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DISCUSSION PAPER

Institute of Agricultural Development in Central and Eastern Europe

COMPARING MEASURES OF COMPETITIVENESS

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SUMMARY

In their Europe Agreements with the EU, the Central and Eastern European countries stated their intention of joining the Union. To ease the process of accession these countries must adjust their economies already prior to becoming an EU-member. Agriculture requires special attention, because it still represents a large share of the total economy in these countries. A better understanding of the competitiveness of agricultural products at domestic and EU markets is essential for providing the necessary economic framework to make the process of joining the EU as smooth as possible.

Competitiveness can be analyzed at various levels of the economy: at the enterprise level, the sector level, or the level of the entire economy. Several measures exist for each of these levels. This paper focuses on those used for sector analysis. Since the measures commonly employed for this purpose do not deliver the same results, a better understanding of the underlying causes is necessary. This paper discusses the differences between the various indicators. It identifies the factors leading to disagreement in the results obtained.

ZUSAMMENFASSUNG

In den Assoziierungsabkommen mit der EU haben die mittel- und osteuropäischen Länder ihr Interesse an einer EU-Mitgliedschaft bekundet. Um den Integrationsprozeß zu erleichtern, müssen diese Länder ihre Wirtschaft anpassen. Die Landwirtschaft verdient dabei besondere Aufmerksamkeit, da sie einen nicht geringen Anteil an der gesamten wirtschaftlichen Leistung erbringt. Kenntnis über die Wettbewerbsfähigkeit landwirtschaftlicher Produkte dieser Länder ermöglicht es, die ökonomischen Voraussetzungen für einen möglichst reibungslosen Übergang in die EU zu erreichen.

Wettbewerbsfähigkeit läßt sich auf verschiedenen Stufen der Wirtschaft messen; auf betrieblicher Ebene, für einen Sektor oder für die gesamte Volkswirtschaft.

Auf jeder dieser Stufen gibt es verschiedene Indikatoren. In diesem Diskussionspapier werden solche Indikatoren beschrieben, die zur Messung der Wettbewerbsfähigkeit auf sektoraler Ebene herangezogen werden können. Da sich die Meßzahlen unterscheiden und auch nicht zwingend die gleichen Ergebnisse liefern, ist die Kenntnis der Gründe für diese Abweichungen in den Ergebnissen sehr wichtig. Dieses Papier untersucht und beschreibt die Faktoren, die zu derartigen Unterschieden führen.

CONTENTS

LIST OF ABBREVIATIONS

CEA	Central European Associates
CAP	Common Agricultural Policy of the EU
FDI	Foreign Direct Investment
RXA	Relative Export Advantage Index
RMP	Relative Import Penetration Index
RTA	Relative Trade Advantage Index
RER	Real Exchange Rate
DRC	Domestic Resource Costs
PPP	Purchasing Power Parity

1 INTRODUCTION

The transition from a socialist system to a market economy has induced pronounced adjustment pressures in the former socialist countries, including the Central European Associates (CEAs), i.e. the Central European countries that have association agreements with the EU. In addition, the CEAs have to adapt to external developments such as changes in the Common Agricultural Policy of the EU (CAP) and to implement EU regulations as provided in the White Book of 1994 and the Agreement of the Uruguay Round. Adjustments are especially strong in the agricultural and food sector. These ongoing changes make it difficult to accurately assess the competitive position of CEAs' agriculture. This, however, is necessary for the CEAs in order to adjust effectively to the opportunities and the threats facing this sector.

Thus, the aim of the paper is to discuss the strengths and weaknesses of different indicators commonly used for measuring competitiveness. This seems especially important since a rather large variety of indicators of competitiveness exists, which quite often deliver different, in some cases even contradictory, results. Thus a better understanding of the underlying causes for such divergence is necessary.

The paper is organized as follows. A definition of competitiveness and what it encompasses are given in the next section. This is followed by a discussion of commonly used indicators for quantitatively assessing these different concepts.

2 DEFINING COMPETITIVENESS

Competitiveness is an indicator of the ability to supply goods and services in the location and form and at the time they are sought by buyers, at prices that are as good as or better than those of other potential suppliers, while earning at least the opportunity cost of returns on resources employed (FREEBAIRN 1986, p. 2).[1] Two types of competition are included in this definition. First, the competition on domestic and international product markets and thus the ability to gain and maintain market shares, and second, the competition in factor markets, where those factors employed in producing the goods have to earn at least the opportunity costs. Although pointing to different aspects, both types are indicative of the fact that competitiveness is a relative measure. One always has to make the comparison with a base value. In the case of a market share, it is with regard to market size. If one assesses competitiveness in factor markets, the relation is to the value a factor would have in another production process.

Analyses of competitiveness may differ with respect to the level of investigation. Table 1 provides an overview. Studies can be carried out for various levels of product aggregation, across the entire economy, a specific sector, or for a single product (or aggregate of products). The competitiveness of a product can be assessed at market (sector) level or for a specific farm. Another differentiation of competitiveness exists with regard to the spatial dimension of the analysis. Since it is a relative measure, the competitiveness of enterprises or regions within a country, or between countries, may be compared.

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[1] There is in fact no single definition of competitiveness in the economic literature. The difficulties in defining competitiveness are due to the various dimensions of this concept. The above definition, however, seems to be widely accepted in the economic literature. Its main advantage lies in that it not only considers the output markets, but also considers the factors of production.

The indicator used does not always reveal the spatial extension and the level of product aggregation of a given analysis. A large number of analyses of competitiveness evaluate the performance of an industry (or a sector) either by using an aggregate of all the outputs of this industry, or by looking at its most important commodities. On the other hand, studies at the enterprise level are becoming increasingly common as well. We will return to this issue at a later point.

Table 1: Analyses of Competitiveness According to Level of Product Aggregation and Spatial Extension

	Spatial Extension		
Product Aggregation	Farms	Regions Within a Country	Countries
Entire Economy	no	no	yes
Single Industry	no	yes	yes
Single Commodity	yes	yes	yes

Competitiveness is closely linked to comparative advantage. The only difference between the two is that competitiveness includes market distortions, whereas comparative advantage does not. Both are based on the concept of general equilibrium. Therefore, indicators used to measure competitiveness should make use of general equilibrium approaches, since only these take account of all the interdependencies in an economy.

Although such analyses are desirable, they are not too frequently pursued because of the complexity involved. Studies that investigate only one part of the economy, e.g. an industry or an enterprise, and that approximate or neglect these interdependencies, are more common. A more detailed discussion of this aspect is provided in the next chapter, which also takes up the issue of ex-post and ex-ante performance.

3 INDICATORS OF COMPETITIVE ADVANTAGE

As mentioned above, the concept of competitiveness can be applied at different levels of product aggregation and spatial extension. In addition, past performance (ex-post) or the potential of competitiveness (ex-ante) can be the focus of the analysis. In the following subsection, indicators of competitive performance in the past are discussed, while section 3.2 focuses on those measures which can assess both past performance and future potential.[2]

The quality of the results obtained with these indicators depends to a considerable extent on the quality of the data available. Although this is common to all indexes, it affects some more than others. The quality, type and amount of data required also varies between the measures; the choice of the index to be used is therefore often dictated by data availability.

[2] For an overview on measures of competitive potential and competitive process, see PORTER (1990) or FANFANI et al. (1995).

3.1 Indicators Measuring Ex-post Performance of Competitiveness

Several approaches can be used to analyze the past performance of competitiveness. Most frequently employed are market share indicators, the real exchange rate and Foreign Direct Investment (FDI). They differ widely in their methodologies and data requirements.

3.1.1 Trade and Market Share Indicators

A host of different indicators were developed to measure competitiveness based on market and trade information[3]. Although designed for international comparison, they may also be used to contrast the competitiveness of different regions. These measures are usually calculated for single products or an aggregate of products. As will be seen, most of these indicators are based on trade rather than on domestic market information. Although this is not without problems, one advantage of using trade data is that demand and supply responses are considered simultaneously. Since comparisons based on accounting methods (see section 3.2.1) do not consider these interdependencies, the two sets of measures are not exactly alike. One should therefore avoid overemphasizing any discrepancies between them.

An additional advantage of using trade data is that the costs of marketing and transport to and from the port of entry are also taken into account. This is another characteristic which distinguishes these measures from those based on accounting methods.

Some of these indicators are very simple and therefore less appropriate. As already mentioned above, competitiveness is a relative measure. Thus, indicators based on absolute production and market shares give little information on the competitive position of a product, sector or subsection in an economy. Indicators that compare one sector relative to others should be considered instead. The more sophisticated and comprehensive measures of international competitiveness take account of this aspect (see e.g. BALASSA 1989, SCOTT and VOLLRATH 1992, VOLLRATH 1990); they include the following: the Relative Export Advantage Index, the Relative Import Penetration Index and the Relative Trade Advantage Index.

The Relative Export Advantage Index (RXA)

This index is shown in equation (1). X refers to exports. Subscripts i and k denote the product categories and j and l the countries. The index is defined as the ratio of a country's export share of a certain product in the world market to the same country's share in world export of all other commodities. The special feature of this measure is that the world 'total' is always taken as the sum across all countries except the one studied. This avoids counting countries and commodities in both the numerator and the denominator. Thus, instead of including all exports in the summations of equation (1), the commodity and the country considered are excluded when total exports are summed up. This aspect is especially relevant if a country is fairly important in trade on international markets, and/or if the commodity considered is important in total trade. In these cases, double counting would lead to biased index values.

$$(1) \qquad RXA_{ij} = \left(X_{ij} \Big/ \sum_{l,l \neq j} X_{il} \right) \Big/ \left(\sum_{k,k \neq i} X_{kj} \Big/ \sum_{k,k \neq i} \sum_{l,l \neq j} X_{kl} \right)$$

The level of this index is to be interpreted as follows. Values above unity suggest that the country has a competitive advantage in the considered product category, whereas values below 1 point to a competitive disadvantage.

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[3] In this group belong also the so called Constant-Market-Shares-Analysis (see also LEAMER 1975).

The Relative Import Penetration Index (RMP)

$$(2) \qquad RMP_{ij} = (M_{ij} / \sum_{l,l \neq j} M_{il}) / (\sum_{k,k \neq i} M_{kj} / \sum_{k,k \neq i} \sum_{l,l \neq j} M_{kl})$$

The Relative Import Penetration Index is very similar to the RXA. The differences are that it considers imports, represented in equation (2) by M, and that the interpretation is reversed from that of the RXA. A value of unity is a sign of competitive disadvantage, and values below that are an indication of competitive advantages.

The Relative Trade Advantage Index (RTA)

First used by Scott and Vollrath (1992), the RTA is more complex than the other two. This index gives the difference between the RXA and the RMP.

$$(3) \qquad RTA_{ij} = RXA_{ij} - RMP_{ij}$$

The competitive advantage revealed by this indicator is implicitly weighted by the importance of the relative export and the relative import advantages. Hence, it is not dominated by extremely small export or import values of the commodity considered. A positive value indicates a competitive advantage, and a negative one a competitive disadvantage.

While the RXA and the RMP indexes are exclusively calculated using either export or import values, only the RTA considers both export and import activities.[4] From the point of view of trade theory, this seems to be an advantage. Due to the increase in intra-industry trade, this aspect is also becoming increasingly important.

In addition, the RMP can be very misleading, since it can be heavily distorted due to protection of domestic markets. In the extreme case of an import ban or a prohibitively high import tariff, this measure indicates a high level of competitive advantage, while the reverse might be the case. Another factor which can lead to a distortion of all indicators considering exclusively either exports or imports is the existence of intra-industry trade. If, for example, a country only acts as a transit country, the RXA might indicate high levels of competitiveness that would be purely artificial (PITTS et al. 1995, p. 8). It is important in this respect what a particular country counts as exports, since there are unfortunately variations between different countries' records.

The importance of using both exports and imports simultaneously in calculating an indicator of competitiveness may be illustrated by a simple example. Let us assume the RXA for product i in country j reveals a value of 3, thus indicating a high level of competitiveness for this product. However, the RTA value for the same commodity and country amounts to -1, thereby pointing to a lack of competitiveness. What might have caused these contradictory results? The answer is rather straightforward: intra-industry trade makes up for the difference. Although exports have reached a sizable share, imports of this commodity must have been even larger. Therefore, in considering both exports and imports the RTA is a more comprehensive and superior measure of competitiveness.

[4] This also holds for the net export index developed by BALASSA (1989, p. 81). Although this indicator is often used in studies of competitiveness, it is more suitable for measuring the intra-industry trade of a sector. As a matter of fact, this index is very similar to the Grubel-Loyd index of intra-industry trade. It is less suitable for providing an indication of competitiveness, since it does not take into consideration that competitiveness is a relative issue which cannot be measured in absolute figures.

There are numerical problems with all three indexes. The RXA and RMP are bound from below by zero, but unbounded from above. The RTA is not bound from below either, but a switch in sign indicates a change in competitiveness. Were these indexes completely bounded, the interpretation of any value they took on would be easier, in the sense that one would be in a better position to assess the extent of a country's (lack of) competitiveness.

PITTS et al. (1995) criticize a related problem in all three indexes. In their opinion these indexes cannot be compared across countries, since the size of a country affects the values. Let us assume countries j and l would each export 50 % of a commodity. Let country l be much larger and therefore have a considerably higher share than country j in total world trade in all other commodities. In this example, the RXA value for country j would exceed that of country l, though both countries had the same share in the world market for the commodity considered. Can country j be interpreted as being more competitive than country l? PITTS et al. deny this. However, one could argue that the size of the country should be taken into account: it is much more difficult for a small country to reach the same volume of export as a large one.

It is also difficult to interpret the results of these three measures if they show large annual fluctuations which are due to structural changes. This is the case with most of the transition countries. Since their economies, including the agricultural and food sector, are still under strong adjustment pressure, annual changes in trade structure are quite substantial. It is rather difficult to reach conclusions regarding competitiveness under these conditions .

3.1.2 Real Exchange Rate

The Real Exchange Rate (RER) is a widely used measure of competitiveness. In most cases it is applied to the entire economy. Increasingly it is also employed as a measure for specific sectors (e.g. POGANIETZ 1998).

The RER is defined as the ratio of the price index of tradable commodities (p^T) to that of non-tradable ones (p^{NT}); i.e:

$$RER = \frac{p^T}{p^{NT}} \tag{4}$$

The costs of producing a tradable good differ between countries, mainly because of the varying prices of non-tradable inputs used in producing this commodity, and to a lesser extent, due to tradable inputs. The latter cannot cause large divergence because the price differences between countries are only due to trade policies. Therefore, a relative increase in the cost of non-tradable inputs which is equivalent to an appreciation of the real exchange rate leads to higher production costs.

Since prices for non-tradables are hardly available in the statistics, the real exchange rate is usually approximated by some ratio of foreign to domestic price indexes. One way of applying this method is to divide the nominal exchange rate by the Purchasing Power Parity (PPP). Another alternative that is also often used is to multiply the nominal exchange rate with the ratio of the foreign to the domestic consumer price index, or with the same ratio of the implicit GDP price deflator.

$$RER = \frac{NER}{PPP} = NER \cdot \frac{p^F}{p^D} \tag{5}$$

where NER is the nominal exchange rate expressed in units of domestic currency per one unit of foreign currency, and p^F and p^D are the appropriate foreign and domestic price deflators.

Although the RER is quite often used to measure the international competitiveness of a country, an interpretation of the divergent movements of real exchange rates between countries is rather difficult. This is due to the fact that these changes can be a reflection of or a cause for a change in international competitiveness.

According to foreign trade theory, improvements in the balance of current account will ceteris paribus result in an appreciation of the domestic currency in nominal and real terms. Such a change is obtained if enterprises gain market shares in domestic and foreign markets. The degree of appreciation in the real exchange rate indicates to what extent international competitiveness has increased.

Developments over the last decades suggest, however, that changes in real exchange rates are in the short to medium term very often influenced more by capital movements and their impact on the nominal exchange rate, than by changes in the basic conditions of the real economy. Thus, in order to establish a causal relation between changes in the real exchange rate and international competitiveness, information about the driving force behind the movement in the former is required.

One major advantage of using a version of equation (5) is to be seen in the availability of data. Often consumer price indexes for the domestic and foreign country rather than the purchasing power parity are taken. Although they are more easily available, the problem is that they measure prices of demand, excluding many intermediate goods and factor prices.

3.1.3 Foreign Direct Investments

One way to overcome trade barriers is by investing in other countries. FDIs can therefore lead to a partial substitution of exports. Thus, if a particular nation has a high level of investment in foreign countries, this is also seen as an indicator of competitiveness. Several attempts have been made to incorporate FDIs in the indices of competitiveness (see TRAILL and GOMES DA SILVA 1994, for a detailed discussion). Those indicators are extensions of the RXA index discussed in the previous section.

On the other hand, the amount of FDIs a foreign country attracts is also frequently seen as a sign of competitiveness of that nation as a whole, or of the sector or region attracting the investment. FDIs are then interpreted as the capability of the foreign country to pull in mobile international resources in the form of physical capital and know-how. In such a case, it is assumed that a country will attract FDIs if it has the advantage of production conditions that the country making such investments is lacking.

Thus, one needs to differentiate with respect to FDIs. If a large part of such investments is primarily aimed at opening up foreign markets that can perhaps not be accessed through exports due to trade barriers, they mirror competitiveness of the donor country; otherwise they point to a competitive advantage of the country or region attracting FDIs. Unfortunately, it is generally not easy to distinguish which of the two causes dominates.

3.2 Methods to Measure the Potential of Competitiveness

In the previous section, indicators measuring past competitiveness performance were discussed. Some of these might also be used to assess the impact on competitiveness of new policies that do not deviate too strongly from those in place in the past. However, quite a few analyses of the impact that changes in policy, such as the accession of the CEAs to the EU, have focus on events for which past observations offer little if any insight, because the new

ones are outside the domain of what has been observed. Hence, one needs to assess these impacts using methods capable of capturing the effects of such options.

It is not important in this respect whether these events will actually occur, but nevertheless one rather likes to assess the potential impact the implementation of such policies would have. The indicators discussed in the previous subsection cannot be expected to deliver results of the quality desired. Accounting methods such as production costs and gross margins (profitability), and domestic resource costs can fulfill this task to some extent. However, mathematical or simulation models are capable of providing the most comprehensive insight.

3.2.1 Accounting Methods

Production costs and/or gross margins are often compared across farms to indicate which enterprise has a competitive advantage. Gross margins are obtained by subtracting costs of variable inputs from gross revenue. Since these calculations can be carried out only for a single commodity, such analyses are done at the product level. In general, data of existing enterprises are taken. Sometimes information obtained from individual farms, but averaged over a region or even a country, is also used. The underlying data determine the spatial extent of the analysis, i.e. whether enterprises at a regional or country level, or whether different types of farms are compared.

To allow for easier comparison, it is common to normalize gross margins, e.g. with the value of sales or labor costs. This indicator can provide rather detailed insights into the reasons why enterprises across regions or countries are or are not competitive in a particular good. This is due to the fact that the index is based on a rather detailed breakdown of the various cost items of production and, hence, offers a comparison at this level. Other measures do not reveal such details.

However, the method requires the data employed for comparison to be of the same or at least quite similar quality. To make comparisons across countries, this is a strong requirement which is frequently not met. This can be illustrated using the following two examples: what is counted as an output, and what belongs to variable inputs. The problem with output is that joint products, such as straw in grain production, are often not properly accounted for. The difficulties regarding inputs are even more severe. Inputs that are considered as being variable as opposed to quasi-fixed, and that are therefore included in these calculations, are likely to change from country to country. This makes it necessary to harmonize the information included in the analysis. As an example, capital costs may be part of the calculation if depreciation depends on how much the capital is used, and left out if it is determined by time.

If one wants to draw conclusions about competitiveness, these indicators have to be used with some care. It is likely that too much is read into these figures, because the limitations of the approach are not sufficiently taken into consideration. In general, several shortcomings are associated with this approach.

One major limitation is that gross margins do not offer any insight into whether quasi-fixed factors could be paid in accordance to what they would earn were they used in the production of other commodities. Moreover, if a quasi-fixed factor were to be used in producing only one commodity, it could be disregarded completely; this, however, is rarely the case. Most quasi-fixed factors are rather immobile with regard to other sectors of the economy, but can be employed in producing several agricultural goods. If it is possible to obtain shadow prices as they accrue to the quasi-fixed inputs used in the production of the good analyzed, and to include them in the calculation of production costs, some of the problems could be solved.

One way of achieving this would be to employ a model suitable for generating the necessary information. A general equilibrium approach more or less takes care of all these aspects; partial equilibrium models and production models achieve this to some extent.

Another problem in using accounting methods relates to the question of how representative the results will be. Usually the calculations are carried out for specific enterprises. If used for regional or country comparison, care should be taken to find firms that are representative of the corresponding spatial entity. This requires detailed information on the most important characteristics of the enterprises with regard to competitiveness, as well as an appropriate sampling method.

For international comparison, the omission of distribution and marketing costs in this method is a disadvantage. Where international competitiveness is determined, the costs of transporting the commodity from the point of production to the port of export, or from the port of import to the point of domestic use should not be disregarded. For bulky products, or spatially large and land-logged countries with less developed transportation systems, such costs can seriously impede or even become prohibitive for trade[5].

Additional problems arise if this method is used for considering competitiveness under different policy scenarios. This is due to the assumption that production can be represented by a Leontief function, which does not allow substitution among inputs. Furthermore, accounting methods neglect any repercussions for prices caused by changes in demand for inputs, and neither do they represent similar interdependencies on output markets (no equilibrium condition is implied). A policy change, however, will affect outputs as well as variable inputs, and also the value of quasi-fixed factors. Subjective judgment is required as to whether these omissions affect the results and, if so, by how much.

The extent of this bias depends on several factors. To be more specific, the indicator becomes more biased

i) with increasing mobility of quasi-fixed factors to be used for producing different commodities,

ii) with an increasing share in total availability of use of these factors by the commodity under investigation and

iii) with increasing flexibility of variable input prices.

3.2.2 Domestic Resource Costs and Competitiveness Coefficient

Domestic Resource Costs (DRC) are calculated to measure the comparative advantage of different policy options. This indicator equals the real domestic resource cost required to save or earn a unit of foreign exchange. It can be interpreted as the shadow value of domestic non-tradable factors necessary in producing a traded good per unit of tradable value added. If the domestic value added is greater than the opportunity costs of the used domestic resources (DRC < 1), the considered alternative will lead to growth. Otherwise (DRC > 1) the policy is an inefficient alternative (TWEETEN 1992, p. 61, MASTERS and WINTER-NELSON 1995, p. 243).

[5] SHARPLES (1990, p. 1280) points out that, in the analysis of competitiveness, not only production costs, but also marketing costs should be considered.

$$(4) \qquad DRC_i = \frac{\sum_{j=k+1}^{n} a_{ij} P_j^D}{P_j^B - \sum_{j=1}^{k} a_{ij} P_j^B}$$

with

a_{ij} quantity of the j-th traded (if j≤k) or non-traded (if j>k) input (j = 1, 2, ..., n) used to produce one unit of output i;

P^D_j domestic (shadow) price of input j

P^B_i border price of output i

P^B_j border price of input j.

The DRC is constructed from average budget data based on observed (average) input-output coefficients and imputed shadow prices for the non-traded inputs P^D_j. Usually, the latter reflect the opportunity costs per unit of domestic labor, of land, as well as of fixed capital such as drainage and irrigation. The problems involved in these calculations were already discussed above (see section 3.2.1). Since the input-output coefficients are assumed constant over different policy scenarios, and because imputed shadow prices for each commodity are calculated separately, the indicators ignore any kind of substitution and other cross-price effects.

In addition, the DRC has been criticized for the biased results it usually offers. MASTERS and WINTER-NELSON (1995) show that it is often those alternatives which rely on a high level of non-tradable inputs that are shown to be inefficient. The bias is especially pronounced if the various options to be compared include very divergent combinations of traded and non-traded inputs. In addition, the distinction made between the costs of tradable and of non-tradable components is often rather ambiguous. Finally, it is not easy to gather the necessary input-output coefficients needed for the analysis.

The inverse of the DRC, called Competitiveness Coefficient, is also quite often used. It is intuitively more appealing than the DRC, since it reveals the highest values for those policy alternatives which indicate largest returns to fixed resources, and thus presumably have a competitive advantage (TWEETEN 1992, p. 62).

3.2.3 Mathematical Models

Simulation models are the most comprehensive tool for measuring competitiveness. When employed for this purpose, such models must be robust against policy alterations, since policy changes are very likely to induce quite a number of changes in the way the goods investigated are produced in the economy or sector. Therefore, great emphasis has to be placed on the structure of the model and its parameters. In other words, the system should include parameters that do not alter due to new policies. This characteristic, sometimes referred to as external robustness, is highly demanding on the quality of the model. How well the model reflects this robustness clearly also depends on the divergence of the new policies from those implemented in the past. To use the example mentioned above, the possible accession of the CEAs to the EU is expected to lead to some rather drastic policy changes that can only be analyzed with a model whose structure reflects this robustness

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Not all model types are capable of having such a property. Those econometric models which fall into the class of reduced-form models are less suitable for such analyses, because they include the production and preference structures in a compact and implicit way that likely lacks the details necessary to reach the robustness required. Those commodity and sector models which explicitly include the essentials of the structures are more appropriate. From this point of view, equilibrium models are preferable to other types, since they depict both supply and demand in a rather detailed way. Among these models, those depicting the entire economy and taking account of all economic interdependencies (general equilibrium models) are most suitable. This holds since - as indicated above - competitiveness and comparative advantage are general equilibrium concepts. Since these models are, however, costly and time-consuming to build, they are not often employed for these purposes.

Results of policy simulations with these types of models typically include a variety of different variables such as changes in output, input use, final consumption, export, import, prices etc. It is certainly possible to draw conclusions about changes in competitiveness based on these variables. It might, however, be easier and more informative to calculate e.g. the RTA indicator by using the results of such simulations. The same indicators might be calculated for observed data as well, to make comparisons between past and possible future outcomes.

Highly suitable mathematical models are not often employed for comparing competitiveness across countries, due to the high requirements in terms of manpower, data and time; however, once specified they can easily be used to analyze the impact of a variety of policy scenarios.

4 CONCLUSION

The above discussion has shown a wide variety of measures of competitiveness to exist. They vary considerably with regard to methodology, as well as manpower and data requirements. Some are relatively easy to calculate. The data needed are commonly found in many trade statistics. However, these indicators are suitable only for assessing past performance of competitiveness rather than determining its potential.

Evaluation of the potential of competitiveness demands considerable man-power and data. For this reason, the indicators discussed above are not as commonly used as the ones measuring past performance. On the other hand, if information on the potential is to be obtained the efforts necessary usually are justified.

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