Vertical integration as a factor of competitiveness of agriculture

Vertikální integrace jako faktor konkurenceschopnosti zemědělství

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Abstract: Vertical integration within agricultural and food sector is one of the decisive factors influencing market structure and competitiveness of agriculture. There are two groups of motives for vertical integration. Motive of efficiency is based on the effort to minimise production cost or transaction cost. Market power is not solely the result of horizontal expansion, but if variable inputs are considered, vertical integration may contribute to market power and so to growing share in consumer price. The article analyses and methodologically specifies these motives for vertical integration and determines possibilities of quantification of the effects of vertical integration.

Key words: vertical integration, competitiveness of agriculture, market structure

Abstrakt: Jedním z faktorů, který významným způsobem ovlivňuje tržní strukturu a konkurenceschopnost zemědělství je vertikální integrace v rámci zemědělsko-potravinářského sektoru. Motivy pro vertikální integraci lze shrnout do dvou základních skupin, motiv efektivnosti a motiv tržní síly. Motiv efektivnosti je odvozen ze snah o úspory výrobních nákladů nebo úspor transakčních nákladů. Tržní síla nevzniká pouze jako důsledek horizontální expanze, ale v případě variabilních proporcí výrobních vstupů může také vertikální integrace přispět k vytváření tržní síly, a tím ke zvyšování podílu na výsledné spotřebitelské ceně. Příspěvek analyzuje a metodicky vymezuje tyto motivy pro vertikální integraci a vyjadřuje se k možnostem kvantifikace dopadů vertikální integrace.

Klíčová slova: vertikální integrace, konkurenceschopnost zemědělství, tržní struktura

Vertical integration within agro-food complex is one of decisive factors influencing market structure and competitiveness of agriculture. Both forward and backward integration may be considered. Forward integration means expansion of agricultural production towards product finalization and distribution. Backward integration is directed to the preceding phases to engage inputs from the preceding subjects within the product vertical. The level of vertical integration differs not only between individual industries, but also within each industry. Vertical integration opens a question wheter firms should try to internalise transactions to undertake coordination role of the market with the aim to increase competitiveness of the firm both on domestic and foreign markets.

OBJECTIVE AND METHODOLOGY

Essentially, there are two groups of motives for vertical integration. First motive comes from the effort to increase efficiency, second one from the effort to create market power.

Efficiency motive

Primary reasons leading a firm to the decision for vertical expansion come especially from the effort to minimise costs and increase productivity of inputs. To analyse these effects, we have to distinguish if the efficiency motive is based on the struggle to minimise production cost or to save transaction cost.

If two production phases influence each other, integration may lead to decreasing of production cost. A classical example is thermal benefit existing if one technology produces outflowing heat and another technology uses this heat as a production input. In this case, integration will evidently lead to increased production efficiency. Besides advantages resulting from integration on the technological level, there may exist integration advantages for example in the area of advertising and promotion or in storage. However, integration need not always lead to

The paper has arisen within the research project of FBE MUAF Brno, MSM 431100007 "Forming of the structure of agriculture and food industry and trends in behaviour of entrepreneurial subjects within the process of the Czech Republic integration into the EU".

increased efficiency. In case of scale economies, specialisation may be more convenient.

Even if technological binding or possibility to save some production cost may contribute to integration, production efficiency has mostly only a supplementary character for justification of integration. Moreover, in many cases scale economies are important for productivity of inputs, e.g. efficiencies connected with specialization. The decisive factor for integration is mostly transaction costs. Technologies may have a complementary character, however, this does not mean that they require a property merger. If property is not merged, transactions between two production phases are realized through market. If these transactions are for any reason too costly, a merger brings savings in transaction cost and integration becomes beneficiary.

Transaction costs usually result from the mutual impact of such attributes of people's behaviour as marginal rationality and opportunity, and transaction characteristics as specificity of assets, uncertainty and frequency of transactions. Because uncertainty is generally always present in business, the most important factor determining the level of transaction costs and the contribution of integration is specificity of assets. If transactions require special investments we may speak about specific assets, having zero or very small value for alternative use. With growing specificity of assets, transaction costs are rising and also the potential benefit of vertical integration is increasing. High level of specificity of transaction assets also makes a firm more vulnerable, which is another reason for vertical integration.

Generally, with growing need of specific assets for transaction realisation, the possibility of economies of scale is declining and transaction costs are increasing. For a decision about vertical integration, it is necessary to take into account the total net benefit, considering both possible benefits resulting from specialization and possibilities of reducing transaction cost through integration.

In Figure 1, there is illustrated relation between specificity of assets and cost. Horizontal axis corresponds with specificity of assets, on vertical axis, there are presented costs. The difference in production costs between integrated and non-integrated production is demonstrated by the curve ΔPC. This difference is always positive, which means that vertical integration has a negative effect on the level of production cost. At the same time, it follows from this curve, that with growing specificity of assets, this cost disadvantage is declining. ΔTC illustrates the relation between the difference in transaction cost under market and internal transactions and the level of specificity of assets. If less specific assets are used for transactions, internalisation is more costly than exchange through market. However, with growing specificity of assets, internalisation brings a reduction of transaction cost. At A_0, the level of savings in transaction cost is exactly sufficient to compensate an unfavourable effect of vertical integration on production costs. If the level of specificity of assets is higher than A_0, vertical integration will lead to increased efficiency. Savings in transaction costs overweight increased production costs.

From the figure, is clear, that if production and trade with some commodity does not require any specific investments, product specialization and trade between firms will lead towards cost minimization. For example, if the specificity of assets equals A_1, vertical integration would bring an increase in production costs by $0Y$ and in transaction costs by $0X$. Total increase of costs would be $0Z$. If specific assets are A_2, net benefit in costs equals A_2w. At the level of specific assets A_0, the firm would be indifferent between using of market transactions and integration. In the last case some firms in the industry would be integrated, however, other firms with various

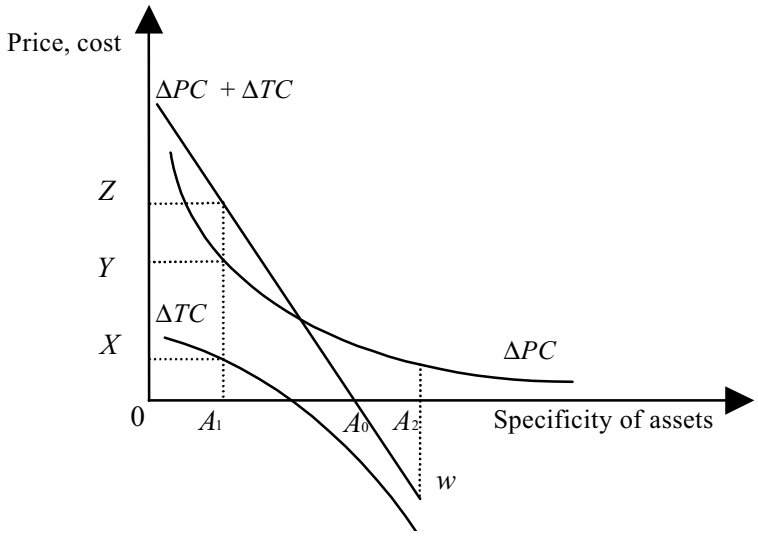

Figure 1. Relationship between specific assets and cost

forms of non-standard contracts would coexist on the market.

Besides specific assets needed for a transaction, the process of internalisation also depends on the level of uncertainty of transactions and on other external effects. Uncertainty in required quality of needed inputs may lead to integration. Also price uncertainty in relation to supply of inputs could lead to internalisation of transactions. Vertical integration may be beneficiary also in the case of existence of information problems about innovations and quality of inputs.

Motive of market power

Undoubtedly, efficiency motive is an important factor in firms' decision making about vertical integration. However, the motive of market power, even if be potentially a very strong motive, need not be so obvious. From economic theory it follows, that monopoly power is a result of horizontal expansion of a firm, not a result of vertical integration, which is motivated by efficiency. However, the statement that monopoly profits may be gained without vertical integration will be valid only under some restrictive preconditions about substitutability of inputs. A firm in monopoly position at some level of product vertical will be able to gain all monopoly profit only if fixed proportions of inputs for given technology are considered. On the other hand, if variable proportions of inputs are characteristic for a technology, vertical integration may contribute to market power and so to a greater share in market price.

For the possibility to quantify a change in market power as a result of vertical integration, it is necessary first to eliminate the effects of savings coming from vertical integration. It may be done if production costs within a particular phase of product vertical will be considered insensitive to vertical integration. Because of the fact, that market power depends also on the market structure, effects of market power have to be evaluated for individual market structures separately.

ANALYSIS

To construct one comprehensive model would be very complex and difficult. More convenient is to evaluate partial aspects of vertical relations on the market. Two extreme possibilities of relations between two linked phases are the situations when both firms are either in competitive environment or if both firms are in a position of a monopoly. Another pairs could be monopoly-competitive environment or competitive environment-monopoly. Between these extreme examples, there may exist situations, where either the preceding or the successive firm or both firms are an oligopoly. An important determinant of relations within a product vertical is also the character of production processes in successive sector and existence of substitutes of production inputs from preceding sector. This means a high importance of existence of monopsony or oligopsony power of successive sector. In case of the existence of monopsony or oligopsony implicit cost of marginal input from preceding sector will be higher than the level of average cost. Then the successive sector will enforce monopsony, respectively oligopsony power through reducing demand for this input.

First, let us consider that there is not a possibility to substitute inputs from the preceding sector (sector A) with other inputs of the successive sector (sector B), and that sector B does not have a monopsony position, which means that products of sector A may be delivered not only to sector B but also to other industries. Industries A and B are oligopolies. In sector A, there are m firms and in sector B, there are n firms. There is not a possibility of collusion of both firms. Then the curve of inverse demand in sector A is $p_B=f(Q)$, where $Q=S_i q_i$, and q_i is production of individual firms. If we consider that firms are identical, then $Q=nq_B$, where q_B is production of individual firms. Then firms in sector B will take price of inputs from A as a parameter. Profit function of these firms will be

$$\Pi_B = p_B q_B - p_A q_A - c_B q_B - F_B$$

Marginal cost of production is constant at level $(p_A + c_B)$, where c_B is the cost of the other inputs. The fixed costs are F_B. The condition for profit maximization of n firms will be

$$p_B\left(1 - \frac{1}{nE_B}\right) = p_A + c_B$$

of which it is clear, that the difference between price and costs is larger the fewer is the number of firms and the lower is demand elasticity E_B. From this condition, it is possible to derive demand for input A

$$p_A(Q) = p_B(Q)\left(1 - \frac{1}{nE_B}\right) - c_B$$

Because marginal revenue of an oligopoly firm is

$$MR_B = p_B(Q)\left(1 - \frac{1}{nE_B}\right)$$

it is possible to define the derived demand for A also as follows

$$p_A(Q) = MR_B(n) - c_B$$

Important is the fact that marginal revenue varies with the change of n. If there is a monopoly in industry B, marginal revenue would be the market marginal revenue. Demand for input A would be market marginal revenue minus marginal cost of other inputs in industry B (c_B). With the growth of n , the curve of marginal revenue will be approaching the demand curve. In perfect competition, the market demand for input A would equal to the difference between market demand curve for B and the price of other used inputs c_B.

Analogically to B, profit function for a firm in industry A will be

$\Pi_A = p_A q_A - c_A q_A - F_A$

where $mq_A = Q$ and c_A, respectively F_A are marginal and fixed costs in industry A. And similarly as for industry B, oligopoly equilibrium for the upstream element of product vertical will be

$$p_A(1 - \frac{1}{mE_A}) = c_A$$

Profit margin will depend again on the number of suppliers m and elasticity of the derived demand E_A. Condition of market equilibrium will be as follows

$$MR_B(n)(1 - \frac{1}{mE_{MR}}) = c_B + c_A$$

where E_{MR} is the elasticity of the marginal revenue curve $MR_B(n)$. Left side represents marginal revenue of a firm in sector A with m firms. The higher the number of firms in the sector, the more will be this curve approaching the demand curve $p_B(Q)$. If there is a monopoly on the supply side, this curve would represent the classical curve of marginal revenue of a monopoly $MMR(m)$.

All these relations are depicted in Figure 2. Firms in sector A (m) face derived demand curve for their products $p_A(Q) = MR_B(n) - c_B$. If they maximize their profits, they try to equalize marginal revenue and marginal cost, e.g. $MMR_B(m) - c_B = c_A$. The result will be the production Q^*, with price per unit p_A^*. Sector B takes this price as a parametric and adds it to the marginal costs of other inputs c_B. And because also sector B has oligopoly character with n firms, considering that they try to maximize their profits, they will equalize marginal revenue and marginal cost $MR_B(n) = p_A^* + c_B$. The corresponding production of final product is Q^* for price p_B^*.

The significance of this analysis resides in the fact, that oligopolistic margin is added at each stage in the production process. These margins lead to reduced final production and increased prices. The lower is the number of firms within a sector, the bigger will be the effect. The maximum effect on output and prices occurs where both sectors are monopolized. If both sectors are competitive, both $MR_B(n)$ and $MMR_B(m)$ coincide with the market demand curve. Each sector would set the price at the level of marginal cost and final output is Y. If sector A is monopolized and sector B is competitive, then $MR_B(n)$ coincides with the market demand curve and $MMR_B(m)$ represents ordinary marginal revenue curve derived from market demand curve. In this case, the supplier of input could exercise monopoly power and collect all resulting profits. An alternative is competitive sector A and a monopoly in sector B. In this case all profit as a result of the monopoly power would be gained by the successive monopoly within the production vertical.

A different situation will be in the case, if inputs from sector A may be substituted in sector B by other inputs. Then if sector A is oligopolistic and sets the price above the level of marginal cost, sector B will substitute inputs from A by other inputs with price at the level of marginal cost. Also the derived demand for A would change, which follows from $E_A = k_A E_B + (1 - k_A)s$, where k_A is the share of A in total factor payments of sector B and s is the elasticity of substitution between A and other inputs. It is clear, that any elasticity of substitution different from zero will increase elasticity of the derived demand and reduce the monopoly power of sector A.

The problem is broader if there is a monopsony in sector B. Derived demand for input from A with n oligopolistic firms in B will be $p_A(Q) = MR_B(n) - c_B$, and with m oligopolists in sector A their marginal revenue $MR_A(m) = MMR_B(m) - c_B$. Because of monopsony position of sector B, the average revenue curve $AR(Q)$ must be defined above the level $p(Q)$. This is the difference between market demand curve for B and cost of other inputs c_B, e.g. $AR(Q) = p_B(Q) - c_B$.

Because of the existence of monopsony on the demand side is on the supply side the main innovation , where we

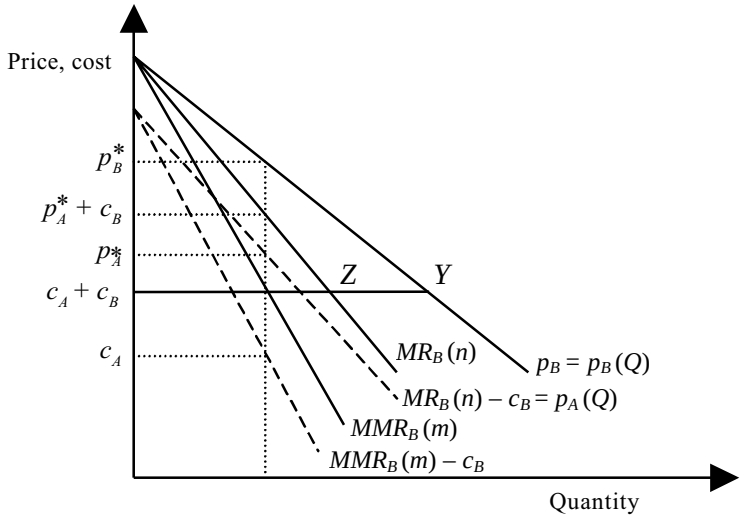

Figure 2. Relationships in the markets within the food vertical

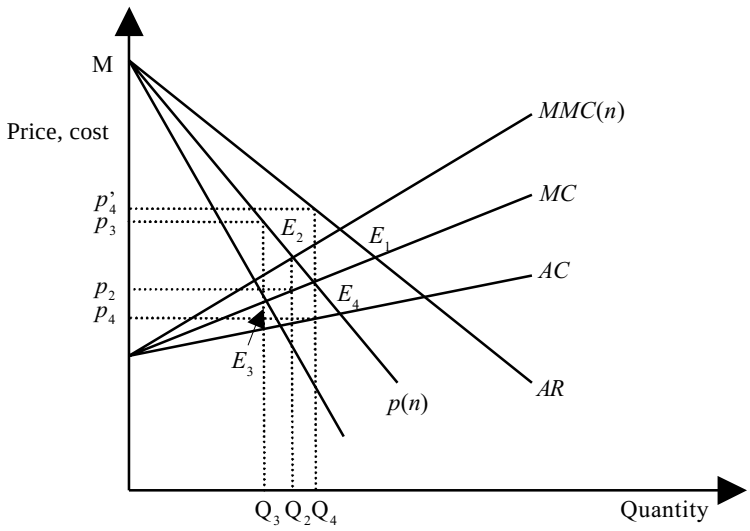

Figure 3. Monopsony within a food vertical

must consider increasing costs of the aggregate supply with the corresponding increase of average costs (*AC*) and marginal costs (*MC*) curves for the industry. This situation is shown in Figure 3. Also there must be considered the marginal cost curve as perceived by individual firms in oligopoly sector with monopsony power *MMC*(*n*). Position of this curve depends on the number of firms in sector *B*.

Assuming sector *A* is competitive, then the industry supply curve will be *MC*. If sector *B* is also competitive, then increasing of production of any firm will have a negligible effect on input supply from sector *A*. Sector *B* will take the price of input as parametric, even if it knows that sector *A* is subject to increasing costs. If sector *B* is monopolized, then the firm will realize that any expansion of production will have a substantial effect on the price of supply of sector *A*. In this case, *MMC*(*1*) represents the usual marginal curve to marginal cost.

Between these two extreme examples lies the possibility of the existence of oligopoly. If there is an oligopoly in the successive sector of production vertical, each firm will realize that increasing of production will not have a negligible effect on demand for inputs from *A* and that price of supply will be growing. Such a firm will consider only additional cost of purchased units of *A*, without regard additional costs generated for other firms in the sector. In this case, *MMC*(*n*) will lie above marginal cost curve *MC*. The difference between these two curves will be growing with the declining number of competitors.

Let us consider that sector *A* is competitive and sector *B* varies from being competitive through to being a monopolist. This will have effect both on the market for inputs from *A*, where demand will vary from competitive through oligopsony to monopsony, and on the market with product of sector *B*, which will vary from competitive through oligolopoly to monopoly. With a great number of firms in the successive sector, the curve of the derived demand *p(n)* will be equivalent to *AR,* e.g. demand curve for the final product net of cost c_B. In Figure 3, this would be represented by the anti-clockwise rotation of curve *p(n)* to the position of *AR.* The equilibrium in the market for input from *A* is at E_1, where *MC* intersects *AR.* However, if there is a possibility of free entry to industry, this equilibrium cannot be a long-run equilibrium, since the supply price at E_1 is higher than the average cost at the same production volume. Supply of sector *A* will increase until all economic profits have been eliminated. With the reduction of the number of firms in the industry, the derived demand curve *p(n)* would rotate in a clockwise direction. The limit of this rotation would correspond with the monopoly position of sector *B*. At the same time, the reduction of the number of firms makes them aware of the growing effect on supply price of input from *A*, so their behaviour would be more and more adequate to *MMC(n).* They would try to equalise their expected net marginal revenue *p(n)* and perceived marginal cost *MMC(n)* at E_2. They would purchase Q_2 units of *A* for price p_2. The smaller the number of firms, the lower output at E_2 and the lower the price of input from *A*.

If there is an oligopoly in the sector *A*, it my exercise a certain market power against the successive sector. If sector *B* does not have oligopsony character, oligopolistic firms in sector *A* will try to equal their expected marginal revenue *MR(m)* to marginal cost of supply *MC*. The equilibrium will be at E_3, with output Q_3 and price p_3. If sector *B* has an oligopolistic character, there would not be a single market solution, since the price will fluctuate between p_4 and p_4'. In spite of the fact that in this case it is not possible to determine the price of the supply exactly, it is obvious, that the existence of oligopsony and monopsony has from the viewpoint of price a negative effect on the supply sector. Moreover, it is evident, that a consequence of the existence of imperfect competition in the market with inputs is lower output and higher prices in the successive sector, which generates economic profit.

DISCUSSION

An important question is the possibility to quantify effects of vertical integration. Difficulty of the answer to this question reflects the complicated definition of output for needs of measurement of added value within individual phases of a product vertical. A consequence of this fact is an existence of many various indexes used in empirical studies. Among the most often used ones, there belong especially the following:

€ Added value/total sale

This index is based on the idea, that the greater is the size of added value by one firm, the higher is the level of integration. The ability of this index to evaluate the degree of vertical integration is limited by the fact, that any price change, change of profitability or a change of tax rates appears as a change of the level of integration. Moreover, this index is not very suitable for comparisons, since the value does not reflect only the degree of integration but also the phase of the firm within a product vertical. Then two firms with the same added value, operating in opposite sectors of the product vertical, e.g. one at the beginning of the vertical and the other at its final phase, would have, according to this index, different levels of vertical integration.

€ Value of stocks/total sale

This index is based on the presumption, that the more phases of production are integrated, the greater is the volume of stocks in relation to the total sale. However, this may be misleading, since vertical integration decreases uncertainty in supplies and hence it has a positive effect on reducing stocks at the individual phases of product vertical. For this reason, the total value of stocks may sometimes point both to increase and to decrease. Moreover, price changes will lead to the above-mentioned problems with changed index under the stable degree of integration.

€ Total purchase or transfers between firms/total volumes of used inputs

This index is used for measurement of backward integration. For forward integration is used an equivalent form: total transfers between firms/total output at the given level of product vertical.

The adequacy of the used approach to the quantification of the effect of vertical integration will depend on the character of analysed industries. Based on concrete conditions, these indices may be modified. Also the interpretation of obtained results must be very careful.

CONCLUSION

Market structure of agro-food complex determines behaviour of individual firms within this industry, which consequently effects performance of this sector. That is why market structure of agro-food complex influences to a great extent competitiveness of agriculture. In spite of the fact that vertical integration and diversification are important factors of the development of market structure, they are not the only ones. When analysing effects of market structure on competitiveness of agriculture, respectively agro-food complex, we must not forget such factors as the number of buyers and sellers operating in this sector and their relative size (market concentration), product differentiation, size of entry barriers and exit barriers from the industry, existence of economies of scale and, last but not least, the character of market environment and position of agricultural producers within product verticals.

The paper has arisen within the research project of FBE MUAF Brno, MSM 431100007 "Forming of the structure of agriculture and food industry and trends in behaviour of entrepreneurial subjects within the process of the Czech Republic integration into the EU".

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Arrived on 28th August 2003

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