Acta Oeconomica, Vol. 33 (3-4), pp. 255-271 (1984)

ECONOMIC REFORM, ALLOCATIVE EFFICIENCY, AND TERMS OF TRADE

E. ZALAI

It has widely been agreed that the distorted price system is one of the causes of inefficient economic decisions in centrally planned economies. The paper investigates the possible effect of a price reform on the allocation of resources in a situation where micro-efficiency remains unchanged. Foreign trade and endogenously induced terms-of-trade changes are focal points in the multisectoral applied general equilibrium analysis.

Special attention is paid to some methodological problems connected to the representation of foreign trade in such models. The adoption of Armington's assumption leads to an export demand function and this in turn gives rise to the question of optimal export structure, different from the equilibrium one—an aspect so far neglected in the related literature.

The results show, that the applied model allows for a more flexible handling of the overspecialization problem, than the linear programming models. It also becomes evident that the use of export demand functions brings unwanted terms-of-trade changes into the model, to be avoided by a suitable reformulation of the model.

The analysis also suggests, that a price reform alone does not significantly increase global economic efficiency. Thus the effect of an economic reform on micro-efficiency appears to be a more crucial factor. The author raises in conclusion some rather general questions related to the foreign trade practice of small open economies.

Introduction

This paper reports about a theoretical and methodological research, in which some issues related to the economic reform concepts in the centrally planned economies are addressed in the framework of a computable general equilibrium model. It should be emphasized right at the beginning that the analysis only focuses on some aspects of economic reform and, despite its quantitative nature, the conclusions arrived at are qualitative ones. Apart from the reform ideas special attention is paid to some methodological problems of foreign trade and its representation in applied general equilibrium models. Foreign trade will be, in general, a focal point in our analysis of changing resource allocation patterns under various assumptions.

Ideas for economic reform in Eastern Europe have in recent years developed through several stages; nevertheless, some basic elements have remained practically unchanged. Among the latter is the establishment of economically more sound price systems, and increased role of prices in economic decisions, both at the central (macro) and the enterprise (micro) level, and a simultaneous decentralization of decision making.

It has been long argued and also a widely accepted view that one of the main causes of inefficient economic decisions in centrally planned economies is the distorted price system. Prices misinform and misguide economic decisions at both the macro- (central planning) and the micro- (enterprise) level. These views were especially typical of earlier stages in the formulation of reform concepts, but various price reforms and price modeling efforts indicate that this issue still is quite in the forefront of interest (see, for example, [10, 11, 9, 3, 2]). We will revisit this issue.

The various suggestions for economic reform have rarely been based on a rigorously developed economic theoretical framework. It is, however, probably fair to say that in most cases they have relied on some intuitive model of perfect competition stimulated by individual or group financial/material interest. Hence, we believe that the adoption of a competitive general equilibrium model framework for the analysis of expected outcomes of economic reform measures is justified.

Since we are dealing with an open economy, special attention is paid to foreign trade and the possible effects of trade-liberalization policies, especially on the export side. Many observers inside and outside Hungary assert that, because of surviving institutional rigidities and worsening external trade conditions, the economic reform did not produce satisfactory results at the micro- (enterprise)-level. The enterprises failed to modernize their product-mix to a sufficient extent and, consequently, the increase in productivity and competitiveness on foreign and domestic markets was smaller than had been expected. In such conditions one may realistically assume that changes in the export volume, even in a small economy like Hungary, are accompanied by, what will be called, endogenously-induced changes in the terms-of-trade.

Thus, in our analysis attention will be focused on rather specific problems. Within the usual comparative static framework we will evaluate the expected impact of a price reform on the allocation of resources and the resulting gains in economic efficiency. Comparative static analysis involves the basic assumption that the underlying structure of the economy (for example, technological conditions and consumer preferences) remains unchanged. This critical feature of the analysis will assume a special meaning in our case. The most plausible interpretation is that efficiency at the micro-level does not change significantly, which is in line with the above remarks. Changes in prices will thus only affect the allocation of resources among sectors and foreign trade (allocative efficiency). Our simulation results suggest that, under such conditions, one can only expect modest results, especially if one accounts for endogenously-induced deteriorations in the terms-of-trade.

As mentioned above, we employ here a model of the computable general equilibrium type to assess repercussions of the assumed changes in a consistent manner. The basic assumption is that changes in relative prices and costs will be followed by appropriate shifts in the composition of inputs, outputs, consumption and trade, following the rules of a laissez-faire market equilibrium. While the model is intended to capture some elements of the working of an economic or planning system in which prices and market considerations play some albeit limited role, it should not and cannot be regarded as a fully adequate, descriptive model of the Hungarian or any other real economy. Our basic aim is to test various reform concepts under the conditions outlined above. We will show that, contrary to some common beliefs, moving closer to a market equilibrium does not necessarily improve Pareto efficiency. The increase in allocative efficiency will be reduced and may even be completely offset by an endogenously-induced terms-of-trade deterioration. The optimum tariff argument suggests that in such cases it might be advantageous to keep some central control over export decisions, since individual exporters may not perceive (or it may not be in their interest to account for) this scale effect.

Finally, the paper also addresses a more general, methodological issue concerning computable general equilibrium modeling. This is the question of the treatment of foreign trade in general, and the so-called Armington assumption in particular. The numerical examples presented will illustrate the effect of alternative assumptions regarding export functions and the size of export elasticities. It will be argued that the export demand functions and values of elasticities frequently adopted introduce unwanted and unreasonable terms-of-trade effects into the analysis, and the these effects should and can be avoided.

The model: an outline

Instead of presenting a complete mathematical statement of the model, we will give an informal, brief outline for the sake of readers less interested in mathematical formulas.* In most of its elements the model follows quite closely what may already be called a "traditional" computable general equilibrium approach. Models of this type have been developed during the past decade in various places for economic policy analyses. Some representative examples are [14; 7; 8; 15; 18]. In this outline we will also comment on some less traditional features of our model, which distinguish it from related models developed elsewhere. The model employed here was developed by the author, in close cooperation with colleagues in the Hungarian National Planning Office. A more elaborate discussion of it can be found in [19; 8; 20].

Commodities in the model represent sectoral outputs and, according to one fairly common statistical classification in Hungary, 19 sectors are distinguished. Commodities are further classified into three categories: domestically produced ones, and competitive and non-competitive imports. Both imports and exports are also classified in terms of dollar and rouble trading areas, which results in a fairly detailed foreign trade structure. Rouble trade in this version of the model is exogenously given, reflecting the fact that rouble trade flows are fixed, as a rule, by five-year bilateral agreements and thus are relatively inflexible over the short term. Exports and competitive imports are treated as perfect substitutes for domestic products. This treatment, especially in the case of imports, is a departure from the traditional, neoclassical general equilibrium models, in which imports are usually treated as imperfect substitutes. Nevertheless, we employ formally similar, relative price-dependent import share functions, as in the more

*Interested readers can find a complete description of the model in [21].

traditional models, which can be derived on the basis of cost-minimization assumptions and a CES-type substitution function. Our rationale for using these import share functions is, however, different from the neoclassical one (which assumes imperfect substitutability and perfect adjustment). They are intended to simply reflect limited (probably imperfect) adjustments to relative price changes, which may be caused by a variety of factors. (It should be mentioned, though, that the numerical results are not much affected by this change in treatment.) As a result, we have two sets of balance equations for the sectoral commodities: one combined balance for domestically produced goods plus competitive imports, and one for the non-competitive imports.

Total use of commodities is split up between production, investment, consumption, and export (if applicable). Use in production and investment is determined through fixed input-output coefficients (Leontief technology). Consumption is treated in a special way, which can be viewed as a generalization of the frequently used Linear Expenditure System (LES). Total consumption is made up of a fixed part (identified here with the base consumption) and a variable part (excess consumption). The structure of the latter is fixed (a Leontief or Kantorovich type of preference function), thus leaving only the level of excess consumption to vary. This makes the implicit objective (welfare) function similar to those employed in some linear planning models. Another special advantage of this formulation is that it allows us to measure welfare changes in a conceptually very simple way.

Gross investment is defined as the sum of replacement and new investment. The former is determined by the variable sectoral capital stocks and fixed replacement coefficients, which are different from the depreciation rates. The amount of new (net) investment is exogenously given in this version of the model. Labor and capital are undifferentiated with respect to their sectoral use; they are assumed to be freely mobile across sectors. The uses of labour and capital in production are specified by Cobb-Douglas production capacity functions (which results in a Johansen-type production technology). Sectors are assumed to minimize the joint cost of labour and capital used. Total available labour and capital are held constant and assumed to be fully utilized.

The rest of the foreign trade relations are modeled as follows. Since rouble trade flows are fixed, we only have one balance-of-payment (current account) constraint in the model on dollar trade. The target deficit level is fixed in the model. Dollar exports are assumed to adjust to relative (domestic/foreign) price changes and the size of shifts is determined by fixed elasticity coefficients.* We employ the following form

$$Z_{id} = Z_{id}^{o} \left(\frac{P_i}{\tau_i \nu_d P_{id}^{VE}} \right)^{\epsilon_{id}}$$

*In two sectors (foreign trade and waterworks) we held export constant. In the first case because of accounting problems (some part of export earning is accounted in the foreign trade sector and, as a result, it shows up as if it were an independent and very profitable exporting activity), and in the second case because of its negligible role and inelastic nature.

where Z_{id} is the base volume of export, ϵ_{id} the constant elasticity parameter, τ_i is an export tariff factor (different from 1 only in the optimal tariff calculations), P_i is the domestic price, V_d the dollar exchange rate and P_{id}^{WE} a constant world market price.

The above form can be given three different interpretations. If P_{id}^{WE} is interpreted as the price of competitors and P_i/V_d (forgetting about the tariff factor for the moment) as the export price of the domestically produced good (i.e. its dollar price in the balance of payment, P^E), then we deal with a usual export demand function. Such a formulation is traditionally supported by Armington's assumption [1] about regional product differentiation and leads to a downward-sloping export demand function. Conversely it means that the export price is assumed to change with the volume of export. This is a tenable assumption even in the case of a "small" country, but leads to some problems seldom addressed in applied models.

If we regard P_{id}^{WE} as the fixed dollar export price of the home products (small country assumption), the above export function can be interpreted as an export supply function. Note, that these two interpretations are completely asymmetric in the sense that in the first case perfectly elastic supply and imperfectly elastic demand is assumed, whereas in the second case just the opposite. This observation quite naturally leads to a third interpretation, in which both supply and demand are assumed to be imperfectly elastic. Thus, we may assume that we have two export functions (with different sizes of elasticity, as a rule), one for demand and one for supply. If we solve them for their equilibrium value, we shall again arrive at the same form as above, in which the equilibrium elasticity and the dollar export price is determined as follows* (for the sake of simplicity some indices omitted).

$$\epsilon = \frac{\alpha\beta}{\alpha + \beta}$$

$$P^E = \left(\frac{P}{V}\right)^{\frac{\alpha}{\alpha+\beta}} P_{WE}^{\frac{\beta}{\alpha+\beta}} = \left(\frac{Z}{Z^o}\right)^{1/\beta} P_{WE}$$

where α and β are the supply and demand elasticities, respectively. We only utilize the first two interpretations in our calculations, but we will come back to the question of alternative forms during the discussion of the results.

Now we turn to the description of the equilibrium pricing rules. As a basic principle we have tried to follow as closely as possible the so-called two-channel, normative price formation rule, discussed extensively in the literature related to price reform ideas (see, for example, [6]). Equilibrium (domestic producers') prices are, thus, defined as the sum

*See [20] for a more elaborate discussion of this point.

of unit material costs, depreciation, wages, and uniformly determined (normative) returns on labour and capital. The normative rates of return on labour and net capital are determined endogenously as equilibrium rates (factor clearing prices). The domesitc price of dollar imports is determined through their world market price and the equilibrium exchange rate. The domestic prices of rouble imports (since they are fixed) need special treatment. In the non-competitive sphere it is assumed to move in proportion to the price of dollar non-competitive imports, whereas in the competitive sphere it varies proportionally to the average price level of the substitutes. And, finally, since we do not record how large the share of inputs from various sources is in different uses, the same average sectoral prices are used to evaluate the composite input in each area of use.

The simulation framework and data

The data* for the model presented in the previous sections were mostly obtained from the 1976 official statistical input-output table of the Hungarian economy [5]. Where direct observations were not available we had to rely on expert estimates or various rather ad hoc methods. Thus, for example, there is no published information available on the area composition of exports and imports. The corresponding data in the model are, therefore, only rough estimates. Similarly, the initial dollar export prices (expressed in domestic currency units) were also estimated using indirect methods. The division of imports into competitive and non-competitive parts was derived from more detailed (product group) investigation based on expert estimates.

The assignment of values to the parameters occurring in the technological and behavioural relationship constitutes a very frequently encountered problem. Available econometric estimates are scarce and very unreliable. We have followed the rather common calibration procedure (see, for example, [16]), in which most of these parameters are "guesstimated" on the basis of available literature and qualitative judgements, combined with single data point estimates. These latter are derived by assuming the initial (base) state of the economy to be, at least partially, one of equilibrium. In this way, the model specification is capable of reproducing the initial position of the economy and comparative static exercises can be performed. *Table 1* contains some of the major indicators of the Hungarian economy in 1976 and also a few crucial model parameters.

The specification of and elasticities in the export relationships deserve special attention here, because the sensitivity of the results with respect to these factors is one of the major concerns of this paper. The main role of the export function is to allow some limited shift in the volume of exports in various sectors, if relative (foreign/domestic) prices change. In linear programming models of resource allocation the same goal (i.e.,

*The author wishes to acknowledge the invaluable assistance of Gy. *Boda* and F. *Hennel* in supplying appropriate data for the model.

Table 1

Sectoral characteristics of production, export and import (percentage shares), and trade elasticity parameters

	Sector	Share in production	Export/ production	$Export/ production*	Export elasticity*	Import/ domestic source	$ Competitive import domestic source*	Import elasticity*	Net income shares**
1.	Mining	2.27	3.63	0.84	–2.00	74.63	18.54	0.50	0.250
2.	Electricity	1.76	1.63	1.01	–3.00	10.34	0.	–	0.068
3.	Metallurgy	4.91	33.01	23.00	–2.50	47.91	7.67	0.50	0.141
4.	Engineering	13.44	43.55	13.24	–2.50	80.14	2.12	0.30	0.282
5.	Construction materials	1.63	12.29	7.91	–2.50	25.02	3.53	0.30	0.203
6.	Chemicals	7.83	20.24	13.05	–2.50	49.18	11.67	0.50	0.301
7.	Light industries	8.97	26.81	13.82	–2.50	26.16	7.93	1.25	0.230
8.	Other manufacturing	1.11	8.98	4.82	–2.50	4.28	0.	1.25	0.128
9.	Food processing	9.96	19.40	13.04	–2.00	15.75	7.05	1.25	0.061
10.	Construction	8.20	0.54	0.15	–2.50	0.	0.	–	0.191
11.	Agriculture	15.75	12.14	7.79	–2.00	4.62	0.79	2.00	–0.058
12.	Forestry and logging	0.60	15.10	14.99	–2.50	26.95	8.66	0.50	0.119
13.	Transport and communications	5.31	8.31	5.39	–2.50	4.42	0.	0.30	0.067
14.	Domestic trade	6.06	2.76	2.24	–1.25	0.	0.	–	0.533
15.	Foreign trade	1.60	26.78	9.97	0.	24.04	2.07	0.30	1.058
16.	Waterworks	0.90	0.80	0.02	0.	0.	0.	–	–0.247
17.	Personal and economic services	2.98	0.	0.	–	0.	0.	–	–0.271
18.	Health and cultural services	3.63	0.	0.	–	0.	0.	–	–0.160
19.	Public administration	3.06	0.	0.	–	0.	0.	–	–0.115
Total		100.00	16.90	8.60		20.70	3.45		

*Hypothetical data. **Uniform rate of return (tax) on wages (30 percent) and on net capital (5 percent) assumed.

allowing for some, but not complete, specialization) is achieved by the use of individual bounds on export activities. Here, in the case of relative price dependent export functions, the larger the elasticities of these functions, the larger the scope for taking advantage of international specialization. If, however, they are interpreted as export demand functions, which is often the case, then the foreign price of the exported goods is dependent on their volume. The smaller the elasticities, the larger the size effect of the export volume on prices. The usual size of these elasticities is relatively small (–3; –1.5) both in the available literature on econometric estimates (13; 17; 4), and in the CGE models using such specifications. These small elasticities, however, imply that endogenously-induced terms-of-trade effects will be rather large, which may be hard to justify on empirical grounds. It will, therefore, be interesting to see how the size of the export elasticities influence the solution of the model. To this end we have repeated each simulation after doubling the size of the initial export elasticities.

Also, beside the pure export demand specification, we have run the model with two alternative variants. The first of these can be tentatively interpreted as an export supply specification. In this run we assume that the volume of export has no effect on the export price, i.e., that the price is dictated by the world market; other than this, we use the same export functions. In the second case, we have tried to calculate a solution corresponding to the logic of a programming model or, using a term familiar in international trade theory, to an optimal tariff situation. In this run we assume that the terms-of-trade effects are real, but that they are not perceived by the atomistic exporters. We wanted to see how the planners' optimum (in which the country takes advantage of this market "power" in international trade) would differ from the laissez-faire equilibrium (the first case). To obtain the exact results would in general require the solution of a relatively large nonlinear programming problem. Since, however, our model is rather close to a neoclassical formulation, we can approximate this solution by introducing appropriate optimum tariffs into the determination of export revenues (for the analytical and theoretical underpinnings of this approach, see [20]).

Thus, in effect, we shall present six runs in total, which differ partly in terms of export specification (pure demand, supply, and optimum tariff) and partly in terms of the size of the export elasticities.

As indicated earlier, the major thrust of our simulation effort is to estimate the impact of a price reform on the economy, if the relative price changes were followed by appropriate reallocation of resources, including foreign trade settled in dollars. In order to do this we assume that the initial state of the economy is "almost" a general equilibrium one, in which the only major distortion manifests itself in the price system. That is, individual decisions are viewed as roughly economically rational, except that they are based on incorrect price information. (As can be seen in *Table 1,* sectoral prices include rather different net incomes (profits) in different sectors.) The above assumption is admittedly very bold, though not inconsistent with some (especially earlier) Hungarian reform ideas. More realistic assumption would require qualitatively different model specifications, for which, for the time being, both theoretical and empirical bases are lacking.

Thus our model, with a slight change in its specification, reproduces the 1976 situation of the Hungarian economy. The change is in the price formation rule. Prices in the base case equal costs, which also include normative net incomes (close to 30 percent on wages and 5 percent on net capital value in 1976), "marked-up" by fixed, but sectorally different profit rates. In the various runs we calculate the effect of the abolition of these profit mark-ups, i.e., the effect of a price reform, where prices are formed according to the principle of uniform (normative) return requirements. The optimum tariff calculation includes, in addition, taxes on exports, which distinguishes it from the other two specifications.

The simulation results

Table 2 contains the sectoral producers' price indices calculated in the various runs. These may be of special interest, because there are a number of published studies that have calculated normative prices on the basis of input-output tables both in Hungary and elsewhere (see 10; 3; 2). These studies have used a somewhat different methodology; for example, in most cases they rely on exogenously-defined normative return rates on labour and capital. Even where they are endogenous (as in the case of [2]), the method followed is different (a closed Leontief model). What makes our model clearly distinguishable from the previous ones is that some of the input coefficients themselves (like those of labour and capital) change in response to price changes and the (domestic/import) compositions of inputs changes too.

In spite of these and other differences in methodology, data, or time period studied, our results show remarkable similarity to those of previous calculations. There are striking similarities, not only in general tendencies, such as disproportionality between global industrial, agricultural, and service price levels, but also in the rank order of sectors according to their normative price level. Comparing the different runs one can see that the price indices in four runs (demand and supply with both sets of elasticities) are practically the same; only the optimum tariff solution results in somewhat different prices, especially in the case of low elasticities. This difference can be clearly traced back to the imported input components and to variations in the dollar exchange rate. The latter decreases from its base level by about 20–25 percent in the four runs mentioned above, whereas in the optimum tariff runs it stays basically the same with high elasticities and increases by nearly 35 percent with low elasticities (see *Table 3*).

One may wonder why the model suggests revaluation rather than devaluation of the Hungarian currency, at least in the pure equilibrium solutions: this seems at first sight in marked contrast with what conventional wisdom would suggest in the case of Hungary. The explanation is in fact rather simple: it is due to the decrease of price level in the major exporting sectors. If the exchange rate remained unchanged or increased, it would, in general, result in growing exports and decreasing imports, and it would thus violate the trade balance condition. Therefore, the exchange rate has to drop accordingly. Even in

Table 2
Producers' price indices in various runs

	Sector	Low elasticities			High elasticities		
		Demand	Supply	Optimum tariff	Demand	Supply	Optimum tariff
1.	Mining	81.16	81.28	79.03	81.37	81.45	80.32
2.	Electricity	86.99	87.07	86.42	87.17	87.23	86.79
3.	Metallurgy	74.28	73.82	85.23	73.52	73.24	77.85
4.	Engineering	67.96	67.77	72.68	67.63	67.51	69.43
5.	Construction materials	79.40	79.40	80.18	79.41	79.42	79.57
6.	Chemicals	65.21	64.66	77.89	64.30	63.98	69.37
7.	Light industries	70.22	69.95	76.46	69.74	69.57	72.25
8.	Other manufacturing	86.89	86.99	84.55	87.02	87.08	85.98
9.	Food processing	95.73	95.62	97.66	95.53	95.46	96.38
10.	Construction	80.80	80.86	79.66	80.88	80.92	80.29
11.	Agriculture	111.39	111.57	107.23	111.67	111.78	109.90
12.	Forestry and logging	89.04	89.18	85.96	89.26	89.34	87.93
13.	Transport and communications	99.89	100.20	94.87	100.44	100.65	98.07
14.	Domestic trade	70.31	70.54	65.25	70.69	70.83	68.53
15.	Foreign trade	46.94	46.65	53.94	46.45	46.27	49.19
16.	Waterworks	155.33	156.39	136.36	157.26	157.97	148.87
17.	Personal and economic services	162.88	164.13	140.32	165.17	166.01	155.23
18.	Health and cultural services	128.83	129.34	118.06	129.67	129.98	125.05
19.	Public administration	118.75	118.85	117.11	118.90	118.96	117.96

this situation, total trade turnover increases and, as expected, relatively more so in the case of higher export elasticities. It is also interesting to see that the increase of exports is larger in the demand than in the supply runs, because in the former increased exports have to make up for the terms-of-trade deterioration (total imports increase at more or less the same rate in the two types of run).

The optimum tariff cases produce results that are qualitatively different from the other four variants and also from each other in the cases of higher and lower elasticities. Lower elasticities imply stronger international market power, the exploitation of which

Table 3

Main indicators (aggregate indices at base prices): First model

Indicator	Base	Low elasticities			High elasticities		
		Demand	Supply	Optimum tariff	Demand	Supply	Optimum tariff
GNP	100.00	102.04	101.58	100.58	103.06	102.42	102.37
GDP	100.00	102.11	101.77	100.91	103.27	102.75	102.66
Final consumption	100.00	99.91	101.52	102.68	100.37	102.28	101.03
Excess consumption	0.00	−369.89	5505.71	9730.08	1323.46	8290.52	3711.55
Dollar terms of trade	100.00	93.20	100.00	104.98	92.65	100.00	94.95
Total trade/GDP ratio	81.10	83.97	82.91	76.66	85.73	84.20	82.07
Total export	100.00	108.40	104.96	94.29	112.95	108.24	106.35
Total import	100.00	103.09	103.13	96.47	105.44	105.14	101.46
Total competitive import	100.00	102.16	103.37	85.09	104.97	105.70	94.94
Total non-competitive import	100.00	103.50	103.02	101.50	105.64	104.89	104.34
Total dollar import	100.00	106.03	106.11	93.11	110.62	110.04	102.85
Total dollar export	100.00	116.51	109.74	88.78	125.44	116.20	112.48
Dollar exchange rate	100.00	80.87	78.53	134.54	76.95	75.52	98.46
Return rate of wages	0.30	0.57	0.58	0.36	0.59	0.59	0.50
Return rate on capital	0.05	0.10	0.10	0.06	0.10	0.10	0.09

results in reduced trade volume and improved terms of trade (see *Table 3*). Thus, quite apart from the increased allocative efficiency, additional welfare gains result from the improving terms of trade. The increased dollar exchange rate (close to a 35 percent devaluation) makes imports decrease. If there were no tariffs on exports, they would increase significantly because of the high exchange rate. The tariffs offset this impetus. The large difference between the exchange rates in the case of pure demand and the optimum tariff run clearly indicates that the tariffs are quite large. Indeed, their size varies between 60 and 100 percent, depending on the size of the export demand elasticity.

When elasticities are higher, the scope for increasing allocative efficiency becomes larger, whereas the terms-of-trade effects become significantly smaller. In fact, it proves to be advantageous to utilize the reallocation possibilities even to the extent where the general level of the terms of trade actually deteriorates. The size of the tariffs becomes, of course, much smaller in this case (20–35 percent) and, as a result of these interacting forces, the exchange rate remains practically unchanged.

Readers interested in more detailed results of the simulation runs can find additional tables in [21]. These include percentage changes in dollar exports and competitive imports in different sectors, and the price terms that explain the direction of change in dollar exports and competitive import shares, as well as detailed statistics on changes in production and on employment of the two primary resources, labour and capital. The analysis of these data is left out of this paper. In the remaining part of the paper we will restrict ourselves to an analysis of various general features of our results and draw some broad conclusions on the basis of the summary *Table 3.*

The main aggregates measuring the output level of the national economy, gross (total) national production as well as GDP, show only a modest increase resulting from the reallocation of resources. This is a common phenomenon frequently encountered in similar resource allocation exercises. More significant changes can naturally be seen in the export and import activities. Except for one case, our calculations interestingly reproduce the historical observation that imports grow faster than output. This is a direct consequence of increased international specialization. As one can see, the measure of the openness of the economy, total trade/GDP increases in all cases but one. The exception is the optimum tariff solution with low elasticities, which suggests that more specialization and increased foreign trade need not necessarily be beneficial for an economy. As we know, this is the case where export prices react rather sensitively to changes in export volumes.

One surprising result of our numerical simulations may be that in one of the runs the move toward a perfect equilibrium situation from a distorted one results in a welfare loss. However, this may only be surprising because we tend to associate competitive equilibrium with Pareto optimality. This is, however, not the case when the economy is open and faces imperfectly elastic export demand. In such a situation the optimal policy is a kind of monopolistic rather than pure competitive equilibrium, as is known from the theory of optimum tariff. This solution is approximated, as indicated earlier, by the optimum tariff run. As we can see, the difference in terms of welfare between the pure competitive (laissez-faire) and the optimum tariff (planners' optimum) solutions is close to three percent of total consumption.

We can further characterize the trade-off possibility between allocative efficiency and terms-of-trade efficiency by means of the supply run. This latter approximates the potential allocative efficiency gain, i.e., the gain that would be achieved in the absence of terms-of-trade changes. As we can see, this potential allocative efficiency gain, at low elasticities, is approximately 1.5 percent of total consumption. In the demand run, the global efficiency has decreased by about 0.1 percent, which means about 1.6 percent loss in efficiency due to the endogenously induced terms-of-trade changes. The optimum tariff run, at the same time, can exploit this efficiency potential to a large degree and increases total efficiency by about 2.7 percent. These results, of course, depend on the sizes of elasticities. With larger elasticities we can see the following picture. At constant export prices the allocative efficiency gain is about 2.3 percent and when these prices change, the loss due to the terms-of-trade deterioration is about 1.9. In this case the optimum tariff solution results also in terms-of-trade losses of about 1.3 percent. Needless to say, these numbers only serve here for illustrative purposes.

Most of our analysis so far has been concerned with the usual low elasticity case. As we have seen, the terms-of-trade effects brought into the numerical simulation through the downward-sloping export demand functions are quite significant, and seem to be quite unrealistic. The same runs repeated with the sizes of these elasticities doubled clearly exemplify the dilemma that the builders of computable general equilibrium models face. Larger elasticities will significantly increase the resource reallocation possibilities and reduce the effect of the terms-of-trade changes. Thus, for example, even in the optimum tariff run, it proves to be advantageous to utilize the resource reallocation potential, even to the extent of incurring a deterioration in the terms of trade. As can be seen, the laissez-faire and planners' optimum solutions do not differ so much as in the previous case. These solutions can, however, be criticized because they allow for unrealistically large shifts in the allocation of resources, primarily in exports.

One may believe that our results, especially the welfare loss occurring after a shift toward equilibrium, have to do with our departure from neoclassical assumptions. The consumption structure is fixed, and thus adjustment on the consumers' part is excluded. Also, as mentioned, import share changes are treated in a non-neoclassical fashion. It is, therefore, interesting to check how sensitive the simulation results are to these changes. To this end we repeated our exercise with a model strictly in line with neoclassical assumptions. In these runs imports were treated as imperfect substitutes and the usual cost minimization assumption was invoked. In the case of consumption we assumed that five percent of total consumption can be readjusted to changing prices in accordance with a Cobb-Douglas-type utility function. Thus we employed an LES-type demand structure. The main indicators of these runs are summarized in *Table 4*. They clearly indicate that the results are qualitatively the same, and even the quantitative differences are negligible.

Table 4

Main indicators (aggregate indices at base prices): Second model

Indicator	Base	Low elasticities			High elasticities		
		Demand	Supply	Optimum tariff	Demand	Supply	Optimum tariff
GNP	100.00	102.35	101.95	100.98	103.41	102.86	102.70
GDP	100.00	102.33	102.05	100.93	103.51	103.09	102.87
Final consumption	100.00	100.00	101.87	102.56	100.56	102.68	101.23
Excess consumption	0.00	−138.99	6628.84	8657.70	1843.16	9563.94	4340.64
Dollar terms of trade	100.00	92.77	100.00	104.59	92.44	100.00	94.79
Total trade/GDP ratio	81.10	84.16	83.04	76.90	85.95	84.40	82.21
Total export	100.00	109.05	105.45	94.70	113.62	108.90	106.83
Total import	100.00	103.38	103.54	96.69	105.84	105.69	101.77
Total competitive import	100.00	102.25	103.62	85.37	105.24	106.11	95.20
Total dollar import	100.00	106.61	106.92	93.55	111.41	111.11	103.46
Total non-competitive import	100.00	103.88	103.51	101.69	106.11	105.50	104.68
Total dollar export	100.00	117.78	110.70	89.60	126.75	117.49	113.43
Dollar exchange rate	100.00	81.58	79.24	136.06	77.44	76.12	99.11
Return rate on wages	0.30	0.58	0.59	0.35	0.59	0.60	0.50
Return rate on capital	0.05	0.10	0.10	0.06	0.10	0.10	0.08

Concluding remarks

Before we draw the main conclusions and formulate some open questions, we would like to highlight the essence of the adopted method of analysis. Approaching from the traditional input-output modelling direction we might characterize our model as a linked system of a physical and a price input-output model. Prices are assumed to affect some parameters traditionally treated as constant, which are thus variable in our interlinked models. From the point of view of the more traditional linear programming models of resource allocation our model can be regarded as a nonlinear programming model, in which some of the shadow price formation rules are substituted by more realistic ones.

The above interpretation, we believe, is a more correct description of the real nature of these macroeconomic models, than the underlying essentially microeconomic theory of general equilibrium. This theory is regarded completely alien to socialist (centrally planned) economies and this explains why applied general equilibrium models are missing from the analytical tools of economists in those countries. One of the aims of our study was to show an example that these multisectoral models have potential advantages over the traditionally used models, especially in addressing issues related to economic reform ideas.

A common weak point of the mutisectoral models of resource allocation is their tendency to produce overspecialized solutions. In the linear programming models overspecialization is avoided by the use of various ad hoc constraints on either some individual or certain groups of variables. In the applied general equilibrium models the same effect is achieved by the introduction of various imperfect substitution schemes. The real advantage of this solution is that it results in more meaningful shadow (equilibrium) prices. The example of the export demand functions shows us however, that this solution may result in some unwanted features, which have not been discussed in the related literature.

We may conclude from our analysis that in computable general equilibrium models it seems crucial to distinguish and separate the envisaged changes in the export prices (terms of trade) from those in the speed of export adjustment. One crude and pragmatic solution might be to use one set of relatively small elasticities in the export functions, and another set of relatively larger elasticities in the determination of export prices, a possibility offered by the export equilibrium formulation, discussed above. Needless to say, the degree of freedom in reallocating resources in an open economy greatly depends on the potential for foreign trade. Thus, it is crucial in such exercises to represent this potential properly. At present it appears that neither the techniques used in linear programming nor those in computable general equilibrium models are fully adequate for handling this problem.

A somewhat related issue concerns the incorporation of optimal tariff considerations into the applied general equilibrium models. It is worth to mention here, that the programming types of models will always produce an optimal tariff solution if volume-dependent export price changes are allowed for. One may analyze such solutions in an applied general equilibrium model, as well as we have shown. The greater flexibility of the applied general equilibrium models is also shown by the fact, that this feature can be eliminated, if not wanted. It is rather questionable that the conditions of the optimum tariff theory are met in reality. For example, in the case of Hungary, the price decrease that follows an increase in export volume characterizes a weak position in the world market, rather than a monopolist position assumed by the theory. The assumed atomistic competitive character of the exporters may also be seriously questioned. These and other considerations imply, therefore, that the resource allocation pattern suggested by a programming model, in which export prices depend on its volume, is further distorted by this optimum tariff feature.

Nevertheless, it is interesting from a theoretical point of view to note that general price distortions may result in welfare improvement, similar, but not equal to the effect of optimal tariffs. Thus, if some international agreements, such as those of GATT, exclude the possibility of applying tariffs on exports, it is, at least in theory, possible to use general taxes on production as a second-best solution.

A further theoretical conclusion concerns our starting hypothesis, i.e. the possible importance of a price reform in a centrally planned economy. A general lesson that can be learned is that economic reforms that do not reach and genuinely affect the micro-decision level—'stop at the enterprise gate'—can produce only modest, if any improvement in overall economic efficiency. Unless there are major changes in the micro-structure of production, leading to more efficient use of resources at the enterprise level and more profitable and exportable products, a price reform followed by a rational reallocation of resources will not produce satisfactory results. Our simulation results also suggest that a complete decentralization of foreign trade, especially the export activity, may not be advantageous if export demand is imperfectly elastic. If domestic firms behave as atomistic price takers, there is some room for the central planning authorities to guide individual decisions in globally more efficient economic directions.

And finally, the analysis calls attention to some problems that relate to the foreign trade practice of small open economies. They are not conclusions derived from the analysis, but rather some general questions related to it and worthy of further study. It follows from our analysis that in a given period and with a given export product structure there is a pattern (structure and level) of foreign trade that is optimal for the economy. Do we have enough knowledge, say, in Hungary about this optimal pattern? Can we really control our trade pattern or is it dictated by the forces of the world market? How far is our present foreign trade structure from this theoretical optimum? Or, one might rightly ask, how large portions of our often reported sizable terms-of-trade deterioration (about ten percent of our national income) has been endogenously induced by the forced increase of export? These and similar questions arise naturally from our study. And they await answers, especially in the light of the last decade that was rather critical from the point of view of the Hungarian foreign trade policy (trade in convertible currencies has significantly increased in this period, at first as a natural lever of economic development, later dictated more and more by the balance of payments difficulties).

References

1. Armington, P.: A theory of demand for products distinguished by place of production. *IMF Staff Papers,* 1969. 16. pp. 159–178.
2. Bánhidi, F.: Price model – price computations. In: Augusztinovics, M. (Ed.): *Long-term models at work.* Akadémiai Kiadó, Budapest 1984.
3. Bárány, B.–Szakolczai, Gy.: A termelés reális költségei és az árszintproblémák (Real costs of production and price level problems). *Közgazdasági Szemle,* 1975. 11–12.
4. Browne, F. X.: Modelling export prices and quantities in a small open economy. *Review of Economics and Statistics,* LXIU 1982. 2.
5. Csepinszky, A. (Ed.): *Ágazati kapcsolatok mérlege 1970–1979* (Input-output tables 1970–1979). Központi Statisztikai Hivatal, Budapest 1982.
6. Csikós-Nagy, B.: *Socialist price theory and price policy.* Akadémiai Kiadó, Budapest 1975.
7. Dervis, K.–De Melo, J.–Robinson, S.: *General equilibrium models for development policy.* Cambridge University Press, Cambridge 1982.
8. Dixon, P. B.–Parmenter, B. R.–Sutton, I. M.–Vincent, D. P.: *ORANI: A multisectoral model of the Australian economy.* North-Holland Publishing Co., Amsterdam 1982.
9. Esze, Zs.–Nagy, T.: A „több csatornás" ipari termelői ártípus (The "multi-channel" type of industrial producer's prices). *Közgazdasági Szemle,* 1963. 1.
10. Ganczer, S.: Price calculations in Hungary. *Economics of Planning,* 1965. 3.
11. Ganczer, S.: Price calculations and the analysis of proportions within the national economy. *Acta Oeconomica,* Vol. 1. Nos 1–2. (1966).
12. Ginsburgh, V.–Waelbroeck, J.: *Activity analysis and general equilibrium modelling.* North-Holland Publishing Co., Amsterdam 1981.
13. Houthakker, H. S.–Magee, S. P.: Income and price elasticities in world trade. *Review of Economics and Statistics,* LI 1969. 2.
14. Johansen, L.: *A multisectoral study of economic growth.* North-Holland Publishing Co., Amsterdam 1959.
15. Kelley, A. C.–Sanderson, W. C.–Williamson, J. G. (Eds): *Modelling growing economies in equilibrium and disequilibrium.* Duke University Press, Durham, North Carolina 1983.
16. Mansur, A. H.–Whalley, A.: Numerical specification of applied general equilibrium models: estimation, calibration and data. In: Scarf, H.–Shoven, J. (Eds): *Applied general equilibrium analysis.* Cambridge University Press, London 1983.
17. Sato, K.: The demand function for industrial exports: a cross-country analysis. *Review of Economics and Statistics,* LIX 1977. 4.
18. Scarf, H.–Shoven, J. (Eds): *Applied general equilibrium analysis.* Cambridge University Press, London 1983.
19. Zalai, E.: *A nonlinear multisectoral model for Hungary: general equilibrium versus optimal planning approach.* WP–80–148. International Institute for Applied Systems Analysis, Laxenburg, Austria 1980. Revised version in Kelley, A. C.–Sanderson, W. C.–Williamson, J. G. (Eds): *Modelling growing economies in equilibrium and disequilibrium.* Duke University Press, Durham, North Carolina 1980.
20. Zalai, E.: *Foreign trade in macroeconomic models: equilibrium, optimum and tariffs.* WP–82–132. International Institute for Applied Systems Analysis, Laxenburg, Austria 1982.
21. Zalai, E.: *Economic reform, allocative efficiency and terms of trade* WP–83–112. International Institute for Applied Systems Analysis, Laxenburg, Austria 1983.

РЕФОРМА ЦЕН, ЭКОНОМИЧЕСКАЯ ЭФФЕКТИВНОСТЬ РАСПРЕДЕЛЕНИЯ РЕСУРСОВ И УСЛОВИЯ ТОРГОВЛИ

Э. ЗАЛАИ

Один из составных элементов концепций хозяйственных реформ в странах Восточной Европы — это проблема реформы цен. Долгое время имеет хождение мнение, согласно которому одной из основных причин неэффективных решений является искаженная и поэтому плохо ориентирующая система цен. В статье на основе многосекторной нелинейной микроэкономической модели анализируется вероятный эффект реформы цен на перераспределения ресурсов прн условии сохранения неизменной экономической эффективности на микроуровне. Центральное место в представленном анализе занимает вопрос структуры внешней торговли и вызванного изнутри изменения условий торговли.

Особое внимание анализ уделяет некоторым теоретическим и методологическим вопросам в связи с внешней торговлей, в частности т. н. гипотезе Армингтона. На основании последней в моделях общего равновесия обычно предполагается, что объем экспорта и удельная экспортная выручка являются взаимозависимыми функциями. Это решение невольно ведет к вопросу об оптимальном объеме и структуре экспорта, отклоняющихся от равновесия. Симуляционный анализ подтверждает известный методологический опыт, согласно которому применение различных нелинейных функций замены является более гибким и реалистическим средством предупреждения «слишком специализированных» решений, чем индивидуальные ограничения. В то же время выясняется и то, что применение функций экспортного спроса вызывает нежелательные изменения условий торговли. Автор показывает, что это неблагоприятное явление можно элиминировать соответствующим изменением модели.

С другой стороны, анализы показывают, что реформа цен сама по себе, даже если за ней последует рациональное перераспределение ресурсов, не изменит существенным образом общую экономическую эффективность. На основании симуляционного анализа, микроэффективность представляется гораздо более значительной, чем эффективность перераспределения. В заключение автор ставит в связи с анализом несколько общих вопросов, касающихся внешнеторговой практики стран с открытым хозяйством.