



How to Measure Useful Life of Cryptocurrency Mining Hardware

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Abstract. The largest Chinese Cryptocurrency Mining Hardware (MH) Company applied half one year on useful life of MH and disclosed it as inventory. However, MH is more a fixed asset according to financial report. We want to know whether the useful life of MH is set reasonable. By proposing economic life method, we find MH's economic life over one year and it's more suitable to be disclosed as fixed asset. Besides, we disclose the recalculated values after adjusting useful life of MH in the appendix, which shows that cost of sales increases over 6.22%, and gross profit decreases over 10.95% compared to the original data in 2018. The distorted data might mislead investors, so the improved method to estimate the useful life could help objectively reflect the financial situation.

Keywords: Cryptocurrency Mining Hardware · Useful Life · Economic Life · Daily Profit

1 Introduction

As of February 2021, the total cryptocurrency market value is close to \$1.2 trillion. According to the report of Technavio, about 57% of cryptocurrency mining hardware market will originate from APAC, among which China is a key market [12]. As the only Chinese company of top five best cryptocurrency mining company, company B was established in 2013 and designed chips specialized in cryptocurrency mining [2]. In 2014, company B launched its mining pool, expanding its business such as mining service and proprietary mining. From 2015 to 2018, Company B mainly launched two kinds of MH for Bitcoin mining (In the following we call them MHA and MHB). Revenue breakdown of company B is shown in Table 1. Both MH sales and proprietary mining need MH manufactured by company B and they make up a large percentage of revenue.

In 2018, Company B disclosed its application proof and prepared for an IPO. Different from traditional financial market, the price of cryptocurrency has fluctuated violently. Company B's business has involved high-risk assets and it hasn't been listed until 2021.

Table 1. Revenue Breakdown of Company B.

Revenue (\$K)	2015-12-31	2016-12-31	2017-12-31	2018-6-30
MH sales (\$K)	107 878	214 698	2 263 237	2 683 853
Mining pool service (\$K)	295	0.2	32 906	43 217
Mining farm service (\$K)	–	–	20 592	21 823
Proprietary mining (\$K)	27 944	53 586	199 330	94 343
Others (\$K)	1 226	479	1 654	2 231
Total (\$K)	137 343	277 612	2 517 719	2 845 467
Proportion of MH sales (%)	78.5	77.3	90.0	94.3
Proportion of proprietary mining (%)	20.3	19.3	7.9	3.3

Table 2. Inventory Breakdown of Company B.

	2015-12-31	2016-12-31	2017-12-31	2018-6-30
Raw materials (\$K)	17 632	3 475	131 535	353 492
Work in progress (\$K)	3 936	27 170	188 631	309 789
Finished goods (\$K)	4 418	1 475	349 523	564 824
Proprietary MH (\$K)	4 302	5 669	27 036	50 344
Total (\$K)	30 288	37 789	696 725	1 278 449

In its application proof, MH is regarded as inventory [3]. If MH belongs to fixed asset, there must be depreciation [4, 5]. Inventory breakdown is shown in Table 2. However, it also shows that the proprietary MH earns cryptocurrency as revenue, which is more in line with the characteristics of fixed asset [6]. Besides, Company B directly set half a year as the useful life of MH. If the actual useful life of MH is longer than one year, the previous disclosure may distort data in application proof. And regarding MH as a fixed asset might be more suitable.

Originally, we try to estimate useful life by calculating the payback period of mining hardware (PPMH). However, the value fluctuates greatly and percentage of PPMH over 180 days is not low. Furthermore, we put forward ELMH method to estimate useful life, based on the characteristic that the daily profit should be greater than zero if MH does not reach its economic life. By using data from company B's application proof and coinmarketcap.com, we find that both ELMHA and ELMHB are longer than one year, which indicates that the actual useful life should be longer than one year. Considering that the purpose of holding MH is to mine bitcoin and recognize revenue, MH is more suitable to be disclosed as a fixed asset. Secondly, according to the principle of substance over form, we propose that idle MH for sale can be disclosed as inventory due to change of holding purpose. Finally, it's assumed that the useful life of MH is set from one to two years based on technical life. We recalculate the cost of sales and gross profit, which

shows that cost of sales increases over 6.22% and gross profit decreases over 10.95% compared to the original data in 2018.

2 Literature Review

2.1 PPMH

Different methods to predict the remain useful life electronic circuits were proposed [9, 10]. However, MH is different from other equipment. Factors that affect the depreciation of MH include the increasing rate of difficulty and the upgrading rate of chips [8]. The higher the difficulty is, the lower the probability of mining successfully is. At the same time, the newly developed MH would squeeze the survival space of old MH. Besides, if electricity expenses exceed the revenue, miner will turn off MH and leave it idle [11].

PPMH can help estimate useful life. In mining pool owned by company B, we find how to calculate PPMH. The theoretical production of a MH is calculated based on Eq. (1) if the MH operates 24 h a day.

$$Prd_i = H_i * \frac{1}{D_i * 2^{32}} * R_i * (24 * 60 * 60) \quad (1)$$

Prd_i means daily production of a MH on day i , Unit in pcs; H_i represents the arithmetic power of MH on day i , Unit in hash/s; R_i stands for the bitcoin reward given to miners on day i when a new block is mined, Unit in pcs; D_i stands for the difficulty of mining bitcoin across the network on day i , unit in hash/s.

We assume that the daily revenue comes from the output of bitcoin, and the daily cost only includes the cost of electricity. Equations of daily profit and payback period are shown in Eq. (2) and Eq. (3).

$$DailyProfit_i = P_i * Prd_i - \frac{P_{w_i}}{1000} * EP \quad (2)$$

$$PPMH_i = C_i / DayProfit_i \quad (3)$$

$DailyProfit_i$ means the mining profit with Mining Hardware open for 24 h. Daily Profit over zero can indicate that MH has economic value. P_i represents closing price of bitcoin on day i , unit in CNY; P_{w_i} represents the power of MH in watts on day i ; EP represents the electricity price in CNY; C represents the cost of MH in CNY. However, as bitcoin is highly volatile, so is PPMH. It's difficult to estimate the useful life by PPMH. In addition, the Eq. (3) is appropriate for miner rather than company B, which could manufacture MH with a lower cost.

2.2 Economic Life

Economic life is the estimated time when an asset remains useful to its owner. Economic life can help estimate the useful life of MH. In general, the economic life of an asset is less than its physical life. Yatsenko and Hritonenko (2011) [13] analyzed the impact of technological improvements on depreciation and salvage value. Jack (2015)

[7] analyzed economic life and argues that accounting method is affected by economic uncertainty while considering physical loss. For MH, we propose daily profit above zero as a reference standard. When the daily profit is greater than zero, MH has economic value. When the daily profit is less than zero, the MH is useless to its owner and should be left idle or sold.

3 Materials and Methods

We collect relevant data from Company B's application proof and the mining pool owned by Company B. Firstly, we assume that MHA and MHB are mainly used to mine bitcoin from 2015-1-1 to 2018-6-30 based on the business milestones in its application proof.

Besides, we downloaded bitcoin trading price and difficulty data from the "coinmarketcap.com" from 2015 to 2018. In order to calculate the PPMH, we also need electricity price data. Electricity price varies by region, and we take Inner Mongolia where Company B's largest mining farm is located as an example. After checking the price table of Inner Mongolia and news about mining, we find that in recent years mining electricity price fluctuates at 0.35 CNY/KMh. For computational convenience we assume that EP had been 0.35 CNY/KMh from 2015 to 2018.

Equation (3) is only adapted to the miners who purchased Company B's MH. The cost does not apply to Company B itself. We use the gross profit method to estimate MH's cost. The improved PPMH method is shown in Eq. (4), where $Rate_i$ represents the gross margin on day i . Gross margins from 2015 to 2018 were 52.0%, 54.5%, 48.2% and 36.2%.

$$PPMH_i^* = \frac{C_i * (1 - Rate_i)}{DayProfit_i} \quad (4)$$

$PPMH_i^*$ means the number of days that Company B who uses MH made by itself to mine for profit could cover MH's cost. Different to normal miners, Company B's just needs to cover the cost of making MH rather than buying MH, so only when $PPMH_i^* \geq 360$ can we presume useful life over one year. And $DayProfit_i > 0$ should be met when it has not reached the economic life. If $DayProfit_i \leq 0$, miners always turn off MH and stop mining. Hence, we further propose ELMH method to calculate the economic life of MH, as shown in Eq. (5).

$$ELMH_i = i, \text{ if } DayProfit_i \leq 0 \quad (5)$$

To estimate the useful life of MH, we apply both PPMH and ELMH method. PPMH method helps estimate useful life with payback period, and ELMH method calculates useful life based on economic life. We could estimate the useful life of MH from two sides.

4 Results and Discussion

PPMH means the payback period of mining hardware for miners; $PPMH^*$ means the payback period of mining hardware for Company B. The Fig. 1 illustrates the Daily Profit and PPMH based on the actual bitcoin time-series data and Eq. (2), (3) and (4).



Fig. 1. Daily Profit and PPMH from 2015-1-1 to 2018-6-30.

Table 3. Descriptive statistics for full sample from 2015-1-1 to 2018-6-30.

	N	Minimum	Maximum	Mean	Std. Deviation
Daily Profit	1277	13.47	262.29	83.38	45.36
PPMH	1277	53.38	1039.17	207.45	134.66
PPMH*	1277	27.65	662.99	109.07	87.22

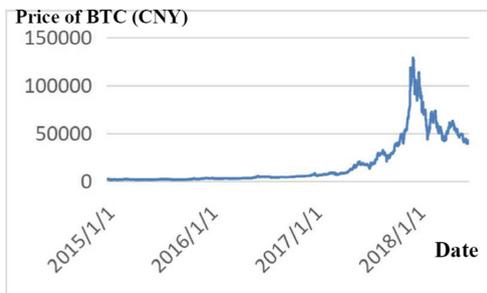


Fig. 2. Price of BTC from 2015 to 2018 based on data of coinmarketcap.

Figure 1 also shows the trends of PPMH, PPMH* and Daily Profit from 2015-1-1 to 2018-6-30. All of them fluctuate greatly. Although PPMH and PPMH* have consistent trends, the value of PPMH* has been lower than it of PPMH. The cost to acquire MH is different for miners and company B. Although daily profit is the same for miners and company B, company B could manufacture and acquire MH with a lower cost.

Table 3 shows the relevant descriptive statistics. The mean values of PPMH and PPMH* were 207 days and 109 days. There are 571 samples with PPMH > 180, accounting for 44.7% of all samples, and 118 samples with PPMH* > 180, accounting for 9.2% of all samples. The percentages of PPMH over 180 days are not low for either miners or Company B. Therefore, it is unreasonable for Company B to directly set the useful life of MH at 180 days.

Prd-A real means the number of BTC production after mining machine A is launched; Prd-A virtual means the number of BTC production after mining machine B is launched; Prd-B real means the number of BTC production after mining machine B is launched; Prd-B virtual means the number of BTC production before mining machine B is

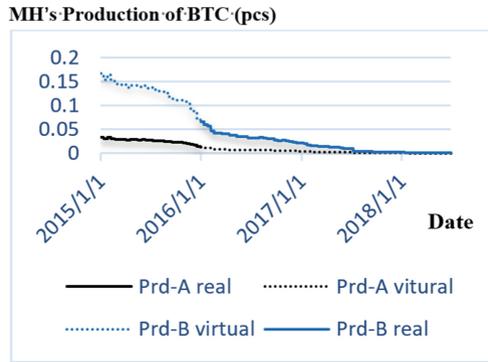


Fig. 3. MH's Production of BTC

launched; The Fig. 2 and Fig. 3 illustrate the price of BTC and Production of BTC based on bitcoin time-series data and Eq. (1).

Daily profit depends on the price and production of BTC. And trend of BTC's price is consistent with trend of daily profit to a degree. On 2016-1-1, upgrading newly developed MHB makes Daily Profit mount greatly because MHB could produce more BTC than MHA. However, the value of daily profit gradually falls back. One reason is that Prd-B is very small in a high difficulty network in 2018. And another reason, we think, is that MHB has reached its technical life. If MHA was still used after 2016-1-1, its value would still be lower than MHB. However, there is no clear distinction after 2018-1-1. Both MHA and MHB are "out of date".

Changing MH has a significant impact on the value of Daily Profit, but the impact returns to the original level over time. Based on the white paper of BTC, the reward of mining change from 25 to 12.5 on 2017-7-10, which made Daily Profit decline sharply. However, the price of BTC mounted to a new degree in 2017-12, making Daily Profit higher than any before.

The result shows that Daily Profit has been over zero from 2015 to 2018, so we apply the ELMH method to estimate useful life. Daily Profit over zero can indicate that MH has economic value. Therefore, we propose to accumulate the number of days with Daily Profit > 0 . We find $ELMHA = 365$ and $ELMHB = 911$. The economic life of MHA and MHB are longer than one year from 2015 to 2018, from which we conclude that the useful life of MH is over one year.

Proprietary MH for own use to produce bitcoin can be considered a fixed asset of Company B if its useful life is longer than one year. When MH for own use reaches its economic life, Company B will shut down MH and stop mining. However, MH reaching economic life can still be sold to other miners, so the purpose of holding MH becomes sale to customers, which meets the definition of inventory. Based on the principle of substance over form, the portion of derecognized MH could be converted to inventories for disposal.

We propose to divide proprietary MH into MH for own use and idle MH. MH used for mining purposes should first be disposed of as fixed assets. Periodically, the useful life of MH is revised in terms of economic benefits, determining whether MH for self-

use needs to be discontinued for confirmation. Upon recognition that MH has reached the end of their economic life, it is transferred to inventory held for sale.

5 Conclusions

Firstly, we use economic life to estimate the useful life of MH and propose the ELMH method to calculate it. We find that the economic life of MH is significantly longer than one year, indicating that the useful life is also longer than one year. Secondly, we propose to divide MH into MH for own use (fixed asset) and idle MH (inventory) to alleviate the problems in accounting practice. Due to the change of holding purpose, idle MH for sale can be disclosed as inventory according to the principle of substance over the form.

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Appendix

After estimating useful life by using ELMH method. It can be assumed that the useful life of MH is longer than one year. However, it's not accurate. Lugovskoj et al. (2001) [1] thought that technical diagnostics should be done on technological equipment to determine its residual service life. Based on it, we think that technical life of MH means the time that old MH is replaced by a new, more advanced MH. If Moore's Law 3 also applies to chips for mining, we assume that the technical life of mining hardware is less than two years, which could help set the useful life of MH from one year to two years. Change in accounting method could be applied if it could correct the amounts in statement. We want to recalculate cos of sales and gross profit in 2018.

Adjusting useful life affects the carrying value of derecognized MH, which in turn affects cost of sales and gross profit. Company B does not separately disclose the cost of sales for MH, but it can be estimated based on the inventory turnover days. As some data are missing, the accounting period from 2017-12-31 to 2018-6-30 is used for estimation. We assume that the final residual value is 30% and straight-line method is still used for depreciation, which is the same with notes in application proof.

Cost of sales includes sales of finished goods and idle MH, we separately estimated cost of sales for proprietary MH. Besides, we recalculate cost of sales and gross profit after setting useful life as 1 year, 1.5 years and 2 years based on straight-line method. Cost of sales and gross profit under different useful life are shown in Fig. 4.

After adjusting the useful life, cost of sales (absolute value) increases B's cost of sales by at least 6.22% compared to the original date, while gross profit decreases by at least 10.95% in 2018. In application proof, company B stated that it made a substantial provision for inventory impairment in 2018 (RISK FACTORS P-47): "An inventory impairment provision of \$391.3 million was recorded due to the decline in the market price of cryptocurrency."

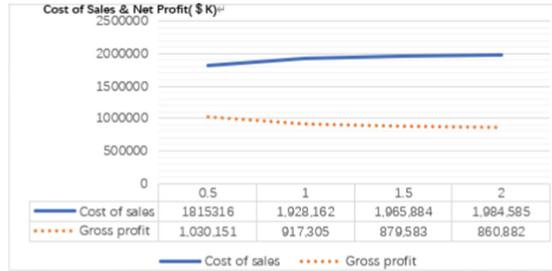


Fig. 4. Cost of Sales (absolute Value) & Gross Profit under Adjusted Useful Life.

Short useful life and large inventory impairment charges may have distorted the data presented by Company B. Therefore, the improved method to estimate the useful life could help objectively reflect the financial situation of Company B.

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