

## MODELS FOR ESTIMATION OF SYNERGY EFFECTS AT INTEGRATION OF FIRMS

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### Abstract

The key problem of firms' integration is an adequate assessment of possible synergistic effects. The creation and functioning of integrated structures is expedient only if they allow achieving a stable positive effect and ensuring the economic growth of firms. The aim of the work is to describe methods for determining the amount of synergy based on the transition from the principle of economy to the principle of strategically coordinated economy. The aim of the work is to describe methods for determining the amount of synergy based on the transition from the principle of economy to the principle of strategically coordinated economy. Achieving the synergy effect makes the merger of firms mutually beneficial and cost-effective. It is shown that the tools for assessing the effectiveness of intra-economic interaction among vertically integrated business groups are: the break-even of the supplier and the consumer in the course of transactions, the assessment of the equilibrium of transfer prices, and the appreciation of the present value from the activities of integrating firms. These tools can be used both proactively at the stage of making decisions about the integration and organizational design of the business group, and in the process of the participants' activities in improving economic relations between them.

**Keywords:** Synergy in the economy, Synergy effects assessment, Vertical integration, Transfer prices, Vertically integrated business groups.

## 1. INTRODUCTION

There are many different integration forms of large business in the global economy. The choice among them is determined by the need to adapt to the external environment, and the purpose and objectives of the firm's activities. The volumes of mergers and acquisitions of firms in the world reach billion U.S. dollars annually (Fig. 1). Most of the integration associations of firms occur during either an industrial crisis, or a sharp revival, an increase in the rate of inflation and a peak of the technological revolution, under the conditions of cardinal structural changes. When making an effective integration transaction, risks are significantly reduced and additional benefits arise from access to already developed markets, cheaper resources and new technologies, as well as from synergies due to the inclusion of the company in economic relations.

However, sometimes firm's activities do not pursue economic efficiency in the long term. Very often implemented integration of firms leads to their bankruptcy. The result of integration is falling revenue, loss of markets, lower operating profit and market value of the transformed firm. In our article, we hypothesize that one of the factors of poor integration is an incorrect assessment of the possible effects of integration. The aim of this work is to study methods for determining the amount of synergy in the integration of firms, the so-called synergy effects.

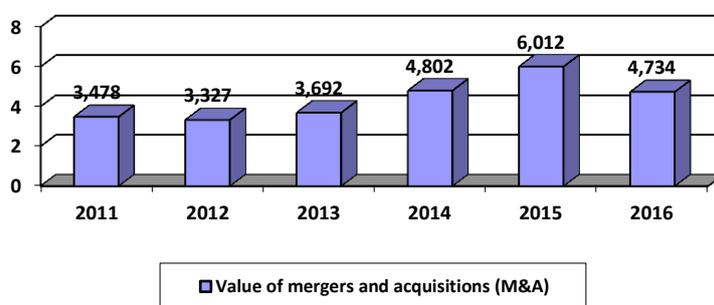


Fig. 1: Value of M&A transactions globally 2011-2016 (in billion U.S. dollars)

Source: SSRN: <https://www.statista.com/statistics/267369/volume-of-mergers-and-acquisitions-worldwide/>

We will study only vertically integrated associations of firms. Vertically integrated structures form a business group through property relations between firms. The activity of a business group is described through a chain of relations "supplier - consumer", when some members of a business group act as suppliers of raw materials, services, goods, and other members – their consumers. It is in such relationships that synergy effects are manifested to the greatest extent.

We will not consider the conglomerate formations of firms, since such associations don't have production, sales or other functional ties between firms.

## 2. DISCUSSION

The problems of formation and evaluation of the performance of integrated production associations and vertical interactions of firms were studied Benso and Anderson (2004), Vinslav (2001), Dementiev (1998), Gubanov (2009), Radygin (2001), Ilyin (2002), Williamson (1996), Yakutin (1998), etc. These researchers analyzed a wide range of economic forms of integration and considered the mechanisms of integration of firms.

Investigations of the processes of firms' integrating using economic-mathematical tools were carried out by Burkov, Dorokhin and Balashov (2002), Voronovitsky (1999), Mezhev (2002), Titov (2007). Identification of synergy effects from the position of their influence on the change in the value of the company was handled by Endovitsky and Soboleva (2007). A special place in the research is devoted to the problems of organizing the economic interaction of integrated firms on the basis of the transfer pricing mechanism (Baldenius and Reichelstein, 2006; Göx, 1999; Popov, 2003; Pleschinsky, 2004; Hevner, 1999, etc.). Such a mechanism allows generating and redistributing an additional systemic effect between participants. The results of the authors' studies help to synthesize a set of tools for evaluating synergy effects that would take into account the specifics of the interaction of participants.

Synergetics (or "working together") is an interdisciplinary field of research originated by Hermann Haken in 1969. Synergy effect in the economy means exceeding the aggregate results of the business group's activity over the sum of the firm's performance results prior to their integration. When assessing synergy effects for merging companies, it is important to identify its source. Sources of synergy in the integration of firms are: monopoly pricing, increasing production (sales), reducing costs and obtaining economies of scale, reducing the need for working capital through the provision of raw materials with a deferred payment, optimizing taxation through transfer pricing mechanisms, etc.

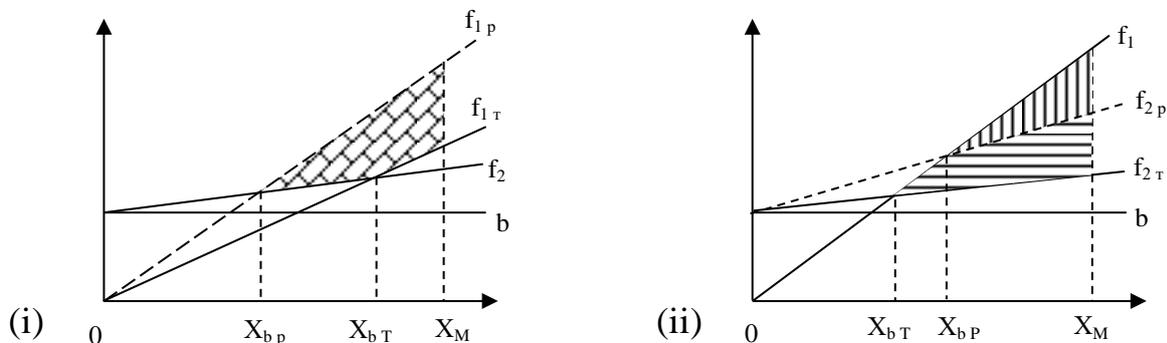
Each participant of vertical integration performs the role of either a supplier or a consumer. The supplier and the consumer try to act rationally, and therefore pursue the goals of maximizing profits. This behavior leads to a conflict of interest. Such contradictions are solved in practice through different mechanisms: either through agreement of contractual terms, or through hierarchical channels (within the framework of an integrated structure). In both cases, it is necessary to take into account the economic interests of the participants, as well as to provide additional profit (or other synergy effect) with the formal parameters of the transaction. However, the choice of a suitable model that would accurately reflect the impact of supply and management signals on the final result of the participants is a difficult task.

### 3. RESULTS

We offer these tools to quantify the value of synergy effects:

#### 1. The model of "cost – sales".

The model is described similarly to the theory of break even, but at the same time for the provider and consumer. The model shows that to achieve the goal (profit) you can change the output and price of products sold. The increase in the price of "supplier" increases the cost "the consumer" and thus reduces its profit. This causes a drop in sales and a decrease in purchases in the next operating cycle. Thus, the price level "supplier" affect the aggregate result of the two companies. Schematically this interaction "supplier" and "consumer" is presented in Fig. 2.



Source: compiled by the authors

Fig. 2: The "cost-of-sale" model of the supplier (i) and the consumer (ii) at market and transfer prices

When drawing Fig. 1 the following notations are used:

$f_{1p}$  – function of the supplier 's sales volume at high (market) prices

$f_{1t}$  – function of the supplier 's sales volume at reduced prices

$f_1$  – function of the consumer's sales volume

$f_2$  – function of the production costs of the supplier

$f_{2p}$  – function of production cost the consumer at high (market) prices purchase

$f_{2t}$  – function of production cost the consumer at reduced purchase prices

X - the volume of sales in physical units

Xb p – breakeven point if the high (market) price of sales (purchases)

Xb T – break-even point at the reduced price of sales (purchases)

XM – volume of sales (production) with production capacity

b – fixed costs

Fig. 2 (i) in the model of "supplier" line f1p shows sales at high (market) prices, and the line f1T – at reduced prices. Brick hatching shows the reduction in profits and break-even of "supplier". "Consumer" on the contrary, for the same level of sales, profit and break-even significantly increase due to the acquisition of resources at reduced prices with the figure with vertical hatching (Fig. 2 (ii)) to the sum of the figures with vertical and horizontal hatching. Accordingly f2 p shows the production function of the costs of "consumer" in the procurement of raw materials at high (market) prices, and the line f2T – at reduced prices.

Positive systemic effect is observed when additional profit consumer exceeds the loss of profits "supplier". It is obvious that such a mechanism of interaction can be realized only when both "supplier" and "consumer" have the same owner and managed from one center. Otherwise, such a scheme must include compensation for lost profits "supplier" from a "consumer", and add to it some premium.

2. The model of commercial lending, based on the adaptation model of equilibrium transfer prices of Pleschinskiy (2004)

In the model, the supplier delivers products in volume X. Part of the products X–R (transfer volume) is to be paid at the high (market) price immediately after delivery, and the remainder (R) – later, once the consumer realizes the end product – at transfer prices. Transfer price contains a premium for the loan. The premium is determined through the rate of a transfer ( $\gamma$ ). Its level depends on the coordination of economic interests of the participants.

The equations of the interaction between supplier and consumer in the model of commercial lending:

$$F_s(\gamma, R, es) = ps(ss) - R\eta_s + (1-n)(1-d)(\gamma-\beta)R + (\alpha(1-n) - \beta) es$$

$$F_c(\gamma, R, ec) = pc(sc) + (1-n)(\alpha-(1-d)\gamma)R + (\alpha(1-n) - \beta) ec$$

fs, fc – profit supplier and consumer in transfer interaction

R – value of the transfer

es, ec – working capital supplier and consumer

ps, pc – net profit supplier and consumer

ss, sc – the costs to the supplier and the consumer

n – tax rate on business profits,  $0 < n < 1$

d – rate of value added tax,  $0 < d < 1$

$\gamma$  – rate of transfer,  $0 < \gamma < 1$

$\beta$  – rate of opportunity cost of capital,  $0 < \beta < 1$

$\alpha$  – loan interest rate,  $0 < \alpha < 1$

$\eta_s$  – reduction coefficient for the profitability of operating activity of the supplier.

These equations allow to determine the amount of additional profit, for distribution among the participants of the integration Association. The additional profit is considered as synergistic effect.

3. Model of Endovitsky and Soboleva (2007), developed for business valuation

The model defines a synergistic effect through the increase in the present value of the activities integrated companies (A and B):

$$\text{Synergy effect} = PVA+B - (PVA + PVB).$$

Considering the cost of the transaction the merger (takeover) the formula for determining the effect looks like this:

Synergy effect = PVA+B – (PVA + PVB) – ΣCd

PVA, PVB – present value of the market value of companies A and B

ΣCd – the total amount of transaction costs for integration.

In the model, you need to determine the billing period, the discount rate and rate of capitalization in order to find the present value.

$$PV_A = \sum_{t=0}^T \frac{CF_t^A}{(1 + WACC_A)^t} + \frac{CF_T^A \times (1 + q)}{(WACC_A - q) \times (1 + WACC_A)^T}$$

$$PV_B = \sum_{t=0}^T \frac{CF_t^B}{(1 + WACC_B)^t} + \frac{CF_T^B \times (1 + q)}{(WACC_B - q) \times (1 + WACC_B)^T}$$

CF<sub>t</sub>, CFT value of the cash flow of companies A and B in the projection period t(T)

g – the long-term growth rate

WACC – the discount rate, found on the model of weighted average cost of capital.

$$WACC = k_d \times (1 - T) \times \frac{D}{E + D} + k_e \times \frac{E}{E + D}$$

k<sub>d</sub> – market rate on the borrowed capital, %

T – rate of income tax, share of units

D – sum of the loan capital of the company

E – amount of own capital of the company

k<sub>e</sub> – market rate of return equity capital, %.

#### 4. CONCLUSION

Integration of firms will be effective only when they allow to achieve a synergistic effect. To assess the synergistic effect, a flexible and universal methodology has not yet been developed. We believe that the tools presented in the article may be useful for carrying out an examination of the organizational and economic decisions taken with reference to the business group as a whole and to each of its participants. The choice of a concrete model for assessing the achievement of synergy is conditioned by the external and internal conditions of interaction between firms, and also by the objectives of the interaction of firms.

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