UNIVERSITY OF NICOSIA
ΠΑΝΕΠΙΣΤΗΜΙΟ ΛΕΥΚΩΣΙΑΣ

DFIN-511

Introduction to Digital Currencies

Session 1

A brief history of money

Objectives of Session 1

- The history of currency and money could fill a full course or even a degree program. In this first session, we will attempt to cover it in one class session. Given this, by necessity, we will need to make significant simplifications and cover stretches of hundreds of years of monetary history in 1 page.

- The objectives for this session are:

  - Understand the main functions of currency and be able to apply them when analyzing various types of historical, current or future currencies

  - Understand, at a high-level, the main forms of currencies used over time and the evolution toward fiat currency

  - Understand, from a monetary perspective, how Bitcoin, the most popular cryptocurrency is designed

- At some level, this is the most theoretical of the sessions as it is simply to provide a framework and some context about currency in general that might be helpful during the remainder of the course

Agenda

1: The Functions of Currencies

2: Barter through Coinage

3: Coinage through Fiat Currency

4: Bitcoin as a Currency?

5: Self Assessment Exercises and Further Readings

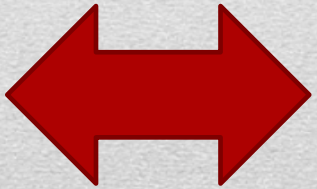
1. The Functions of Currencies

The 3 Main Functions of A Currency:

Medium of exchange

- ***Functions are independent but mutually reinforcing***
- ***No currency is perfect on all these dimensions – all present trade-offs***

Unit of account



Store of value

Medium of Exchange

- **What is a medium of exchange?**
  - A more efficient way to exchange products and services than the barter system (that otherwise requires a "double coincidence of wants" – *see page 10*)
  - In this regard, money serves the role of an *intermediary* between the products or services that people want to trade
- **What makes a good medium of exchange?**
  - Durability: Metals / gems vs. tobacco / chocolate
  - Transportability: Paper money / electronic registers vs. metals / gems
  - Divisibility: Metals / paper money vs. cattle
  - Non-counterfeitability: A long-standing problem for almost all currencies
  - Fungibility: Each unit is identical to others in its characteristics and functions. Paper money vs. cattle/tobacco/cowrie shells

Unit of Account

- **What is a unit of account?**
  - A standard *measurement* of the value of goods, services, economic activities, assets and liabilities.
  - A common unit of account is what allows us to compare:
    - The value of 10 lemons vs. 1 book
    - The financial results of a furniture manufacturer with those of an internet portal
    - The size of the economy of Delaware with that of Rhode Island

- **Stability**: Stability of the value of the unit of account makes it more useful as a unit of account. In inflationary currencies, for example, over long periods of time, results are not comparable, leading to the need to use *nominal* (actual) vs. *real* (inflation-adjusted) values in order to make measurements comparable again

- **Does the Unit of Account have to be the same as the Medium of Exchange?**
  No! But usually it is. Some exceptions:
  - Unidad de Fomento (UF) in Chile: A national indexed unit of account used to adjust for inflation
  - External currency pegs: In high inflation countries, merchants have been known to post prices in dollars or other stable currencies (the Unit of Account) but to settle in local currency at the current exchange rate (the Medium of Exchange)

Store of Value

- **What is a store of value?**
  - A store of value is a mechanism by which wealth can be ***saved*** and retrieved in the future with some predictability about its future value
  - Store of value is not a function solely of currencies, but of assets in general
  - As all asset prices have greater or lesser degrees of unpredictability, there is no perfect store of value

- **What drives the ability of something to be a 'store of value'?**
  - Current expectations of stable or predictably knowable future demand for the asset
  - Current expectations of stable or predictably knowable future supply of the asset

- **Notable Stores of Value:**
  - Gold / Silver / Diamonds
  - Reserve currencies and/or the bonds of reserve currency nations
  - Stocks / Bonds / Real Estate

Note that all of these assets are subject to volatility and none are a perfect store of value

2. Barter through Coinage

Barter

- The earliest form of commerce and trade was through barter, an activity of simply trading goods or services directly, without any intermediary 'medium of exchange.' In small villages or tribes, with limited specialization of production and similar needs and wants, this was an acceptable approach

- Barter suffers in a modern specialized economy from the need to uncover a "double coincidence of wants" (William Jevons, Carl Menger, late 19th century). If you assume that everyone is both a seller and buyer of goods and services, the seller has to believe that the good / service that they are receiving from their buyer will, in turn, be acceptable to the sellers that they buy from, a "double coincidence" that imposes significant costs

- What is perhaps surprising, in this light, is barter's resiliency in some pockets of modern economies:

    - Cultural habits: Gift exchange is a form of barter that has not, on the whole, been supplemented with more efficient methods like cash transfers

    - International Bilateral / Bloc Trading: Even as late as the 1980s, there were many bilateral agreements, most notably with the Eastern Bloc and Iran, that primarily involved commodities (such as oil or grain) being exchanged for heavy industrial equipment and products

Arguments against barter

- An argument against the predominant idea that primitive society used barter exclusively was presented by anthropologist David Graeber in his 2011 book, Debt: The first 500 years. He argues against the prevalence of barter, and argues for the extended use of debt in small scale societies he coins “Human Economies”.

- This argument is substantiated according to Graeber, by the lack of anthropological evidence of purely barter based economies before coin based economies emerged. He takes this to imply that while barter was practiced extensively when interacting in low trust environments (merchants from afar visiting the village), in smaller and tighter communities, informal but socially crucial debt and favors were preferred between trusted parties (villagers).

- To this end, he differentiates between the use of money/debt/barter between commercial economies (wide ranging, lower trust, short term relationships) and human economies (tighter range, higher trust, longer term relationships). This further challenges the conventional economic thinking of value and its exchange; tighter groups transactions were perhaps more of a social lubricant and cement, than the exchange of value as we’ve come to acknowledge from the current uses of money.

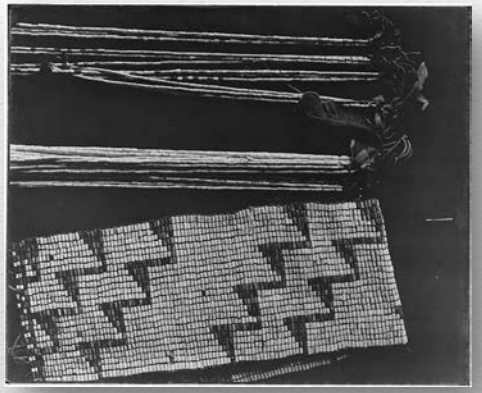
Primitive Money

"All money that is not coin or, like modern paper money, a derivative of coin"
– P. Grierson, Professor of Numismatics at Cambridge

- Primitive money was the only form of money until coinage was invented in Lydia (Greece) in the 7th Century BCE
- Remained in heavy parallel use through the 19th century - e.g. tobacco was made legal tender in Virginia in 1642 and remained so for nearly two centuries
- Remains in parallel use in isolated economies – e.g. cigarettes in prisons
- While an improvement on barter in terms of efficiency, can suffer as a medium of exchange in the areas of transportability, durability, fungibility and divisibility. It is also vulnerable to positive and negative supply shocks that cause price volatility, making it, at times, unstable as a store of value and unit of account

Notable Forms of Primitive Money

Cowry Shells



Wampum Belts

Cattle

Whale's Teeth

Grain

Tobacco

Image Source: Wikimedia Commons

The curious case of the Rai of Yap

A Rai stone, definitely not transportable

Image Source: Wikimedia Commons

The curious case of the Rai of Yap

- The Rai are large stone disks used on Yap island in the Western Pacific. They were “minted” from the limestone deposits of the nearby island of Palau and used as a currency until the 20th century. Pre-Bitcoin, they were a minor footnote in the study of primitive currency

- Given their extraordinary size (up to 9,000 pounds), Rai stones were not moved when spent, but simply changed owners. Every transaction was ‘recorded’ orally within the small community, with the stone’s ownership history becoming common knowledge. Eventually, the “transaction history/ledger” became the only part that mattered (e.g. a stone was once dropped by the canoe transferring it to Yap and sank. The stone was deemed to still be money, since it still exists, even though no one has seen it since, or has access to it)

- This is particularly important, because it demonstrates a naturally occurring use of a **ledger of transactions.** This ledger was shared orally between the inhabitants, attributed ownership and delegated property without a single stone moving, because everyone agreed on it

- As we will see later in the course, there are some abstract similarities between the Rai ledger and how the Bitcoin ledger accounts for transactions

The Invention of Coinage

- Modern coinage was first invented either in ancient China or ancient Greece, depending on how one defines the separating line between primitive money and modern coins

- China created metal cowries (along with spades, hoes and knifes) as early as 1200 BCE – these metal objects can be considered either institutionally standardized primitive money or early modern coinage. They eventually evolved into standardized circular coins around 200 BCE, though solely of base metals, and, therefore, in very low denominations (traded 1,000 to 1 with Western coins)

    - Historical note: As Portuguese trade emerged with China in the 15th century, these coins became known by their Tamilian (South Indian) name of காசு / kāsu / coin money. Today, that name survives, for money in small denominations, in the English word “cash”

- The first clearly modern coinage was developed in Lydia, a Greek kingdom (in modern-day Turkey) in approximately the 7th century BCE, in stamped coins of electrum (a gold/silver mix). While ingots previously existed in Cappadocia and Crete, the Lydian coins are generally accepted as the first modern coinage in form and style and marked a big step forward in transportability, standardization and institutionalization

The Invention of Coinage

Early 6th Century BCE Lydian Coins

Western Han Ban Liang ("Cash")

Image Source: Wikimedia Commons

The Era of Coinage

- After coinage was invented in Lydia, it spread through the Greek city-states and was eventually adopted by the Romans.

- In aggregate, metal coinage became the dominant form of currency in Western economies well into the 18th or 19th century and was issued in a bewildering number of permutations and combinations. A money changer's manual published in Amsterdam in 1606 listed 341 silver and 505 gold coins[1]

- The fact that coins contained valuable commodity metals led to ongoing difficulties with debasement and shaving/clipping

    - Coin issuers were perpetually tempted to debase coins (reduce the quantity of valuable metals in coins)
    - Users of coins were also tempted to shave or clip coins, a minor benefit on a per-coin basis, but in aggregate a profitable exercise. Note: Discouraging shaving is what led coins to eventually develop ridged edges
    - Debasement led to Gresham's law that ***"Bad Money drives out Good Money"*** – in other words, people prefer to hold on to clearly good money and spend clearly bad money until only bad money is in circulation

- Metal coinage also presents some problems relating to maintaining a stable Unit of Account over time. Changes in the prices of the underlying metals change the effective value of the coin relative to its initial value, making useful comparisons across time difficult

1 – Richard Van Der Borght, "A History of Banking in the Netherlands," The Journal of Commerce and Commercial Bulletin, 1896, Vol IV, p.192

3. Coinage through Fiat Currency

Some Useful Definitions

- Commodity money: Money that has some other non-monetary use and value (e.g. gold for jewelry). Both primitive and modern money can be commodity money
- Gold standard: This is a form of commodity-backed money or, under some definitions, representational money, where paper notes were redeemable for gold (or, in alternative models, silver)
- Fiat money: Money that is irredeemable for a commodity and only redeemable for fiat money
- Legal tender: A legal requirement to accept a certain currency to meet financial obligations
- Bank notes: Also: bill, note, paper money. A form of promissory note that was usually commodity-backed and private (in its early forms) and is usually fiat and national/sovereign (in its current forms)

Jiao Zi – The First Paper Bank Note

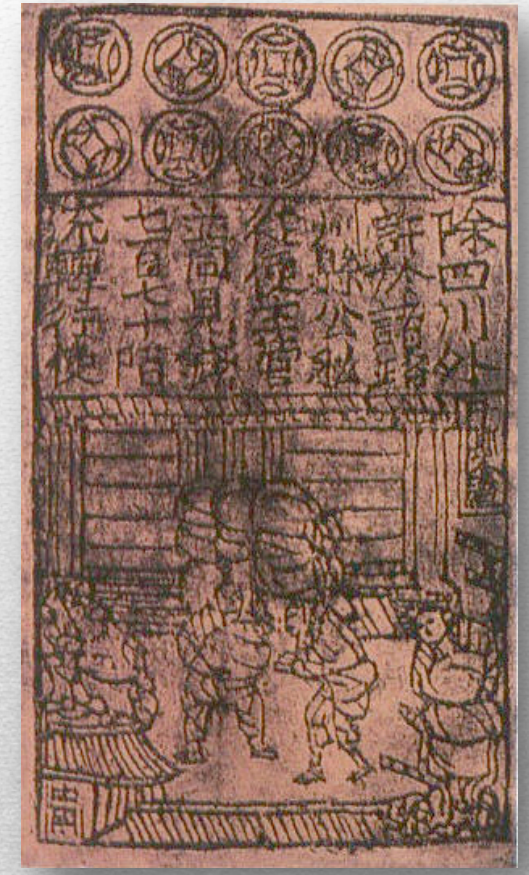


Image Source: Wikimedia Commons

Chengdu, Sichuan Province, China

~10th century AD

Paper Currency Emerged in China

- General consensus is that paper currency emerged in China
- As was seen hundreds of years later in Amsterdam, the origins of paper currency, began with **receipts of deposits** of coin currency. As we recall, Chinese 'cash' coinage was in very small denominations, making it unwieldy for large commercial transactions
- Merchants would deposit their coinage at a small number of government-authorized deposit shops and use their receipts to trade more conveniently
- By 1120, the government had recognized the potential of paper money and started issuing the first generally circulating banknotes, granting itself a monopoly in the area. Currency remained regional until 1265 when the Song government produced a national currency, with notes representing 1 to 100 strings of 'cash'

Marco Polo described this innovation

"With these pieces of paper, made as I have described, he [Khubilai Khan] causes all payments on his own account to be made; and he makes them to pass current universally over all his kingdoms and provinces and territories, and whithersoever his power and sovereignty extends. And nobody, however important he may think himself, dares to refuse them on pain of death. And indeed everybody takes them readily, for wheresoever a person may go throughout the Great Kaan's dominions he shall find these pieces of paper current, and shall be able to transact all sales and purchases of goods by means of them just as well as if they were coins of pure gold. And all the while they are so light that ten bezants' worth does not weigh one golden bezant.

Furthermore all merchants arriving from India or other countries, and bringing with them gold or silver or gems and pearls, are prohibited from selling to any one but the Emperor. He has twelve experts chosen for this business, men of shrewdness and experience in such affairs; these appraise the articles, and the Emperor then pays a liberal price for them in those pieces of paper. The merchants accept his price readily, for in the first place they would not get so good a one from anybody else, and secondly they are paid without any delay. And with this paper-money they can buy what they like anywhere over the Empire, whilst it is also vastly lighter to carry about on their journeys."

Marco Polo and Rustichello of Pisa, "Book Second, Part I, Chapter XXIV: How the Great Kaan Causeth the Bark of Trees, Made into Something Like Paper, to Pass for Money over All His Country," in *The Book of Ser Marco Polo: The Venetian Concerning Kingdoms and Marvels of the East*, translated and edited by Colonel Sir Henry Yule, Volume 1 (London: John Murray, 1903)

The Bank of Amsterdam, Part I

- Depository receipts for precious metals had existed in Southern Europe countries for centuries, but the first true public bank was the Bank of Amsterdam, founded in 1609

- The Bank of Amsterdam was guaranteed by the City of Amsterdam and was tasked with bringing order and efficiency to the wide range of coinage in circulation in Amsterdam, a major commercial center at the time

- The Bank accepted local, foreign and debased coins, valued them according to common standards, and then gave credit in an account in a common value, *'bank money,'* for which it issued a receipt (and charged a small administrative fee). This standardization of values significantly diminished the incentives to debase money (and the profitability of doing so) and was an important step in making European currency more efficient

- As in China, we see that the first step toward paper money was a receipt for metal coinage, that itself became tradeable

- Bank of Amsterdam, however, also presaged several other modern Central Banking and banking concepts including:
  - A state guarantor, while maintaining an independent entity from the Treasury
  - A form of legal compulsion (the bank money was ***required*** to be used for transactions above a certain value)
  - Fractional reserve lending (something we will discuss in the next page)

The Bank of Amsterdam, Part II

- The Bank of Amsterdam, initially operated solely as a depository institution, on a 100% reserve basis. In other words, none of the precious metals on deposit were loaned out to other parties
- In time, however, the Bank of Amsterdam started lending money to the Dutch East India Company, initially on a short-term basis, out of the deposits of others
- This activity is known today as 'fractional reserve banking' and is a key aspect of how money is created and how money supply is managed in a modern economy. We will discuss this later in the course, in the session on Central Banking, but, for now, it suffices to note that this was one of the earliest steps toward modern fiat money, generating notes that were only fractionally backed by metal deposits
- Unfortunately, the Dutch East India Company fell on progressively harder times and eventually defaulted to the Bank of Amsterdam. So, in a manner that would be repeated by thousands of banks over the ensuing centuries, the Bank of Amsterdam become an early victim of overly optimistic lending, was taken over by the City of Amsterdam in 1791 and wound up in 1819

The Bank of England

- While the Bank of Amsterdam died a premature death, the Bank of England, founded in 1694, survived through to the present day, became the predecessor of all modern Central Banks and was, for centuries, the most important Central Bank in the world, during the period that the pound sterling was the world reserve currency

- The Bank of England was founded as a private bank, incorporated to allow William III to borrow 1.2M sterling that the city goldsmiths could not support. In exchange for a share rights offering of 1.2M sterling (that was then lent to the government), the bank gained the right to **issue notes**, including against the government bonds it had received

  This was an important right and another step toward modern fiat currency. In time, and through a succession of Acts restricting its competitors, the Bank of England came to monopolize bank note issuance in England and Wales, effectively become the Central Bank of the UK

- The bank notes of the Bank of England went through successive policy changes, driven largely by Acts of Parliament that required or suspended the redeemability of these notes to metals (primarily to a Gold Standard), depending on the political and economic environment. During periods when they were irredeemable, these were among the first forms of fiat money in Western nations

- The Bank of England remained in private hands from 1694 until it was nationalized via the *Bank of England Act of 1946*

Bank Notes & Legal Tender: UK Case Study

- One common misconception about modern fiat currency is the role of 'legal tender.' Many people believe 'legal tender' means 'you are required to use this currency' and this subsequently gives currency its value

- In fact, the Anglo-Saxon definition is quite different and narrow, simply stating that a debtor cannot refuse settlement of an existing debt in the legal tender of the nation. In other words, the legal tender can be used as a Medium of Exchange for outstanding debt (but does not require its use for prospective transactions nor as a Unit of Account)

- The UK provides a fascinating study on this topic:
  - The Bank of England is the only bank authorized to issue banknotes in England & Wales and its notes are legal tender in both

  - In Scotland and Northern Ireland, however, banknotes are still issued by seven retail banks (thanks to an Act in 1845), provided they keep equivalent assets on deposit at the Bank of England. These banks are, in Scotland, the Bank of Scotland, Clydesdale Bank, Royal Bank of Scotland and, in Northern Ireland, the Bank of Ireland, AIB Group, Northern Bank, Ulster Bank

  - Interestingly, neither the bank notes of the Bank of England, nor the bank notes of the private banks in Scotland and Northern Ireland, are considered legal tender in Scotland or Northern Ireland. In fact, no bank notes of any kind are legal tender in Scotland and Northern Ireland (though some coinage is in limited amounts)

- Bank notes are, of course, accepted for day-to-day trade in Scotland and Northern Ireland as a matter of convention without being legal tender (in much the same way as checks and credit cards are). This is an excellent reminder that almost all currencies are accepted largely as a matter of convention

The USD and the Federal Reserve

- By the 20th Century, the US dollar (USD) had replaced the pound sterling (GBP) as the most important reserve currency in the world and, as a consequence, the Federal Reserve became the key Central Bank in the world

- Like the GBP, the USD exhibited a long history of fluctuating through periods of convertibility and non-convertibility to metals throughout its history. Specifically, the USD has been a fully metal-backed currency for 124 years of its existence, a fully fiat currency for 58 years and quasi-metal-backed for 39 years, as follows:

1792-1834:	Bimetallic Standard (Gold and Silver), but Basically Silver
1834-1862:	Basically Gold Standard
1862-1879:	Fiat Paper Money
1879-1933:	True Gold Standard (though with significant derogations from it during WWI)
1934-1973:	Quasi-Gold Standard (only for foreign exchange with Central Banks, not for individuals)
1973-2014:	Fiat Paper Money

- Today, the USD is a 100% fiat currency with no redeemability into any commodity assets, managed by the Federal Reserve, the Central Bank of the United States

- As with many modern fiat currencies, the dollar is managed with a bias toward slight inflation (targets are usually 2-3% per year) in order to discourage hoarding of money, stimulate economic activity and maintain full employment

Bretton Woods – The Quasi-Gold Standard

- Toward the end of World War II, at the Bretton Woods conference (July 1944), many major world economies attempted to regulate future intra-country financial flows and currency 'competition' through fixed exchange rates pegged to the USD, itself pegged to gold

- The structure of Bretton Woods was based around the USD
  - The USD would remain redeemable for gold at $35/ounce
  - Ratifying countries pegged their currencies to the USD (generating an implicit gold standard for them)
  - The newly formed International Monetary Fund would act as a bridge for payment imbalances among the ratifying countries

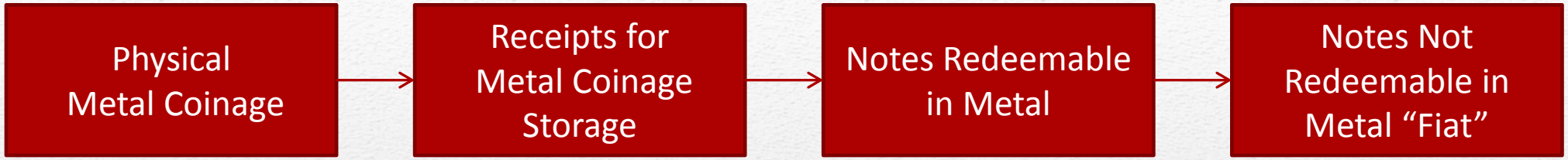
- This gold standard was not available to citizens, just to counter-party Central Banks so it is not considered a full gold standard

- The peg to gold started coming under pressure in 1960 and ran into severe difficulties in 1968. The USA, abandoned the Bretton Woods agreement in August 15, 1971. Among a number of measures announced by President Nixon, "the gold window" was closed, and gold could no longer be exchanged at a fixed rate with US Dollars (also called the "Nixon Shock")

- This action effectively marked the end of metal-backed sovereign currencies and the move from commodity money to fiat money

Currently no countries use a gold standard – all sovereign currencies today are fiat currencies

Simplification: From metals to paper

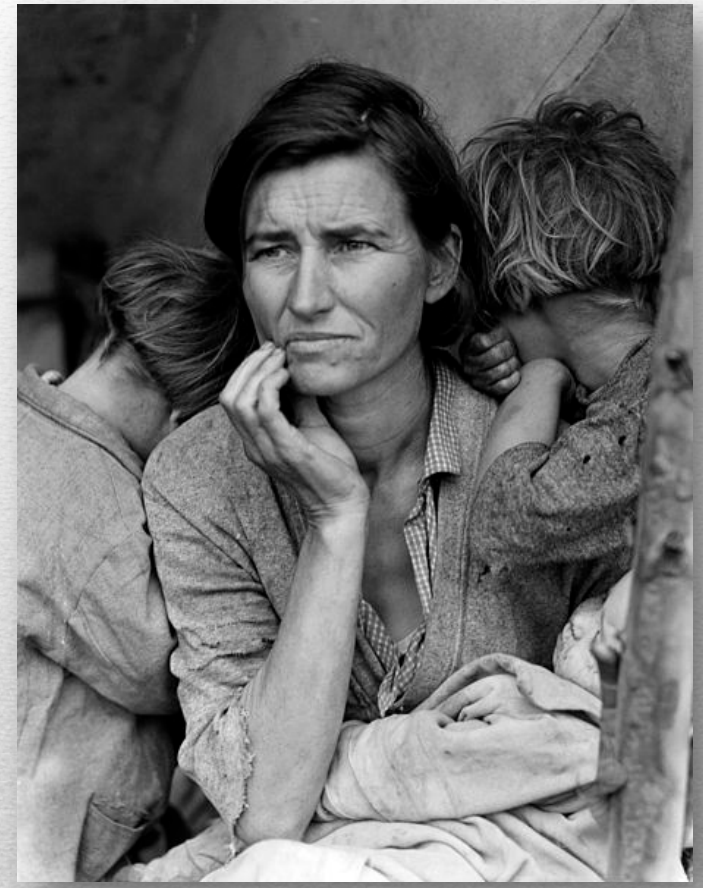


~700 BCE (Greece)	**900 AD (China)**	**~1200 AD (China)**	**1800s+ (on & off, in West)**
~200 BCE (China)	**~1600 AD (Europe)**	**~1700 AD (Europe)**	**Globally, post-1973**

Primitive / commodity money has continued to exist in parallel through most of this period

When Currency Goes Wrong: Deflation & the Great Depression

Bank Run, American Union Bank



Destitute Migrant Workers, 1932

Image Source: Wikimedia Commons

When Currency Goes Wrong: Deflation & the Great Depression

- The stock market collapse of 1929 triggered a recession in the United States

- Constrained by the gold standard, the Federal Reserve constricted money supply, worsening the already very severe domestic economic pressures and causing severe deflation. Deflation, by making debts larger in real-terms, tends to create a self-fulfilling trap for economies, with progressive defaults, continued deflation and increased unemployment (and loss of productive output caused by that increased unemployment)

- The Great Depression effectively caused the end of the domestic gold standard in the United States. In 1933, with severe deflation ravaging the economy, Congress and President Roosevelt took the following measures:
  - Devalued the dollar in gold terms
  - Suspended the gold standard (except for foreign exchange)
  - Revoked gold as universal legal tender for debts
  - Banned private ownership of significant amounts of gold coin in order to increase Treasury holdings of gold

- Some parts of Southern Europe (e.g. Greece) are facing a modern form of the same issue via their use of the Euro. Given their severe economic depression, the natural response would be to allow their currency to depreciate, making their products and services less expensive, increasing demand for them and increasing employment

  They are, however, locked into an 'expensive' currency that is functioning like a gold standard and forcing the adjustment in prices to happen through internal devaluation (deflation), which is leading to Depression-level unemployment figures (nearly 30% in Greece)

When Currency Goes Wrong: Hyperinflation

Using German Marks as wallpaper

Zimbabwean Notes, 2008

Image Source: Wikimedia Commons

When Currency Goes Wrong: Hyperinflation

- In extreme circumstances, paper currency is vulnerable to hyperinflation if the money supply is not controlled. Two of the definitive examples in the 20th century came from over-printing to meet war obligations

- **Germany, 1923.** Germany had very high war reparation obligations after World War I that it had to meet in foreign currency. Unable to meet its obligations, it tried to print more Marks to buy foreign currency, triggering a further drop in Marks, necessitating more printing and creating a vicious spiral. Once the Mark was untradeable on foreign markets, the printing was used to finance government operations

  The paper Mark traded at 6.7 Marks to the US dollar in 1919. By November 1923, the US dollar was worth 4,210,500,000,000 Marks

- **Hungary, 1945:** Hungary is believed to have had the single worst episode of hyperinflation in history (for similar reasons – an economy devastated by war and high reparations). Its inflation peak was at 1.3 × 10^16 percent per month (which approximately means that prices doubled every 15 hours)

- Inevitably, in cases of hyper-inflation, the country re-denominates its currency and has to start anew

- While there is no hard line, aside from extreme cases like the above, it is believed that once inflation reaches double-digits, it starts having negative coordination effects in the economy in terms of requiring constant re-adjustment of prices and wages to stay in sync. Most credible modern Central Banks try to keep inflation in the 2-3% range

4. Bitcoin as a currency?

Private currencies: Rationale

A large number of private currencies have been created, either with specific properties in mind (precious metal backing) or with specific uses (in-game or community currencies) by a number of communities or organizations. The reasoning behind their creation has differed, according to who created them, but they usually have fallen in these general categories:

Inflation avoidance by pegging to hard(er) commodities (gold, silver, labor, energy)

Increased velocity of money (due to demurrage – a cost to hold currency), as in the case of the The Wörgl Experiment, therefore promoting increased spending

Ease of access and facilitation of trade, usually within a closed community (private money must be exchanged for conventional currencies, and then used within the community)

Mutual exchange of credit, either in time or in a "local exchange trade system" (LETS)

Private currencies: Limited Scope

- Several thousands of private currencies are currently in use globally
- Pre-Bitcoin private currencies generally had a centralized issuer

  This, as a general rule, has limited their scope to a narrow geographic community, to the environment of their issuer (aka, a game credit) or made them vulnerable to regulatory pressure
- Examples of corporate environment currencies include Facebook credits, “Linden Dollars” for use in Second Life, and even Disney coins that can be exchanged for conventional currencies for use in their theme parks
- Services that have attempted to make commodity backed currencies, such as Liberty Reserve and e-Gold, have run into significant regulatory difficulties, often ending in the dissolution of the issuer and/or criminal charges against the operators, under anti-money-laundering or other criminal statutes. This has demonstrated the significant vulnerability of centralized private currencies toward state actors

Private Currencies: Bitcoin

- Private: Not issued by a sovereign
- Decentralized: No centralized issuing party / counter-party, instead units are issued algorithmically to a decentralized group of parties
- Digital: Fully electronic currency, with no underlying peg to assets or commodities and no necessary physical manifestation
- Cryptocurrency: Anti-counterfeiting is conducted through cryptography

A private decentralized digital cryptocurrency

For discussion: Is Bitcoin a fiat currency (used only by convention) or a commodity-backed currency (where the commodity is the usage of the applications that the Bitcoin network enables)?

Bitcoin: The Blockchain

- Bitcoin's most prevalent innovation is the concept of the "blockchain", a publically reviewable ledger containing a verified record of every transaction. In this sense, individual Bitcoins, the mediums of exchange in this network, exist only as entries in the decentralized Bitcoin ledger of transactions

- From a currency perspective, Nakamoto's work achieved an effect similar to replacing the oral ledger of Yap island, with an irrefutable ledger of transactions on which anyone owning units can "write", and an ownership database that needed no central issuer, controller, verification or storage

- From a computing perspective, this is considered a significant innovation that we will analyze further in the following lecture

Bitcoin: Monetary Policies

The network facilitated by the same protocol has a number of interesting features from a **monetary perspective**.

- **Fixed Supply:** The money supply is regulated from the protocol itself and only 21,000,000 bitcoins (BTC) will ever exist. They are being issued on a declining schedule (currently 25 BTC every approximately 10 minutes)

- **Transparent "monetary policy":** This policy is available to everyone to examine and verify, as the protocol is based on open source code

- **Driven by consensus**: Each user chooses to agree on the proposed set of rules, propose their own, or recreate the whole network with their own set, but independently from the original (as the changes would not be compatible). Key characteristics (like money supply) can't change unless a majority of participants in key parts of the system vote to change them

Bitcoin as a Medium of Exchange

Bitcoin shows very interesting potential as a digital medium of exchange:

- **Highly durable**: No way for it to degrade (it is just code) and the blockchain is backed up on thousands of computers globally
- **Highly portable**: Can transact, without an intermediary, worldwide with notification in seconds, initial confirmation in 10 minutes and near-irreversibility in 1 hour. Can be 'transported' with a simple digital file or memorized passphrase. Note that, in actuality, nothing is being transported, except a means to access (a password or series of letters/words/numbers) the specific bitcoins' ownership.
- **Highly fungible**: The Bitcoin protocol treats each unit and subunit equally.
  Advanced note: All bitcoin transactions are recorded in a publicly available ledger; thus, perfect anonymity in the Bitcoin network is a difficult task. If we think of the Bitcoin network in terms of trace-ability[1], Bitcoin can not be considered as a totally fungible form of currency.
- **Highly divisible**: Each bitcoin can be divided into 100 million units
- **Highly resistant to counterfeiting**: To date, nobody has proposed a solution to break the public-key/private-key cryptography underpinning Bitcoin

[1]http://gendal.wordpress.com/2013/10/26/bitcoin-more-than-a-currency/

Bitcoin as a Unit of Account

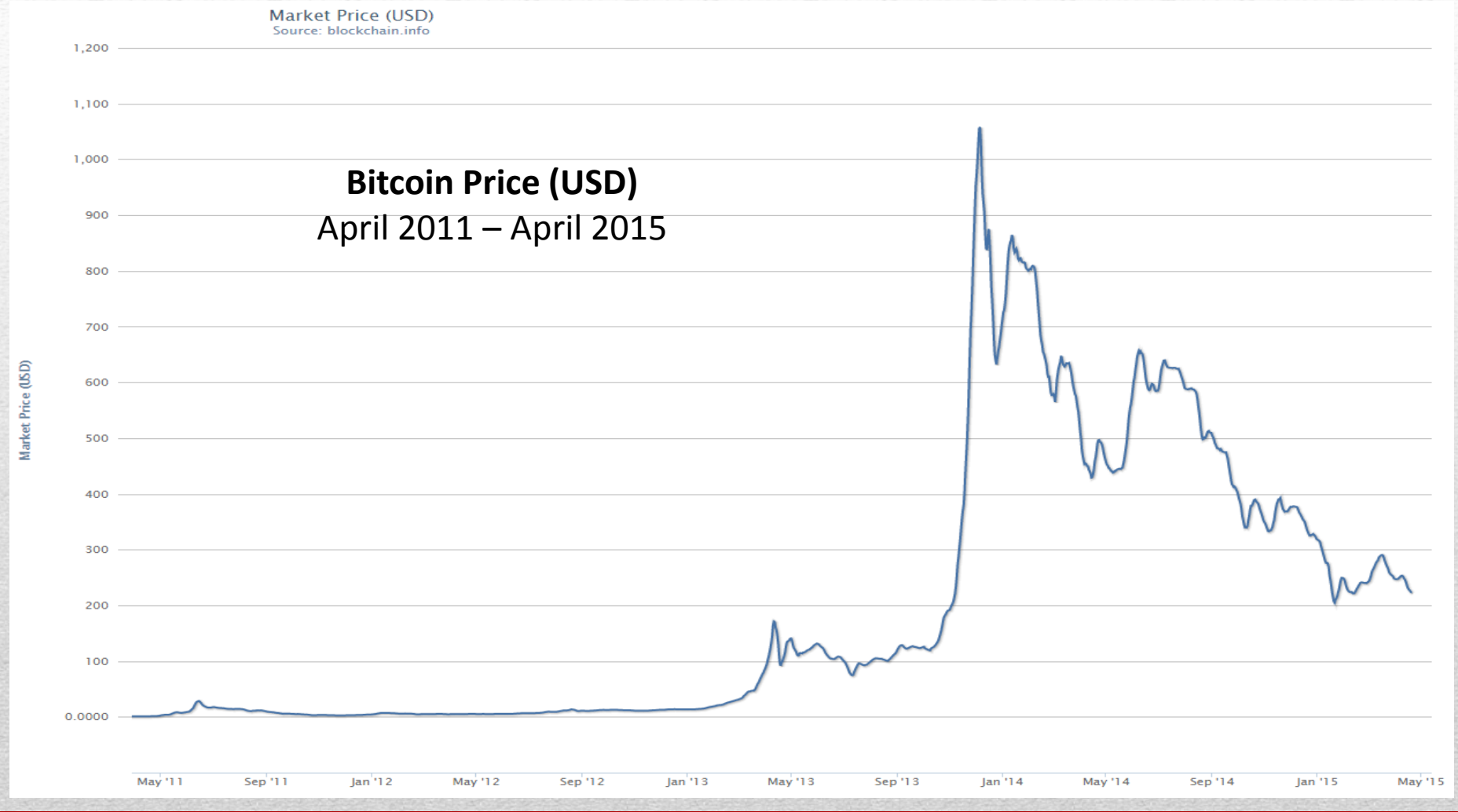
Bitcoin as a Unit of Account

- It would be hard to argue that, to date, Bitcoin would be a viable unit of account. Its price has fluctuated significantly, making meaningful comparisons for items denominated in Bitcoin almost impossible over time

- Could the price become more stable over time? Positive factors:
  - Regulatory environment will become clear over time, reducing one of the factors that impact its price
  - Markets between Bitcoin and fiat currency will become more liquid and perhaps more stable
  - Futures markets will develop between Bitcoin and fiat currency, stabilizing spot prices

- Could the price become more stable over time? Negative factors:
  - No Central Bank to manage supply so price set fully by demand that is subject to usual demand swings
  - Even long standing commodities like gold tend to show greater variability in pricing than fiat currencies for this reason

Bitcoin as a Store of Value



Bitcoin as a Store of Value

- Bitcoin as a store of value is perhaps the single most controversial debate in Bitcoin
  - Supporters would point out that Bitcoin has been an excellent store of value from the perspective that, over time, its price has risen dramatically
  - Detractors point to the high volatility and wonder if there is an underlying source of value in the first place
- What drives value in Bitcoin? Well, like all other assets and currencies, current expectations of future supply and demand:
  - The supply side in Bitcoin is quite predictable as it is based on a mathematical formula
  - The demand side in Bitcoin will be driven by 'what usage cases can be implemented in Bitcoin that can't be implemented without it?'

    If those usage cases are valuable and require Bitcoins to be implemented, then there will be a market demand for Bitcoins and therefore a market price. This is what supporters refer to as the value of the 'network' in Bitcoin

Bitcoin as a Store of Value

- It is likely that the valuation of Bitcoin is somewhat of a self-fulfilling prophecy in both positive and negative directions with multiple equilibria

- A simplistic valuation model of Bitcoin would be:

  Value of transactions conducted in Bitcoin / velocity of money (how long does the user hold the Bitcoins) + discounted present value of (value of future transactions in Bitcoin / future velocity of money)

- Velocity of money is likely to be higher if Bitcoin is viewed as a poor store of value, suppressing the value of Bitcoin and reducing its appeal as a store of value

- Conversely, if Bitcoin is viewed as an acceptable, stable source of value, there will be less pressure to exchange Bitcoin, lowering the velocity of money, increasing its valuation and increasing its appeal as a store of value

Summary

- Currency has three functions:
  - Medium of Exchange
  - Unit of Account
  - Store of Value

  No currency plays all those roles perfectly. There are always trade-offs, between efficiency and stability, ease of use and counterfeitability, inflation risks and deflation risks, and so on

- Currency has passed through the following phases, though long overlapping cycles exist:
  - Barter
  - Primitive Money
  - Commodity Money
  - Fiat Money

- Bitcoin is a new form of currency that is:
  - Private
  - Decentralized, with a fixed algorithmic money supply
  - Possibly commodity-backed

Self-Assessment Exercises

(Pick at least 3 to complete)

1. Post in the appropriate forum thread, 2-3 paragraphs comparing any two types of currencies along the dimensions of the functions of currency and rate their pluses and minuses in this regard

2. Post in the appropriate forum thread, a short paragraph, describing your local currency and how potential changes in its supply or demand you are aware of, have affected its exchange rate over a timeline you choose

3. Post in the appropriate forum thread, research and mention your opinions on why a decentralized currency may have benefits over a centrally issued one for private issuers

4. In the appropriate forum thread, express your opinion in the question in page 37: Is Bitcoin a fiat currency (used only by convention) or a commodity-backed currency (where the commodity is the usage of the applications that the Bitcoin network enables)?

Self-Assessment Exercises

5. Research and post in the appropriate forum thread a brief analysis of a private currency and its characteristics, advantages and disadvantages compared with paper money issued from a central bank. Discuss whether such currencies can address potential deflation risks.

6. Post in the appropriate forum thread 2-3 paragraphs highlighting the special characteristics of Rai in the Yap island, compared to any fiat currency. Discuss on its advantages and disadvantages.

7. All 3 functions of a currency need to exist for it to be widely useful and usable. If you could prioritize these functions from primary importance, to secondary to tertiary, which order of importance would you give them, and why ?

Some Further Reading

The Big Problem of Large Bills: The Bank of Amsterdam and the Origins of Central Banking
Working Paper 2005-16, Federal Reserve Bank of Atlanta
http://www.frbatlanta.org/filelegacydocs/wp0516.pdf, p. 1-11
(interesting history of the early days of the Bank of Amsterdam)

Congressional Research Service, 2011. Brief History of the Gold Standard in the United States
http://www.fas.org/sgp/crs/misc/R41887.pdf
(history of the gold standard in the US)

Money in the Modern economy: An Introduction (Bank of England)
http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/2014/qb14q1prereleasemoneyintro.pdf
(good, basic explanation of modern money)

Monetary Theory and the Great Capital Hill Baby Sitting Co-op Crisis
http://cda.morris.umn.edu/~kildegac/Courses/M&B/Sweeney%20&%20Sweeney.pdf
(An amusing story of inflation and deflation in a commodity-backed paper currency that was backed by baby-sitting hours)

Digital Currency: New Private Currencies Like Bitcoin Offer Potential and Puzzles
Econ Focus, Q3, 2013, Federal Reserve Bank of Richmond
http://www.richmondfed.org/publications/research/econ_focus/2013/q3/pdf/feature1.pdf
(a brief overview of Bitcoin from a Central Banker's perspective)

Some Further Reading

Nick Szabo : Shelling Out – The Origins of Money
http://szabo.best.vwh.net/shell.html

Why Bitcoin Matters, Marc Andreessen
http://dealbook.nytimes.com/2014/01/21/why-bitcoin-matters/
(article explaining the basic Bitcoin characteristics, by a Bitcoin evangelist)

Bitcoin's future - Hidden flipside, How the crypto-currency could become the internet of money
http://www.economist.com/news/finance-and-economics/21599054-how-crypto-currency-could-become-internet-money-hidden-flipside
(article on the Economist, explaining a preliminary form of money and its correlation to Bitcoin)

Andreas Antonopoulos: "Mastering Bitcoin, Unlocking Digital Crypto-Currencies"
https://github.com/aantonop/bitcoinbook/blob/develop/ch01.asciidoc
(book available for purchase, but also in Github for public feedback and contribution)

Wences Cesares : What is Bitcoin ?
https://www.linkedin.com/pulse/20141120164624-208991-what-is-bitcoin
(overview of Yap and it's parallels with Bitcoin)

David Graeber : Debt: The First 5000 Years,
http://libcom.org/files/__Debt__The_First_5_000_Years.pdf
https://www.youtube.com/watch?v=CZIINXhGDcs
(Video lecture on the book by the author, relevant to debt as a precursor to barter)

Questions?

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