

# A Decentralized Central Bank Digital Currency

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# A Decentralized Central Bank Digital Currency

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# **ABSTRACT:**

Central bank digital currency (CBDC) is a digitized fiat currency. As the nature of the central bank is centralized, the CBDC is also centralized. This paper proposes a decentralized CBDC that is controlled by many central banks together or countries in the world. It is only for international transactions between member countries. While domestic transactions continue to use the national currency of each country. A decentralized CBDC can explore the advantages of digital technologies more deeply than the centralized ones by making reconciliations between central banks in real-time. Furthermore, this system provides international liquidity for all (member) countries in the world sustainably and free of charge. This system eliminates global imbalances, makes the exchange rate more stable, and so makes the whole international monetary system naturally more stable. In doing so, the system does not require economic integration so that all countries in the world may join without many conditions.

Keywords: Cryptocurrency, organic system, global currency, international monetary

system, global imbalances

JEL classification: O38, E40, E50

# 1 Introduction

When cryptocurrencies reached their first peak in 2017, experts and various central banks in the world explored the possibility of digitizing fiat currencies. The goal is to get all the advantages of digital technology so that fiat currencies are not left behind (Bordo & Levin, 2017). The main advantage of cryptocurrencies was that they could make transactions between countries much faster and at much lower costs. That is something that paper money cannot achieve with the available technology.

Experts and central banks then introduced the central bank digital currency (CBDC) or central bank cryptocurrency (CBCC). Simply put, CBDC is a digital currency issued by a central bank or government. It was different from the cryptocurrency that was circulating at that time which was issued by non-government, not even by anyone like Bitcoin. Following the nature of central banks, CBDCs are also centralized. It is issued and managed by one central bank and one country. Currently, almost all central banks in the world are assessing and exploring CBDCs. In 2020, the People's Bank of China issued a digital Yuan, which is the first digital fiat currency issued by a major economy (Areddy, 2021). With all the advantages, it is only a matter of time, digital fiat currency will replace paper currency as paper currency replaced metal currency (coins).

This paper proposes a model for a decentralized CBDC that is issued and managed jointly by all countries (central banks) in the world, or member countries. Therefore, it is a real international currency in nature. The model name is "organic international monetary system" or "organic IMS" or "organic system" for short. The organic system is an international currency system that is built and managed by all countries in the world or member countries and becomes part of their respective national currencies. Organic currency does not stand alone but stands above the national currencies of member countries. The organic system is fully digital so it is also called international or decentralized CBDC. The exchange rate between the organic currency and the national currency of each member country fully follows the economic fundamentals of each country which is called an "auto-balancing system".

As part of CBDC, all the advantages of digital systems also apply here. The organic system can make transfers and transactions cross-borders in minutes or even seconds at almost negligible cost. Moreover, as decentralized, the system can also reconcile between central banks in real-time and keep the balance between them. It can explore the advantages of digital systems deeper than centralized CBDCs. As jointly managed, the organic system can provide international liquidity for all (members) countries in the world free of charge and sustainably. They no longer need to buy international currency from other countries and do not need to owe overseas just to meet FX reserve's needs. The organic system can also balance the external balance sheets of all (member) countries and eliminate global imbalances permanently. Countries in the world no longer need to maintain the balance of payments because the system has done it in real-time and in all conditions. The organic system can make the international monetary system (IMS) more stable by eliminating imbalances and making the exchange rate more stable by following the fundamentals. To achieve this, the organic system does not require economic integration. Thus this system can start anywhere in the world and all countries may join.

#### 1.1 Literatures

There is a lot of recent pieces of literature on CBDCs. The most general and in-depth overview is given by Bordo & Levin (2017). According to them, CBDC can be a very efficient medium of exchange as well as a stable means of storing and measuring value. With CBDC, the central bank can make monetary policy more effective, efficient, and transparent in the future. Governments can make inflation targets more convincing and record-keeping better. This has deep implications for the accuracy of monetary, fiscal, and even tax policies. In general, they view CBDC "very optimistically" although it is necessary to keep caution. Barrdear & Kumhof (2016) found that CBDCs can make transactions very efficient. According to their calculations, issuing a CBDC of 30% of GDP in the US could increase GDP by 3% as a result of reductions in real interest rates, distortion of taxes, and monetary transaction costs. Through the BIS papers, Barontini & Holden (2019) surveyed and found that the majority of central banks in the world assessed CBDC. Those central banks prospect CBDC with caution. They also found that several central banks were ready to issue CBDCs shortly. Follow-up surveys in the later BIS papers conducted by Boar, Holden, & Wadsworth (2020) and Boar & Wehrli (2021) show that emerging countries are more enthusiastic regarding CBDC while developed countries tend to be conservative. Some of them are ready to go. To find out whether CBDC affects monetary stability, Brunnermeier & Niepelt (2019) built a simulation with a "generic model of money and liquidity". They concluded that the CBDC did not cause instability in the monetary system. The results of their research have convinced the concerns of the parties so far. In general, experts consider CBDC as a technological "new leap" and see it "optimistically with caution". As part of the CBDC, almost all the advantages, disadvantages, and problems in CBDC in the literature are also applicable in the model proposed in this paper.

We have not found literature that directly addresses decentralized CBDCs or jointly managed by multiple central banks. We, therefore, searched for other literature outside the digital realm, namely a jointly managed IMS that is not a single currency. We found that the closest model is Bancor or Keynes Plan. Keynes built this model more than 70 years ago. To this day, the model is still the most advanced in terms of international currency that is managed jointly by all countries in the world and theoretically might be able to eliminate global imbalances and make the IMS symmetrical (Costabile, 2009), (Alessandrini & Fratianni, 2009), and (Carabelli & Cedrini, 2010).

In general, Bancor as documented in IMF publications is as below (Keynes, 1969):

Countries in the world establish the International Clearing Bank (ICB) which serves as the world's central bank. The ICB issues an international payment unit called Bancor. Bancor is pegged to gold. For convenience, Bancor is only used among central banks; the public cannot use it. Upgrading bancor into a truly international currency for public use requires further research. The Bancor exchange rate with the national currencies of all countries is fixed. If there is an imbalance then adjustments are made. Member countries receive an allocation of Bancor of one year of international trade. Bancor does not require any guarantee of gold or other international assets for member countries. Meanwhile, non-member countries can buy Bancor with gold. Member countries that experience a trade surplus or

deficit of <sup>1</sup>/<sub>4</sub> of the quota will be charged an interest fee of 1%, while more than <sup>1</sup>/<sub>2</sub> quota will be charged with an interest fee of 2%. The ICB also asked them to adjust the exchange rate so that the surplus and deficit do not continue. Member countries may increase their quota by depositing gold in one way. This means that they can buy bancor with gold but cannot sell bancor to buy gold.

The main contribution of the Keynes model is that the system is symmetrical, can provide international liquidity to all (member) countries in the world in a sustainable manner and (almost) free of charge, and (in theory) can maintain a balance between countries. At that time, external or global imbalances had occurred on a global scale. Keynes called them "balance of financial terror". the This contribution is still very relevant today. Because until today, the world does not have a sustainable source of FX reserves and global imbalances are also growing, even bigger than when Keynes proposed this model.

While the main contribution of this paper is to explore the possibility of decentralized CBDC. As far as we know, the literature on this subject is very limited to none. This paper continues what Keynes has done before to build a fully symmetrical and democratic IMS with new models and technologies. This paper also proposes a truly international currency, which is managed by all countries in the world democratically.

# 2 The model

Organic IMS or organic system is an international currency system built jointly by all member countries in the world and becomes part of their respective national currencies. The organic system issues international means of

payment which is referred to as organic currency. The organic currency is only for international transactions between member countries. While domestic transactions continue to use the national currency. The organic currency cannot circulate outside member countries. Organic currency does not stand alone, but stands on and is guaranteed by the national currency of each country. That's why it's called "organic". Organic currency and national currency coexist, live side by side, and are interchangeable or "hybrid". The organic system uses digital technology, automation, and decentralization so that it can be called "decentralized CBDC". The exchange rate between the organic currency and the national currency uses an auto-balancing system, namely anchoring the exchange rate to the economic fundamentals and the neutrality of the external balance sheet of each country (Rahman, 2022).

# 2.1 Governance

The joining countries establish a union and build the intergovernmental body, such as the United Nations of International Monetary (UNIM). Ideally, UNIM is under the United Nations and coordinates with the IMF. UNIM then establishes the global or the world central bank (WCB). The WCB is responsible to UNIM.

The WCB has a representative office in each member country which is called the world central bank national (WCBN) or with country name (eg the WCBN Indonesia or WCBN England). The WCBN and the national central bank (NCB) of each member country work together to control the circulation of organic currency and operate the exchange rate system. World central banks (WCB and WCBNs) control the international monetary system (IMS) while national central banks control the national monetary system (NMS). So this is different



Figure 1 The organizational structure of the organic system

from the Euro model, wherein in the Euro model, all national central banks follow the ECB in regulating and controlling the monetary system. In the Euro model, there is no NMS. All monetary policies follow one policy, one size fits all, created by the ECB. Meanwhile, in the organic system, all national central banks are independent in running and controlling the NMS as it is today.

Each WCBN and NCB operates at least one supercomputer. All these supercomputers become the core of the system.

The voting rights of each member country are proportional to the amount of organic currency used for international transactions. Member fees finance all operations costs. Contribution is proportional based on the amount of organic currency circulating in each country.<sup>1</sup>

# 2.2 Digitization, semi-automation, and decentralization

#### Digitization

The organic system is digitized and issues digital currency. Digital currency is a currency that is "printed", stored, and managed in the form of a "digital code". With digital form, transactions can be done at high speed and efficiency, surpassing all other types of currencies in the world today. The most advanced digital currency existing today is a cryptocurrency that has emerged with blockchain technology, automation, and decentralization (Narayanan, Bonneau, Felten, Miller, & Goldfeder, 2016) and (Hougan & Lawant, 2021).

Two forms or models of digital currency are available for CBDC today. *First*, the token model, which is in principle, the same as paper

<sup>&</sup>lt;sup>1</sup> The contribution of 0.1% – 1% of the use of organic currency in each country annually is more than enough to finance the entire operations of the sistem. These costs are still much lower than the costs of maintaining FX reserves today. It should be noted that the majority of central banks in the world currently build FX reserves with foreign debt with interest rates in the range of 1%-4% per year. As for countries with large surpluses,

they issue domestic bonds with higher interest rates to buy foreign currency circulating in the market and retain it into FX reserves. According to Rodrik (2006), developing countries in the world spend an average of 1% of their GDP to maintain FX reserves. This huge cost is not necessary in the organic system because the system provides FX reserves and maintains them for all member countries free of charge.

money "printed" in the form of digital codes. Each token has a unit and a serial number. In contrast to paper money, each digital unit can be divided into very small units that paper money cannot. Tokens can circulate among users. Like Bitcoin, this system requires distributed ledger technology (DLT) to verify each token, ownership status, and transaction. experts have developed Several DLT technology to suit the needs of the central bank. One of them is Danezis & Meiklejohn (2016) who developed a DLT model for CBDC that is more efficient than Bitcoin. The verification process can be carried out in a decentralized manner by certain parties appointed by the central bank. Another model that can work on a large scale and decentralized or semidecentralized is the Omniledger built by Kokoris-Kogias, et al. (2018). And there are several other models.

*Second*, account-based. This model is the same as that used by banks in general today. The public may create an account in banks. Transfers between accounts can be done spontaneously and free of charge. With current technology, the general public can create an account directly at the central bank as was done by the Bank of England previously. The current technology can maintain a large number of accounts efficiently.

The organic system is closed and decentralized as will be explained later. Therefore, the organic system can use both tokens and accounts at once, with a simple verification process. The choice of technology is open to discussion.

## Semi-automation

Automation is a process that operates on its own without human intervention or with minimum supervision. Automation is one of the trends in industry 4.0. The advantage of automation is that the system can work more quickly, objectively, and efficiently. As for the drawbacks, for complicated work, nontechnical, and not routine, sometimes the results are not as desired so that human intervention is still required.

cryptocurrency In the realm, а decentralized system that works automatically is known as a decentralized automated organization or DOA. DOA is "an organization that, under predefined rules, operates autonomously or semi-autonomously in an open-source software which is distributed across all (computers) stakeholders, transparent, secure and auditable" (Aste, Tasca, & Matteo, 2017). While according to Hsieh, Vergne, Anderson, & Lakhani (2018), DAO is an "organization that uses software rules to execute organizational routines, plus votes from some class of members to alter and extend those routines. No direct management is required".

In the organic system, in general, there are two classes of day-to-day operations, namely technical and non-technical. Technical activities use an automated system and do not require intervention, for example, exchange rates and transactions between accounts. As for non-technical activities that require intervention, the execution system runs manually as usual.

# Decentralization

Decentralized is a system that operates at several centers or cores, not at one particular center. A multi-core system is more robust and reliable than a centralized system because there is no dependency on a single part or a particular part. If any part of the system fails then the rest of the system still functions normally. This prevents the system from catastrophic failure.



Figure 2 The difference between centralized, decentralized, and distributed

Baran (1964) divided the centralization of a system into 3 levels, namely centralized, decentralized, and distributed. Centralized is a system that operates on a single core as the center of operations and control. Centralized systems are very efficient and inexpensive. The drawback is the dependence on the center. If the center fails, then the whole system fails. An example is current central banks and commercial banks' operations. Decentralized is a system that operates in multiple centers or cores. This system is more complicated than the centralized one but more reliable. When some centers fail, other centers that are still normal can still work normally. Thus the system can still run. Distributed is a system with no center at all or center-less. All operations are distributed to all units. This system is very complicated but the most reliable. An example of a distributed system is Bitcoin. With a distributed system of millions of cores operated by the public in the world, it is almost impossible to stop Bitcoin operations in any reasonable way. Even if there are only a few computers in operation around the world, Bitcoin can still run normally.

The organic system connects several central banks. Therefore, the nature of the



*Figure 3 The decentralized structure of the organic system* 

organic system is decentralized (middle Decentralization applies picture). both organizationally and technically. Organizationally, for example, all member countries are cores. All WCB, WCBNs, and NCBs are cores. They are organizationally equal. Then technically, each WCBN and NCB operates at least one supercomputer which is the core. Simply put, a decentralized organic system is illustrated in the figure 3 above:

#### Member countries

Member countries, WCBNs, and NCBs are organizationally the core. All of them are equal and proportional based on voting rights.

# Supercomputer

Each WCBN and NCB operates at least one supercomputer. Technically, all supercomputers are the core of the system. Software and data in all supercomputers are parallel. All data and software are in all supercomputers. Thus, damages or disruptions in one or more cores can be backed up by other cores.

## Main network

All supercomputers are connected to the main network called the backbone.

## Client

The general public, commercial banks, companies, and all kinds of equipment connected to the main network are clients. Clients can get all services in the system.

## Service

Since the operation of the system has been financed by the contributions of member countries as mentioned above, all services are, in principle, free of charge. Key services, such as accounts, transfers, payments, and money exchange, are free for the public. This will make the international transfer and payment system very efficient.

In principle, the system can also open to business services created by third parties or "add-ons" attached to the main service. Commercial banks and other service providers can enter this field. It is open to future discussion.

# 2.3 Distribution and control

# From the global central bank national to the national central bank

The amount of organic currency needed by each member country is calculated based on its international transactions with fellow member countries. There are several options for determining this number. We can use the "quota" recommended by Keynes for Bancor, which is a year of international trade. We can also use the average number of FX reserves of industrialized countries over the last decades which has become the "rule of thumb", which is 3 months of imports. We prefer to use the rule of thumb of FX reserves of industrialized countries because it has been proven effective and efficient for decades, which is 3 months of international trade. We then call this number the "ideal amount". So-called because this amount is not a quota but only a benchmark. This means that member countries can still get an allocation greater than the ideal amount, as will be explained below. The ideal amount is open for future discussion.



Figure 4 The distribution of organic currency from the world central bank national to the national central

The WCBN then sends the organic (international) currency in the "ideal amount" to the NCB. As collateral, the NCB sends back the national currency in the same amount. The amount of national currency pledged as collateral is always equal to the amount of organic currency in circulation. If the national currency depreciates against the organic

currency, the NCB will send the shortage so that the amount is the same again. And vice versa. Thus, the collateral amount and the organic currency in circulation are always the same.

The collateral is only kept by the WCBN, doesn't circulate, and is only in the form of a note, does not need to be printed. Thus, this guarantee system does not require economic or monetary costs. This makes the organic system very efficient. The organic currency is distributed to all member countries free of charge with a guarantee system that is also (almost) free of economic and monetary costs.

#### From national central bank to the public



Figure 5 The distribution of organic currency from the national central bank to the public

People who need organic currency for transactions between member countries can buy directly to the NCB with the national currency through the backbone. The proceeds from the sale (seigniorage) become government revenue. Then people who no longer need organic currency can sell it directly to the NCB. Purchase costs (negative seigniorage) become government costs. Since the system has been financed by government contributions, the exchange transaction does not require spreads. This means that the public can buy and sell organic currency at exactly the same rate, without spreads. For example, if the buying price of organic currency is 10 yuan, then the selling price is also 10 yuan.

## Control

When the organic currency in circulation is equal to or below the "ideal amount" as described above, the system exercise "passive control". This means that the NCB does not intervene. The issuance and withdrawal of organic currency follow the demands of society. If the public needs organic money they just buy it. On the other hand, when they no longer need it, they can sell it. This is called passive control. When the amount of organic currency in circulation exceeds the "ideal amount", the government needs to intervene. The intervention could be in the form of "tax of holding organic currency". This is called "active control".

It should be noted that the excessive use of organic currency or above the "ideal amount" is actually detrimental to the country itself. The excessive use of organic currency reduces the use of the national currency thereby reducing the ability of NCBs to control the NMS and reducing the effectiveness of their monetary policies. Meanwhile, excessive use of organic currency for imports or outgoing transfers is not possible regarding the exchange rate system as will be explained below.

In principle, this system can provide international liquidity to all member countries whatever they need including above the "ideal amount" in a very efficient way.

#### 2.4 Exchange rate

The exchange rate in the organic system does not only function as a tool or place for exchanging money, but more than that, to maintain the balance and stability of the system. The organic system does not use existing exchange rates, either floating or fixed or a combination of both. The organic system uses its own which is called "auto-balancing".

Auto-balancing is an exchange rate system that follows the economic fundamentals of each country and keeps the external balance sheets of all countries in a neutral state. The auto-balancing equation (equation 1) is as follows (Rahman, 2022):

$$E = \frac{P_{Local}}{P_{Global}} \cdot \left(\frac{GDP + Deficit external balance}{GDP + Surplus external balance}\right)$$
(1)

- E : Exchange rate
- P<sub>Local</sub> : the average prices of tradable goods and services in the domestic market in the national currency
- P<sub>Global</sub> : the average prices of tradable goods and services on international markets in international currency
- GDP : Gross domestic product

The equation contains two components, namely the actual purchasing power or true exchange rate (P<sub>Local</sub>/P<sub>Global</sub>) and the external balance sheet balancer ((GDP+ Deficit external

balance)/(GDP+ Surplus external balance)). They work as follows:

# First, the actual purchasing power

The first component reflects the actual and real purchasing power of each national currency in the international market. Thus, the exchange rate between the national and international currencies is neither overvalued nor undervalued, but at the real and actual value. With this first component, the average price of tradable goods and services in the domestic market is the same as in the international market. Thus, the country's trade tends to be balanced, not excessive surplus or excessive deficit.

# Second, the balance of the external balance sheet

The second component pegs the exchange rate to the external balance sheet in a neutral state. If a country's external balance sheet is in a surplus, for example, due to too many exports, the exchange rate of its national currency will automatically rise so that the trend will reverse into a deficit. Thus, the country's external balance sheet tends to return to a neutral state (no surplus and no deficit). On the contrary, when the country's external balance sheet is in deficit due to too many imports, for example, the exchange rate of its national currency will decrease so that the trend will reverse into a surplus. Thus, the country's external balance sheet tends to return to a neutral state.

# Simple example

To understand how the auto-balancing exchange rate works, let's create a simple case. When the exchange rate of the Indonesian rupiah (IDR) equals its actual value, the average price of tradable goods and services in Indonesia is fairly the same as in the international market. So Indonesia's trade tends to be balanced or neutral, not surplus and not a deficit. A limited amount of deficit or surplus may still occur but not excessive. An excessive trade surplus indicates an undervalued national currency exchange rate. On the other hand, an excessive trade deficit indicates an overvalued national currency exchange rate. A neutral exchange rate, right on actual purchasing power, tends to form a fairly neutral trade balance.

However, when Indonesia's trade is still a surplus, for example, the surplus will accumulate. The equation above (second component) will then respond by increasing the exchange rate of IDR. Thus, the price of imported goods becomes cheaper, thereby increasing the import trend. On the other hand, the price of exported goods in the international market will be more expensive, thereby reducing the export trend. Thus, Indonesia's trade balance will tend to turn into a deficit so that its external balance sheet tends to return to neutral.

Simply put, the auto-balancing exchange rate makes the trade competitiveness of all countries neutral so that their international trade tends to be balanced as well. Then even if there is still a surplus or a deficit in any amount, the exchange rate will respond accordingly which makes the external balance sheet return to a neutral state. As the name implies, autobalancing makes the external balance sheets of all member countries tend to be neutral in all conditions.

The auto-balancing exchange rate works automatically and in real-time. It cannot be intervened by anyone including the government. Even money exchange transactions that do not have underlines, or what we know as speculative transactions, do not affect the exchange rate. Because the exchange rate only follows the real price of tradable goods and services or fundamentals. The exchange rate in the organic system works like a mirror that reflects the real purchasing power of each currency. The exchange rate is a mirror that reflects the fundamentals and is not affected by noise transactions. This balancing system has very deep implications for the whole system as will be explained in the discussion below.

# 3 Discussion

As part of CBDCs, all the advantages of digital systems as mentioned by the experts above also apply here. Among them is that this system can make transfers and transactions across the globe in just minutes or even seconds with almost negligible cost. Sending money between countries is the same as sending an email. Transactions between countries are the same as exchanging data on the internet. This system can perform deeper, more detailed, and real-time recording beyond the paper-based. than the ordinary CBDC Then, more (centralized CBDC), as decentralized, the organic system can also comprehensively reconcile between central banks in real-time. This allows the organic system to explore more capabilities of the digital system than ordinary CBDCs.

# 3.1 Provide international liquidity for the whole world sustainably and free of charge

This is one of the advantages of a democratically shared-managed system. In a democratic system, anything created at no cost or almost no cost, can, in principle, be

distributed to all members free of charge. And so the money. To some extent, the government can create money at no cost. In the organic system, the combination of member governments can create shared money (almost) at no cost too. So they can distribute the money (almost) at no cost too. In comparison, the Keynes Bancor is also a shared-managed system. Therefore, Bancor can also provide international liquidity allocations to all member countries free of charge and without a gold guarantee, following the agreement.

This is the main differentiator with the undemocratic system as it is today. In the current system, international currency comes from the currency of certain countries, namely the US dollar which is the US currency, and the euro which is the Euro currency. They are not real international currency. They are only governed by their host countries, for their own sake, and not for the benefit of the world. It is impossible for the US and the Euro to distribute their currencies for free to all countries in the world. There are only two ways for countries in the world to get international currency. First, they must "buy" with a surplus of international trade or incoming investment. Second, if they can't afford it then they have to owe along with the interest costs. The second way is that most countries in the world do to meet the needs of FX reserves.

Another advantage is that the organic system can provide international liquidity without causing an imbalance so that it is sustainable in nature. This system issues international currency to all member countries with a guarantee of the national currency of each country. Each international currency in circulation is always guaranteed by the international currency collateral. Their number is always the same.

In terms of accounting, when international currency increases, the number of national currency collateral also increases. The balance of the two is always maintained in every issuing country. That way, the addition of international currency does not change the external balance sheet of all countries, amount. regardless of the When their international transactions increase, the allocation will also increase, guarantees also increase, their external balance sheet remains balanced. Thus, the system can provide any international currency needed for international transactions without affecting the balance between countries so that it is sustainable in the long run. In comparison, Bancor Keynes can also provide international liquidity in a sustainable manner. international When transactions increase, the allocation of international currencies also increases, and this does not affect the balance sheet of that country or other countries.

This cannot happen in the current system such as the US dollar. When international transactions rise, the need for international currency rises, the US must have a deficit to provide international liquidity to all countries in the world. The US provides the world with international liquidity by making its balance sheets in deficit and other rest countries in The current surplus. system provides international liquidity by creating imbalances in nature. This has happened for decades, causing a huge global imbalance, in which the US as the majority provider of international currency has a large deficit. Global imbalances are a potential source of long-term instability which, at any time, could explode in the form of a crisis like what has occurred in 2008. The current system is not sustainable in providing international liquidity. A long time ago, Triffin (1978) had predicted that the system using the international currency of a certain country (US) with gold guarantees at that time (Bretton Wood system) was not sustainable in the long term. Using the expanded method and without gold collateral, Farhi, Gourinchas, & Rey (2011) also predicts that the current system is also unsustainable because the ratio of the US economy is always shrinking compared to the global economy while the need for international liquidity globally is increasing. Similar predictions were also made by Eichengreen (2006). The current system is not sustainable in providing international liquidity. The increasing need for international liquidity increases global imbalances and makes the system even more unstable.

# 3.2 Maintain the external balance sheets of all countries in the world

The organic system always keeps the external balance sheets of all member countries in the world in a neutral or balanced state. Thus, it could completely eliminate global imbalances permanently.

As explained earlier, the auto-balancing exchange rate makes trade and external balance sheets of all member countries tend to be in a neutral state, not in deficit and not in surplus, under all conditions. Thus, the organic system can eliminate global imbalances of all countries in the world. Bancor can also eliminate global imbalances in different ways. Bancor uses lower and upper limits to maintain balance. Countries with a trade deficit or a surplus of 1/4 quota are subject to a 1% interest fee and an 1/2 quota 2% interest fee. The global central bank (ICB) also encourages the country concerned to adjust the exchange rate. Thus, member countries are encouraged to keep their external balances in a balanced state.

Bancor and the organic system maintain the balance of the balance sheet in different ways. Bancor uses manual methods and government intervention to maintain balance. While the organic system, on the contrary, uses automated, real-time, and cannot be intervened. In the organic system, the exchange rate works automatically and cannot be intervened. The cannot intervene. Noise government transactions such as speculation also do not affect the exchange rate. The exchange rate only follows the fundamentals and the neutrality of the external balance sheets of each country.

As a comparison, the current IMS does not have balancing systems. The external balance (trade balance, balance of payment, dan external balance sheet) is left to each country. As a result, countries in the world can push external balances out for national interest purposes. They can promote massive export by undervaluing the exchange rate to boost economic growth. These countries can have large and continuous surpluses at the expense of other countries that have large deficits. Based on data released by The World Bank (2020), from 1970-2018, one-third of the world's countries had a surplus and the remaining, twothirds, had a deficit. Most of them are continuous. In this way, the global imbalances continue to grow and make the whole system unstable. Global imbalances are an inherent part of the current system. There is no rational way to eliminate them.

## 3.3 Make the system stable

The organic system makes the international monetary system more stable than the current system.

There are two main causes of instability in the current system. *First,* global imbalances. Countries with large and persistent deficits are naturally dependent on foreign debt. For countries whose financial systems are shallow, this makes their monetary systems vulnerable and unstable. In the end, this makes the whole unstable. Second, exchange system rate fluctuations. The vast majority of currency transactions in the world do not have underline, or what we call noise transactions or speculative (Kruger, 1996). Speculative transactions tend to overshoot thereby increasing fluctuations (Long, Shleifer, Summers, & Waldmann, 1990) and (Barberis, Shleifer, & Vishny, 1998). A lot of research shows that speculation makes the system unstable. The combination of global imbalances and exchange rate fluctuations destabilizes the entire system. Our current IMS is naturally unstable and cannot be stable in this way.

The organic system eliminates the two main factors of instability above. *First*, as explained above, the organic system eliminates global imbalances. *Second*, as explained above too, the exchange rate completely follows the fundamentals. Speculative transactions do not affect exchange rates. Thus, naturally, the exchange rate will be more stable than the current system which is filled with noise transactions.

We take the example of fluctuations in the Indonesian rupiah exchange rate at the end of 2018. Based on BPS (2018) data, Indonesia's international trade in 2018 (until September) had a deficit of US\$3.7 billion. This made the market begin to lose confidence in the rupiah. Investors began to "speculate". The rupiah fell and was very volatile. At that time, the exchange rate fell more than 10% at its lowest point. This is consistent with the models of Long, Shleifer, Summers, & Waldmann (1990) and Barberis, Shleifer, & Vishny (1998) that speculation tends to overshoot, makes the exchange rate volatile, and enlarges the variance from fundamentals. For comparison, if we use the exchange rate model in the organic system, the rupiah exchange rate should be much more stable. Using equation 1 above, with a deficit of 3.7 billion dollars and Indonesia's GDP at that time in the range of 1 trillion dollars, then the depreciation of the rupiah is only about 0.37% from its neutral value. Thus, by fully following economic fundamentals and external balance sheets, the auto-balancing exchange rate is, theoretically, much more stable than the current system.

With the elimination of the two main factors that cause instability, namely global imbalances and exchange rate fluctuations, the organic system, theoretically, makes the international monetary system naturally more stable.

As for Bancor, in theory, it should also be able to make the system more stable than the current system. First, as explained above, disincentives for excessive surpluses or deficits make countries in the world maintain the balance of trade and payment. In this way, Bancor should reduce global imbalances. Second, Bancor uses a fixed exchange rate so it does not fluctuate. The side effect of a fixed exchange rate is that it can cause imbalances and asymmetric shocks (Mundell, 1961). To reduce imbalances, Bancor provides an adjustment system. Countries with excessive surpluses are encouraged to increase their exchange rates. And countries with excessive deficits are encouraged to lower their exchange rates. So, Bancor should also eliminate or reduce the factors that cause instability. Thus, in theory, Bancor should also make the system more stable.

# 3.4 Without economic integration

One of the biggest challenges in creating a common currency is the requirements for comprehensive economic integration. The Euro is a great example. As a single currency, the Euro requires comprehensive economic integration. As in the theory of Mundell (1961), countries that will unify their currencies must be economically integrated. If the integration is not fulfilled it can cause an asymmetrical shock and imbalance. While achieving economic integration is not easy. The Euro area took decades to achieve this.

Unlike the Euro model, the organic model does not require comprehensive economic integration. All countries in the world can join under their conditions as they are. There are two reasons why the organic system does not require comprehensive economic integration. First, this system only issues an international currency that coexists with the national currency of each country. The organic system does not eliminate the national currency. Thus, each country still has its own national currency and has control over monetary and economic policies. Second, the auto-balancing exchange rate follows the fundamentals and maintains the external balance of each country neutral in all conditions. Thus, imbalances do not occur. Comprehensive economic integration is not required and the balance sheets of all countries are always maintained.

In addition, the organic system can work with a condition that "some countries join and some not". That is if some countries in the world agree and some do not, then the agreeing or supporting countries can proceed. They can start to form an organic union and set up a world central bank. It's not necessary that all countries in the world must agree. The organic system can still start and all functions can run normally. So it can avoid a deadlock. Meanwhile, countries that do not agree may remain with the current system or may also join later. Therefore, this system can start anywhere in the world and other countries may join without comprehensive economic integration and without waiting for the consensus of all countries in the world, if the consensus is very hard to achieve.

## 3.5 Limitation

Beside the various advantages above, the organic system also has some limitations. *First*, as a fully digital system, all the limitations of digital systems that have been discovered by experts today also apply here. For example, this system cannot execute manual transactions and there is no option for manual transactions. When there are internet interruptions or blackouts then the system cannot work in those areas. Since it uses the internet network as the backbone, this system is also vulnerable to attacks. The current internet security system can suppress threats to the minimum extent. But the threat may still exist.

*Second*, organic currency cannot circulate outside member countries. There is no option for organic currency to circulate outside member countries. If firms or the public wants to use organic currency then the government must join. This limits the use of organic currency only among member countries.

# 4 Conclusion

Currency digitization has a huge impact in increasing the speed and efficiency of transactions and the effectiveness of recording. This impact will be more significant and deeper when digitization is combined with decentralization between countries. The digital and automation function will maximize because it can make reconciliation between countries automatically and in real-time. The decentralized CBDC can explore capabilities of digitization and automation technology more widely than the current centralized CBDCs.

The organic system can provide international liquidity for all (members) countries in the world sustainably and free of charge. They no longer need to buy international currency from other countries and do not need to owe abroad just to meet their FX reserves.

The organic system always keeps the external balances (trade balance, balance of payment, and external balance sheet) of all (members) countries in a neutral state in all conditions. So, it eliminates global imbalances permanently. Countries in the world no longer need to maintain the trade balance, balance of payment, and external balance sheet because the system has kept them in real-time, under all conditions, and cannot be intervened.

The organic system makes the exchange rate more stable by following the fundamentals. Then, coupled with eliminating external imbalances, this system can make the IMS naturally more stable than the current IMS.

The organic system does not require economic integration and can start with some countries joining and some not. Thus this system can start anywhere in the world and all countries may join.

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