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Aggregation and Analysis of Blockchain-Based Stellar Financial Exchange Network

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Abstract— **One of the most important issues that researchers in various fields such as computers and economics need today is the data of cryptocurrency transfers along with traditional currencies, in a way to be able to evaluate the growth rate of cryptocurrencies or the impact of various rules and issues of blockchain networks on these new currencies as well as traditional currencies together. In this article, we are going to present a new data set created by a financial exchange market called Stellar and based on blockchain technology, as well as a place to exchange cryptocurrencies as well as traditional currencies. One of the main features of this data set is the placement of traditional currency exchanges and cryptocurrencies next to each other and the preparation of financial exchanges on the basis of the blockchain system.**

Keywords— cryptocurrency; Distributed Exchange Market Dataset; Cryptocurrencies Dataset

I. INTRODUCTION

With the increasing development of cryptocurrencies and their efficiency in financial exchanges, issues such as structural analysis of blockchain networks, stabilization of conversion rate exchange and also understanding the behavior of users of these networks have already become important. On the other hand, the new generation of financial exchanges, which are based on digital exchanges, have also created a revolution in financial transactions with the advent of cryptocurrencies, which has caused a new wave of changes in economic markets and its prospects. With the today's increasing demands, scientists and economic analysts need to first access real-world financial exchange data, and ensure that the information is accurate. The blockchain-based Stellar Financial Exchange Network allows researchers to provide accurate data on financial transactions, in addition to traditional currency exchanges and cryptocurrencies in a way that we do not need a third party to approve the exchanges.

Blockchain networks have created markets in which financial exchanges do not need a third party to verify and review asset transfers by making extensive changes to the financial transfer system.

To describe the importance of economic data, we can point out that by using this data, economic analysts, portfolio managers of capital markets and also the government men can understand the process of changes in an economic market, the impact of laws on that market, the process of economic growth in a market along with the society, as well as price predictions of exchange rates.

One of the most important of this information is financial exchange information in a capital market, which is a very suitable platform for analyzing user behavior and general policies of that market.

II. RELATED WORKS

In [1], the datasets created by the popular Bitcoin and Ethereum cryptocurrencies are introduced as large datasets which are applicable in areas such as fraud detection, illegal transactions, and economic critical point detection and other important areas. This book also provides a basic description of the various features that can be obtained from the dataset of a cryptocurrency or the general structure of this type of data.

In [2], it has also been pointed out that blockchains have great potential for use in finance, gaming, financial transfers and asset chains, but one of the serious challenges in this area is the behavioral analysis of these networks users and their categorization based on their behavior. Here, the authors evaluate this data with the transactional sequences of Bitcoin network which are obtained from the general history of this network and also by using their proposed method, which is a method of behavioral analysis.

In [3], they have also collected data sets from the Chinese future market and analyzed the behavior of this market users by using clustering methods.

In this data set, due to the nature of this market, there is only one asset on each side of every financial transaction, which can be considered as one of the items that have not been considered in this article. Because in the new generation of economic markets, which are formed by the structure of blockchain networks, in financial exchanges different assets are exchanged between different users.

For example, in a dataset collected from the Stellar network, a transaction may be exchanged between two users of Ether and Bitcoin cryptocurrencies, but at the same time, two other cryptocurrencies can be exchanged between two users, such as Ripple and Tether.

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In [4], also, by collecting important data, they have analyzed and examined important cryptocurrencies such as Bitcoin, Ether, Litecoin and Ripple, which have the largest amount of capital in the cryptocurrency market. In fact, in this article, they have collected data related to the exchange of different cryptocurrencies from the Binance market and have tried to understand the effects of the rules applied on the price of cryptocurrencies, which the major of them are the rules applied in late 2017 and in early 2018. In this research, by recognizing the transaction pattern of these important cryptocurrencies, they try to understand these markets better.

In [5] is one of the researches in the field of economics and especially in the field of digital cryptocurrencies.In this article, by using Bitcoin network data, we have tried to simulate a Bitcoin exchange market, in which there are two factors. One factor is that it chooses its sales strategy based on neural networks and the other factor is that it uses a random strategy.

The modeling performed in this paper uses a multi-factor method which is used to analyze complex systems in which different factors affect, such as complex economic systems.

Considering that the research done in this article is one of the first multi-factor simulations in the field of digital cryptocurrencies, however, due to the huge growth in the number of cryptocurrencies in the current situation, at first, it is necessary for the simulated data to be more diverse. This means that the agents must have the ability to exchange more assets and, secondly, the number of agents in this simulation increases.

III. DATASET

The data set we have collected in this article includes transactions and financial exchanges between Stellar network users[6]. Using blockchain technology, this network creates a new generation of distributed exchange markets, so that the users of this network can exchange money with each other without the need for a third party.

The time period of the collected data is from 12/01/2018 to 12/30/2019, in which 1650718 purchase or sale operations have been created. Of this total, 1165274 operations were new purchase request operations and 891449 operations are for editing or removing previous requests. All these operations are collected in 6680451 ledgers. In total, 16338 users of this data set have performed asset exchange operations, so that 466 assets have been put up for sale and 444 assets have been purchased.

Operations in the Stellar Network: Operations in the Stellar Network are grouped in the form of transactions so that each transaction can include several operations (operations such as changing a user account, registering an offer to purchase or sell an asset, editing or deleting one Offer and money transfer between users).

Ledgers: Ledgers (21) have the role of storing transactions in the Stellar network, so that in each ledger can be placed several

transactions, so that each transaction also includes several operations.

It has been mentioned before that the dataset obtained in this article is from a set of financial exchanges in the Stellar network.

According to the structure of Stellar network transactions, the data of the sale and purchase of assets are divided into two general modes:

- Offer to purchase an asset
- Offer to sell an asset

Based on the description provided by [6], any offer to buy or sell by a market agent can be generally converted into a buy or sell offer, if a person intends to buy Bitcoin (BTC) and in exchange offers Ethereum (ETH), it can be seen that the person has registered a request to sell Ethereum (ETH) in the network.

Similarly, if the same person intends to sell Bitcoin (BTC) again, while in return he intends to buy Ethereum (ETH), this time he can be considered as an Ethereum (ETH) seller. According to this description, in general, all requests made in the Stellar network are seen as a sales request.

A. Description of data fields

In this section, we describe the data fields of each proposal in the Stellar network.

- **Source_account**: This feature indicates the ID of the person who created the offer within the network.
- **Offer_id:** If this feature is equal to zero, it means that this offer has just been created by the user and is included in the sales list (22).
- **Created_at:** Indicates the time of the creation of this proposal.
- **Ledger_id:** Indicates the ID of the ledger in which this offer is placed.
- **Transaction_hash:** As mentioned, each offer in the Stellar network is placed in a transaction where each transaction is a sum of several operations, in this field the transaction hash value (23) in which this operation belongs to is placed.
- **Selling_asset_type:** Indicates the type of asset that the bidder intends to sell. If its value is equal to the native value (24) within the Stellar network, the next two fields have no value.
- **Selling_asset_code:** The code of the asset to be sold.
- **Selling_asset_issuer:** Is the identity of the person who created this asset on the network. Due to the structure of the Stellar network, any asset can be created by a user and transferred through the anchor (25) that exist in the network. In other words, the anchors have the role of confirming the transfers in the network.

- **Amount:** Indicates the amount of the asset that the bidder provides for sale.
- **Price_r {n,d}:** This property consists of two values, n and d, and is the value of the asset being sold versus the asset being purchased. For example, if a person wants to sell 1 Bitcoin (BTC) for 100 Ethereum (ETH), the value of this feature is {1,100}.
- **Price:** This field is created by multiplying two n properties in the price_r field by the amount field.
- **Buying_asset_type:** Indicates the type of the asset that the bidder intends to receive in return for the asset he is selling. If the value is equal to the native asset within the Stellar network, the next two fields have no value.
- **Selling_asset_code:** The code of the asset to be sold.
- **Buying_asset_code:** The asset code that the bidder wants to receive.
- **Buying_asset_issue:** It is the ID of the person who created this asset on the network and is used by the bidder.

The data used in this paper are collected by Application Programming Interface (API) (26) provided by Horizon Stellar servers.
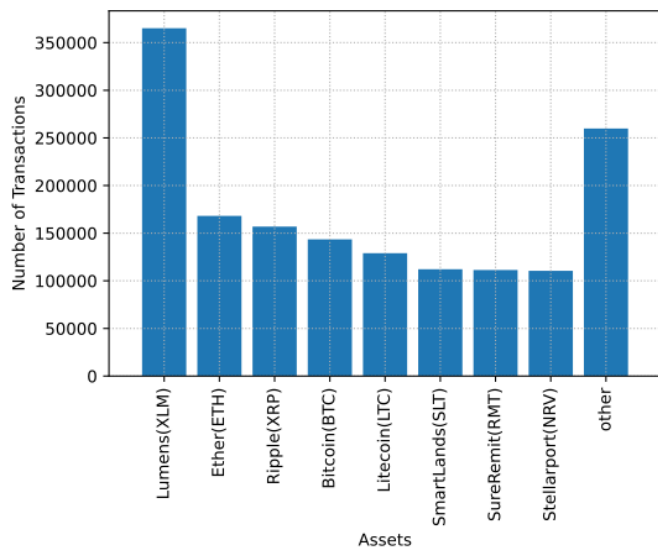

Fig.1 Number of transactions based on the assets that are in the sales section

Fig. 1 shows the number of asset transactions that are in the sales section, and Fig. 2 shows the number of asset transactions that are in the purchase section.

Fig. 1 and Fig. 2 show that in the Stellar network, the largest volume of financial transactions is related to the native assets of the Stellar network, Ethereum (ETH) and Bitcoin (BTC), respectively. In Fig. 1 the vertical axis represents the number of operations in which each asset is in the sales section of

operations, and in Fig. 2, the vertical axis indicates the number of operations in which each asset is in the purchase section.

In similar articles that have worked on the economic data of similar markets, the markets have been structured in such a way that they pay only one type of the various assets that each user buys, in other words, in each financial transaction. On the one hand, it is the exchange of a specific and unique asset, while in the Stellar exchange market, they offer different assets in exchange for the different assets that users buy. For example, a person who intends to buy Bitcoin (BTC), can offer US dollars for it, while another person can offer a similar offer at the same time, except that the asset provided by this person instead of US dollars is Ripple cryptocurrency.
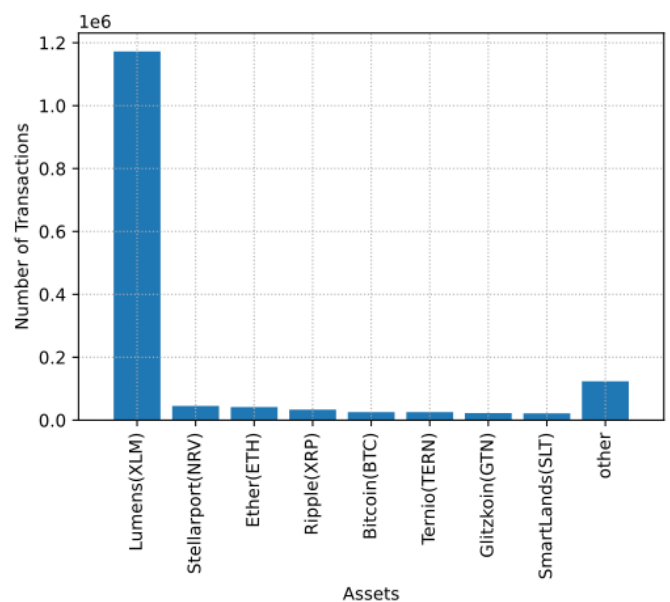

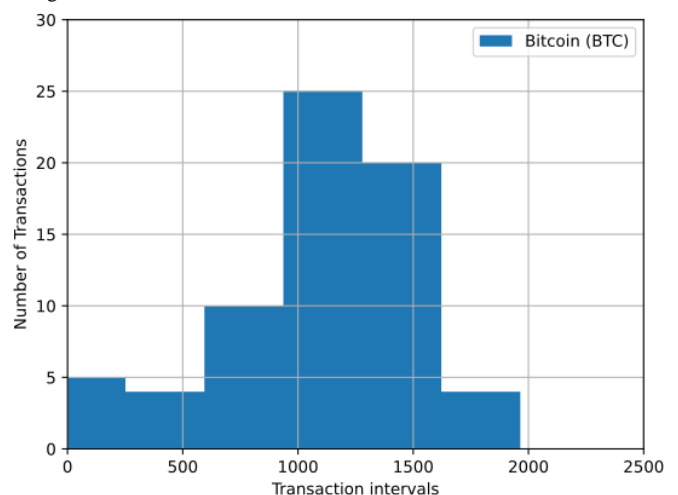Fig. 2. Number of Transactions Based on Assets in the Purchase Section

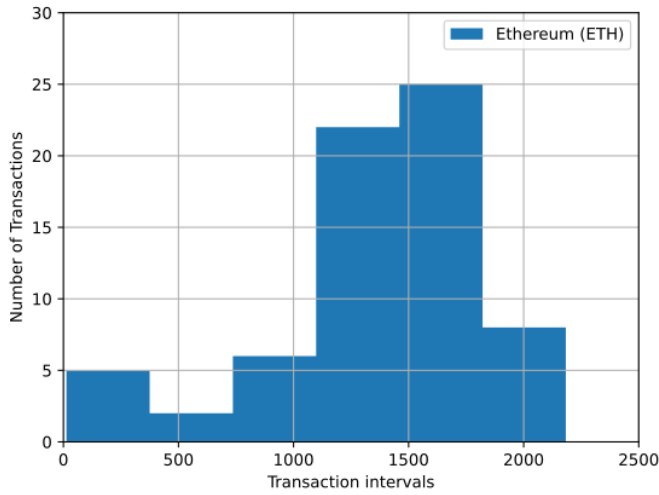Fig. 3. Histogram of the number of transactions of Bitcoin (BTC) users

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Fig. 4. Histogram of the number of transactions of Ethereum (ETH) users

IV. ANALYZING THE DATASET

In this section, focusing on the two cryptocurrencies Bitcoin (BTC) and Ethereum (ETH), we intend to provide a better description of the financial transactions of this dataset. For this reason, among the operations performed in this set of exchanges data, at least on one side of which is one of the cryptocurrencies of Bitcoin (BTC) or Ethereum (ETH), we are dividing them into two groups. Table1 shows the number of transactions for each Bitcoin (BTC) and Ethereum (ETH) asset, which represents all transactions in which at least one of them is Bitcoin (BTC) or Ethereum (ETH). Here, the period of time that is analyzed and reviewed is related to 1/10/2019 to 12/30/2019.

TABLE I.   NUMBER OF TRANSACTIONS IN EACH CLASSIFIED GROUP

Number of offers	Asset type
169130	Bitcoin (BTC)
209727	Ethereum (ETH)

Fig. 3 and Fig. 4 are the histogram diagrams that describe the dispersion of the number of users who have used Bitcoin (BTC) and Ethereum (ETH) assets, which are the native assets of the Ethereum (ETH) network in their operations, respectively. The vertical axis represents the number of users and the horizontal axis is divided into [1000 ,500) , (500 , 0], etc., and users for each number of transactions they have in the Stellar network and one of the desired assets that they used in their operations are in one of the intervals of this chart.

According to these two figures and Table 3, it can be seen that firstly in the Stellar network, users are more interested in the Ethereum (ETH) cryptocurrency, in other words, Ethereum (ETH) assets are used more than Bitcoin (BTC) in the exchanges of this network, and secondly, users who have conducted more operations, they perform most of their transactions on Ethereum (ETH), and thirdly, they provide the validity of the Stellar network and, consequently, the accuracy of this network information, because the users who have done more transactions are far more than users who have only one or a limited number of transactions in the Stellar network and no longer use their account.

Given that in both Figures 3 and 4 and Fig. 5, the number of exchanges of Ethereum (ETH) assets is much higher than of Bitcoin (BTC) assets, Fig. 6 demonstrates another view of the exchanges.

Fig. 6, which shows the volume of asset exchanges per day in the Stellar network, demonstrates that despite the fewer number of Bitcoin (BTC) exchanges than Ethereum (ETH), the volume of its exchanges are much larger than Ethereum (ETH). One of the main reasons for this can be attributed to the value of bitcoin compared to Ethereum (ETH). In fact, it can be said that due to the sharp fluctuations of Bitcoin (BTC) in this time period, the owners of this asset are not very interested in making small amount exchanges on this asset. In other words, Bitcoin (BTC) is used as a capital among the people, and the exchanges on it will be done in high amounts.

Despite the fact that Ethereum (ETH) assets are somewhat less valuable than Bitcoin (BTC) and have also seen fewer fluctuations, it can be said that due to the inherent characteristics of this asset, it is more capable for daily usage than Bitcoin (BTC).

Given the points discussed in this dataset, it is also worth mentioning that according to Fig. 5, which shows the number of asset exchange operations between the two assets, as we approach the end of 2019, which simultaneously with the outbreak of Covid-19 disease, the number of financial exchanges in this network declines significantly. This can also be seen in Figure -6, which as we approach the last days of 2019, the volume of exchanges also decreases.

Fig. 7 is describing the changes in inventory. This feature actually determines the amount of sales of each user on different days. In this case, in daily intervals, the difference between the total number of user purchases on that day and the total number of user sales on that day is called the change in inventory [3].

In Fig. 7, we present the rate of change in inventory of all users who have conducted a Bitcoin (BTC) or Ethereum (ETH) exchange on the network by day. One of the main features that this property shows us per user is the level of risk taking characteristic of the network users. Based on this, according to the description provided about this feature, if the amount of user purchase is more than the amount of sales, it can be said that the user is investing in the desired asset, or in other words, the user is taking more risk of that asset, and if it is selling that product, it means that the user is releasing that asset, so the user's risk taking level to that asset is reduced, so the user's risk taking is reduced.

In Figure 7, because the display of this feature by each user is out of the discussion of this article, a general graph of this feature is displayed throughout the network, which for each purchase carried out in the network, one sale can be recorded. It can be said that in general, the rate of change of this feature for the two assets of Bitcoin (BTC) and Ethereum (ETH) is near zero or +1 and -1.
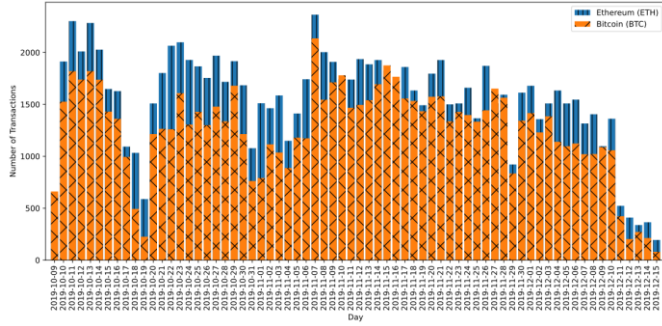

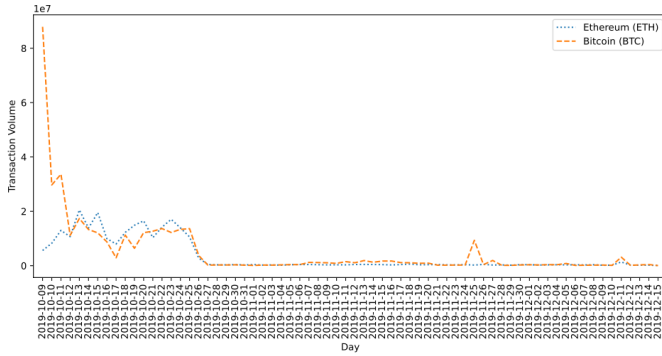Fig. 5. Number of transactions of Bitcoin (BTC) and Ethereum (ETH) users separated by day

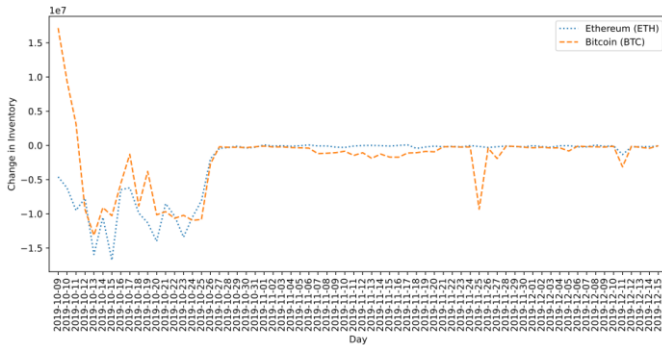Fig6. The volume of transactions of Ethereum (ETH) users separated by every day

Fig. 7 The amount of changes in the assets of Bitcoin (BTC) and Ethereum (ETH) users by day

V. CONCLUSION

In this paper, the Stellar market financial exchange dataset was collected, which is based on blockchain technology. Using this dataset and the features obtained through it, it can be pointed out that researchers in the field of economics or computer can use the financial exchange information of this network to simultaneously investigate the financial data of traditional currencies and cryptocurrencies. As mentioned earlier, one of the main challenges in previous research in the field of user behavior was that the data in those articles did not pay any attention to the diversity of assets.

Accordingly, in this data set, based on the features mentioned it, it can be used in simulating new exchange markets, stable cryptocurrency markets (29), discovering user behavior or predicting the conversion rate of cryptocurrencies or various currencies.

REFERENCES

[1] S. S. Chawathe, "Clustering Blockchain Data," in Clustering Methods for Big Data Analytics: Techniques, Toolboxes and Applications, O. Nasraoui and C.-E. Ben N'Cir, Eds. Cham: Springer International Publishing, 2019, pp. 43–72.

[2] B. Huang, Z. Liu, J. Chen, A. Liu, Q. Liu, and Q. He, "Behavior pattern clustering in blockchain networks," Multimed Tools Appl, vol. 76, no. 19, pp. 20099–20110, Oct. 2017, doi: 10.1007/s11042-017-4396-4.

[3] G. Shi, L. Ren, Z. Miao, J. Gao, Y. Che, and J. Lu, "Discovering the Trading Pattern of Financial Market Participants: Comparison of Two Co-Clustering Methods," IEEE Access, vol. 6, pp. 14431–14438, 2018, doi: 10.1109/ACCESS.2018.2801263.

[4] M. Gidea, D. Goldsmith, Y. Katz, P. Roldan, and Y. Shmalo, "Topological recognition of critical transitions in time series of

[5] cryptocurrencies," Physica A: Statistical Mechanics and its Applications, p. 123843, Jan. 2020, doi: 10.1016/j.physa.2019.123843.

[6] L. Cocco, G. Concas, and M. Marchesi, "Using an artificial financial market for studying a cryptocurrency market," J Econ Interact Coord, vol. 12, no. 2, pp. 345–365, Jul. 2017, doi: 10.1007/s11403-015-0168-2.

[7] Stellar Development Guides | Stellar Foundation.