Compertz Prediction Model of Life Cycle of Huawei Pay with on Block Chain

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Abstract. Blockchain technology is more and more widely used in the financial field. Many financial products are developed and applied using blockchain technology. In this paper, we used econometric mathematical method, obtained the Compertz Prediction Model for Huawei Pay. Considering of blockchain and statistical dates, some results of this paper have some research value for life cycle of Mobile Pay field.

Keywords: Mobile payment · block chain · Life Cycle

1 Introduction

Which a peer-to-peer distributed ledger compute has gained success recently, named Block chain [4]. Computer algorithms and cryptography is the essence of block chain, meanwhile it is a decentralized digital system. Forge and tamperproof is main feature of block chain, and block chain can be used to manage and transactions of digital date. Block chain does not need to has authoritative intermediary.

Recently, block chain can be used to various filed, for example, health care finance. Payment network in Ripple has been designed, which allows many bank of different countries do transfer and exchange transaction deal. The key of this network is without third-party intermediary. Other application with block chain is crowdfunding, which can found own digital currency and raise funds. The feature of this crowdfunding is that supporter can sell and buy their digital equity [1]. Another important field is intelligent-contract with block chain. Definition of contract is defined by executed by the code. The whole process is automated and does not require manual participation [2, 3]. This will open up a new field. Distrust Loans: someone who you don't know can lend your money on the Internet, meanwhile you can use your intellectual assets as collateral. This method must reduce the costs of credit inevitably, and make more competition [5, 6]. For another example, electronic medical records, health and virus databases are also widely used in block chain [7], and a new framework on contracts based blockchain was proposed.

Scientific research institutes and government departments have joined the research and development of block chain technology, and respond the internet innovation. In March 2021, Huawei Company Officially obtained the mobile payment license.

Now, Block chain is named terminator for internet financial. If so, the whole Internet will be impacted.

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The number of consumer of WeChat and Alipay is very huge and stable, so Huawei faces challenges and pressures from WeChat and Alipay. Meanwhile, the new technology, such as block chain, will affects these internet financial products deeply.

2 The Study Method

In this section, we use official date and analyze the lifetime cycle model of Huawei Pay, considering the defection of Block Chain. There are several steps in this paper. Meanwhile, some results in this paper are based on mathematical model and statistical dates.

A. We the whole life cycle are divided into four periods: input, growth, maturity and recession period. Each period has different characteristics.

B. The Compertz model [8] is introduced in second step. Meaning and expression of some key parameters are shown.

C. We obtained the Life Cycle Prediction Model of Huawei Pay based on Compertz model. Some key parameter are calculated with some statistical data simultaneously.

D. In the last part, some import curves are shown, and several key conclusions are analysed.

Life cycle of product is also named growth or reasoning curve. It's mean that the whole time from launch to be eliminated. The life cycle include four processes: the input, the growth period, the maturity and the recession period. This step can be shown as in Fig. 1.

This step can describe as follows:

Stage 1: Input Period is shown in Fig. 2

When Huawei Pay is working in the market, it must compete fiercely with AliPay and WeChat. There is a huge number of subscriber in AliPay and WeChat. So we consider that in the early, the users of Huawei Pay will increased slowly, even if it has a large number of consumer.

Stage 2: Growth Period is shown in Fig. 3

We can clearly find that Profit and users are increased in this stage. One part of the users is diverted to the Huawei Pay duo to user's curiosity and policy reasons.

Stage 3: Maturity Period is shown in Fig. 4

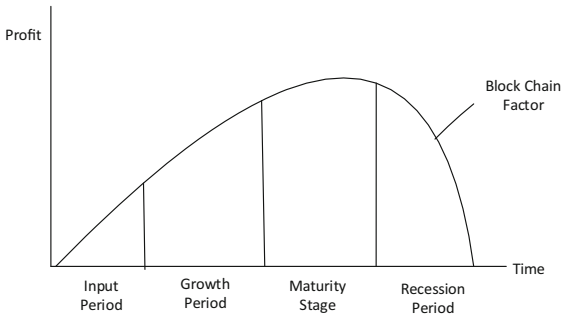

Fig. 1. Huawei Pay's life cycle.

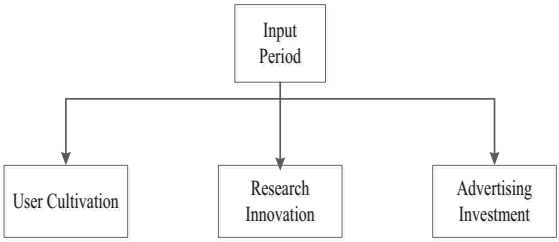

Fig. 2. Input period.

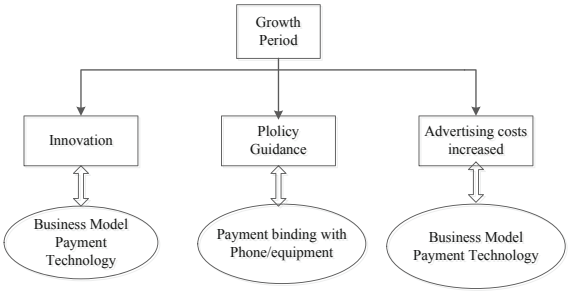

Fig. 3. Growth period

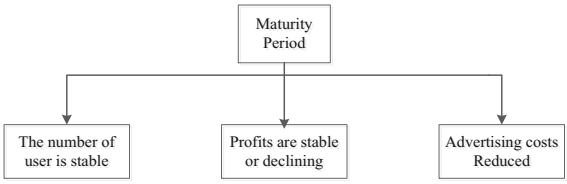

Fig. 4. Maturity period

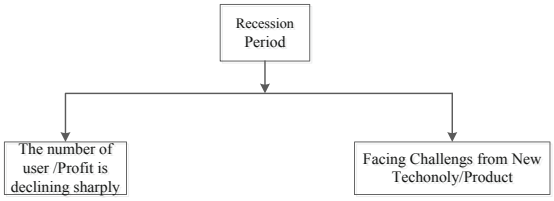

Fig. 5. Recession period

The target of user and profit is to be stable, meanwhile the upward trend tends to be flat.

Stage 4: Recession Period is shown in Fig. 5

We can see that profits of market fell sharply, then block chain played an important role.

3 Huawei Pay's Life Model

Compertz curve of life cycle we introduce is a symmetrical S curve. Figure 6 shows the Curve.

Mathematical model of curve is shown as:

$$\hat{y}_t = Ka^{b^t} \tag{1}$$

$\hat{y}_t$, K represents the value of predictive and saturation respectively, and a is the position of the curve. b is the slope. t which can be day, months and years, described time parameter.

Formula (1) can calculate the derivative and second derivative.

$$\hat{y}'_t = Ka^{b^t} b^t \ln a \ln b \tag{2}$$

$$\hat{y}''_t = Ka^{b^t} b^t \ln a (\ln b)^2 (\ln a + 1) \tag{3}$$

Set $\hat{y}''_t = 0$, inflection point P_1 can be expressed as:

$$(t, \hat{y}_t) \to \left(\frac{\ln\left[-(\ln a)^{-1}\right]}{\ln b}, \frac{k}{e} \right), 0 < a < 1 \tag{4}$$

So, inflection point of input and growth is P_1. We can see that below P_1 is input, and above P_1 is growth. If $\hat{y}_t = K$, $\hat{y}_t$ has the maximum value. Assume $\hat{y}_t = K$, t is obtained, which present the maturity time.

Maturity period consists of early and later period, which is shown as following equation:

$$t' = t \pm \sigma_i (i = 1, 2, 3) \tag{5}$$

The value of σ_i depends on length time of life cycle. For example, t' is more than 5, $\sigma_i = 3$. Let life time is from 1 to 5, then $\sigma_i = 2$.

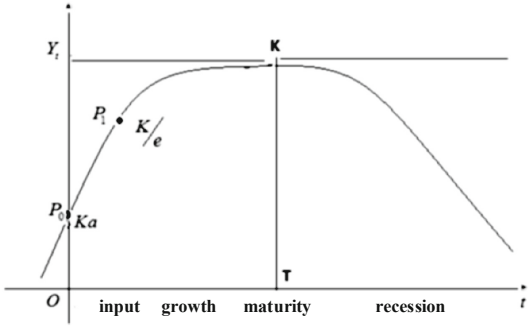

Fig. 6. Compertz curve

We take λ into the (1), and b is the slope of curve, the new life cycle model of Huawei Pay is expressed as following:

$$\hat{y}_t = Ka^{(\lambda b)^t} \tag{6}$$

Here, λ is block chain factor, and it will be used in the recession time. In former three stages, λ doesn't work. But, it will pay a important role during the recession time.

For calculating the parameters, the model can be rewritten as following formula,

$$\log \hat{y}_t = \log K + \log(a)(\lambda b)^t \tag{7}$$

Here, we make $\hat{y}_t = \log \hat{y}_t$, $K = \log K$, $a = \log a$, we can obtain the formula:

$$\hat{y}_t = K + a(\lambda b)' \tag{8}$$

Then we use the Logarithm algorithm to modify this formula.

$\sum_1 \log y_t$, $\sum_2 \log y_t$, $\sum_3 \log y_t$ is added separately to determinate the sum of the logarithm value. Lastly, several parameter $\log a$, $\log K$, b can be obtained:

$$\lambda b = \sqrt{\frac{\sum_3 \log y_t - \sum_2 \log y_t}{\sum_2 \log y_t - \sum_1 \log y_t}} \tag{9}$$

$$\log a = (\sum\nolimits_2 \log y_t - \sum\nolimits_1 \log y_t) \frac{\lambda b - 1}{((\lambda b)' - 1)^2} \tag{10}$$

$$\log K = \frac{1}{r}\left[\sum\nolimits_1 \log y_t - \frac{[\lambda b]^r - 1}{\lambda b - 1} \log a\right] \tag{11}$$

What we need to do in combination is the anti-number operation.

The above analysis and calculation are only applicable to the input, growth and maturity. For the recession, our approach is that make curve rotates 180°. It can be shown Fig. 6.

4 Compertz Prediction Model of Huawei Pay

4.1 Prediction and Calculation of Parameters

Data from related research institute, companies and departments are used in this section. The number of users can be obtained with this model.

The exact derivation steps can be shown in next calculation.

Here, we make the following assumptions: making, $r = n/3$ $r = n/3 = 6/3 = 2$, respectively. It should be noted that n is the real user number. With the date of Table 1, some important results can be obtained.

Table 1. Prediction of Huawei Life Cycle.

Year N	Time t	Real Number of User (Ten thousands)	log y_t	Forecast Number (ten thousands)	Maturity year
2016	0	90	1.95	1205.1	2078
2017	1	100	2.00	1400.8	2077
2018	2	110	2.04	1605.2	2076
2019	3	260	2.41	1952.6	2075
2020	4	310	2.50	2014.3	2074
2021	5	550	2.74	3245.4	2073
2022	6			6821.4	2072
2023	7			9100.8	2071
2024	8			9820.1	2070
2025	9			10981.9	2069
2026	10			14023.6	2068
2027	11			17058.1	2067
2028	12			19002.5	2066
2029	13			20008.6	2065
2030	14			21156.7	2064
2031	15			21156.7	2063
2032	16			23456.8	2062
2033	17			25690.7	2061
2034	18			30008.9	2060
2035	19			31005.2	2059
2036	20			32000.9	2058
2037	21			32260.6	2057
2038	22			32500.8	2056
2039	23			33000.4	2055
2040	24			33099.7	2054
2041	25			33100.3	2053
2042	26			33102.4	2052
2043	27			33168.0	2051
2044	28			33168.2	2050
2045	29			33168.4	2049
2046	30			33168.5	2048
2047	31			33168.6	---

$$\sum\nolimits_1 y_t = 1.32 + 2.17 = 3.95 \tag{12}$$

$$\sum\nolimits_2 y_t = 2.45 + 2.84 = 4.45 \tag{13}$$

$$\sum\nolimits_3 y_t = 3.09 + 3.13 = 5.24 \tag{14}$$

$$b^2 = \frac{\sum_3 y_t - \sum_2 y_t}{\sum_2 y_t - \sum_1 y_t} = \frac{0.79}{0.50} = 1.58 \tag{15}$$

With formula (10), we can obtain $\log a = 0.23$ and $a = 1.70$.
Meanwhile, we can have the value of K expressed by (16):

$$\log K = \frac{1}{r}\left[\sum\nolimits_1 \log y_t - \frac{b^r - 1}{b - 1}\log a\right], K = 33168.6 \tag{16}$$

When we take a, b and K into (1), model curve of Huawei Pay can expressed:

$$\hat{y}_t = Ka^{b^t} = 33168.6(0.23)^{\lambda 1.58t} \tag{17}$$

From 2016 to 2044, we let $t = 0,\ 1,\ 2\ \ldots\ 37$ respectively into (17), the number of user can be predicted.

4.2 Critical Point Calculation

We take $\lambda = 1$, $t = 0$, then, the inflection point P_0 can be shown:

$$P_0(t = 0,\ Ka^{\lambda b^t} = 33168.6(0.23)^{\lambda 1.58t} = 11228.09) \tag{18}$$

From input to growth, the inflection point is P1. It can be shown as following:

$$t = \frac{\ln\left[-(\ln a)^{-1}\right]}{\ln b} = \frac{\ln\left[-(\ln 0.23)^{-1}\right]}{\ln 1.58} = 8.3208 \tag{19}$$

$$\hat{y}_t = \frac{K}{e} = \frac{33168.6}{2.71828} = 12202.05 \tag{20}$$

So P_1 can be expressed $P_1(8.3208, 12202.05)$. Then, some conclusion can be obtained. Input time is from 2016 to 2024, the growth time is from 2018 to 2047.

K is the limit value, it is an important time point for maturity time. $K = 33168.6$, $t = 31$. When t = 31, the corresponding year is 2047. So, we can estimate that $2047 + \sigma_i$ is the length of lasted time. We take $\sigma_i = 3$ as shown in model, time span of maturity is from 2044 to 2050. From 2050, recession time will occur. It should be noted that, $\lambda \neq 1$, and it works as a key factor role during this times.

So, the detailed curve is shown as in Fig. 7. In each of stage of life cycle, λ has different function of Huawei Pay.

Then, the curve can be expressed as the following Fig. 6 shows. The different λ value has different effect on life cycle of Huawei Pay. It can be known clearly from Fig. 7 that λ led the line of life cycle to decline sharply (Fig. 8).

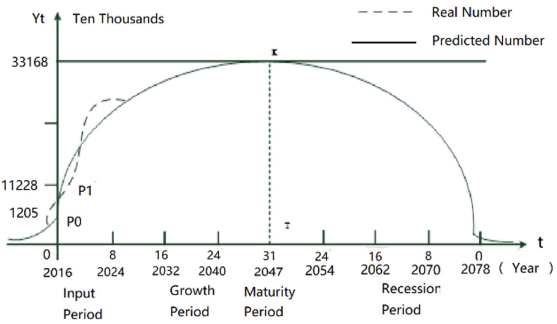

Fig. 7. Life cycle curve of Huawei Pay.

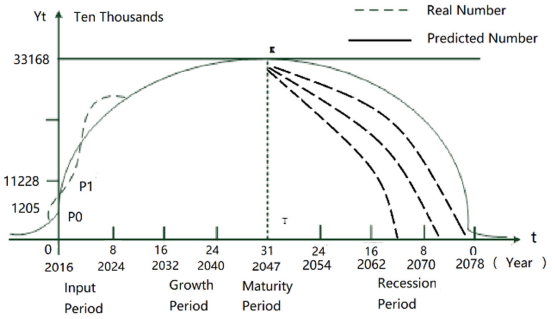

Fig. 8. Life cycle curve of Huawei Pay with λ

5 Conclusions

The lifetime Cycle and customer of HuaweiPay is analyzed based on theoretical model and blockchain factor. The research results of this thesis are of great practical significance in the application of mobile pay and other finance field.

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