Goods and services will cost fewer, more valuable bitcoins. In this way, bitcoin resembles natural

\[12\] Nakamoto, 1
resource based currencies, such as gold or other precious metals. Precious metals have many problems that make them a poor currency.

1. Subdivision - As an economy grows with a limited money supply the currency must be divided into smaller and smaller units. At some point this becomes nearly impossible and transactions become difficult to negotiate as smaller payments become impossible.

2. Opportunity cost - Precious metals often have other uses besides currency. If a useful precious metal is used as a currency, this purpose increases its value on top of the value associated with its other uses. This problem increases with deflation.

3. Trust - Pure gold is very soft and silver and copper tarnish. These issues with precious metals result in the creation of alloys (also a type of subdivision). The subsequent coins are no longer pure. This creates an issue of trust. How do you know that your coinage is the proper ratio?

4. Limited and uncertain money supply - Precious metals were used as stores of value, due to their limited nature and easy identification. However the total amount of a metal is not truly known. A large deposit could be discovered tomorrow that changes the value of the currency overnight. This causes unforeseen volatility.

While bitcoin's deflationary characteristics make it resemble a precious metal currency, it addresses many of the issues associated with such currencies. Bitcoins are sub-dividable out to 8 decimal points, and with 21 million bitcoins, this is equal to 2.1e15 (or 2.1 Quadrillion) units of currency. This is far more than the 9.7 trillion USD M2 money supply. Bitcoin is a pure currency, its sole purpose is to be a transferable holder of value, it has no other function. Since a public record of all transactions and currency created is held in the block chain, bitcoins cannot be counterfeited. Finally the money supply

---

of bitcoin is limited and known. While bitcoin may initially resemble a precious metal currency, its
digital and mathematical nature allows it to get around the issues associated with precious metals.

Bitcoin is still deflationary and that is a stark contrast to most modern fiat currencies. Because
inflationary/deflationary spikes create uncertainty, most economists favor a low rate of continual
inflation\(^\text{15}\). Typically inflation is blamed on the powers that be. The money supply being in the hands of
a government in debt, creates a short term incentive to devalue the currency and pay back debtors. To
address this issue congress created the Federal Reserve System. This system is supposed to operate
independently of the rest of the federal government with one of its goals being to keep inflation in
check through manipulation of the money supply. While the FED reacts to economic conditions and
alters the money supply, bitcoin has no FED. Instead we have a known money supply and its growth
rate.

We can hypothesize that bitcoin will follow the many drastic fluctuations of the pre-FED USD and likely
more so given the smaller size of the bitcoin economy and the fixed currency amount. So far this
hypothesis holds up. The bitcoin total economy has risen from a value of $0 to over $200 million and
has recently fallen in value to as low as $14 million. These rises and declines have taken place in a
period of just over two years.

In the long run, with no hypothetical bitcoin FED manipulating the supply of bitcoins to control
inflation/deflation, and assuming the bitcoin economy grows, we will have deflation in the economy.

With the traditional problems of other precious metal based deflationary currencies dealt with through
technology, we have an interesting long term scenario. Extrapolating from this scenario we can make a
hypothesis about the long term effects of deflation in the bitcoin economy.

\[^{15}\text{Hummel, Jeffery R. "Death and Taxes, Including Inflation: the Public versus Economists · Econ Journal Watch:}
\text{Inflation, Deadweight Loss, Deficit, Money, National Debt, Seigniorage, Taxation, Velocity." Econ Journal Watch:}
\text{Scholarly Comments on Academic Economics. 27 Jan. 2007. Web. 23 Nov. 2011.}
\text{<http://econjwatch.org/articles/death-and-taxes-including-inflation-the-public-versus-economists>}.\]
As bitcoins deflate and gain value relative to other currencies, those holding bitcoins become more wealthy. As deflation happens the incentive to hold bitcoins and not spend them increases. This could hurt the bitcoin economy as no one wants to spend their coins today if they are going to be more valuable tomorrow. Ultimately the decreased spending of bitcoins will hurt the bitcoin economy, which in turn lowers the value of bitcoin relative to other currencies and decreases the rate of deflation. In the long term I hypothesize that a equilibrium will be reached where deflation will be low enough that people are willing to spend their bitcoins. The need for economic activity in the function of determining bitcoins value will function as a stabilizer in the long term.

If this equilibrium holds, and the central banks of the world are unsuccessful in controlling inflation in their own countries, we may see people begin to use bitcoin as a safe haven against inflation. With a money supply that is known and cannot be changed, bitcoin could end up resembling the gold market.

In the short term, deflation is not bitcoin’s main hurdle. There are many other short-term obstacles that must be cleared before we know if the growth of the economy can outstrip the money supply. Bitcoin is an ingenious but imperfect system and only time will tell if the genius outweighs the flaws. The jury is still very much out still on bitcoin.

**Technical Analysis**

TA makes three main assumptions and derives its methods from these assumptions:

1. Market action discounts everything.\(^\text{16}\)

All relevant information is already reflected by prices. This sounds like a dangerous assumption, but it is the cornerstone of TA. 50 years ago, it would have been prudent to accept this assumption with a boulder of salt. However, in the modern era, where it takes less than a second for information to travel

\(^\text{16}\) Kirkpatrick and Dahlquist, 17
across the world and buying and selling stocks is nearly instantaneous, it no longer sounds that
farfetched.

2. Prices move in trends.\(^\text{17}\)

Price trends reflect the emotional sentiment of investors. We have all seen stocks rise and thought, "I
can make some money off this as well". By buying the stock we add more fuel to the flame and
encourage others to jump in as well, thus possibly creating a bubble. The reverse is true as well. We see
our precious stock start to tumble and we panic, sell, and others follow suit, thus creating a crash. These
psychological patterns help create trends.

3. History tends to repeat itself\(^\text{18}\)

This assumption is based on the fact that investors are humans, and we behave like humans. The
development of our brains has resulted in us handling opportunity and risk in semi predictable ways. In
theory we should tend to mirror the decisions of past investors. The prospect theory being a prime
example. The prospect theory teaches us that losses hurt more than gains. In line with the prospector
theory, investors will sell sooner when they start to lose money, than when they see large gains. This is
one of the many patterns that repeats itself in financial markets.\(^\text{19}\)

4. Trends are are fractal\(^\text{20}\)

Meaning that within every trend there are smaller trends. For example we can look at bitcoin as a
whole and see two very obvious long term trends.

\(^{17}\) Kirkpatrick and Dahlquist, 18
\(^{18}\) Kirkpatrick and Dahlquist, 18
\(^{19}\) Kahneman, Daniel, and Amos Tversky. *Prospect Theory: An Analysis of Decision under Risk.*
<http://www.princeton.edu/~kahneman/docs/Publications/prospect_theory.pdf>. 18
\(^{20}\) Kirkpatrick and Dahlquist, 18
However, within these trends there are many smaller upward, downward, linear, or nonlinear trends. This fractal nature of trends should allow us to use TA to profit in any time frame.

From these assumptions, TA derives many different tools in an attempt to predict future price action. These tools are far from exact and as such TA is largely regarded as a pseudoscience by some and should not be the soul basis for investment decisions. However some investors swear by these tools and consider them invaluable. We can now evaluate these tools in the Bitcoin market.

A favorite among analysts is moving averages. Moving averages take a certain amount of prior data and average it to get a value.
The black line is a 5 day moving average, that averages the prior 5 days of price action and closely mirrors the current price action due to its shorter frame of reference. The purple line is a 30 day moving average that does not stick as close to the current price action due to its longer frame of reference. Moving averages are very useful in showing trend reversals. When the short average crosses the long average this can be an indication of a trend reversal.

The next indicator we will test is the Relative Strength Index (RSI). RSI is a market momentum oscillator\textsuperscript{21}. RSI is used to measure the velocity and magnitude of movements in a price. More positive changes result in a higher RSI, fewer positive changes result in a lower RSI. RSI values range from 0 to 100, with values greater than 70 typically considered to be over bought, and values below 30 being considered over sold. When the RSI oscillator deviates outside the range of 30-70, it indicates that a correction maybe be imminent.

The final indicator we will be looking at is volume confirmation which is a powerful tool from the Dow theory that can tell us whether or not the new high in a trend is the peak or a continuation of the trend\textsuperscript{22}. As prices reach new subsequent highs, if volume is not increasing with price it can be a signal that the trend is running out of steam and that a reversal is imminent, this is called Volume divergence. Volume convergence takes place when subsequent highs are matched with increasing volume, providing evidence that the trend is continuing.


\textsuperscript{22} Kirkpatrick and Dahlquist, 83
Illustration of Volume Convergence/Divergence:

The first graphic demonstrates volume convergence and signals that the upward trend is continuing. The second graphic illustrates volume divergence, signaling that the trend has peaked and the upward trend is losing steam.

The Bitcoin/USD market

Bitcoin's trade history creates a unique data set with which to test the effectiveness of TA. Bitcoin has seen shocking volatility; prices rose from under $1 to over $31 in about two months. Then declined from a high of $31 to a low of $2 in 4 months and have since recovered 50% to $3. Is TA useful in such an emotional market? Let's put our tools to the test both in long term and short term scenarios.

RSI

The relative strength index (RSI) should tell us when bitcoins are overbought (peaking) or oversold (bottoming) and make investment decisions accordingly. Below is the price action during the June 2011 bitcoin peak.
On June 8th we see the RSI index clearly crossing the overbought value of 70 and peaking at value of 91, signaling that bitcoins are over bought and a correction is imminent. On June 9th that correction began and bitcoins fell from $31 to $24 in 2 days. In this short term situation the RSI indicator alerts us when is a good time to cash out and protect ourselves from the coming decline.

However RSI can be calibrated and used for any trading period. In short term trading we can calculate the RSI based on hours, minutes, and down to individual trades. As in the bitcoin peak example, RSI alerts very well to the peaking of bitcoin prices and encourages us to sell. If we follow a blind trading rule that we buy when the hourly average RSI drops below 30 and sell when it crosses over 70 this would be our result:
RSI<30 | Price ($) | RSI>70 | Price ($) | % Gain
---|---|---|---|---
10/24/11 | 2.5 | 10/29/11 | 3.82 | 52.8%
10/19/11 | 2.1 | 10/22/11 | 2.95 | 40.48%
9/26/11 | 4.75 | 9/30/11 | 4.9 | 3.16%
9/15/11 | 5.1 | 9/20/11 | 6.8 | 33.33%
9/9/11 | 4.3 | 9/11/11 | 7.0 | 62.79%

RSI performs very well in the bitcoin market when calibrated to hourly data, even in the long term linear downward trend. Countless other examples of this are evident going back in time, and the return rate should be even greater during the exponential upward trend.

In the long-term RSI is not as powerful of a tool. By charting when RSI peaks in the oversold/overbought boundaries we can show the effectiveness of the RSI index. Below is a chart of the RSI values calculated from volume weighted daily price averages.

If we follow a blind trading rule that we buy when the daily average RSI drops below 30 and sell when it crosses over 70 this would be our result:
<table>
<thead>
<tr>
<th>Period</th>
<th>RSI&lt;30</th>
<th>Price ($)</th>
<th>RSI&gt;70</th>
<th>Price ($)</th>
<th>% Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>9/8/10</td>
<td>0.034</td>
<td>9/30/10</td>
<td>0.0614</td>
<td>80.41%</td>
</tr>
<tr>
<td>3-4</td>
<td>12/1/10</td>
<td>0.1121</td>
<td>12/24/10</td>
<td>0.2483</td>
<td>121.41%</td>
</tr>
<tr>
<td>5-6</td>
<td>4/3/11</td>
<td>0.4837</td>
<td>4/17/11</td>
<td>1.0761</td>
<td>122.45%</td>
</tr>
<tr>
<td>7-8</td>
<td>7/5/11</td>
<td>12.80</td>
<td>8/20/11</td>
<td>11.4806</td>
<td>-10.31%</td>
</tr>
<tr>
<td>9-10</td>
<td>8/29/11</td>
<td>8.9807</td>
<td>11/2/11</td>
<td>3.2309</td>
<td>-63.82%</td>
</tr>
</tbody>
</table>

Keeping in mind that this is the result of a trading rule that cares only about the RSI, we can conclude that in the long term RSI performs very well during upward trends and poorly during downward trends. These results should be taken with a grain of salt since it is very easy to do well in an exponential upward trend like we see with bitcoin. In summary RSI appears effective in short term trading, but should be used with caution in long term trading.

**Moving Averages**

The comparison of long vs short moving averages can provide us with a clue about whether or not current trends are reversing. Starting with the long-term picture, again using daily volume weighted averages of prices.
This data has been truncated due to the narrow and low volume trading prior to February 2011:

If we follow a simple trading rule that we buy when the 5-day moving average crosses the 30-day moving average in the positive direction, and sell when drops below we get these results:

<table>
<thead>
<tr>
<th>Date</th>
<th>Price ($)</th>
<th>Date</th>
<th>Price($)</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/14/11</td>
<td>1.06</td>
<td>7/2/11</td>
<td>15.52</td>
<td>1364.15%</td>
</tr>
<tr>
<td>8/23/11</td>
<td>11.03</td>
<td>8/25/11</td>
<td>10.00</td>
<td>-0.09%</td>
</tr>
</tbody>
</table>

Similar to the RSI index, we see stellar performance during the exponential upward trend. Where the results differ is that the MA comparison protects us from taking risks that the RSI index would have had us take during the downward trend. The MA comparison did yield one false signal, but the cost was very small in comparison to the losses seen with RSI. MA comparison is a powerful, albeit conservative, long term tool.

Like RSI, we can calculate the moving averages using small time intervals. Instead of the average being sourced from volume weighted daily averages, we can compute the average from the last 5 days worth
of hourly periods, or last 5 days worth of trades. We will check the performance of the MA comparison method during short term trading using hourly averages:

<table>
<thead>
<tr>
<th>Date</th>
<th>Price ($)</th>
<th>Date</th>
<th>Price ($)</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/11/11</td>
<td>2.88</td>
<td>11/12/11</td>
<td>3.25</td>
<td>12.84%</td>
</tr>
<tr>
<td>11/9/11</td>
<td>3.06</td>
<td>11/9/11</td>
<td>3.07</td>
<td>0.37%</td>
</tr>
<tr>
<td>11/7/11</td>
<td>2.96</td>
<td>11/8/11</td>
<td>3.06</td>
<td>3.39%</td>
</tr>
<tr>
<td>11/2/11</td>
<td>3.20</td>
<td>11/3/11</td>
<td>3.22</td>
<td>0.63%</td>
</tr>
<tr>
<td>10/26/11</td>
<td>2.80</td>
<td>10/30/11</td>
<td>3.58</td>
<td>27.86%</td>
</tr>
</tbody>
</table>

Short term MA trading, like long term MA is very safe, however it can give false signals when trading ranges are very narrow. As seen with the 11/2 and 11/9 example, we still net a little, however due to imperfect timing and depending on the amount of money we are investing we would likely lose a small amount of our investment. During times of great volatility MA comparison can help protect our investment and help us to decide when to invest. A more complex analysis that could yield benefits is to compare the angle at which the short MA intersects the long MA. This analysis could help weed out false signals as a result of noise.

**Volume Convergence/Divergence**

Volume convergence/divergence is useful in confirming new trends, or disregarding price action as dangerous noise. Starting with the long term picture we can chart we can analyze the two prevalent long term trends.
In the long term we see rising positive volume correlated with rising bitcoin price confirming the trend is continuing. This is a false signal and the exponential trend quickly reverses. The downward linear trend demonstrates volume confirmation much better. We see increasing negative volume as prices continues to decline. A better way to apply volume confirmation may be to analyze what type of volume is taking place during a trend. The initial exponential trend has many more days of positive volume, giving support for an upward trend. The reverse is true during the downward linear trend. This analysis is could be done in a similar fashion to RSI, but using volume instead of prices. With the bitcoin market we must consider that the volume in the bitcoin market is hugely variable, which adds more uncertainty to the picture.

In the short term the picture becomes more fuzzy. Bitcoin is a unique market where many earlier adopters are holding on to large amounts of coins waiting to cash out and there are many late adopters waiting for an opportunity to buy. What often happens is an earlier adopter cashes out and a late
adopter swoops in to pick up cheap coins. As a result of this we see large volume days where an individual decides to liquidate all of his coins followed by days of narrow sideways trading.

This pattern is seen over and over again during the linear downward trend. High volume sell off, followed by lower volume upward corrections. The volume of the sell off vs the volume of the positive corrections can be used to judge the overall direction of the trend.

**Conclusion**

TA is a powerful tool in this market once we understand its limits. Bitcoin is a fascinating, albeit imperfect system for mainstream adoption. The complexity of the system makes it difficult for the non-computer literate to understand. Complexity aside bitcoin also lacks a brand name to trust and oversight. This combined with the technical complexity makes the system very difficult for the average individual to trust. This could change if the bitcoin developers are successful in their attempt to make bitcoin more user friendly. These current limitations relegate bitcoin to being an asset traded by more risk adverse and technologically inclined traders, keeping the market small. This low liquidity creates
spikes and can create false signals, throwing some of our indicators off. Keeping these limitations in mind we find that each of the indicators tested have different strengths and weaknesses.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Long-term</th>
<th>Short-Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSI</td>
<td>Performs well during upward trends, poorly during long term trends. Use with caution.</td>
<td>Performs very well regardless of trend.</td>
</tr>
<tr>
<td>MA comparison</td>
<td>Safer than RSI, and performs very well. Prevents us from taking unnecessary risks. However, MAs offer no information about peaks in trends.</td>
<td>Performs very well, however misses many opportunities compared to RSI. Again, safer.</td>
</tr>
<tr>
<td>Volume Confirmation</td>
<td>Potential of giving false signals due to the low liquidity of the bitcoin market. Volume spikes are common and difficult to discern.</td>
<td>The comparison between the downward and upward volume can give insights into the continuation of a trend.</td>
</tr>
</tbody>
</table>

Ultimately we see that TA is very effective when applied correctly. More abstractly we also must ask why do these tools work so well. In my opinion it boils down to the availability of this information. Due to the computer savvy culture surrounding bitcoin, data is free and easily accessible. Also websites such as bitcoincharts.com allow the creation of charts with numerous technical indicators without the knowledge of more formal and expensive charting software. With the information being easily accessible, the theories of TA being easily accessible online, we see a situation of self fulfilling prophecies. Traders can follow the indicators and sell and buy accordingly, essentially proving the indicators correct, especially in the short term.

Understanding how people believe in TA can allow us to capitalize on the indicators movements. The key is to think ahead of the average trader. To do this, we must consider how the typical trader approaches short term trading in the bitcoin market. To beat the typical traders we must think one
setup further, and the key to that is angles. The MA angle at interception can help rule out false signals based on the slope of the intersect with the long average. The same basic theory could be applied the RSI index as well. By examining the angles or slope of these indicators, while keeping in mind fundamentals, we may have a better shot at beating the market.

Another approach could be to narrow our trading range, especially in the case of the RSI index. The RSI index being one of the most self fulfilling indicators with clear boundaries of when you "should" buy and sell. This being common knowledge, the market follows this index very well, especially in the short term. The risk lies in missing the peak. A viable strategy would be to buy when RSI traditionally says oversold and sell shy of the overbought line. Traders will typically wait for that clear signal of RSI>70 to sell, but if we sell at a lower RSI, say greater than 65, this is safer and depending on the size of the investment may decide the short term peak. This approach will lower our risk when using the RSI index at the cost of potential profits. Ultimately it depends on the investors risk tolerance.

The future of bitcoin itself is difficult to assess. Steeped in technological barriers and a history of fraud, some believe bitcoin may have crashed beyond recovery\textsuperscript{23}. Bitcoin itself seems to currently be sunk in a long term downward trend. However the overall bitcoin trend may be following Gartner's Hype Cycle\textsuperscript{24}:


Bitcoin has already reached the "Peak of Inflated Expectations" and has been headed down. If bitcoin is here to stay, it is possible that we are in the "Trough of Disillusionment", and will soon be entering the "Slope of Enlightenment". This all depends on whether or not the bitcoin community can overcome the apparent complexity and issues of trust. Only time will tell.

Bitcoin is only the first of its kind. If bitcoin ultimately fails it will not be long before someone creates something similar. As wealth becomes more and more virtualized we will see more and more markets like the bitcoin market are created where this type of analysis proves to be very lucrative. Ultimately the key is information, not just technical, but knowing about the market first. These internet markets are easily created and easily destroyed. By being a creator, or early participant armed with an understanding of the successful indicators, the potential returns are incredible.
Sources


All other information is the product of hours of internet conversations via instant messaging or forum discussions going back to when I initially discovered bitcoin in February of 2011.
**Data and Charts**

All trade data pulled from the mtgox bitcoin exchange, which represents a vast majority of the bitcoin trade volume:

http://bitcoincharts.com/t/trades.csv?symbol=mtgoxUSD&start=0

All charts generated in excel were created by myself using the above data.

All other charts are created using bitcoincharts.com