Principles of Money, Banking and Finance

Balance Sheets , Money Creation and Stable Coins

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Learning objectives

- Understand how money is created and destroyed
- Understand settlement process
- Understand banking intermediation
- Understand the creation of stable coins

Session outline

- Central Bank and commercial bank balance sheets

- Interbank transactions

- Settlement systems

- Creation and distraction of money

- Stable coins

Section 1: Balance Sheets

Balance sheets in the Economy

- View the economy as a set of interrelated balance sheets.

- Banknotes are obligations of the central bank and are held as assets by households and businesses.

- Deposits are liabilities of commercial banks and are held as assets from households and businesses.

- Loans are liabilities of households and businesses and are held as assets from commercial banks.

- When a bank / business / household has a negative equity position, it becomes insolvent because equity has zero value and the value of the assets is insufficient to meet creditors' liabilities.

- Money consists of two main components, depending on the issuer. The first is the so-called "outside money", called the "monetary base", consisting of banknotes issued by the central bank, as well as commercial bank deposits with the central bank. Outside money is an asset of the private sector and is a liability of the central bank. The second component is "inside money", which includes the various types of deposits which are a liability of the commercial banks and an asset of households and businesses.

Balance sheets in the Economy (Outside versus Inside Money)

Table 1: Balance sheets of central bank, commercial banks, households and businesses

Central Bank	
Assets	**Liabilities**
Gold FX reserves Loans to banks Securities Other assets	Deposits of commercial banks Deposits of Central Government Banknotes Other liabilities Net worth

| Commercial Banks		Households/Businesses	
Assets	**Liabilities**	**Assets**	**Liabilities**
Banknotes Deposits at the CB Loans Other investements	Deposits Market financing Net worth	Banknotes Deposits Real Estates Other assets	Loans Other liabilities Net worth

Interbank Transactions

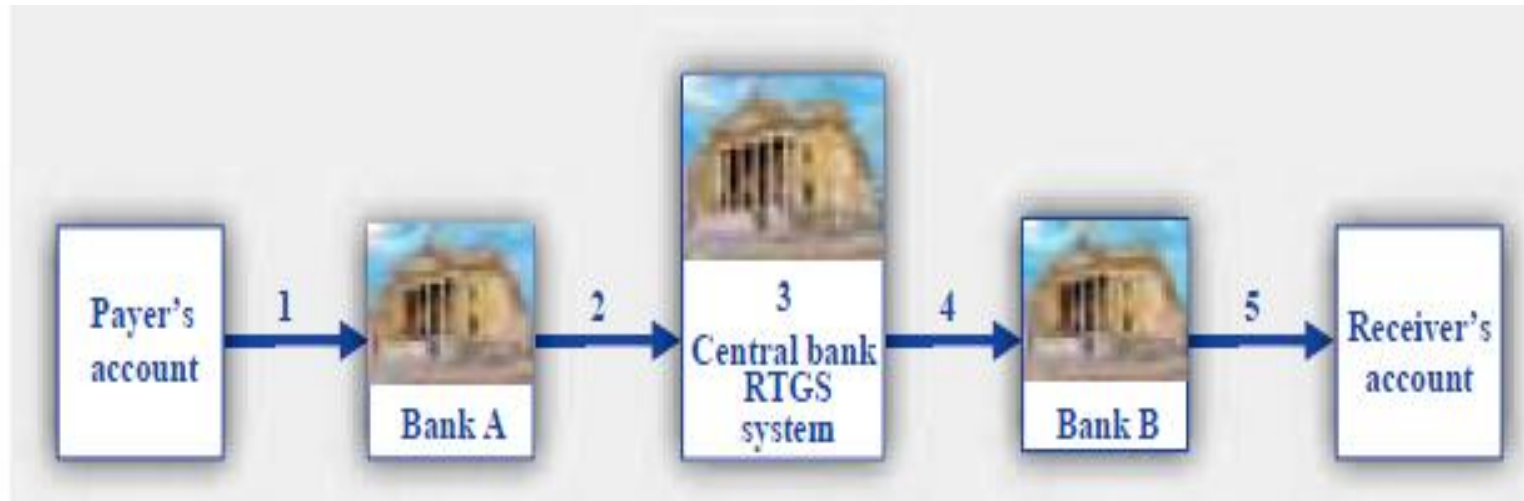*Real-Time Gross Settlement, RTGS systems*
In these payment systems, transactions are settled on a real-time basis
Designated-time Net Settlement systems, DNS systems.
These systems work on a net basis by clearing of debit and credit positions of all system members.
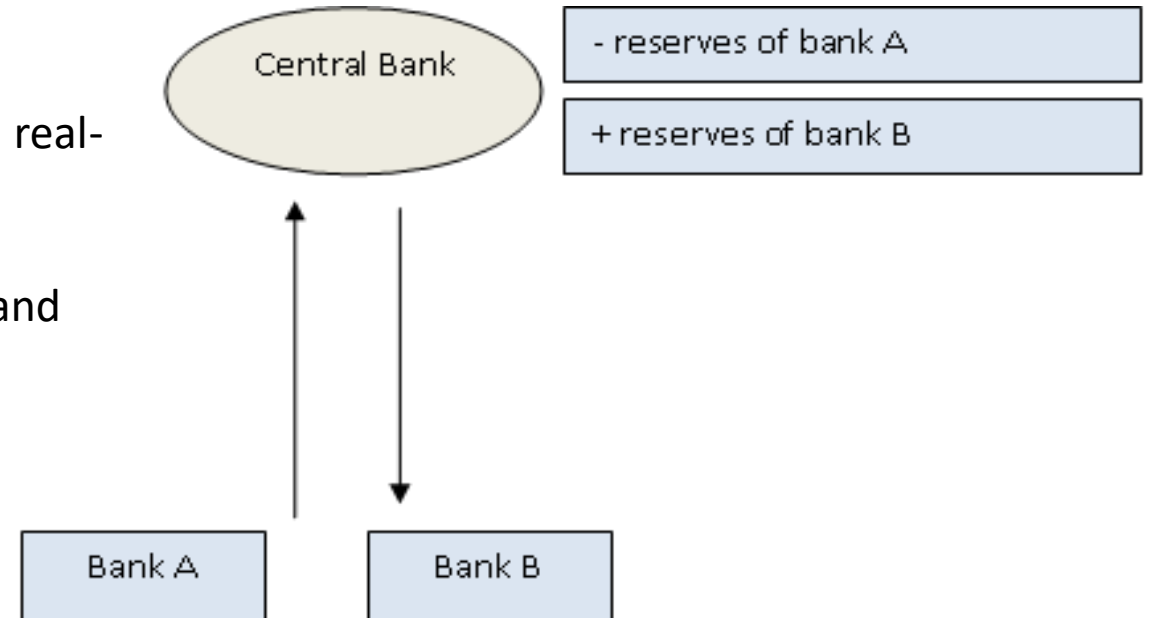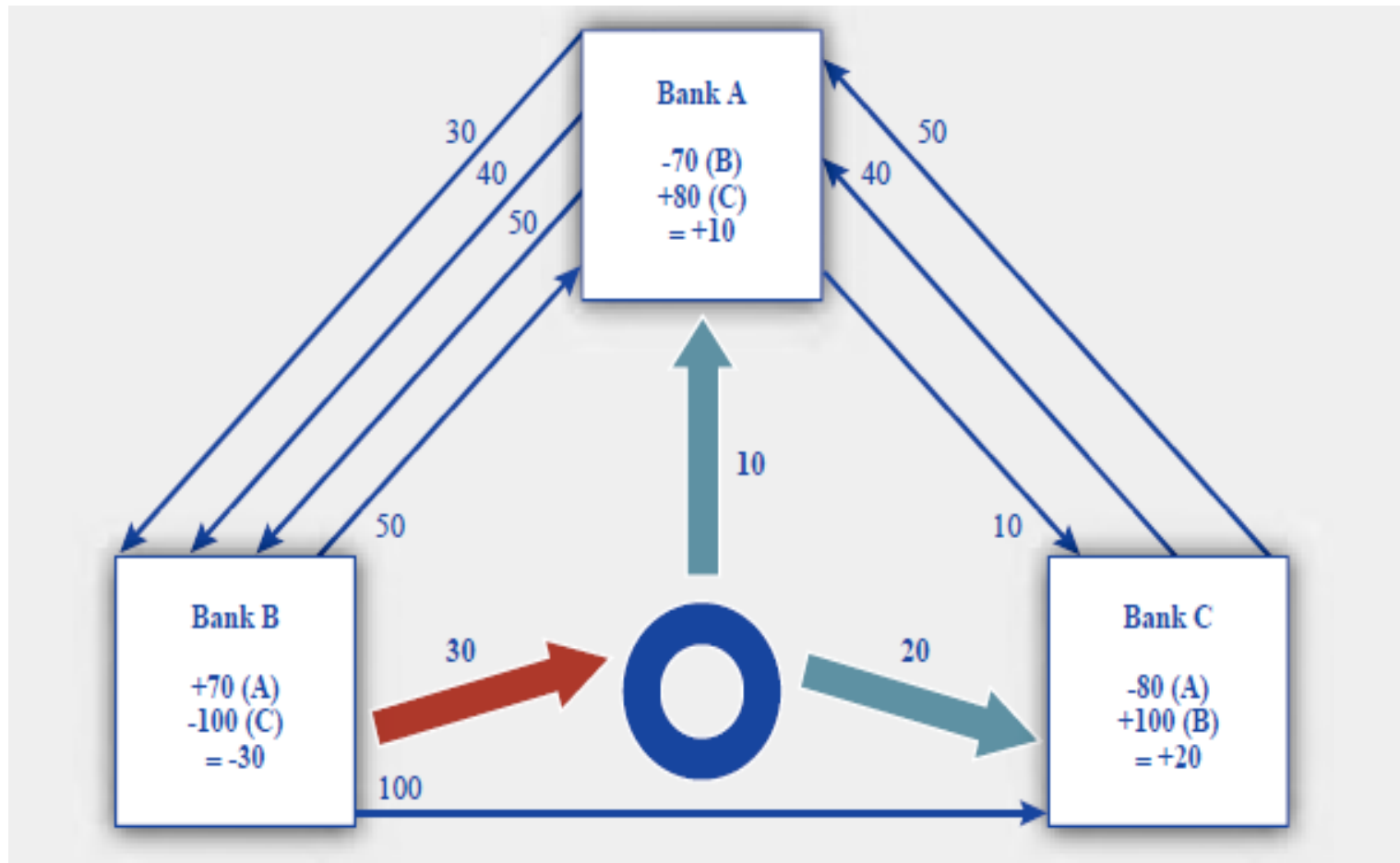
System RTGS. Settlement with central bank money

Transfer of bank deposit (central bank settlement)

Deposit Transfer

Central Bank	
Assets	**Liabilities**
Gold FX reserves Loans to banks Securities Other assets	Bank A reserves -100 Bank B reserves +100 Banknotes Other liabilities Net worth

Commercial Bank A		Commercial Bank B	
Assets	**Liabilities**	**Assets**	**Liabilities**
Banknotes Deposits at the CB -100 Securities Other assets	Deposits -100 Market-financing Net worth	Banknotes Deposits at the CB +100 Securities Other assets	Deposits +100 Market-financing Net worth

Multilateral net settlement system

(Source: Kokkola, 2010)

FX settlement with access to payment systems

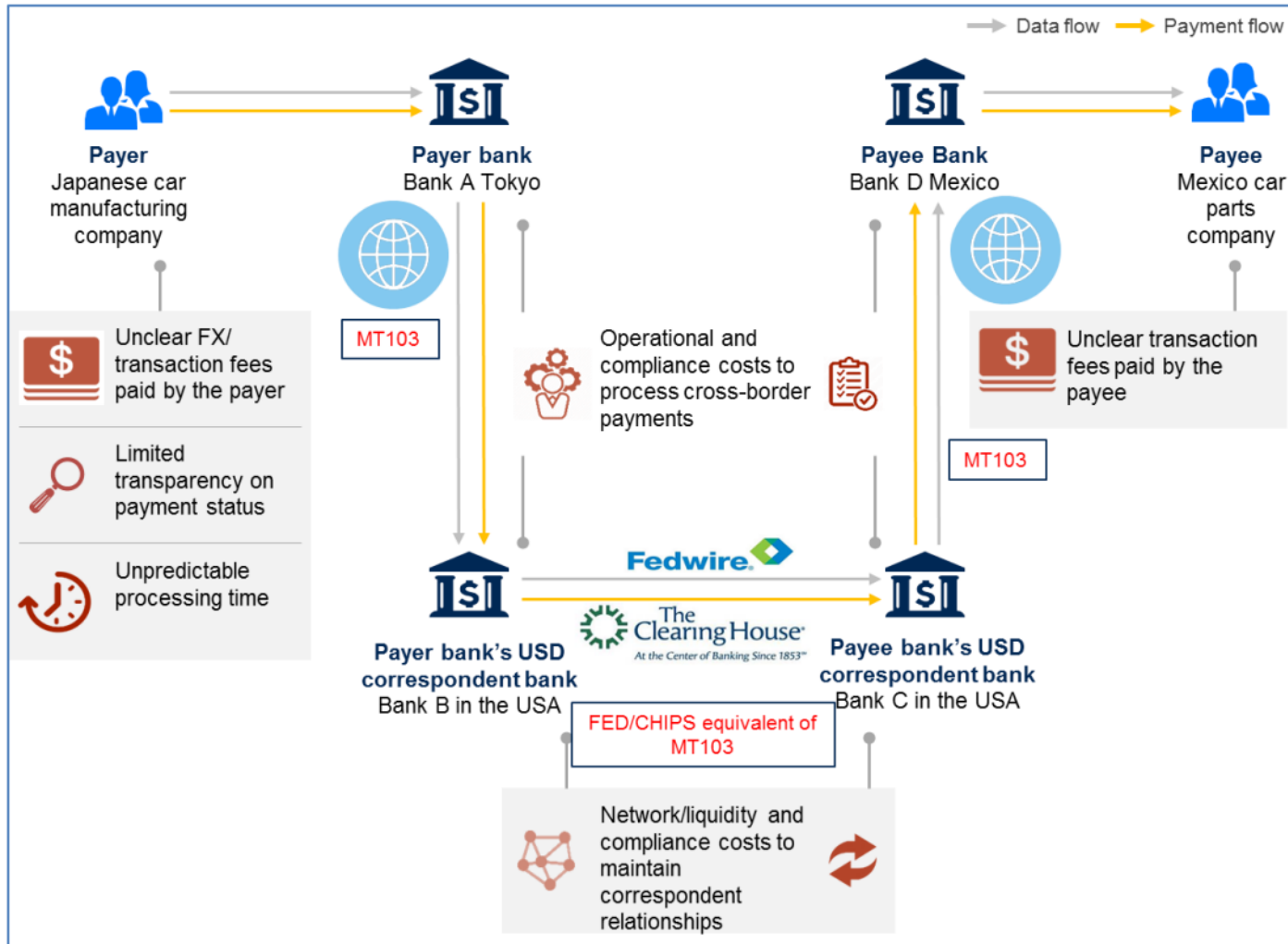**FX settlement with direct access to central bank payment systems**

ECB - euro	
Assets	**Liabilities**
Gold FX reserves Loans to banks Securities Other assets	Bank A reserves -100 euros Bank B reserves +100 euros

FED - dollars	
Assets	**Liabilities**
Gold FX reserves Loans to banks Securities Other assets	Bank B reserves -110 dollars Bank A reserves +110 dollars

Commercial Bank A	
Assets	**Liabilities**
Deposits at the ECB -100 euros Deposits at the FED +110 dollars	Deposits Market-financing Net worth

Commercial Bank B	
Assets	**Liabilities**
Deposits at the FED -110 dollars Deposits at the ECB +100 euros	Deposits Market-financing Net worth

FX settlement with correspondent banks

ECB - euro	
Assets	**Liabilities**
Gold FX reserves Loans to banks Securities Other assets	Bank A reserves -100 euros Correspondent bank of Bank B reserves +100 euros

FED - dollars	
Assets	**Liabilities**
Gold FX reserves Loans to banks Securities Other assets	Bank B reserves -110 dollars Correspondent bank of Bank A reserves +110 dollars

Commercial Bank A	
Assets	**Liabilities**
Deposits at the ECB -100 euros Deposits at correspondent bank +110 dollars	Deposits Market-financing Net worth

Commercial Bank B	
Assets	**Liabilities**
Deposits at the FED -110 dolar Deposits at correspondent bank +100 euros	Deposits Market-financing Net worth

Correspondent bank of Bank B	
Assets	**Liabilities**
Deposits at ECB + 100 euros	Deposits of Bank B +100 euros Market-financing Net worth

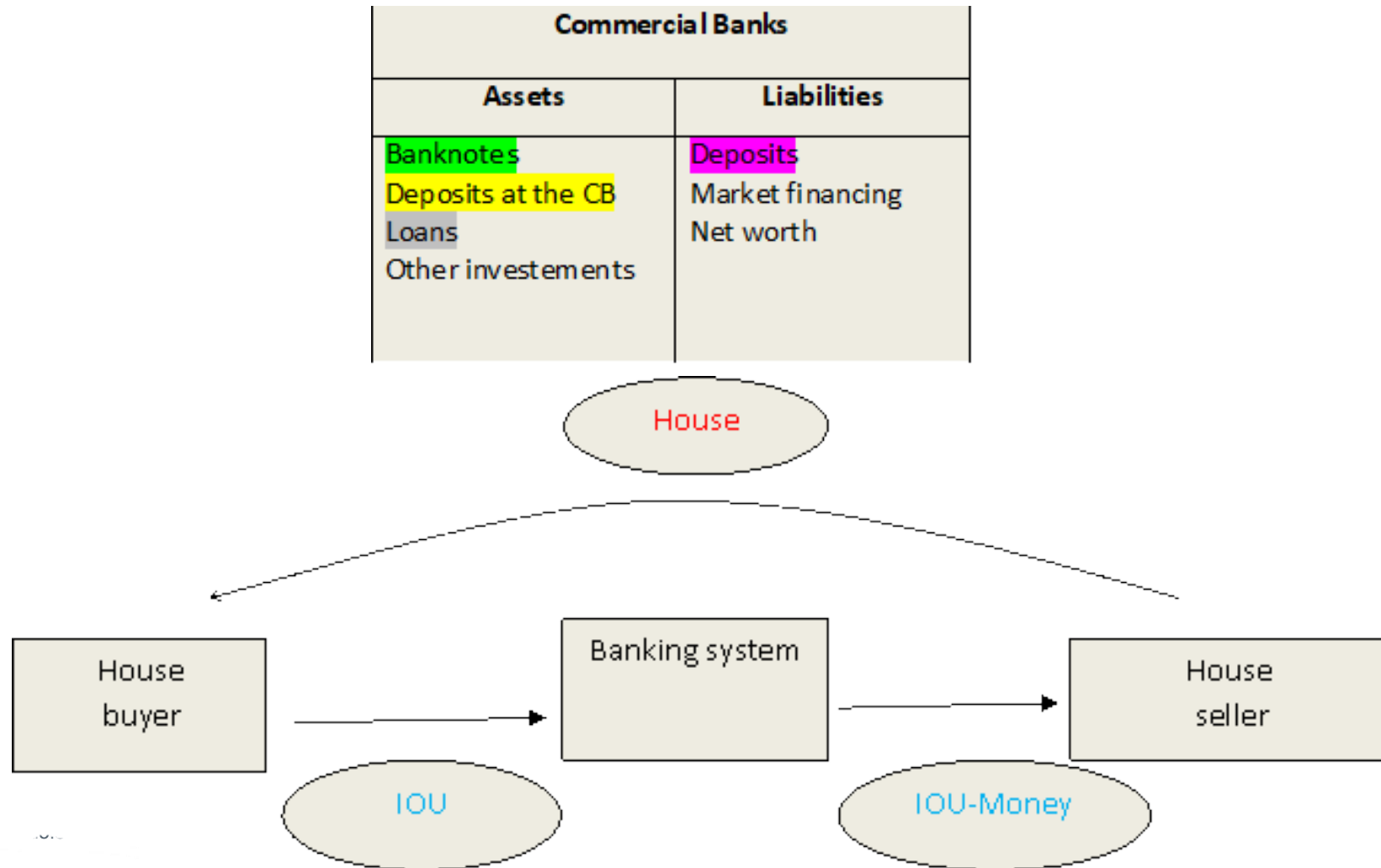| Correspondent bank of Bank A	
Assets	**Liabilities**
Deposits at the FED +110 dollar	Deposits of Bank A +110 dollars Market-financing Net worth

FX settlement with correspondent banks

Continuous Linked Settlement (CLS) system
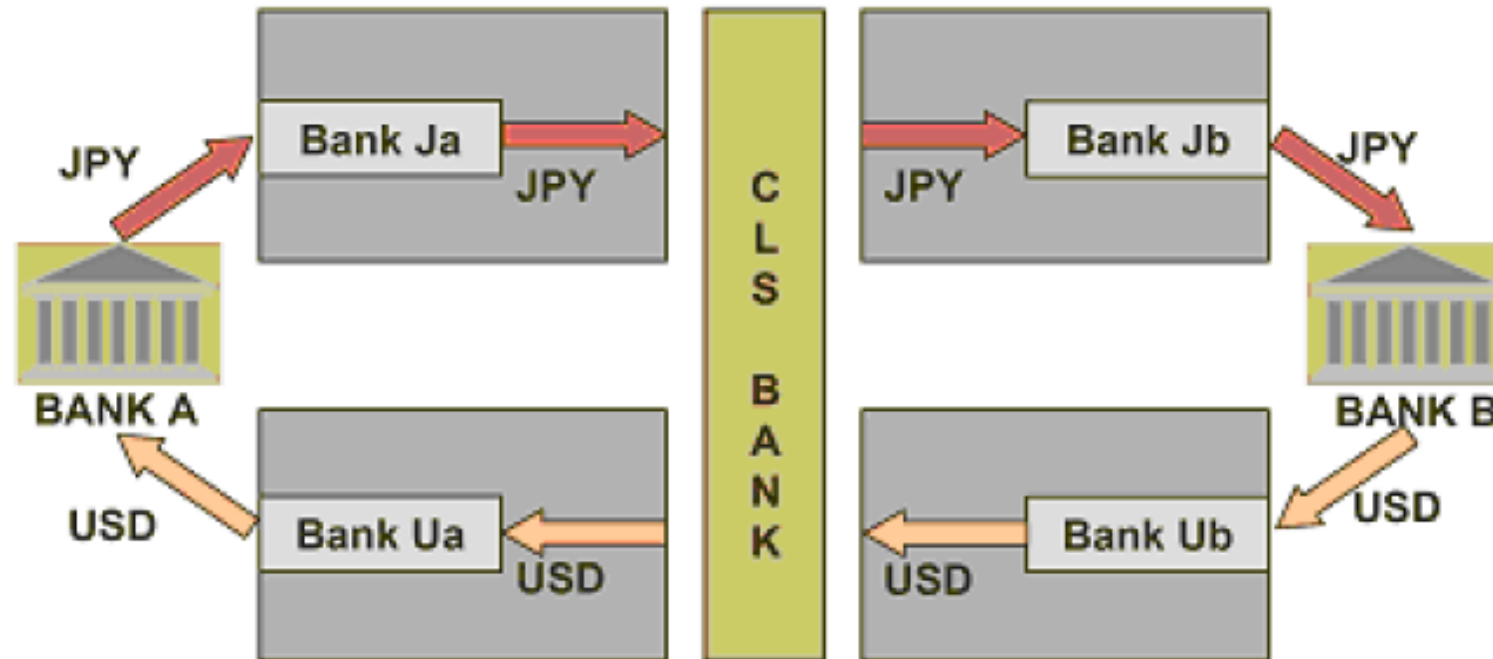
Source: BIS

Money is a financial liability of the banking sector. It is created endogenously when banks provide new credit (inside money)

Commercial Banks	
Assets	**Liabilities**
Banknotes	Deposits
Deposits at the CB	Market financing
Loans	Net worth
Other investements	

House

House buyer → Banking system → House seller

IOU

IOU-Money

Money creation through the provision of new loans

New Loan

Commercial Bank A

Assets	Liabilities
Reserves <mark>Loans +100</mark> Other assets	<mark>Borrower's deposit +100</mark> Market-financing Net worth

House Purchase

Commercial Bank A

Assets	Liabilities
<mark>Loans +100</mark> <mark>Reserves -100</mark> Other assets	<mark>Borrower's deposit -100</mark> Market-financing Net worth

Central Bank

Assets	Liabilities
	<mark>Bank A reserves -100</mark> <mark>Bank B reserves +100</mark>

Commercial Bank B

Assets	Liabilities
<mark>Reserves +100</mark> Other assets	<mark>Property seller's deposit +100</mark> Market-financing Net worth

Creation and destruction of money when loans are repaid

- When a loan is repaid, that is, the borrower repays the money, a claim and a deposit of equal value are erased from the balance sheets of the banking system. Repaying a loan reduces bank deposits and "destroys" part of the existing deposits.

Commercial Bank A	
Assets	**Liabilities**
Reserves	Borrower's deposit - 100
Loans -100	
Other assets	Market-financing
	Net worth

Creation and destruction of money when loans are repaid

- Minsky (1986, p. 249), —Money is unique in that it is created in the act of financing by a bank and is destroyed as the commitments on debt instruments owned by banks are fulfilled. Because money is created and destroyed in the normal course of business, the amount outstanding is responsive to the demand for financing. Banks are important exactly because they do not operate under the constraint of a money lender -banks do not need to have money on hand in order to lend money.

Minsky, H.P., (1986), Stabilizing an Unstable Economy, New Haven, CT: Yale University Press.

Source: Lorem ipsum dolor sit amet

Creation and destruction of money in the banking system

- Are there any limits to the amount of loans and deposits that banks can create?

- Deposits are endogenously created by the banking system, but there are parameters that impose significant constraints on new lending and consequently on the creation of new deposits.

- Banks issue new loans when their profit margin is satisfactory and when credit risk is low, so the growth rate of lending depends on the phase of the financial cycle. Lending is also subject to restrictions due to the banking regulatory framework and capital adequacy rules (equity constrained), and is affected by the behavior of households and businesses, as well as their willingness to take out new loans.

- Of course, one important factor in limiting money creation through lending is the central bank's monetary policy through interest rate changes. Increasing interest rates makes it harder to borrow because it increases the cost of repaying loans, and a corresponding reduction in interest rates makes it easier to borrow because it reduces the cost of repaying loans.

Source: Lorem ipsum dolor sit amet

Creation and destruction of money in the banking system

- Suppose that the aggregate bank balance sheet consists of Assets = loans + reserves + other investments and Liabilities = deposits + borrowing + net worth. It follows that:

$$\Delta(\text{deposits}) = -\Delta(\text{borrowing}) - \Delta(\text{net worth})$$

$$+\Delta(\text{loans}) + \Delta(\text{reserves}) + \Delta(\text{other investments})$$

Creation and destruction of money in the banking system

- Deposits decrease/increase when banks increase/decrease borrowing from non-banks or from individual investors (for example, with repos or by issuing bonds).

- Deposits decrease when banks issue new equity or retain profits and deposits increase when banks pay dividends or buyback stocks.

- Deposits decrease/increase when loans decrease/increase.

- Deposits decrease when reserves decrease because the central bank is selling assets to non-banks and deposits increase when the central bank is buying assets from non-banks.

- Deposits decrease when banks sell some of their assets (e.g., government bonds) to non-banks and deposits increase when banks buy assets from non-banks.

Central Bank Asset Purchases (secondary market) from Banks & Private Sector

Quantitative Easing – Buying securities from MFIs

Central Bank	
Assets	**Liabilities**
Securities ↑	Reserves ↑ MFI

MFIs	
Assets	**Liabilities**
Reserves at the CB ↑	
Securities ↓	

non MFIs	
Assets	**Liabilities**

Central Bank	
Assets	**Liabilities**
Securities ↑	Reserves ↑ MFIs

MFIs	
Assets	**Liabilities**
Reserves at the CB ↑	Non MFIs ↑ Deposits

non MFIs	
Assets	**Liabilities**
Securities ↓	
Deposits ↑	

Increase in deposits

Government Issues Bonds (to finance deficit) which are purchased by Banks

Central Bank		MFIs		non MFIs	
Assets	**Liabilities**	**Assets**	**Liabilities**	**Assets**	**Liabilities**
		Bonds ↑	Non MFIs Deposits ↑	**Deposits** ↑	

Banks buy assets from the non-financial sector

Central Bank		MFIs		non MFIs	
Assets	**Liabilities**	**Assets**	**Liabilities**	**Assets**	**Liabilities**
		Assets ↑	Non MFIs Deposits ↑	**Deposits** ↑	

Surge in M1! Why?

Source: Board of Governors of the Federal Reserve System (US)   myf.red/g/JalE

https://fred.stlouisfed.org/series/M1SL

M2

https://fred.stlouisfed.org/series/M1SL

M3

Source: Organization for Economic Co-operation and Development   myf.red/g/NACJ
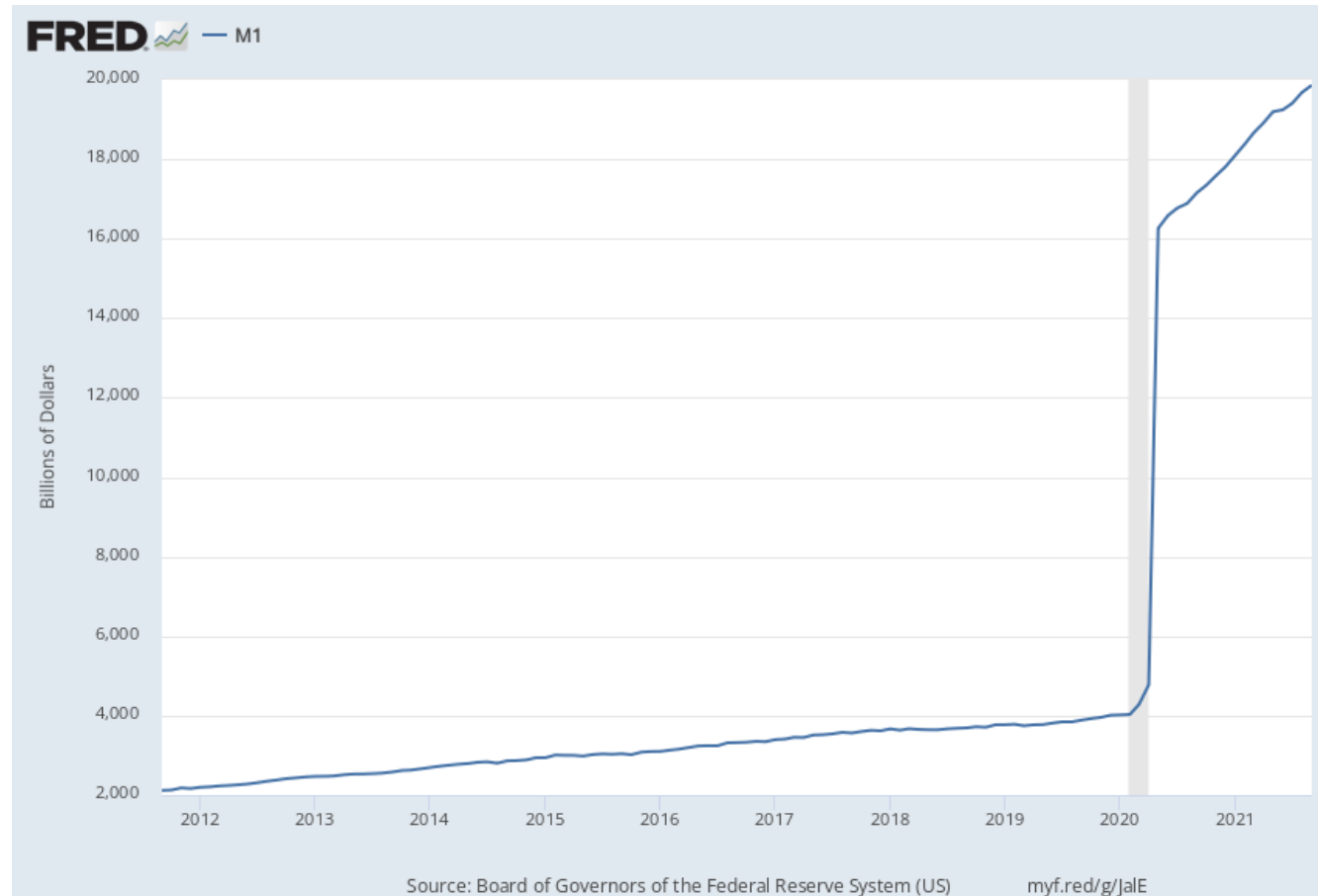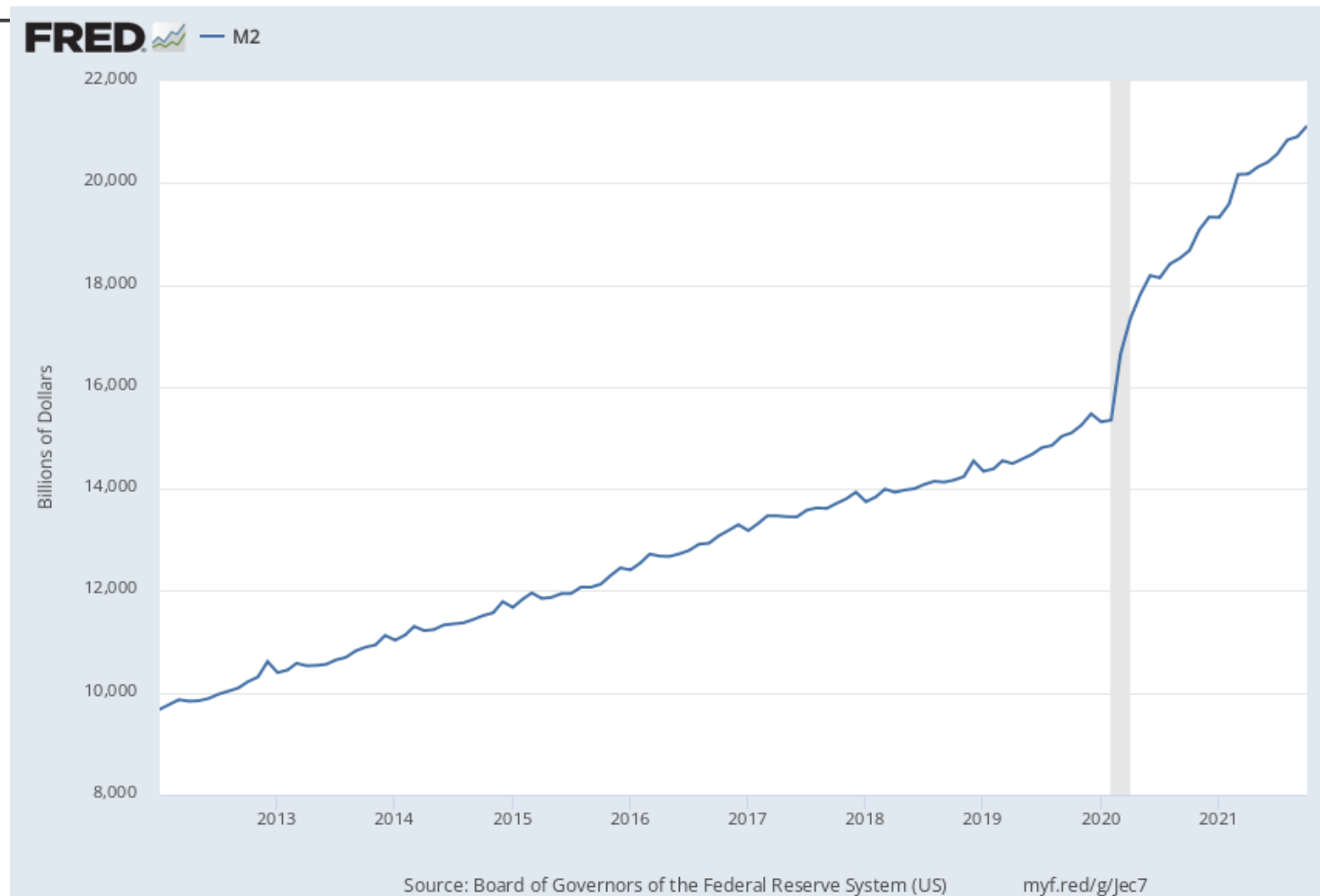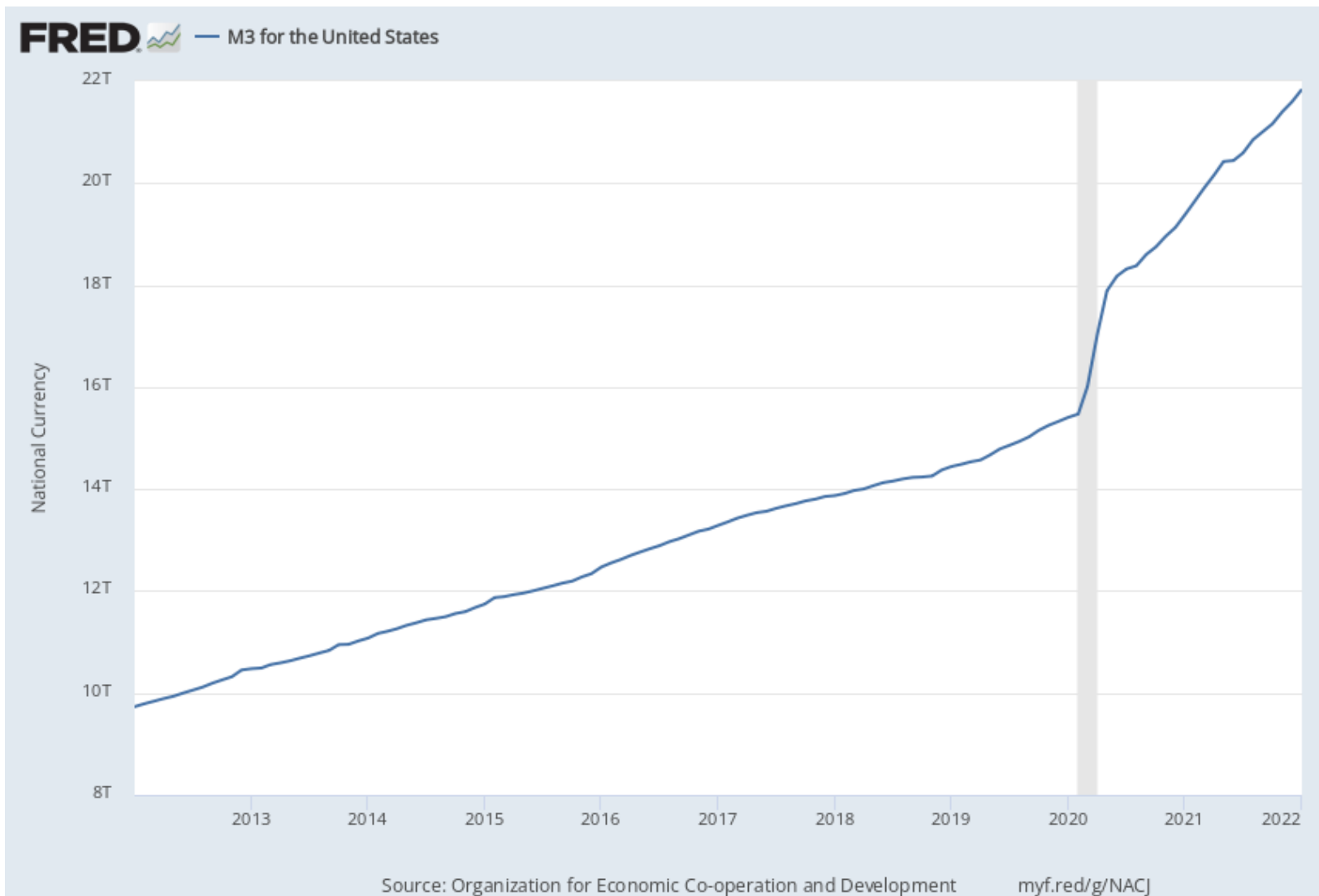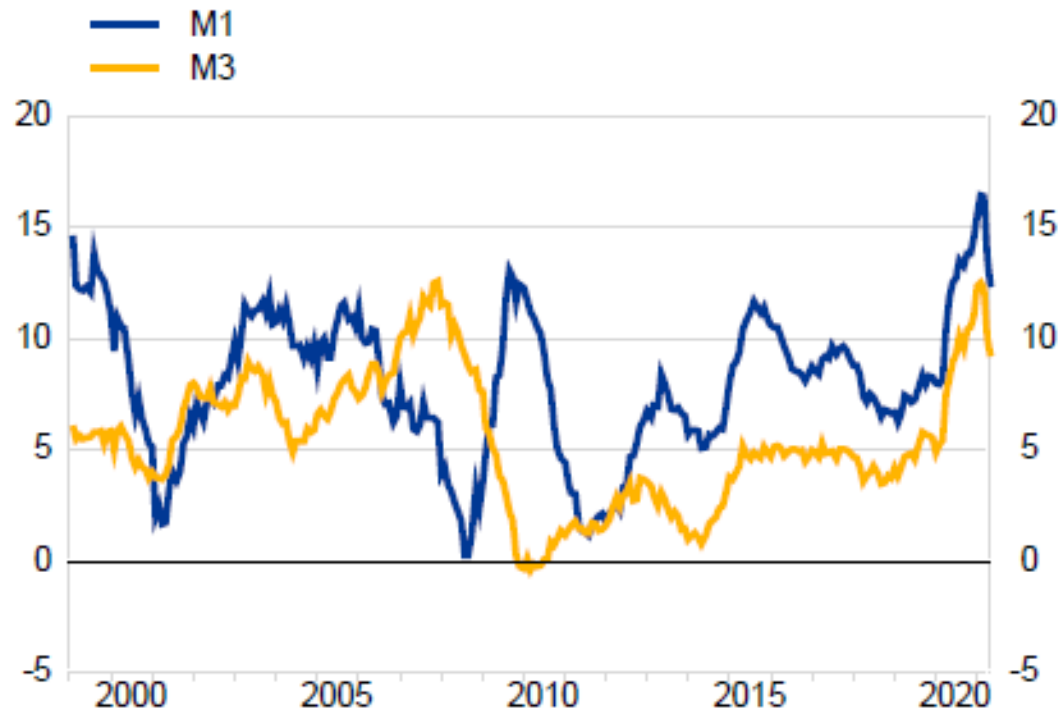
Federal Surplus or Deficit [-] as Percent of Gross Domestic Product
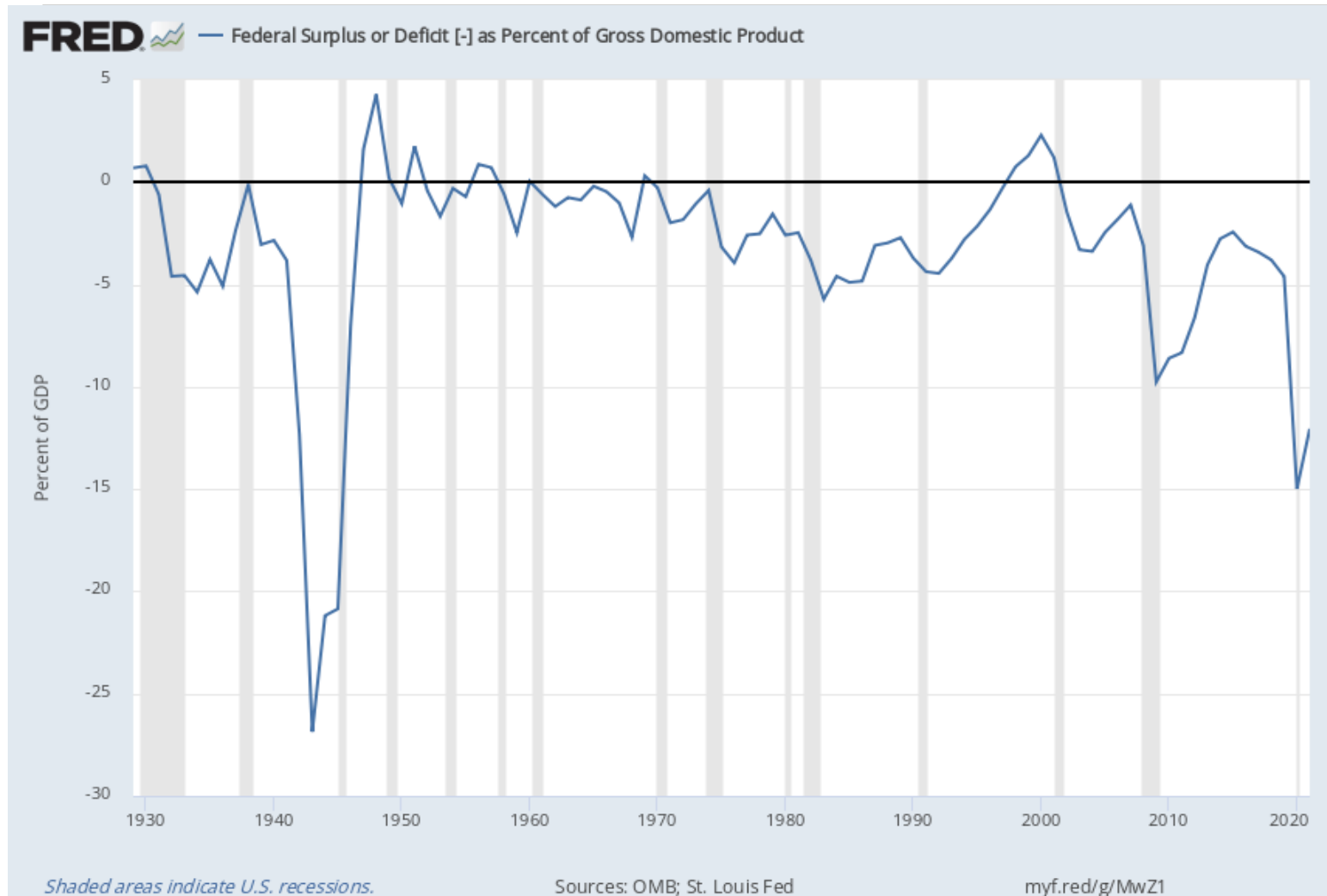
Real GDP
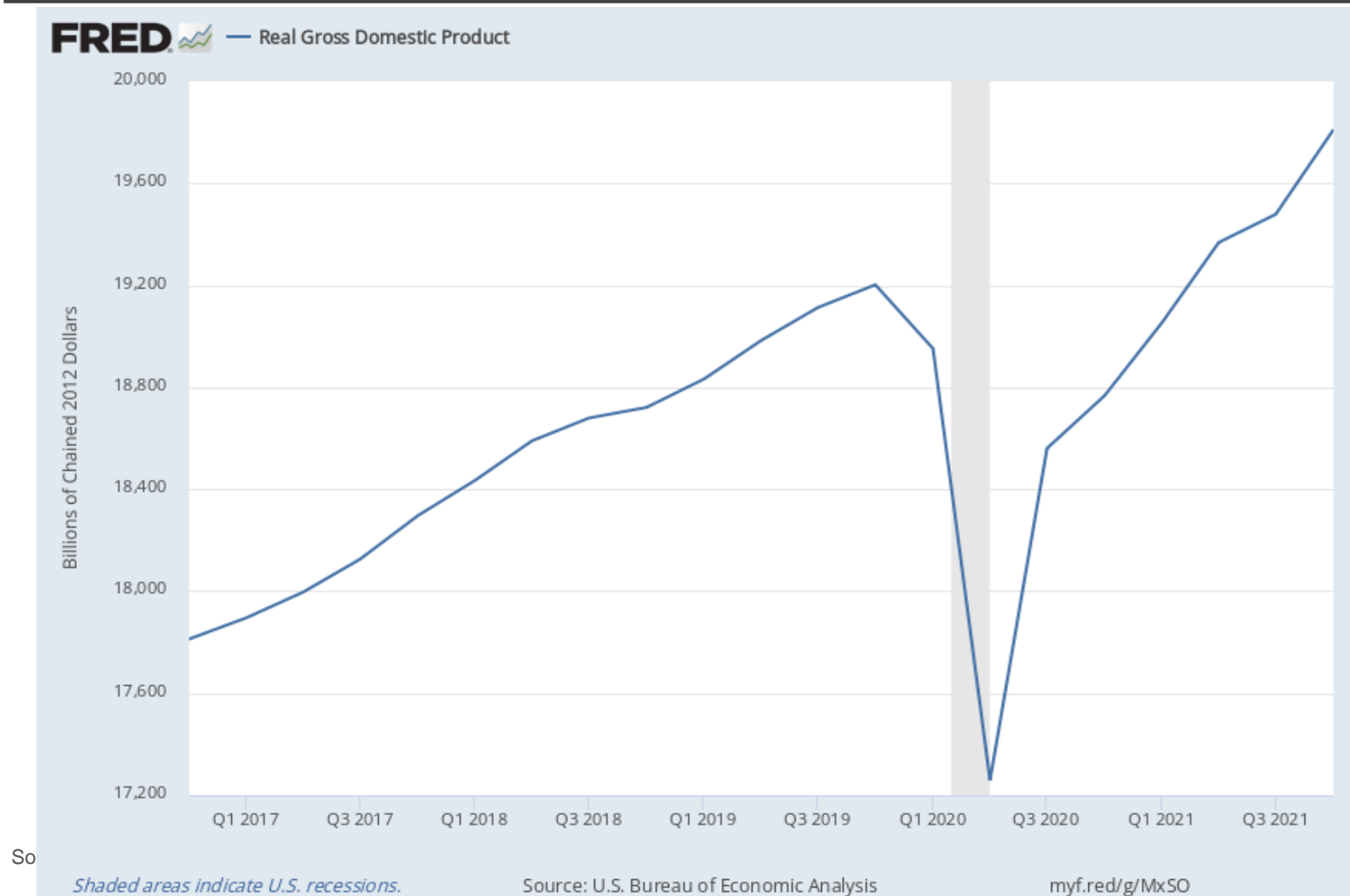
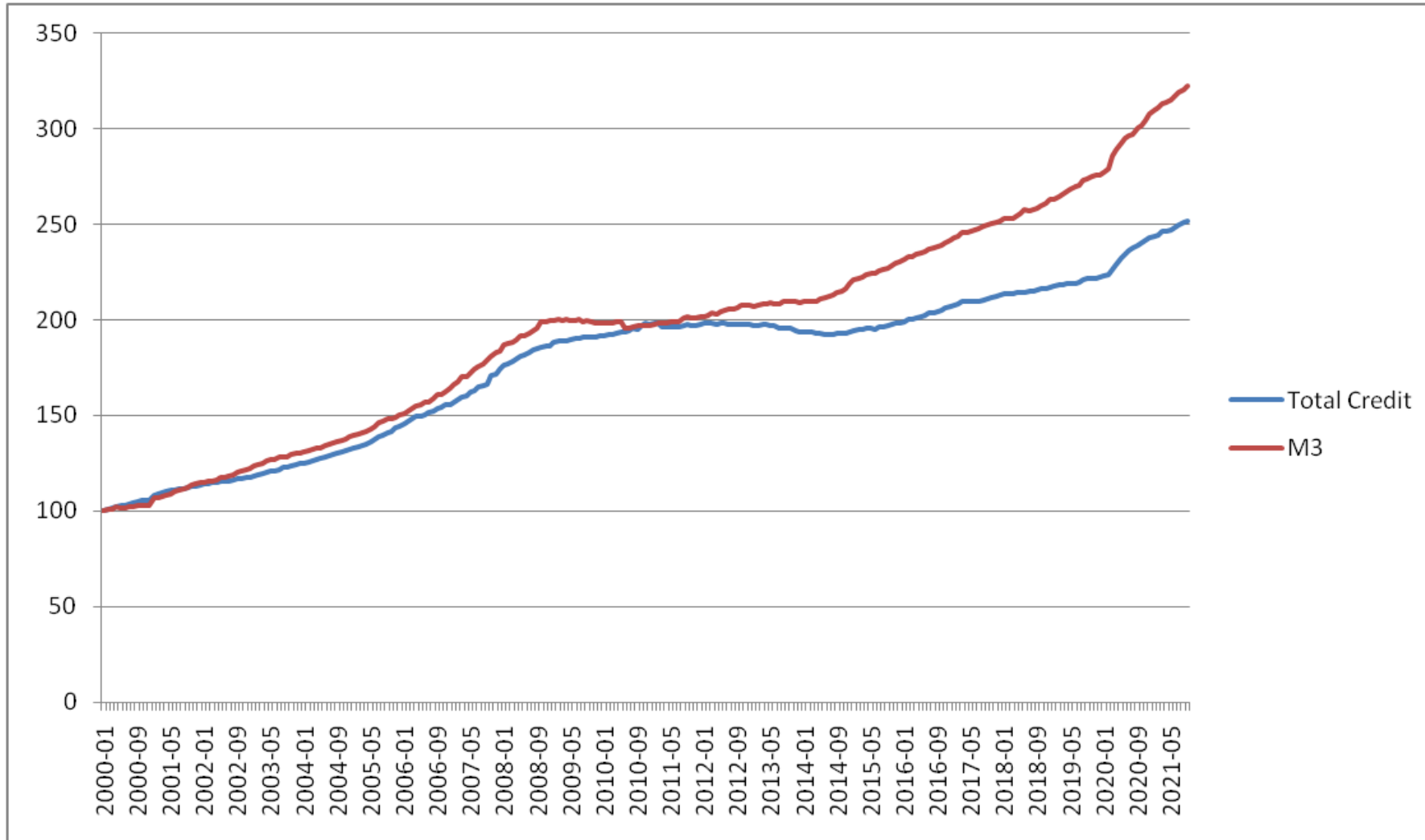# Eurozone

1.2 Monetary aggregates
(annual growth rates; seasonally adjusted)

— M1
— M3

1.3 Counterparts
(annual growth rates; seasonally adjusted)

— longer-term financial liabilities
— credit to general government
— loans to other euro area residents
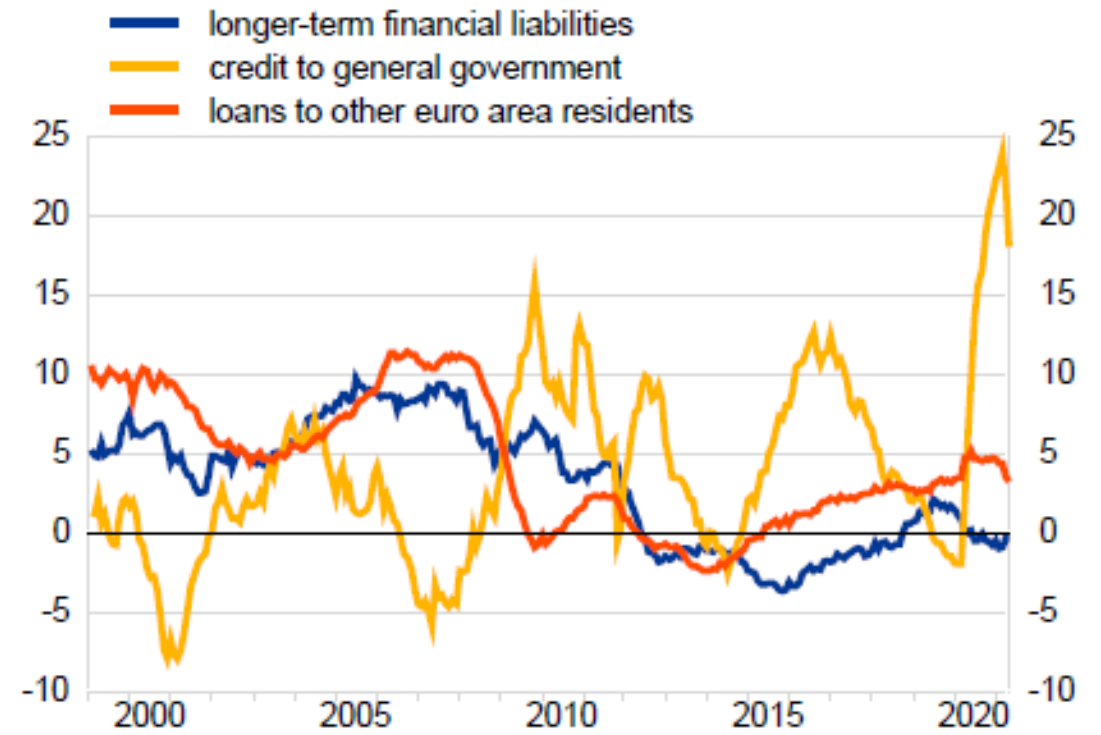
Eurozone Total Credit/M3

Eurozone- Total Credit/M3/Monetary Base
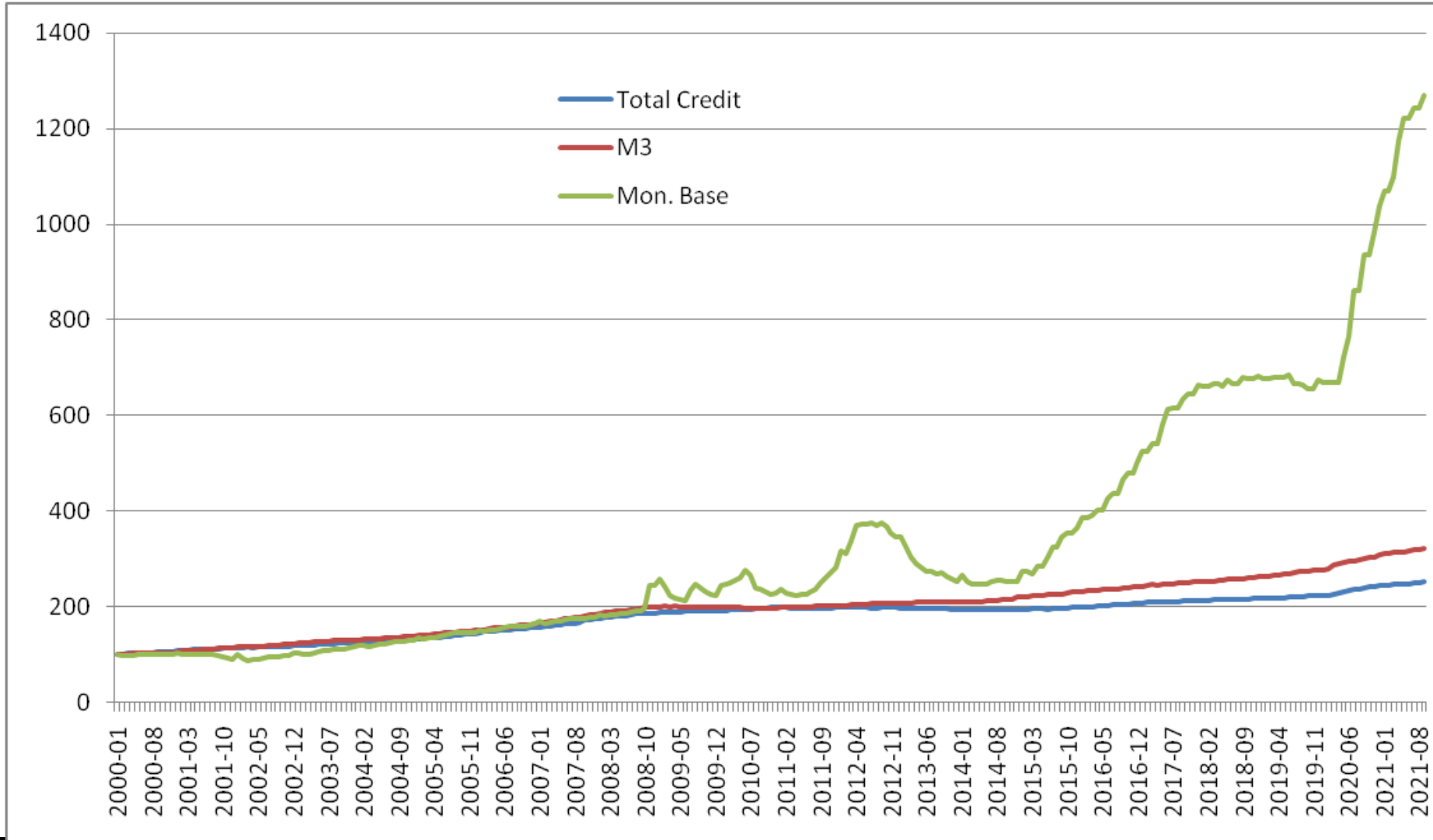
Section 2: Stable Coins

Centralized versus Decentralized

Source: Baran, 1964

Centralized systems	Decentralized systems	Distributed systems
The conventional banking system with the Central Bank as the central node.	The conventional payment system with direct interaction of users with different banks and payment providers. The Central Bank again acts a central node.	Peer-to-peer payment. Peers collectively maintain and operate the system (the database of all transactions). Users communicate with each other and settlement is automatic.

Source: Lorem ipsum dolor sit amet

Distributed Ledger Technology (DLT)

- Traditionally, information has been recorder in centralized databases. The distributed ledger technology is decentralized database that can be used in order to record information.

- The distributed ledger technology was developed in computer science research by Haber and Stornetta (1991, 1997), who highlighted the cryptographic benefits of hash-linked, chronologically ordered and time stamped records.

- Under this structure, past records are particularly difficult – if not impossible – to change ex post. This is because each data block contains a difficult-to-reverse reference to the previous block (via a complex enough hash function), and thus effectively contains references to all previous blocks.

- The information stored can vary from transaction data to real and financial asset ownership and other recordings.

- DLT "have the potential has the potential to be as ground-breaking as the invention of double-entry bookkeeping in 14th century Italy".

- The Blockchain used by bitcoin is a particular type of distributed ledger technology.

Source: Lorem ipsum dolor sit amet

Public Ledger

- Bitcoin payments are recorded in a ledger which is publicly available. The public ledger records all bitcoin payments made since the digital currency was created in 2009. https://blockchain.info/

| Public Ledger	
Address	**Bitcoin Balance**
13PkmTRamYQ9zVnhfG9W8ZBV6MUeaFzpd3	10.1267
1H6ZZpRmMnrw8ytepV3BYwMjYYnEkWDqVP	5.2345
1EmSRLsXg8yaQX8xe9QLoyxz9KVuBDrcJJ	0
……………..	

Source: Lorem ipsum dolor sit amet

Link between the blocks through the hash values to create a secure and immutable ledger

Block 1 Transaction	
Genesis Hash:	0
Transaction:	IOU=3
Nonce:	0
Block 1 Hash:	04433e759fca782671ac268f5e8b1e949110972eda87dce257f4958d2f191151

Block 2 Transaction		
Block Hash:	1	04433e759fca782671ac268f5e8b1e949110972eda87dce257f4958d2f191151
Transaction:		IOU=2
Nonce:		5
Block Hash:	2	039167a955a23a8c0cca113990de968303a7cdaa2647209cde49ad948f345dd3

Block 3 Transaction		
Block Hash:	2	039167a955a23a8c0cca113990de968303a7cdaa2647209cde49ad948f345dd3
Transaction:		IOU=30
Nonce:		18
Block Hash	3	09176be95b89c839d2332fa5ed6d62638b2459fbf1b05081f37c20672ee8c7e4

Source: Lorem ipsum dolor si

Bitcoin daily volatility (rolling 90-day)
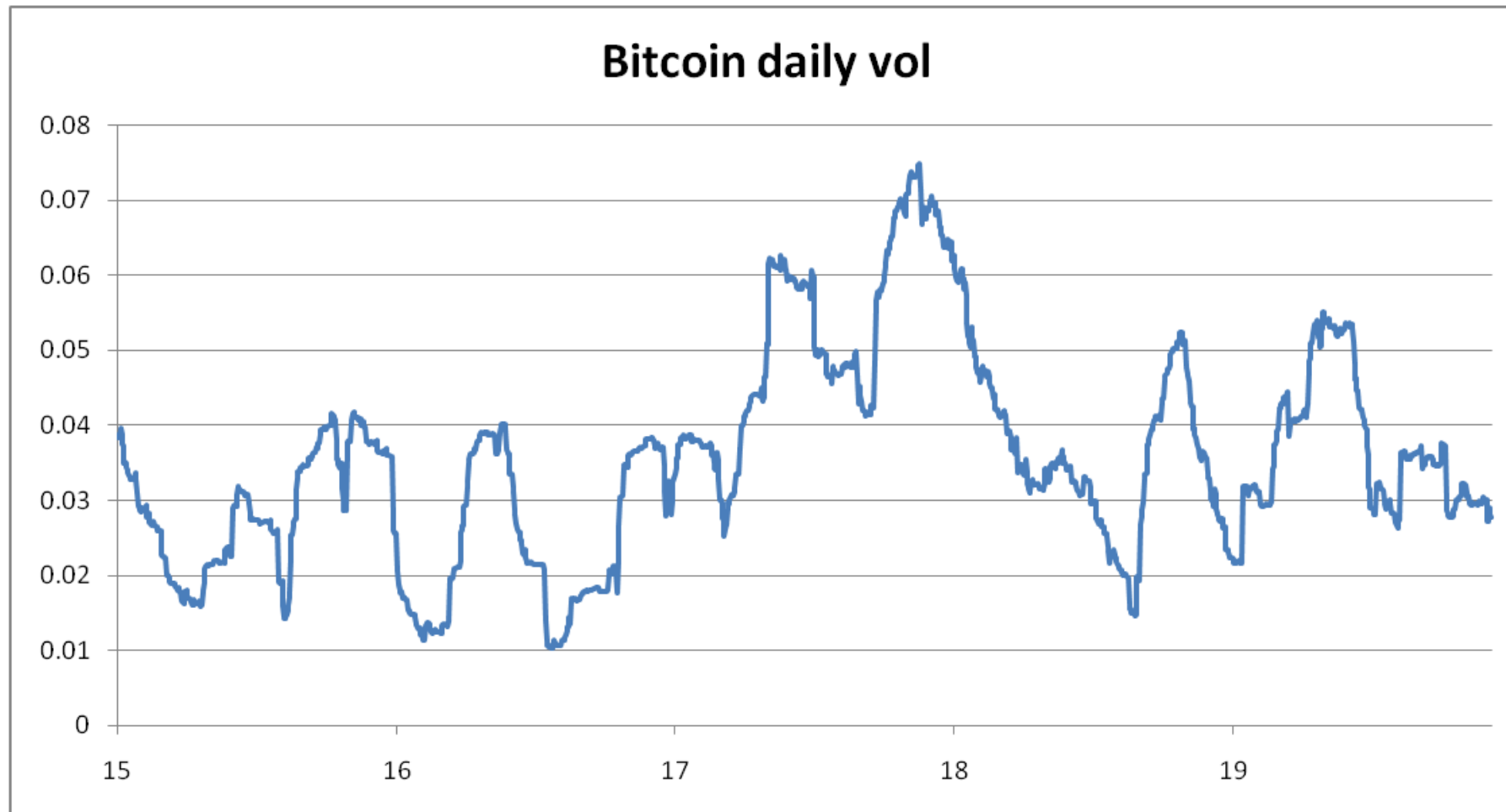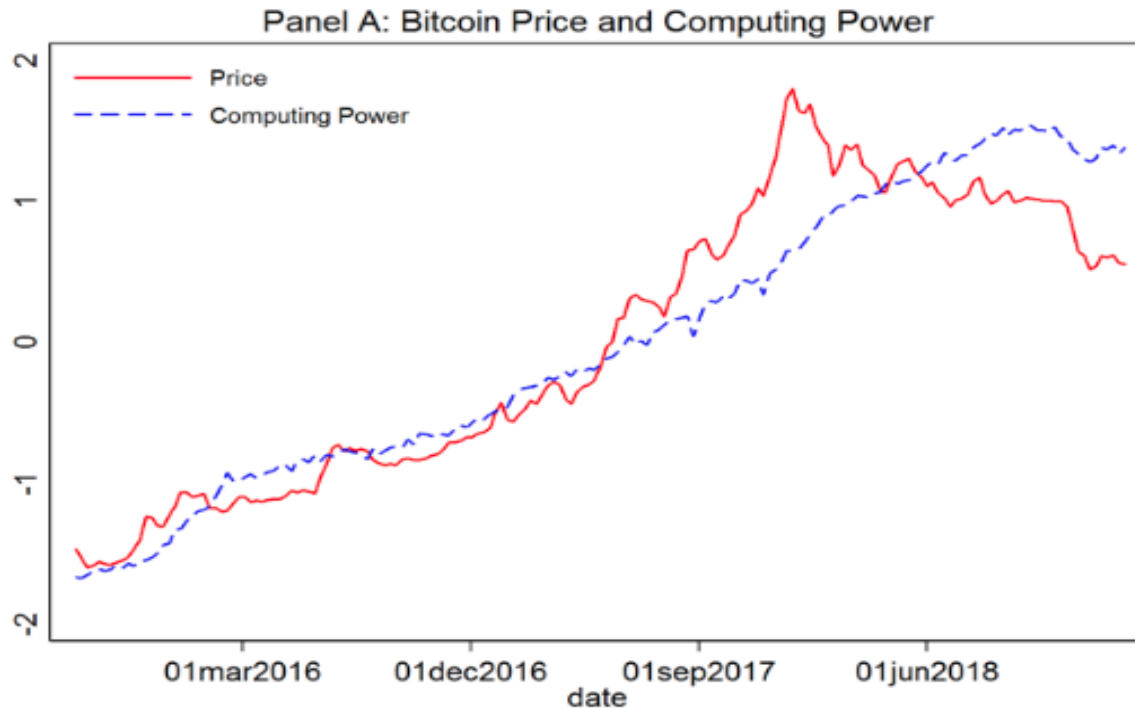
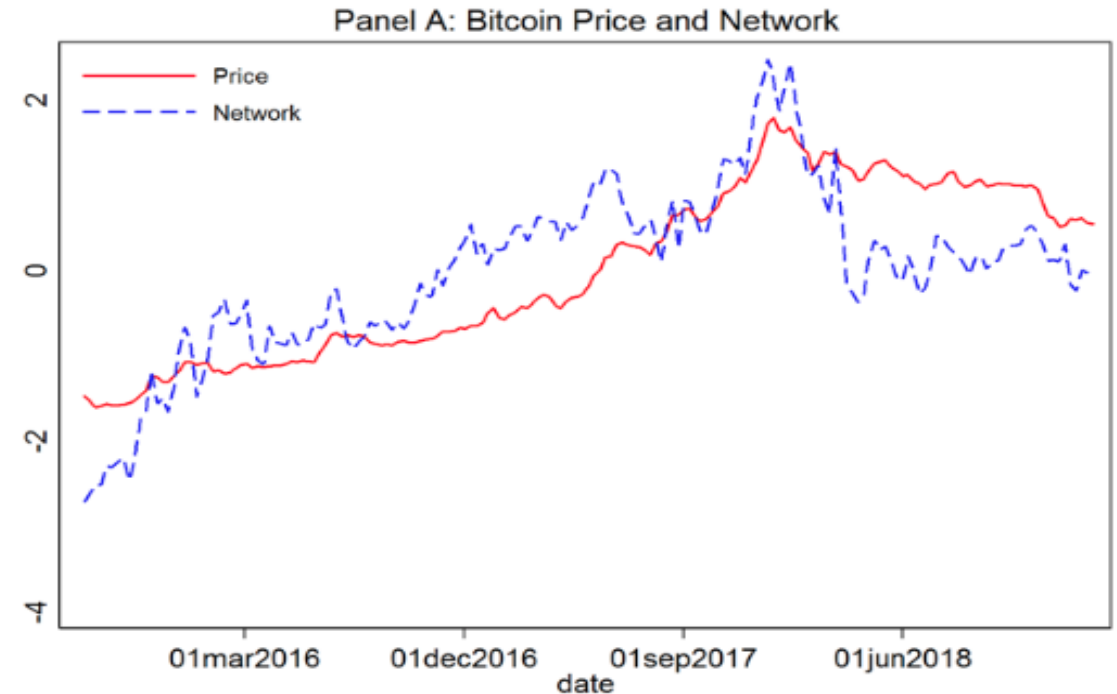# Gold daily volatility (rolling 90-day)

Gold and Bitcoin

Bitcoin return (y axis) versus Gold return (x axis)
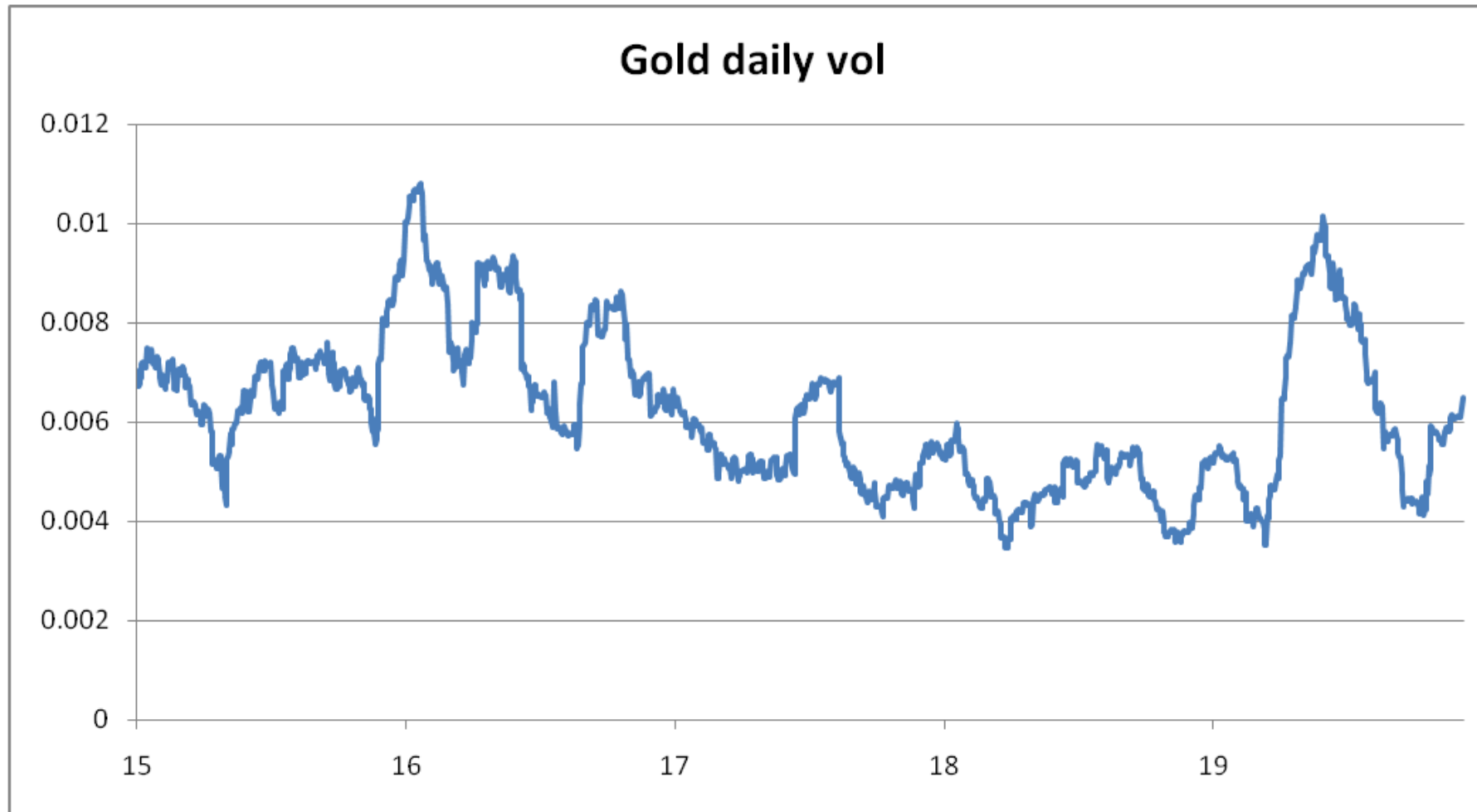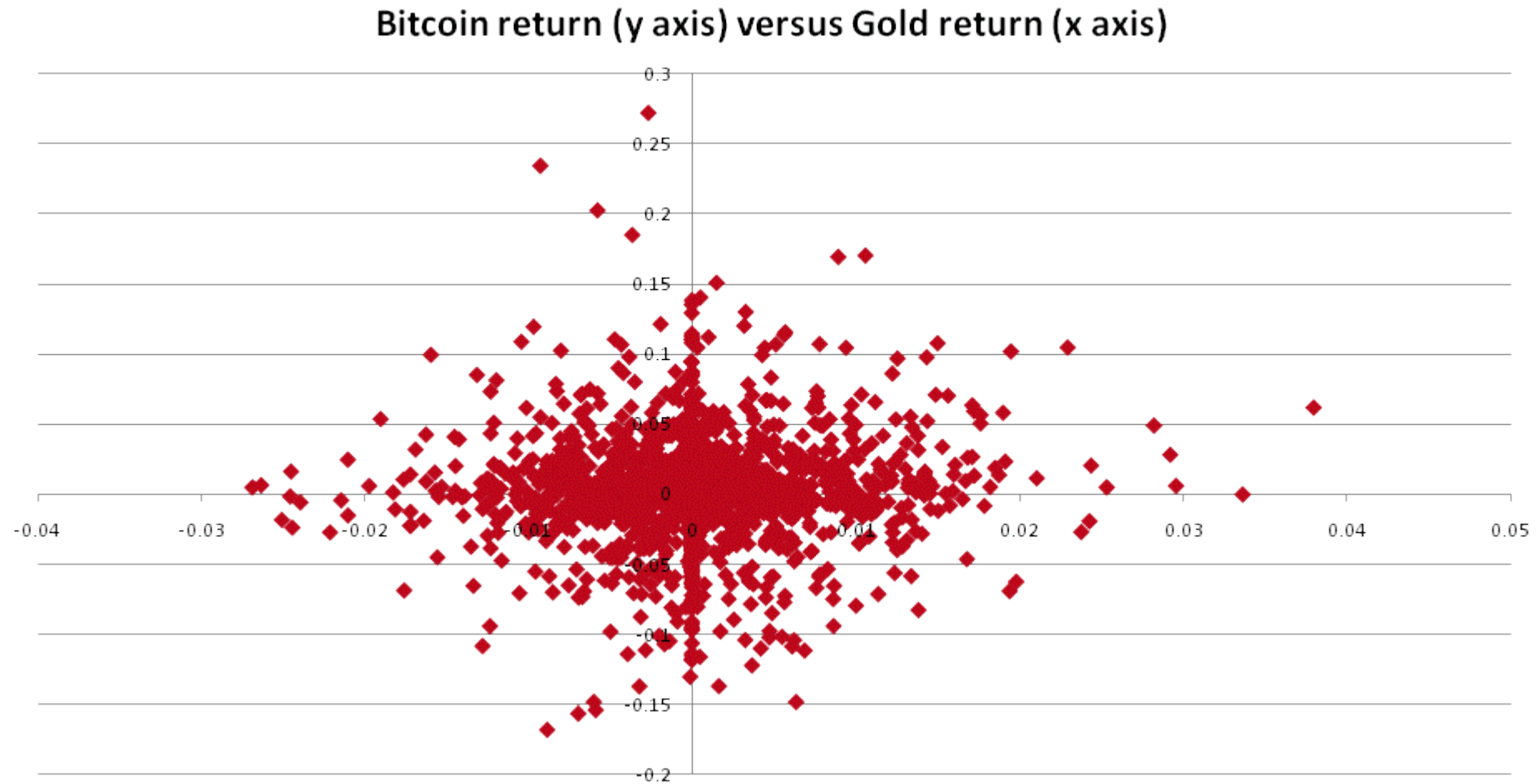
Source: Lorem ipsum dolor sit amet

Cryptocurrency prices and fundamentals
https://voxeu.org/article/fundamental-drivers-cryptocurrency-prices

Weekly averages of log price and log computing power (log hashrate)

Weekly averages of log price and log network size (log of unique active addresses)

Stable Coins

- Stable coins are financial assets fully backed by other assets, such as bank deposits, government bonds, cryptocurrencies or other securities. Stable coins are convertible to a predetermined quantity of other assets. They are stable in the sense of convertibility, the price might be volatile.

Intermediary	
Assets	**Liabilities**
Deposits in local currency **Deposits in foreign currency** **Government bonds** **Cryptocurrencies** **Other assets**	Tokens Net worth

Source: Lorem ipsum dolor sit amet

Stable Coins - Facebook's Libra (Diem)

- The plan is for the Libra token to be backed by financial assets such as a basket of currencies and US Treasury Securities in an attempt to avoid volatility. Pegging a currency in a basket of other currencies is know in economics as a "currency board". In the currency board the liabilities of the central bank (cash and reserves of commercial banks) are in principle fully covered by liquid foreign-currency securities.

| Intermediary-Facebook	
Assets	**Liabilities**
Basket of Currencies Government bonds Other assets	Libra Net worth

Source: Lorem ipsum dolor sit amet

Stable Coins - Facebook's Libra

- Libra will be exposed to exchange rate risk. Suppose that local currency represents 10% in the basket of currencies. The holder of libra will essentially hold a foreign-currency investment.

- Libra designers believe that a 'run' on the Libra is not a threat due to full convertibility. However, part of the collateral assets will be government bonds. In times of crisis and high redemption rates this may lead to fire sales and destabilization of the bond market.

- There is redemption risk in libra. Libra holders will not have direct access to collaterals and there is no binding promise of convertibility. The so called "resellers", will be allowed to carry out larger transactions from libra into fiat currencies and vice versa.

- The supply of libra will be completely elastic, in bitcoin the supply is fixed.

- Libra will convert Facebook to a gigantic money-market fund.

- Significant seigniorage profits for Facebook. Libra will have zero interest rate, but the collateral assets will generate positive interest income.

- Given the size of Facebook, libra could be a serious threat to financial stability.
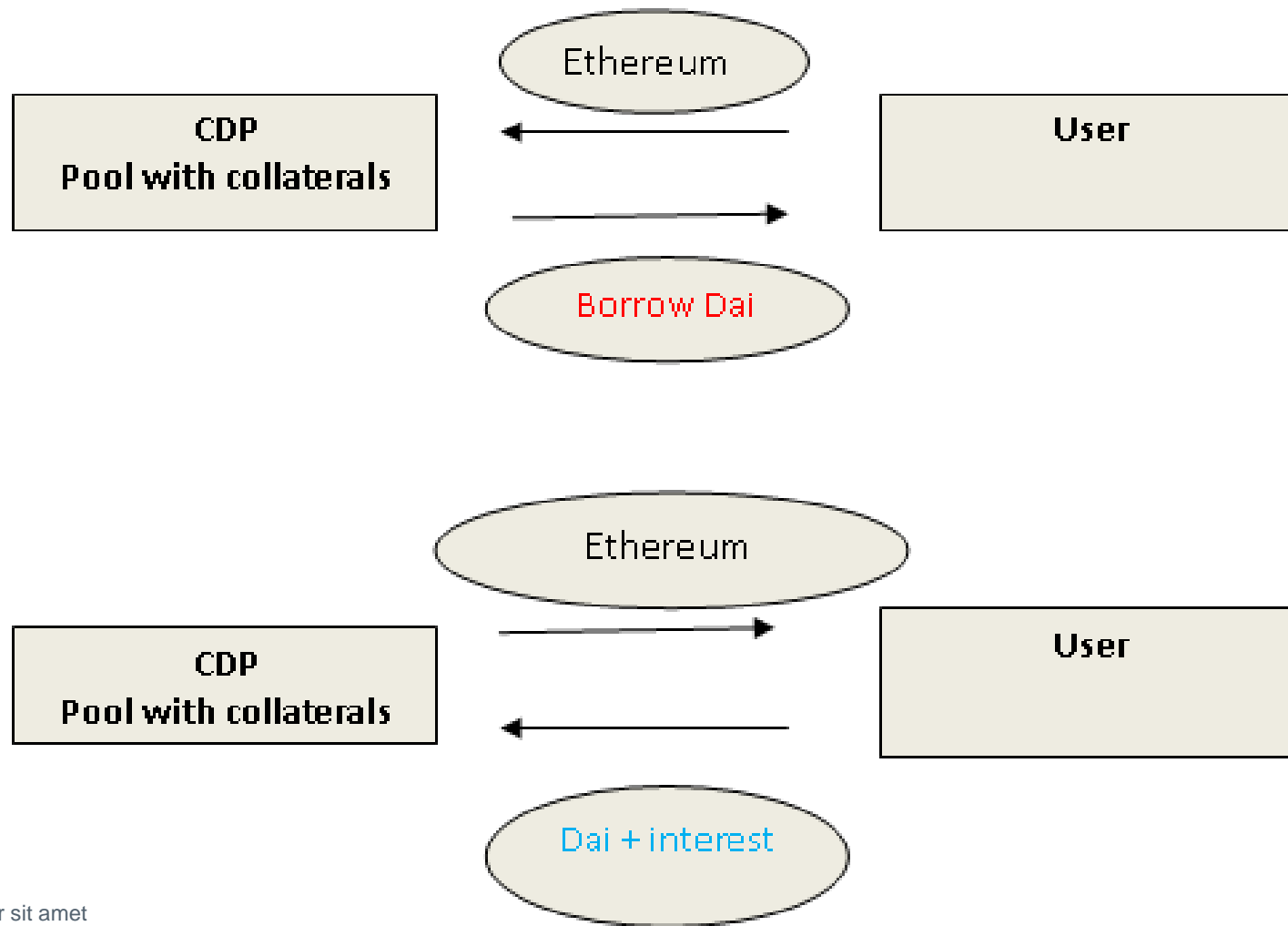
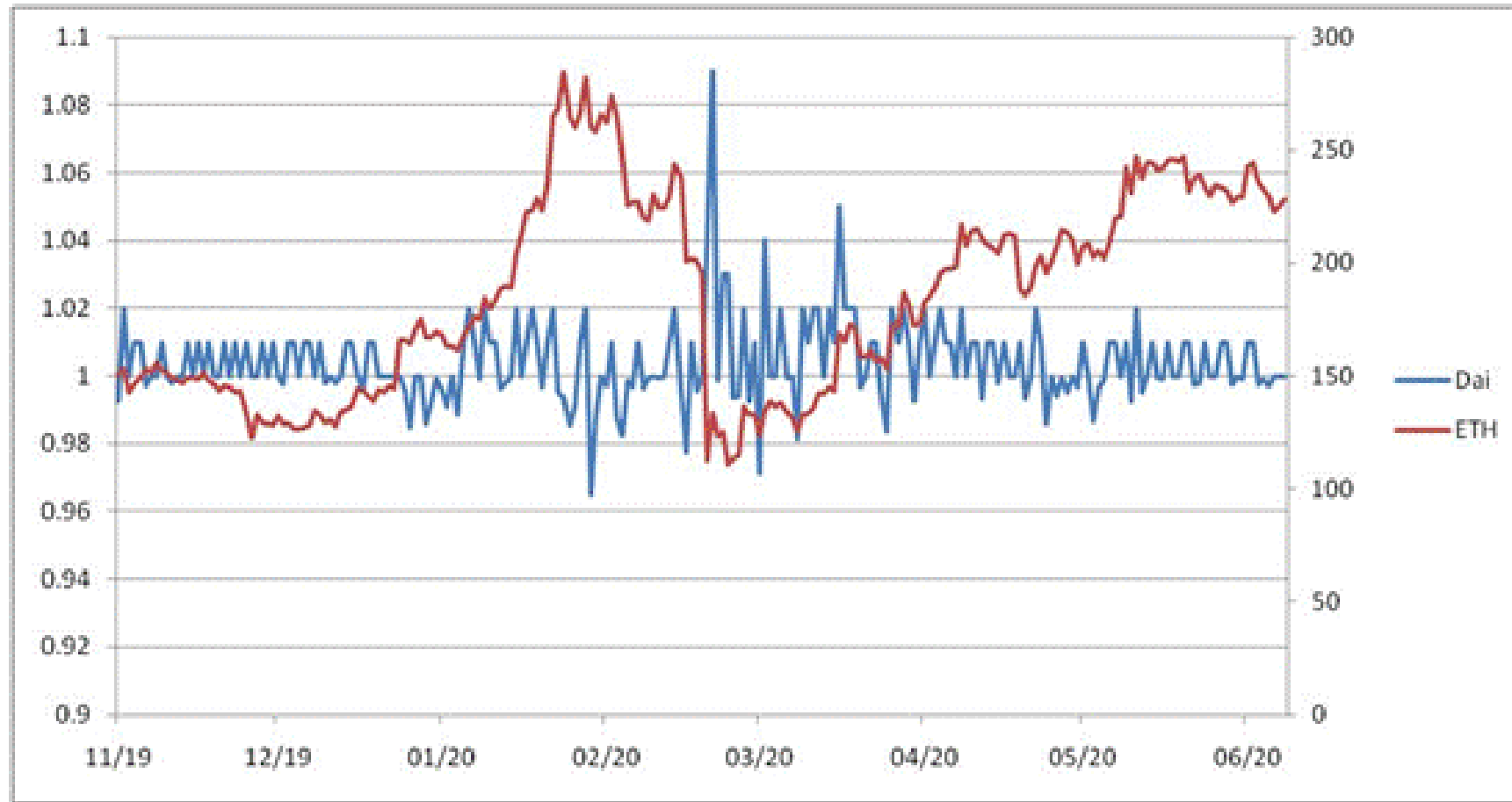# Stable Coins- Tether token (USDT)
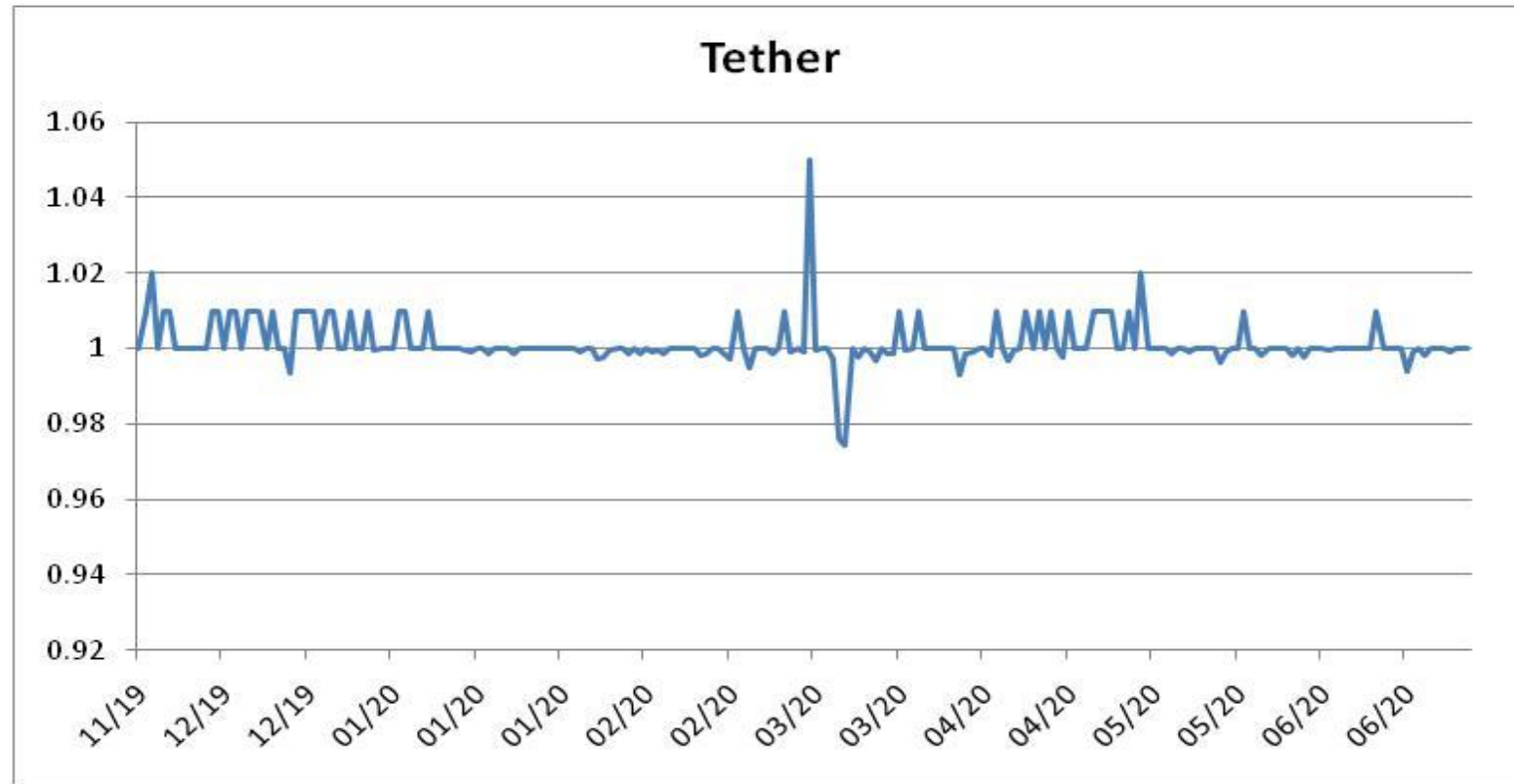
Source: Lorem ipsum dolor sit amet

Decentralized stablecoins - Dai

Source: Lorem ipsum dolor sit amet

Decentralized stablecoins - Dai

Source: Lorem ipsum dolor sit amet

Conclusions

Conclusions

- Balance sheets in the economy interact
- Payment systems are important financial infrastructures
- Money is created through the provision of new loans
- Stable coins are alternative forms of money that can be created as IOUs or in a decentralised manner

Source: Lorem ipsum dolor sit amet

Further reading

Further reading

- Dotsis G., IOU, Money, Banking and Cryptocurrencies, lecture notes.

- Libra: The known unknowns and unknown unknowns (https://voxeu.org/article/libra-known-unknowns-and-unknown-unknowns)

Source: Lorem ipsum dolor sit amet

Further reading (optional)

- Barrdear, R. Ali, J., Clews R., Southgate J. (2014) The Economics of Digital Currencies, Bank Engl. Quart. Bull. 54, 276-286.

- IMF (2016), "Virtual Currencies and Beyond: Initial Considerations," Staff Discussion Note 16/03.

Source: Lorem ipsum dolor sit amet