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The Impact of Short-Term Hype on Predicting the Long-Term Behavior of Cryptocurrencies

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Abstract

The article examines the impact of the short-term interest towards cryptocurrencies on the quality of prediction based on the Bass equation. Based on a series of tests to cut off short-term growth of the number of active wallets, it was found that there was no effect on the dynamics of the number of active wallets for Bitcoin in the long term and efficiency.

Keywords: Blockchain, Bass equation, cryptocurrency, hype effect, payment systems.

Introduction

Cryptocurrencies, originally created as an alternative to government money and existing payment systems, have become a very popular high-risk investment tool in the modern world. This, in particular, led to the fact that both the price fluctuation and the dynamics of active users of cryptocurrencies largely began to depend on both internal factors of the system (such as, for example significant investment of businessman Elon Musk in Bitcoin analyzed by to Bloomberg (2021)) and external news (for example, BBC (2021) mentioned increased volatility in the markets due to the ban of cryptocurrencies in China

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and Ryan Browne (2021) showed the hype from news on Twitter). There are many studies showing the correlation of cryptocurrency prices with the dynamics of the number of tweets about this cryptocurrency ("Twitter effect" or "hype effect"). For example, this topic was investigated by Aharon D.Y. et al (2021) and Sattarov, O., et al (2020). In turn, our empirical observations show that the "Twitter effect" can be both long-term (for example, a panic in the market) and short-term (an advertising campaign or the launch of a new exchange).

For several years we have been developing an effective way to predict the dynamics of the behavior of cryptocurrencies using the modified Bass and Verhulst equation. In our previous papers (Dostov et al (2019) and Dostov et al (2020)), based on the assumption that cryptocurrencies retain the features of payment systems and considering them as a set of users, we have proved that the growth of the audience of the oldest cryptocurrencies is predictable and does not depend on long-term promotions or marketing incentives.

In this article, we want to draw attention to short-term sharp changes in the number of active wallets, which can signal both the "hype effect" and short-term currency interventions on the market. We are interested in an impact on the quality of forecasting by using the modified Bass and Verhulst equation. We hypothesize that because the Bass equation has no "long-term memory", i.e., the leading role in the construction is played by the step of the time series, but not the value of the initial data, the removal of short-term peaks will not lead to a change in the configuration of the equation and its coefficients.

The paper is divided into 3 parts. In the first park, we will consider the concept of cryptocurrencies and the factors that allow us to identify them as payment systems. In the second part, we describe a method for calculating the Bass equation without considering short-term peaks. Finally, in the third part, we will review the results of the experiment and draw conclusions.

The definition of cryptocurrencies and active wallets

Cryptocurrency is a kind of digital currency, accounting for internal units of account is provided by a decentralized payment system (the most famous of which is the blockchain). Sebastião, H.M.C.V. et al (2021) pay attention to the fact, that the first known cryptocurrency (Bitcoin) originated in 2009 and was initially positioned as an alternative payment method for goods and services, which does not require an intermediary during the transaction to create the necessary level of trust between the buyer and seller. In this paradigm bitcoin is a payment system (a set of rules, procedures and technical infrastructure that ensure the transfer of value from one economic entity to another). Ethereum and Ripple were positioned in the same way. Considering cryptocurrencies as payment systems allowed us to apply the modified Bass and Verhulst equation for their prediction (Dostov V. et al (2019), Dostov V. et al (2020)), which in general has the following form (1):

$$x = \frac{x_0 K e^{rKt}}{x_0(e^{rNt} - 1) + K} \tag{1}$$

where:

- current number of users x0;
- the maximum number of users, for example, the entire audience of a given country, K. Therefore, the number of potential users not currently participating in the system is K-x0;
- audience capture rate, which reflects the probability that a given user will start using the service: r>0 (the reverse time of the decision) within a given period;
- time moment t.

The optimal parameters of the model are calculated using the Python programming language and the SciPy library by minimizing the sum of squared deviations of the calculated values of the Bass equation and real data.

Nevertheless, since 2016, cryptocurrencies (including those mentioned above) are increasingly considered as an investment and speculative tool. This leads to a change in user behavior. By our research, we can identify the transformation in behavior by using indicators of the dynamics of the number of active addresses of certain cryptocurrencies from BitInfoCharts (2021). This indicator shows the number of unique addresses that were active on the network as a sender or recipient. The indicator includes only addresses that were active in successful transactions. Giving the fact that cryptocurrencies have features of payment systems, for the purpose of determining the overall dynamics of the number of users, the indicator of active addresses is fundamental. However, because of the specifics of the financial market, the behavior of active addresses does not fully correlate with the dynamics of the development of payment systems. Figure 1 shows a graph of the number of active Bitcoin addresses for the entire observation period.

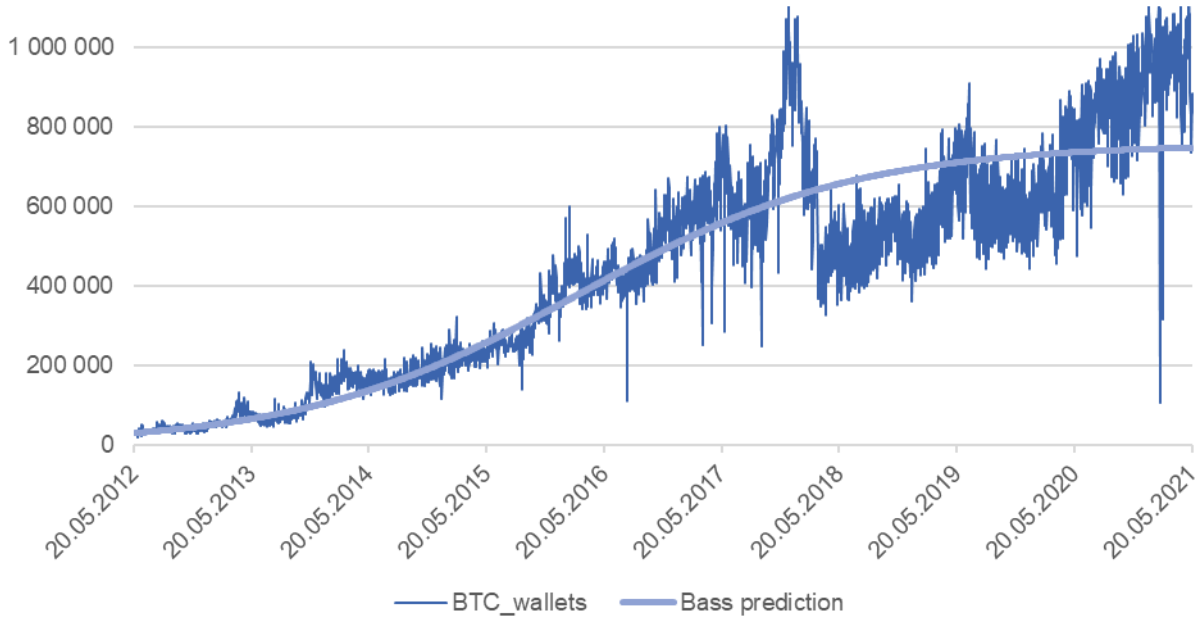

Fig 1. Dynamics of active wallets of Bitcoin users for all the time of observations, and the Bass equation trend

Figure 1 shows that since 2016, because of the investment component, single spikes, uncharacteristic for payment systems, appear on the graph of active addresses. Spikes towards an increase in the number of wallets may be associated with the "hype effect" or an increase in the activity of players before the trend reversal. Spikes towards a decrease in the number of addresses signal a period of waiting for further trading indicators of technical analysis for long-term speculators.

To study the dynamics of cryptocurrencies, spikes can potentially lead to a decrease in the accuracy of the forecast when obtaining the coefficients of the model. In this regard, it is important to understand the strength of this effect and the behavior of the Bass model without short-term spikes.

Research Methodology

Our previous studies (Dostov V. et al (2019), Dostov V. et al (2020)) have shown that there is no "long-term memory" in the equations constructed based on the Bass and Verhulst formula - the dependence of the behavior of the equation is solely on the coefficients and time lag. On the other hand, taking the sum of squares of forecast errors from real data as a quality criterion makes short-term peaks a significant indicator.

We propose the following research algorithm:

1. First of all, the parameters of the Bass equation are calculated based on real data. To do this, we use the scipy.optimize.minimize function from the scipy library of Python language. The minimization criterion is the sum of the squares of the deviations of the calculated data from the real ones.
2. At the second stage, the parameters are adjusted by minimizing the number of deviations of the calculated data from the real ones.
3. For the trend line obtained from the Bass equation, the mean square error is calculated
4. From the trend line, two lines are postponed parallel to it with the addition of standard deviation and subtraction of standard deviation (Figure 2).
5. All values of the source data that do not into the corridor are cut off and taken equal to the trend value in this period.
6. Based on the new initial data, steps 1-6 are repeated until the oscillation of the Bass equation coefficients stops.
7. Based on the data obtained, a forecast is made to determine the accuracy of the forecast.

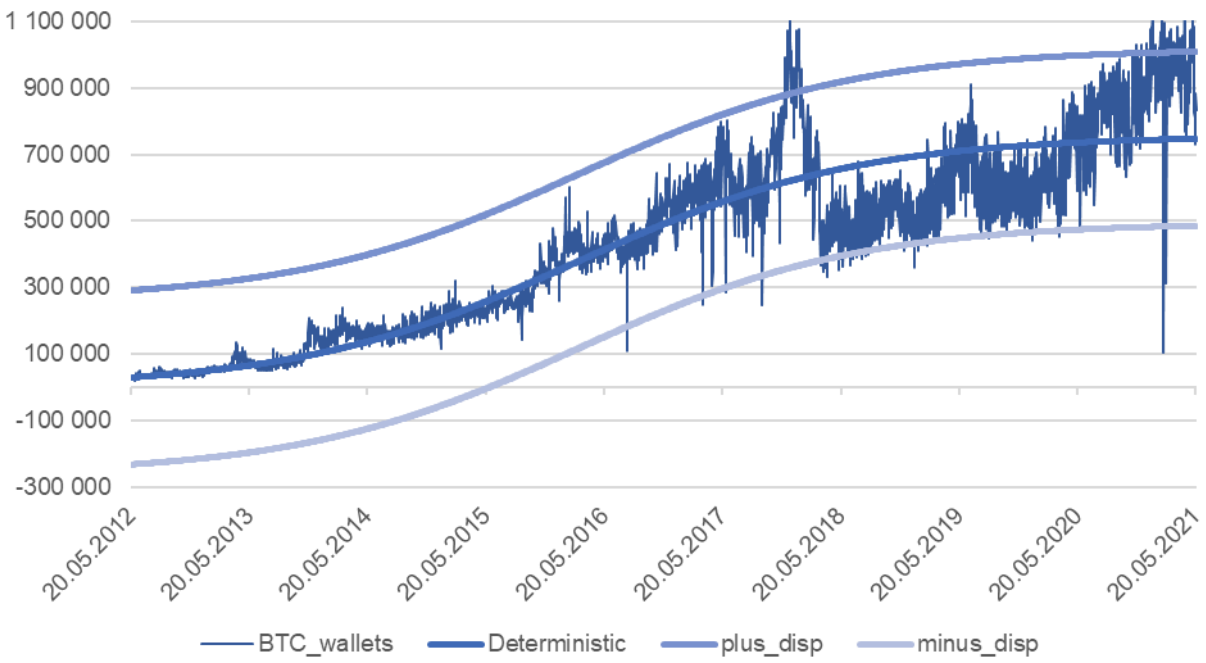

Fig 2. The number of active Bitcoin addresses with the superimposed trend of the Bass equation and the mean square deviation corridor. Data not included in the corridor will be deleted for the next iterations

Bitcoin was chosen for the study as the closest cryptocurrency to payment systems. The forecast will be based on two periods - from May 2012 to May 2019 – the first significant mentions of bitcoin and the first hype of 2018 (forecast for the next 257 days); from May 2012 to May 2021 – a period in which there is an increase in the number of single peaks and an additional period of January 2021 hype is fixed (forecast for the next 287 days). In the second case, the forecast is made for the hype period – so it will be possible to visually check the hype unaccounted for by the model.

Research results

The dynamics of changes in the coefficients of the Bass equation for Bitcoin is presented in Table 1.

Table 1: The results of the study for the test period of observations (2021 – 2019)

	K	r	x0
Initial Data	1 178 472	0,00206	29 540
Cycle 1	1 106 064	0,00213	29 540
Cycle 2	1 106 064	0,00213	29 540
Cycle 3	1 106 064	0,00213	29 540
Cycle 4	1 106 064	0,00213	29 540
Cycle 5	1 106 064	0,00213	29 540
Cycle 6	1 106 064	0,00213	29 540
Cycle 7	1 106 064	0,00213	29 540
Cycle 8	1 106 064	0,00213	29 540
Cycle 9	1 106 064	0,00213	29 540

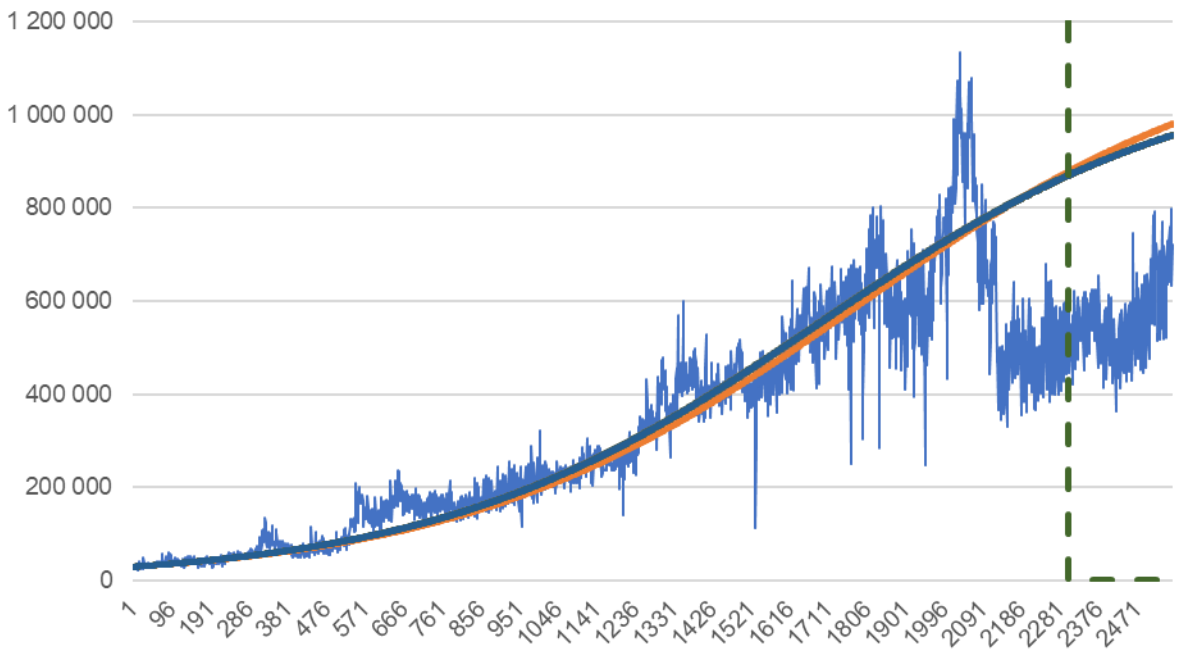

Fig 3. Graphical representation of the Bass equations for Bitcoin (2012-2019)

Table 2: The results of the study for the test period of observations (2012-2019)

	Number of users on the last day of observations	Deviation of the results from the original Bass, %	Deviation of the results from the initial data
Initial data (average value on test data)	570 386		0
Initial values of the Bass equation	979 746	0%	409 359
Cycle 1	955 511	-2%	385 125
Cycle 2	955 511	-2%	385 125
Cycle 3	955 511	-2%	385 125
Cycle 4	955 511	-2%	385 125
Cycle 5	955 511	-2%	385 125
Cycle 6	955 511	-2%	385 125
Cycle 7	955 511	-2%	385 125
Cycle 8	955 511	-2%	385 125
Cycle 9	955 511	-2%	385 125

In the first test, the stationarity of the Bass equation indicators is achieved at the first removal of single peaks. Moreover, the deviation of the new line from the original Bass is only 2 per cent. This leads to an increase in the quality of the forecast, although both lines at first glance have a negligible degree of predictive power. However, Figure 2 shows that the dip in Bitcoin's popularity was temporary, and in this case, the long-term prediction of the Bass equation is accurate.

Similarly, we made a comparison for Bitcoin included last "hype effect" of 2021. The results are presented in Tables 3 and 4, as well as in Figure 4.

Table 3: Dynamics of the coefficients of the Bass equation based on the number of active Bitcoin addresses (2012- May 2021)

	K	r	x0
Initial Data	980 961	0,00203	29 540
Cycle 1	713 303	0,00240	29 541
Cycle 2	887 450	0,00215	29 540
Cycle 3	965 965	0,00205	29 540
Cycle 4	763 285	0,00232	29 541
Cycle 5	763 285	0,00232	29 541
Cycle 6	763 285	0,00232	29 541
Cycle 7	763 285	0,00232	29 541
Cycle 8	763 285	0,00232	29 541
Cycle 9	763 285	0,00232	29 541

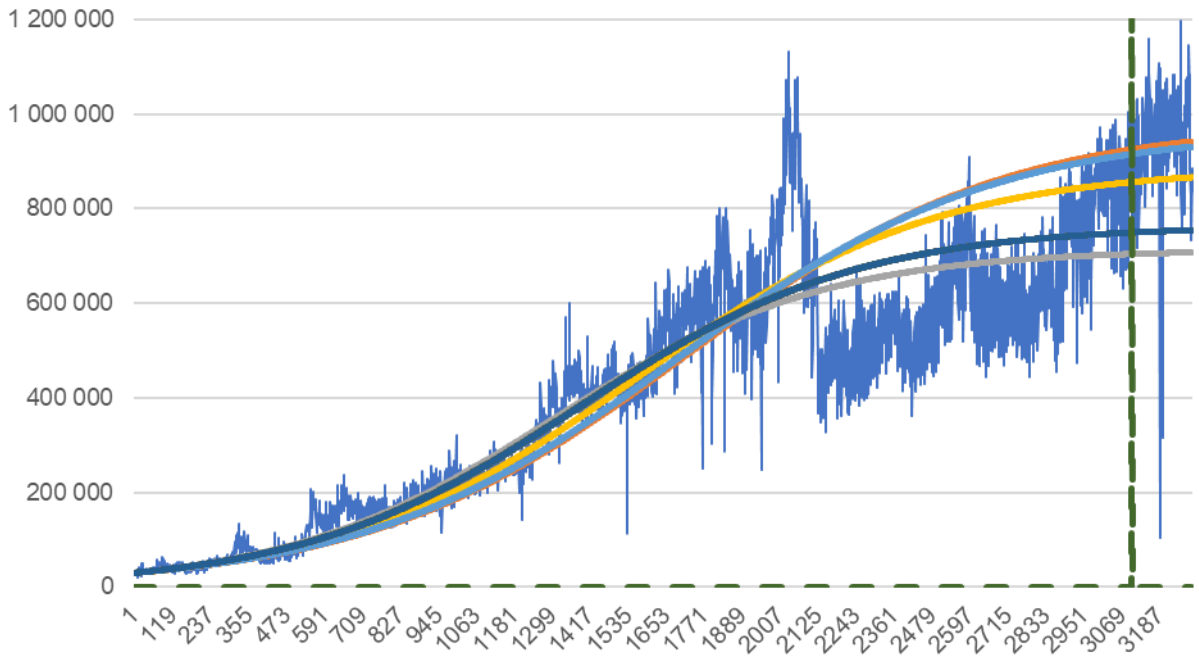

Fig 4. Graphical representation of the Bass equations for Bitcoin

Table 4: The results of the study for the test period of observations (2012- May 2021)

	Number of users on the last day of observations	Deviation of the results from the original Bass, %	Deviation of the results from the initial data
Initial data (average value on test data)	945 008		0
Initial values of the Bass equation	941 951	0,00%	-3 057
Cycle 1	707 241	-24,92%	-237 767
Cycle 2	866 215	-8,04%	-78 793
Cycle 3	930 800	-1,18%	-14 209
Cycle 4	754 172	-19,94%	-190 836
Cycle 5	754 172	-19,94%	-190 836
Cycle 6	754 172	-19,94%	-190 836
Cycle 7	754 172	-19,94%	-190 836
Cycle 8	754 172	-19,94%	-190 836
Cycle 9	754 172	-19,94%	-190 836

The coefficients came to a stationary form on the fourth iteration of the cycle. Figure 4 shows that the spread is significant. At the time of the fourth cycle, the spread was 19.94%. Based on the average value of the number of active addresses in the test period, the Bass equation on the initial data demonstrates a greater level of approximation. This is obviously due to an increase in market volatility and an increase in the number of single peaks. However, the accuracy of the data obtained can be verified over a wider testing period. Figure 5 and Table 5 show the dynamics of the number of active wallets and the Bass equation over a longer period (until August 2021).

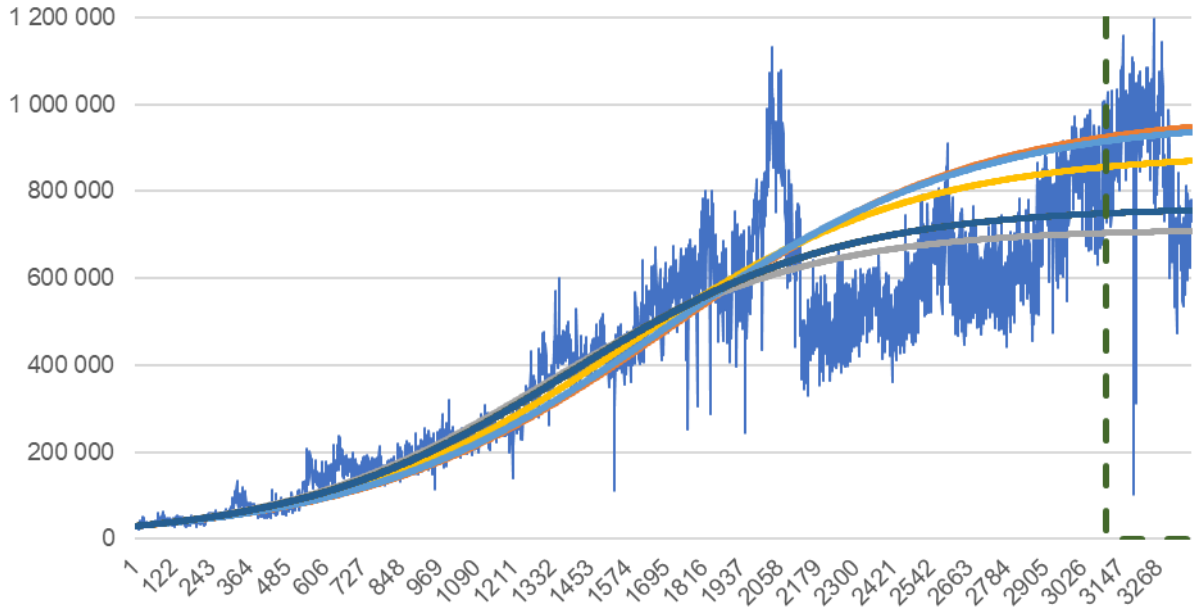

Fig 5. Graphical representation of the Bass equations for Bitcoin (2012- August 2021)

Table 5: The results of the study for the test period of observations (2012- August 2021)

	Number of users on the last day of observations	Deviation of the results from the initial data
Initial data (average value on test data)	877 426	0
Initial values of the Bass equation	947 976	70 550
Cycle 1	708 366	-169 061
Cycle 2	869 733	-7 693
Cycle 3	936 305	58 878
Cycle 4	755 805	-121 621
Cycle 5	755 805	-121 621
Cycle 6	755 805	-121 621
Cycle 7	755 805	-121 621
Cycle 8	755 805	-121 621
Cycle 9	755 805	-121 621

Figure 5 and Table 5 show that the quality of the description by the Bass equation of the behavior of the number of active wallets, considering and without taking into account single peaks, despite the large spread, is generally comparable.

Conclusions

Thus, we were able to demonstrate that, depending on the observation period, the nature of the cryptocurrency and the degree of speculation in the market, single peaks either do not affect the accuracy of the forecast or lead to a slight decrease in its effectiveness. This means that with further research, these peaks may be omitted.

In addition, we once again managed to confirm the effectiveness of using the Bass equation to predict the dynamics of payment systems and cryptocurrencies that have features of payment systems.

The obtained results of the paper will be used by us in subsequent studies.

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