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The Impact of a Final Product Release to the Share Price of a Manufacturing Company

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Abstract: In this research we study how the release of the product to the market (release of computer game in this case) may affect the share price of its developer/publisher. Financial data were obtained for 9 public companies-developers/publishers of computer games which satisfy three pre-defined criteria. Then all games developed/published by the companies were examined and 69 games published during period from 2004-2013 were selected in accordance with three other criteria. After that the data were processed by two methodologies. The first methodology is a set of ordinary linear regressions where the dependent variable is the cumulative daily return on shares of a developer/publisher of the game and the explanatory variable are the factors of the financial performance of the company, industry, country as well as the actual and the expected quality of the game. The second methodology is a type of event analysis in which the dependent variables are abnormal return and cumulative return of excessive shares. In both cases for estimation of real quality of the game average expert score from Metacritic website was used whereas expected quality was modeled using adaptive expectations method which took into account real quality of previous games of corresponding developer/publisher. With the first method it was found that the release of information about the game and the quality of the game itself increases the quality of the forecast the company's share price by >25-45% but only for the first two days after the release. The results of the second method show that the release of any game causes a short-term excessive increase in the share price by 1.83% and with the release of a "good" game causes a 3.96% increase. The results can be used by investors to obtain additional return and by management of manufacturing companies to understand better the factors which influence the value of their company. These results also carry inference that the release of the product (computer game) has a positive short-term impact on the share price of the manufacturing company, especially if the quality of the product turned out to be higher than expected.

Key words: Price, share, profitability, securities market, product, capitalization

INTRODUCTION

Release of the final product to the market (the release of a computer game in this case) is an important event for its developer and publisher. Some games are designed for many years (for example, Half-Life 2, DukeNukemForever, etc.) sometimes determining the future success of the company. According to Baker (2011), investors take into account information about the release of the game when trading shares of companies-developers of video games. However, despite this, there was found no any academic research on the topic. This is a serious gap that will be partly removed in this research. The results of this study are of interest for the three types of agents:

- Investors which will be able to improve the share price forecast and earn extra profit
- Owners/top managers of companies engaged in the development/publishing of computer games (they will figure out how customers expectations can affect the capitalization of their company)
- Consumers/players (if they learn that their opinion has a significant impact on the company, the more likely they will be motivated to give feedback to the developers more frequently)

In the first place, the type of research will be discussed in detail. There after, the data and methodology of the final sampling will be described. Then two approaches to estimate the impact of the event in

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question to the share price as well as results obtained with these approaches and recommendations for investors will be considered and applied. Finally, researcher will consider the shortcomings of the research and conclusions will be made.

General type of the research: In this research, we used quantitative (correlation) type of research. It suits well to this topic for several reasons.

First, the main purpose of this research is to test the causal relationships and any other type of research cannot give us so accurate tools to perform this task. Secondly, using this type of research it will be easier to find a suitable methodology for testing the impact of release of the game as most articles on event-analysis. The common name of researches that investigate the impact of an event on a certain parameter, mainly on the share price use the correlation type of research. Thirdly, the research must have high external validity (as it is assumed that the work can be of use to investors for predicting share prices of companies-developers/ publishers of computer games); correlation type of research has such an advantage due to the large number of investigated cases.

Data and sample: This study is entirely based on secondary data. All financial information (share price, market indexes, accounting rates, etc.,) was obtained from Bloomberg; information about the date of release of the games was taken from the official developer/publisher sites. Data on the quality of the games was taken from the site Metacritic (the quality is evaluated on a 100-point scale).

Firstly, the news agency Bloomberg data base was used in order to find all the public companies that develop/produce computer games. Then three constraints were imposed to this list of companies:

- The company must develop/release at least one computer game in the interval from 2004-2013
- The company's shares shall be traded for at least 500 day during the above time period
- The main income of the company must be obtained through the development/production of video games

The first constraint was made in order to avoid inclusion in the sample of very old games that were released when the market was very different from today's. The second is intended to increase the statistical power of the tests: if to include into the sample the companies with an extremely illiquid shares, it is very likely that the relationship between the share price and the release of the game will not be detected even if it exists. The latter constraint has been imposed for the same reason: it is logical to assume that for such giants as Microsoft or Sony (they also develop and produce computer games) release of a game will not have a significant impact on the price of their shares as this event is not significant for these companies while for example, each game release is extremely important for Activision Blizzard. The latter constraint simply separates these two types of companies.

After the imposition of constraints only 18 companies have fallen in the sample. However, since financial data processing is extremely time-consuming, it was decided to pick 9 companies randomly. The list of companies which shares were considered in this study are presented in Fig. 1.

The next step is to choose the games that have been developed/published by the above-mentioned companies. There are also three constraints:

- Information on the release date of the game and its quality should be available
- The game should be released at least the second for the company under consideration
- For 60 day before and 10 day after the release of the game the company under consideration should not produce a release of any other game.

The first constraint is imposed in order to ensure the availability of all necessary information. The second constraint-to estimate the expected quality of the game was possible. According to the method of adaptive expectations which will be applied in this study, the expected quality of the game depends on the actual and expected quality of previous games of the company. If the considered game is the first for the company then the estimate of expectations is not possible. The third constraint was introduced solely because of the peculiarities of the methodology used: for the qualitative estimation of the impact of events on the price of shares it is necessary to ensure that no other similar events occur during this period (MacKinlay, 1997).

After imposing all the constraints 69 computer games (releases) left in the final sample. Full list of games under consideration is shown in Fig. 2. It is possible verify that the resulting sample is representative: it contains games of different genres from different countries with different quality and the release date. This will ensure a high external validity of the results.

MATERIALS AND METHODS

This approach uses the methodology which resembles a conventional regression analysis and has been widely discussed in the study by Binder (1998). For each game, the share price behavior is studied on the day of release and 21 day after it (which is approximately equal to one calendar month). Such a long period of time was chosen in order to examine how long, on average, an abnormal rate of return due to the inefficiency of the market after the release of the game appears (if the market was effective, the share price would have changed immediately after the release).

The dependent variable in the regression for each day is the cumulative return per share on this day . The share price alone cannot be the dependent variable due to autocorrelation violating the Gauss-Markov conditions. Where is the cumulative return in the ith day after the release of the game with

P_t-the closing price in the t-th day after the release of the game. Cumulative returns for 22 day (including the day of release) can be represented as a matrix (Fig. 1):

- Where game game is a computer game under number n
- Day i is ith day after the release of the game

In order to predict the cumulative return for each day, it is required to take into account not only the information about the actual/expected quality of the game but also to control other variables that could affect the profitability of the shares. Therefore, own regression is displayed for each day. Model of cumulative returns for each day is as follows:

$$CR_i = \alpha + \sum_{t=1}^{n} (\beta_t X_t) + \varepsilon_i \quad (1)$$

Where:

X_t = An explanatory variable t (discussed below)

ε_i = An error for the ith regression

This approach has certain constraints which will be discussed in detail in the section "shortcomings".

Estimation of the explanatory variables (the actual and the expected quality of the game): Event classification is a common practice for event analysis. For example, Ball and Brown (1968) separated the announcements of company earnings into "good" and "bad" depending on incomes in a previous period. Therefore, in this study it is also necessary to develop a method of discrimination of studied events (which are game releases here):

- To do this, you must determine
- What is the true quality of the game released
- What were the expectations of the quality of the game released

Comparing these two parameters, it is possible to determine what information (negative/neutral/positive) is carried by a release of the game. Unfortunately, there is no a universal way to estimate these parameters and it must be created.

The most obvious way to estimate the quality of the game is the use of estimates from reviews of computer games. This method seems to be very reliable: according to Baker (2011), reviews of games largely determine the behavior of consumers and can predict the commercial success of a game. In addition, the Deloitte (2007) study indicated that a review of a product influenced the decision to purchase 82% of respondents.

In this study, researcher will use the average expert estimation from the site Metacritic. This source was chosen for several reasons. Firstly, it is widely used both by scientists (Plucker *et al*., 2009; Situmeang *et al*., 2014) and investors (Baker, 2011). Secondly, it contains the evaluation of most computer games, respectively, the probability to miss an unpopular game will be within the statistical error that increases the external validity of the study. Thirdly, the site provides a relatively objective estimation of the game quality due to the aggregation of a plurality of expert evaluations what increases the internal validity of the research.

Since it was not revealed any data source which would provide information about the expectations of the quality of computer games the assumption was made in the study that expectations follow the model of adaptive expectations:

$$E(Q_i^n) = E(Q_{i-1}^n) + \lambda \times (Q_{i-1}^n - E(Q_{i-1}^n)) \forall i \neq 1, \lambda \in [0;1] \quad (2)$$

Where:

Q_i^n = The actual quality of the ith game in a row for the company n

$E(Q_i^n)$ = The expected quality of the ith game in a row for the company n

λ = The discount rate what determines how much the difference between the actual and the expected quality of the previous games influence the expected quality of thegame

Here, it is assumed that $\lambda = 0.5$. Using this model ensures a balanced and gradual adaptation of expectations: if the quality of a previous game in the

company proved to be too high/low relative to expectations, it will have no tangible effects on expectations about the quality of the game in question. However, if the actual quality of the many games in the past turned out to be above/below the expectations, the expectations of the quality of the new game will be significantly changed.

Adaptive expectations model is also quite interesting as it displays some of the psychological aspects of consumer behavior. For example, Erdem (1998) and Situmeang *et al*. (2013) argued that consumers associate the properties (including quality) of previous goods produced by a particular company with the properties of the current products. Anderson (1973) and Oliver (2009) also argued that the success of the previous products increases the expected quality of future products of the same company. These empirical results are accepted into account by the adaptive expectations model.

Selection of control variables: There is an impressive amount of academic literature offering a variety of options that can be used to predict the daily return on share. For example, Scholtens and Wang (2008) found that the return on share is positively correlated with the market return, the price of oil but negatively correlated with the ratio of the company's book value to its market value. Lakonishok *et al*. (1994) argued that the information on incomes, dividends and book value of the company in prior periods may be successfully used to predict share returns. However, some scientists support the hypothesis of efficient markets and argue that it is impossible to predict the share price (Kim and Shamsuddin, 2008; Fama and French, 1993). Therefore, the choice of control variables is highly controversial, as no matter what set of parameters would have been chosen it may still be criticized. Furthermore, some important parameters may not be included in the model due to lack of knowledge that will lead to an error of dropped variable. However, the most available and important parameters were considered in this study (their full list is given in Fig. 2).

It is worth noting that for all financial parameters ("price/earnings" ratio, capitalization of the company, etc.,) we applied not an absolute value and its annual percentage change. This was done because by Collier (2012) accounting ratios and other financial information must always be compared with something: with the expected value, the value of this parameter in a competing company or the value of the previous periods. Accordingly, the latter option was chosen because of its accessibility.

Data analysis: After defining the variables and the sample there was formed an information set for each day. The set is as follows (Fig. 1):

	game _1	game_ 2	...	game _ n	...	game _ 69
day _0	CR_0^1	CR_0^2	...	CR_0^n	...	CR_0^{69}
day _1	CR_1^1	CR_1^2	...	CR_1^n	...	CR_1^{69}
...	...	...	...	...	...	...
day_ i	CR_i^1	CR_i^2	...	CR_i^n	...	CR_i^{69}
...	...	...	...	...	...	...
day _21	CR_{21}^1	CR_{21}^2	...	CR_{21}^n	...	CR_{21}^{69}

Fig. 1: Matrix

dependent variable	independent variable					
CR_2^1	$indret_2^1$	$Cntret_2^1$	...	$Expindex_4^1$	$Good_2^1$	Bad_2^1
CR_2^2	$indret_4^2$	$Cntret_4^2$	...	$Expindex_4^2$	$Good_4^2$	Bad_4^2
...	...	...	...	...	...	...
CR_2^n	$indret_2^n$	$Cntret_2^n$	...	$Expindex_2^n$	$Good_2^n$	Bad_2^n
...	...	...	...	...	...	...
CR_2^{69}	$indret_2^{69}$	$Cntret_2^{69}$	...	$Expindex_2^{69}$	$Good_2^{69}$	Bad_2^{69}

Fig. 2: Day X

It is necessary to solve the multicollinearity problem before obtaining a final model. To do this, parameters with VIF (Variance Inflation Factor) higher than five are removed from the model one by one. The final model for each day is as follows:

$$\begin{aligned} CR_i = {} & \alpha + \beta_1 indret_i + \beta_2 ?ntret_i + \beta_3 prev\_ret_i + \\ & \beta_4 PEchange_i + \beta_5 Pbkchange_i + \beta_6 Capchange_i + \\ & \beta_7 Equitychange_i + \beta_8 EPSchange_i + \beta_9 Quality_i + \\ & \beta_{10} Expindex_i + \varepsilon \end{aligned} \quad (3)$$

In this model are of interest not only the sign and significance of the coefficients of the parameters and but also the extent to which the inclusion of these parameters (which provide information about the released game) into the model increases the quality of its forecast. For this purpose two types of models were created; some of them include some information about the game (and), others do not and then their coefficients of determination should be compared.

RESULTS

The regression analysis results are presented in Despite the fact that a small number of factors were significant, those used to explain the possibilities of the models were quite high: the average adjusted determination coefficient is equal to 46.1% with a range from 31.9-55.4%.

The coefficient of "quality game" parameter was statistically significant only in the day of release while the index of "expected quality of the game" was statistically significant in the 19th day after the release. However, this is not so important. Histogram 1 shows that the inclusion of information about the expected/actual quality of the game at the release date and the next day significantly increases the quality of the predictions of cumulative

return on share. Therefore, it can be concluded that allowance for the information about the release of the game can be useful to predict the share price of its developer/publisher on the day of the release and on the next day; the usefulness of such information for the next days is very small. It is worth noting that only the actual quality of the game was statistically significant but not the expected quality. This can happen for two reasons. Firstly, perhaps, almost no one in the financial market takes into account expectations of players and therefore the difference between the expected and the actual quality (this is what reveals the expectations index) becomes useless. Secondly, it is possible that expectations are important in fact, but in this study they were not modeled properly causing their insignificance.

Recommendations: Despite the fact that in most cases the parameters of the game released were not statistically significant, investors should take into account information about the game release upon speculation in shares of developers/publishers of video games for 48 h after their release. If the quality of released games were high, then, all things being equal, the share price will rise. If, after the release of the game more than two trading days have spent, the information on it would likely be useless.

Second approach: This study represents an alternative approach to estimation of the impact of a computer game release on the share price. This approach uses the classic event analysis which has proved its reliability and validity in such researches as MacKinlay (1997) and Binder (1998). The main ideas of the approach:

- Determine how the share price should change during the release of the game if it (release) would not be present
- Compare the expected share price behavior with the real one
- And to conclude whether this difference is statistically significant

Classification of games releases: First it is necessary to determine which news a particular release of the game bears for the financial market: some of them carry a positive message, the another negative, so it is advisable to analyze the different types of events separately. In this research, the type of news is determined by how the quality of the game corresponds to the expected quality and is calculated according to the formulas. Release of the game is considered "good" if:

$$EM_i = \frac{Q_i - E(Q_i)}{E(Q_i)} > 0.1 \quad (4)$$

"Normal" if:

$$EM_i = \frac{Q_i - E(Q_i)}{E(Q_i)} \in [-0.1;0.1] \quad (5)$$

"Bad" if:

$$EM_i = \frac{Q_i - E(Q_i)}{E(Q_i)} < -0.1 \quad (6)$$

Where:

EM_i = The percentage by which the actual quality of the game i was higher/lower than the expected quality
Q^i = The actual quality of ith game
$E(Q_i)$ = The expected quality of ith game

After using this classification it becomes clear that in the sample there are present 16 bad, 30 normal and 23 good releases. In the future, these three groups of events will be analyzed separately to increase the accuracy of the study.

Definitions of the expected behavior of a share price: After the discrimination of releases in the three groups, there is a need to model how the share price should behave if the game release would not be present. Upon that, it is interesting not only the behavior on the day of release and a few days before and after it. A group of days for which the share price behavior will be considered is called "event box" where 0 is the day of release. In this research, event box includes 21 trading day that is 10 day prior to the release of the game and 10 day after the release are considered.

Once the days for which it is necessary to simulate a "normal" behavior of the share price are determined, it is possible to pass directly to the most modeling. To do this, a regression should be created that uses the behavior of the share price from the "estimation box" to predict a price in the "event box" (Fig. 1); the estimation box in this study is 50 trading days. It is understood that about the game's release the share should behave roughly according to the same principles and rules as in the previous 50 day. In other words, the coefficients for each parameter in the estimation box shall be equal to the coefficients in the event box for each release and the dependent variable is the daily return on share what is equal to:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (7)$$

where, P_t the share price on day t. Regression also includes two types of explanatory variables: industry risk

factor (represented by daily return for industry share index) and a risk factor for the country where the company is located (represented by daily return of the share index of the country and the daily percentage change in home currency rate to the US dollar for all countries except for the US). Eventually, the regression is as follows:

$$R_t^{share} = \alpha + \beta_1 R_t^{industry} + \beta_2 R_t^{country} + \{\beta_3 R_t^{currency}\} + \varepsilon \quad (8)$$

Where:

R_t^{share} = Daily return on shares in day t (one of 50 day of the estimation box)
$R_t^{industry}$ = Daily return on industry share index in day t
$R_t^{country}$ = Daily return of the country's share index
$R_t^{currency}$ = Daily percentage change in home currency rate to the US dollar
ε = Error

When calculating the regression, attempts have been made to minimize the number of insignificant parameters and at the same time to maximize the determination coefficient (R^2). The minimum value of R^2 of all 69 regressions is 0.11%, the maximum is 57.35%, the average is 21.16%. That is the risk factors described above explain on average, higher then 20% of the variance of daily return on shares. However, it should be careful upon interpretation of results, since in some cases the determination coefficient is not >1% what means that for some releases it has not managed to determine the mechanism of share price changes with sufficient quality.

Using the coefficients shown in the previous equation, the expected daily return in the event box for each of 21 day and for each release is calculated by the eqution:

$$E(R_t) = \alpha + \beta_1 R_t^{industry} + \beta_2 R_t^{country} + \{\beta_3 R_t^{currency}\} \quad (9)$$

Testing the deviation from the expected behavior of share price: Now we need to calculate how the actual behavior of a share differed from the predicted (i.e., to calculate the abnormal return) and if this difference is statistically significant, we should conclude that the difference was caused by the release of the game. Abnormal daily return is calculated as follows:

$$AR_t^n = R_t^n - E(R_t^n) \quad (10)$$

where, AR_t^n an abnormal daily return (abnormal return) in the ith day of the game (n). After that, it is necessary to determine whether an average daily abnormal return significantly differs from zero (if the release of the game does not affect the behavior of the share, then, on average, the abnormal daily return should be approximately equal to zero). Abnormal daily average return is calculated as follows for each of 21 day of the event box:

$$AAR_t = \frac{\sum_{n=1}^{69} AR_t^n}{69} \quad (11)$$

where, AAR_t is average abnormal daily return (average abnormal return) in the ith day. After AAR is counted for each day, the significance of its difference from zero is tested using Student's t-test. Hypothesizes are as follows:

$$H_0: AAR_t = 0$$
$$H_1: AAR_t \neq 0$$

DISCUSSION

AAR values and test results for all types of gameevents are presented in. It may be noted that the only significant AAR was detected only for 3 day before the bad release. The result is unconvincing: only one significant value for 84 AARs that could happen by accident. Therefore, it can be concluded that sufficient evidences were not found to say that abnormal profitability is more/less than zero in any of the day.

However, AAR is not a single indicator that allows us to understand the behavior of a share price. Abnormal returns received for a certain period of time could be summarized and we can understand what the overall abnormal return might be received by the investor owning an asset at a predetermined time interval. This measure is called the Cumulative Abnormal Return (CAR) and is calculated as follows:

$$CAR_t^n = \sum_{i=-t}^{+t} AR_i^n \quad (12)$$

Where:

CAR_t^n = Cumulative abnormal return from ownership of the asset n in the range of from-t to+t. The intervals are usually chosen symmetrical and day of the event t = 0 is exactly in the middle
Ar_i^n = Abnormal profitability of ownership of the asset n in the ith day before/after the game release

In order to determine whether CAR is significantly different from zero, it is necessary to use a t-test for average CAR value for each period (as was done for AR). It was decided to select three intervals with sizes 5, 11 and

21 trading day (which is approximately equal to one, two or four calendar weeks, respectively). Values CAAR and their statistical significance are shown in. For better visualization the values CAAR for "all", "good", "normal" and "bad" releases are presented in diagrams.

It can be concluded from the table that by buying a share of the developer/publisher for 2 day before the release of each game (regardless of its actual and expected quality) and selling it since 2 day after its release, the investor will receive, on average, a statistically significant abnormal return equal to 1.83%. However, if an investor will invest more thoughtfully and use this strategy only for the release of "good" games, his/her income will increase >2 times and will be equal to 3.96%.

Release of the usual and bad games has not revealed statistically significant abnormal return. As for the time interval of 21 day none CAAR was significant what may indicate that the share price of a computer game developer/publisher come to equilibrium less than in two weeks after the release.

Assumptions: Despite our desire to make this research as accurate and valid as possible, it still has several shortcomings which can be corrected in the next researches. Three major shortcomings were found: the problem of sampling, estimate of the expected and the actual quality of the game and the model specification error.

Total 18 companies were included in the original sample. However, it is possible that some small companies were not included in it due to the fact that they simply have not been found upon searching. Therefore, it can be argued that the sample was obtained in a way convenient for a researcher rather than random, what formally prohibits to generalize the results of this work. In addition, the second constraint imposed on the companies for their inclusion in the sample likely excludes the small companies with illiquid shares while on the contrary, the third constraint excludes large companies. The first constraint on games excludes unpopular (no reviews) games from the sample. All these constraints reduce the external validity of the research.

Estimation of the expected and the real quality of the games can also be subject to criticism. Firstly, there is no evidence that the average expert estimation shows the true quality of the game. Sun (2012) argues that expert opinions are usually strongly polarized making the variation of expert opinions higher the variation of the true quality of the games. Situmeang *et al.* (2014) notice that the experts are quite conservative and are not used to put too different ratings for the games from the same series: only a very large deviation from normal quality can make them change their minds that on the contrary reduces the variation in estimates. Secondly, there is no evidence that expectations about the quality of the game are generated by adaptive expectations model with discount factor = 0.5. The existing model of expectations also does not include a set of parameters that can potentially influence the expectations of players. Therefore, the approach to the estimation of the expected and the real quality is not accurate, it reduces the internal validity and a test power.

Last major drawback lies in the choice of control variables. It is possible that some important parameters are not included in the model. For example, French (1980) and Lim *et al.* (2010) proved the existence of seasonal effects in the share price, namely the return on shares in Monday are significantly lower than in other days, so it would be reasonable to add to the basic regression a dummy variable "Monday".This was not done because of the complexity of the process. In addition, the opinions about the presence of so-called "Monday effect" vary greatly in the academic environment. So may be the model in its current form is specified incorrectly what reduces the accuracy of the results.

There are a few minor drawbacks. Firstly, the difference between the developers and publishers of computer games was ignored (this reduces the accuracy of the study). Secondly, we cannot be sure that the results obtained in this study will be useful in the future, given the innovative nature of the video game industry (this reduces the external validity). Thirdly, the study assumes that the information about the quality of the game is available only after the release of the game that is not true since beta versions are released for many games by that the quality of the final product can be estimated with sufficient accuracy (this reduces the representativeness of the test).

CONCLUSION

In this research, evidences were found that the release of the game (especially the one quality of which has exceeded expectations) on average has a positive effect on the share price. This effect lasts for a few days after the release. However, taking into account the shortcomings of the study it is reasonable to double-check the results before their application or at least use the study to predict the share price for only known developers/publishers which receive revenues primarily from the sales of video games, only after the release of the popular games.

RECOMMENDATIONS

This methodology seems more "representative" than the previous one, so investors should pay particular attention to its results. However, it should be understood that it is also more complex and cannot take into account such financial indicators as the annual change in earning per share as the value of this indicator in the 50 day time frame is static.

The results of this methodology are a bit similar to the previous ones. Investors should buy shares in a couple of days before the release of the game and then sell them 2 day after the release. It would also be beneficial for the investor to pre-determine whether the game will be "good" and apply the above-mentioned strategy only for such games to double profit from each transaction. It should be noted that the period during which it is possible to receive abnormal profits is very limited: for a 21 day interval, even average cumulative abnormal rate of return for "good" game was not significant, so investors need to react quickly to events to make a profit.

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