

# The Case for XOR

Makoto Takemiya

SORAMITSU Co., Ltd.  
t@soramitsu.co.jp

**Abstract.** XOR is a supranational currency that has its supply and primary market managed by a computer program that runs on a blockchain. XOR is not controlled by any country, company, or individual, and is thus a global economic system designed for the common good of humanity. To facilitate economic growth, money must be deployed in an economy to create new goods and services. Unlike other cryptocurrencies, such as Bitcoin, countries can make proposals to fund productive investments via XOR allocated from a fund, or from minting TBCD, which is convertible to XOR on the open market, all via an open governance process. This means that XOR does not act as a foreign currency that is outside the control of democratic governments, but rather can be integrated into the domestic economy wherever it is used, to fund nominal GDP growth. Furthermore, XOR is not a debt-based currency, so more egalitarian social outcomes can be realized, compared to contemporary economic systems, as economic growth is not inhibited to service an ever-growing debt. Thus using XOR as legal tender in countries for discharging debts, purchasing goods and services, and paying taxes, can lead to increased economic growth, because increased productive output can be funded.

## 1 Introduction

Money allows the finite resources in our world to be allocated efficiently, without requiring central planning that would be impossible to solve optimally due to the combinatorial complexity involved in such a calculation. Money provides a satisficing (i.e., *good enough*, cf. [9]) solution to resource allocation, and as such, economics has the potential to uplift societies and shape our world for the better, but only if economic systems are rationally constructed to create socially beneficial outcomes.

Money has three defining properties: it is a unit of account (i.e., a measure of value), a store of value, and a unit of exchange. These properties allow money to solve the problem of lack of trust in exchange relations and allocation of finite resources. Currently, in most markets, fiat currencies issued by central banks best realize these properties. However, this has not always been the case: historical examples of both successful privately-issued money and unsuccessful central bank-issued money abound.

The rapid technological maturation of cryptocurrencies has led to intense debate on the role of non-central bank-issued digital money in 21st century

economies and societies [8]. Cryptocurrencies are digital assets secured and controlled via cryptographic proofs, issued and transacted on distributed ledger technologies (DLTs) such as blockchain. As the diversity and sophistication of cryptocurrencies have increased, a consensus has formed that the monetary utility of a given cryptocurrency will depend upon how well it can act as a measure of value, a store of value, and a unit of exchange [4].

Cryptocurrencies could offer a range of advantages over contemporary, debt-based fiat systems, especially for cross-border interoperability, speed, efficiency, security, resilience, programmability, political independence, decentralization, and transparency. The natively digital nature of cryptocurrencies suits them to the complex 21st century financial landscape, which will include not just peer-to-peer transactions, but also automated and machine-to-machine transactions.

This paper will explore how a cryptocurrency called XOR can be used by countries to facilitate reliable and predictable economic growth. First, we explain what economic growth is and how it can be achieved. Next, we discuss how XOR can promote economic growth in countries that accept it as legal tender. We then compare a XOR-driven economy versus use of Bitcoin as legal tender in countries like El Salvador. Finally, we explain the steps for a country to accept XOR as legal tender and integrate it into their economy.

## 2 Creating Economic Growth

Economic growth typically is defined as an increase in transactions contributing to the gross domestic product (GDP) [2] of a country. GDP transactions are, in turn, typically increased by either increasing the quantity or the efficiency of utilization of factor inputs, in order to create new goods and services. Factor inputs are typically taken in macroeconomics to be land, labor, capital, and technology. Fully utilizing these inputs optimally to create goods and services (output) can lead to the full realization of potential output,  $Y^*$ . It is important to note that transferring existing assets from one owner to another (asset transactions) do not contribute to the accounting used to calculate the GDP for a country, because no new output is created.

The potential output for a country can be conceptualized as a function of the quantity of factor inputs (QFI) and their use (total factor productivity; TFP):

$$Y^* = f(QFI^*; TFP^*), \quad (1)$$

where  $QFI^*$  and  $TFP^*$  are the potential quantity of factor inputs and potential total factor productivity, respectively. Put in simple terms, to reach the potential output of a country, resources (factor inputs) should be utilized optimally to create the highest total value of goods or services.

The equation of exchange shows, intuitively, that the amount of money used in transactions ( $M \times V$ ;  $M$  := quantity of money,  $V$  := velocity, or, number of times the same money is used in transactions in a year) has to equal the value of the transactions ( $P \times Q$ ;  $P$  := price of goods/services,  $Q$  := number of goods services sold):

$$M \times V = P \times Q. \quad (2)$$

However, in economies where cash is used or electronic payment providers do not provide all statistics, the value of all transactions in an economy is not known directly and is instead proxied via nominal GDP ( $P \times Y$ ;  $Y$  := output of goods/services in an economy):

$$M \times V = P \times Y. \quad (3)$$

As Werner [12] points out, using the equation of exchange without differentiating the use of the money<sup>1</sup> in it has many known problems, including the famous “velocity decline” problems observed in economies with speculative asset bubbles. So, it is important to disaggregate the types of money used in the equation of exchange, depending on money used for purchases of goods or services that contribute to GDP (i.e., money used for real economic transactions,  $M_R$ ) and money used for asset purchases, which are not included in GDP accounting (i.e., financial or speculative use of money,  $M_F$ ).

$$\Delta M_R \times V_R = \Delta(P_R \times Q_R) = \Delta(P_R \times Y_R) \quad (4)$$

$$\Delta M_F \times V_F = \Delta(P_F \times Q_F). \quad (5)$$

While simple, these equations have profound implications, which are backed up by empirical evidence in [12]. Namely, how money is created and allocated in an economy directly determines the: 1) amount of economic growth (or contraction), 2) stability of prices, and 3) the formation of asset bubbles [13]. Because  $V_R$  is typically stable in a large economy (people have common needs that do not change, like daily food, water, and shelter), and  $P_R$  also resists change due to the reluctance of firms to adjust prices [1], changing  $M_R$  is the primary way to attenuate real GDP,  $Y_R$ , by enabling the creation of new goods and services.

Important to note here is that interest rates are not used in these equations. That is because interest rates are the price of borrowing money and not a causal factor related to the quantity of money. In fact, higher interest rates are positively correlated with nominal GDP growth in many economies, and Granger causality analysis has shown that higher nominal GDP growth *causes* higher interest rates [12] (pp. 110, etc.). So there is no empirical support showing that lowering interest rates leads to economic growth, meaning that this is not a relationship that exists in reality.

Another common misconception is that foreign direct investment (FDI) can lead to economic growth. Insofar as a country is not using a foreign currency that is neither issued nor controlled by their local banking sector, it has been demonstrated that FDI does not have a statistically significant relationship with

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<sup>1</sup> Note: in this paper we just treat all credit and money aggregates as *money* for simplicity.

economic growth [3]. Intuitively, this is because foreign investors who are competent always extract more value than they create, as they seek capital gains and not a socially beneficial outcome for the countries they invest in. Therefore, FDI cannot be relied on to facilitate economic growth in a country, and competent monetary policy should try to eliminate FDI to the furthest extent possible.

In summary, to have economic growth, money should be created and allocated to facilitate the creation of new goods and services, based on a real economic need to utilize more factor inputs, more efficiently.

### 3 XOR as a Catalyst for Economic Growth

XOR is a cryptocurrency designed to mitigate the volatility risks, governance lacunae, and inefficiency of first-generation cryptocurrencies like Bitcoin. It is the native token of SORA, a decentralized economic system based on a blockchain network and founded to enable cryptocurrencies to advance humanity by funding new productive output of goods and services. The SORA economic model, technical implementation, and governance mechanisms all suit it for use as a medium of exchange, as well as both a measure and store of value.

SORA's economic model is based on the empirical research of Fisher [5, 7], Werner [11], Shimomura [15], Kurihara [6], and Yamaguchi and Yamaguchi [14], as well as of SORAMITSU<sup>2</sup> founder Takemiya [10].

As explained in Section 2, to enable economic growth, money must: 1) be able to be issued in response to genuine economic demand, while 2) resisting arbitrary issuance (e.g., in response to political pressure), but rather issued only for the creation of new goods or services. It should also: 3) be issued in a way that enables forward guidance (i.e., that sends signals to the market) about liquidity and price.

XOR fulfills these requirements through the use of a *token bonding curve*—an algorithm (or, smart contract in the blockchain parlance) that automatically manages the token supply elastically in response to demand. As shown in Figure 1, the token bonding curve is comprised of two pricing functions, which define the primary market prices for XOR: 1) a buy-price function, and 2) a sell-price function. The buy-price function is a line, starting at 634 USD per XOR and increasing by 1 USD for each 1,337 XOR issued. The buy-price function mints XOR when people buy from it, putting the currency used to buy the XOR into reserves, which are used by the sell-price function. The sell-price function, in turn, is set to buy back XOR at 20% less than the buy-price function and it sells the reserves held by the token bonding curve in exchange for XOR. Whereas the buy-price function mints XOR, the sell-price function burns XOR, reducing the XOR supply. In the event of inadequate reserves held by the token bonding curve, the sell-price function sells tokens along a continuous curve, starting at 20% less than the buy-price function's current price for XOR. The mathematics behind the token bonding curve are known to all participants in the XOR mar-

<sup>2</sup> <https://soramitsu.co.jp>

ket and are transparent, meaning that forward guidance on XOR liquidity and prices are possible using the buy-price and sell-price market data.

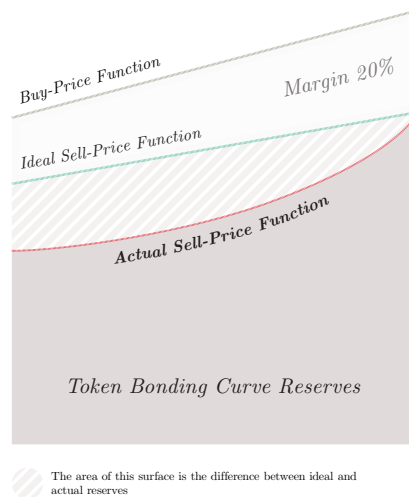


Fig. 1: The SORA token bonding curve as the primary market maker to buy and sell XOR.

Because the buy-price and sell-price functions of the token bonding curve mint and burn XOR, respectively, the XOR supply is elastic and able to scale either up or down to any sized economy, making it suited for adoption by countries of any size as legal tender as a money with stable and predictable purchasing power.

On a technical level, the XOR token bonding curve and the blockchain technology (Parity Substrate) used to validate transactions are much more computationally efficient than first-generation cryptocurrencies: transactions take an average of 3 seconds to complete and cost only a few cents, whereas transactions on Bitcoin can take upwards of 15 minutes to complete and cost several dollars. SORA has no mining and uses very little electricity, while Bitcoin uses more electricity than many countries to power their unnecessary and wasteful mining competition. The SORA network has been benchmarked with 100 million accounts transacting at a sustained throughput of 6,000 transactions per second, proving transactional capacity suitable for most countries. The decentralized cryptocurrency exchange, Polkaswap, launched on the SORA network in April 2021, has validated the efficiency and scalability of XOR under real mar-

ket conditions, with millions of successful transactions and no security issues to date.

The XOR economy is rationally governed by decentralized token voting on the SORA blockchain. Referendums among token holders to perform actions such as upgrading the network, distributing XOR from the treasury, or even minting and allocating TBCD (Token Bonding Curve Dollar), a token that is convertible to XOR and is used for funding productive initiatives, allowing the economy to adapt to the needs of XOR users, including governments that use XOR as a legal tender currency. Because governments can make proposals to fund productive initiatives, such as basic research or the creation of new goods or services, XOR acts as a domestic fiat currency would, but without costly interest payments or moral hazards involved in overly diluting their domestic currency. By not giving bureaucrats other peoples' money to spend, they are more likely to take care and work hard to prevent misallocation. With the XOR model, all expenditures result in the possible inflation of the XOR money supply, because TBCD can be used to mint XOR via the token bonding curve smart contract, which directly affects all XOR holders, including the bureaucrats, so it is no longer *other peoples' money*. This solves a significant structural moral hazard in contemporary monetary systems, where the decision makers do not have significant, personal "skin in the game," and often create and allocate money for buying votes via inefficient public works projects or other unproductive uses.

Using a XOR-based economy also precludes the need for taxation, as governments can be funded without taking money from their producers. This helps to reduce corruption, as governments that do this would not have sources of income other than from democratically allocated XOR tokens, as well as to provide a better incentive structure for producers. Governments traditionally tax only those who are productive, not taxing those who are burdens on society, which is the opposite of what should be done from a system dynamics perspective. By not taxing the productive classes, at least the incentive structure in society is not actively mis-aligned, as it is in most contemporary fiat currency systems.

Taken together, all these properties of XOR and the SORA economic system provide significant advantages to governments and their citizens, compared to contemporary economic systems. To further understand the benefits of using XOR as legal tender, next we will compare use of XOR to the legal tender status of Bitcoin in El Salvador.

## 4 Comparison to Bitcoin Legal Tender Status in El Salvador

Excitement over various advantages of using cryptocurrencies has led to widespread speculation and private adoption of cryptocurrencies, primarily as a store of value, but also as a unit of exchange: the total market capitalization of the two most popular cryptocurrencies, Bitcoin (BTC) and Ethereum (ETH), is over \$450 Billion USD; thousands of merchants accept them as payment; and ATMs

exist at which they can be bought using payment cards or cash<sup>3</sup>, or sold for cash. In many jurisdictions, cryptocurrencies are recognized as valid a means of payment.<sup>4</sup> It is even possible to purchase Bitcoin from Swiss Federal Railway ticket machines using cash and a valid Swiss phone number as KYC, and certain localities accept tax payments in selected cryptocurrencies, giving them quasi-legal tender status, such as the Cantons of Zug<sup>5</sup> and Lugano.<sup>6</sup>

El Salvador recently pushed the debate on the monetary function of cryptocurrencies forward by recognizing Bitcoin as a legal tender: as of September 7th, 2021, Bitcoin may be used to discharge debts, accepted as payment for goods and services, and used to pay taxes. The main objectives behind the El Salvadoran Bitcoin Law are to lower the cost of international remittances, provide access to the financial system for the unbanked, and reduce reliance on the USD, which El Salvador adopted as legal tender in 2001.<sup>7</sup>

On a technical level, the main mode of Bitcoin distribution in El Salvador is via a mobile application, Chivo Wallet, designed in cooperation between the government and one or more technology providers. Chivo wallet utilizes another blockchain called Algorand<sup>8</sup> to enable faster transactions than would be possible on the Bitcoin blockchain, which is notoriously slow and expensive to use. Users are also free to use other Bitcoin wallets as well. Cash-in/cash-out can be performed at government exchange agents or presumably at banks, as well as at a still-small, but growing, number of Bitcoin ATMs.

Some remarkable early successes have been announced by the chief proponent of the Bitcoin Law, President Nayib Bukele, primarily regarding popular uptake:

- As of the 3rd October 2021, three million El Salvadorans have used Chivo Wallet—nearly 50% of the population—in part driven by a sign-up bonus of \$30 USD in Bitcoin<sup>9</sup>
- More money has flowed into, than out of, Bitcoin ATMs<sup>10</sup>
- A partnership has been struck with multinational firms Puma Energy and Uno Terra to incentive Bitcoin uptake through discounts on fuel bought with the currency<sup>11</sup>

<sup>3</sup> <https://coinatmradar.com>

<sup>4</sup> <https://www.oecd.org/tax/tax-policy/taxing-virtual-currencies-an-overview-of-tax-treatments-and-emerging-tax-policy-issues.htm>

<sup>5</sup> <https://www.zg.ch/behoerden/finanzdirektion/steuerverwaltung/tax-payment-with-cryptocurrencies>

<sup>6</sup> <https://www.nasdaq.com/articles/lugano-switzerland-will-make-bitcoin-legal-tender>

<sup>7</sup> <https://www.pwc.com/gx/en/financial-services/pdf/el-salvadors-law-a-meaningful-test-for-bitcoin.pdf>

<sup>8</sup> <https://coingeek.com/shocker-bitcoin-in-el-salvador-is-fake/>

<sup>9</sup> <https://twitter.com/nayibbukele/status/1444775650292899840> (<https://twitter.com/nayibbukele/status/1444775650292899840>)

<sup>10</sup> <https://twitter.com/nayibbukele/status/1445923488083107845>

<sup>11</sup> <https://twitter.com/nayibbukele/status/1443410462129983490>

- Bitcoin wallet apps appear to have garnered better user reviews than many El Salvadoran banking apps<sup>12</sup>
- The governmental Bitcoin Trust, authorized in August 2021 with a balance of \$150 million USD, has accumulated a “surplus” of \$5 million, some of which will be used to build a veterinary hospital<sup>13</sup>

However, international organizations and economists based in the global North, such as the IMF and World Bank, have mostly voiced disapproval of the El Salvadoran Bitcoin Law<sup>14</sup>. These organizations are well known to have political affiliations that could conflict with any move away from dollarization, regardless of the efficacy of using cryptocurrencies to promote economic growth. Thus other Central and South American countries, are withholding judgment for the time being, and the Central American Bank for Economic Integration (CABEI) has committed to providing El Salvador with technical assistance. Dante Mossi, executive president of CABEI, indicates that while El Salvador’s move is experimental, it could instigate a snowball effect within the region if successful<sup>15</sup>.

Unfortunately, using Bitcoin as a legal tender in El Salvador severely limits the ability of their economy to grow. As shown in Section 2, to increase the goods and services at the same price level, more money should be put into circulation, to facilitate the creation of those goods and services. Bitcoin is a foreign currency to El Salvador because new Bitcoins cannot be minted to fund the production of goods and services, thus the government is at the mercy of foreign investors to inject Bitcoin into the El Salvadoran economy, in the same way that the USD also is a foreign currency that must originate from abroad. Thus instead of using newly created money to fund economic growth, the government has been buying Bitcoin as a speculative investment, or even worse, using limited energy resources to mine Bitcoin, which uses money and resources that could instead have gone into productive output for the economy.

Additionally, Bitcoin has limited long-term viability. The supply is supposedly limited to 21 million tokens, but with that limit, future miners will not be able to sustain sufficient mining activity to properly secure the Bitcoin network<sup>16</sup>. This will lead to either changing the Bitcoin protocol to have more than 21 million Bitcoins, changing the consensus away from Proof-of-Work, or the Bitcoin network will be easily exploited and not safe to use. Any of these options is going to severely damage the reputation and viability of Bitcoin and

<sup>12</sup> <https://www.kevinrooke.blog/el-salvador-and-bitcoin-two-weeks-in/>

<sup>13</sup> <https://www.reuters.com/business/finance/el-salvador-use-bitcoin-gains-fund-veterinary-hospital-president-says-2021-10-10/>

<sup>14</sup> <https://blogs.imf.org/2021/07/26/cryptoassets-as-national-currency-a-step-too-far/>

<sup>15</sup> <https://www.reuters.com/business/finance/remittance-costs-key-take-up-salvadoran-bitcoin-plan-development-bank-2021-08-24/>

<sup>16</sup> For reference, on December 29, 2022, \$340,000 were paid to miners in transaction fees, while \$14 million were paid to miners in newly minted Bitcoins. This shows the daily amount of value that miners need to secure the network, which must be paid for from the Bitcoin economy, in exchange for no productive output (no new goods or services that users can spend Bitcoins on).



thus Bitcoin cannot be considered safe or reliable in the long term and should not be the basis for any national economy.

XOR, on the other hand, does not have these downsides. XOR does not act as a foreign currency to a country, because a country such as El Salvador, could make proposals for injecting XOR into their economy to create new productive output. Instead of spending public funds to buy XOR, like El Salvador does with Bitcoin, the XOR ecosystem can give money to the government or to the producers of goods or services directly. This can unlock the full potential output of a country, because all factor inputs can be fully utilized, to the extent possible given the total factor productivity of the country. In simple terms, using XOR allows a country to utilize its factor inputs for production of new goods and services to their full potential, because the need for money is satisfied. Money is an artificial construct and can be created as needed, so long as it is created to facilitate production. Because XOR creation is done with the democratic oversight of token holders, with the aim to allocate XOR only for the creation of new goods and services, devaluation of XOR will not occur as the price level within the economy can stay stable.

Also, XOR exists on the SORA network which uses environmentally friendly and safe technology to gain consensus about transactions in the network, and there is no mining. Because of the lack of Proof-of-Work mining, SORA does not need to pay miners or waste the energy resources of a country. Instead, the SORA technology can quickly, cheaply, and efficiently process hundreds of millions of transactions per day.

## 5 Steps to Implement the SORA Economic System in a Country

The first step to take advantage of the benefits that use of XOR can offer a country is to pass legislation allowing XOR to be used as legal tender, meaning that it should be allowed for: 1) payment of debts, 2) payment for goods or services, and 3) payment for taxes and government services. Drafting the legislation is something we can help with, but there are two main options for the use of XOR: 1) to use XOR as the only currency allowed for transactions in the country, or 2) allow XOR to be used in parallel with other currencies, such as those already in use in the country. Whereas 1) can most quickly facilitate use of XOR in a country and could potentially reap the most economic benefits, the fastest, 2) allows multiple currencies (such as a domestic fiat currency along with XOR) to coexist and thus the market can choose the best currency for their needs. Option 2) is the model that El Salvador adopted when they passed their Bitcoin legislation.

Once the proper legislation is in place that allows XOR to be used to pay debts, pay for goods or services, and pay for taxes and government services, then rolling out localized wallet software for the populace is the next step. This can be done at low cost by using the open source SORA wallet, shown in Figure 2, and customizing it with the brand of the country, as well as any other idiosyncratic

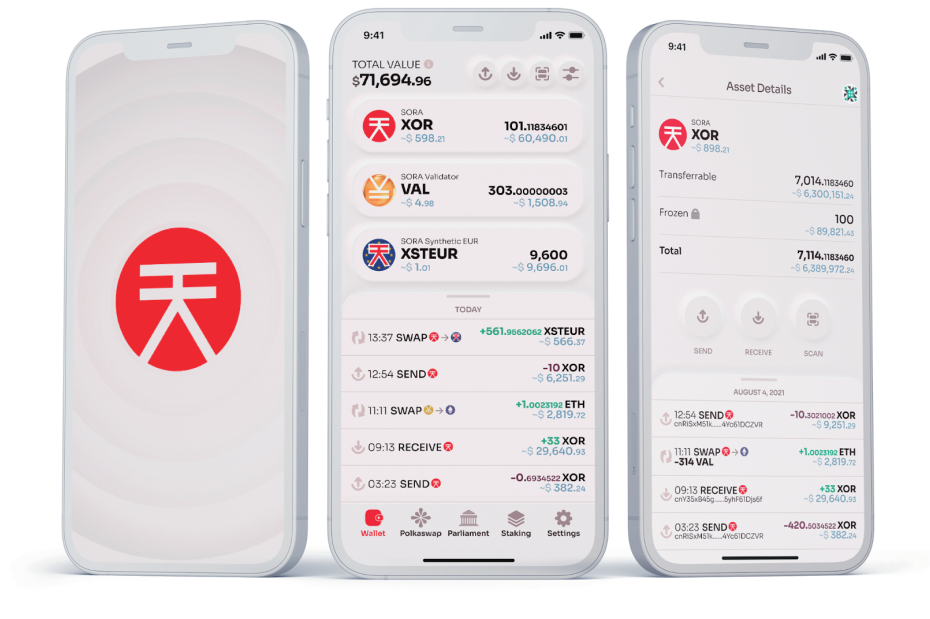


Fig. 2: The open source SORA mobile wallet.

needs that the country or its populace might have. This work can be funded through grants from the SORA ecosystem via the SORA Builders Programme<sup>17</sup>, which provides financing for the development of software and apps in the SORA ecosystem.

With the legislation and wallet software in place, the next step is for the government of a country adopting XOR to designate a person in charge of liaising with the SORA community. This person should be able to write proposals in English and communicate with the SORA ecosystem to make the proposals needed by the country to allocate XOR. Additionally, if the country has the resources, it is highly recommended to appoint a committee in charge of analyzing the economy, the quantity and quality of factor inputs for production, and determine where to deploy XOR to best increase the production of goods and services. This is something the SORA ecosystem can also help with setting up and building a process around with the government.

The key point is that very quickly and with no cost, any government in the world can adopt XOR as legal tender and start receiving the benefits of being a part of the SORA economy. If XOR is accepted as legal tender in parallel with other currencies, there is very little systemic risk to the economy as well, because market forces will be able to choose the most useful currencies to use.

<sup>17</sup> <https://medium.com/sora-xor/sora-builders-programme-979bea8831ed>

## 6 Conclusions

Creating money that is used to create new goods and services leads to economic growth without consumer price inflation. Money creation and allocation is the most important tool for providing for a prosperous society, able to fund the creation of new goods and services to push humanity forward.

Cryptocurrencies are a new form of money that holds the potential to make international trade more efficient, but legacy cryptocurrencies, like Bitcoin, have many disadvantages that limit their efficacy for facilitating economic growth. In particular, Bitcoin acts as a foreign currency to economies that use it, which limits the potential for economic growth because new money cannot be created for the production of new goods and services.

XOR is a new type of cryptocurrency without the technical or economic limitations of its predecessors. It can easily handle the transactional needs of hundreds of millions of users. By adopting XOR as a legal tender in a country, the country can take advantage of more efficient international trade, while also being able to receive and allocate XOR for the productive creation of goods and services, which leads to economic growth and a more prosperous lifestyle for their citizens. A XOR-based economy in a country that has a government which actively makes proposals to allocate XOR for productive uses, is not limited by capital to create output using their factor inputs. Such a country can reach its full potential, while joining a supranational economic system, which allows more open and uninhibited trade, without the need for selling national assets to foreigners via foreign direct investment.

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