

Political Theory of Decentralized Democracy

Foundational principles and practical approaches to decentralized self-governance at the state level

Abstract

This document describes an approach to creating a decentralized version of such systems as fiat currency, banking, taxation, budget allocation and governance. Main characteristics of the decentralized governance are that the people vote on the money supply and its sources, tax and interest rates; the majority voters may be financially liable to the minority voters if public spending defaults; stock market can be extended to small and medium business; and there can exist a procedure for ethical use of personal user data for commercial purposes.

There is a software application that can be potentially created that allows it to spin up an instance of decentralized government whenever one is needed. An individual can then install the app and connect it to as many instances as needed. The instance provides monetary and fiscal systems that make it possible to build institutions that are equivalent to those of the traditional government. The autonomous nature of the instance and the strict set of rules that it sets provide an additional layer of institutional trust.

The traditional democratic system has been designed in the times when our capabilities were extremely limited in comparison to the modern times. By extending the representative mechanism of democracy we can construct a parallel system that adds another layer between the traditional government and the market. In this document we are going to explore the limits that we can take democracy and constitutionalism to with our current technology.

Disclaimer

This document is not selling or promoting cryptocurrencies. However, given the nature of the theory presented here, we will have to discuss some emerging experimental technologies from the point of view of computer science and monetary theory.

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I. Introduction

The goal of this document is to apply principles of decentralization to traditional financial and political systems, and as a result derive their decentralized version that is theoretically supposed to perform better than the original. The goal is not, however, to invent completely new and different systems, but rather to take existing systems and replicate them in a decentralized setting.

When replicating a system we are going to rely on collective intelligence as the main tool for decentralization such that all key components of the system have to be powered by group decision making and self-organization. The primary instruments for collective intelligence that we are going to rely on are democracy and the market.

Financial System

Monetary System

A monetary system determines how currency is created. Sum of all currency units in the system forms the **currency supply**.

Gold Standard

Historically, gold and gold-backed currencies represented the standard unit of money. Ultimately, the total supply of gold is known and is fixed. It consists of the gold that is already on the market; and it also can be estimated how many more natural deposits of gold there are in the world. Gold standard is a monetary system with a **fixed supply** of currency.

A notable characteristic of the fixed supply currency is that credit generally tends to be expensive and limited. On the other hand, it is immune to inflation. However, long-term nobody can really predict with absolute certainty that the underlying asset is going to retain its value. For example, it may still happen that gold falls out of fashion or a synthetic alternative may be discovered.

Fiat Currency

The move away from the gold standard to fiat money was a move away from a monetary system with fixed supply of currency to a monetary system with **variable supply** of currency. The supply of fiat currency is largely determined by the supply of credit and consists of [34, p. 102]: consumer and commercial loans provided by commercial banks [\[See: Example 1\]](#); government spending [\[See: Fiscal System\]](#); operations by the central bank [\[See: Open Market Operations\]](#); and international trade transactions [\[See: Foreign Exchange Operations\]](#).

Example 1 - Currency Supply

To understand how banks supply currency let's read from the article titled "How is money created?" by the central bank of the United Kingdom [1]:

Most of the money in the economy is created by banks when they provide loans.

Most of the money in the economy is created, not by printing presses at the central bank, but by banks when they provide loans. ...

Therefore, if you borrow £100 from the bank, and it credits your account with the amount, 'new money' has been created. It didn't exist until it was credited to your account.

This also means as you pay off the loan, the electronic money your bank created is 'deleted' – it no longer exists. ...

Currency is created when banks make loans and currency is destroyed when loans are paid back. When loans are made by banks, they exist as bank deposits which are therefore used as a measure of currency supply.

Credit Properties

Notable characteristic of a variable supply currency is that credit generally tends to be more available compared to a fixed supply currency. On the other hand, variable supply currency is susceptible to inflation. Another interesting effect is that money in the fiat system itself becomes subject to forces of supply and demand, when supply is not fixed but rather is shaped by demand. Credit availability is what drives most investment and it can be argued that it is directly responsible for the drastic increase in economic growth in the last several decades compared to the last several centuries [34, p. 127].

In economics saving and investing are the two sides of the same coin. And in finance all assets are viewed as a form of currency with a varying amount of liquidity. From the monetary theory perspective we can then say that all financial and commodity assets combined including gold constitute a monetary system with a fixed supply of currency. Looping back to economics, we can conclude that variable supply currency is more suitable for investing because credit is cheaper, and fixed supply currency is more suitable for saving because of the superior retainment of value.

Banking System

The banking system consists of the central bank and commercial banks. The primary role of the central bank is to limit in meaningful ways the total amount of loans that commercial banks are able to provide. All banks have a special account with the central bank that is called a reserve account. Reserve accounts hold a special type of money that is called Central Bank Money (CBM). The amount of CBM that a bank holds is referred to as bank reserves or bank liquidity. CBM can be only created by the central bank and can only be transacted by banks and the central bank [34, p. 146]. CBM can be viewed as an utility currency that facilitates the banking system.

Money that is created as a result of commercial bank credit is called bank money. CBM cannot be converted into bank money and vice versa. However, both CBM and bank money are denominated in the same units with one to one equivalence in value.

Example 2 - Netting, Refinancing and Reserve Requirements

To understand how exactly the central bank regulates commercial banks, let's expand on [Example 1](#). There are two commercial banks: bank A and bank B; and two customers: customer X and customer Y. Customer X has an account at bank A and customer Y - at bank B. The same as in the original example customer X takes a loan of £100 from bank A. Then customer X transfers the £100 to the account of customer Y at bank B in exchange for a good or a service.

At the end of the day the total amount of transfers between banks is summed up in a procedure that is called netting [3], and in our example bank A has £100 in reserve obligations to bank B. It means that bank A has to transfer £100 from its reserve account at the central bank to the reserve account of bank B. If bank A doesn't have £100 in reserves then it can ask the central bank for a special type of a loan that is called refinancing [43] or a loan at key interest rate. At this point the central bank has to decide if it thinks that lending policy of bank A was valid and if it should grant the refinancing. Banks can also borrow excess reserves from other banks. After the transfer Bank B has £100 in excess reserves which means that it can be sure that it can make a loan of £100 and be able to cover its reserve obligations to some other bank at the end of the day. Netting is performed by an independent agency that is called a clearing agency.

The reserve mechanism is there to prevent certain obviously malicious kinds of behavior, that's why banks generally can't make frivolous loans or make unreasonably large loans. However, only by itself it can't limit the currency supply. If on the same day customer Y takes a loan of £100 from bank B that is then transferred to bank A, then reserve obligations of both bank A and B to each other are going to net out to zero allowing both banks to make more loans by lowering the interest rates. This behavior is generally undesirable because it can lead to excessive borrowing and inflation.

To establish a limit on the expansion of the currency supply there exists a regulation that obligates the banks to keep a certain amount of reserves at their reserve account. The amount is called required reserves and is calculated as a fraction of the sum of bank deposits. The fraction is called the reserve requirement ratio (r). Let's say that in our example r is 10%. Both banks have deposits of £100 therefore they each must keep £10 in their reserve accounts as required reserves. Now they can only be sure that they can make a loan of £90 and be able to cover their reserve obligations. This way more loans lead to more deposits which lead to more required reserves, hence making banks more reluctant to increase credit operations.

Example 3 - Loan Sale

A bank can always try to sell a loan that it made, effectively crossing it out from its books. A bank can make a loan of £100 at 5% interest to a customer and then sell that loan to a third party for £102.5, then close £100 on their books and keep the £2.5. Loan sale does not change the currency supply [2].

Example 4 - Currency and Credit

To illustrate one particular mathematical effect on the currency supply, let's again expand on [Example 1](#). There is one commercial bank and two customers A and B. We assume that we start out with a total currency supply of zero. Both customers take a loan of £100 at five percent from the bank. The total currency supply is now £200. When customer A returns their loan to the bank then the total currency supply becomes £95. It is now not mathematically possible for customer B to return their loan, and they are now in a situation where their only options are either to default or to take out another loan.

Open Market Operations

A central bank can sell and buy treasury and corporate bonds [32][34, p. 94, 172]. Operations on the open market by the central bank change the currency supply: sale operations destroy currency and purchase operations create currency. Banks can use excess reserves to purchase treasury bonds.

Foreign Exchange Operations

When an entity sells a foreign deposit to a bank, the bank pays by crediting the account of the entity which increases the total amount of deposits and therefore the currency supply [34, p. 104].

Computer Networking

Each bank has a separate database where it keeps balances, transactions and client data. For example, if the bank database was to suddenly disappear out of existence then all the data is also gone. There is no backup database in the central bank that keeps everyone's bank balances. Each bank has a separate infrastructure but one that is also bridged with other banks such as to enable transactions. However, one bank can't access client data in another bank.

From the computer networking point of view it can be said that the banking system is a shared network of licensed nodes that is supposed to keep an account of fiat currency. It can also be said that fiat currency with the exception of notes and coins is a digital currency. 98% of the currency supply in most countries exists in digital form as bank deposits while physical currency is only 2% [34, p. 100].

Banks can and do sell customer data. Customers do not have control over this process. Banks also use customer data to construct predictive statistical models for a variety of purposes such as credit scoring and customer service. [33]

Fiscal System

Fiscal system determines how taxation and government budgeting works. A government budget is a document that presents anticipated tax revenues and proposed expenditures. In most parliamentary systems, the budget requires approval of the legislature.

To understand how the government spending and taxation is arranged let's read from [5]:

Sovereign government spends by issuing checks or, increasingly, by directly crediting bank accounts. There is a simultaneous credit to bank reserves (the bank's assets increase due to the reserve credit, and its liabilities to the recipient of the government payment increase by the same amount). Including leakage from bank deposits to cash withdrawals, government spending creates currency dollar-for-dollar. Tax payments reduce currency outstanding dollar-for-dollar, since tax payments take the form of a deduction from the taxpayer's deposit at her bank and an equivalent deduction from the bank's reserve account at the Fed. Essentially, the bank acts as an intermediary between government and the nongovernment sector (that receives payments from government and that pays taxes to government). Government currency is 'redeemed' when taxes are paid, which simultaneously destroys currency as well as the taxpayer's liability to government.

To summarize, government spending effectively amounts to currency creation and taxation - to currency destruction. However, this is true only for the central or federal government. Regional and municipal governments cannot create money and can only raise it by issuing municipal bonds or taking loans, which are then financed by local taxes.

Stock Market

The stock market is crucial for long-term economic development. Stocks represent long-term investments that require institution building. Natural consumers of the stocks are pension funds. They are the ones who are interested in the long-term value of their investments, while most other market actors are more focused on their immediate gains. Pension funds usually form the demand side for long-term obligations. Stock exchanges, rating agencies, insurance agencies, financial regulators constitute the stock market infrastructure.

Board of Directors

A board of directors is the governing body of a company that is supposed to represent the interests of shareholders that hold the stock of the company. The company has to provide compensation for board members, and board members also frequently receive the stock of the company as a form of compensation.

Financial Instruments

Credit Insurance

Let's read from [6]:

Credit insurance guarantees a lender will be repaid if a borrower is unable to pay his or her debt due to, for example, death or disability. Although credit insurance is solely for the benefit of the lender, it is purchased and paid for by the borrower.

Business owners may be required to purchase credit insurance as a condition of borrowing the money.

Insurance policies can also be sold in the same way as loans [\[See: Example 3\]](#)

Revenue Share

A company can issue a debt obligation that is paid back from the company's revenue. Let's read from article [7] what are the parameters of a revenue share security:

Payback Multiple: A multiple determines how much money will need to be paid back to investors by the maturation date. As soon as the revenue share security is issued, the face value of the note equals [your investment] x [multiple]. For instance, if you invest \$100 on a note that has a multiple of 2.0x, it will be worth \$200 at issuance.

Revenue Share %: The percentage of revenue payable to investors at the defined payment frequency. ...

Payment Frequency: How often payments will be made to investors (quarterly, monthly, or yearly). ...

Maturation Date: This is when the note must be paid in full.

Credit Default Swap

When a third party buys a loan from a creditor [\[See: Example 3\]](#), the third party can make an agreement with the creditor that in the case of the loan default the creditor has to pay to the third party some amount of money. To initiate the agreement the third party has to pay to the creditor the amount that is lesser than that specified in the agreement, the difference between the two amounts is called premium. [8]

Asset-Backed Security

When a third party buys multiple loans [\[See: Example 3\]](#) and other debt obligations, it can bundle them up into a single security. [9]

Politico-Economic Theory

Market Failure

Given that markets are driven by the individual interests trying to maximize their personal utility, there are situations when markets do not lead to the simultaneous maximization of group utility. These situations can be characterized as markets failing to distribute resources efficiently.

Common types of market failure [10]:

1. Natural monopoly. Industries with high infrastructure costs such as water and electric utilities, transport networks do not allow for competition.
2. External effects. The situation when costs or benefits are shifted to a third-party.
3. Indivisibilities. The situation when the barrier to entry is too high or too low.
4. Asymmetric information. The situation when there is a major discrepancy in knowledge about costs and benefits among market participants.
5. Public goods. Services such as defense, law enforcement and basic education do not inherently possess market incentives.
6. Property rights. Markets are unable to function without full and complete property rights.
7. Monopolies and oligopolies. Markets are unable to function without competition.

Government Failure

The counterpart to market failure is the government failure which is studied by the discipline of Public choice [11]. It allows us to analyze political systems through the economic lens and to describe a set of situations and tradeoffs when the behavior of different political actors such as politicians, voters and government agencies may not lead to the maximization of group utility.

Common types of government failure:

1. Decision-making vs. external costs. In the majoritarian voting system the cost of collective decisions ultimately has to be imposed on the minority as an externality. The cost of making a collective decision is higher for the qualified majority than for the simple majority, but the external cost is lower. Unanimity has the highest decision-making cost and the lowest external cost.
2. Indivisibility of public goods. Individual preferences cannot be expressed in the same way with public goods as with market goods. Public goods do not come as an array of possible options to choose from. Preferences for public goods are expressed through elections once in a time period which doesn't allow for the same level of continuity as market choices that are being made every day. Public goods are usually not chosen individually as opposed to market goods but they come as a bundle of different policies for multiple sectors of the economy.
3. Expansionary pressure. There are multiple forces that pressure the government to constantly expand such as special interest groups, the possibility for debt financing, the ability to shift external costs to the minority and policy bundling practices.

4. Choice and outcome. While the outcome of a market choice is usually known, the outcome of a choice made by voting in an election for a candidate may be significantly different than what was actually voted for.
5. Tactical voting. Voters may choose not to express their true preferences because they know that their preferred candidate is going to lose and instead vote for a more viable candidate.
6. Cycling paradox. The situation where candidate A wins over candidate B and candidate B wins over candidate C, but C wins over A.
7. Voting system. There are two types of voting systems that are often used. First, each district elects one representative with plurality vote which often produces disproportionate results. Second, voters vote for political parties that propose lists of candidates which runs the risk of disproportionate influence of the party leadership. Therefore, mixed voting systems are often used instead.
8. Rational ignorance. Any one individual vote is statistically unlikely to change the outcome of an election while costs associated with making an informed choice for an individual voter are high. Therefore, many voters may not see the benefit to being informed in the first place.
9. Vote motive. Politicians tend to choose policies that increase their number of votes rather than those that reflect their true political position.
10. Median voter theorem. Policies that receive the most voter support tend to be clustered at the political center.
11. Democratic failure. There are situations where voters may act irrationally which may result in ineffective resource allocation from the economic perspective.
12. Special vs. general interests. General interest groups do not have proportional influence compared to special interest groups. The costs associated with special interests are shifted to the general public while the benefits are reaped only by those in the in-group associated with special interest.
13. Vote trading. Bundling multiple policy proposals into a single proposal by a legislature and a practice by legislators of exchanging favors where they vote for each other's proposals.
14. Rent seeking. Situations where the government creates monopolies by granting special legal privileges to a particular group of entities.
15. Budget maximization. The counterpart to the profit motive for government agencies.

Tragedy of the Commons

The tragedy of the commons characterizes a situation where some common resource gets depleted by its consumers because of their lack of coordination [12]:

... ranchers grazing their animals on a common field. When the field is not over capacity, ranchers may graze their animals with few limitations. However, the rational rancher will seek to add livestock, thereby increasing profits. Thinking logically but not collectively, the benefits of adding animals adhere to the rancher alone, while the costs are shared.

The tragedy is that ultimately no rancher will be able to graze the field, due to overconsumption.

Governing the Commons

To counter the overconsumption of shared resources Elinor Ostrom developed a regulatory framework in her book "Governing the Commons: The Evolution of Institutions for Collective Action" that allows groups of people to manage shared resources. Let's read from the summary of her book [13]:

Any group that attempts to manage a common resource (e.g., aquifers, judicial systems, pastures) for optimal sustainable production must solve a set of problems in order to create institutions for collective action; there is some evidence that following a small set of design principles in creating these institutions can overcome these problems.

People are trapped by the Prisoner's Dilemma only if they treat themselves as prisoners by passively accepting the suboptimum strategy the dilemma locks them into, but if they try to work out a contract with the other players, or find the ones most likely to cooperate, or agree on rules for punishing cheaters, or artificially change the incentive ratios - they can create an institution for collective action that benefits them all. This resonates with Peter Kollock's taxonomy of strategies for dealing with social dilemmas - one strategy is to change the rules of the game.

... She found that in many different cultures all over the world, some groups would find ways to overcome the obstacles that defeated others - by creating contracts, agreements, incentives, constitutions, signals, media to enable cooperation for mutual benefit.

Social dilemmas of multiple dimensions are obstacles on the path to creating institutions for collective action; these dilemmas must be overcome if institutions are to succeed or exist at all. Lack of information about the system can be an obstacle to agreement among the individuals who make up the system. ... Another obstacle, free-riding, creates the second order social dilemma concerning who will bear the cost of policing the rules once they are agreed upon. So although the overall formula is simple - social dilemmas can be solved through institutions for collective action that are built by overcoming known obstacles - in practice, each group that struggles to build an institution works under the handicap of being largely unaware of knowledge about how such institutions succeed and fail.

In comparing the communities, Ostrom found that groups that are able to organize and govern their behavior successfully are marked by the some basic design principles:

1. Group boundaries are clearly defined.
2. Rules governing the use of collective goods are well matched to local needs and conditions.
3. Most individuals affected by these rules can participate in modifying the rules.
4. The rights of community members to devise their own rules is respected by external authorities.
5. A system for monitoring member's behavior exists; the community members themselves undertake this monitoring.
6. A graduated system of sanctions is used.
7. Community members have access to low-cost conflict resolution mechanisms.
8. For CPRs [Common-pool resources] that are parts of larger systems: appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Constitutional Economics

The field that studies potential new kinds of economic and political arrangements is called constitutional economics [14].

Constitutional economics as a scientific subdiscipline is characterized by a particular kind of orientation in social analysis. Whereas orthodox economic analysis attempts to explain the choices of economic agents, their interactions with one another and the results of these interactions, within the existing legal-institutional-constitutional structure of the polity, constitutional economic analysis attempts to explain the working properties of alternative sets of legal-institutional-constitutional rules that constrain the choices and activities of economic and political agents. The emphasis is on the rules that define the framework within which the ordinary choices of economic and political agents are made. Thus constitutional economics analysis involves a 'higher' level of inquiry than orthodox economics. It examines the choice of constraints as opposed to the choice within constraints. Thus the constitutional economist has nothing to offer by way of policy advice to political agents who act within defined rules. On the other hand, the whole exercise is aimed at offering guidance to those who participate in the discussion of constitutional change. Constitutional economics offers a potential for normative advice in

constitutional matters, whereas orthodox economics offers a potential for advice to the practising politician.

Potential economic and political rules should be individually itemized. It is necessary to have some mechanisms for rule enforcement. Traditionally, only social enforcement mechanisms are utilized. Deviation from the rules shouldn't lead to meaningful individual utility maximization. Rule enforcement and adherence should lead to individual utility maximization.

Following the individualist methodology, 'social action' must be decomposed into the actions of the individuals of whom society is made up; the exercise of social binding, specifically, must be seen as an intrinsically multilateral activity. Each agrees to a set of rules and procedures because this is the price each must pay to restrict the conduct of others. 'Weakness of the social will' will arise precisely because it is opportunistically rational for any individual to depart from the collectively agreed rules and procedures.

Moreover, in the setting with which constitutional economics is concerned, there is no external technology available that is totally effective or that is not excessively costly. The tools of enforcement and maintenance must themselves be socially constructed. Human beings are not bound by nature to pursue rules: they are endowed with the capacity to deviate from rules if it is profitable to do so. Accordingly, we must search out rules which so order individuals' behaviour that it is individually profitable for most people to keep and enforce those rules most of the time. The gains from violation should not be too great. The analysis of the kind of rules and the associated institutional apparatus that exhibit these properties represents a centrepiece of constitutional political economy as an area of inquiry.

Potential economic and political rules should focus on decision making mechanisms rather than trying to directly influence the economy and politics. Changes in rules must be approved unanimously. All spending must specify how it's going to be paid for.

Constitutional political economy could be characterized as 'Wicksellian' political economy. In his basic work on fiscal theory, Wicksell (1896) called attention to the significance of the rules within which choices are made by political agents, and he recognized that efforts at reform must be directed towards changes in the rules for making decisions rather than towards modifying expected results through influence on the behaviour of the actors. In order to take these steps, Wicksell needed some criterion by which the possible efficacy of a proposed change in rules could be judged. He introduced the now familiar (near to) unanimity or consensus test. Thus, for Wicksell, 'the

consent of the governed' was the point of departure for the evaluation of government activities. As he concluded:

It is a necessary condition that expenditures and the means of financing them be voted upon simultaneously. ... If this procedure should become general practice, a very important practical step would have been taken in the direction of the system proposed in this essay. The requirement of the veto right of the minorities would follow sooner or later as a logical and necessary consequence. ... It stands to reason that a combination which satisfies everyone ... must be imbued with more justice than any other which might appeal more to an accidentally greater half of those interested, but which would be at the expense of the others. Once this is conceded, the right of minority veto is already recognized in principle. (Wicksell, 1896 [1962], p. 116)

Fiscal Federalism

The field that studies how to maximize group utility when distributing fiscal responsibilities among central/federal and regional levels of government is called fiscal federalism [15]. It describes situations and tradeoffs when one level is preferable to another:

9. Varying Preferences. Increase of variability in individual preferences among regions leads to increase in responsibilities of local governments.
10. Mobility. Increase of variability in responsibilities of local governments leads to increase in competition for residents among local governments.
11. Spatial Effects. When responsibilities are specific to a geographical region, local governments are preferable. When responsibilities span multiple regions, central government is more preferable.
12. Externalities. The situation when a local government receives benefits or costs from another local government.
13. Government Effectiveness. The situation when the same responsibility has lower or higher costs for one level of the government than another one.

Constitutional Catalaxy

The field that studies economic and political arrangements as a dynamic open-ended system of competition, coalition building and conflict resolution is called constitutional catalaxy [17]. Open-ended analysis is focused on the process of market and political actors converging on a set of prices and political agreements rather than on the process of personal utility maximization.

One constitutional rule is preferable to another if it doesn't result in a conflict between two separate groups.

Instead, we can focus on how different constitutional orders result in the boundaries between conflicting groups. If under one set of constitutional rules, there is significant disagreement such that there are clearly defined sides in a high-stakes political conflict, but under another there are terms of an acceptable post-constitutional exchange that would satisfy the parties—or, perhaps more promising, if the contested issue were taken off the table, such that sides never formed in the first place—then we can say the latter constitution is more amenable to harmonious social existence.

There is an inherent tradeoff between procedural liberalism and democracy that must be balanced by enforcement of constitutional rules. Traditionally, constitutional enforcement relies on social mechanisms and cannot be fully self-enforced. Procedural liberalism requires majority support and must be able to counter attempts at derailing it.

Constitutional order has to be open to change and exploration of more beneficial arrangements through the process of constitutional entrepreneurship.

Scholars are beginning to recognize the importance of institutional entrepreneurs, in the sense that these entrepreneurs are not mere arbitrageurs within existing rules, but innovators of the rules themselves. For example, Leeson and Boettke (2009) point out the importance of institutional entrepreneurs in devising *de facto* rules systems conducive to economic development. Kuchař (2016) shows how institutional entrepreneurs can change the meaning of foundational sociocultural institutions. And Martin and Thomas (2013) explore how institutional entrepreneurship changes when it is applied to pre-constitutional, constitutional, and postconstitutional levels, demonstrating that institutional entrepreneurs can and will innovate at ‘higher’ tiers of rules when they cannot achieve their goals in ‘lower’ tiers. Each of these studies deals with constitutional entrepreneurship, as we use the term ‘constitutional.’ Furthermore, it is open-ended: it represents genuine novelty and cannot be predicted in advance by deductions from a previously-specified state of the rules. Our analysis complements this new literature by (a) focusing on how genuine social antagonism operates within constitutional systems and (b) discussing how liberal constitutions can, if not resolve, at least ameliorate these antagonisms even when constitutional craftsmanship operates outside the confines of systems in which tradeoffs can be concretely specified and hence conflicting plans can be permanently reconciled.

Monetary Constitutionalism

The field that studies potential new kinds of monetary rules is called monetary constitutionalism [18].

Potential new monetary rules should be simple. It is unclear what rules are the most optimal.

O'Driscoll (2016) emphasizes the importance of the arguments about knowledge and decision-making articulated by Hayek and later by Friedman in the context of monetary policy. The idea of optimal monetary policy is problematic in a world of dispersed information. The Hayekian analysis of the emergence of order confirms Friedman's intuition for a simple monetary rule. A monetary rule facilitates the emergence of monetary order. Moreover, the complexity of the world suggests simple rules. (Epstein 1995) Rules are effectively ways to reduce the information requirements of a complex coordination problem. Rule complexity would defeat the purpose of having rules. The more complex the phenomena, the stronger the case is for simple rules. (ibid. 348)² So the prospect for adopting a monetary rule is probably greater today than 50 years ago. What is unresolved according to O'Driscoll is the choice of a particular rule, a task that will require a great deal of additional analysis (ibid. 350).

Rule enforcement in regards to the central bank is difficult. Central banks have properties of a monopoly.

Several authors go on discussing monetary policy reform proposals for a world of central banks (McCallum 2015; Schnabl 2015). All such proposals raise the question of how to bind the central bank to the desired goals. Rules can be written out, but how can they be made binding? (also White ibid. xiv) ...

In general economic theory, monopoly is bad and an affirmative case must be made for it. (O'Driscoll ibid. 256) In this sub-field of economic science, however, the case for a monopolistic central bank seems to have become dogma.

There is an inherent tradeoff between commitment to rules and administrative discretion.

As regards the conduct of monetary policy in particular, the debate regarding (pre-commitment by) rules versus discretion is an old one dating back at least to Henry Simons (1936) paper. More recently Kydland and Prescott (1977) showed that a regime that pre-commits policymakers to behave in a particular way is preferable to a regime that allows policymakers pure discretion, that is, to choose a policy independently at each point in time. It is today commonly accepted that a strong case is to be made that a

monetary policy regime that demonstrates a high degree of commitment would lead to better economic outcomes but also that perfect commitment by policymakers is almost impossible to achieve in a democratic society and that rules-based policy, although one useful mechanism to enhance the credibility of commitment, is not perfect (Plosser 2016).

Rules should be self-enforceable. It should be impossible to intervene with the rules.

Robust Political Economy which raises the question «Which institutions perform best when people have limited knowledge and are prone to self-interested behavior?» Robust political economy suggests that an enforceable—ideally self-enforcing— monetary constitution is desirable because it (i) checks agents' (policymakers and individuals alike) self-interested behavior and (ii) mitigates the less-than-perfect cognitive capacities of these agents by providing a stable institutional framework that anchors expectations (ibid. 284); (c) Property rights and constitutional governance; arbitrary, i.e. non-rule based, interventions in the monetary framework can undermine property rights and introduce an element of uncertainty into the economic system.

Rules should provide a framework for economic activity. Rules should be able to restrict a set of choices that can be made within the framework. Rules should be able to account for costs and benefits of choices that were made. Rules should be able to establish a limit on currency supply.

In the most general sense a genuine constitution provides the basic framework that determines how behavior, including economic activity, is controlled. In particular, it establishes boundaries concerning the kinds of choices that are permissible and provides the mechanism for deciding how the harms and the benefits flowing from a decision are allocated between the decision maker(s) and other members of the society (De Alessi 1992, 321). With respect to the monetary sphere in particular Köhler and Vanberg (2015, 65) state that «(a)ny monetary regime, be it in the private or the public sphere, that operates within a framework of rules can in the most general sense be said to be «constitutionalized,» but the term «monetary constitution» is typically used in a more specific sense, implying that specific rules pertain to the production and use of money that go beyond the general system of rules that otherwise govern the operations in markets and politics.» In the narrower sense a monetary constitution has also been defined as a rule or set of rules aiming essentially at limiting the discretionary powers of the monetary authorities, e.g. by imposing certain limits to the growth rate of the monetary base or the money supply.

Rules must be proven to be more optimal.

The view that will be upheld in this paper, however, is that the case for an explicit and distinct monetary constitution is far from obvious. The burden of proof definitely rests on those authors who advocate proposals for such a distinct constitution.

Rules may be both market-driven and government-driven.

However, it has been argued that if the market–chosen common monetary standard is not the best standard available, a case exists for affirming that a switch to a better monetary standard can in principle be more efficiently made through government-coordinated collective action (ibid. xi).

Rules must be agreed upon by a group that is subject to them. Costs and benefits of proposals to the group must be presented clearly.

Köhler and Vanberg (2015) distinguish explicitly between matters of legitimacy and matters of prudence in constitutional choice. The central tenet of constitutional economics is that constitutional regimes, monetary or otherwise, can ultimately derive their legitimacy from no other source than the voluntary agreement among the members of the group that are subject to the respective regimes. With regard to the second question this implies that, if advisers want their recommendations to find acceptance, the arguments they offer in their support must appeal to the common interest of the ultimate addressees, convincing them that they can benefit from heeding the advice. In other words, advisers must seek to convince their addressees that prudent pursuit of their own interest requires them to choose what is recommended.

Rules must account for imperfect information and self-interest. Rules must provide incentives that maximize group utility.

Within this context, a «robust» set of institutions may be defined as one that generates beneficial results even under the least favourable conditions. (Leeson and Subrick, 2006) Such conditions may arise as a consequence of human imperfections. In the context of institutional analysis there are two human imperfections that must be accounted for when considering the robustness of alternative regimes. The first of these is the «knowledge problem» already mentioned. Human beings are limited in their cognitive capacities. Robust institutions should therefore allow people to adapt to circumstances and conditions of which they are not directly aware, and under conditions of «bounded rationality» must enable them to learn from mistakes and to improve the

quality of their decisions over time (Pennington *ibid.* 3). The second human imperfection that must be accounted for is the possibility that people may act out of self-interested motivations. People may not be willing to contribute towards the advancement of their fellows' interests unless they are able to gain some personal benefit from doing so. Incentives may matter, and as a consequence institutions must be judged on their capacity to channel potentially self-interested motivations in a way that generates beneficial outcomes at the societal level (Pennington *ibid.* 3).

It should be beneficial to agents in the system to follow the rules.

In this connection it has been suggested that a monetary constitution should, as much as possible, be self-enforcing. Which monetary constitution—if any—is self-enforcing? If the monetary constitution is founded on unreasonable assumptions concerning agents' knowledge or incentives, it is also unreasonable to expect the monetary constitution to enforce itself (*ibid.* 286). The knowledge problem applied to monetary constitutions requires the monetary constitution to be upheld even when agents—whether ordinary market actors or policymakers—know very little about how the economy «really works» (*ibid.* 287). With respect to the incentive issue a self-enforcing monetary constitution must be one that agents operating within the system—both policymakers and private agents—have an incentive to uphold rather than undermine (*ibid.* 288). Modern discretionary central banking does not meet this challenge.

Polycentric Banking

The field that studies potential banking systems that do not have a central banking component is called polycentric banking [40].

Polycentric banking rules must adhere to Ostrom's design principles. Credit should be viewed as a common-pool resource.

This institutional literature suggests that a broader public economics perspective would provide intriguing and useful insights. Banking institutions face the same kind of general problems in terms of knowledge, incentives and transaction costs, as other institutional arrangements addressing collective issues. Furthermore, the opposition between monocentric and polycentric governance, which we bring to bear on central banking, has been at the center of numerous other debates concerning the governance of public goods and of communal property (V. Ostrom 1991; Aligica and Boettke 2008; E. Ostrom 2010). To our knowledge, no one has noticed the relevance of these debates to the

governance of banking systems, and, as a result, important insights from the institutional literature have not yet been properly incorporated in the post-crisis literature.

Once we look at the problem from the more general perspective of Ostrom's "design principles" for robust institutions of governance (E. Ostrom 1990; 2005; Wilson, E. Ostrom & Cox 2013; Aligica & Tarko 2014), and in particular from the point of view of the theory of polycentricity (V. Ostrom 1991; E. Ostrom 2005: chapter 9; 2010; Aligica & Tarko 2012; 2013), we are able to develop (a) a much stronger argument for the superiority of free banking over central banking, and (b) explain which version of the many possible free banking systems is likely to work well. In other words, the structural weaknesses of central banking appear in a new light, and the concept of free banking is developed beyond the mere idea of a decentralized banking system. The polycentric perspective leads us to ask which rules are necessary to assure that a decentralized system will work well. We refer to a free banking system operating under proper over-arching rules, i.e. rules that effectively prevent commons problems such as the over-expansion of credit, as polycentric banking, and we argue that the proper over-arching rules are indeed discovered by a process of self-governance similar to the one described by Elinor Ostrom in *Governing the Commons*. ...

Rules cannot assume that all actors in the system are going to behave rationally, have perfect knowledge or be altruistic; and that all actors are going to act in the interest of a group rather than their own. Customers should be able to choose from a set of services and be able to discontinue the service.

It is here that polycentric theories of governance enter the picture. Most famously developed by E. Ostrom, these theories provide a framework for understanding under which conditions the interactions of many agents tend to lead to an emergent order that approximates the optimum – i.e. a productive social order. In other words, they developed the process-based institutional theory of how people can arrive in practice at relatively efficient public and collective goods governance structures. The underlining microeconomic logic behind this endeavor, referred to by E. Ostrom (1998) as "a behavioral approach to the rational choice theory of collective action", and more recently as "robust political economy" (Boettke and Smith 2015b; see also Boettke and Leeson 2004; Leeson and Subrik 2006; Penington 2011), focuses on the idea that institutional arrangements are robust if they lead to productive social outcomes even when the agents involved suffer from cognitive biases, lack complete information, and are

self-interested. By contrast, fragile institutional arrangements only work well under restrictive assumptions about rationality, knowledge, and incentives. Economists often pursue models under such restrictive assumptions because they are easier to analyze mathematically. But, when we venture into the public policy arena, we need to move our attention toward robust arrangements because people have limited knowledge and cannot be trusted to be altruistic.

Attaining good social outcomes may be difficult because the knowledge necessary to solve the problems is dispersed, and knowledge aggregation mechanisms may be faulty. Moreover, as pointed out by Hayek (1948; 1960: chapter 7), the knowledge may not even be created under certain institutional arrangements. Hayek (1948) notes, that the market order not only aggregates the information about costs and values into prices, but it also creates this knowledge, because without the trading process preferences cannot be accurately revealed. Similarly, Hayek (1960: chapter 7) argues that the knowledge about the best solutions to collective problems is less likely to be discovered outside of liberal democratic arrangements in which all affected people have the opportunity of voice and exit, and they face an actual choice among a plurality of candidates and parties. Other examples include the common law, federalism, and the scientific community (V. Ostrom 1991). What all these examples have in common is the idea that knowledge can be more easily and reliably created by means of genuine choice among real-world alternatives, as compared to the case when the alternatives are merely hypothetical and imagined. Polycentric structures thus possess significant knowledge-creating capacities.

We also must consider whether decision-makers have the incentive to actually implement what they know to be the best solution. What is best personally for the decision-maker may not correspond with what is best from a general welfare perspective. To give the example of markets again, as the Bertrand competition model shows, when free entry exists, firms are forced to satisfy consumer demands because that is the only way in which they can make profits. This “invisible hand” idea can be extended to certain non-market contexts as well. For example, a polycentric system of public administration is more likely to satisfy citizens’ preferences than a centralized system (E. Ostrom 1976; McGinnis 1999; Aligica & Boettke 2009; Boettke, Lemke & Palagashvili 2012; 2014; 2015). The mechanism is the same: the threat of beneficiaries’ exit creates strong incentives on the part of providers to take the beneficiaries’

preferences into account. Once again, we get the same conclusion: a polycentric order is more robust than a monocentric one.

Rule creation and enforcement must not require a single entity but rather a collective of entities that cooperate and compete with each other.

Not all imaginable decentralized systems count as polycentric. The key idea about polycentricity is that decentralization operates under certain over-arching rules which assure that the emergent order is a productive one (V. Ostrom 1991; E. Ostrom 2005: chapter 9; E. Ostrom 2010; Aligica & Tarko 2012). Importantly, these over-arching rules do generally not need a single, monopolistic enforcer acting as an outsider regulator. On the contrary, as documented by many examples, collectives often succeed in creating systems of mutual monitoring and mutual rule enforcement.⁸ The literature on free banking reveals that, indeed, in a variety of historical examples, banks have created collective arrangements for monitoring and enforcing rules against reckless behaviors (Selgin & White 1994; White 1989; Dowd 2015). The institution of the clearing house has served as the main mechanism for creating and enforcing such rules.

It is in this sense that free banking systems are polycentric. Polycentricity requires a system of organizations with overlapping spheres of activity that cooperate and (non-coercively) compete within an overarching set of rules which they themselves create, monitor and enforce. Polycentricity is a feature of governance systems that are decentralized and operate in an environment where agents with decision-making capacity confront an array of incentives and information appropriate for welfare-enhancing governance. The features of free banking systems that render them polycentric are the source of their robustness. Importantly, as argued earlier, central banking necessarily lacks this stability-enhancing institutional architecture.

Central Bank Digital Currency

There is some exploration of the idea of a currency that is issued by the central bank [4]. However, given that most currency is created through bank credit and that the central bank is not supposed to provide commercial or consumer loans, and it's not even possible for the central bank to take on all the demand for credit, it remains highly unclear what exactly CBDC is trying to achieve [2]. So far CBDC looks more like a "sovereign stock" type of an asset, than a currency. Potentially a useful financial instrument but one that is not particularly relevant to the present discussion.

Another way to go is for the government to try to replicate the entire financial system with bank and central bank money, and license commercial banks to issue credit with CBDC. Presumably, it can allow the government to implement additional rules for transactions. However, this is something that the government can already do and does with the traditional banking system. The government has the power to order banks to implement any rules that it wants. There are no benefits to creating a duplicate system.

Participatory Budgeting

The fiscal framework that allows for collective decision-making is called participatory budgeting [19]. There are four main stages of the budget cycle: formulation, approval, execution, and oversight. Presently, participatory budgeting is the most viable on the local level in rural communities.

Participatory Budgeting is broadly defined as a process or mechanism through which citizens participate in decision-making around the allocation of public resources (Wampler cited in Shah 2007). This may be more narrowly defined as a process by which citizens, acting as individuals or represented through civic associations, voluntarily and regularly contribute to decision-making at a certain stage(s) of a budget cycle (Goldfrank 2006). Through public participation in the budget process, Participatory Budgeting can reinforce democratic legitimacy and serve as an important tool of vertical accountability.

The budget cycle, whether it is at a national or state/local level, is typically a year-long process divided into four main stages: formulation, approval, execution, and oversight (Ramkumar 2008). Distinct stakeholders are involved in different decisions at each stage of the budget cycle. In the budget formulation stage, the executive branch of a national government, or its equivalent at the local level, puts together the budget plan. During budget approval, the relevant legislative branch debates, alters, and approves the tabled plan. Once the plan is approved, the executive branch of the national or local government implements the budgeted policies during the budget execution stage, producing reports on expenditure in the process. In the final stage of the cycle, the national or supreme audit institution and legislature, or the appropriate local equivalent, independently account for and evaluate expenditure made under the budget (IBP 2010).

While participatory mechanisms can be introduced at each of these stages, the process of Participatory Budgeting is most common in the pre-budget phase of the budget cycle—i.e., during budget formulation (OECD 2019). Budget formulation is less technical than postbudget stages of the budget cycle and can thus be more readily attuned to

gather the needs and priorities of communities through public input at the start of the budget process.

Similarly, while participatory practices exist across the budget process, including at the national or central level, opportunities for public engagement in budget formulation are primarily situated at the local level (Wampler & Touchton 2017). As the level of government with greatest proximity to citizens, local governments are ideally placed to facilitate public participation in decision-making processes and, in principle, best suited to understand local needs and priorities (UNHRC 2015). This proximity to the public makes local government a natural conduit for Participatory Budgeting.

Voting Systems

Liquid Democracy

The combination of direct and representative democracy is called liquid democracy [20].

Imagine a group (or population) with universal suffrage, all of whose members (or voters) are entitled—for every collective decision (or policy)—to either cast their vote directly or to delegate it to a representative (or proxy). Anybody can freely decide why and to whom to delegate their vote, or to run as a proxy. Voters can choose different representatives for different issues, with each proxy representing their original voters for one or more policies, or policy areas, so long as the delegation is not withdrawn. There is no cap on the total number of representatives, and proxies can redelegate to other proxies. For every decision, non-delegating voters cast a single vote, while proxies cast all delegated votes plus their own. If we assume, to simplify, that the decisions are binary, the outcome is defined by majority rule. This entire process is facilitated by information and communication technologies.

Ranked Choice Vote

The voting system where voters cast their vote as a ranked list of candidates is called ranked-choice vote [21]. The rules must specify the length of the list.

Quadratic Vote

The voting system where voters can trade their vote is called quadratic vote [22]. Each voter is apportioned a certain number of voting units that they can either vote with or sell. Voting units that were given in favor of a proposal by a voter are converted into votes with the square root

rule. For instance, one unit equals one vote, four units equals two votes, nine units - three votes and so on.

Futarchy

Decision markets and prediction markets allow betting on outcomes of particular events [23]. Theoretical method of public policy selection through prediction markets is called futarchy.

Computer Science

Cryptocurrency

From the computer networking point of view it can be said that a cryptocurrency is a shared network of volunteer nodes that keep an account of the underlying digital asset. Each node is supposed to run under the same protocol and each node keeps the history of all asset transactions. It can be shown mathematically that under certain conditions it is practically impossible to compromise the network [24]. Given this property it can be said that such a network is trustless meaning that you don't rely on faith but rather have relative certainty that the network is going to act in accordance with some predefined rules. It can also be said from the computer networking point of view that such a network is decentralized meaning that there is no single authority that is able to override the rules of the network.

Basic forms of cryptocurrency set the hard limit on the number of currency (asset) units that can exist. From the monetary perspective cryptocurrency is a monetary system with a fixed supply of currency.

Protocol that runs the network specifies the algorithm that can be used to randomly generate a pair of keys (or addresses). Generating keys can be viewed as an equivalent to creating an account that can hold currency units. First key in the key pair is public: you can give it to somebody who wants to send you a transaction. Second one is private: you never give it to anybody and you must use it in order to send a transaction to somebody.

Another form of cryptocurrency that is called stablecoin provides a digital asset whose market value is supposed to be tied to some other asset such as a sovereign currency or a commodity [4]. Potentially a useful financial instrument but one that is not particularly relevant to the present discussion.

Privacy vs. Anonymity

Let's compare the banking system and basic cryptocurrency from the perspectives of a network client and a network provider. When the client opens up an account in a bank and makes a transaction, the bank knows exactly who the client is and what the transaction was, and is supposed to keep that information secret from the general public. It can be said that the network client has no anonymity in relation to the network provider, but the client has privacy in relation to the rest of the world because nobody except the provider can know that the transaction has been made and what exactly the transaction was.

When the network provider is a basic cryptocurrency and the network client makes a cryptocurrency transaction, the network provider doesn't know the identity of the client and just appends the transaction to the transaction history. It can be said that the network client has anonymity because nobody knows who exactly made the transaction, but the client doesn't have privacy because anybody in the world can know that the transaction has been made and what exactly the transaction was.

There exists another form of cryptocurrency that provides full encryption of the transaction history. When a network client makes a transaction of cryptocurrency that is fully encrypted, nobody can know who made the transaction, what the transaction was or if the transaction even happened. In this case it can be said that the network client has both privacy and anonymity.

Smart Contract

There is a form of cryptocurrency that is the same as the basic cryptocurrency but that also uses a protocol that adds general computational capabilities to the shared network. A network client can generate an address and deploy an arbitrary computer program to the network at that address. They can then publish the address of the program on their website on the internet. Other network clients can use the address to interact with the program by taking actions that the program allows to perform. The program can be designed to allow additional privileges to its creator but it cannot be unilaterally altered or overridden by the creator nor anyone else. A program that runs autonomously on a shared network is called a smart contract. [25]

Token

The most basic type of a smart contract is a token contract. Token is a type of digital asset that is similar to the stock issued by a company or corporation. However, unlike stocks, tokens do not represent equity. In fact there is no legal framework yet that defines the rights of token holders. Tokens can be bought in exchange for the base currency of the shared network. [26]

Decentralized Autonomous Organization

Another type of a smart contract is a DAO contract. DAO is similar to a company or corporation but one that is governed by the network participants. However, unlike corporations, DAO doesn't yet have a well defined legal status [26]. The most basic type of DAO is an investment fund that is tied to a special type of token contract. Participants can buy fund tokens in order to vote for investment proposals that were submitted to the fund. The voting power of the participant is determined by the number of tokens that they hold. Proposals that cross some threshold receive funding from the revenue raised by the fund from selling tokens. [27]

Decentralized Finance

There exist financial services such as credit, insurance, exchange that are provided by DAOs on a shared network. Generally, all monetary activity associated with tokens and smart contracts is called decentralized finance.

Human-Computer Interaction

Decentralized Governance

Decentralized networks allow to coordinate network participants without a central authority [31].

By eliminating the figure of the middleman, blockchain technology makes it possible to replace the model of top-down hierarchical organizations with a system of distributed and bottom-up cooperation. Instead of relying on a centralized operator or middleman, blockchain-based networks are designed to operate in a fully distributed manner, relying on a decentralized infrastructure to coordinate the interaction of all people contributing to these networks. Thanks to these new technology, we can thus witness the emergence of new decentralized crowd-sourcing organizations, which also aggregate the contribution of multiple people, but that do not require any kind of intermediary figure in order to manage the flow of contributions.

There are limitations to market-driven governance of a decentralized network.

The free market has, however, many limitations. First and foremost is the issue of transactionality. If the governance structure for decentralized blockchain-based networks or applications were based, only and exclusively, on market dynamics, many of the social interactions and noncommercial activities performed on top of these networks would ultimately turn into marketdriven transactions. Whether a blockchain is used for the purpose of trading or contracting, or whether it is used to facilitate coordination among a decentralized network of peers, the transactionality inherent in market-based governance systems might ultimately influence the underlying motivations of people interacting through the platforms—replacing ideological principles and social or relational motivations with economic rationality and instrumental logic.

There are limitations to trustless networks.

Given these limitations to market-based governance, we might wonder whether blockchain technology can actually provide the necessary infrastructure for a more decentralized society. To be sure, by eliminating the figure of the middleman, blockchain technology allows for people to cooperate in a more decentralized manner. Yet, if we look at the real-world applications of the technology, we can see that they actually promote a very individualist approach to collaboration. Often praised for their potential to support or facilitate a more collaborative economy, the current implementation of existing

blockchain-based networks is often inconsistent with the original conception of the collaborative economy—defined as an economy based on “horizontal networks and democratic participation” (Botsman & Rogers, 2010). In its original conception, the collaborative economy was not meant to rely on a centralized (trusted) authority responsible for mediating interactions between a distributed network of (untrusted) actors. Rather, players in the collaborative economy had to contribute towards building and validating trusted relationships between members of their communities (Hawlitschek & al., 2016). Conversely, with a blockchain, trust is perceived as something that should be reduced to the maximum. Economic transactions and social interactions are mediated by a so-called “trustless system”, where trust in people is replaced by trust in the underlying technological framework.

Accordingly, when it comes to decentralized cooperation and collaboration, one of the greatest feature of a blockchain—its trustless infrastructure—is also one of its greatest drawbacks. Specifically, the trustlessness of these systems actually lessen the opportunities for people to create strong social connections and community ties. Because people do not need to trust one another, they also do not need to create bonds between each other.

Most critically, because of the specific payoff structures embedded into a majority of these blockchain-based systems—which assume that everyone is a defector—these systems are generally designed to work in highly antagonistic environments, rather than collaborative ones (Kroll & al., 2013). Hence, while the robustness of these systems is usually high, their efficiency is, however, significantly inferior to what it could have been, had they been designed to account for the fact that most people are more likely to cooperate than to defect.

Decentralized networks should allow network participants to express trust.

Accordingly, if the potential of blockchain technology is real, it is crucial to acknowledge the limits of existing attempts at adopting a market-driven approach to the governance of decentralized blockchain-based applications. In addition to the technical challenges that still have to be addressed by these emergent technologies, one of the main challenges that yet has to be addressed is how to implement a new layer of trust on top of these trustless infrastructures, so as to enable people to collaborate and engage into trusted interactions, while maintaining the benefits of decentralization.

Decentralized governance should be designed to increase group utility.

If technology can be a powerful tool to promote individual freedoms and autonomy, it cannot—by itself—constitute the basis for a free and decentralized society (Benkler, 2016). The decentralized infrastructure of blockchain technology may well increase the opportunities for people to organize and coordinate themselves in a more open and less hierarchical way, but it does not constitute, as such, a sufficient condition to ensure a sustainable decentralized governance structure.

There is an inherent tradeoff in security between centralized and decentralized governance.

It is important not to conflate the notion of decentralization at the infrastructural level with decentralization at the governance level (Agre, 2003). While it is, indeed, difficult to deploy a distributed governance system on top of a centralized infrastructure—because the party who controls the infrastructure inherits the power to influence the system—at the same time, a decentralized infrastructure does not necessarily entails a decentralized governance structure. Quite to the contrary, a decentralized infrastructure is often much weaker than its centralized counterpart. Given the lack of a central authority in charge of managing and protecting it, the system can in fact be more easily co-opted by external forces (Bauwens, 2009).

Blockchains and Constitutional Catallaxy

Decentralized networks are able to establish a constitutional order that is beneficial for competition and cooperation among network participants [37].

It should be said that social scientists have analogised the concept of the political constitution to describe other kinds of (reasonably well-ordered) human activity. To give one example, Arielle John (2015) has described informal cultural norms as resembling constitutional features insofar as shared frameworks of meaning between non-intimates informs, but does not determine, both expectations and interactions. Most relevant for our purpose is the idea that individuals and their entities are able to engage one another using information and communications technologies, and the technological derivatives of ICTs, using programmed codes and technical protocols implicitly treated as fundamental working rules of a law-like or even constitutionalising character. In the context of discussion about the Internet, Krecké (2004, 303) depicts the emergence of a “decentralized, self-regulatory process of governance which starts to emerge within

cyberspace and which does not closely resemble the current hierarchical structures of law production.”

Scholars are coming to see blockchain technology, a ledger technology representing the confluence of computer science, cryptography and economic incentives, as possessing constitutional properties enabling heterogeneous users to compete and collaborate for mutual benefit (e.g. Berg and Berg 2018; De Filippi and Wright 2018; Rajagopalan forthcoming). We agree with this assessment, for reasons to be explained below, however our contribution to this nascent literature seeks to emphasise an underappreciated aspect of the “constitutional” features of blockchain: changes to the fundamental working rules of blockchain qua constitution are necessarily of an emergent character. The emergence of blockchain rules, in turn, reflects a participatory process wherein users of this technology are seeking to achieve (net) benefits, not only in an institutionally comparative sense against mainstream hierarchical methods of data recognition and storage. The “constitutional catallaxy” of the blockchain is unfolding to improve internal coordination and governance practices within this ecological techno-system, say, in the guise of improvements in data processing speed, security features, and so on.

Constitutions establish meta-rules of a system. Network rules must not determine individual outcomes of network participants.

The constitution poses as a statement of meta-rules of the game for the organisation and conduct of a polity, including with respect to the treatment of citizens by the state in accordance with the rule of law. It is generally held by constitutional scholars that the constitution should ideally enunciate abstract rules which subordinate the exercise of political power and which do not invoke discriminatory treatment towards certain members of the community (Fuller 1964). A key mechanism under the Buchanan approach to ensure the design of generic constitutional rules is to assume that individuals negotiate the terms and conditions of the constitution under a “veil of uncertainty.” It is supposed people will rationally focus upon aspects of the general interest when agreeing to constitutional terms and conditions: “[t]he uncertainty that is required in order for the individual to be led by his own interest to support constitutional provisions that are generally advantageous to all individuals and to all groups seems likely to be present at any constitutional stage of discussion” (Buchanan and Tullock [1962] 1999, 78-79). ...

Decentralized networks can establish a process of dynamic and open-ended rule development.

It has been argued by critics of constitutional political economy, and with some force, that the theoretical presumptions underpinning this theory are limiting to the extent that the political task of constitutionalism is conceived as restricted to a time-limited, close-ended period of a polity's existence. Taking the precepts of constitutional political economy at face value, then, any subsequent constitutional developments are perceived as analytically anomalous or, going further, viewed as malign from the standpoint of democratic accountabilities and, perhaps more fundamentally, protecting economic and social liberties. Whereas conceiving constitutions as a political ordering mechanism advanced prior to social interaction conveniently provides a basis for much of political science and other social-scientific thinking, recent developments in the literature invite us to consider an alternative vision of constitutions, and constitutionalism, as a dynamic, open-ended and contestable process between vying interests within political space.

Drawing upon work in the recently-developed field of "constitutional catallaxy" (e.g. Runst and Wagner 2011, Rajagopalan and Wagner 2013, Novak 2018; Salter and Wagner forthcoming), we interpret constitutionalism as a catallactical enterprise of rule-setting, and often involves the promulgation of novel insights concerning how best to condition the political order. The effective understanding of the workings and application of the constitutional order can be pluralistic by nature, and subject to contestation and change. In other words, constitutional adjustment is an emergent political phenomenon instigated, often unintendedly, by policy, legal and other entrepreneurs seeking to reframe the possibilities for viable political action amongst levels of government as interpreted as constitutionally valid. The study of constitutional catallaxy potentially allows for even very extensive reforms to constitutional arrangements to become permissible, should the underlying circumstances of political interaction allow for it.

Whereas the application of constitutional political economy, and the new-found notion of constitutional catallaxy, has been largely limited to the condition of political constitutions, it has been recognised most recently that platform-based technological applications, such as blockchain, possess working rules which convey a constitutionalising sense amongst developers and users (Berg and Berg 2018, Rajagopalan forthcoming). According to (Rajagopalan forthcoming, 3), "[t]he Bitcoin protocol in particular is essentially a set of rules written in computer code governing what is, and what is not,

allowed by the participants in the Bitcoin network. No single participant can change the rules, though new rules (in the form of upgrades to the open-source software) can be advanced by different individual participants. The key to understanding Bitcoin's rules is understanding consensus. In this context, James Buchanan's scholarship is relevant to this new technology." Our argument is that it follows from the proposition that the fundamental working rules of blockchain are represented as the constitution for recording, securing and validating data and information, that elements of constitutional catallaxy are also evident in the blockchain space.

Rules of a decentralized network are determined by network participants.

One of the post-contractarian breakthroughs of constitutional political economy was the understanding that, rather than being static, constitutions are themselves dynamic institutions subject to change. The neat delineation between "constitutional" and "post-constitutional" does not reflect the process of amendment which constitutions are regularly subject to (Voigt 1999, Salter and Wagner forthcoming). This catallactical model of constitutional design can be readily seen in the blockchain ecosystem, with users participating in a continuous process of debate over the meta-rules which govern their preferred protocol. Rajagopalan (forthcoming) describes blockchain protocols as consisting of both constitutional, and ordinary rules. In this sense, the constitutional rules of blockchain protocols place limitations on the actions of the participants, restricting the supply of the native token or the size of a block for instance. The choice of these constitutional rules is however subject to a dynamic process whereby users propose, and debate changes to, those rules. The original drafting of, and any subsequent amendment to, those rules requires the consent and acceptance of groups of users who each face their own incentives and technical limitations.

There is an inherent tradeoff between establishing the rules and changing the rules. Coordination among participants of a decentralized network leads to improvement of the network.

The constitution is widely renowned as a central feature of economic, political and social interactions in the "Great Society" populated by multitudes of individuals with divergent aspirations, motives and values. Buchanan's constitutional political economy project attempts a grand conceptual rationalisation of constitutional objectives, as well as functions, within the classical liberal philosophical frame (Buchanan 1987). Despite the intellectually exquisite analytical and normative properties of constitutional political

economy, drawing in no small measure from social contract theories, the framework developed by Buchanan and other scholars has not gone unchallenged. Whereas the requirement for coordination-intensive unanimous (or near-unanimous) agreement of constitutional terms, during a pre-constitutional phase, connotes agreement and stability, it equally begs the question as to how constitutional adjustments could be feasibly rendered to accommodate changing individual or group preferences.

Constitutional catalaxy is an attempt to comprehend the multiplicity of outlets through which change in the fundamental working rules governing human action may be funnelled, remaining within the confines of positive rather than normative political economy. In this paper we suggest that blockchain activity is constituted by numerous rules but which are subject to change, as actors within this ecosystem actively seek to improve coordination in ways which successfully improve technological efficacy in terms of data contemporaneity, reliability and security.

Governance and Protocols

Decentralized networks should be able to shape the structure of institutions [38].

Governance of protocols: previous work on governance and Internet protocols has focused on how protocols are developed and governed through technical decision-making of standards groups such as the IETF [31, 79], or the private sector may regulate them through the supposed invisible hand of the market [73]. This research often takes the perspective that users have little ability to decide on what they want the Internet to look like, as control becomes increasingly hierarchical and centralized.

Governance by protocols: recent research has also pointed to how protocols are designed in ways such that they can be used as mechanisms of control (e.g., for government monitoring). This research focuses on “governance by Internet infrastructure, rather than governance of Internet infrastructure” (emphasis in original) [32]. This research examines both powerful governments or organizations coopting Internet infrastructure for their own political purposes, and the attempts to make alternative distributed network protocols that cannot be centrally governed [89].

Governance shaped by protocols: in the first strand of research, governance is enacted onto distributed network protocols by governments, organizations, or “the market”; in the second strand, governance is enacted onto users through the technical configurations

developed by governments and organizations; and in this third strand I introduce here, instead of governing users of the protocol, the protocol itself shapes the structures of governments and organizations. This strand is not focused on the governance of protocols or governance by protocols, but on how governance structures themselves are shaped by technical protocols. Research has shown that Internet protocols influence the governance, organization structures, and ability to innovate of the corporations that develop hardware components of the Internet's infrastructures [117]. To explore this third strand, I examined how imaginaries of decentralized autonomous systems envision using blockchain protocols to shape the governance of institutions.

Commons 3.0

Decentralized networks should be able to facilitate economic cooperation [39].

Commons 1.0 covered the economic universe of natural resource commons, e.g. forests, fisheries and irrigation systems (Ostrom 1990). Commons 2.0 has developed over the past two decades by extending analysis to information and knowledge commons, particularly digital commons, e.g. open source software, peer production, open science, open innovation (Benkler 2006, Ostrom and Hess 2007, Madison et al 2010, Frishmann et al 2014, Allen and Potts 2015). Commons 1.0 showed how effective institutions of private governance could create small-scale cooperation with cheap talk and monitoring. Commons 2.0 showed how publically observable reputational mechanisms could also overcome the free-rider problem (the social dilemma) at larger scale to generate cooperation in the production and maintenance of quasi-public goods.

Blockchain is Commons 3.0 in that it provides a technical solution (cryptographic consensus) to the problem of cooperation in joint or group production at scale while still maintaining the benefits of commons-type (i.e. polycentric) institutional governance. A blockchain is a trustless commons in which effective rules are embedded in constitutional smart contracts that are cryptographically secure and crypto-economically implemented. The working hypothesis is that the structure of these rules is likely to be similar to the eight 'design rules' identified by Ostrom (1990) (Cox et al 2010).

Decentralized networks should be able to facilitate democratic processes. Decentralized networks should allow for collective choices at the lowest level of authority. Decentralized networks have a potential to overcome limitations of traditional democracy.

A blockchain is a cryptographic consensus mechanism. Beyond applications to finance, law, and economics, a further application of the blockchain technology is politics, i.e. crypto-democracy, by facilitating secure low-cost tamper-proof 1P-1V voting. By lowering the cost and raising the perceived trust in voting institutions and outcomes, crypto-democracy can shift the margins on the efficient use of democracy (e.g. toward more frequent referenda, or tournament-style voting), and efficient scale (e.g. toward global). A new research program follows from running through the suite of public choice results and models modified for a world of crypto-democracy. For example, Condorcet cycles on voting and Arrow's "impossibility theorem" still hold unchanged, but claims to the strategic significance of agenda setting may need to be weakened, and Down's (1957) logic about the irrationality of voting, Brennan and Lomasky's (1993) claims about expressive voting, and Caplan's (2007) claims about voter ignorance may require modification. This follows from a key finding of public choice economics, namely that the problems with democracy cannot be fixed with better quality people (i.e. more noble politicians, better informed voters), but only with better institutions. Constitutional constraints are one pathway (Buchanan and Wagner 1977), but another is polycentric governance by which the domain of democracy is matched to the most efficient information and incentive context. Blockchain-based governance is highly scalable, and can therefore potentially enable collective choices at the lowest feasible level of political authority. The tyranny of the majority (Buchanan and Tullock 1962), exploitation by organized minorities (Olson 1965) and rational voter ignorance are all significantly mitigated when self-organizing communities can adapt to optimal size based on governance not resource conditions.

Decentralized networks provide an institutional alternative to the government and the market for economic coordination.

Blockchains are a new but potentially revolutionary technology as a cryptographically secure decentralized ledger upon which can be placed any information requiring public validation (e.g. money, contracts, property titles, identity, etc.). One way to look at the economics of blockchain is as a new general-purpose technological innovation that is undergoing the Schumpeterian phases of adoption and diffusion through the economy, as a kind of internet 2.0. Yet this nascent characterisation of the blockchain (including bitcoin) as an epochal new ICT, thus emphasising disruptive new markets and industries, while not wrong, is nevertheless misleading. For blockchain is also an 'institutional

technology', a governance technology for making catallaxies, or rule-governed economic orders. Blockchains thus compete with firms, markets and economies, as institutional alternatives for coordinating the economic actions of groups of people, and may be more or less efficient depending upon a range of conditions (behavioural, cultural, technological, environmental, etc). This is what makes blockchains interesting from an institutional and public choice perspective.

Consortium Blockchain

A shared network of selected nodes is called consortium blockchain [28]. Consortium blockchain is not computationally intensive and has a high throughput.

Consortium blockchain: The consortium blockchain consists of a pre-selected set of nodes or computers that are responsible for controlling access to the blockchain network resources (Dib et al., 2018). The goal of the consortium blockchain is to eliminate the individual/single autonomy of the private blockchain by having multiple entities or organisations in charge of consensus and decision making for the benefit of the whole network of peers. Since only pre-selected organisations are allowed to validate transactions and consensus, incentives are not necessary in this network. The pre-selected set of nodes make it partially private, partially public and semi-decentralised. More precisely, it provides the benefits of public blockchain in terms of efficiency and scalability while still permit some degree of central safeguarding and monitoring like in private blockchain. The consortium blockchain such as Hyperledger fabric (Cachin, 2016) is designed to meet the needs of the enterprises where a group of collaborating agencies exploit the blockchain technology to improve service delivery. All consensus participants of the consortium blockchain are known and reputable, therefore, malicious users cannot join the network freely.

Server-side Encryption

The technology that allows for data to be hosted without the host being able to read the data is called a crypto system [29].

In this paper, we describe our cryptographic schemes for the problem of searching on encrypted data and provide proofs of security for the resulting crypto systems. Our techniques have a number of crucial advantages. They are provably secure: they provide provable secrecy for encryption, in the sense that the untrusted server cannot learn anything about the plaintext when only given the ciphertext; they provide query

isolation for searches, meaning that the untrusted server cannot learn anything more about the plaintext than the search result; they provide controlled searching, so that the untrusted server cannot search for an arbitrary word without the user's authorization; they also support hidden queries, so that the user may ask the untrusted server to search for a secret word without revealing the word to the server. The algorithms we present are simple, fast (for a document of length, the encryption and search algorithms only need $O(n)$ stream cipher and block cipher operations), and introduce almost no space and communication overhead, and hence are practical to use today

Virtualization

The way to package software that allows it to be run independent of an operating system is called containerization [30]. Such a package is called an image. Image can be used to spin up an unlimited number of containers that all run the same computer programme.

In the history of computing, Containers have unique recognition because of its importance in virtualization of infrastructure. Unlike traditional Hypervisor virtualization where one or more independent machines run virtually on physical hardware via an intermediate layer, containers run the user space on top of the operating system kernel. Containers provide the isolation between multiple user work space instances. Because of this unique feature container virtualization is often referred to as operating system level virtualization. Instead of starting a complete operating system on the host operating system containers shares the kernel with the operating system which eliminates the overheads and it also provide isolation between the applications. These features of the containers make it possible to ship the small container which acts as a complete operating system which encapsulates only those files which are needed to run our desired applications.

II. Design Principles and Objectives of Democratic Decentralization

In this chapter we are going to discuss what and why we are trying to accomplish, and what principals are going to guide our proposed solution that is detailed in chapter III. What we want is to give an ability to a group of people to make an agreement to directly vote on a set of contracts that are proposed by agents that are supposed to govern the group. Our hypothesis is that we can design a system of contracts in such a way that allows it to set incentives towards agent behavior that is in the best interest of the group and that allows it to achieve complete self-governance. We want it because currently there is no democratic system that allows complete self-governance by direct vote and if we were to discover such a system we could potentially use it to supplement the existing one to achieve more optimal resource allocation and increase political harmony.

Politico-Economic System

Private and Public Choice

We are going to combine market and democracy into a unified system of contracts to maximize group utility. We'll have to account for certain situations and tradeoffs that, if unbalanced, can lead to decrease in group utility. We are going to perform a combined analysis of market and democracy failure from the perspective of a group of voters who choose from a set of contracts.

Market side:

1. Natural monopoly. The system of contracts must allow it to provide services that generally cannot be selected through the mechanism of market competition among providers, for example construction of road, pipe, electric grid networks. A group of voters has to be able to finance an unlimited number of agents that must cooperate in order to provide the service.
2. External effects. The system of contracts must allow it to reject services with high external costs. A group of voters has to be able to select a contract that accounts for external costs.
3. Indivisibilities. The system of contracts must allow it to provide services that have a high barrier to entry. A group of voters has to be able to finance agents in order to overcome the barrier.
4. Asymmetric information. The system of contracts must allow it for a group of voters to finance specialized intermediaries that are going to perform information intensive services.
5. Public goods. The system of contracts must allow it for a group of voters to finance agents that provide public goods.
6. Property rights. A group of voters has to be able to finance agents that provide protection of property rights.

7. Monopolies and oligopolies. The system of contracts must allow it for competition to emerge. A group of voters has to be able to switch their votes from monopolistic agents to competing agents.

Democratic/Government side:

1. Decision-making costs vs. external costs. The system of contracts must allow a group of voters to balance the costs of group decision making in relation to external costs that are incurred by the minority of voters in the group. For every set of contracts the group has to be able to choose the most appropriate set of voting rules that includes simple, qualified and unanimous majority voting.
2. Indivisibility of public goods. The system of contracts must allow for a group of voters to express their individual preferences in a similar way with public goods as with market goods. The system must be able to provide public goods as an array of possible options to choose from. Voters must be able to express their preferences continuously and be able to change their mind. The system must allow it to vote on a bundle of different policies for multiple sectors of the economy.
3. Expansionary pressure. Increase or reduction in the number of budget consuming contracts in the system must be decided by voters.
4. Choice and outcome. The system of contracts must allow it to vote on proposals that are very specific in what their outcome is supposed to look like.
5. Tactical voting. The system of contracts must not limit voters in the number of choices they can make such that voters are able to support multiple competing proposals.
6. Cycling paradox. Cycling is reduced because of 5.
7. Voting system. The system of contracts must allow voters to choose their representatives individually as well as lists proposed by political parties.
8. Rational ignorance. The system of contracts must allow voters to know that their vote is going to have an immediate impact that is not dependent on the vote outcome. The system must allow voters to know exactly what is the personal cost that is associated with their vote. When voting has an immediate cost, voters are more likely to get informed.
9. Vote motive. The system of contracts must allow it for representatives to exist without the necessity to win the majority in an election and to just represent those voters who voted for them. Voters must be able to make any number of independent choices from a set of proposed representatives.
10. Median voter theorem. The system of contracts must allow it for a broad range of policies to be able to exist simultaneously.
11. Democratic failure. The system of contracts must allow it for a penalty for irrational voting behavior to exist.
12. Special vs. general interests. The system of contracts must allow it for general interests to be proportionally represented.
13. Vote trading. The system of contracts must allow it for transparent and explicit vote trading practices to exist.
14. Rent seeking. The system of contracts must allow voters to balance the amount of rent seeking behavior.

15. Budget maximization. The system of contracts must allow it for competition among budget consuming agents to exist.

Governing the Commons

The system of contracts must allow it for a group of voters to establish institutions for collective action to manage common-pool resources.

1. Group membership. The system must allow it to establish group boundaries.
2. Governance. The system must allow voters to establish rules that are well matched to their needs and conditions.
3. Legislative power. The system must allow voters to influence the rule-making process.
4. Traditional government. The system must allow integration with the government.
5. Executive power. The system must allow it for rule enforcement mechanisms to exist.
6. Penalties. The system must allow it for a graduated system of sanctions to exist.
7. Judicial power. The system must allow it for low-cost conflict resolution mechanisms to exist.
8. Management. The system must allow it for multiple layers of nested enterprises to manage the common-pool resources.

Constitutional Economics

The system of contracts must allow it for a group of voters to establish economic and political rules.

1. Itemization. Contracts in the system should be individually itemized.
2. Rule enforcement. The system of contracts must provide some mechanisms for rule enforcement. Deviation from the rules shouldn't lead to meaningful individual utility maximization. Rule enforcement and adherence should lead to individual utility maximization.
3. Decision making. Contracts in the system must provide decision making mechanisms within the rules.
4. Rule alteration. Changes in rules must be approved unanimously.
5. Financing. All spending must specify how it's going to be paid for.

Fiscal Federalism

Each group of voters both on central/federal and local level must have its own dedicated system of contracts. Local level groups should be able to require their voters to join central level groups. It must be possible to distribute fiscal responsibilities among the groups.

1. Varying Preferences. If variability in individual preferences among local level groups increases then responsibilities of local groups must be able to increase.
2. Mobility. Increase of variability in responsibilities of local groups leads to increase in competition for residents among local groups.

3. Spatial Effects. When responsibilities are specific to a geographical region, local groups are preferable. When responsibilities span multiple regions, central groups are more preferable.
4. Externalities. When a local group receives benefits or costs from another local group, voters must be able to choose contracts that account for external effects.
5. Government Effectiveness. The situation when the same responsibility has lower or higher costs for one group level than another one.

Constitutional Catallaxy

The system of contracts can be viewed as a framework of constitutional rules for competition, coalition building and conflict resolution for a group of voters that allows it to arrive at a set of prices and political agreements.

1. Conflict. Voters must be able to choose rules that do not result in a conflict between two separate groups of people.
2. Liberalism vs democracy. Voters must be able to balance procedural liberalism and democracy. The system must allow it to self-enforce certain sets of rules.
3. Majority. In order for the system to exist it must have the majority support.
4. Self-preservation. The system must be able to counter attempts at derailing it.
5. Entrepreneurship. The system must allow it for rules to be discovered through the process of constitutional entrepreneurship.

Monetary Constitutionalism

The system of contracts must allow it to establish monetary rules.

1. Monetary rules should be simple.
2. It is always unclear what rules are the most optimal. Voters should be able to choose what they think is the optimum.
3. The system must allow for self-enforcing rules in regards to the central bank.
4. The system must allow for non-monopolistic central banking.
5. The system must allow it for a group of voters to balance the tradeoff between commitment to rules and administrative discretion.
6. Monetary rules should be self-enforceable.
7. It should be impossible to intervene with the rules.
8. Monetary rules within the system of contracts should provide a framework for economic activity.
9. Monetary rules should be able to restrict a set of choices that can be made within the system of contracts.
10. Rules should be able to account for costs and benefits of choices that were made.
11. Rules should be able to establish a limit on currency supply.
12. Rules must be proven to be more optimal.
13. Rules may be both market-driven and government-driven.
14. Rules must be agreed upon by a group that is subject to them.

15. It must be possible for costs and benefits of proposals to the group to be presented clearly.
16. Rules must account for imperfect information and self-interest.
17. Rules must provide incentives that maximize group utility.
18. It should be beneficial to agents in the system to follow the rules.

Polycentric Banking

The system of contracts must allow it for a group of voters to establish banking rules that do not rely on central banking but rather on polycentric banking.

1. Credit is a common-pool resource.
2. Rules cannot assume that all actors in the system are going to behave rationally, have perfect knowledge or be altruistic; and that all actors are going to act in the interest of a group rather than their own.
3. The group should be able to choose from a set of services and be able to discontinue the service.
4. Rule creation and enforcement must not require a single entity but rather a collective of entities that cooperate and compete with each other.

Participatory Budgeting

The system of contracts must allow it for a group of voters to establish a fiscal framework that allows for collective decision-making. The system must allow voters to have influence over four main stages of the budget cycle: formulation, approval, execution, and oversight. The system must be able to provide services on both national and local levels in both rural and urban communities.

Decentralized Futarchy

We can take the idea of public policy being selected by a market mechanism that is presented by the original futarchy, and substitute one market mechanism for another. Instead of the prediction market we can apply the stock market. The system of contracts must allow it for a group of people to select public policy proposals by listing them on an exchange and then adopting those that trade at higher prices. The system must allow it to build new policies on top of the old ones such that investments in the old policy retain some of their value as the new one is adopted and the old one is discarded.

Computer Networking

Decentralization Failure

The main promise of the cryptocurrency tokens was to become a financial instrument that could potentially allow small and medium sized businesses to raise capital without obstacles that are posed by the high barrier to entry into the stock market. With traditional stocks it is hard to get

listed on a reputable stock exchange and get rated by a reputable rating agency, and to be able to pay for a Board of Directors to ensure proper oversight. Only the bigger market players can afford it. Ultimately, the token concept has failed to deliver on its promise due to the lack of key components that are precisely the obstacles that it tried to avoid. Absence of the proper legal status and oversight, and of the stock market infrastructure that is necessary to support it, and of small and medium sized institutional investors who would be interested to invest in it make cryptocurrency tokens not a particularly viable financial instrument.

The main promise of the DAO fund concept is that it could allow it to create institutional investors that are not bound by the restrictions of the stock market. Traditionally, an institutional investor has to obtain membership at reputable stock exchanges and invest only in assets rated by reputable rating agencies. Ultimately, the DAO fund concept has failed to deliver on its promise due to the lack of key components that are precisely the restrictions that it tried to avoid. Absence of the proper legal status and oversight, and of the stock market infrastructure that is necessary to support it, and of potential investment opportunities that traditionally present themselves through the stock exchange make DAO fund not a particularly viable financial institution.

So far researchers at the European Commission have concluded that the recent developments in decentralized technology did not translate into the public sector [36]:

The scope: Contrary to how it is often portrayed, blockchain, so far, is neither transformative nor even disruptive for the public sector. We have not observed the creation of new business models, the emergence of a new generation of services nor direct disintermediation of any the public institutions involved in the provision of governmental functions. Truly transformative services which enable decentralised voting or civic governance without direct involvement of governments are missing from the current landscape.

What this document is trying to show is that there is a way to accomplish exactly the things that the European Commission said the current strain of decentralized technologies has yet failed to accomplish. Concepts such as crypto tokens and DAO funds that were supposed to be the avant-garde of financial decentralization appear to be not sufficient to create a complete market and public sector ecosystem just by themselves. Because an army can't just consist of the avant-garde, there must also be the arrière-garde. The support infrastructure layer that is supposed to service and connect an asset issuer to an asset consumer is currently missing in the world of decentralized finance. Although there are stock exchanges for digital assets, they specialize mostly in international finance and focus only on the bigger players, just like the traditional stock exchanges. Oversight in the form of Boards of Directors, rating agencies and financial regulators is non-existent. What we need is a decentralized market and public sector ecosystem that is complete and that can function on any scale.

Decentralized Governance

The system of contracts must allow for decentralized governance of a group of people.

1. The system of contracts must allow it to coordinate network participants without a central authority.
2. The system must provide an alternative to market-driven governance.
3. The system must provide an alternative to trustless architecture.
4. The system must allow network participants to express trust.
5. Governance of the system must be designed to increase group utility.
6. The system must allow voters to balance the inherent tradeoff in security between centralized and decentralized governance.

Blockchains and Constitutional Catallaxy

A group of people must be able to establish a shared network that produces a constitutional order that is beneficial for competition and cooperation among network participants.

1. The shared network must establish meta-rules for the group.
2. Network rules must not determine individual outcomes of group members.
3. The shared network must be able to establish a process of dynamic and open-ended rule development.
4. Rules of the shared network must be determined by network participants.
5. The group must be able to balance the tradeoff between establishing the rules and changing the rules.

Governance and Protocols

A group of people must be able to establish a shared network that is able to shape the structure of institutions that govern the group.

Commons 3.0

A group of people must be able to establish a shared network that allows it to govern common-pool resources.

1. The shared network must be able to facilitate economic cooperation.
2. The shared network must be able to facilitate democratic processes. The network must allow for collective choices at the lowest level of authority.
3. The shared network must be able to provide an institutional alternative to the government and the market for economic coordination.

Consortium Blockchain

A group of people must be able to establish a shared network of selected nodes.

Server-side Encryption

A group of people must be able to establish a shared network that allows for data to be hosted without the host being able to read the data.

Virtualization

A group of people must be able to establish a shared network that allows it to run software packages independent of an operating system of the network.

Democracy

Voters have to be able to delegate as well as to vote directly. A group of voters has to be able to choose among different types of voting procedures such as simple, qualified and unanimous majority vote or anything in between, ranked choice vote and quadratic vote as well as market selection procedures such as decentralized futarchy.

Traditionally, when there is an election or referendum the thing that is being voted on is some position of authority in the government or some policy. In a decentralized voting system we can allow it to combine the two, meaning that a group can vote on a policy that is attached to an authority (agent) that is supposed to implement the policy. The authority in this case means any entity such as a company or a government agency.

Requirement 1 - Clarity

A contract must be clear in what it allows to do. The terms of the contract have to be designed in such a way that a voter must be able to know exactly what actions the contract allows to perform. Only under this condition can the voter make a decision that can be qualified as informed.

Requirement 2 - Privacy

A voter may have a reasonable expectation of privacy and vote secrecy.

Requirement 3 - Majority vs. Minority

Although contracts are approved by the majority of the vote, the voters who are in the minority must have an ability to protect themselves to some reasonable degree from possible negative consequences of decisions made by the majority. Votes that are in the minority must still count to some extent and must still be able to have some impact on the system.

Decentralization

Decentralization doesn't mean getting rid of the center, rather it means moving the center somewhere else. In our context it means moving the center towards direct/liquid democracy. Anytime we require an analogue of a traditional institution or a new type of institution that wields

some kind of authority, we are going to replicate it with a contract that can be voted on directly by voters.

These new kinds of institutions will require their legal status to be defined in the same way as it is defined for companies and businesses [26]. For instance, principles of non-discrimination must apply to the new institutions. The legal status of rules produced by the new institutions should be similar to a terms and conditions agreement, and organizational and municipal by-laws. All participants in the system must agree to the rules in order to participate.

In the traditional elections and referendums it is assumed that the will of the people is going to be carried out through the government. In our case it must be carried out through institutions that are set up by the system of contracts that are selected by a group of people.

In the traditional legislature the power to write laws, introduce them for the vote and vote on them is centered in a singular institution. In our case the system must allow for separate institutions to be responsible for the tasks of writing, introducing and voting on legislation. There must be an unlimited number of institutions that can perform these tasks.

The system must be compatible with the traditional government. The system must allow it for a group of voters to finance the traditional government. There are certain areas that are impossible to decentralize such as response to disasters, pandemics and foreign military invasions. The system must allow it for central and decentralized governments to cooperate and compete in a way that leads to group utility maximization.

Requirement 4 - Autonomy

The system has to be autonomous such that no single party to a contract is able to unilaterally override the terms of the contract. A voter must be reasonably sure that the contract they voted for remains in the same exact form that they voted for for the period specified in the contract.

Requirement 5 - Monetization and Seed Funding

A contract must be designed to allow the agent that proposed the contract to somehow monetize their activity, meaning agents must be able to receive some kind of payments for their services. And not only that but also contracts must provide agents with instruments to raise start-up capital.

Financial System

Monetary System

The system of contracts that is used by a group of voters must provide its own fiat currency subsystem. Every group of voters has their own currency. Groups can then establish a link between their monetary systems.

Requirement 6 - Credit Supply

The system of contracts must allow for money to be created as credit as well as the result of foreign exchange operations. Money creation is determined by voting on a set of contracts. Contracts may be proposed by agents, agents must specify all necessary contract parameters when proposing a contract, there can be an unlimited number of contracts that can be proposed and an unlimited number of agents that can propose them. There are following possible types of money creation contracts:

- Commercial and consumer credit. Interest rate and payback period must be specified for every contract such that voters can make an informed decision. The amount of credit that a contract can provide can be of the following types:
 - Fixed. Fixed amount of currency that can be created.
 - Reserve. The amount is determined by reserve requirements.
 - Algorithmic. The amount is determined by a computer programme.
- Decentralized government spending. The amount of spending and individual income tax rate must be specified for every contract.
- Open Market Operations. The amount that can be used for sale or purchase of securities and the amount of reserves that can be loaned on the interbank market must be specified for every contract. Technically, these amounts can be set to infinity in which case the behavior of the decentralized monetary system is going to be analogous to that of the traditional monetary system.
- Foreign Exchange. Contract must specify an exchange rate for foreign currency.

Requirement 7 - Credit Repayment

It has to be possible for the system to be in a state where it is mathematically possible to cover all debt obligations in the system such that currency supply equals or is greater than zero. The contradiction presented in [Example 4](#) makes the traditional system mathematically inconsistent. It is important to provide voters with an instrument that can allow them to expand the currency supply without expanding debt at the same time.

Additionally, as opposed to the traditional fiat currency that is not supposed to ever disappear, a decentralized fiat currency must have an ability to shut down if the group of voters decides to disband. During the shutdown process all existing obligations have to be covered for the shutdown to complete successfully and that requires that all obligations can actually be covered.

Fiscal System

In the US individual income tax accounted for 50% of the federal tax revenue in 2019, and the payroll tax - for 36% [44]. It means that the primary task for the system of contracts is to enable taxation in the employer-employee context.

It should also be noted that yearly government spending is comparable in size to the overall wealth of the private sector [45] which means that it is quite a substantial amount. However, it is not the goal of this document to suggest that taxes and government spending should be lower

or higher. Instead the goal is to design a general framework that can allow it to implement any particular policy in the most optimal way.

Decentralized fiscal system must allow for budgets and taxation to be determined by a group of voters. However, as per [Requirement 3](#) voters who are in the minority must be able to shield themselves from bad budgeting decisions. Taxation is a pretty heavy-handed instrument and voting is a pretty crude instrument. There must be an additional mechanism that will be able to counterbalance these drawbacks. And the mechanism is to introduce additional costs for the majority for making bad budgeting decisions.

To understand the balancing mechanism let's look at a simple example. There are three houses owned by persons A, B and C. They make an agreement to pay a construction agency to build a road. There are two construction agencies X and Y that are competing for the project. The

budget for the project is m , each person must contribute $\frac{m}{3}$. Persons A, B and C vote on which construction agency gets the project. Let's say A and B vote for X, and C votes for Y. The agreement says that if C doesn't believe that X is going to deliver the project and the budget is going to be wasted, then C can invoke a special provision in the agreement. The provision says that if the project fails then A and B must both pay $\frac{m}{6}$ to C. If the project doesn't fail then C must pay $\frac{m}{3}$ to X.

Requirement 8 - Government Spending

Voters must have an ability to know in any given state of the system how much money can the decentralized government spend as per [Requirement 1](#) that all contracts must be clear in what they allow to do. Each budget item must also include the means of financing of expenditures set by the item.

Requirement 9 - Spending per Representative

The United States House of Representatives has 435 members and the federal budget for the 2020 fiscal year was set at \$4.79 trillion. It amounts to 0.09 representatives per billion dollars in one voting procedure.

$$\begin{aligned} \text{Spending per Representative} &= \frac{\text{Representatives}}{\text{Budget, billions}} \\ &= \frac{435}{4790} \\ &\approx 0.09 \text{ representatives/billion dollars} \end{aligned}$$

Let's assume that we can vary the number of representatives. It would require approximately 4833 representatives to achieve the rate of one representative per billion dollars which is something that is not out of the realm of possibility. Hence, we want to give the voters in the

decentralized fiscal system a possibility to vary the rate of the number of representatives per certain amount of currency units.

$$\begin{aligned} \text{Variable Representatives} &= \frac{1 \text{ Billion} \times \text{Representatives}}{\text{Spending per Representative}} \\ &= \frac{1 \times 435}{0.09} \\ &\approx 4833 \end{aligned}$$

Requirement 10 - Budget Itemization

To guarantee that the decentralized fiscal system allows for an additional number of representatives [\[Requirement 9\]](#) and an increased number of voting procedures, there must exist strict itemization of the budget and separate voting procedure for each item rather than one voting procedure on the budget as a single document. It must be possible for every budget item to be voted on independently from any other item.

Stock Market

When designing the system of contracts, we are going to focus on creating incentives for long-term investments. If there's no demand for long-term obligations then there's going to be no supply of long-term obligations, hence no incentive to build institutions and make long lasting investments. Many developing countries do not have a functioning stock market and even in developed countries it is practically non-existent at the level of small and medium sized businesses.

Often the main barrier to long-term investments in developing countries is the lack of trust. When financial and other institutions of a country are not well developed, potential investors of a pension fund are afraid that their contributions are simply going to be stolen by the fund manager or that the fund is simply not going to be there anymore when the time for repayment comes.

Requirement 11 - Secure Finance

A contract that handles financial obligations must be designed in such a way that an investor can be reasonably sure that their investments cannot be stolen if the contract was configured in the right way.

Requirement 12 - Board Financing

Another major hurdle that forbids small and medium sized companies from going public is that paying for a Board of Directors is prohibitively expensive for the company. The system of contracts must allow shareholders to fund the Boards of the companies whose stocks they are invested in.

Requirement 13 - Locality

When an investor is making a portfolio or social security investment, the investor must have the possibility to be reasonably sure that the portfolio fund can then make investments on their behalf only in a specific geographic area on the municipal, regional or national level. It is going to give an opportunity to a group of people to become financially invested into their own community while still keeping the option for personal portfolio diversification.

Technically, in the traditional system nothing prevents such restrictions from existing. But it is just not going to be profitable to invest in local assets compared to national and international assets. So investment funds do not offer it as a service to specialize location. The system of contracts must allow it for a group of voters to make a choice to sacrifice some profitability in favor of locality. When presented with the choice on the group level rather than individual, it is more likely for a group to balance its investments in favor of locality.

Requirement 14 - Infrastructure

The system of contracts must allow for the stock market infrastructure of oversight bodies, stock exchanges, rating, insurance and regulatory agencies.

III. Decentralized Democracy

It is technologically possible to construct a political system with direct/liquid democracy as a source of power. Individuals can form groups to pool their resources together and to vote on who is going to manage those resources and on who has authority to produce laws and regulations; and enforce them; and resolve conflicts in accordance with them. Traditional financial systems can be replicated and improved by building on fiscal, monetary and risk management mechanisms such as fiat currency, taxation, budgeting and tenders, banking and central banking, securitization, insurance and portfolio investment.

Voter District

Fiscal System

A group of individuals who decided to join together creates a **platform for public tenders** where service providers can put up proposals for consideration by the group. A proposal must specify a personal income tax rate together with any and all additional information that may relate to services that the service provider promises to provide to the group. **Members of the group then vote on proposals and pay personal income taxes directly to their service providers**, or pay to cover the debt obligations [\[See: Public Obligations\]](#) of their service providers. Service providers compete with each other by proposing more favorable tax rates and providing higher quality services. **If a proposal receives the majority vote of the group then it applies to all members of the group**, otherwise it applies to only those who voted for it. It means that everybody pays taxes on proposals that have the majority vote. It also means that proposals with less than 50% of the vote are still getting funding just not from everybody.

Delegation

Members can revoke their vote at any moment, and if a proposal loses majority support it doesn't apply to the whole group anymore but only to those who are still in support of it. Members can delegate their vote and also revoke the delegation at any moment. Entities who wish to become delegates can put up proposals for consideration by the group that must specify their commission that they receive as a fraction of tax payments that are being made by those who delegated to them. **Any member can have an unlimited number of delegates and may also allow for chain delegation**, where delegates can delegate their vote to other delegates in which case the initial commission gets split between delegates in the chain. If the vote is revoked by a voter personally it can't be then added again to the same proposal by their delegate, and this rule also applies in the case of chain delegation.

Management

Let's call a group of individuals who vote on their personal income taxes a voter district. Anybody can create a voter district and **the creator of the district is in charge of admitting members**. At the time of creation of a district the creator must specify the commission rate that the district receives as a fraction of tax payments that are being made by the district members.

Districts are supposed to compete with each other for members and may specialize in different areas of interest.

Sovereign Voter District

Monetary System

Let's call a special type of a voter district that acts as a basis for a monetary system a sovereign district. It is the same in a sense that anybody can initiate one and that it provides a platform for public tenders, but it also has a currency that is tied to it. **When a service provider introduces a proposal up for a vote in a sovereign district, it must specify an amount of currency units** that the service provider seeks to receive for their services. If the proposal gets the majority vote then **the amount of currency units specified in it gets created in the service provider's account, and at the same time currency units that are being paid in taxes by district members on the proposal get destroyed**. Creation and destruction of currency units directly alters the overall currency supply. Basic voter districts can only redistribute the currency created by the sovereign district.

Emission Bill

The process of currency creation and destruction can be characterized as district members taking a loan from themselves, and then incrementally paying it down with their taxes. **The money loaned is managed by the service provider** who created the proposal for the loan. Of course any loan always contains a possibility of default, and this is a risk that members need to evaluate for themselves and need to be able to insure against [\[See: Public Obligations Insurance\]](#). Technically, it is possible to take a loan that has the tax rate of zero which means the loan does not have to be destroyed and in effect constitutes a positive constant in the currency supply [\[See: Requirement 7\]](#). Minority voters who pay taxes on a proposal that they didn't vote for also have a possibility to shield themselves from the proposal default [\[See: Credit Default Swap\]](#).

Let's call a currency unit of a sovereign district a token. Let's also call sovereign district members the people. Let's also call a proposal by a service provider that is being funded by district members a bill. A bill is called active if it has the majority vote. Let's call a bill in a sovereign district that changes the supply of tokens an emission bill. Let's call the amount of tokens specified in an emission bill that are supposed to be created by the bill an emission bill value.

Public Administration

Sovereign districts act as the most top-level administrative construct and are supposed to operate at the level of entire cities and states. There can be municipal, regional and national sovereign districts.

Regional and national level districts provide an opportunity for income redistribution. Service providers from municipal districts that have a comparatively lower income rate can submit bills in the regional and national level districts to receive additional funding.

Sovereign districts can specify a list of other sovereign districts of the higher administrative level. A potential district member must be first registered in one of the districts on the list in order to obtain district membership. Let's call a sovereign district that is tied to another sovereign district membership a complementary district.

Organization

The term service provider is defined here in relation to a voting district and can mean both governmental and private. Let's call any governmental or private entity that operates in a voting district an organization. Any entity can create an organization account that allows it to pay employees and pay corporate taxes [\[See: Tax Enforcement\]](#), and also to compete for taxpayer funding. So let's call any entity that receives taxpayer funding a public organization, and those who do not are just an organization. A public organization is called active if it has an active bill.

Hosting License

Each sovereign district has a separate database that keeps all transactions and voting data. The database is replicated such that multiple copies of it exist in different places hosted by **different organizations who can apply to become a database host by creating a proposal and putting it up for a vote by the people**. If it gets the majority support then the organization gets to download a copy of the database from other hosts who have already gotten the majority vote before that. The first host is the sovereign voter district itself. Every new transaction that is added to the database has to be validated and co-signed by every host and every host has full access to the data, and everyone else has access only to their own accounts and also to public data [\[See: Public Data\]](#). Hosts can access the database by performing a query which specifies exactly the criterion that was used to select the data. All queries made by a host are visible to every other host. Transactions can be rolled back if every host has co-signed on it. At the time of creation an account can be configured in different ways depending on its type, and these configurations can't be later altered by the account creator [\[See: Requirement 4\]](#).

Let's call a proposal to host the sovereign district's database a hosting license. A hosting license is called active if it has the majority vote of the people. When a bill is created in a sovereign district it may also include a request for a hosting license that activates if the bill becomes active. All token transfer transactions that are made from a public organization account are public data. It's also worth noting that in general this type of database has a high throughput, transactions are commission-free and it is not resource intensive however there are risks of individual hosts leaking or mishandling private data and of all hosts being compromised.

Hosting License Image

Optionally, a hosting license can specify that it allows voting on the procedure of private data aggregation and sale. **The license holder has to put up for a vote the computer code that is supposed to connect to the district's database and perform data selection and computations, and is supposed to output the result**. Let's call the computer code that operates on the private data of the people an image. Anybody can then download the image, inspect the code, and test it on their own account or on a test dataset, and see what results it

produces. An image is called active if it has the majority vote of the people. At the time of creation of an image it must also specify the price to run the image on the district's database to obtain the results it produces; and the commission rate that the license holder receives as a fraction of revenue from data sales. **The revenue from data sales gets uniformly distributed among district members.** Minority voters who didn't vote for the image can choose to opt out.

At the time of creation an image can be restricted by a host such that it can only be used by specific organizations. This is necessary when the data that is being sold contains personally identifiable information and can't be freely traded on the open market, and when the proper chain of custody of the data has to be maintained.

Bill

Voting districts can define their own tagging options that all bills must be tagged with at the time of creation. **When delegating their vote district members can choose which tags their delegate is allowed to vote on on their behalf.** Tax rate of a bill can be specified as a range of **tax brackets** with an appropriate bracket being determined based on an amount of tokens that is being transferred. Also the maximum budget of a bill can be specified as an absolute number of tokens and when reached it automatically will reimburse those who paid before by those who paid after the limit was reached in a uniform fashion. A bill may also specify a minimum budget that has to be reached in a certain time period and until then taxed tokens stay in an escrow account and are automatically reimbursed if the target is not reached.

A bill must also specify a renewal date after which a public organization that created the bill may change bill parameters and then voters and their delegates have to confirm or revoke their votes. If parameters do not change then the bill is automatically renewed, and in the case of an emission bill it is going to yield its value in tokens.

Public Organization

Public organizations are separated into several distinct types that their bills must be also tagged with. First order public organizations provide their services directly to the people. Second order public organizations guide the rules of how those services must be rendered. There are three types of second order organizations that mirror the principle of separation of powers. First, legislative public organizations produce laws and regulations. Second, executive public organizations check compliance with those laws and regulations. Third, judicial public organizations resolve conflicts that may arise in a service, legislative and executive process. Let's say for example that a voter district allows one tag option named "A". Then all available tags in that district are going to be A, A-legislative, A-executive, A-judicial.

Public organizations derive their authority from the number of votes that they have. However, the majority is not required to participate in the political process. **Second order public organizations act to limit the authority of the first order public organizations in meaningful ways. There may be an unlimited number of public organizations of all types.** Public organizations must establish by themselves constitutional rules and procedures that

determine seniority. The exact process may be different in every case and is subject to consensus and (re)negotiation among the involved parties.

Law Enforcement

All organizations that are created in a sovereign district are subject to laws and regulations produced by the legislative public organizations of the district. First order public organizations directly enforce compliance with those laws and regulations. Then executive public organizations check if enforcement action itself was in compliance with the laws and regulations and if necessary bring action to judicial public organizations.

Tax Enforcement

Tax enforcement is a crucial service that public organizations have to provide. First, they must make sure that all organizations use their accounts to pay their employees and do not conspire to arrange payments outside their account. When an organization is using its account to transfer an employee's salary, it automatically makes all necessary personal income tax payments of the employee on all of their bills [\[Organization: Pay Employee\]](#). Second, **legislative organizations may develop tax codes that tax commercial and other activity** and it's up to public organizations to enforce them. When an entity knows the total number of tokens it has to pay in corporate taxes in accordance with the tax code, the entity can pay its taxes by performing a special type of transfer transaction [\[Token: Pay Taxes\]](#). Corporate tax revenue gets uniformly distributed among active bills of the sovereign district.

Public Property

Public property and assets that are managed by public organizations remain in ownership of the public. A voter district has to keep an account of all public assets that are under its management. Public organizations together with their district should figure out an exact way to assign public assets to district tagging options that bills are tagged with and then the district can put this information as part of a tag description. Public organizations that receive taxpayer funding from the same tag have to cooperate in their management of public assets and must find a way to most effectively divide their responsibilities among each other.

Fiduciary License

Optionally, at the time of creation of a voter district it may put a restriction on a bill's ability to become active: the bill has to be introduced to the district by a special type of account that has the majority vote in the district. Let's call the ability to introduce a bill for a vote a fiduciary license. Fiduciary license is considered active if it has the majority vote of district members. Let's call an entity with active fiduciary license a fiduciary. To become a fiduciary any entity can put up a proposal for a fiduciary license up to a vote in a district that must specify the commission rate that the fiduciary is going to receive as a fraction of tax revenue on the bills that the fiduciary will have introduced; and another commission rate as a fraction of voter's personal income.

Conflict of Interest

Conflict of interest is something that should be closely considered. First, there are simple rules in place that do not allow it to perform certain actions that would cause conflict such as an entity with a fiduciary license that is submitted for a vote in a district can't use its account to also submit a proposal to be a delegate; same organization can't use its account to put a bill up for a vote that is tagged as legislative and then put up another one that is tagged as judicial. Second, public organizations have to enforce compliance with these rules to ensure that all organizations do not operate multiple accounts that are in conflict.

Financial System

Banking System

Banking License

Tokens can be created in the form of commercial and consumer loans. **Any entity can submit a proposal in a sovereign district that must specify a number of tokens that the entity can create in the form of loans.** The proposal must also specify the commission rate that the entity is going to receive as a fraction of loan payments. Let's call a proposal that allows it to make loans a banking license, and the total amount of tokens that can be loaned with the banking license a banking license value. A banking license becomes active if it receives the majority vote in the district. A banking license directly increases the potential token supply. Let's call an entity that holds an active banking license a bank. There can be an unlimited number of banks. **Banks make decisions about who to loan to.** Loans have to specify a maturity date, however generally there are no automatic rules that enforce a loan payment and a borrower has to initiate the payment.

Deposits

Banking license can specify that it accepts deposits and specify the commission rate that depositors receive as a fraction of loan payments. Deposits are added onto the banking license value. Revenue from the commission gets distributed among depositors in proportion to the deposit amount compared to the sum of all deposits.

Loans are drawn proportionally from deposits and from the base value of a license. And then they are further drawn proportionally from every deposit. The amount that is drawn from a deposit is not available for withdrawal.

Banking License Image

Alternatively, the banking license value can be specified by a bank as computer code that contains a scoring model. When a potential borrower applies for a loan, the computer code is supposed to connect to the district's database, select relevant data of the borrower, evaluate the scoring model and decide whether to grant the loan application or not based on the resulting

score of the borrower. Let's call computer code that is supposed to make loans automatically a banking license image.

A banking license doesn't allow a bank to directly access the district's database. Also banks do not have access to the data of borrowers that was used in the process of a loan application by an image. However, the bank needs some user data to be able to construct a scoring model. So in order to construct and calibrate their scoring models, banks have to buy user data from the database hosts [\[See: Hosting License Image\]](#).

Central Bank

Central Banking License

Optionally, at the time of creation a sovereign district may specify that it allows monetary regulators to set monetary policy of the district. Any entity can submit a proposal in a sovereign district that allows it to become a monetary regulator. Let's call a proposal to regulate monetary policy a central banking license. A central banking license becomes active if it receives the majority vote in the district. Let's call an entity that holds an active central banking license a central bank. There can be an unlimited number of central banks. Let's call a central bank that has a license with the most votes a primary central bank. There can be only one primary central bank per sovereign district.

Sovereign districts must specify a commission rate that central banks receive as a fraction of tax payments that are being made by the people. Revenue from the commission gets distributed among central banks in proportion to the number of votes that they have compared to the overall number of votes of all central banking licenses.

Relative Units

When central banking configuration is enabled in a sovereign district, the value of emission bills and banking licenses may be specified as the number of relative units instead of the absolute number of tokens. The number of tokens that these contracts can create is then determined by the rate of conversion of relative units into tokens. Initially the rate starts out as one to one. The primary central bank can change the relative units rate thus increasing/decreasing the amount of tokens that can be loaned on all banking licenses and emission bills in the district. Central banking licenses must specify the limiting range of how much the rate can be changed in either direction in a time period.

Reserve Units

A sovereign district may be configured such that any contract or wallet that keeps tokens must be tied at the time of creation to a banking license. When a bank proposes a banking license, the banking license value may specify the number of units of a special currency that can only be transacted by banks and central banks. Let's call the special currency used by the banking system to balance the credit supply a reserve currency. When a borrower transfers a loan they took from a bank to an account that is tied to another bank, an obligation is formed between the

two banks that must be covered with the reserve currency. At the end of the day the district's database runs a netting procedure that calculates reserve obligations between the banks and automatically transfers reserve currency from one bank to another to balance their obligation.

A central banking license may specify the number of units of reserve currency that the central bank can lend to the banks in the form of refinancing. A bank can also loan excess reserves to another bank. If a bank is unable to cover its reserve obligations then the underlying banking license can't be used to make loans anymore. Customers choose which bank to tie their account to based on which bank they'd prefer to do business with in the future, such that the bank would be able to make loans by being able to cover its reserve obligations to other banks. Netting can be overseen by a clearing agency that obtained a hosting license.

Price Index

Price index is a measure of relative price changes in a sovereign district. The primary central bank is responsible for calculating and setting the price index of the district each month.

Open Market Operations

A central banking license can specify the maximum amount of tokens that can be created/destroyed in open market operations by a central bank. Active central banks can issue and sell treasury bonds which is going to decrease the overall token supply, and they can buy them back or pay them out which is going to increase it. When the limit of a central banking license is reached, the central bank can't perform operations on the open market with the underlying license anymore.

Treasury bonds must specify maturity date and nominal value in tokens or relative units, or specify the nominal value as a number of tokens that is going to be adjusted to the price index when repaid. Treasury bonds pay out automatically by creating tokens in the bond holder's account and they cannot default. Banks can buy and sell Treasury bonds from and to central banks and each other using the reserve currency.

A central bank can also buy and sell securities as part of operations on the open market. Central banks can never hold tokens. Any tokens that a central bank receives when it sells assets are immediately destroyed and the bank's limit on operations is increased by the same amount.

Exchange Rates

Two different sovereign districts can establish a bridge between each other's tokens by having their respective active central banks co-sign on an exchange rate. When tokens of district "A" are converted into tokens of district "B", tokens A get destroyed and tokens B get created. Creation and destruction of tokens directly alters the overall token supply on both sides of the exchange. **A taxpayer who is a member of two sovereign districts that are bridged can configure their account to split their tax payments between the two districts** and convert a fraction of their tax payments from one token to another. Both sides can decide to suspend the bridge at any moment.

Abstract Currency

Sovereign districts can initiate and join currency unions. Currency union provides a utility currency that exists only as an abstraction: no one can actually hold it in their balance. An active central bank of a potential member district must submit a proposal to the currency union that specifies an exchange rate between the token of the district and the currency of the currency union. The proposal must be then cosigned by at least one active central bank of each member district. When a token exchange transaction between two member districts takes place, tokens of district "A" are first converted into the currency of the union and then immediately converted into tokens of district "B". Let's call the currency of a currency union an abstract currency.

Abstract currency can act as a national currency of a county, and all price tags can be denominated in it instead of tokens for convenience.

Stock Market

All organizations can issue stocks and bonds using their account. Stocks should be viewed in their traditional form and public organizations have to establish what rights shareholders have and provide protections of those rights, and shareholders on their part have to take advantage of their rights and organize. An organization account technically allows to issue an unlimited number of categories of stocks, however it must be specified at the time of creation of a category if additional shares can be issued in that category. Bonds have to specify nominal value and maturity date, however generally there are no automatic rules that enforce a bond payment and an organization has to initiate the payment.

Public Obligations

In the case of a public organization its obligations are treated differently and automatic rules do apply. Instead of going into the organization account, **tax revenue automatically goes to cover obligations that the organization has**. An exact amount of monthly payments is calculated based on the maturity date of a loan or bond. A fiduciary that introduced the organization has to co-sign its securities issuance and loans. Let's call the sum of all emission bills, loans and bonds of active public organizations and the total amount of open market operations by the central banks a sovereign debt.

Board of Directors

Shareholders can submit proposals to initiate the Board of directors of a company whose stock they hold. Proposal must specify the number of seats on the Board and the number of additional shares to be issued that Board members are going to receive as compensation. The proposal is approved by the majority shareholder vote.

Any entity can then submit a proposal to become a Board member that can specify the commission rate on trades of the stock that the potential Board member is going to receive. Proposals with the highest number of shareholder votes get the seats. Also Board members can be financed indirectly by shareholders if shareholders chose to do so [\[See: Portfolio\]](#).

Financial Organizations

There are special types of organizations that provide basic financial services that allow it to manage investments and risks. These are by no means a complete replacement for traditional financial institutions that provide services and products that are infinitely more complex. However they do provide a set of automated rules that guarantee certain behavior and restrict a set of possible actions. Also additional rules apply when these organizations receive taxpayer funding.

Rating Agency

Rating agency is a special type of organization that at the time of creation must specify a set of available rating options and then can assign these options to securities. Other entities that hold and trade securities can then consume these ratings in order to restrict the scope of securities they are allowed to perform operations with. A rating agency must specify one commission rate on trades of securities that use the agency's rating; and another commission rate on revenue of entities that hold securities that use the agency's rating.

Stock Exchange

Exchange is a special type of organization that lists organizations whose shares and bonds are allowed to be traded on it; and is in charge of admitting members who are allowed to trade on it. When an organization is being listed on an exchange, it may agree to restrict a direct sale of the organization's securities and only allow the sale through the exchange. At the time of creation an exchange must specify the commission rate that it is going to receive as a fraction of trade operations. **It may also specify a list of ratings that securities must have in order to be allowed to be traded on the exchange.** Rating agencies receive commission from trade operations. An organization can be listed on multiple exchanges. An exchange has an ability to stop trading on certain securities for a limited period of time.

Portfolio

Portfolio is a special type of contract that can hold securities and tokens. Portfolio is restricted such that it only allows buying and selling securities, and can't be used to make a transfer transaction of its assets. At the time of creation of a portfolio it may be restricted such that it can only trade securities on specific exchanges and can only hold securities with specific ratings [\[See: Requirement 11\]](#). Rating agencies receive commission from portfolio revenue. A portfolio may specify the commission rate on premium when assets are sold and the commission rate on securities yield, that the portfolio manager receives. A portfolio can hold shares of other portfolios however portfolios can't buy each other shares and generally create cyclical dependencies of multiple portfolios.

When a portfolio holder has an obligation that is supposed to be financed by the portfolio, automatic asset sale may occur if the holder is unable to cover periodic payments on their obligations and if assets can be sold at a premium.

A portfolio may also specify another commission rate on its revenue that is received by the Board members of companies whose stock is held by the portfolio [\[See: Requirement 12\]](#). Revenue from the commission is distributed among the Boards in proportion to the share of the stock in the portfolio.

Portfolio Fund

Portfolio fund is a special type of organization that manages a portfolio on behalf of investors. It must specify a number of shares that represent partial ownership of the portfolio. It must also specify the commission rate that the fund manager receives as a fraction of revenue from selling shares.

Insurance Fund

Insurance fund is a special type of organization that manages a portfolio and provides financial insurance services. **When a banking license is initially created by a bank, the bank can make an agreement with insurance funds to insure the license.** Additional commission rate for the banking license must be specified that insurance funds are going to receive as a fraction of loan payments. Other instances that can be insured include individual loans, bonds and emission bills. In the case of obligations of a public organization, the insurer receives a fraction of tax payments. Insurance funds must also specify the commission rate that the fund manager receives as a fraction of insurance payments. Assets may be sold automatically to cover fund's obligations.

Pension Fund

At the time of creation of a portfolio fund, it may be specified that the fund is going to start paying back its contributors after a certain period of time and also specify a period that the fund is supposed to cover its obligations in. Let's call a portfolio fund that pays back its contributors a pension fund. Payback value is adjusted for inflation with the price index. A pension fund may also specify the commission rate that the fund manager receives as a fraction of investor contributions. Assets may be sold automatically to cover fund's obligations.

Public Financial Organizations

Exchanges, insurance, pension and portfolio funds, and rating agencies can also compete for taxpayer funding by putting up bills for the vote in a voter district. Let's call taxpayer funded financial entities third order public organizations. If a public exchange is active, meaning it has the majority vote in the district, it automatically lists all active public organizations in the district; and all district members are allowed to trade on it; and it no longer has commission on trades.

If a public insurance fund is active it automatically covers all active public organizations in the district. Tax revenue of a public insurance or pension fund is used to cover its obligations. A public portfolio fund has its shares calculated as a fraction of tokens contributed by a taxpayer as compared to the total amount of tokens contributed to the fund by all taxpayers. An active public rating agency doesn't have commission and it may restrict the scope of securities that other active third order public organizations in the district are allowed to hold.

Financial Instruments

Credit Insurance

A borrower can default on their loan. It is going to decrease the overall amount of tokens that can be loaned with the banking license that was used to make the defaulted loan. Tokens from the defaulted loan remain locked and unavailable for being lent again until somebody repays the defaulted loan. If the banking license or the defaulted loan is insured then insurance payments that insurers receive are automatically going to go towards covering the defaulted loan. The same also applies to defaulted bonds that were insured. An exact amount of monthly payments is calculated based on the maturity date of a loan or a bond. Also bank and other commissions on the defaulted loan that is being repaid by insurance is suspended.

Public Obligations Insurance

A public organization can default on its emission bill if it's unable to provide the service that it promised. **If the bill isn't insured then the people continue to pay taxes on it until it's been repaid.** However, if the bill is insured then it becomes an obligation of an insurer. The same also applies to defaulted loans and bonds of public organizations however the difference is, because an emission bill has to get the majority vote, it applies to all the people which may not be the case for a loan or bond.

Revenue Share

There are several types of entities that are able to receive revenue in the form of commission payments such as banks, central banks, stock exchanges, insurance funds, rating agencies, Board members, voter districts, delegates, fiduciaries and hosts [\[See: Requirement 5\]](#). These entities can issue a special type of obligation that automatically redirects a fraction of entity's revenue to the holder of the obligation. It must specify a number that determines the nominal value of the obligation as a multiple of the initial investment. It must also specify the percentage of revenue that is paid to investors and the maturity date of the obligation. Let's call a security that pays a fraction of revenue of some underlying contract a revenue share.

Credit Default Swap

When there is an emission bill, loan or bond created by a public organization that has the majority vote, the voters who didn't vote for the organization and who believe it is going to default on its obligations have a possibility to shield themselves from being stuck with its obligations after it defaults and recoup some of their tax losses [\[See: Requirement 3\]](#). A minority voter can create a special escrow account and make the initial investment by transferring the amount of tokens into it that they wish to recoup in the case of default, not exceeding the amount they have paid in taxes to the organization so far. The account must specify a maturity date before which they believe the underlying obligation is going to default. In the case of no default before the maturity date, the escrow account automatically transfers the initial investment to the organization. In the case of default, the account transfers the initial investment back to the swap holder and creates an obligation with the matching amount of tokens for the organization. Let's call the special type of an escrow account that transfers tokens in the case of

default of the underlying obligation a credit default swap, and the initial investment that is necessary to initiate a swap a swap value, and the obligation of a public organization that is created in the case of default a swap premium.

The minority voter doesn't have to pay taxes to cover the defaulted obligation unlike the majority of taxpayers, and the swap holder is also going to receive a swap premium in tax payments from the majority. A voter district at the time of its creation must specify the minimum value that is required to initiate a swap as an absolute number of tokens, or a relative number of currency units if the central banking configuration is enabled.

Swap Delegation

Voters can delegate the ability to create a swap to a portfolio fund. To become a delegate the fund must submit a proposal to a voter district that specifies the commission rate that the holder of a swap receives as a fraction of swap premium. Potential swap values of individual voters are combined into a swap pool. The fund can create swaps by providing the initial investment. All pool participants have a proportional share in every swap created from a swap pool.

However, there are important limitations to the swap mechanics. There has to be a weight that adjusts individual voter's swap premium according to the amount of risk that they take. The weight has to account for the individual voting record: if the voter doesn't also support other public organizations in the same category then their weight is decreased compared to those who do. Let's call the weight that adjusts the swap premium of a voter a swap coefficient.

Asset-Backed Security

There is a special type of contract that represents a security that is supposed to hold a collection of obligations such as treasury and corporate bonds, revenue shares, loans, insurances and swaps. The security cannot hold equity. The contract must specify the number of shares. Investors who buy shares of the security receive a fraction of payments from the obligations in proportion to the total amount of shares. Let's call a security whose value is determined by the underlying pool of obligations an asset-backed security. The contract can also specify the commission rate that the manager of an asset-back security receives as a fraction of payments on the obligations.

A manager of an asset-back security and issuers or holders of obligations can arrange an agreement where issuers transfer an obligation to become a part of the security and in exchange they receive the revenue from payments that occur when investors buy shares of the security. All transfers must be finalized before the shares can be sold. Issuers receive revenue in proportion to the size of obligations that they contributed to the security.

Networking

Domain

Each sovereign district must have an IP address or a domain name that identifies the physical location of the district on the internet.

Open Source

Computer code that runs a sovereign district and its database has to be open to the public and free of charge. Anybody can download, analyze and execute the code to ensure its integrity. Software experts can also make contributions to the code. In order to apply a software update to the system, all hosts have to cosign on it and all users have to confirm the updated terms of service to be able to continue using the system.

Derivative Image

Computer code of banking and hosting license images is open source and can be used by other banks and hosts to propose their own images that somehow build on the original. An image can specify the commission rate that the image owner is going to receive as a fraction of revenue from other images that are derived from their image. For that to be possible other image owners have to explicitly tie parent images to their image. Let's call an image that is based on other images a derivative image.

If an owner of a derivative image believes that the commission rate is not appropriate in their case they can create another image that adjusts the rate of the parent image. Let's say that the rate of the image A is x , and the owner of the derivative image B believes it ought to be y , then they can create an auxiliary image C as a derivative of the image A with the rate set to y/x and set the image C as the parent of the image B. Let's call a derivative image that adjusts the parent commission rate a proxy image.

Public Data

Public data provides aggregate value of all transactions in a district and is meant as an indicator of financial health of the district. It provides the overall number of tokens that were created, destroyed, paid in taxes, exchanged and defaulted on. A banking license provides the total amount of loans, total amount of loan payments, payments that are past due and the number of tokens that were defaulted on, but not individual loan details unless the borrower is a public organization. A fiduciary license provides the number of tokens that were defaulted on that the fiduciary signed off on. A public organization provides the total number of tokens paid to it in taxes and the number of votes that it has but not individual tax payments and voting data. Individual voter data is also not accessible to the organization itself such that it can't know who exactly voted for it and how much taxes they paid to it.

Account Suspension

If a hosting, banking, fiduciary license or a bill is believed to be compromised it can be suspended for a certain period of time if all second order organizations in a district co-sign on it. During the suspension period voters of the district can vote to transfer account ownership to the district. Or they may simply decide to revoke their vote or both. In the case when a second order bill is believed to be compromised it can also be suspended if all other second order organizations co-sign on it. A district account can not be suspended but it can be transferred if all second order organizations cosign on a proposal that specifies a new district account owner and if then the proposal gets the majority vote of district members.

Software Client

Anybody can create an application that connects to the district's database and allows users to manage their accounts. Let's call an application that provides desktop and mobile user interfaces for network participants a client. Clients compete with each other by providing better user interfaces. Users can then choose to share on their social media links to bills, districts, delegates and licenses that they support.

Monitoring Image

Identity theft is an even bigger risk for the kind of system that is being proposed here than for the traditional system. To counter this threat hosts can deploy computer code that performs additional transaction validations. Let's call the computer code that is supposed to flag suspicious transactions a monitoring image. Active hosts can deploy an unlimited number of monitoring images that are executed for every transaction that occurs and that also can access the district's database, however the image can't communicate any of the data that it uses back to the host.

A monitoring image does not require a vote and it is not open source. As network monitoring doesn't under normal circumstances have any impact on the network itself, there is no need to vote on every image but only vote one time to grant authority to the host to perform network monitoring. The code that is used for monitoring must be secret for security purposes because if an attacker knows exactly how monitoring works they can find a way to circumvent the algorithm. The code may also be highly specialized to a particular domain and type of account, and may be licensed and sold as proprietary software. It doesn't mean however that open source alternatives can't exist.

Custom Contract

There is a programming language that allows writing programs that can be deployed to the network and that allow interaction with network users. It can be used to create new or extend existing contracts.

Composite Image

If there is a bank or host that holds an active image in multiple sovereign districts then it can deploy another image to any one of the districts that when executed can consolidate data from initial images. Let's call an image that is able to perform computations on the data from multiple sovereign districts a composite image. At the time of creation of a banking or hosting license image it can be restricted in such a way that it can only be executed only by specific composite images. This way a composite image can operate on consolidated raw data without exposing access to the raw data itself.

Traditional Government

Transition Process

A process of transition from the traditional form of government to decentralized democracy requires broad societal support. Political parties have to be formed and elected on the platform of transitioning to decentralized democracy. In parallel, voter districts have to be formed with the help of venture capital. Then the government has to develop the rules of cooperation with a decentralized government with regards to public property and other government assets; and move a portion of financing of governmental agencies to voter districts; and abolish the traditional government taxation in favor of the decentralized one. After the process is complete the traditional government and its three branches continue on with their duties as guarantors of the Constitution while decentralized democracy is in charge of public policy.

Government Account

At the time of creation of a sovereign voter district a special type of account can be designated that has an ability to create tokens; and set additional personal income tax rate for all district members; and set a commission on commercial and other taxes that are paid in the district. Tokens that are received in the form of taxes get destroyed. Let's call the special type of account that can create tokens and set additional taxes a government account.

Extensions

Futarchic Public Policy

Optionally, a voting district can provide a platform where any entity can submit public policy proposals. It can be seen as a separate branch of power that is co-equal to public organizations, and that guides their activities. A public policy proposal itself is just a textual document and it doesn't have any programmatic rules that can enforce it in the real world. It also does not require taxpayer funding.

An author of a public policy has to specify in a proposal the number of shares, price of a share and exchanges that agreed to list the proposal. The author receives the revenue from the initial sale of the shares. Public policies are then selected by public organizations based on their

market capitalization. The author can also specify an additional commission on tax payments for bills that use their policy. Policies can have derivatives and be proxied in the same way as images [\[See: Derivative Image\]](#). Also revenue shares can be tied to a policy.

Alternative Selection Policies

Simple majority vote is just one possible selection policy for proposals in a district. Other selection policies can be applied to bills, licenses and images that are being proposed, such as qualified and unanimous majority vote, ranked choice vote, quadratic vote and futarchy. The district has to specify all necessary parameters for every type of selection policy, and specify the policy for each tag.

As a result of selection every proposal gets a score. One way to convert the score into votes is to normalize the score to be between 0 and 1 by dividing it by the maximum score. Normalized score is then multiplied by the number of voters, and that's the number of votes that proposals are assigned. Proposals that have the majority vote become active. Bills that do not have the majority vote are assigned a new tax rate which equals the old tax rate of the proposal multiplied by its normalized score.

Coalition

It is possible to delegate the vote to delegates not just on one on one basis but also to delegate to a legislative body. Let's call the contract that establishes a legislative body a coalition. It must specify a list of coalition members and the terms for delegation. Members can introduce and vote on bundled sets of proposals. Voting rules must be specified such as simple, qualified or unanimous majority vote, and also if the votes cast by coalition members are secret or public. Delegation revenue is uniformly distributed among coalition members. Coalitions A and B can establish Coalition C as members. If a coalition member leaves a coalition then their account has to be transferred to their successor.

IV. Class Summary

Class summary provides a description of the database that facilitates Decentralized Democracy. The database stores a set of user accounts and a set of contracts. Accounts allow users to create contracts. Every account and contract has its own address. And also one can generate an address and use it as a wallet.

Types

Contracts and accounts contain a set of parameters that reflect their state. There are following types of parameters:

- Constructor parameters. These fields are set by the creator of a contract or account at the time of its creation. Generally, these fields cannot be altered and are public. Fields that can be altered by the creator are marked as Non-Constant. Fields that are hidden from the public are marked as Non-Public.
- ❖ Private parameters. Fields that reflect interactions with a contract or account; and that cannot be unilaterally changed by the creator. Generally, these fields are hidden. Fields that are not hidden are marked as Public.
- Functions. Actions that contract or account allows to perform. Functions can have inputs. Inputs are displayed as a list of parameters in function description.

Contracts

Token

A contract that represents the currency of a sovereign district. There can only be one contract of this type per database.

- Voter District
[Sovereign Voter District](#).
Sovereign district that uses the token as currency.
- ❖ Balances
List of [Balances](#).
Currency holders.
- Transfer Tokens
 - Sender
Address.
Transaction sender.
 - Receiver
Address.
Transaction receiver.
 - Amount
Number, tokens.
Transaction amount.

Tokens can be transferred from one account to another. Sender has to initiate a transaction and specify the receiver and amount.

→ Transfer Taxable Income

- Employer
[Organization](#).
Transaction sender.
- Employee
[Voter](#).
Transaction receiver.
- Amount
Number, tokens.
Transaction amount.

Compensation in an employer-employee context. The transfer can only be performed from the employer's organization account, and must specify a voter account as receiver. It distributes a fraction of the amount among the active bills of the voter.

→ Pay Taxes

- Taxpayer Entity
Address.
Transaction sender.
- Amount
Number, tokens.
Transaction amount.

All taxes other than personal income taxes are paid by performing this transaction. It uniformly distributes the amount among the active bills of the sovereign district.

$$Sovereign\ District = Token_{Voter\ District} \quad (1)$$

$$Banking\ License, \widehat{Banking\ License} \in Sovereign\ District_{Banking\ Licenses}$$

where:

$$Banking\ License_{Bank} \neq \widehat{Banking\ License}_{Bank} \quad (2)$$

$$Reserve\ Obligations(Banking\ License, \widehat{Banking\ License}, Date) = \sum_{Balance \in Token\ Balances} Balance_{Amount}$$

where:

$$Balance_{Source} = Banking\ License \wedge Balance_{Target} = \widehat{Banking\ License}$$

$$\wedge Banking\ License_{Transfer\ Date} = \widehat{Banking\ License}_{Transfer\ Date} = Date \quad (3)$$

$$Net(Banking\ License, \widehat{Banking\ License}, Date) = Reserve\ Obligations(Banking\ License, \widehat{Banking\ License}, Date) - Reserve\ Obligations(\widehat{Banking\ License}, Banking\ License, Date) \quad (4)$$

Balance

Any address that corresponds to an account, contract or wallet can be used to store tokens.

- Owner
Address.
The address of an account, contract or wallet that this balance belongs to.
- Amount
Number, tokens. Non-constant.
Number of currency units held by the owner of the address.
- Transfer Date
Date.
The day that the transfer(s) to the balance occurred. When the netting procedure is enabled, mutual reserve obligations of the banks are calculated at the end of each day.
- Origin
[Banking License](#) or [Central Banking License](#) or [Emission Bill](#) or [Exchange Rate](#) or [Abstract Exchange Rate](#).
Contract that was used to create tokens. When the netting procedure is enabled, mutual reserve obligations of the banks are calculated based on balances that have different source and target banking licenses. Non-reserve origins are ignored in the netting.
- Source
[Banking License](#). Optional.

When the netting procedure is enabled, the balance has to be tied to a bank by the owner.

❖ Target

[Banking License](#). Optional.

The bank from which tokens were transferred to the balance. Initially, origin is the target.

Bill

A piece of fiscal legislation that is supposed to provide funding for a public organization through personal income tax redistribution. Related: [Emission Bill](#).

- Description
Text.
Services that the organization is promising to provide.
- [Tag](#)
One of the tagging options that are specified in the voter district.
- Organization
[Public Organization](#) or [Exchange](#) or [Portfolio Fund](#) or [Insurance Fund](#) or [Pension Fund](#) or [Rating Agency](#).
Service provider that created the bill and that is going to receive tax payments.
- Voter District
[Voter District](#) or [Sovereign Voter District](#).
Voter district that this bill is being proposed in.
- [Fiduciary License](#)
Optional.
Fiduciary that introduced this bill.
- [Hosting License](#)
Optional.
Allows the organization to become a database host.
- Public Obligations
List of [Loans](#) and [Bonds](#). Optional.
Obligations tied to the bill that are being financed by taxpayers.
- Public Policies
List of [Public Policies](#). Optional.
Policies that the bill is supposed to implement.
- Renewal Period
Number, month.
Period of time after which the bill can be altered.
- Minimum/Maximum Value
Number/Number, tokens. Optional.
Possible range of the overall number of tokens that can be collected in taxes by the bill.
- Tax Rate
Number, %.
A fraction of the voter's personal income that the organization receives in taxes, or that finances public obligations on this bill.
- Variable Tax Rate

Function: number, tokens → number, %. Alternative.

Tax rate is calculated based on the voter's total income.

❖ Tax Payments

Number, tokens. Public.

The amount of tokens that have been paid in taxes to the organization.

❖ [Proposal Selection](#)

Public.

Method by which the bill is approved.

$$Voter\ District = Bill_{Voter\ District} \quad (1)$$

$$Fiduciary\ License = Bill_{Fiduciary\ License} \quad (2)$$

$$Bill_{Public\ Policy\ Rate} = \sum_{Public\ Policy \in Bill_{Public\ Policies}} Public\ Policy_{Bill\ Commission} \quad (3)$$

$$Bill_{Total\ Tax\ Rate} = Bill_{Tax\ Rate} \times (1 + Voter\ District_{Bill\ Commission} + Fiduciary\ License_{Bill\ Commission} + Bill_{Public\ Policy\ Rate}) \quad (4)$$

Public Policy

Proposal that consists of a single document.

- Description
Text.
Contents of the policy.
- Voter District
[Voter District](#) or [Sovereign Voter District](#).
Voter district that the policy is being proposed in.
- Author
Address.
Account address of the policy creator.
- Derivatives Commission
Number, %.
A fraction of revenue from selling shares of the derivative policies that the author receives.
- Bill Commission
Number, %.
Additional tax rate for the bills that implement this policy.
- Parent Policies
List of [Public Policies](#).

- Other policies that this policy is based on.
- [Futarchic Procedure](#).
Selection procedure for the policy.
- Exchanges
List of [Exchanges](#).
Stock exchanges that the policy is listed on.
- Revenue Share
List of [Revenue Shares](#). Optional.
A share in the author's revenue.
- ❖ Derivative Policies
List of [Public Policies](#). Public.
Other policies that are derived from this policy.
- ❖ Bills
List of [Bills](#) and [Emission Bills](#). Public.
Bills that implement the policy.

Emission Bill

Inherits from [Bill](#).

Type of bill that is supposed to create tokens in the organization's account and destroy tokens that are received in tax/insurance payments.

- Voter District
[Sovereign Voter District](#).
Emission bills can be proposed only in a sovereign district.
- Value
Number, tokens or [relative units](#).
The number of tokens that gets created that the organization receives in taxpayer funding.
- Insurances
List of [Insurances](#). Optional.
Insurance funds that agreed to insure the bill.
- Minimum/Maximum Value, Public Obligations
None.
Inherited parameters that do not exist for this type of contract.
- ❖ Swaps
List of [Credit Default Swaps](#).
Swaps can be created by or on behalf of voters who didn't vote for this bill.
- Default
If the organization fails to provide services that it promised then it can default.

$$Sovereign District = Emission Bill_{Voter District} \quad (1)$$

$$Fiduciary License = Emission Bill_{Fiduciary License} \quad (2)$$

$$Monetary Policy = Sovereign District_{Monetary Policy} \quad (3)$$

$$Emission Bill_{Public Policy Rate} = \sum_{Public Policy \in Emission Bill_{Public Policies}} Public Policy_{Bill Commission} \quad (4)$$

$$Emission Bill_{Insurance Rate} = \sum_{Insurance \in Emission Bill_{Insurances}} Insurance_{Commission} \quad (5)$$

$$Emission Bill_{Total Tax Rate} = Emission Bill_{Tax Rate} \times (1 + Sovereign District_{Bill Commission} + Monetary Policy_{Central Banks Commission} + Fiduciary License_{Bill Commission} + Emission Bill_{Public Policy Rate} + Emission Bill_{Insurance Rate}) \quad (6)$$

Delegation

A proposal by a delegate to vote on behalf of voters.

- Delegate
[Delegate](#) or [Coalition](#).
Entity that created this proposal.
- Tags
List of [Tags](#).
Restricts the scope of delegation only to bills with the specific tag.
- Voter District
[Voter District](#) or [Sovereign Voter District](#).
Voter district that delegation is taking place in.
- Permissions
Options: [Fiduciary License](#), [Hosting License](#), [Hosting License Image](#), [Banking License](#), [Central Banking License](#).
Additional permissions to vote on licenses.
- Bill Commission
Number, %.
A fraction of tax payment of the voter on a bill that the delegate receives.

- Chain Delegations by the Delegate
List of [Delegations](#). Non-Constant. Optional.
Other delegates that this delegate supports.
- Chain Commission
Number, %.
A fraction of the other delegate's commission that this delegate receives.
- Voting Record
List of [Proposal Selections](#). Non-Constant.
Proposals that the delegate supports.
- ❖ Defaults
Number, tokens. Public.
Total amount of public obligations of the bills, that the delegate voted for, that were defaulted on.
- ❖ Voter Delegations
List of [Voters](#).
Voters who delegated their vote to this delegate.
- ❖ Chain Delegations to the Delegate
List of [Delegations](#). Public.
Other delegates that support this delegate.

Fiduciary License

A proposal by a fiduciary to introduce bills up for the vote.

- [Fiduciary](#)
Account that created this license.
- [Tag](#)
Restricts the scope of the fiduciary only to bills with a specific tag.
- Voter District
[Voter District](#) or [Sovereign Voter District](#).
Voter district that bills are introduced in.
- Bill Commission
Number, %.
A fraction of tax payment of the voter on a bill that the fiduciary receives.
- Fiduciary Commission
Number, %.
A fraction of voter's income that the fiduciary receives.
- Delegate Commission
Number, %.
A fraction of fiduciary revenue that delegates, who voted in favor of this fiduciary, receive.
- ❖ Fiduciary Record
List of [Bills](#) and [Emission Bills](#). Public.
Bills that the fiduciary introduced.
- ❖ Defaults
Number, tokens. Public.

Total amount of public obligations of the bills, that the fiduciary introduced, that were defaulted on.

❖ [Proposal Selection](#)

Public.

Method by which the fiduciary is approved.

Hosting License

A proposal to host the district's database.

- Images
List of [Hosting License Images](#). Non-Constant.
Images proposed by the host.
 - Voter District
[Sovereign Voter District](#).
Proposals to host the database can be introduced only in the sovereign district.
 - Revenue Share
List of [Revenue Shares](#). Optional.
Securities that represent a share in the host's revenue.
 - ❖ [Proposal Selection](#)
Public.
Method by which the license is approved.
- Propose a [Hosting License Image](#)

Hosting License Image

A proposal to sell private data from the district's database.

- Host
[Hosting License](#).
The hosting license holder that created this proposal.
- Image
Computer code that is supposed to connect to the district's database and extract data.
- Price
Number, tokens or [relative units](#).
Price to extract data.
- Host Commission
Number, %.
A fraction of image revenue that the host receives.
- Delegate Commission
Number, %.
A fraction of image revenue that delegates, who voted in favor of this image, receive.
- Derivatives Commission
Number, %.
A fraction of revenue from the derivative images that the host receives.
- Parent Images
List of [Hosting License Images](#). Optional.

- Other images that this image is based on.
- Organizations
 - List of [Organizations](#). Optional.
 - Organizations that are allowed to buy data from this image.
- Composite Images
 - List of [Hosting License Images](#). Optional.
 - Images that are allowed to buy data from this image.
- ❖ Derivative Images
 - List of [Hosting License Images](#). Public.
 - Other images that are derived from this image.
- ❖ [Proposal Selection](#)
 - Public.
 - Method by which the image is approved.
- Run the Image
 - Buy the data that this image produces.

Banking License

A proposal by a bank to provide loans.

- [Bank](#)
 - Bank account that proposed this license.
- Voter District
 - [Sovereign Voter District](#).
 - Banking licenses can be introduced only in the sovereign district.
- Value
 - Number, tokens or [relative units](#).
 - The amount of tokens that are available in loans with this license.
- Algorithmic Value
 - [Banking License Image](#). Alternative.
 - Loan approval process is automated.
- Reserve Value
 - Number, [reserve units](#). Alternative.
 - When the netting procedure is enabled, the license may specify the amount of units of the reserve currency that are initially available to the bank.
- Reserve Requirement Ratio
 - Number, %. Optional.
 - When the netting procedure is enabled, the license may specify that the bank must keep a fraction of the sum of balances that are tied to it [\[Balance: Source\]](#) as reserve units.
- Payback Period
 - Number, month.
 - The length of time in which the borrowers are supposed to pay off their loans.
- Bank Commission
 - Number, %.
 - A fraction of loan payments that the bank receives.
- Delegate Commission

- Number, %.
- A fraction of loan payments that delegates, who voted in favor of this license, receive.
- Depositor Commission
 - Number, %.
 - A fraction of loan payments that depositors receive.
- Insurance
 - List of [Insurances](#). Optional.
 - Insurance funds that agreed to insure this license.
- ❖ Loans
 - List of [Loans](#).
 - Loans created with this license.
- ❖ Deposits
 - List of pairs (address; number, tokens).
 - List of depositors and the amount of tokens that they contributed.
- ❖ Defaults
 - Number, tokens. Public.
 - Sum of values of loans that were defaulted on.
- ❖ Past Due
 - Number, tokens. Public.
 - Total amount of payments that are past due.
- ❖ [Proposal Selection](#)
 - Public.
 - Method by which the license is approved.
- Make a Deposit
 - Depositor
 - Address.
 - Amount
 - Number, tokens.

Anybody can transfer tokens to the license to be used by the bank to make loans in addition to the license value.

Banking License Image

A scoring model that is used in the automated loan approval.

- [Banking License](#)
 - The license that this image is tied to.
- Image
 - Computer code that is supposed to connect to the district's database and evaluate the scoring model on the loan applicant's data.
- Derivatives Commission
 - Number, %.
 - A fraction of loan payments from the derivative images that the bank receives.
- Parent Images
 - List of [Banking License Images](#).
 - Other images that this image is based on.

- Composite Images
List of [Banking License Images](#). Optional.
Images that are allowed to access data from this image.
- ❖ Derivative Images
List of [Banking License Images](#). Public.
Other images that are derived from this image.
- Apply for a [Loan](#)
Potential borrowers can apply for automated loans.

Central Banking License

Entities that hold this license set the monetary policy of a sovereign district.

Relative Units

Supply of tokens that is fixed and that is directly voted on, and that originates as credit is the sum of values of banking licenses, emission bills and open market operations by the central banks. These values may be also specified as the number of relative units that are converted into tokens when a token creation action is performed from the underlying contract. The number of tokens that these contracts are supposed to supply may be proportionally increased or decreased by the primary central bank by changing the conversion rate of the special units [\[Monetary Policy: Relative Units Rate\]](#).

Reserve Units

The banking license value may also specify the number of units of the reserve currency that banks use to cover their obligations to each other that result from token transfer transactions. The supply of tokens that originates from reserve banking licenses is not fixed.

- [Central Bank](#)
Central bank account that proposed this license.
- Voter District
[Sovereign Voter District](#).
Central banking licenses can be introduced only in the sovereign district.
- Relative Units Rate Bounds
Number.
Restricts by how much the relative units rate can be increased/decreased in a time period.
- Refinancing Operations
Number, [reserve units](#). Optional.
The amount of units of the reserve currency that the central bank can loan to commercial banks.
- Open Market Operations
Number, tokens and [relative units](#).
The limit on the amount of currency that can be created/destroyed by the central bank as the result of operations on the open market.

- Exchanges
List of [Exchanges](#).
Exchanges that the central bank can perform open market operations on.
- Assets
List of [Bonds](#) and shares of [Asset-Backed Securities](#). Non-Constant.
Securities held by the central bank as part of operations on the open market.
- Delegate Commission
Number, %.
A fraction of the central bank's revenue that delegates, who voted in favor of this license, receive.
- ❖ Bonds
List of [Treasury Bonds](#). Public.
Bonds issued by the central bank as part of operations on the open market.
- ❖ [Proposal Selection](#)
Public.
Method by which the license is approved.

Monetary Policy

Policy that regulates the currency of a sovereign district. There can only be one contract of this type per database.

- Voter District
[Sovereign Voter District](#).
Sovereign district that is governed by the policy.
- Central Banks Commission
Number, %.
A fraction of the sovereign district's tax revenue that the central banks receive.
- ❖ Primary Central Bank
[Central Banking License](#) Public.
Entity that holds the central banking license with the most votes in the district is the primary central bank.
- ❖ Open Market Operations
(+/-) Number, tokens. Public.
The total amount of tokens that was created/destroyed by the active central banks.
- ❖ Forex Operations
(+/-) Number, tokens. Public.
The total amount of tokens that was created/destroyed in foreign exchange operations.
- ❖ Relative Units Rate
Number. Public.
Rate set by the primary central bank that determines the value of banking licenses, emission bills and treasury bonds.
- ❖ Price Index
List of numbers, %. Public.
Monthly price indices set by the primary central bank.
- ❖ Interbank Market

List of [Interbank Loans](#). Public.

Reserve currency loaned by banks and central banks.

❖ Exchange Rates

List of [Exchange Rates](#). Public.

Token exchange rates with other sovereign districts.

❖ National Currencies

List of [Abstract Currencies](#). Public.

Currency unions that the district is a part of.

$$Central\ Banking\ License = Monetary\ Policy_{Primary\ Central\ Bank} \quad (1)$$

$$Tokens = Relative\ Units \times Monetary\ Policy_{Relative\ Units\ Rate} \quad (2)$$

$$\Delta Monetary\ Policy_{Relative\ Units\ Rate} \in [-Central\ Banking\ License_{Relative\ Units\ Rate\ Bounds}, Central\ Banking\ License_{Relative\ Units\ Rate\ Bounds}] \quad (3)$$

Treasury Bond

Debt securities of a sovereign district.

- Nominal Value
Number, tokens or [relative units](#).
Number of tokens that are to be repaid.
- Indexed Value
Number, tokens. Alternative.
Number of tokens that are to be repaid is calculated by applying the price index of a sovereign district [\[Monetary Policy: Price Index\]](#) to the bond's initial value.
- Maturity Date
Date.
Date of the bond repayment.
- Price
Number, tokens.
Initial price of the bond.
- ❖ [Asset Holder](#)
Bond holder.

Insurance

Insurance of financial obligations.

- Obligation
[Emission Bill](#) or [Banking License](#) or [Loan](#) or [Bond](#).

- The underlying obligation that is being insured.
- Insurer
 - [Insurance Fund](#).
 - An entity that provides insurance services.
- Commission
 - Number, %.
 - A fraction of payments on the obligation that the insurer receives.
- ❖ Ratings
 - List of [Ratings](#). Public.
 - Ratings assigned to the insurance.
- ❖ [Asset Holder](#)
 - Insurance contract holder that receives insurance payments. Initially, the holder is the insurance fund that insured the obligation.

Loan

A contract between a bank and a borrower.

- Amount
 - Number, tokens.
 - The amount of tokens that are being loaned.
- Maturity Date
 - Date.
 - Expected date of loan repayment.
- [Banking License](#)
 - License that was used to create this loan.
- Borrower
 - Address.
 - Account address of the borrower.
- Insurance
 - List of [Insurances](#). Optional.
 - Insurance funds that agreed to insure this loan.
- Public Financing
 - [Bill](#). Optional.
 - When the borrower is a public organization, the loan is paid back by voters with their taxes.
- ❖ Loan Payments
 - Number, tokens. Public/Hidden.
 - The amount of loan payments on the principal amount that were made. When the borrower is a public organization, the field is public.
- ❖ Past Due
 - Number, tokens. Public/Hidden.
 - The amount of loan payments that are past due. When the borrower is a public organization, the field is public.
- ❖ Ratings
 - List of [Ratings](#). Public.

Ratings assigned to the loan.

❖ Swaps

List of [Credit Default Swaps](#).

Swaps can be created when the borrower is a public organization.

❖ [Asset Holder](#)

Loan holder that receives loan payments. Initially, the holder is the bank that made the loan.

→ Pay

- Amount
Number, tokens.

The borrower can initiate a transfer transaction to make a loan payment.

→ Default

If the borrower can't meet their obligations then they can default.

$$Banking\ License = Loan_{Banking\ License} \quad (1)$$

$$Loan_{Insurance\ Rate} = \sum_{Insurance \in Loan_{Insurances}} Insurance_{Commission} + \sum_{Insurance \in Banking\ License_{Insurances}} Insurance_{Commission} \quad (2)$$

$$Loan_{Interest\ Rate} = Banking\ License_{Bank\ Commission} + Banking\ License_{Delegate\ Commission} + Banking\ License_{Depositor\ Commission} + Loan_{Insurance\ Rate} \quad (3)$$

Interbank Loan

Interbank loan of reserve currency.

- Borrower
[Banking License](#).
Bank that is borrowing the reserves.
- Lender
[Banking License](#) or [Central Banking License](#).
Refinancing by a central bank or lending out excess reserves by a commercial bank.
- Amount
Number, [reserve units](#).
The amount of units of the reserve currency that is being borrowed.
- Interest Rate
Number, %.
Loan interest rate.

- Maturity Date
Date.
Expected date of loan repayment.

Board of Directors

An executive committee that supervises the activities of an organization.

- [Stock Category](#)
The stockholders of the organization that the Board represents.
- Number of Members
Number.
Number of seats on the Board.
- Stock Compensation
Number, shares.
Additional shares that are issued as compensation for Board members.
- ❖ Status
Options: active/inactive. Public.
Shows if the proposal to initiate the Board has the majority of shareholder votes.
- ❖ Votes
Number, shares. Public.
Number of shareholder votes in favor of initiation of the Board.
- ❖ Board Members
List of [Board Memberships](#). Public.
Proposals by potential board members to join the Board.

Board Membership

Request to become a member of a Board of directors.

- [Board of Directors](#)
The Board that the proposal is being introduced in.
- Director
Address.
Account address of the potential Board member.
- Trades Commission
Number, %.
Commission on trades of the stock that the potential Board member is going to receive.
- Revenue Share
List of [Revenue Shares](#). Optional.
A share in revenue of the Board member.
- ❖ Status
Options: active/inactive. Public.
Shows if the potential Board member has enough shareholder votes to get the seat on the Board.
- ❖ Votes
Number, shares. Public.

Number of shareholder votes that the potential Board member received.

Stock Category

A contract that represents ownership of a corporation or company.

- Issuer
[Organization](#).
Account of the stock issuer.
- [Asset Shares](#)
Shares of the stock.
- ❖ Boards of Directors
List of [Boards of Directors](#). Public.
Proposals by shareholders to initiate the Board of directors.
- ❖ Ratings
List of [Ratings](#). Public.
Ratings assigned to the stock.

Bond

A contract that represents a corporate or public debt.

- Nominal Value
Number, tokens.
Number of tokens that are expected to be repaid.
- Maturity Date
Date.
Expected date of the bond repayment.
- Price
Number, tokens. Non-Constant.
Initial price of the bond.
- Issuer
[Organization](#).
Account of the bond issuer.
- Insurance
List of [Insurances](#). Optional.
Insurance funds that agreed to insure the bond.
- Public Financing
[Bill](#). Optional.
When the issuer is a public organization, the bond is paid back by voters with their taxes.
- ❖ Bond Payments
Number, tokens. Public.
The amount of bond payments that were made.
- ❖ Past Due
Number, tokens. Public.
The amount of bond payments that are past due.
- ❖ Ratings

List of [Ratings](#). Public.

Ratings assigned to the bond.

❖ Swaps

List of [Credit Default Swaps](#). Public.

Swaps can be created when the bond issuer is a public organization.

❖ [Asset Holder](#)

Bond holder.

→ Pay

- Amount
Number, tokens.

The organization can initiate a transfer transaction to make the bond payment.

→ Default

If the organization can't meet its obligations then it can default.

Revenue Share

A share in revenue.

• Issuer

[Bank](#) or [Central Bank](#) or [Exchange](#) or [Insurance Fund](#) or [Rating Agency](#) or [Board Membership](#) or [Voter District](#) or [Sovereign Voter District](#) or [Delegate](#) or [Public Policy](#) or [Fiduciary](#) or [Hosting License](#).

Contract that is the source of revenue.

• Limit

Number, tokens.

Maximum amount of tokens that can be raised in investments.

• Payback Multiple

Number.

A multiple that determines how many tokens will need to be paid back to investors compared to their initial investment.

• Commission

Number, %.

A fraction of revenue of the source contract that goes towards covering the obligation.

• Payback Period

Number, months.

Period of time it is supposed to take for the payback to complete.

❖ Investors

List of pairs (address; number, tokens).

List of investors and the number of tokens that they invested.

❖ Ratings

List of [Ratings](#). Public.

Ratings assigned to the securities.

❖ Past Due

Number, tokens. Public.

Total amount of payments that are past due.

→ Default

If the issuer can't meet their obligations then they can default.

Asset-Backed Security

Securities whose value is derived from combining multiple obligations into a group.

- Manager
Address.
Entity that manages the security.
- Assets
List of [Bonds](#) and [Treasury Bonds](#) and [Loans](#) and [Insurances](#) and [Revenue Shares](#) and [Credit Default Swaps](#).
The pool of underlying obligations.
- Manager Commission
Number, %.
A fraction of payments on the obligations that manager receives.
- [Asset Shares](#)
Shares of the securities. A single share represents fractional ownership of revenue in proportion to the total number of shares.
- ❖ Ratings
List of [Ratings](#). Public.
Ratings assigned to the security.
- ❖ Defaults
Number, tokens. Public.
Total value of obligations that were defaulted on.
- ❖ Past Due
Number, tokens. Public.
Total amount of payments that are past due.
- Confirm Obligation Transfer
When an issuer of an obligation and the manager of the asset-backed security make an agreement, the issuer can transfer the obligation such that it becomes one of the underlying assets of the security and they then receive a portion of revenue that results from the sale of shares of the security. The security manager has to confirm the transfer.

Credit Default Swap

A contract that shields a voter in case of default on a public obligation.

- [Voter](#)
Non-Public.
Voter account of the taxpayer.
- Value
Number, tokens.
Amount of tokens that were used as an initial investment to create the swap.
- Obligation
[Emission Bill](#) or [Bond](#) or [Loan](#).
Underlying obligation of the swap.

- Delegation
[Swap Delegation](#). Optional.
Fund that created the swap.
- Maturity Date
Date.
Expected date of the obligation default.
- ❖ Swap Coefficient
Number, %.
Individual weight of the voter that adjusts swap premium.
- ❖ [Asset Holder](#)
Swap holder that receives swap revenue in the case of the swap event. Initially, the voter or the portfolio fund that created the swap on behalf of the voter is the holder.

Swap Delegation

A proposal by a portfolio fund to create credit default swaps on behalf of voters.

- [Portfolio Fund](#)
Fund that created the proposal.
- [Tag](#)
Restricts the scope of delegation only to bills with a specific tag.
- Commission
Number, %.
A fraction of swap premium that the swap holder receives. Initially, the fund that created the swap is the holder.
- ❖ Swaps
List of [Credit Default Swaps](#). Public.
Swaps created by the fund.
- ❖ Delegations
List of [Voters](#).
Voters who delegated to this fund.

Portfolio

A contract that represents a set of securities; and rules that restrict what kinds of securities can be added to it.

- Liquid Assets
Number, tokens. Non-Constant.
Number of tokens that the portfolio holds.
- Assets
List of [Bonds](#) and [Treasury Bonds](#) and [Loans](#) and [Insurances](#) and [Revenue Shares](#) and [Credit Default Swaps](#) and [Quadratic Vote Policies](#) and shares of [Stocks](#), [Portfolio Funds](#), [Asset-Backed Securities](#) and [Futarchic Procedures](#). Non-Constant.
Securities held by the portfolio.
- Exchanges
List of [Exchanges](#).

- Exchanges that the portfolio can buy securities from.
- Rating Options
List of [Rating Options](#).
Ratings that are required for securities in the portfolio.
- Holder
[Portfolio Fund](#) or [Insurance Fund](#) or [Pension Fund](#).
Fund that holds the portfolio.
- Premium Commission
Number, %.
A fraction of the premium that the fund manager receives when assets are sold.
- Yield Commission
Number, %.
A fraction of the securities yield that the fund manager receives.
- Boards Commission
Number, %.
A fraction of the fund's revenue that is received by Boards of directors of the companies whose stocks are held by the portfolio.

Tag Option

Name and description of a separate category of spending.

- Name
Text.
Category name.
- Description
Text. Optional.
Additional information including information about public property that is tied to this category.
- Voter District
[Voter District](#) or [Sovereign Voter District](#).
District that created the tag option.
- Selection Policy
[Majority Vote Policy](#) (default) or [Ranked Vote Policy](#) or [Quadratic Vote Policy](#) or [Futarchic Policy](#).
Method by which spending is allocated in this category.

Tag

Separate category and branch of spending.

- [Tag Option](#)
Detailed description of the tag.
- Second Order Tag
Options: legislative, executive, judiciary. Optional.
Special designation for a separate branch of power.
- Spending Proposal

[Bill](#) or [Emission Bill](#).

Spending contract that is being tagged.

- Representation Proposal

[Delegation](#) or [Swap Delegation](#) or [Fiduciary License](#). Alternative.

Representation contract that is being tagged.

Exchange Rate

Token exchange rate that is agreed upon by two active central banks of the corresponding sovereign districts.

- Voter District A

[Central Bank](#).

Active central bank that represents side one of the exchange rate agreement.

- Voter District B

[Central Bank](#).

Active central bank that represents side two of the exchange rate agreement.

- A to B Exchange Rate

Number.

Exchange rate of tokens of the voter district A to tokens of the voter district B.

- B to A Exchange Rate

Number.

Exchange rate of tokens of the voter district B to tokens of the sovereign district A.

Abstract Currency

Currency union of multiple sovereign districts.

- ❖ Rates

List of [Abstract Exchange Rates](#). Public.

Exchange rates that are agreed upon by the member districts.

- ❖ Members

List of [Sovereign Voter Districts](#). Public.

Sovereign districts that are participating in the currency union.

Abstract Exchange Rate

Proposal to establish an exchange rate between the sovereign district's currency and the currency of a currency union.

- Voter District

[Sovereign Voter District](#).

Token of the sovereign district that is the object of the exchange rate agreement.

- Solicitant

[Central Bank](#).

Active central bank that made the exchange rate proposal.

- [Abstract Currency](#)

Currency of the currency union that is the object of the exchange rate agreement.

- Token to Abstract Currency
Number.
Exchange rate of tokens of the sovereign district to the currency of the currency union.
- Abstract Currency to Token
Number.
Exchange rate of the currency of the currency union to tokens of the sovereign district.
- ❖ Status
Options: active/inactive. Public.
Shows if the proposal is confirmed by all member districts.
- ❖ Signatures
List of [Central Banks](#). Public.
The exchange rate proposal must be approved by at least one active central bank of each member district.

Rating Option

Quality score assigned to securities.

- Name
Text.
Option name.
- [Rating Agency](#)
Entity that created the rating option.
- Trades Commission
Number, %.
Commission on trades on exchanges that are using this option.
- Revenue Commission
Number, %.
Commission on revenue of portfolios that are using this option.
- ❖ Consumers
List of [Portfolios](#) and [Exchanges](#). Public.
Entities that are using this option.

Rating

Securities rating.

- [Rating Option](#)
Rating by an agency.
- Security
[Stock](#) or [Bond](#) or [Loan](#) or [Insurance](#) or [Asset-Backed Security](#) or [Revenue Share](#) or [Portfolio Fund](#) or [Quadratic Vote Policy](#) or [Futarchic Procedure](#).
Security that is being rated.

Proposal Selection

Proposal that is being selected.

- Contract
 - [Bill](#) or [Emission Bill](#) or [Fiduciary License](#) or [Hosting License](#) or [Hosting License Image](#) or [Banking License](#) or [Central Banking License](#).
 - Contract that is being proposed.
- ❖ Voting Selection Procedures
 - List of [Majority Vote Procedures](#) or [Ranked Vote Procedures](#) or [Quadratic Vote Procedures](#). Public.
 - Vote as a selection procedure.
- ❖ Futarchic Selection Procedure
 - [Futarchic Procedure](#). Public. Alternative.
 - Proposal is selected based on its market capitalization.
- ❖ Number of Votes
 - Number. Public.
 - Number of votes that is derived from the selection procedure.
- ❖ Status
 - Options: active/inactive. Public.
 - Proposed contract becomes active if it has the majority vote.

Vote

A vote in support of a bill or license.

- [Voter](#)
 - Non-Public.
 - A person that the vote belongs to.
- Voter District
 - [Voter District](#) or [Sovereign Voter District](#).
 - The district that the vote is taking place in.
- [Delegation](#)
 - Optional.
 - Delegate who made the vote.
- Voting Procedure
 - [Majority Vote Procedure](#) or [Ranked Vote Procedure](#) or [Quadratic Vote Procedure](#).
 - Type of the selection procedure.
- Status
 - Options: active/revoked. Non-Constant.
 - Shows if the vote is revoked or not.

Coalition

Delegation to a group of entities.

- Members
 - List of addresses or [Coalitions](#).
 - Coalition members.
- [Delegation](#).

- Terms of delegation to the coalition.
- Vote Rule
 - Options: simple (default), qualified, unanimous.
 - The type of majority that is required in order for a proposal to pass.
- Vote Secrecy
 - Options: public/secret.
 - Votes of coalition members can be displayed publicly or kept hidden.
- ❖ Proposals
 - List of [Coalition Proposals](#).
 - Proposals that are introduced by the coalition members for the vote.

Coalition Proposal

A bundle of proposals that a coalition can vote on.

- [Coalition](#)
 - The group that is supposed to vote on the bundle.
- Proposals
 - List of [Proposal Selections](#).
 - The bundle of proposals that are being introduced for the coalition to vote on.
- ❖ Status
 - Options: active/inactive. Public.
 - Proposals in the bundle receive votes delegated to the coalition if the bundle has the majority vote of the coalition members.
- ❖ Votes
 - List of addresses or [Coalitions](#). Public/Hidden.
 - Coalition members that voted for the proposal.

Selection Policy

Method for selecting proposals in a voter district.

- Voter District
 - [Voter District](#) or [Sovereign Voter District](#).
 - Voter district that chose this policy.
- Proposal Type
 - Options: [Bill](#) and [Emission Bill](#), [Fiduciary License](#), [Hosting License](#), [Hosting License Image](#), [Banking License](#), [Central Banking License](#).
 - Type of proposal that is being selected.
- Policy
 - [Majority Vote Policy](#) (default) or [Ranked Vote Policy](#) or [Quadratic Vote Policy](#) or [Futarchic Policy](#).
 - Method by which proposals of the proposal type get selected.

Majority Vote Policy

One vote per voter per proposal.

- [Selection Policy](#)
Policy type.
- Vote Rule
Options: simple (default), qualified, unanimous.
The type of majority that is required in order for a proposal to pass.
- ❖ Procedures
List of [Majority Vote Procedures](#). Public.
Selection procedures of the proposals.

Ranked Vote Policy

One vote per voter as a ranked list of proposals.

- [Selection Policy](#)
Policy type.
- Tag
[Tag Option](#).
Restrict the scope of proposals to only those with a specified tag.
- Maximum Number of Choices
Number.
Maximum length of a ranked list.
- ❖ Procedures
List of [Ranked Vote Procedures](#). Public.
Selection procedures of the proposals.

Quadratic Vote Policy

Multiple votes per voter per proposal as a square root of the number of vote units.

- [Selection Policy](#)
Policy type.
- Tag
[Tag Option](#).
Restrict the scope of proposals to only those with a specified tag.
- Number of Vote Units
Number.
Amount of vote units that are initially allocated for each voter.
- Exchanges
List of [Exchanges](#).
Exchanges that vote units are listed on.
- ❖ Vote Units Holders
List of pairs (address; number, vote units).
List of vote units holders and the number of vote units that they hold.
- ❖ Ratings
List of [Ratings](#). Public.
Ratings assigned to the vote units.
- ❖ Procedures
List of [Quadratic Vote Procedures](#). Public.

Selection procedures of the proposals.

→ Transfer Vote Units

- Sender
Address.
- Receiver
Address.
- Amount
Number.

Vote units can be transferred from one account to another.

Futarchic Policy

Number of votes is derived from the market capitalization of the proposals.

- [Selection Policy](#)
Policy type.
- Tag
[Tag Option](#).
Restrict the scope of proposals to only those with a specified tag.
- Exchanges
List of [Exchanges](#).
Exchanges that are used to calculate the market capitalization of the proposal.
- ❖ Procedures
List of [Futarchic Procedures](#). Public.
Selection procedures of the proposals.

Majority Vote Procedure

Single vote of a voter in favor of a proposal.

- Policy
[Majority Vote Policy](#).
Policy that sets the rules of the selection procedure.
- Voter Choice
[Proposal Selection](#).
Proposal that is being voted for by a voter/delegate.
- [Vote](#)
Voter/delegate that made the choice.

Ranked Vote Procedure

Ranked vote of a voter.

- Policy
[Ranked Vote Policy](#).
Policy that sets the rules of the selection procedure.
- Voter Choice
Ordered List of [Proposal Selections](#).
Proposals that are being voted for by a voter/delegate.

- [Vote](#)
Voter/delegate that made the choice.

Quadratic Vote Procedure

Vote of a voter in favor of a proposal with multiple vote units.

- Policy
[Quadratic Vote Policy](#).
Policy that sets the rules of the selection procedure.
- Voter Choice
[Proposal Selection](#).
Proposal that is being voted for by a voter/delegate.
- Amount
Number, vote units.
Number of vote units that the voter/delegate chose to give for the proposal.
- [Vote](#)
Voter/delegate that made the choice.

Futarchic Procedure

Number of votes or public weight of a proposal is proportional to its market capitalization.

- Policy
[Futarchic Policy](#) or [Public Policy](#).
Policy that sets the rules of the selection procedure.
- Futarchic Choice
[Proposal Selection](#) or [Public Policy](#).
Proposal that is being selected.
- [Asset Shares](#)
Shares of the policy.
- ❖ Market Capitalization
Number, tokens. Public.
Total value of all shares of the proposal.
- ❖ Ratings
List of [Ratings](#). Public.
Ratings assigned to the proposal.

Asset Shares

A contract that represents fractional ownership of an asset.

- Asset
[Stock](#) or [Portfolio Fund](#) or [Asset-Backed Security](#) or [Futarchic Procedure](#).
An underlying asset.
- Number of Shares
Number.
A single share represents fractional ownership of an *asset* in proportion to the total number of shares.

- Variable Number of Shares
Number. Non-Constant. Alternative.
Total number of shares may be not fixed but rather set by the issuer. Can only be used when the asset is a stock.
- Price
Number, tokens. Non-Constant.
Initial price of a share.
- ❖ Shares
List of pairs (address; number, shares).
List of shareholders and the number of shares that they hold.
- Transfer/Sell Shares
 - Old Holder
Address.
 - New Holder
Address.
 - Amount
Number.
 - Price
Number, tokens. Optional.
 Shares transferred from one holder to another.

Asset Holder

A contract that represents ownership of an asset.

- Asset
[Bond](#) or [Treasury Bond](#) or [Loan](#) or [Insurance](#) or [Credit Default Swap](#).
An underlying asset.
- ❖ Holder
Address.
Account address of the asset holder.
- Transfer/Sell the Asset
 - Old Holder
Address.
 - New Holder
Address.
 - Price
Number, tokens. Optional.
 The asset can be transferred from one holder to another.

Accounts

Voter

Individual district member account.

- Voter Districts
 - List of [Voter Districts](#) and [Sovereign Voter Districts](#). Non-Constant.
 - All voter districts that the voter is a member of.
- ❖ Votes
 - List of [Votes](#).
 - Votes made by or on behalf of the voter.
- ❖ Delegations
 - List of [Delegations](#).
 - Delegates that can vote on behalf of the voter.
- ❖ Swap Delegations
 - List of [Swap Delegations](#).
 - Portfolio funds that can create swaps on behalf of the voter.
- ❖ Swaps
 - List of [Credit Default Swaps](#).
 - Swaps created by or on behalf of the voter.
- ❖ Active Proposals
 - List of [Bills](#) and [Emission Bills](#) and [Banking Licenses](#) and [Central Banking Licenses](#) and [Hosting Licenses](#) and [Hosting License Images](#) and [Fiduciary Licenses](#).
 - Proposals that the voter voted for and also proposals that have the majority vote in a district.
 - ❖ Active Bills
 - List of [Bills](#) and [Emission Bills](#).
 - Subset of active proposals.
- ❖ Taxes Paid
 - Number, tokens.
 - Total amount of tokens that were paid in taxes by the voter.
- Make a [Vote](#)
 - Vote in support of a proposal.
- Revoke a [Vote](#)
 - Revoke support from a proposal.
- Make a [Delegation](#)
 - Allow a delegate to vote on behalf of the voter.
- Revoke a [Delegation](#)
 - Revoke the possibility to vote on behalf of the voter.
- Confirm [Voter District](#) membership
 - Join a voter district.

$$Voter_{BillRate} = \sum_{Bill \in Voter_{Active\ Bills}} Bill_{Total\ Tax\ Rate} \quad (1)$$

$$Voter_{Fiduciary\ Rate} = \sum_{\substack{Fiduciary\ License \in Voter_{Active\ Proposals} \\ Voting\ District \in Voter_{Voter\ Districts}}} Fiduciary\ License_{Fiduciary\ Commission} \quad (2)$$

where:

$$Fiduciary\ License \in Voting\ District_{Fiduciary\ Licenses}$$

$$Voter_{Delegate\ Rate} = \sum_{\substack{Vote \in Voter_{Votes} \\ Bill \in Voter_{Active\ Bills} \\ Delegation \in Voter_{Delegations}}} Bill_{Tax\ Rate} \times Delegation_{Bill\ Commission} \quad (3)$$

where:

$$Vote_{Voting\ Procedure[Voter\ Choice][Contract]} = Bill \wedge Vote_{Delegation} = Delegation$$

$$Voter_{Total\ Tax\ Rate} = Voter_{BillRate} + Voter_{Delegate\ Rate} + Voter_{Fiduciary\ Rate} \quad (4)$$

Delegate

An account that allows it to vote on bills on behalf of voters.

- Delegations
List of [Delegations](#). Non-Constant.
Proposals created by the delegate.
- Revenue Share
List of [Revenue Shares](#). Optional.
Securities that represent a share in the delegate's revenue.
- [Vote](#)
Vote in support of a proposal.
- Revoke a [Vote](#)
Revoke support from a proposal.
- Propose a [Delegation](#)
Create a proposal that allows the delegate to vote on behalf of voters.
- Delegate to another delegate

Fiduciary

An account that allows it to introduce bills up for a vote.

- Revenue Share
List of [Revenue Shares](#). Optional.
Securities that represent a share in the fiduciary's revenue.
- ❖ Licenses

List of [Fiduciary Licenses](#). Public.

Licenses proposed by the fiduciary.

→ Confirm a [Bill](#)

When a public organization first publishes a bill, the fiduciary that is specified in it has to make a confirmation that they are indeed taking fiduciary responsibility in regards to the bill.

→ Confirm a [Loan](#), [Bond](#) or [Stock Category](#)

Confirm securities issuance by a public organization.

→ Propose a [Fiduciary License](#)

Create a proposal that allows it to introduce bills up for a vote.

Organization

An account that represents a company or a corporation.

Public Organization

Organization accounts can also be used to represent a taxpayer funded entity.

❖ Stocks

List of [Stock Categories](#). Public.

Stocks of the organization.

❖ Bonds

List of [Bonds](#). Public.

Bonds issued by the organization.

❖ All Bills

List of [Bills](#) and [Emission Bills](#). Public.

For public organizations, bills that are proposed by the organization.

❖ Active Bills

List of [Bills](#) and [Emission Bills](#). Public.

For public organizations, bills proposed by the organization that have the majority vote in a district.

❖ Status

Options: active/inactive.

For public organizations, shows if the organization has an active bill.

❖ Exchanges

List of [Exchanges](#). Public.

Stock exchanges that the organization is listed on.

→ Pay Employee

- Employee

- [Voter](#).

- Amount

- Number, tokens.

Perform a transition to transfer personal income [\[Token: Transfer Taxable Income\]](#).

→ Create a [Bond](#) or [Stock Category](#)

Issue securities.

- Propose a [Bill](#) or [Emission Bill](#)
Create a bill.
- Remove [Stock Category](#)
The organization can delete the stocks if it owns all of them in that category.

Voter District

An account that represents a group of individuals who are voters and taxpayers. Related: [Sovereign Voter District](#).

- Tagging Options
List of [Tag Options](#). Non-Constant.
Tags that are available in the district.
- Bill Commission
Number, %.
A fraction of tax revenue that the district receives.
- Selection Policies
List of [Selection Policies](#).
Methods by which proposals are selected in the district.
- Revenue Share
List of [Revenue Shares](#). Optional.
Securities that represent a share in the district's revenue.
- Minimal Swap Value
Number, tokens or [relative units](#).
The least amount of tokens that is required in order to initiate a credit default swap.
- ❖ Members
List of [Voters](#).
Voters that are registered to vote in the district.
- ❖ Bills
List of [Bills](#). Public.
Bills that are up for the vote in the district.
- ❖ Public Policy Proposals
List of [Public Policies](#). Optional. Public.
Public policy of the district.
- ❖ Delegations
List of [Delegations](#). Public.
Proposals by delegates to vote on behalf of voters.
- ❖ Fiduciary Licenses
List of [Fiduciary Licenses](#). Optional. Public.
Fiduciaries that are up for the vote in the district.
- ❖ Active Proposals
List of [Bills](#) and [Fiduciary Licenses](#). Public.
Proposals that have the majority vote in the district.
 - ❖ Active Bills
List of [Bills](#).
Subset of active proposals.

- Invite a [Voter](#)
Add a district member.

Bank

Inherits from [Organization](#).

Entity that makes loans.

- Licenses
List of [Banking Licenses](#). Non-Constant.
Licenses proposed by the bank.
- Revenue Share
List of [Revenue Shares](#). Optional.
Securities that represent a share in the bank's revenue.
- Propose a [Banking License](#)
Create a proposal that allows the bank to make loans.
- Make a [Loan](#) or [Interbank Loan](#)
Loan tokens to a borrower or loan excess reserves to another bank.

Central Bank

Inherits from [Organization](#).

Entity that regulates the currency supply of a sovereign district.

- Licenses
List of [Central Banking Licenses](#). Non-Constant.
Licenses proposed by the central bank.
- Revenue Share
List of [Revenue Shares](#). Optional.
Securities that represent a share in the central bank's revenue.
- ❖ Status
Options: primary / secondary.
Shows if the central bank has a license with the most votes in the district.
- Set Relative Units Rate
Set the rate that determines the value of a banking license or an emission bill [\[Monetary Policy: Relative Units Rate\]](#). This action can be performed only by the primary central bank.
- Set Price Index
Add monthly price index to the price index list [\[Monetary Policy: Price Index\]](#). This action can be performed only by the primary central bank.
- Issue/buy [Treasury Bond](#)
Perform an open market operation with treasury bonds [\[Central Banking License: Bonds\]](#).
- Buy/sell [Bonds](#) or shares of [Asset-Backed Securities](#).
Perform an open market operation with securities [\[Central Banking License: Assets\]](#).
- Confirm token [Exchange Rate](#) or [Abstract Exchange Rate](#)
Create a bridge between tokens or between the token and a currency union.

- Propose an [Exchange Rate](#) or [Abstract Exchange Rate](#)
Propose an exchange rate or make a request to join a currency union [\[Abstract Currency: Rates\]](#)
- Propose a [Central Banking License](#)
Create a proposal for a central bank.
- Make an [Interbank Loan](#)
Refinance a bank.

Exchange

Inherits from [Organization](#).

Entity that allows it to trade securities.

- Listed Entities
List of [Organizations](#) and [Portfolio Funds](#) and [Asset-Backed Securities](#) and [Public Policies](#) and [Quadratic Vote Policies](#) and [Futarchic Policies](#). Non-Constant.
Securities issuers that are allowed to be traded on the exchange.
- Rating Options
List of [Rating Options](#).
Ratings that are required for securities to be traded on the exchange.
- Members
List of Addresses. Non-Constant.
Members who are allowed to trade on the exchange.
- Trades Commission
Number, %.
Commission on trades that the exchange receives as revenue.
- Revenue Share
List of [Revenue Shares](#). Optional.
A share in revenue of the exchange.
- Invite a member
- List an [Organization](#) or [Portfolio Fund](#) or [Asset-Backed Security](#) or [Public Policy](#) or [Quadratic Vote Policy](#) and [Futarchic Policy](#)

Portfolio Fund

Inherits from [Organization](#).

Entity that can hold and trade securities on behalf of shareholders.

- [Portfolio](#)
Assets held by the fund.
- Commission
Number, %.
A fraction of revenue from selling shares that the fund manager receives.
- Swap Delegations
List of [Swap Delegations](#). Non-Constant.
Proposals by the fund to create swaps on behalf of voters.
- [Asset Shares](#)

- Shares of the fund.
- ❖ Ratings
 - List of [Ratings](#). Public.
 - Ratings assigned to the shares of the fund.
- Create a [Credit Default Swap](#)
 - Funds can initiate swaps on behalf of voters.

Insurance Fund

Inherits from [Organization](#).

Entity that provides financial insurance services.

- [Portfolio](#)
 - Assets held by the fund.
- Commission
 - Number, %.
 - A fraction of insurance revenue that the fund manager receives.
- Revenue Share
 - List of [Revenue Shares](#). Optional.
 - Securities that represent a share in insurance payments.
- ❖ Insurances
 - List of [Insurances](#).
 - Insurance contracts provided by the insurer.
- Confirm [Insurance](#)
 - Make a confirmation that the fund takes on insurance obligations.

Pension Fund

Inherits from [Organization](#).

Entity that allows it to pay back investors over time.

- [Portfolio](#)
 - Assets held by the fund.
- Payback Maturity
 - Number, years.
 - Period of time that it takes for the payback to start.
- Payback Period
 - Number, years.
 - Period of time it takes for the payback to complete.
- ❖ Contributions
 - List of pairs (address; number, tokens).
 - List of contributors and the number of tokens that they contributed.

Rating Agency

Inherits from [Organization](#).

Entity that assigns rating to securities.

- Rating Options
List of [Rating Options](#).
Possible ratings that can be assigned to securities by the agency.
- Ratings
List of [Ratings](#). Non-Constant.
Ratings made by the agency.
- Revenue Share
List of [Revenue Shares](#). Optional.
Securities that represent a share in revenue of the agency.
- Rate [Stock](#) or [Bond](#) or [Loan](#) or [Insurance](#) or [Asset-Backed Security](#) or [Revenue Share](#) or [Portfolio Fund](#) or [Quadratic Vote Policy](#) or [Futarchic Procedure](#).
Assign rating to a security.

Traditional Government

A government account grants additional privileges in the fiscal system of a sovereign district. The government can create an account and publish its address, and then sovereign districts can tie the government account to their accounts.

- Set the Government Emission Bill
Create an emission bill for a sovereign district [\[Sovereign Voter District: Government Emission Bill\]](#).

Sovereign Voter District

Inherits from [Voter District](#).

Primary voter district that allows currency creation. There can only be one account of this type per database.

- Domain/IP
Text.
Domain name or IP address of the district.
- [Traditional Government](#)
Optional.
Special account of the traditional government that has an ability to set the government emission bill for the district.
- Complementary Districts
List of [Sovereign Voter Districts](#). Optional.
Membership in one of the districts on the list is required for membership in this district.
- [Token](#)
Currency of the district.
- [Monetary Policy](#)
Optional.
Policy that regulates the token supply.
- ❖ Bills
List of [Bills](#) and [Emission Bills](#). Public.
Bills that are up for the vote in the district.

- ❖ Emission Bills
 - List of [Emission Bills](#). Public.
 - Subset of bills.
- ❖ Government Emission Bill
 - [Emission Bill](#). Optional. Public.
 - Emission bill that is created by the government account of the district and that doesn't require voter approval to become active.
- ❖ Banking Licenses
 - List of [Banking Licenses](#). Public.
 - Banking licenses proposed in the district.
- ❖ Central Banking Licenses
 - List of [Central Banking Licenses](#). Public.
 - Central banking licenses proposed in the district.
- ❖ Hosting Licenses
 - List of [Hosting Licenses](#). Public.
 - Hosting licenses proposed in the district.
- ❖ Active Proposals
 - List of [Bills](#) and [Emission Bills](#) and [Banking Licenses](#) and [Central Banking Licenses](#) and [Hosting Licenses](#) and [Fiduciary Licenses](#). Public.
 - Proposals that have the majority vote in the district.
 - ❖ Active Bills
 - List of [Bills](#) and [Emission Bills](#). Public.
 - Subset of active proposals.

$$\text{Monetary Policy} = \text{Sovereign District}_{\text{Monetary Policy}} \quad (1)$$

$$\begin{aligned} \text{Sovereign District}_{\text{Government Credit}} = \\ \sum_{\text{Emission Bill} \in \text{Sovereign District}_{\text{Emission Bills}}} \text{Emission Bill}_{\text{Value}} - \text{Emission Bill}_{\text{Tax Payments}} \end{aligned} \quad (2)$$

where:

$$\text{Emission Bill} \in \text{Sovereign District}_{\text{Active Proposals}}$$

$$\begin{aligned} \text{Sovereign District}_{\text{Bank Credit}} = \\ \sum_{\text{Banking License} \in \text{Sovereign District}_{\text{Banking Licenses}}} \sum_{\text{Loan} \in \text{Banking License}_{\text{Loans}}} \text{Loan}_{\text{Value}} - \text{Loan}_{\text{Loan Payments}} \end{aligned} \quad (3)$$

where:

$$\text{Banking License} \in \text{Sovereign District}_{\text{Active Proposals}}$$

$$\begin{aligned} \text{Sovereign District}_{\text{Token Supply}} = & \text{Sovereign District}_{\text{Government Credit}} \\ & + \text{Sovereign District}_{\text{Bank Credit}} \\ & + \text{Monetary Policy}_{\text{Open Market Operations}} \\ & + \text{Monetary Policy}_{\text{Forex Operations}} \end{aligned} \quad (4)$$

$$\begin{aligned} \text{Sovereign District}_{\text{Sovereign Debt}} = \\ \sum_{\text{Emission Bill} \in \text{Sovereign District}_{\text{Bills}}} \text{Emission Bill}_{\text{Value}} - \text{Emission Bill}_{\text{Tax Payments}} \\ + \sum_{\text{Bill} \in \text{Sovereign District}_{\text{Bills}}} \sum_{\text{Loan, Bond} \in \text{Bill}_{\text{Public Obligation}}} \text{Loan}_{\text{Value}} - \text{Loan}_{\text{Loan Payments}} \\ \quad \vee \text{Bond}_{\text{Nominal Value}} - \text{Bond}_{\text{Bond Payments}} \\ + \text{abs}(\text{Monetary Policy}_{\text{Open Market Operations}}) \end{aligned} \quad (5)$$

where:

$$\begin{aligned} \text{Emission Bill} \in \text{Sovereign District}_{\text{Emission Bills}} \wedge \text{Bill} \notin \text{Sovereign District}_{\text{Emission Bills}} \\ \wedge \text{Bill}, \text{Emission Bill} \in \text{Sovereign District}_{\text{Active Proposals}} \end{aligned}$$

V. Conclusion

What this document is arguably has been able to show that there exists potentiality for a new kind of a social contract that pushes democracy and market incentives all the way to their constitutional limits. This push gives us a lot of new territory that was unreachable before certain technological advancements of the current era, and that can be used to build institutions and economic arrangements for collective action on both local and national scale without a central authority.

The main set of promises of decentralized democracy is that it is going to be able to facilitate:

1. Democratic Finance. Monetary and fiscal policy that is determined by the vote of the people. Public and private credit comes into existence through the democratic process.
2. Balanced Majoritarianism. Democratic process that is balanced in terms of the costs to the minority of that process. The process disincentivizes the majority from making reckless decisions.
3. Small-scale Investments. Stock market system that incentivises equity creation on a small and medium scale. First, it removes major costs from the business and shifts them to investors. Second, it produces demand for small-scale investments as a consequence of localism. Third, it enables an infrastructure that is required to service the investments.
4. Ethics in Data Use. Private data access policy that is determined by the vote of the people. People can allow limited access to their private data and receive benefits from allowing it.

When every individual is able to express their political beliefs in a meaningful fashion and has the confidence that they've made a meaningful personal contribution towards their dearly held beliefs, it can be argued that it is going to lead to decrease in societal tension and increase in social harmony.

This document puts out a call to the world to explore and experiment with the idea of decentralized democracy. There are several different steps that one can take with it:

1. Build theoretical mathematical models that formally analyze democratic decentralization through social choice, game theory and mechanism design.
2. Produce educational and scientific materials that explain benefits of democratic decentralization.
3. Build the software system that runs decentralized democracy.
4. Organize social and political movements that promote democratic decentralization.
5. Try it out in the field with volunteer communities and businesses.

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Join

Reddit: r/DecentraliseDemocracy

<https://www.reddit.com/r/DecentraliseDemocracy/>

Github: DecentralizedDemocracy

<https://github.com/DecentralizedDemocracy/DecentralizedDemocracy>

Email: decentralizeddemocracy@gmail.com