The Influence of the Effect of Marketing Incentives on the Dynamics of the Development of Classic and Cryptocurrency Payment Systems

Victor Dostov[1,2][a], Pavel Pimenov[1][b], Pavel Shoust[1,2][c] and Victor Titov[1,3][d]

[1]Federal State Budgetary Educational Institution of Higher Education "Saint-Petersburg State University" 7-9 Universitetskaya Emb., St Petersburg, Russia

[2] Distributed Ledger Technologies Center of Saint-Petersburg State University, 1-3 Cadet line of Vasilievsky Island, St Petersburg, Russia

[3] Modern Financial Technology Laboratory of Saint-Petersburg State University, 1-3 Cadet line of Vasilievsky Island, St Petersburg, Russia

Abstract: The article examines the role of marketing incentives and social hype on the growth rate and the number of customers of developing payment systems, both classic and cryptocurrency. The authors prove that using marketing incentives can have only a short-term positive effect, which does not provide changes in the typical trend of the payment system development. The conclusions were confirmed by a comparative analysis of the results of the modified Bass equation application and by an empirical study conducted by Indonesian researchers in the form of a sociological survey. For this purpose, a trend for the number of transactions using electronic money in Indonesia was built. The study confirmed generally the findings of Indonesian researchers. Nevertheless, it is established that in contradiction with the conclusions of Indonesian researchers, marketing incentives provide an effect on the market, however relatively small one. The same results were demonstrated for Bitcoin and WebMoney payment systems dynamics.

1 INTRODUCTION

The development of payment systems is an important aspect of the digitalization of society and its financial system. The owners of the platform and the state are interested in the rapid growth of the number of users of their product and the number of transactions. In this regard, to increase the involvement of the population, the development of the payment system is accompanied by various marketing incentives – promotions, bonuses, etc.

Nevertheless, our previous research (Victor Dostov, Pavel Shoust, 2019, 2020) and accumulated empirical experience show that the effect of marketing incentives is short-term and cannot sufficiently affect the development of the payment system. There are other studies on this topic, but they are often limited to conducting statistically significant surveys, which, nevertheless, demonstrate the preferences of people who are already familiar with digital technologies and the banking market.

In this paper, we want to show and prove that marketing incentives have a limited impact on the dynamics of payment systems development, and it can be identified both using empirical statistical methods (sociological surveys) and using mathematical models. For this purpose, we analysed the development of electronic money in Indonesia from 2016 to 2021, as in the context of statistical surveys conducted by other researchers, so as using the modified Bass equation.

The practical effect of the study is to form an evidence base for the revision of marketing plans of payment system owners to reorient financial and time resources to more important areas of interaction with

---

[a] https://orcid.org/0000-0003-4518-2883
[b] https://orcid.org/0000-0002-4683-8525
[c] https://orcid.org/0000-0002-2276-7523
[d] https://orcid.org/0000-0002-2005-0123

potential customers for the development of the payment system.

2 PREDICTOR ANALYSIS

Research on determining the impact of marketing incentives on the pace of development of payment systems mainly focuses on determining the factors that encourage people to become users of the payment system. Often the emphasis is on social aspects, as well as comfort. For example, the study "Factors Affecting the Acceptance of Mobile Payment Systems in Jordan: The Moderating Role of Trust" (Manaf Al-Okaily, Mohd Shaari Abd Rahman and Azwadi Ali 2019), which begins a cycle of research on the behavior of the JoMoPay payment system, focuses on the study of the social effect, the price effect and the conviction of potential customers in the availability of ready-made infrastructure. In the third article of the research cycle "An Empirical Investigation on Acceptance of Mobile Payment System Services in Jordan: Extending UTAUT2 Model with Security and Privacy" (Manaf Al-Okaily, Mohd Shaari Abd Rahman, Emad Abu-Shanab and Ra'Ed Masa'deh, 2020), the researchers conclude that the expected application performance, social impact, price, security and privacy have a significant effect on the behavior of potential customers. However, simplicity, the comfort of usage and customer satisfaction are not important factors for starting using the payment system.

Interesting study in the context of determining the effect of marketing incentives is made in the paper "Digital wallet war in Asia: Finding the drivers of digital wallet adoption" by Putri Natasya Fanuel and Ahmad Nurul Fajar (Putri Natasya Fanuel and Ahmad Nurul Fajar 2021). Based on a survey of 457 users of digital wallets using the extended technology acceptance model (TAM2) and innovation diffusion theory (IDT), the researchers found that the main factors for choosing payment systems by customers are usefulness, simplicity and innovation. At the same time, the hypothesis about the influence of advertising on customer behavior was rejected as insignificant. This conclusion was made by using a combination of coefficient of determinant, predictive relevance, effect size of coefficient determinant and effect size of predictive relevance. However, the authors believe that different types of promotions will be effective for different user demographics. In the question of an effect from the experience of using the payment system by other users (social effect), a small relationship has been established. Nevertheless, the authors of (Putri Natasya Fanuel and Ahmad Nurul Fajar 2021) are sure that the influence of experience takes place and the main reason for the low correlation is the relative novelty of payment systems in the Indonesian market.

For the purpose of this paper, a key issue is an applicability of (Putri Natasya Fanuel and Ahmad Nurul Fajar 2021) findings in other markets. The specifics of Indonesia can be crucial in determining the effect of marketing incentives for other countries. It is necessary to find a way that could form an understanding of the role of marketing for Indonesia and the other regions.

3 APPLICATION OF THE BASS EQUATION

We are sure that the hypotheses of the researchers can also be verified by using mathematical methods for predicting the development of payment systems.

In our previous studies (Victor Dostov, Pavel Shoust, 2019, 2020a, 2020b), we aimed at providing an analysis the possibility of predicting the behavior of the payment system over time. We proceeded from the assumption that payment systems developing is customer-driven and it is defined by generalized customer behavior. To confirm this hypothesis, modified equations of Bass innovation diffusion and Verhulst were used. The advantage of this approach is that the indicators used in the model have a pronounced economic aspect. The following parameters used in the proposed trend building model are (Victor Dostov, Pavel Shoust and Elizaveta Popova, 2019):

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

As it was shown in (Victor Dostov and Pavel Shoust, 2020), the configuration of the modified Bass equation largely depends on the type of relations that arise between customers and companies within the

payment system. In our early works (Victor Dostov, Pavel Shoust and Elizaveta Popova, 2019), we conditionally divided payment systems into two types. The type of payment system may change over time depending on the structure of the market, the size of the payment system and the nature of the management company functioning (Victor Dostov and Pavel Shoust, 2019). Depending on the type of payment system, its behavior is significantly different. In customer-to-business, C2B payment systems, a limited number of customers make payments for a resource with unlimited capacity (for example, contactless card payment). The dynamics of the development of the C2B system can be described by equation (1), hereinafter referred to as the first type equation:

$$\frac{dx}{dt} = a(N - x) - bx \qquad (1)$$

In person-to-person, P2P systems, payments are made within a closed audience (for example, cross-border transfers). It is important to note that the decision to use the system is significantly affected by the presence of other clients in this system at the point in time. The P2P system is described by equation (2), hereinafter referred to as the second type equation:

$$\frac{dx}{dt} = a(N - x)x - bx \qquad (2)$$

In graphical representation, this difference is manifested in the different nature of development. If C2B is characterized by initially high growth rates and gradual attenuation of development, then for P2P systems the growth rate increases gradually, reaches an inflection point and slows down by analogy with a C2B payment system. The difference in the dynamics of the development of C2B and P2P payment systems is shown in Figure 1 (Victor Dostov, Pavel Shoust and Svetlana Krivoruchko 2020).
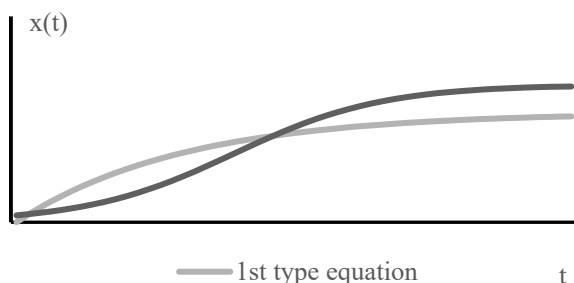

Figure 1: Graphical representation of the modified Bass equations.

In our previos work (Victor Dostov, Pavel Shoust and Svetlana Krivoruchko 2020), we united the first and second types of the equation. For further qualitative purposes we will use simplified solution in the following form, ignoring customer fatigue coefficient:

$$x = \frac{x_0 N e^{aNt}}{x_0(e^{aNt} - 1) + N} \qquad (3)$$

For the purposes of this work, it is important to note that based on empirical data for all markets where the modified Bass equation was applied, we have repeatedly come to the following conclusions (Victor Dostov, Pavel Shoust and Elizaveta Popova, 2019):

- The growth rate of users does not depend on the number of current and potential users in C2B systems and is impacted significantly by these parameters in P2P systems;
- The moment of the start of using the payment system by a typical user is random;
- Marketing incentives do not affect the overall dynamics of the payment system development.

These conclusions were confirmed by us based on the analysis of the payment systems development dynamic for the Russian, European and Asian markets. In addition, the modified Bass equation allowed us to assume that some cryptocurrencies also have features of payment systems and their behavior over long time intervals is quite predictable, typical and obeys conclusions 1-3 (Victor Dostov, Pavel Shoust and Svetlana Krivoruchko 2020).

In case of marketing incentives, the Bass equation allows us to identify both the beginning of active financing, gradual attenuation of the effect and the return of dynamics to the predicted values. The prime example is the dynamics of the development of the Russian payment system named WebMoney (Figure 2) (Victor Dostov, Pavel Shoust and Elizaveta Popova, 2019). In the case of constructing a modified Bass equation, it can be noted that in 2009 the real data exceed the predicted values. This is a complex effect of the launch of new services of the company (for example, a service for organizing and optimizing task setting), which was accompanied by an active marketing campaign. The analysis of news reports for the period shows that the main methods of promotion were various discounts and bonus programs for store customers who pay for purchases using WebMoney. Nevertheless, the growth did not lead to significant changes in the payment system development – the

real data values drop to forecasted already in 2013 going back to predicted generalized Bass curve.
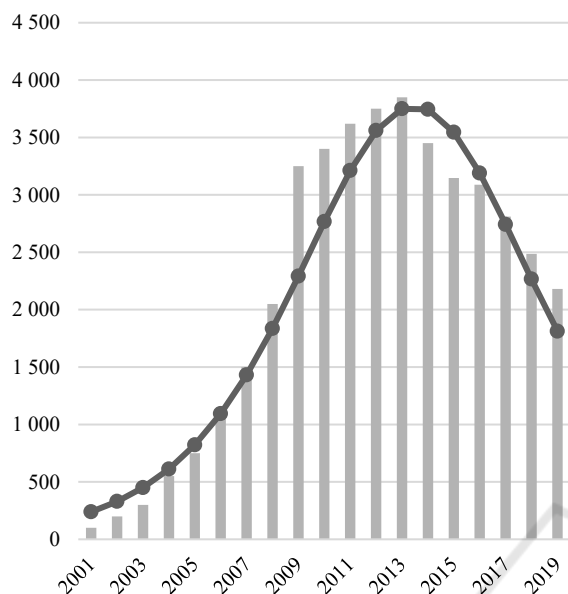

Figure 2: New Webmoney wallets, thousand per year.

Similar conclusions were obtained by analyzing cryptocurrencies. Because cryptocurrencies were initially considered as an alternative to traditional payment systems, some of them demonstrate visibly the main characteristic features of payment systems instead of being pure speculative instruments (David G.W. Birch 2020). In our previous works (Victor Dostov, Pavel Shoust and Svetlana Krivoruchko 2020), we chose Bitcoin and Ethereum, because, unlike other currencies that were originally created as purely investment instruments, Bitcoin and Ethereum retained many features of payment systems.

It was shown in our previous works (Victor Dostov and Pavel Shoust, 2019, 2020) that during the Bitcoin active growth in 2018, there was a quasi-marketing effect – most people received information about the value of the currency not through their friends who actively use the product, but through the media, which is, in fact, advertising. The declared possibility of high profitability of the instrument due to possible increase of it exchange rate to fiat currencies, unusual for traditional payment systems, resulted in sharp spike of Bitcoin usage (Figure 3), but after passing the active wave of interest, the average indicators of active wallets returned to the predicted values obtained by applying the modified Bass equation.
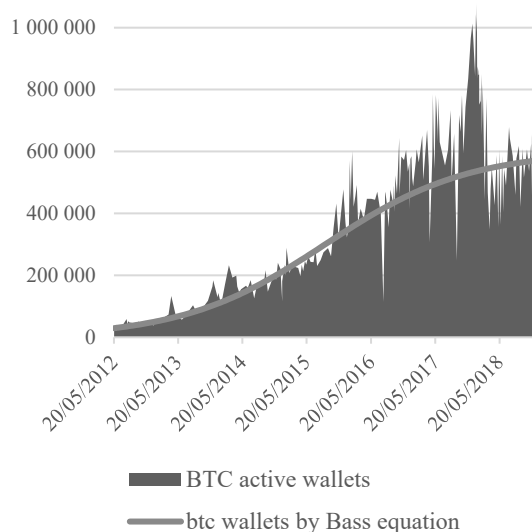

Figure 3. Bitcoin active wallets.

Such behavior of payment systems demonstrates that marketing incentives or other nature's hype can provide a more significant growth of the payment system, but the effect will be short-term and will not affect the overall dynamics of development.

4 APPLICATION OF THE BASS EQUATION FOR THE ANALYSIS OF THE INDONESIAN PAYMENT MARKET

Let's try to combine our results with the study of Indonesian scientists. According to the work (Putri Natasya Fanuel and Ahmad Nurul Fajar 2021) there is a low role of marketing in deciding to start using the payment system. In this case, it is logical to assume that any marketing activity will lead to a slight deviation from the forecast line constructed based on the modified Bass equation. Putri Natasya Fanuel and Ahmad Nurul Fajar confirm this position, pointing out that the inefficiency of the usage of marketing incentives can be indirectly confirmed by the policy of the Indonesian payment service GoPay, which in 2019 abandoned the practice marketing incentives' usage (Putri Natasya Fanuel and Ahmad Nurul Fajar 2021). Nevertheless, when answering questionnaire questions, a person is often more rational than in the conditions of a real marketing influence. Therefore, we can assume a different

configuration. Our research (Victor Dostov, Pavel Shoust and Svetlana Krivoruchko 2020) shows that marketing incentives are accompanied by a sharp surge in user activity with a gradual fading of this effect. This does not contradict the article (Putri Natasya Fanuel and Ahmad Nurul Fajar 2021), because Putri Natasya Fanuel and Ahmad Nurul Fajar suggest as different types of promotions will be effective for different user demographics.

For goals of analysis, let's take the dynamics of the number of transactions with the usage of electronic money in Indonesia (Statistik Sistem Pembayaran (SSP) 2020). We consider this approach relevant because GoPay was the first company to change the approach to advertising. This confirms that there were attempts to apply marketing incentives in the market. In (Putri Natasya Fanuel and Ahmad Nurul Fajar 2021) authors are also confirming this position. The results of the study are shown in Figure 4 (Statistik Sistem Pembayaran (SSP) 2020).
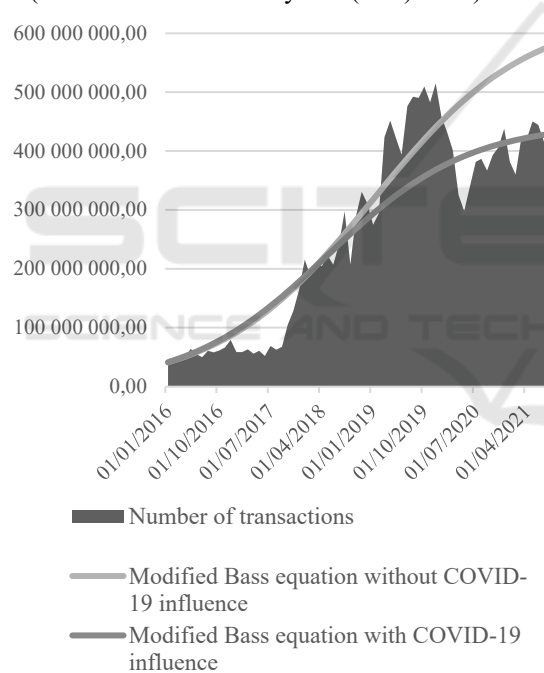

Figure 4. Dynamics of transactions using electronic payments in Indonesia.

To estimate marketing action effects, first, we take pre-action data, find generalized Bass equation solution (3) coefficients minimizing the standard deviation of the trend from the real data. Then we plot (3) for all ranges of data, estimating deviation of (3) from real data in the post-action stage. If the deviation is small, it means that marketing action did not provide a long-term effect and vice versa. Concerning obtained results, first of all, it should be noted that the

trend behavior shows the Indonesian e-money market is a pronounced P2P. The graph clearly shows a period of a smooth increase in the number of transactions with the presence of an inflection of growth rates characteristic of P2P and their gradual slowdown. The behavior of the graph correlates with studies, the authors of which are sure that there is an effect from the experience of using the payment system by other users.

It can be noted that the sharp increase in the number of transactions in 2019 is also sharply decreased at the beginning of 2020. It is worth mentioning, however, that the fall is mainly due to the COVID-19 epidemic, the active peak of which account precisely for April-May 2020. Therefore, in addition to the forecast based on the real data, we maintained the dynamics of the number of transactions' growth rate and put a second trend line, conditionally ignoring the negative impact of COVID-19. The coefficients of the trend lines are presented in Table 1.

Table 1: Indicators of the Bass equation for the Indonesian market.

Bass equation	Current number of transactions (x0)	Maximum number of transactions (N)	Audience capture rate (a)
Including the impact of COVID-19	41 300 860	447 031 653	0.081
Excluding the impact of COVID-19	41 300 860	636 213 098	0.074

The characteristic period of a sharp increase in the number of transactions and the attenuation of the growth rate by the beginning of 2020 are characteristic markers of marketing incentives' usage in the market. Based on the assumed configuration, we have built a forecast graph without the COVID-19 influence. In both cases, since March 1, 2019, there are values on the chart that are greater than forecast ones. The behavior of real data completely repeats similar configurations of payment systems that have been appeared in our previous studies. Generally, we can say, that both "positive" influence of marketing actions and "negative" effect of COVID-19 still affects long-term behavior in 2021, but this influence is very low comparing to peak amplitudes provided

by these factors. As we see, in 2021 real data behavior is quite close to prediction based upon pre-action and pre-COVID data.

5 CONCLUSIONS

The results of the study show that the application of the modified Bass equation empirically mostly confirms the results of the statistical analysis by Putri Natasya Fanuel and Ahmad Nurul Faja about the absence of a significant long-term positive effect from marketing incentives. Moreover, we were able to demonstrate that this effect does not depend on regional characteristics or the demographic structure. Nevertheless, the application of the modified Bass equation on the Indonesian market, as well as cryptocurrency market and other payment markets, shows that the effect of marketing incentives is present, but to a low extent and not in long terms, which is partially contrary to the conclusions of Indonesian researchers. However, this discrepancy is understandable and does not affect the main thesis of the paper.

The research of Indonesian scientists also provides opportunities for the formation of predictive values of the modified Bass equation parameters. This will allow us to form effective forecasts of the development of payment systems from the beginning of their development. This issue will be considered by us in the next studies.

REFERENCES

Victor Dostov, Pavel Shoust and Elizaveta Popova 2019 Using Mathematical Models to Describe the Dynamics of the Spread of Traditional and Cryptocurrency Payment Systems *Misra S. et al. (eds) Computational Science and Its Application.* ICCSA 2019 11620 457-471

Victor Dostov and Pavel Shoust 2020 A Generalization of Bass Equation for Description of Diffusion of Cryptocurrencies and Other Payment Methods and Some Metrics for Cooperation on *Market Misra S. et al. (eds) Computational Science and Its Applications –* ICCSA 2020 12251 3-13

Victor Dostov, Pavel Shoust and Svetlana Krivoruchko 2020 A Using mathematical models for analysis and prediction of payment systems behaviour *Proceedings of Fifth International Congress on Information and Communication Technology –* ICICT 2020 2

Manaf Al-Okaily, Mohd Shaari Abd Rahman and Azwadi Ali 2019 Factors Affecting the Acceptance of Mobile Payment Systems in Jordan: The Moderating Role of

Trust *Journal of Information System and Technology Management* 4(15) 16-26

Manaf Al-Okaily, Mohd Shaari Abd Rahman, Emad Abu-Shanab and Ra'Ed Masa'deh 2020 An Empirical Investigation on Acceptance of Mobile Payment System Services in Jordan: Extending UTAUT2 Model with Security and Privacy *International Journal of Business Information Systems* 1(1) 1

Putri Natasya Fanuel and Ahmad Nurul Fajar 2021 Digital wallet war in Asia: Finding the drivers of digital wallet adoption *Journal of Payments Strategy & Systems* 15 (1) 79-91

David G.W. Birch 2020 The Currency Cold War: Cash and Cryptography, Hash Rates and Hegemony (Perspectives) *London Publishing Partnership* 256 p

Statistik Sistem Pembayaran (SSP) 2020 *Bank Indonesia* https://www.bi.go.id/id/statistik/ekonomi-keuangan/ssp/uang-elektronik-infrastruktur.aspx