Financial Leverage Trap

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Abstract

Recently yet larger attention is paid by economists to problems producing unstable financial situations. When latter economic crisis began, a part of economists understood, that the existence of economic crisis is a defect of the world economy system itself, the result of its imperfection. The cause of financial crisis is not some cosmetic economy defect, but a substantial feature of the system, maybe even its flaw, which rushes to experience recurrent shakes not only separate economies, but also all world economy system. Last decade research identified that "flaw" – two economical paradoxes, occurring as rising profitability and debt trap paradoxes. They occur only when markets become saturated. Ant the globalization keeps stimulating these processes. In the article the reader is introduced with the influence of market saturation and economical paradoxes on investment with financial leverage. It is showed, how logistical model highlights loan capital specific behavior, and the logistical growth dynamics of investment with a negative member.

Keywords: financial leverage, capital gearing, logistical model, market capacity.

1. Introduction

Modern literature notes, that such investment with leverage is highly risky. It is stated, that capital, credit, market, currency, inflation, liquidity, systemic and other risks may be experienced while investing. Literature also notes, that more funds may be lost than there was lodged in guarantee deposit account, because the size of initial margin (of guarantee deposit) is relatively small compared to the value of future contract (Helfert 2001, Sornette 2003). Notably, though risks are high, but their source is not indicated.

Theme relevance (topicality). In economic growth, as in each nature's or social life area, market economy laws express through outwardly looking chaos and randomness chains. Admittedly, internal laws control both individual economic processes, and whole economic growth overall.

Primarily the problem of market saturation and economic paradoxes arises, while analyzing unstable financial situations. The research of market saturation together with application of logistical analysis allows merging contradictory areas of modern economy theory. Through logistical analysis recently discovered paradoxes cause crisis situations in economy. However, it is hard to identify and properly assess them because of their unusual behavior. If you want to understand the operation of economical paradoxes, it is necessary to fathom out the market capacity term, to distinguish closed and open market, to understand market saturation phenomenon.

Modeling capital growth, it was determined that saturated markets behave differently from unsaturated ones. Increasing profitability paradox causes economic bubbles, and debt trap paradox – suddenly increasing debt service weight and debtor bankruptcy. Logistical analysis allows to explain not only the causes of crisis, but also to prefigure means of crisis reduction.

The purpose of the article – to present the evaluation model of debt trap paradox and financial leverage risk investing in stock markets. To gain one's aim, these tasks are posed:

- to show, how market saturation is coherent to market capacity;
- to analyze debt trap paradox;
- to discuss and analyze financial leverage characteristics;
- to compile financial leverage mathematical model;
- to compose financial leverage trap model using logistical analysis tools;
- to examine and to describe financial leverage trap model;
- to analyze financial leverage trap case.

2. Market capacity. Market saturation.

Market is a trade field, where buying and selling processes take place. It means, that at least two participant act in the market: seller and buyer. Trade sustainable in the market is based upon principle of equivalence. Equivalence is based upon the price of commodity or services, which is actually monetary term of commodity value. Thereby, benchmark of one of the most important processes happening in the market is capital, its quantitative term. In capital capacity aspect, markets can be **closed**, **open** or **semi-closed** (generally these markets are common). All markets have their own capacity (the capacity of endless market is also endless) (Knyvienė I., Girdzijauskas S., Grundey D. 2010).

Market capacity can be understood as the amount of capital that could be effectively assimilated in a specific investment environment. The main characteristic of market capacity is potential capital. Market capacity – is the largest theoretically possible sales amount of particular product or service, which could be reached by all companies in the market in a definite time. If products or services of the same market are constantly produced and increasingly sold, market gradually fills and market **saturation** is reached. Term "saturation" usually means fullness, filling to the limit, complete load, satiety. (Burns A., Mitchell W. 1946, Knyvienė I., Girdzijauskas S., Grundey D. 2010, Girdzijauskas S., Mialik A., Jociūtė E., Zujytė N. 2011).

For example we know, that in 100 mili-litres of room temperature water one can dissolve only 35.9 grams of edible salt. And not a milligram more! And how is with capital? Is it really possible to invest as much as we want into a limited size market?

Saturation conception is very common in natural sciences and in the field of technologies. Saturation is very important in chemistry, physics, biology, medicine and etc., while in economics no attention was paid to saturation. To saturate market, it has to be finite or closed. The size of such market is defined by its capacity. We can consider, that an endless market could not be saturated, because its capacity is endless and market can never be entirely filled (Girdzijauskas S. 2006, 2010, 2011, Girdzijauskas S., Štreimikienė D. 2010).

Overall, whole market capacity could be understood as comprising of two parts: of already filled part and of not filled part. Let's entitle already filled market *real market*, and not yet filled – *market niche*. Then *market capacity* will be equal *real marker* plus *market niche*, i.e.:

$$Market\ capacity = Real\ market + Market\ niche$$

That way semi-closed, and especially closed markets, can become saturated expanding investment. Whereas, open markets cannot become saturated, only overproduction is possible there.

As we can see, there are closed, open and transitional, i.e. semi-closed, markets. Relating to collective growth trends, the capacity of those markets is not stable. Usually capacity increases gradually, and markets can become saturated only if capital enters more rapidly than they expand. Saturation of these markets proceeds through exchange markets or auctions.

Submitted reasoning implies, that saturation, asserting in many fields, such as chemistry, physics, medicine, biology, technology sciences and etc., exists also in social field and influences economical processes. These suggestions more frequently occur in global literature (Sterman John D. 2000, Sornette D. 2003, Modis T. 2005, Juchem Neto J. P., Claeyssen J. C. R., Ritelli D. 2009, Malthus 1998). Regrettably, they involve on the outward, superficial side of this matter. During last decade more profound research, performed in Lithuania, exceeded expectations – it has been proves, that saturation not only exists in financial field, but also asserts paradoxically, and therefore is one the most important factors inflicting economical cataclysms.

3. Economic growth (capital accumulation) models

Both economic growth and capital accumulation (investment profitability and etc.) are usually modeled using compound interest. In that case, accumulative sum after *n* periods is:

$$K_n = K_0(1+i)^n, \tag{1}$$

where K_0 – initial investment, K – accumulative sum of investment after n periods, i –interest rate, n – investment duration or number of investment periods.

Compound (exponential) percent model unbounded growth. Whereas, each growth is finite. Limited, i.e. logistical, growth models better correspond to natural process of growth (Girdzijauskas S. 2002, 2004, Girdzijauskas S., Mackevičius R. 2009):

$$K = \frac{K_p \cdot K_0 \cdot (1+i)^n}{(K_p - K_0) + K_0(1+i)^n}, \tag{2}$$

where *Kp* – potential (marginal, maximal) value of invested capital, other values – as in formula (1). Notably, compound interest formula (1) is an individual case of logistical model (2), when potential value of invested capital is infinitely large.

It is noticed, that using logistical model (2), when saturation increases, internal return of investment is not decreasing (which would be logical), but increases. Furthermore, increase of internal return intensifies when saturation approximates to the limit, i.e. the saturation point. Such paradoxical growth of profitability bulges price bubbles and poses assumptions for crisis to occur.

4. The paradox of debt trap

Alongside with the paradox of growing profitability another similar phenomenon emerges due to the same reason – market saturation. It is **the paradox of debt** or **credit trap**. It could be defined in the following: *if investment is made in the closed (limited capacity) market, the rate of borrowed capital (debt) growth exceeds the rate of private capital growth. Moreover, the difference of growth rates, that was rather insignificant at the beginning, increases fundamentally after a certain number of periods* (Girdzijauskas S. 2008, 2011, Girdzijauskas S., Štreimikienė D. 2010). Consequently, if the market is not saturated, both private and borrowed capitals increase identically (Fig. 1).

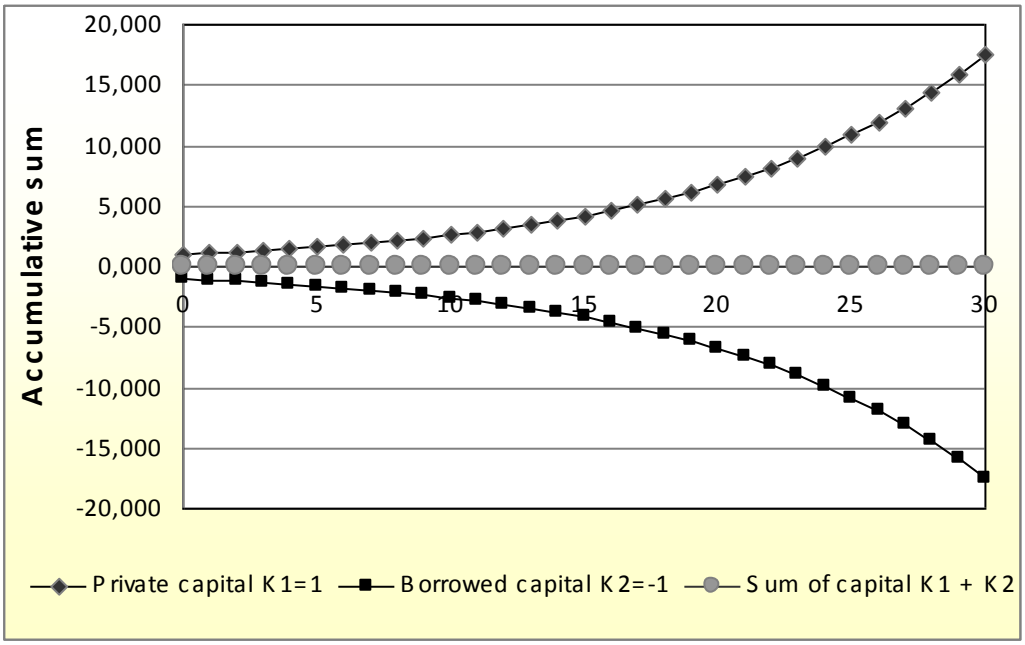

Fig. 1. Dynamics of private and borrowed capital in the free (unsaturated) market.

Figure 1 shows the alternation within time of two investments identical in absolute dimension that are equal to 1 monetary unit. It has been calculated using the compound interest model (1) or the logistical interest model (2), when market saturation is equal to 0. Apparently, the development of both private and borrowed capital is uniform, except the sign of the borrowed capital (as usually) is negative. Thus, sum of both of these quantities at any moment of time remains equal to 0. It is showed by the middle straight in the figure no.1. The case is different, if investment market is of limited capacity.

Let us analyze accumulation of capital using the logistical growth model (2), when market saturation level is higher than 0. Modeling the accumulation of capital it is necessary to estimate the particularity of borrowed capital accumulation. As mentioned above, if capital accumulation is modeled using the compound interest model, tiek skolinto kapitalo dinamika yra vienoda (1 pav.). Meanwhile, the logistical model reveals the specific behavior of borrowed capital: the dynamics of borrowed capital is more rapid than dynamics of private capital.

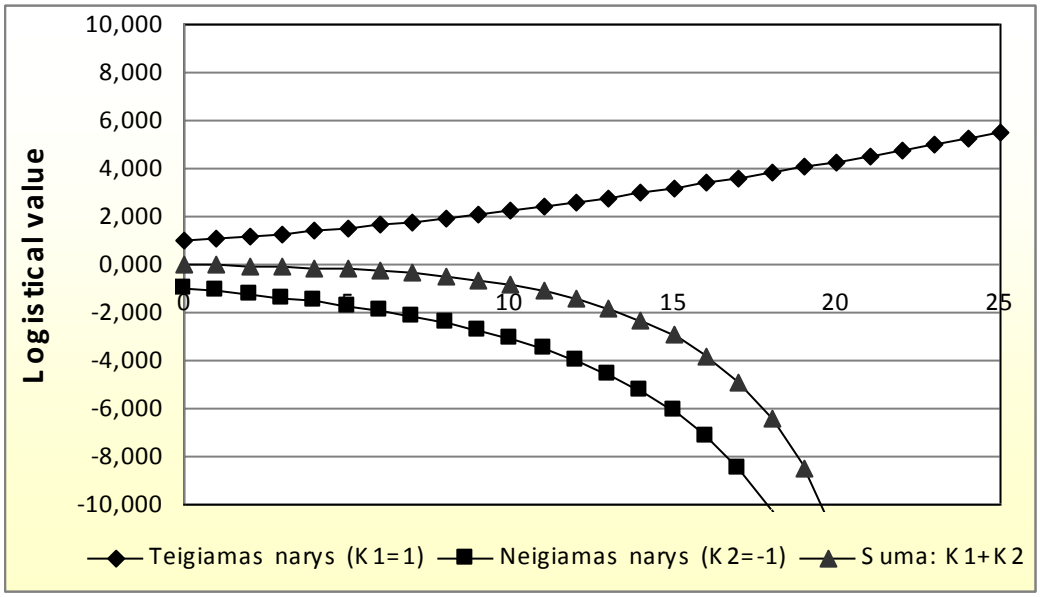

Fig. 2. Logistical dynamics of investment with negative member, when profit rate and market saturation are both equal to 10%.

Figure 2 shows the dynamics of logistic growth of investment with a negative member. The investment contains two components – a positive member, or private capital, which is equal to 1 conditional monetary unit, and a negative member, or debt, that is also equal to 1 monetary unit. In this case, market saturation totals 10%, and the interest rate of the investment is also 10%. The middle curve in the figure shows the cumulative alternation. Here we observe, that only at the very beginning the cumulative member remains equal to 0; afterwards it starts decreasing and remains negative all the time. Hence, the investment that contains the same amount of private and borrowed capitals, suffers loss from the very beginning of investment. Moreover, loss growth rate yet increases through time. If market saturation is increased, the level of loss gets even higher. The same effect is reached increasing the interest rate.

5. Financial (bank) leverage. Leverage risk and leverage trap (financial leverage; gearing). Leverage trap investing in stock markets.

In banking activities financial leverage is implied as the ratio between borrowed and private capital. In other words, it is the impact on general level of profit when investment is financed at the expense of both private and borrowed capital. How does it work in bank practice? Let us discuss a particular example. The investor of securities who possesses a certain (yet, in his own mind, inadequate) sum of money intends to invest it into securities of company X. He applies to the bank to find out the possibilities for buying the intended securities and borrowing the deficient sum as well. The core of such agreement is that it becomes possible to buy profitable securities for borrowed money, and at the same time use that money as a deposit thus paying smaller interest for obtained loan than for securities. In bank practice it is accepted, when possessing one relative monetary unit it is possible to borrow the sum up to 2 monetary units of the same value. Thus, bank client has the possibility to borrow and invest three times higher funds than he disposes at that moment. It is an appealing possibility, especially when high profitability securities are bought, and the bank interest is fairly low. Regardless of that, banking practice has bitter experience and warns that investment with leverage is rather risky engagement. The risk sources are not fairly clear and therefore it is necessary to examine explicitly the presumptions for successful investment as well as reasons for possible failures. One of the possibilities is to develop a mathematical model and analyze the process of investment using that model (Girdzijauskas S., 2010, 2011). The main focus in that model falls on leverage and the model of interest assessment. Leverage is the multiplier or coefficient which accelerates the growth of capital. Meanwhile, the growth of capital may be modeled in various ways, but this time, presumably, capital grows according to the rule of compound interest (1). Leverage operates through the private capital and therefore in case of investment it is summed with 1, which directly estimates that private capital.

Investment with leverage could be modeled using compound interest this way: if K_0 – private invested funds (capital), j – supposed earning power of investment (earning ratio), i – interest rate of bank giving the leverage, m – leverage (leverage ratio), then annual investment succession is:

$$K_1 = (K_0 + m \cdot K_0) \cdot (1 + j) + m \cdot K'_0 \cdot (1 + i);$$
$$K_2 = (1 + m) \cdot K_0 \cdot (1 + j)^2 + m \cdot K'_0 \cdot (1 + i)^2;$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$K_n = (1 + m) \cdot K_0 \cdot (1 + j)^n + m \cdot K'_0 \cdot (1 + i)^n.$$

The developed model of investment with leverage consists of two parts: investment and debt (credit). Investment includes compound interest, where growth rate is related to profitability of that investment. The interest is multiplied by the sum of both 1 and leverage. Meanwhile, the debt (credit) includes compound interest with interest rate of debt multiplied by pure leverage (private capital is free of interest). The interest of debt after n periods is calculated taking the initial sum (i.e. private capital) as negative quantity, i.e. $K_0 = -K'_0$. This way, the size of investment after n periods, and having redeemed previously received credit, would be calculated using following formula:

$$K = (1 + m) \cdot K_0 \cdot (1 + j)^n + m \cdot K'_0 \cdot (1 + i)^n \qquad (3)$$

Herein it is necessary to consider the rates of compound interest return of this model (3). If these rates of return are equal ($j = i$), then model (3) turns into ordinary formula of compound interest (1).

It should not be forgotten, that within debt the initial (private) capital is regarded with negative sign $(K_0 = -K'_0)$. This way leverage is worth using only if profitability *j* of an investment is higher than the interest rate *i* (*j* > *i*) taken by the bank financing the investment. It seems obvious, though when investment profitability fluctuates considerably, it is not easy to control the moment when investment's profitability falls below the mentioned limit. This is how one falls into the leverage trap, when market faces the situation where investment's profitability becomes lower than interest rate (*j* < *i*) taken by the bank financing the investment.

Figure 3 shows, that in case of successful leverage based investment (the upper curve, *j* = 0.2), cumulative sum is growing rapidly, and, credibly, it brings the expected result. The second curve from the top (*j* = *i* = 0.1) shows, that investment is neutral – leverage does not bring any results, however, the growth is observed, yet, it occurs exclusively at the expense of private capital. Problems arise when investment's profitability becomes lower than bank interest rate (*j* < *i*). The third curve from the top (*j* = 0.05) is continuously declining, which means that investment is unprofitable: after about 9 periods the initial investment turns equal to 0 and further decreases increasingly. The much worse investment is, where *j* = -0.05 .

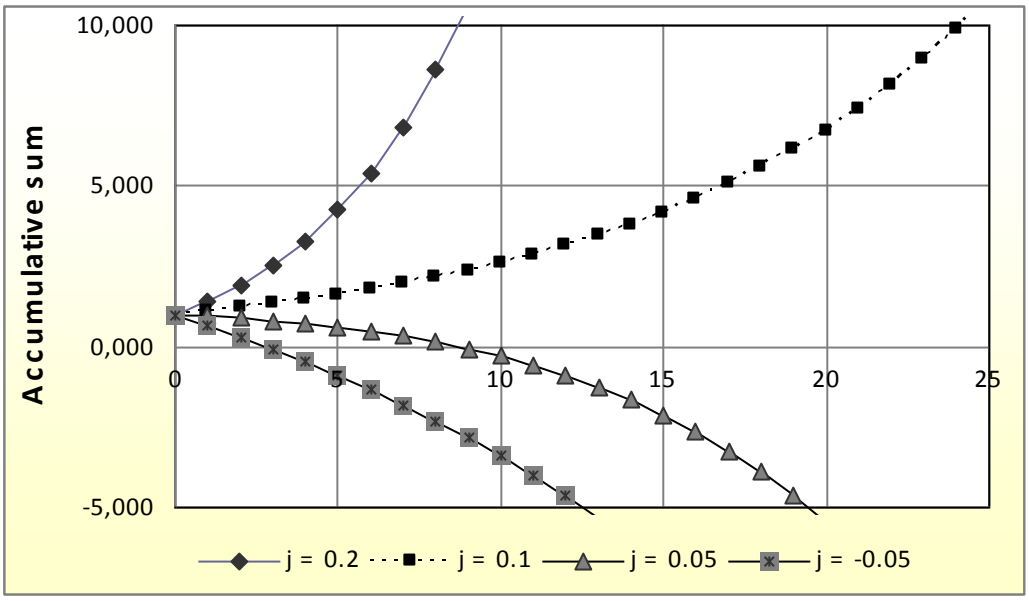

Fig. 3. Investment leverage graphs with different earnings ratios (m=2, K0=1, i=0.1).

Returning to formula (3). In this equation every element contains expression of compound percent formula. Let us change it with logistical interest formula (2). We get a calculation model for investment with leverage in saturated market (Girdzijauskas, 2011):

$$K = (1+m)\cdot \frac{K_p \cdot K_0 \cdot (1+j)^n}{(K_p - K_0) + K_0(1+j)^n} + m \cdot \frac{K'_p \cdot K'_0 \cdot (1+i)^n}{(K'_p - K'_0) + K'_0 (1+i)^n} \qquad (4)$$

where *Kp* – potential (marginal, maximal) value of invested capital, K_0 – initial investment, K'_0 – borrowed sum equated to initial investment, *K* – accumulated sum of investment after *n* periods, *i* – interest rate, *n* – investment period or number of investment periods.

This model allows calculating the value of investment after *n* periods and after the credit received at the beginning is returned. Since this model is based on logistical interest, the calculating sum of investment is obtained after estimation of market saturation.

Upon remark, that if *j* = *i*, then formula (4) turns into an ordinary logistical percent formula (2) only in that case, when saturation is equal to 0. In other words, if market becomes open and therefore unsaturated, then formula (4) turns into formula (2). Such transformation does not apply, if market has any degree of saturation.

Figure 4 shows the capital growth, when investment with leverage (*m* = 2) is made into entirely open market, and market saturation equals 10%. The upper curve demonstrates capital growth in open (unsaturated) market.

Such growth is modeled with reference to formula (2) or formula (4), in latter one using rather high (compared to K_0; for instance, 1 million times higher) market capacity (value K_p). The lower curve shows growth of the same capital in a slightly saturated market (in this case, 10%). Here the most significant feature is observed: investment behaves completely different in saturated market than in unsaturated one. Only at the very beginning growth in both markets is similar. Afterwards growth diagrams diverge. From the 14th period growth in the saturated market is gradually turning into irresistible decline. When saturation is increased, the decline begins notably earlier. The difference between these two curve ordinates may be considered as the natural expression of investment risk (Fig. 4).

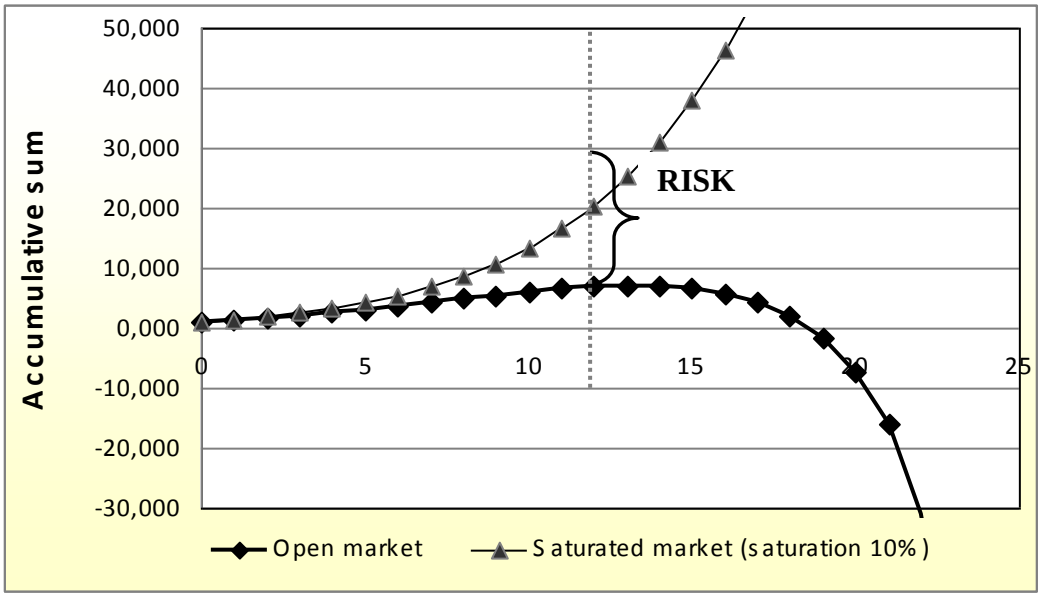

Fig. 4. Investment with leverage in unsaturated and saturated markets (m=2, K0=1, Kp=10, j=0.2, i=0.1).

The diagrams in Figure 4 demonstrate, that market saturation substantially alters the conditions of leverage investment. Different bend in the curves implies, that depending on the market state the same investment may give completely opposite results: high profitability may be obtained in open market, while in saturated market loss may be even higher.

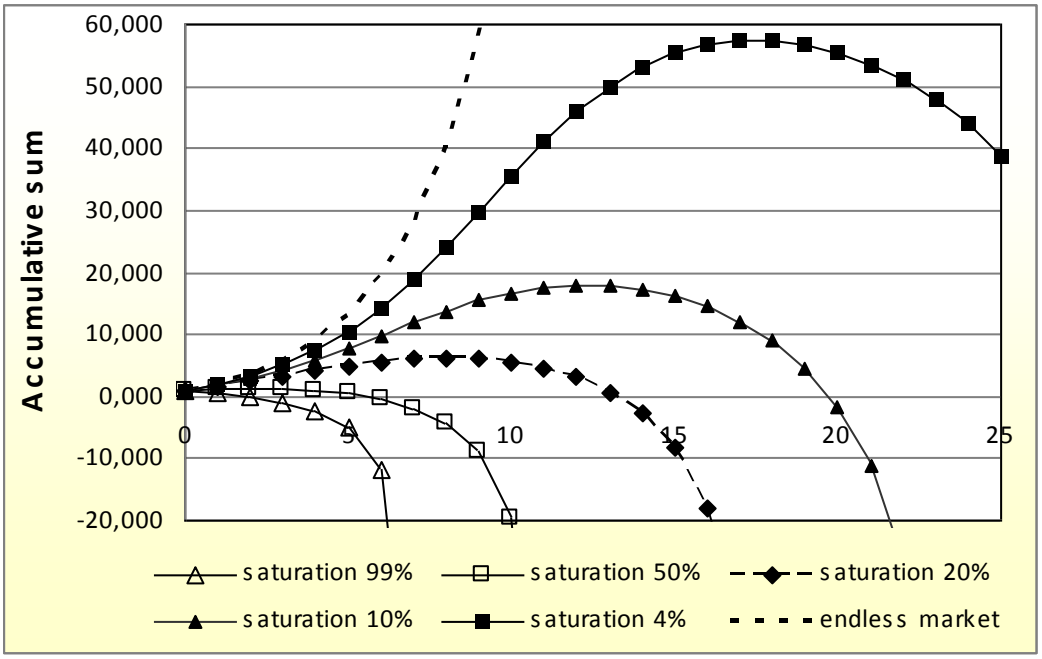

Fig. 5. Investment with leverage in different saturation markets (m=2, K0=1, j=0.4, i=0.1).

Difference between these curve ordinates (vertical quantities) may be treated as the risk of leverage investment. When the duration of investment and the saturation degree of the market into which the investment is made increase, the investment risk also increases. It is clearly demonstrated in Figure 5. Ignorance of market situation, and incomprehension and misjudgement of processes running in the market, produce the major risk of leverage investment. The trade itself with leverage effect in the saturated market is the potential threat for suffering financial crisis.

6. Analysis of bank case in Lithuania

One of the most interesting real cases about credit trap and market saturation was the stock issued by the Bank X in Lithuania and linked with stock indexes (SASO). With reference to the data by the Securities Commission (SC), in 2007 SASO was distributed with value of 1.09 billion Litas. In 2008 – value was 196.8 million Litas, and in 2009 – value barely reached 71.2 million Litas. These figures demonstrate, that this instrument was the most popular in 2007. The bank was referred as the market leader in this segment.

The principle of SASO operation was that the issued stock return depended on the index stocks were linked to. The most popular world stock indexes were chosen, like Dow Jones, DAX and etc. The operation principle of the stock itself asserts, that stock issuer acquires index option for 5-10% of invested sum, that option guarantees return demonstrated by the index, and the rest 90-95% amount of money are put into deposit. Usually SASO term is 3 years. During this period, 90% of invested sum through interest rate increases to 100% of invested funds – this part becomes the security that investor will retrieve all his invested funds. Meanwhile, the bought call option allows expectations for index return. If index increased in three years, then SASO instrument implements the option and obtains the difference, which forms if index was increasing during that mentioned period. If index was not increasing, then option becomes worthless and the investor retrieves his invested funds because deposit earned them.

In 2007 two factors became the engine of SASO product expansion: the first one was rapidly increasing market overheat and bubble growth. Agreeably to the logistical capital management theory, namely the bubble growth increases internal market return given the market saturation, which also increased the investors' desire to invest more and more. Secondly, given the high motivation to invest leverage investment was freely used – using borrowed capital and this way expecting even higher return. Services offered by the Bank X were negatively echoed after the occurrence of credit trap effect, when financial bubble was to explode and borrowed capital started to increase significantly faster than private, and growth of borrowed capital eventually reduced private capital, though the investment was made into relatively safe SASO securities.

In the given example the scheme of operation was suchlike – the investor, who had no funds for investment, mortgaged his own realty, and used the obtained funds for leverage investment into SASO. The latter ones were laid out as not risky securities, because after 3 years in case of the worst scenario the whole invested sum would be refunded. Scheme seems to be engaging, though problem occurs because very big leverage was used, which quickly starts to influence negatively given the market saturation. Financial leverage emerges in two stages – first, when loan for investment is taken, and second, when credit (lent funds) was invested into SASO using leverage.

SASO is a safe instrument, when held until redemption, though in the middle of period it can become very risky if leverage is used. If index decreases, SASO price also drops, because bought option becomes worthless, and the deposit is worth 90% of the invested sum. In that case bank starts to demand for supplementary deposit to ensure loan redemption, because if investor decides to sell this instrument, bank cannot be secure about loan redemption. Since part of investors didn't have supplementary funds, then bank impelled to sell these investments and investors faced huge loss. In this case the risk was very high and it was assessed neither by the investors, nor by the bank itself. Consequently many citizens of Lithuania suffered loss.

Conclusions

- Financial leverage allows achieving good results in investing only if market, into which the investment is made, is not saturated. However unsaturated market also has investment risk: when investment profitability becomes smaller than interest rate taken by the bank financing the investment ($j < i$), then investment suffers loss. Therefore open (unsaturated) market risk lies in variability, fluctuation and decline below the interest rate of bank, financing the given investment, of investment profitability rate.

- Modern literature on investment with leverage denotes that suchlike investing is risky, though does not indicate the source of that risk.
- Investment with financial leverage becomes very sensitive to the changes in profitability, if market, where the investment is made, is at least partially saturated. Then conditions of investment with leverage change fundamentally: "pressure" of borrowed capital runs from the very beginning of the investing, and after some time turns into huge loss.
- Financial leverage models show, how the same investment can give completely opposite results: huge profit can be gained in open (unsaturated) market, while in saturated market – even bigger loss.
- Analysis of practical example case confirms our modeling results.

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