About an Estimation of Company's Capitalization in the Conditions of Prices Changing

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Abstract

We offer a new approach to the estimation of a fundamental component of a company's capitalization in the low competitive production sector of an economy (for ex. Russian processing sector). The approach is based on the results of a research of a class of mathematical models, which describes production functioning taking into account the current assets deficit and the product demand instability. The modern version of the model is formalized in Bellman's equation form, which describes the dependence of the company's capitalization on the indicators of its activities and market conditions. Based on the Bellman's equation solution and average production indicators calculation (the calculation is based on the stochastic process analysis of trade inventories in stock dynamics) we offer a new method which allows to analyze the impact of market conditions on company's capitalization. We apply the method to the analysis of capitalization dynamic of large Russian carmakers during 2012-2016. By means of the model the influence of change of a price structure on the capitalization of KAMAZ Company is investigated.

1 Introduction

The process of Russia's integration into the system of international economic relations leads on one hand to strengthening of the domestic and import production competition in the internal market. On the other hand, it opens possibilities for import and implementation of new technologies . These changes are especially urgent

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for the processing sector which was created during the Soviet period in the conditions of a closed economy. The potential of the sector development in many aspects determines Russia's position in the international economic relations system. Nowadays the technological backwardness of the processing sector leads to the loss of its production in competition with better imported analogues. This situation leads to delays in product sales, producer's current assets deficit and the need of crediting the production costs . However in the conditions of a heterogeneous production system and an unstable financial situation the economic consequences of the implementation of sector upgrade programs require a detailed analysis that takes into account features of sector functioning and feedback in an economic system. Such an analysis requires mathematical models and methods development which allow to analyze and predict production indicators taking into account the features of the processing sector activities in the conditions of high market volatility.

The current assets deficit leads to the dependence of processing sector companies' activity on credit resources availability. Thus, companies' indicators in market conditions essentially depend on credit ratings. One of such indicators is the company's capitalization which is the pledge of the company's revolving funds crediting. The instability of financial and economic situation leads to an interest rate increase for producers and as a result to a fall of companies' credit rating. The fall of the credit rating involves a decrease in the company's capitalization level. It leads to further growth of a loan interest rate. As a result the company finds itself in a "trap" of high interest rates. Therefore the development of methods of economic measurements directed at the estimation and forecasting of real capitalization of the company based on its activities indicators analysis is an important task.

Methods of analysis of processing sector activities which takes into account current assets deficit and production sales delays were being developed by the authors for more than 15 years. We develop mathematical models on the base of Houthakker-Johansen approach to the description of a production system [Johansen, 1972]. However, we consider not only production, but also the financial and economic conditions of a company's activity. So far we have developed the system of models which consistently describes production functioning schemes in the processing sector at various stages of Russian economy evolution [Petrov et al., 1999],[Avtukhovich & Shananin, 2000], [Akparova & Shananin, 2005], [Obrosova & Shananin, 2013], [Obrosova & Shananin, 2014], [Obrosova & Shananin, 2015] (Low Competitive Sector Production models – LCSP models). The modern version of LCSP model describes the production in low competitive sector taking into account current assets deficit, unstable demand and restriction of trade infrastructure [Obrosova & Shananin, 2013], [Obrosova & Shananin, 2014], [Obrosova & Shananin, 2015]. The model reflects the industry's production specifics in the period of the quasi-stable economic conditions that have arisen in Russia after 2008. The following basic assumptions are the basis of the model: 1) the moments of product sales form a stochastic Poisson flow; 2) there is a trade infrastructure restriction - the maximum size of one-time product sale is Y^*; 3) the replenishment of production's current assets happens in a competitive loans market. The model is formalized in the form of Bellman's equation. The solution gives a fundamental component estimation of a company's capitalization depending on the model parameters. The fundamental component allows to estimate the actual company's cost from its activities' indicators in the developed economic conditions. It is cleared from speculative "jumps" which affect company's market capitalization. In the model we consider the influence of such parameters as interest rate, characteristics of the product demand stability, structure of the products and raw material prices, etc on the producer activities. Thus, we offer a technology of analysis of the company's fundamental capitalization dependence on indicators of its activities and environmental conditions.

One of results of the LCSP model investigation is a calculation of the optimal (from the view point of company's income maximization) producer's warehouse replenishment mode [Obrosova & Shananin, 2014], [Obrosova & Shananin, 2015]. Evaluation methods of the influence of the stochastic flow of demand requests on optimum indicators of inventory systems are studied in inventory system theory [Whitin & Hadley, 1963]. However the research purpose of the theory is the minimization of total expenses of retail inventory system servicing, not production. Questions of demand and other environment characteristics' influence on a company's production indicators remain beyond the scope of the inventory system theory.

Based on the results of a research into the LCSP model we obtain the equation system of the model which parameters and variables are interpreted in terms of the official companies' IFRS standard reports. The conducted investigation allows to offer technology of analysis of financial and economic environment influence on company's indicators which produces a low competitive product. In the paper we show the use of technology on the example of two large companies of the Russian automotive industry: KAMAZ and SOLLERS. The model is identified according to the companies's IFRS reports of 2012-2016 (for SOLLERS 2013-2016). In terms of the LCSP model the analysis of the influence of an economic environment change on the company's capitalization is carried out. The results allowed to explain the discrepancy of market expectations and real company's indicators and to

analyze the influence of the company's income deflator on the company's fundamental capitalization component. By means of comparative statics methods in terms of the model we analyzed the influence of the advancing increase in prices for raw materials and accessories (the ruble devaluation result at the end of 2014) on the KAMAZ company capitalization.

2 The LCSP Model Description and Research Results

We will consider the production functioning with the capacity of η, issuing a uniform product. Let's define: y - product unit cost, p - product price, Y^* - the maximum amount of one-time product sale, Y_0 - current value of trade inventories in stock. We'll assume that

- the product sales moments form a Poisson stochastic process with parameter λ;
- the replenishment of the company's revolving funds is possible by a credit line only;
- from the moment of a product sale the company functions at full capacity by a credit line $K(t)$ under percent r during the period τ chosen by the company's owner; if after the time period τ a sale didn't come, production stops until the buyer's request;
- at the time of the product sale the producer receives revenue, repays the cumulative loan debt and can appeal to bank behind the credit line again;
- the product sales income which remained after the loan payment is removed from turnover; the credit is used on the revolving funds replenishment only.

Then $K(t) = y\eta\theta(\tau - t)$, where $\theta(x) = 1 \quad \text{if} \quad x > 0 \quad \text{and} \quad 0 \quad \text{if} \quad x \leq 0$. The volume of production at the time t is $Y(t) = Y_0 + \eta \min(t, \tau)$, and a loan debt is $L(t) = \frac{\eta y}{r}\left(e^{rt} - e^{r(t-\tau)_+}\right)$. The task of the production owner consists in the choice of time period τ during which production costs for the credit are accounted, for the maximization of discounted with Δ mean value of income $W(Y_0)$:

$$W(Y_0) = \sup_{\tau \geqslant 0} \int_0^{+\infty} \lambda e^{-(\lambda+\Delta)t} \left[p \min\left(Y(t), Y^*\right) - L(t) + W\left(\left(Y(t) - Y^*\right)_+\right)\right] dt. \tag{1}$$

The solution $W(Y_0)$ of Bellman's equation (1) can be interpreted as the firm cost with inventory Y_0. The cost is determined based on company's production indicators and parameters of the economic environment (interest rate, structure of the prices, etc.). The value of $\frac{\lambda W(0)}{y\eta}$ characterizes a company's capitalization fundamental component in relation to its revolving funds. Changes of a company's position in the market and the level of company's creditworthiness are connected to the change of this indicator. When $\frac{\lambda W(0)}{y\eta}$ is close to 1 it corresponds to the limit of the company's profitability.

Statement 1 [Obrosova & Shananin, 2014]. *Let profitability conditions*

$$\lambda + \Delta > r,\ Y^* > 0,\ p > y\frac{\lambda + \Delta}{\lambda + \Delta - r}$$

be true. Then the equation (1) has a unique solution in a class of continuous, non-negative, not decreasing, concave functions limited together with the derivative on a half-interval $[0, +\infty)$.

The solution of the equation (1) is found in an explicit form (see [Obrosova & Shananin, 2014]).

Statement 2 [Obrosova & Shananin, 2014]. *The optimum producer's behavior corresponding to the solution of the equation (1) is described as follows: in the conditions of lack of product sales the company works at full capacity by means of the credit before the inventory size* $(\zeta_0 + 1)Y^*$*, and further stops until sale moment. The solution of Bellman's equation allows determining*

1) optimum inventory characteristic ζ_0 *as an unique root of the equation:*

$$f\left(\zeta_0, R, \frac{\lambda + \Delta}{\lambda}, \frac{\lambda Y^*}{\eta}\right) = 0, \tag{2}$$

where parameter $R = \frac{p - y\frac{\lambda+\Delta}{\lambda+\Delta-r}}{p}$ *corresponds to the company's profitability value;*

2) the value $\frac{\lambda W(0)}{y\eta}$ *as a function of model parameters and* ζ_0*:*

$$\frac{\lambda W(0)}{y\eta} = \Phi\left(\zeta_0, \lambda, \frac{\lambda Y^*}{\eta}, R, r, \Delta\right). \tag{3}$$

An explicit form of functions f and Φ is found in [Obrosova & Shananin, 2014].

The identification of the LCSP model parameters requires a calculation of average indicators of production activities in model terms as the official companies' annual accounts contains the data. The solution of this problem is based on the analysis results of Markov stochastic process of trade inventories in stock dynamics $X(x,t)$: $X(x,0) = x$, $X(x,t) \in [0,(\zeta_0+1)Y^*]$. It is proved that the stochastic process $X(x,t)$ is ergodic (any initial distribution converges to final distribution) [Obrosova & Shananin, 2015]. Property of ergodicity allowed offering a technique of calculation of company's indicators comparable to the official annual account data. The account data contains the indicators averaged on time. The technique is based on indicators calculation (in model terms) averaged on final probabilities distribution of inventory change. Owing to the ergodicity property averaging on time is comparable to averaging on final distribution. The dynamic analysis of stochastic process of inventories change allows to obtain explicit forms of average values of capacity utilization coefficient u and average trade inventories Q depending on model's parameters [Obrosova & Shananin, 2015], [Obrosova & Shananin, 2016].

The equation (2) and expressions of average trade inventories and capacity utilization coefficient form complete system of model equations. A set of the system output variables determines a basic point for the chosen year and is the following: λ - the characteristic of market conditions, ζ_0 - the characteristic of an optimum inventory level, $\frac{\lambda Y^*}{\eta}$ - a ratio of demand and production capabilities. A set of input parameters of the model's equations system is observed by official statistics: r - average loan interest rate, Δ- income discounting coefficient, R - company's profitability value, u - average capacity utilization coefficient, $\frac{yQ}{yu\eta}$ - turnover of producer's trade inventories. We developed the technique of input and output model parameters interpretation in terms of official companies' IFRS annual reports. In [Obrosova & Shananin, 2016] we give the equations system of the model for a case $0 < \zeta_0 < 2$ in an explicit form. The model calculations show that the analysis of system solutions over the specified range is sufficient for research purposes.

On the basis of the model investigation results we offer the the following scheme of the analysis of the economic environment indicators' influence on processing sector company's characteristics. As a result of identification we obtain a set of input parameters of the equations system of the model in a year t. The solution of the system determines a basic model point $\lambda, \zeta_0, \frac{\lambda Y^*}{\eta}$ in a year t. From (3) in the basic point we obtain the basic value of the fundamental component of company's capitalization in relation to revolving funds $\frac{\lambda W(0)}{y\eta}$ in a year t. The analysis of the economic environment indicators' influence on the company position can be carried out by a method of comparative statics. The method is based on the assumption that in the conditions of sharp change of an environment (for example, change of structure of the production component prices and selling prices $\frac{y}{p}$ as a result of a currency rate collapse) at short temporary scales other indicators don't have time to change. Therefore it is possible to analyze the influence of the chosen indicator on a company's position in case of basic values of other parameters. In particular for the price environment influence analysis we fix the values of variables and parameters of the model in the basic point $r, \Delta, \lambda, \zeta_0, \frac{\lambda Y^*}{\eta}$ and analyze the dependence $\frac{\lambda W(0)}{y\eta}(R)$ owing to a ratio (3) where $R = R\left(\frac{y}{p}\right)$ (see Statement 2).

3 Analysis of the Economic Environment Influence on the Company's Capitalization

Typical representatives of the companies working in the conditions of current assets deficit and the competition to import are the companies of the Russian auto industrial complex. Russia's accession to the World Trade Organization (WTO) in 2012 led to a toughened competitive struggle in the domestic automobile market. The introduction of utilization levy had partially compensated for the negative consequences of this action. The Russian car makers receive the compensation of utilization levy from the state, and foreign carmakers pay this fee completely. That increases the price of imported cars. Because of the industry problems, the state realizes programs of product demand stimulation for domestic carmakers.

In this part we'll apply the LCSP model to the research of economic operating conditions of the Russian companies KAMAZ and SOLLERS. KAMAZ is a region-forming enterprize. So it is in a priority area of state interests and it gets individual state support. SOLLERS (the main activity field are UAZ cars and a number of

domestic assembly plants for foreign cars) participates in the state support programs that addressed at all car makers and isn't provided with large state orders.

KAMAZ Company. Calculation results. The model is identified according to the KAMAZ annual reports 2011-2016. By means of the model the fundamental component of the company's capitalization in relation to revolving funds $\frac{\lambda W(0)}{y\eta}$ according to conditions 2011-2016 is constructed (a continuous fat curve, a triangular point marker, fig.2a). The fundamental component of the capitalization differs from the market expectations which take into account a speculative factor. In fig.2a the dashed line (round point marker) corresponds to the market estimation of KAMAZ's capitalization in relation to revolving funds. The value of market capitalization is based on the year averaged share value of KAMAZ (Moscow exchange). By means of the LCSP model we carried out the analysis of fundamental and market capitalization discrepancy. We analyze the discrepancy of line items of the George Soros reflexivity theory [Soros, 1994] containing the detailed humanitarian analysis of fundamental and speculative components of the company's capitalization and mechanisms of their mutual influence. In terms of the LCSP model the reflection of the market expectations which characterizes a speculative component is the deflator of the company income Δ. Calculations by comparative statics method confirm that Δ has a significant influence on the fundamental capitalization of the company (fig.1).

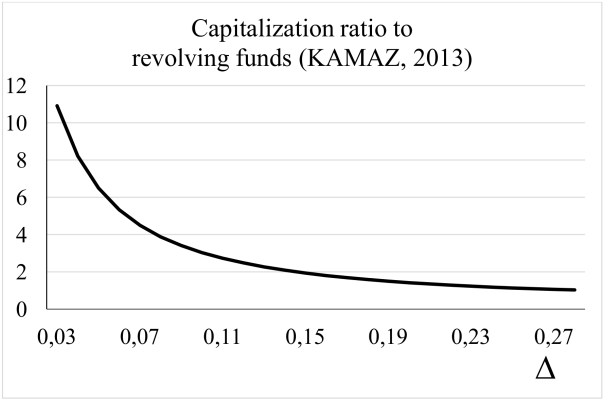

Figure 1: The influence of income deflator on company capitalization

In fig.2b the dynamics of a company's income deflator Δ corresponding to the basic scenario (continuous fat curve, triangular point marker) and the real market capitalization change (dotted curve, round point marker) calculated in the model are shown. The thin curve (fig.2a, transparent point marker) corresponds to the company's profitability limit, i.e. to the values $\frac{\lambda W(0)}{y\eta}$ close to 1. The same curve in fig.2b determines the corresponding values of the company's income deflator Δ calculated in the model. In fig.2c results of the model calculation of the company's product demand dynamics $\frac{\lambda Y^*}{\eta}$ are provided.

The calculations show that in the conditions of sales recession expectations in 2012 because of WTO accession the market capitalization decreased while the fundamental capitalization component grew (fig.2a). The market expectations of 2012 correspond to high growth rate of income deflator Δ (dotted curve, round point marker, fig.2b). However the expectations were false - in 2012 the KAMAZ production sales grew (fig.2c). It led to some improvement of the market expectations and Δ decreased in 2013 (dotted curve, fig.2b) against the background of further fall of the market capitalization (dotted curve, fig.2a). The fall in demand of 2013 (fig.2) and interest rates growth led to an essential decrease in the fundamental component of the company's capitalization in 2013 (continuous fat curve, triangular point marker, fig.2a). Further decline in demand in the conditions of the crisis of 2014 led to a decrease in the fundamental and market capitalization. However previous high rates of fundamental capitalization were expressed in further fall of Δ which reflects market expectations (dotted curve, fig.2b). In 2014 KAMAZ was at the limit of profitability in spite of state support. The market expectations of capitalization in 2014 were lower than the fundamental capitalization which still corresponded to a profitable value of Δ (triangular marker, fig.2b). In 2015, despite the large state order the fundamental company indicators were under the profitability limit (model calculation of 2015 is impossible). Strong state support of KAMAZ in 2015-2016 (subsidies for credits interest payment and production components) led to the fact that the company came to profitability limit in 2016 and the fundamental indicator $\frac{\lambda W(0)}{y\eta}$ was slightly higher than the market expectations (fig.2a) even in the conditions of a continuing demand decrease (fig.2c).

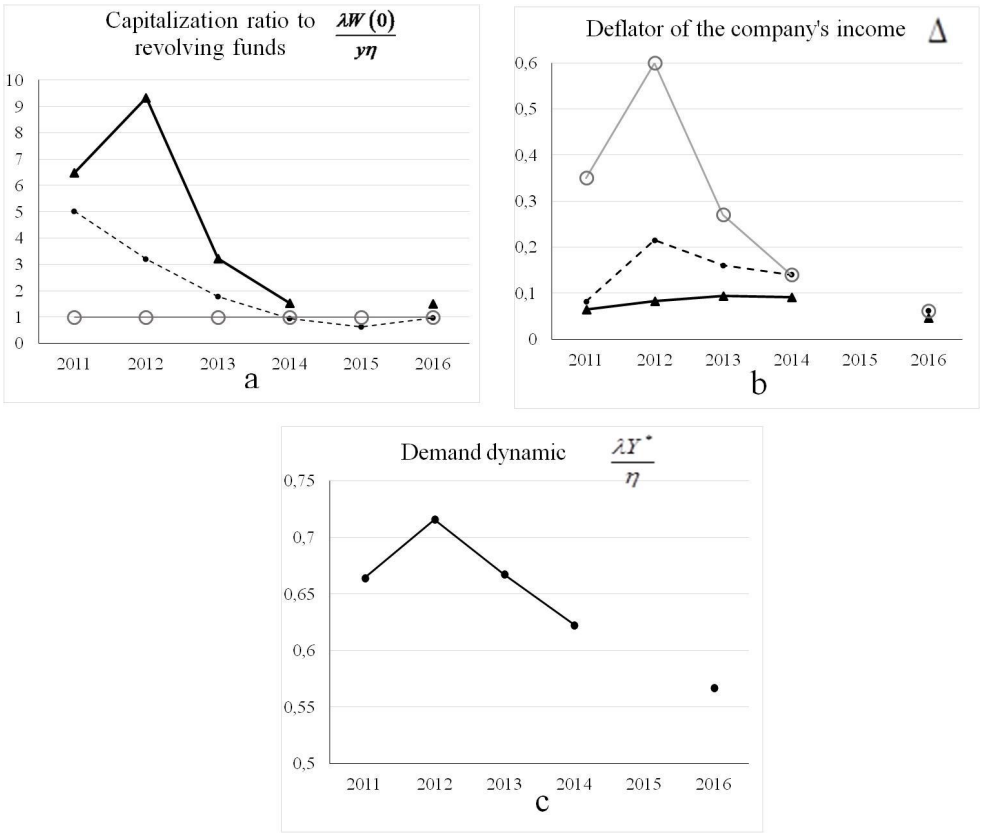

Figure 2: Calculation results, KAMAZ

At the same time the value of Δ which corresponds to fundamental capitalization is practically at profitability limit unlike 2014 (fig.2b, triangular and transparent markers 2014, 2016). It characterizes a company's position as less stable in comparison with 2014. We'll notice that the state support of KAMAZ allowed it's entrance to the profitability area in 2016 with a small decrease of capacity utilization from $u = 0.54$ in 2014 to $u = 0.49$ in 2016.

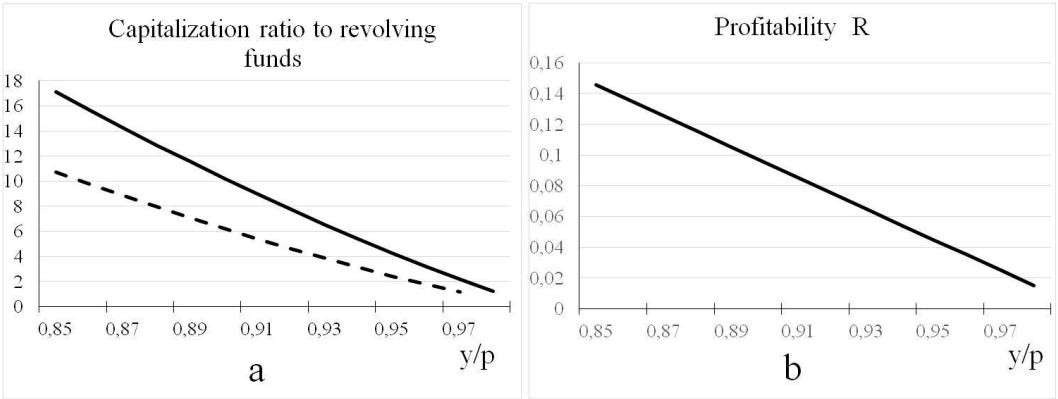

Figure 3: KAMAZ (2016), Comparative Static

The essential part of production costs of Russian automakers is connected with the imported component purchase. The currency crisis in the end of 2014 changed the structure of the component's cost and products' price. Besides instability of the foreign exchange market it led to the growth of loan interest rates. By the

method of a comparative static we calculated the influence of the price structure $\frac{y}{p}$ change on the fundamental capitalization $\frac{\lambda W(0)}{y\eta}$ in cases of basic and increased interest rate value ($r = 0.047$ is a continuous curve and $r = 0.062$ is a dotted curve, fig.3a). In fig.3b corresponding change of company's profitability R in case of $r = 0.047$ is shown. The calculations confirm that the advancing increase in components prices and growth of a loan interest rate influence the fundamental capitalization of the company negatively.

SOLLERS Company. Calculation results. The model is identified according to SOLLERS annual reports 2013-2016. In fig.4a,b results of the model calculations of the fundamental capitalization estimation $\frac{\lambda W(0)}{y\eta}$ and the according level of the income deflator Δ are given (continuous fat curves, fig.4a,b). The dotted curve reflects SOLLERS market capitalization dynamics (biddings results at the Moscow exchange) on fig.4a and corresponding change of Δ as a result of model calculation (fig.4b). The thin continuous curve corresponds to SOLLERS profitability limit. The model calculation of product demand dynamics is shown in fig.4c.

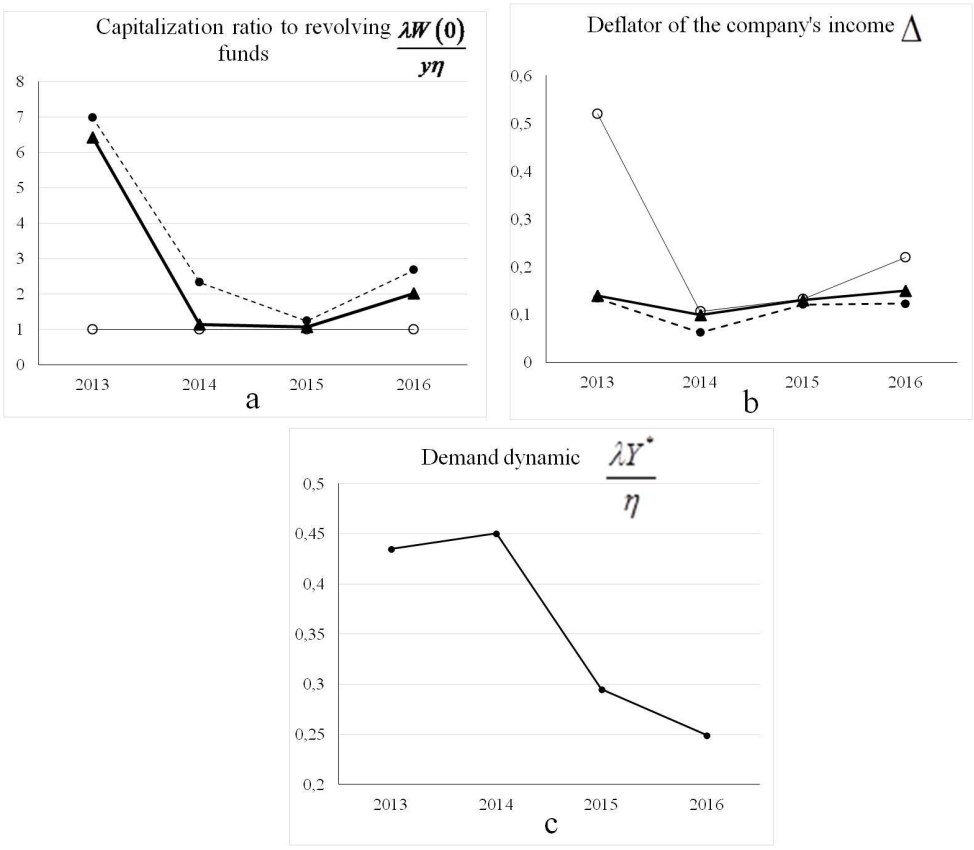

Figure 4: Calculation results, SOLLERS

In the absence of large state orders SOLLERS shows similar dynamics of both fundamental and market capitalization component in 2013-2016. At the same time the market expectations are slightly higher than the fundamental capitalization (fig.4a). The currency crisis of 2014 led to a sharp fall of the fundamental capitalization of the company to the limit of profitability (fig.4a, continuous fat curve) despite some demand growth (fig.4c). The announced plans of the company to sell of the unprofitable share of business (FORD SOLLERS joint business) led to the fact that expectations of the market corresponded to lower values of Δ in 2014 (dotted curve, fig.4b). As a result the fundamental capitalization component remained at profitability limit in 2015 (continuous fat curve, fig.4a). The decline in demand delay in 2016 and the essential decrease of company's capacity utilization from $u = 0.43$ in 2014 to $u = 0.24$ in 2016 led to the growth of the fundamental capitalization component in 2016 (4a, continuous fat curve) in case of some deterioration of market expectations (growth of Δ - fig.4b). Based on SOLLERS statements of production renewal plans (the Ssang Yong cars plant in Vladivostok was stopped earlier in connection with a currency crisis of 2014) in 2016 we see the growth of

SOLLERS market capitalization.

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