JXN as a utility token: a cost-benefit analysis

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1 Introduction

Overall, a technology is useful whenever it removes friction while trading. This applies to the cryptocurrency sector too.

As we have already stated, one of the goals of having two tokens in the network is to decouple the transactional motives from the investment motives. How? Simply by having two different reward mechanisms. So, if `JAX` is understood as a means of payment, what is the purpose of the JAXNET token (`JXN` hereafter)?

We posit that `JXN` is both a cryptocurrency and a utility token. Our token valuation paper (Leger 2021) already details a pricing model to estimate the value of `JXN` when accounting for the EA registry. If it also outlines some of the issues with the EA registry from an economic perspective, it doesn't go into the details.

This note has two main purposes: i) to demonstrate that `JXN` is a utility token and it can bring extra value to its holders, ii) to describe the probable attacks that an EA can conduct and some strategies to avoid them.

Regarding the latter point, we need to clarify immediately that miners hold the power to design the strategy they see fit to whitelist their own EA and make them recognized by other miners. The paper just shows some different strategies that miners are free to disregard, amend, or adopt. Overall, they are the ones who have authority over the network, no one else.

2 Understanding `JXN` supply at the Genesis block

The following section details the dynamic of the premine supply of `JXN` at the MainNet launch. This is important because monetary mass and velocity are key parameters in the analysis in the following sections, since both affect the token value and agents' behaviors.

`JXN` supply at the genesis block is 36 million. Even though the network has no limited supply, the creation of `JXN` coins is very slow.

To give some perspective to the reader, let's compare `JXN` supply with Ethereum 1.0, since it has no limited supply either and works as a Proof-of-Work network. As of the end of August 2021, there are 117,316,389.69 ETH in circulation. With the 36 million premine, a maximum of 72 million `JXN` can be created over the next 5 years after the MainNet launch, assuming no `JXN` coins are burnt (we'll come back to that later). The reward is fixed at 20 coins per block after 5 years. Every year, a maximum of 1,051,200 coins. In these conditions, it will take the network approximately 40.5 years to reach the current supply of ETH.

As of October 12, 2021, we conducted 5 burning ceremonies over the course of the public sale, removing 2.5 mil tokens from the OpEx wallet out of circulation. This implies a

$\left(\frac{2.5}{40}\right) = 6.25\%$ cut from the Team and Ecosystem growth wallets. Hence, the new premine should be $36,670,676$ tokens. However, due to some delays in launching the MainNet, and in order to take into account price movements and a burning ceremony that should have taken place on October 13, 2021, we burnt $670,676$ tokens and rounded the premine up to just 36 mil. Thus, we burnt extra $670,676$ from the Ecosystem growth, OpEx and Team wallets. We also move $150,000$ tokens from the Team and Ecosystem wallets to the advisor pool ($94,500$ and $55,500$ tokens respectively), so as to keep the Team proportion to 9.45% of the total premine, as well as to help us onboard more advisors in the future. These numbers are final, as they are integrated into the genesis block. This means that no more burning ceremonies will take place. The new premine is as follow:

Table 1: Premine and token distribution

Token distribution	**# of `JXN` coins**	**% of `JXN` coins**
Team	3,402,000	9.45%
Advisors	350,000	0.97%
Private pre-sale	868,484	2.41%
Strategic Investors	2,000,000	5.56%
OpEx wallet	13,000,000	36.11%
Liquidity Pool	2,000,000	5.56%
LT Ecosystem growth	8,749,645	24.30%
Pre-seed & seed Investors	5,629,870	15.64%
TOTAL premine	36,000,000	100%

Over the next 5 years, in order to incentivize miners to secure the network, a maximum of 40 mil `JXN` coins can be minted. At early stages, the block reward is set at 340. If miners decide to mine `JAX` coins, they will receive 320 `JXN` coins locked over $36,000\ blocks + X$ `JAX` coins proportionally to their hashrate. Alternatively, if they only choose JXN, then they will get 320 `JXN` locked over $36,000\ blocks + 20$`JXN` immediately. This should incentivize miners to print `JAX`, hence bringing enough liquidity to the market, regardless of the opportunity cost of minting $BTC +$ `JXN`. In total, a maximum of $5,256,000$ `JXN` tokens out of 40 mil can be burnt, provided miners always choose to mine `JAX` coins. This means that early investors get 50% dilution, helping reduce their weight and influence of the coin price.

Therefore, over the next 5 years, the circulating supply of JXN should be in between $70,744,000$ and $76,000,000$ coins. Then the supply will grow at a steady state of $1,051,200$ JXN per year, provided 0 JXN is burnt to create JAX. This is a maximum and we expect this number to be much lower. So, it will take a minimum of 44 years for the network to reach the current supply of ETH. And it will take approximately 2 years for the network to reach the Litecoin circulating supply. However, one should note that the rate of issuance of JXN goes down very quickly and growth is very limited.

But assuming that no JXN is ever burnt over the course of 5 years – or even less – is very conservative, because without JAX coins, the network does not scale and is, therefore, of no use.

Let's now assume that on average between 10 and 75% of JXN are burnt overtime to create JAX coins. That means that with the 36 million premine, one needs between 10 and 75% more time (or from 3.7 to 27 years) to reach the level of the current supply of ETH.

How could the supply be so dynamic? This is due to the incentive mechanism we designed to ensure that the supply of JAX is always bounded by miners' profit maximization (Manoharan, Leger, and Shyshatskyi 2021).

3 Utility token, utility price, & the "ICO paradox"

Let us first define what a utility token is. The Merriam-Webster dictionary defines it as: "a digital token of cryptocurrency that is issued in order to fund development of the cryptocurrency and that can be later used to purchase a good or service offered by the issuer of the cryptocurrency." However, this definition is not really satisfying, since it conflates the token value at time t_0 both with the success of the fundraise and its future usage on the platform. Using this definition means that one should be able to calculate the net present value of a utility token by discounting its future cash flow. A method well used in corporate finance, which entails no difference between a token and any other asset. Certainly, a Google share does not allow you to buy its services, and this is precisely where the utility token comes into play. Therefore, this common definition should be refined and more focused on the platform usage rather than its ability to raise money based on future use cases.

In economic theory, utility is used to model consumers' preferences over a set of goods or services, and therefore it helps to maximize the "value" of different outcomes. The concept is also used in finance to determine the benefits one can expect from their asset's performance. Now that utility is better understood, we can proceed and give a more precise definition of the concept of a utility token.

Such a token, as per our definition, allows its users to assess in numeraire productivity and performance of the goods and services offered by a blockchain-based platform. This definition is derived from the work of (Cong, Li, and Wang 2021), where "the equilibrium value of tokens is determined by aggregating heterogeneous users' transactional demand rather than discounting cash flows". Hence, the transactional utility makes up a fair share of the token price, as we can see in our token valuation report (Leger 2021).

Another point in mind is that the utility value and the investment motives may seem to be conflicting at first. The investment is rather helpful for increasing user adoption in the early stage, as early buyers will take the risks upon themselves with some expected returns in mind. To put it simply, early adopters are more prone to be risk lovers early on. Thus, we can reconcile the investment motive, which is a short-term one, and the future utility that is determined by long-term features development and productivity. One can expect lower speculation once the coin is well adopted and market liquidity is high.

Having two coins on the same network prevents the ICO paradox from taking place. This paradox is ultimately an informational paradox (Holden and Malani 2019), such as the future value of `JXN` as utility tokens cannot be maximized. The paradox goes as follow:

> *"The basic empirical relationship that drives the ICO paradox: attempts to reduce miner compensation under either PoW or PoS increase transaction velocity on a blockchain ledger, i.e., the number of transactions that the digital ledger can record in a given interval of time. This relationship is easy to explain for PoW. Because harder computational puzzles require more computing power and thus electricity to solve, they also require greater compensation for miners. Because more difficult puzzles also require more time to solve, all else held constant, there is a positive correlation between the time required to validate and record a transaction and the required compensation for miners. Because greater validation time implies that fewer transactions can be recorded in a given interval of time, there exists a negative relationship between the velocity of transactions and miner compensation."*

By following the same model as Bitcoin for rewarding miners with a fixed coinbase within a 10 minutes average block time. Then, EA agents will actually compete for block space to advertise their fee and increase both the value and the security of the network at the same time.

Now that we have a clearer definition of a utility token, we can delve into its utility price. The definition is straightforward[1]:

$$\textit{Utility price} = \frac{\text{Market cap}}{\text{\# of circulating tokens}} \tag{3.1}$$

From this ratio and relying on the quantitative theory of money, it is easy to understand that the utility price is greatly impacted by the velocity. The higher the velocity, the

[1] As in: https://hackernoon.com/token-velocity-what-it-is-and-why-you-should-care-56ab2592b8c4

lower the expected price. This is particularly true if "the elasticity of the revenue effect is smaller than the elasticity of the latter velocity effect, then, paradoxically, improving the efficiency of the utility token will decrease token price even as it increases trades on the platform." (Prat, Danos, and Marcassa 2019)

We have added staking functions for both `JAX` and `JXN` coins, which will help reduce the velocity and, hence, increase the price of these tokens. Also, as we mentioned above, decoupling the functions of the coins and their respective rewards on the chain will also limit the price depreciation.

One other important parameter from the quote above is the concept of elasticity, but not limited to revenue elasticity. For instance, Bitcoin supply is rather inelastic. Regardless of its price, supply will always be bounded at 21 million. This is not the same for `JXN` coins as supply is not limited like on Bitcoin. However, a low growth rate of its supply can be enough to trigger an upward price movement in the long run, as long as demand is increasing faster than supply. The demand elasticity of the `JXN` coin will also be affected by its intrinsic utility. This latter point is directly related to what `JXN` coins are mainly used for on the beacon chain.

Let's investigate another type of transactions on the beacon chain. We argue that the beacon chain will be used for EA registrations and EA listings updates. However, these transactions are mostly one way, as once a transaction is paid, there is no necessity for the counterparty to use these coins right away.

To whom EAs pay the registration fees? Mining pools come as the first main intermediary for whitelisting EAs, although there is a bit of a twist since, at first glance, there are incentives to not block EAs of other mining pools[2]. The user has the interest to choose any EA who is active on the beacon chain, i.e. updating his/her liquidity and fees regularly. While miners will increase the security of the network by validating and confirming EA beacon chain transactions, the EA will use this space to trigger the true utility of our decentralized network, which is to transfer value at low fees.

4 The multiple purposes of `JXN` on Jax.Network

As ETH is the gas that helps running smart contracts on the blockchain, as well as the cryptocurrency that secures the network from 51% attacks, `JXN` serves also as a utility token. We can also argue that `JXN` is a store of value, which implies speculative movements. As a matter of fact, `JAX` is the coin on our network, while `JXN` is both a coin and a token, whose price reflects the value of the entire network as well as the utility of the token itself. This peculiarity revamps entirely the current understanding of tokens and coins,

[2]Part of the answer is that including transactions in the next block is a statistical game, which miners can only win by increasing their computing power. Thus, giving them incentives to have as many trustworthy EAs whitelisted as possible, in order to increase the number of transactions, and hence their revenues. We will come back to these questions below.

thus, their expected value. This holds especially true when comparing `JXN` to BTC. Indeed, as per common definition, a coin has its own blockchain and limited use, while tokens can follow a standardized template to be created.

It is understood that the more the shards are used to process blockchain-based transactions of value, the higher the price of `JXN`. The two are correlated despite their different reward mechanisms. In fact, `JXN` can't hold any value as long as shards are not used, since it's the core of our value proposition. Also, `JXN` tokens are used to register EA listings, these are the backbone of our scalability solution because they will allow the transfer of liquidity between shards, facilitating cross-shard transfers in a decentralized manner.

The backbone of the value proposition of the JaxNet protocol is to provide a scalable solution with a less volatile transactional cryptocurrency, which is underwritten by electricity spent to produce one coin. In order to achieve this, the network relies on shards, or more precisely, parallel chains, that can be created on demand according to network parameters.

Now few remarks need to be added regarding the peculiarity of the beacon chain that issues `JXN` coins. Firstly, as far as `JXN` coins are concerned, if the beacon chain is a store of value, then it should be considered as a sort of a savings account for the whole network. As such, it is understandable that the utility of `JXN` coins is inversely related to the rate of inflation in shard chains (in Fisher's sense). Indeed, inflation on shards will incentivize users to increase their holdings in `JXN` coins to avoid purchasing power losses, up to the limit that `JXN` holders will swap their coins for `JAX` coins.

Secondly, utility is also driven by network effects. We focus here exclusively on one side of the demand for using the platform, users, assuming that the other side, miners or merchants, is already onboard. In this context, more users joining the shards will increase the overall network value, and their choice of whether to join the platform is influenced by other users joining. Overall, a higher number of users will facilitate the increase in value when network effects start kicking in.

Thirdly, `JXN` is central to ensure the proper security of the entire network. Indeed, miners, by merge-mining the Bitcoin network, will allocate their hash power to Jax.Network as well. By doing so, miners, whether they mint `JAX` or `JXN`, will increase the total security. `JXN`, therefore, embeds how much computing power miners are willing to spend to defend the network.

Finally, the beacon chain token has many purposes beyond being just another digital store of value, and it can be argued that its value should grow over time. The beacon chain is a utility token, which can be used, in no particular order of importance:

i) for DAO registrations;

ii) for exchange agent registrations;

iii) for Layer-2 dApp registrations;

iv) for fraud proof etc.;

v) for collateral custodians for Layer-2 governance DAC;

vi) to pay for the security of Jax.Network by incentivizing Bitcoin miners to merge-mine Jax.Network;

vii) as gas fees for exchange agent (EA) listing transactions and other critical transactions;

viii) to incentivize miners to defend the beacon chain that holds the shard registry;

ix) to incentivize miners to defend the Bitcoin network when the BTC reward drops to 0;

x) to reflect the value of the transactional payments ecosystem of Jax.Network;

xi) if the shards have a transactional value that is also reflected in the price of JXN, then some network effects have to be considered as well, i.e. transactional volumes of stablecoins;

xii) as an entry point for the DeFi ecosystem on Bitcoin. Together with Stacks, JAX can be used as the go-to decentralized stablecoin for DeFi.

5 Misbehaviors of EAs

Exchange agents (EAs) are the liquidity providers for cross-shard transactions. They are at the heart of our scaling solution, and work like a DEX for liquidity provisions and smooth decentralized payments. We need to dedicate at least a few paragraphs to this core functionality of the JaxNet protocol and detail how the incentives play out. In order to provide smooth cross-shard transactions, since the shards are independent from each other, the network has a set of intermediaries, who can become the nodes and provide enough liquidity across all shards.

How does it work? Each EA needs to register on the beacon chain and advertise his/her fee. For instance, EA 15 has $10,000$ `JAX` coins on shard 30. She agrees that these coins can be swapped with any other shards in exchange for a fee retributed in `JAX`. This amount of liquidity and fee are registered on a listing registry available through the beacon chain. Each time this registry is changed, he/she needs to update it and pay a transaction fee on the beacon chain in `JXN` again. So, the fees collected on shards must be higher than the fees paid on the beacon chain for the EA to make a profit.

More formally, an EA has an incentive to register if:

$$\sum_{i=1}^{S} \beta >= \sum_{i=1}^{B} \alpha \tag{5.1}$$

With β being the amount of fees collected by the EA across all S. And α, being the fees paid by the EA in JXN on the beacon chain B to maintain an up-to-date listing registry.

What are the events which can trigger an update of the listing registry of this EA in our example?

i) A part of $10,000$ JAX was swapped with another shard and the EA needs to update the liquidity available;

ii) No swaps occurred for some time, so the EA needs to adjust his/her requested fees to reflect the market rate;

iii) The EA needs to keep signaling he/she is online in order to increase the success rate of the swap. Indeed, in the third case, due to the limited number of queries users can do on the blockchain, they have an incentive only to ping EAs who are online.

Two questions come to mind. Firstly, at what point can we estimate network congestion? Secondly, can a malicious liquidity provider advertise fake rates and affect the cross-shard mechanism due to information asymmetries?

Regarding the first question, assuming that one query into the listing registry takes 10 milliseconds, the user can ping 100 nodes within 10 seconds and $60,000$ within 10 minutes. Now let's assume that $100k$ DEXs are registered on the beacon chain, this means that only 60% of the listing registry can be queried within one block time frame. In other words, not all EA listings can be queried and compared in order to be able to do a cross-shard transaction under 10 minutes, and even less if the user wants the cross-shard transaction to be processed more quickly.

The congestion issue brings about negative externalities, because it will increase search costs for the user and lower transaction time. By limiting the number of EAs the user can access within one JXN block time, we can provide a viable solution, provided EAs are randomly picked and limited to one block. However, there is a technical issue that can prevent this solution from working effectively. Indeed, the EAs are queuing to get their transaction confirmed and validated by miners. The higher the fee they set, the higher the probability for EAs to see their transactions getting through. But this gives some room for the malicious EA to cheat.

This queuing problem is technically unavoidable since it relates directly to the blockchain structure itself, where miners can decide whether or not to include a specific transaction into the next block. There is no priority given to the transaction (Aune et al. 2018) like in any normal queuing system based on standard "first-come, first-served" service delivery. Miners usually just pick transactions that advertise the highest fee. Therefore, it all comes down to the level of decentralization of the network for such issues to be less statistically probable.

Then, the user will parametrize the queries, when using the decentralized EA, to optimize his chance to get the best rate. One way to do it is to select only an online EA, because this means their DEXs are updated regularly as well as their rate. In this setting, there are much more listing registrations than queries. It means users have competitive fees for cross-shard transactions.

The latter is an indication of the incentives for an EA to flood the market with a fake registry and derail the cross-shard transaction mechanism, which brings us to the second issue related to the information asymmetry on decentralized networks. In our case, an attacker can also conduct a "Sybil attack" with the objective to short the market and make a quick profit. The attack goes as follows: the malicious EA agent will create a lot of listing registries without having the necessary liquidity that he/she promises. There is clearly an asymmetric information between the EA and the user that can lead to a "market for lemons" (Akerlof 1970), that would drive honest EAs out of the market, bringing the whole platform to a standstill since no cross-shard transactions would be processed.

The user knows the EA is honest with probability q and a cheater with probability $1 - q$. The user will know for sure that the EA is dishonest only after the transaction is agreed upon. Before that, he/she can only estimate the level of honesty and this probability is not accurate. Thus, an asymmetry of information exists between the EA and the user, potentially driving the honest EA out of the market.

However, this will be proven costly since the attacker will need to regularly update his own listing in order to keep up with the competition. He/she will, therefore, incur a cost without making any profits since the left-hand side of the equation (5.1) will go down to zero. Besides all this, in order to conduct this "Sybil attack", one needs to assume that the attacker is shorting his/her `JXN` position. As we mentioned, the utility of the EA will partly reflect the price of `JXN`. Hence, paying the fees in `JXN` to keep the fake registry needs to be compensated by a higher expected profit.

The effectiveness of the attack will depend on the congestion rate of the beacon coin, the total number of EAs on the network, and the level of transaction fees. Indeed, if the beacon chain is rather free, it will put the attacker in a risky position since other liquidity providers can register their offers to compete with him. Conversely, a highly congested network would prove difficult to manipulate due to the number of competitive EAs maintaining their registry for a profit. In that case, `JXN` transaction fees will also be higher. Finally, this attack can only be a short-term one since the attacker is shorting the market, but not looking to destroy the network from within.

6 "Lawlessness" and decentralized networks: incentive mechanisms for reliable EAs

The main difficulty is that only hardcoded rules can bring order and optimal decisions, while usually people resort to third-party institutions to prevent misbehaviors. One can size the difficulty of the task when achieving an optimal rule-based decision process to a decentralized network. To narrow down the topic and stay relevant, one needs to understand whether JXN, under the definition of a utility token, can bring more value to the participants, as opposed to using another decentralized network. In our case, everything has to be done outside contract law and only can be enforceable on-chain.

An interesting stream of economics known as law and economics and particularly lawlessness of economics (Dixit 2011), can be applied in blockchain to study rational behaviors, when governments are unable to enforce property rights. Another stream of research is mechanism design. We do not intend here to develop a full model since we leave it to miners on how to organize their incentive mechanisms in the best way. We intend here to give some insights to the reader on how it can be achieved with economics.

A utility token has greater ramifications in a decentralized network, since it implies economic governance or arrangements to organize a specific community in a trustless and decentralized fashion. One needs to foster "mutuality of advantage from voluntary exchange" (Buchanan 1991). However, one cannot resort to the law, as of today, transactions on a blockchain-based network are not legally binding. So, how to achieve workable arrangements to organize a decentralized community, so as to achieve an optimal exchange? This sole note will obviously not cover the whole topic of economics governance in a decentralized community. This is surely out of the scope of this small contribution. However, using this particular framework to better understand the inner workings of JXN as a utility token can bring some benefits and clarity.

In medieval times, private judges were keeping records on cheaters (Milgrom, North, and Weingast* 1990). One peculiarity of the fairs is that cheaters would never go twice to the same fair, just like a malicious EA would not reuse the same public key twice, rendering difficult to track misbehavior. But the converse is also true, an EA using multiple keys may have some incentives to cheat. Thus, an EA always using the same keys can be whitelisted and pinged more easily in order to create some reputation filters on a decentralized network.

The main focus is to deter potential future cheating or manipulation that would prevent a cross-shard transaction from operating smoothly. One understands that it is very costly for any user to collect past cheating behavior of EAs before transacting. Also, past cheating may have already had negative externalities resulting in users leaving the platform in the current time period.

Another hurdle is that our platform has no influence over prices and quantities (level of liquidity advertised) registered by each EA. The level of control in this context is, thus, much lower than in regular digital platforms. Nonetheless, the platform has the responsibility of ensuring that cheating behavior is deterred. Amazon marketplace is actually the closest example. An EA sets the price and quantities are determined by market optimal equilibrium. Our goal is to define an information structure so as to minimize the costs of implementation on our blockchain.

On a public network, many actions cannot be done to mitigate dishonest behavior:

i) Revoke the node or the address;

ii) Create red flags;

iii) Ban an EA;

iv) Create a reputation system linked to a specific ID.

In some ways, an EA needs to advertise that he/she is honest and trustworthy. Can a viable solution emerge from the market itself?

7 Solutions

From the short analysis above, we can draw the following preliminary conclusions. Certainly, further investigation needs to be conducted and formal analysis set up in order to adjust hardcoded rules. We leave this setting to mining pools, as they have the best knowledge and interest to grow the token value. Further, we showed that they have the power to deter misbehaviors of EAs.

What can we infer from the above analysis?

We have the following positive sides in the current setting:

i) Improved security, as `JXN` moves towards a utility token model with low velocity;

ii) EA registry working as a toll to update the registry through the beacon chain;

iii) Staking, which will lock tokens and remove them out of circulation;

iv) Issuing tokens to finance the ecosystem growth;

v) Burning and supply reduction (we argue that we don't really burn tokens in our network. It is rather a transfer of value between different tokens that bear different usages or services that require an entry cost for security reasons).

Drawbacks of using `JXN`:

i) Potential high switching costs (Athey et al. 2017);

ii) Revenue model: not a fee per unit of trade like large platforms (i.e. Google), but rather selling a utility token and hoarding it in our company reserves;

iii) Higher velocity for EA registry will affect miners' compensation;

iv) Information asymmetry risks: the update of EA registry will help filter better and more reliable information;

v) Non-conventional platform economics due to decentralization;

vi) Low fixed costs of mining can move miners away from `JXN` tokens at early stages (Garratt and Oordt 2020). This is why the coinbase reward is set higher.

We propose here a potential solution to correct the drawbacks listed above. The EA registration process can work as a toll fee to avoid misbehavior, where full disclosure always gives an advantage to honest EAs and penalizes dishonest ones.

As the true liquidity of EAs is impossible to verify, one needs to introduce a proxy to assess the trustworthiness of the EA, some sort of decentralized reputation system. Make the EA pay for being able to deliver this service and query according to their reputation which is based on transaction fees paid.

This way the EA needs to constantly update his/her liquidity information on the beacon chain and users simply choose an EA from the latest set of EAs who have frequently updated their liquidity information on the beacon chain.

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