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COMPUTABLE GENERAL EQUILIBRIUM (CGE) MODELS FOR SOCIALIST ECONOMIES

by

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1. Introduction

There is a long tradition in socialist countries of using multisectoral models to provide the analytic basis for economic planning. Input-output models have long been used in various forms to solve the "material balances" problem in quantitative planning. Dynamic input-output models, some quite elaborate, have also been used both for medium-term, five-year plans and for long-run, prospective planning.[1] There has also been a great deal of research and experimentation with linear programming models, although they have never been widely used in actual planning exercises.[2] This work flourished in an environment where direct quantitative controls were the major policy instruments and where the price system was not viewed as important. Since the late 1960s, however, there have been major reform movements in some socialist countries which have sought to improve economic performance by instituting a

[1]See, for example, Augusztinovics (1984), who describes a variety of such models applied to Hungary.

[2]For a discussion of the development of LP models in Hungary, see Kornai (1974).

new economic system incorporating increased use of market mechanisms and price incentives. Hungary and Yugoslavia were leaders in this movement.

During the past decade, multisectoral computable general equilibrium (CGE) models have been widely used in developing countries to analyze issues such as income distribution and structural adjustment.[3] These models simulate the workings of a market economy in which suppliers and demanders interact across markets in response to price signals. In its purest form, a CGE model provides an empirical implementation of the Walrasian model of production and exchange under perfect competition. However, in most applications --especially in developing countries-- modelers have moved far from the Walrasian ideal and have incorporated a variety of "structuralist" features that explicitly recognize the existence of rigidities and imperfections in actual economies. A CGE model thus need not assume that decisions of producers and consumers reflect profit and utility maximization in a system of competitive markets, but can incorporate a wide variety of institutional and behavioral specifications. What is assumed is that economic performance is at least in part the outcome of decentralized decisions made by producers and consumers in response to market signals. Thus, suitably adapted, a CGE model should provide a good framework for policy analysis in a post-reform socialist economy.

CGE models have been developed for two Eastern European countries: Hungary and Yugoslavia. Both models were developed under the auspices of the World Bank to analyze issues of structural adjustment in the medium term. They focus on the impact of changes in foreign capital inflows and international

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[3]For a discussion of CGE models applied to developing countries, see Dervis, de Melo, and Robinson (1982). Manne (1985) provides an updated survey of country applications and Shoven and Whalley (1984) survey work on CGE models of developed countries focusing on issues of public finance and international trade.

trade on the structure and performance of the economy. The Yugoslav model was developed at the World Bank, while the Hungary model is based at the National Planning Office (NPO) of Hungary. Various applications of the Yugoslav model are described in World Bank (1983), Robinson and Tyson (1985), and Robinson, Tyson, and Dewatripont (1986). The Hungary model is still under development and descriptions are available only in draft form.[4]

In this paper, we describe the basic features of the Hungarian and Yugoslav CGE models, identifying the important similarities and differences between them. Since descriptions of the Yugoslav model are already published, we focus the discussion more on the Hungarian model. We also present some results of simulations of the Hungarian model over the 1981-85 period. A comparison of model results under alternative assumptions allows one to identify how economic performance would have been affected by different economic conditions. In this paper, the simulations are designed to sort out the relative importance of external shocks and internal policy responses to economic performance in Hungary during the 1981-85 adjustment period. The focus in on the genesis of the foreign-exchange shortage and the nature of policy reaction to it during the period. Simulations with a similar focus for Yugoslavia have already been published.[5]

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[4]The NPO-Bank model of Hungary builds on important earlier work by Zalai (1983), who built the first CGE model applied to Hungary. The model of Yugoslavia was built with the assistance of two Yugoslav researchers, Joze Mencinger and Lovro Pfajfar, who have used it for policy analysis in Yugoslavia. See Pfajfar and Mencinger (1984).

[5]Robinson and Tyson (1985) analyze the 1976-80 period, while Robinson, Tyson, and Dewatripont (1986) look at the 1981-84 period and also discuss forward runs for 1985-90.

2. The CGE Models

The models operate by simulating the operation of markets for factors, products, and foreign exchange. They are highly nonlinear, with equations specifying supply and demand behavior across all markets. A solution for a given year generates market-clearing prices and quantities for sectoral output, employment, and foreign trade, producing all the elements of the circular flow in the economy. The Hungary model has 12 production sectors, 3 labor categories, and 2 household types. The Yugoslav model has 18 sectors, 4 labor categories, and 2 household types. Both models include institutions comprising government, the "rest of the world," and an aggregate capital account which serves the function of a financial sector that collects savings and allocates investment funds to sectors. Depending on how one counts, the models have around 1000-1500 equations that are solved for each period in a dynamic simulation.

Production and Employment

In CGE models, the usual practice is to specify that sectors maximize profits, given neoclassical production functions and competitive output and factor markets. In the Yugoslav model, the assumption of profit maximization is replaced by a more complex set of relationships that attempt to capture the operation of self-managed firms. The specification is discussed in Robinson and Tyson (1985). The net effect is to make enterprises less responsive to price signals and to generate personal incomes of workers that do not equal their marginal revenue products (or efficiency wage). In the Hungary model, the specification is closer to the neoclassical version, although we have experi-

mented with alternative specifications. In one, firms are assumed to set a target output, which they then modify only partly in response to market signals. Their actual supply in this case is a weighted average of the target and profit-maximizing output, with targets being updated over time according to a lagged adjustment process. In the historical period, the two alternatives yielded very similar results, so we decided to stay with the neoclassical specification since it was simpler. In other applications, the differences might well be important.

For two sectors, mining and electricity, the Hungarian model deviates from the neoclassical assumptions. In these sectors, domestic prices are assumed to be fixed and a different mechanism than price adjustment is assumed to work to clear the market. For electricity, supply is assumed to adjust through variations in capacity utilization so that supply always equals demand. In the mining sector, which includes oil, imports are assumed to adjust so as to equate supply and demand.

In both models, aggregate employment for each labor category is fixed endogenously, and the models solve for equilibrium wages and the sectoral allocation of labor. Within each period, sectoral capital stocks are assumed fixed, so the model solves for sectorally differentiated "profit" rates, or marginal revenue products for capital. Since the models incorporate sectoral taxes and subsidies, it is possible to compute profits both before and after taxes, and so use the model to explore the size of the distortions induced by the tax and subsidy systems.

Foreign Trade

These models are designed to focus on issues of trade policy, especially the ways an economy can adjust to shortages of foreign exchange. In one variant, the models treat all the sources of foreign exchange --exports, foreign capital inflows, net factor income, remittance income, and reserve changes-- as exogenous. In a second variant, sectoral exports are determined endogenously and are assumed to be a function of the relative price to domestic producers of domestic versus export sales.[6] In both models, exports were specified exogenously for the base historical run, while endogenous export functions were specified for some counterfactual experiments.

Both models assume that domestically produced tradable goods and imports are imperfect substitutes. For each tradable sector, consumers demand a composite good which is a CES aggregation of domestic and imported goods. Trade substitution elasticities vary by sector. Given this approach, the demand for imports depends on the relative price of domestically produced and imported goods. The world prices of imports and exports are fixed, but the domestic prices depend on trade policy instruments such as the exchange rate, tariffs, and subsidies. This specification makes the domestic price system relatively autonomous compared to earlier multisector models in which domestic and foreign goods were assumed to be perfect substitutes. This treatment assumes a continuum of tradability by sector, with the responsiveness of

[6]The specific form of the export function is that the ratio of export sales to domestic production is a logistic function of the ratio of the export price to the domestic sales price. See Dervis, de Melo, and Robinson (1982), chapter 7, for a detailed discussion. An alternative functional form we have tried in the Hungary model is a constant elasticity of transformation (CET) function, which gives similar results. This approach is described in Condon, Robinson, and Urata (1985). In both variants, econometric work is sorely needed to estimate the parameters. We have had to rely on "guesstimates" in the applications discussed here.

domestic prices depending on the relative shares of imports and exports in total domestic supply, as well as on the trade substitution elasticity and on the export supply elasticity.

Both Hungary and Yugoslavia carry out a substantial fraction of their trade with the Eastern bloc. For example, in 1979-81, trade with socialist economies accounted for 57 percent of Hungary's exports and 52 percent of Hungary's imports. The comparable figures for Yugoslavia were 45 percent and 29 percent respectively.[7] Hungary is a member of CMEA and trade with the Eastern bloc countries is carried out on the basis of long-term contracts and at inter-bloc prices that often differ significantly from world market prices. Most of this trade is denominated in rubles, although a significant and increasing share is denominated in convertible currencies.[8] Yugoslavia, unlike Hungary, is not a member of CMEA, and most of its trade with the Eastern bloc is based on world market prices and denominated in convertible currencies.[9] In addition, Yugoslavia's trade with the East is not based on long-term contracts and hence tends to be more variable than Hungary's trade with the East. As an illustration, there are often substantial short-run deficits in the direction of Yugoslav exports from West to East in response to changing market opportunities.

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[7]Balassa and Tyson (1985).

[8]The share of Hungary's imports from socialist countries in convertible currencies is around 12 percent. The share of exports to socialist countries in convertible currencies has risen from 14 percent in 1970 to over 24 percent in 1981. See World Bank (1984).

[9]Yugoslavia only recently began to publish trade statistics on a clearing and non-clearing basis. The figures show that on average about 80 percent of Yugoslavia's trade with socialist countries was on a clearing basis between 1980 and 1982. This implies that a substantial portion of Yugoslavia's convertible currency earnings on Eastern bloc markets was not available to cover its convertible currency deficit with the West during this period.

Because of the significant share of CMEA trade in total Hungarian trade, and the special features of this trade, the CGE model for Hungary distinguishes between ruble and non-ruble trade flows.[10] CMEA exports and imports denominated in rubles are set exogenously, reflecting the type of relatively long-term contracts characterizing this trade. Western trade, or trade denominated in dollars, is determined endogenously to achieve equilibrium in the foreign exchange market.[11] The model has two exchange rates, one for rubles and one for dollars. Historically, the ruble exchange rate has been fixed and unchanging, although implicit tariffs and subsidies have been imposed which serve to keep the effective ruble and dollar exchange rates roughly in line. In the Hungary model, when we do experiments which vary the exchange rate, we move the two rates together in order to keep the calculation simple.

The total demand for foreign exchange in both the Yugoslav and Hungarian models is determined by summing desired imports across all sectors. The total is compared with the supply of foreign exchange arising from exports and all other exogenous sources (including net foreign capital inflows, reserve decumulation, and factor income from abroad). When both dollar and ruble exports are specified exogenously, in effect the balance of trade is exogenous in the models. An adjustment mechanism is specified to equate the supply and demand for foreign exchange. One variant is to specify a flexible exchange rate which

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[10]At the time the CGE model for Yugoslavia was constructed, data breaking down imports and exports between Eastern and Western sources were not available at the sectoral detail required for the model.

[11]As noted earlier, Western trade and trade denominated in dollars are not exactly the same, since some Eastern trade is carried out on the basis of convertible currencies. The Hungarian statistics used in the model only allow a distinction between trade denominated in rubles and trade denominated in convertible currencies (measured in dollars), without a further distinction into geographic source.

adjusts endogenously to clear the foreign exchange market. Another variant is to fix the exchange rate, and specify an endogenous rationing mechanism to achieve the equilibrium level of imports.

In the Yugoslav model, a complicated rationing scheme is specified which contains elements of both fixprice and flexprice rationing. The model seeks to capture in a stylized way the elaborate and complex system by which foreign exchange is rationed in Yugoslavia. In the Hungary model, there is a much less complex quantity rationing scheme where demanders of sectoral imports are forced to accept only a fraction of their desired imports, given the disequilibrium price arising from the fixed exchange rate.[12] This quantity rationing rate is assumed to vary sectorally, with some sectors such as agriculture being more severely rationed. The effect of quantity rationing is that demanders of imports receive less than they wish at the existing price, but are subsidized in that they pay less for the imports they receive than they would if a free market prevailed.

Note that in the Hungary model, oil imports are not rationed. As noted above, the domestic price of the mining sector, which includes oil, is fixed and imports are assumed to clear the market. While there was apparently no direct rationing of oil during the 1981-85 period, this treatment is probably an oversimplification. In fact, the model tends to generate oil imports somewhat above those actually observed in the historical base run. In Yugoslavia, there was severe direct rationing of oil and gasoline during the period, and the model is specified to reflect it.

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[12]The details of the specification are discussed in Dervis, de Melo, and Robinson (1982), chapter 9, and, for the Yugoslav model, in World Bank (1983).

Import rationing generates a "scarcity premium" or rent on imports that strongly encourages import substitution, but that generates a wedge in incentives against exports. In addition, the allocation of scarce imports to enterprises at a price reflecting only the official exchange rate represents a major subsidy to the recipients. The effect is to provide major hidden subsidies to heavy users of imported intermediate and capital goods and to distort their efficient allocation among competing uses, leading to losses of output.

The difference between the actual cost of rationed imports and their value to demanders is unobservable in an actual economy. However, in the CGE model, we can compute this difference since we specify the underlying behavioral functions. The resulting value of quantity rationing (VQR) measures the amount demanders would be willing to pay for imports (valued at the margin) minus the amount they actually pay. The VQR can be seen as a measure of the "chaseable rents" generated in the system by import rationing. The existence of such rents undoubtedly elicits "rent seeking" behavior on the part of various actors in the system.[13] Even with tight controls and good will, any significant level of VQR must generate a major strain on the economic system. We capture this phenomenon in both models by assuming that there are sectoral efficiency losses which are a function of each sector's demand for imports of intermediate and capital goods. Thus, sectors which are more import dependent are subsidized from import rationing because they receive rationed imports at a lower price, but are hurt because they must bear efficiency costs arising from the ration-

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[13]For a theoretical discussion of this phenomenon, see the classic article by Krueger (1974). Dervis and Robinson first incorporated rent seeking into the CGE framework in their model of Turkey. Since then, it has been used in a number of models. For a description of the approach, see Dervis, de Melo, and Robinson (1982).

ing. The aggregate value of this efficiency loss is assumed to be a function of the aggregate VQR.

Demand, Prices, and Macro Closure

The demand side of the model works by tracing through the circular flow the incomes generated in the productive sectors and modelling the various demands they induce. Consumers are assumed to have price-sensitive expenditure functions: linear expenditure systems for two consumers in the case of the Hungary model, simple fixed sectoral expenditure shares in the case of the Yugoslav model. Government demand is modelled with fixed expenditure shares. In both models, aggregate government consumption is exogenous, government revenue is endogenous (given a variety of tax parameters), and government savings is determined residually. Enterprises and households also have savings functions, so the model will complete the circular flow, generating total savings, and hence a demand for investment goods.

Given supply and demand for each sector, the CGE model solves endogenously for a set of equilibrium wages, prices, and an exchange rate or import rationing rate to clear the markets for labor, products, and foreign exchange. The model is Walrasian in spirit in that the equilibrating mechanisms work through changes in relative prices. The absolute price level is set through the choice of a wholesale price index as numeraire whose value is projected exogenously over time. All price changes should be viewed relative to this exogenous index. In particular, variations in the exchange rate affect the balance of trade through their impact on the relative price of tradables to nontradables --the real exchange rate. A devaluation raises the price in domestic currency of imports and exports relative to domestic goods sold on the domestic market.

The effect is: (1) to induce producers to produce import substitutes and to export, and (2) to induce demanders to increase their demand for domestic goods over imports. Given that all capital flows and the aggregate price level are exogenous, there is no place in the model for endogenous macroeconomic linkages between the exchange rate, domestic inflation, interest rates, and international capital flows. The model seeks a flow equilibrium in the balance of trade, not an asset equilibrium in the money and bond markets. While there are clearly interesting relationships among these exogenous variables that provide the subject of much macroeconomic theory, that is all exogenous to the CGE model.

Changes in the model's exchange rate required to achieve equilibrium in the balance of trade can be viewed as measuring required changes in the economy's nominal exchange rate, given the choice of numeraire. In trade theory models, it is often convenient to choose the nominal exchange rate as numeraire in order to focus on the relative price changes that drive the model. In the CGE model, the equilibrating mechanism at work is through changes in the real exchange rate, but it is much more convenient to choose a numeraire such that the exchange rate is recognizable. As long as one remembers that any calculation is conditional on the assumptions about foreign capital inflows and the aggregate price level, there is no theoretical problem with this approach.

The problem of achieving macroeconomic balance between aggregate savings and investment is a separate issue involving what has been called the macro "closure" of the model. There are many ways discussed in the literature for achieving savings-investment equilibrium in CGE models corresponding to

various theoretical views about how the macro system works.[14] In the Yugoslav model, a number of different closure rules were specified, depending on the particular application of the model. For some experiments, the model was savings driven, with aggregate investment set equal to endogenously determined savings (known as neoclassical closure). Sometimes aggregate real investment was set exogenously, with institutional savings rates assumed to adjust to achieve macro balance (known as Johansen closure). Finally, in some forward runs described in Robinson, Tyson, and Dewatripont (1986), a special Yugoslav closure was specified in which inflation is endogenous and nominal personal incomes are exogenous. All these closures were developed to capture the stylized facts of the Yugoslav system under various policy regimes.

In the Hungary model applied to the 1981-85 period, the macro closure problem is much easier to handle. During this period, Hungarian policy makers set aggregate investment targets in quantitative terms and enforced them through direct control of investment projects. The savings required to finance the aggregate investment target was generated by appropriating most of the investible surplus generated by enterprises and by maintaining relatively tight control over the course of real income paid in the state sector of the economy. This is the mechanism employed in the Hungary CGE model and it represents a direct forced-savings closure.

In Yugoslavia, although closure is in fact achieved via forced savings, inflation which erodes the purchasing power of nominal incomes is a critical component of the process. The process is difficult to model within the CGE framework, since the model does not contain any asset markets. In Hungary,

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[14]For a survey of various macro closure rules, see Rattso (1982). Robinson and Tyson (1984) and Ginsburgh and Robinson (1984) discuss different conceptual frameworks for considering macro issues in CGE models.

where there are direct controls over enterprise saving and real incomes, which are critical to the adjustment process, it is much easier to incorporate the process within the CGE model.

3. Hungary: 1981-85

In the past, when faced with a balance-of-payments problem, Hungarian policy makers have responded by imposing quantitative rationing of imports and, to a lesser extent, by increasing exports through the imposition of export targets. Little use was made of exchange rate policy. When faced with foreign exchange shortages after the second oil crisis, the Hungarians again resorted to a system of quantity controls.

There are several explanations for the continued use of quantity controls and the failure to use an active exchange rate policy during the recent adjustment period in Hungary. First, the prevailing price regulations linked domestic and world prices, which meant that a devaluation would automatically tend to increase the prices of both tradables and nontradables, with inflationary consequences for the aggregate price level. The Hungarian authorities were generally concerned about aggravating price pressures, since the gradual reduction of consumer subsidies was by itself already pushing the aggregate price level upward. Second, given the softness of enterprise budget constraints, the responsiveness of enterprises to changes in the exchange rate could not be relied upon to produce the adjustment required by external constraints.[15] Third, quantity controls give state and party authorities

[15]For a discussion of soft budget constraints, see Kornai (1980). Even though Hungary shares the features of soft budget constraints with its East European neighbors, it is an oversimplification to characterize its as a pure

direct control over the distribution of critical resources among competing claimants, a power such authorities are slow to relinquish.

The incentive effects of the quantity controls chosen were antithetical to the thrust of the economic reforms that were re-introduced in 1979. Those reforms call for a major shift toward greater reliance on market mechanisms and a concomitant change in the nature of the policy instruments the government uses to guide the economy. What we observe in the 1981-85 period is an uneasy mix of policies, some aimed at increasing the role of the market, while others involve direct rationing of imports, especially through control over investment, and direct pressure on enterprises to export. The experiments with the CGE model show the impact of some of these contradictions.

Starting in the late 1970s, the Hungarian economy faced a steady deterioration in its ability to borrow abroad. After 1980, export earnings also stagnated, and the economy faced increasingly severe shortages of foreign exchange after 1981.[16] Figures 1 and 2 indicate the trends. After 1980, Hungary had to generate surpluses in its balance of trade in order to meet its obligations in the capital account. The worst year was 1982, with the current and capital accounts moving into surplus in 1983. However, Figure 2 shows a steady fall in the dollar value of imports after 1980. The foreign exchange shortages required real as well as financial adjustments.

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shortage economy in which enterprises struggle to produce as much as possible with little regard to costs or salability of output. The real issue in Hungary is not the existence of sensitivity of enterprises to price signals, including the exchange rate, but the degree of such senstivity. What seems certain is that such sensitivity is weaker than in market economies based on private ownership, profit maximization, and hard budget constraints.

[16]For a comparison of the Yugoslav and Hungarian experience during this period, see Balassa and Tyson (1985). Robinson, Tyson, and Woods (1986) also compare the experience of the two countries, concentrating on the role of the IMF.

Figure 1

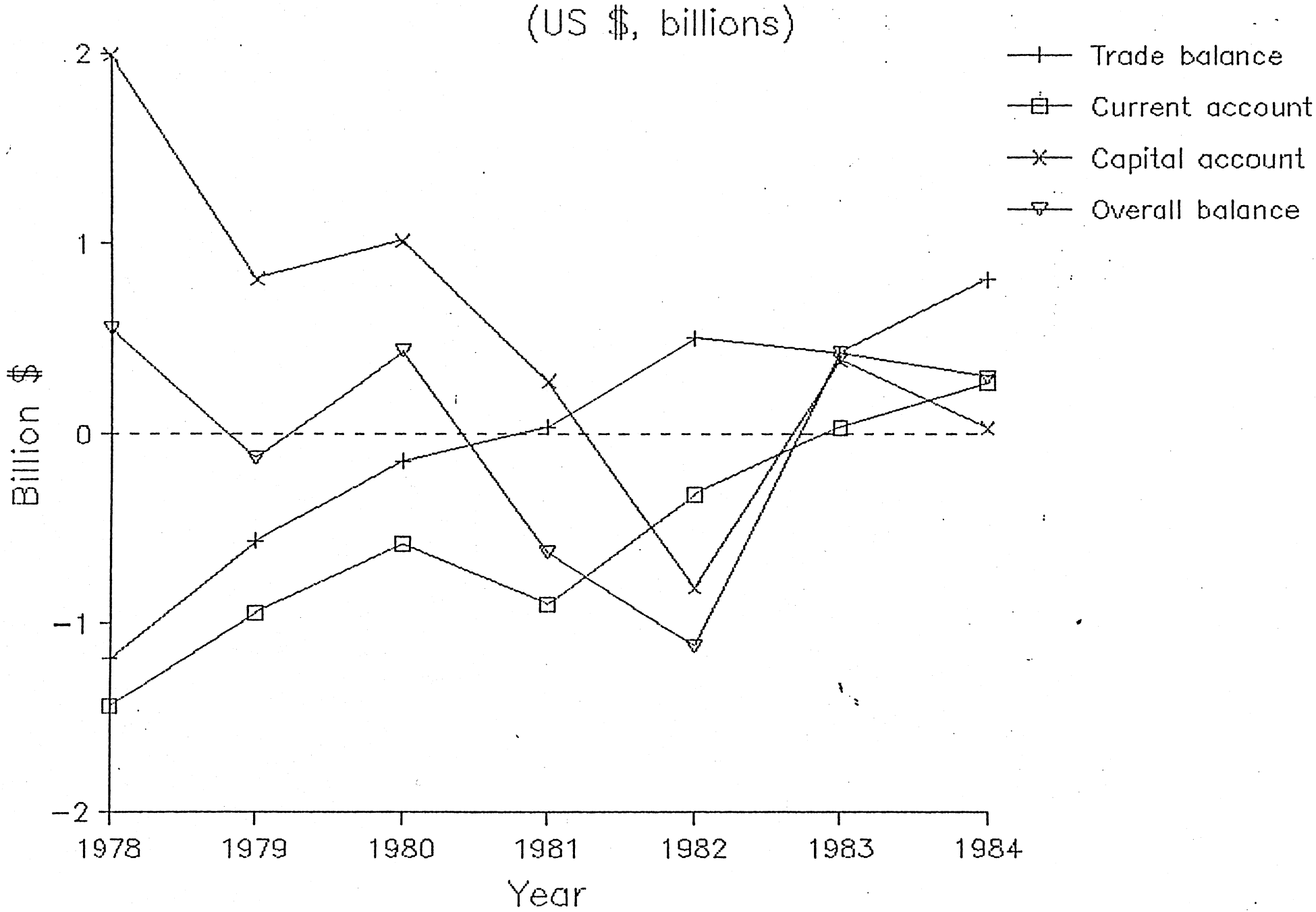
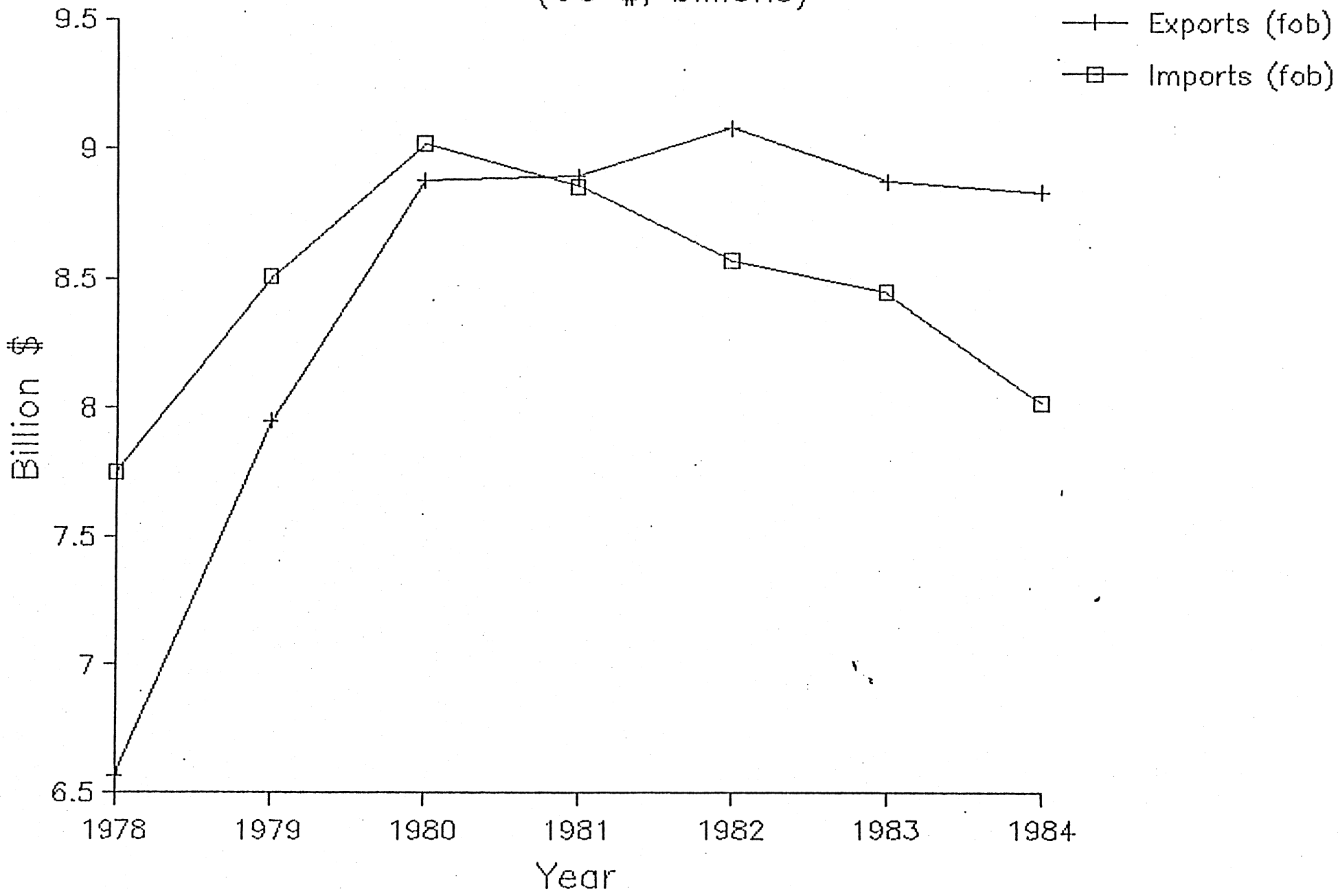

Hungary: Balance of Payments
(US $, billions)
Trade balance
Current account
Capital account
Overall balance
Billion $
2
1
0
−1
−2
1978
1979
1980
1981
1982
1983
1984
Year

Figure 2

Hungary: Total Exports and Imports

(US $, billions)



The Base Run

The model takes up the story in 1981, with the base run covering the period 1981-85. Table 1 presents selected macro variables from the base run. In general, the base solution values are very close to historical data --within a percent or so for almost all macro aggregates.[17] Table 1 shows the impact of the foreign exchange shortages on economic performance. Growth rates are well under historical trends, and 1983 was an especially hard year. The model solution for 1985 reflects estimates of exogenous variables as of the summer of 1985. At this time (December 1985), the projections of export and GDP growth seem overly optimistic. The projected surplus in the balance of trade also appears too high. However, the basic results from the counterfactual experiments are not sensitive to changes in the terminal year, so we decided not to revise the 1985 data until firmer estimates are available.

Given the foreign exchange shortages, the stagnation of export earnings during this period was especially worrisome. Did export earnings stagnate because of a decline in demand in western markets, or were there problems with export supply in Hungary? The question is important. If exports were hurt because of domestic policy choices, then it is necessary to make policy changes in order to generate exports in the future.

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[17]We have adhered to U.N. system of national accounts (SNA) definitions for the GCP accounts, which differ somewhat from standard Hungarian accounting conventions. There are differences in the valuation of exports and imports, as well as the standard problems in moving from the material product system (MPS) of accounts to the SNA. There are also minor differences in trade statistics arising from the fact that we use input-output data. Exports and imports of services are defined slightly differently in the input-output and foreign trade statistics, and there may also be differences in the sectoral definitions.

Table 1

Hungary: Base Run, 1981-85
Macroeconomic Variables

Real Growth Rates (percent)

	1981-82	1982-83	1983-84	1984-85	1981-85
Private consumption	1.70	-2.55	3.52	4.02	1.64
Govt. consumption	-.76	4.14	-6.65	-1.31	-1.22
Fixed investment	-3.35	-4.29	-7.57	2.51	-3.24
Exports	2.65	7.14	7.41	5.02	5.54
Imports	-3.80	-.35	.33	2.83	-.27
GDP	2.75	1.10	2.95	4.12	2.73

Ratios to Current GDP (percent)

	1981	1982	1983	1984	1985
Private consumption	58.1	57.2	58.3	57.1	57.4
Govt. consumption	9.6	9.7	10.1	9.3	9.0
Fixed investment	25.1	24.8	25.1	21.6	20.9
Exports	42.7	41.3	42.8	45.7	45.4
Imports	38.5	36.0	38.6	36.9	35.7

Non-ruble Trade Shares (percent)

Non-ruble/total trade	1981	1982	1983	1984	1985
Exports	55.9	55.2	54.0	55.4	55.6
Imports	53.4	48.9	48.0	49.5	50.8

Notes:
Real GDP accounts are defined in 1981 prices.
GDP shares: exports are valued in domestic prices.
Imports are valued in world prices times the official exchange rate.
Non-ruble trade shares: exports and imports are valued in trading prices times the official exchange rate.

The growth of real exports, shown in Table 1, was quite good. In 1981-82, the growth rate was about the same as that of GDP, but significantly faster thereafter. The stagnation of export earnings was due to a decline in dollar prices, which was partly due to the revaluation of the dollar relative to hungary's major trading partners during this period. Anecdotal evidence also indicates that there were problems with marketing exports in the West, as well as incentive problems within Hungary. The detailed price trends will be considered below.

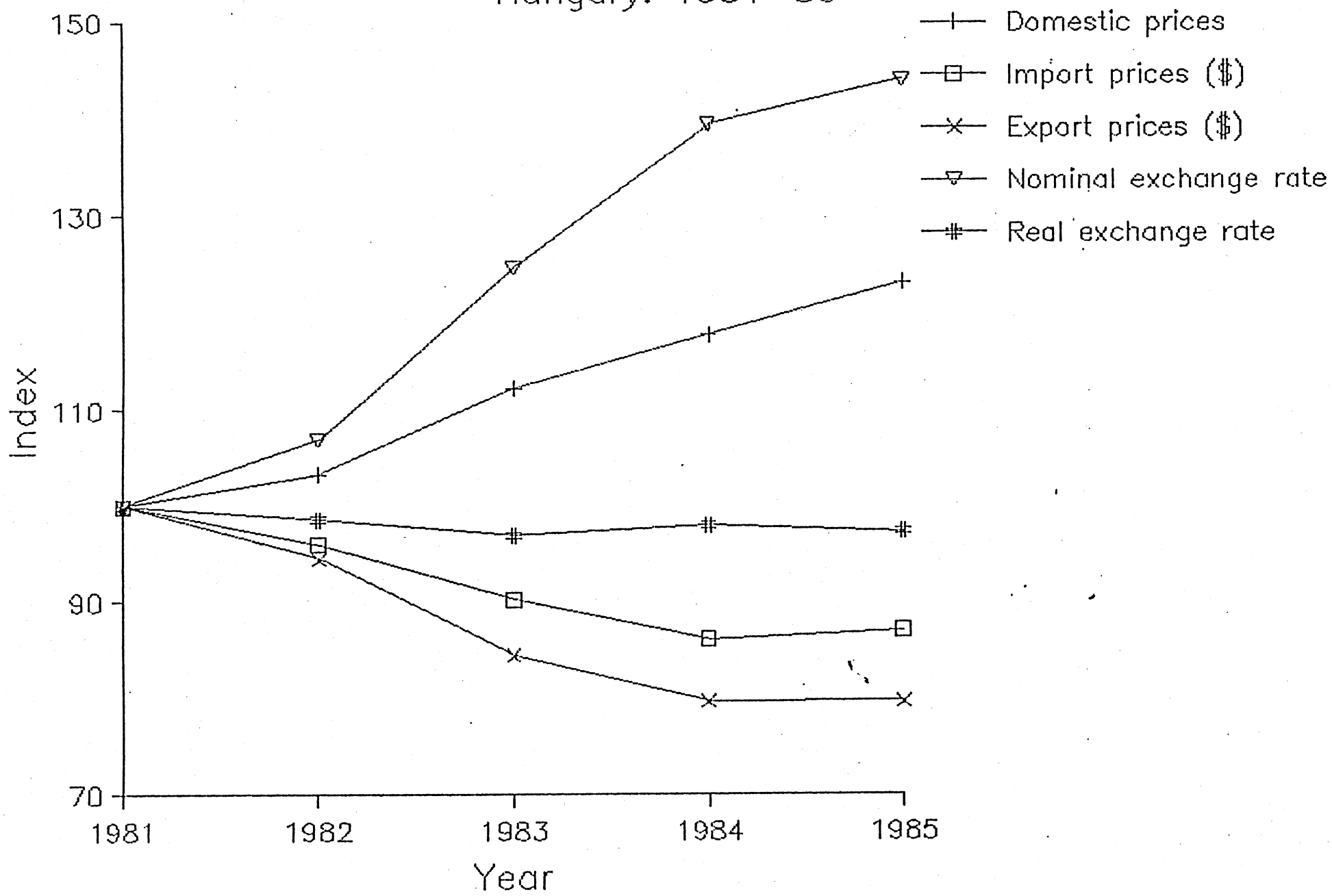
Table 1 indicates that the ruble-dollar composition of exports changed very little during the period. The convertible currency share of exports remained around 55 percent, with only a very slight drop to 54 percent in 1983. Thus, neither the dollar volume nor structure of exports changed during this period. While there was undoubtedly some decline in Western demand for Hungarian exports, Hungary was able to maintain the value share of its Western exports. On the other hand, the convertible currency share of imports dropped significantly, indicating that the import rationing was much more severe on imports from the West.

While real exports increased, the data and model results indicate that there were major changes in domestic incentives against exporting. Figure 3 presents data on exchange rate and price movements in the 1981-85 period. Hungary did devalue the forint against the dollar, and the devaluations were larger than the changes in the domestic price level. However, Hungary's major trading partners during this period experienced a revaluation of their currencies against the dollar, so the dollar import and export prices facing Hungary fell. The result is that the real effective exchange rate actually revalued slightly during this period. Thus, in a period of foreign exchange shortage,

Figure 3

Prices and Exchange Rates

Hungary: 1981–85



which would normally call for a real devaluation, there was no such policy response. Note also that there was a small shift in the international terms of trade against Hungary --dollar export prices fell more than dollar import prices-- which exacerbated the foreign exchange problem and would normally call for a larger real devaluation.

The real exchange rate is interesting only as an indicator of incentives for exporting and import substitution. We also have direct evidence of the shift in incentives. Figure 4 presents data on the ratio of the price a sector receives for an export sale to the price it receives for a sale on the domestic market. These prices are in forints, including all indirect taxes and subsidies, and so measure the incentive facing a producer to sell on the world market versus the domestic market. The data are presented separately for six sectors, which together comprise 96 percent of merchandise exports in 1981, for ruble and non-ruble exports. When the index falls below 100, it indicates a deterioration in export incentives relative to the base year, 1981.

Figure 4 shows that there was a major deterioration in export incentives during this period, especially for non-ruble trade. The interesting question that arises from these data is how Hungary managed to increase real exports, in spite of the decline in export incentives. The answer is that apparently policy makers resorted to quantity controls, setting export targets for enterprises.[18] Quantity targetting of exports represented a significant step away from the reforms in the economic system that were stated as goals around 1980.

Table 2 presents data from the base run on the extent of quantitative rationing of imports. The ratio of actual to desired imports, assumed equal

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[18]The mechanisms by which these targets were set and compliance encouraged is complex, involving political entities as well as economic institutions. See Tyson (1985) for a discussion.

Figure 4

Ratio of export to domestic prices

Hungary: 1981–85, dollar trade

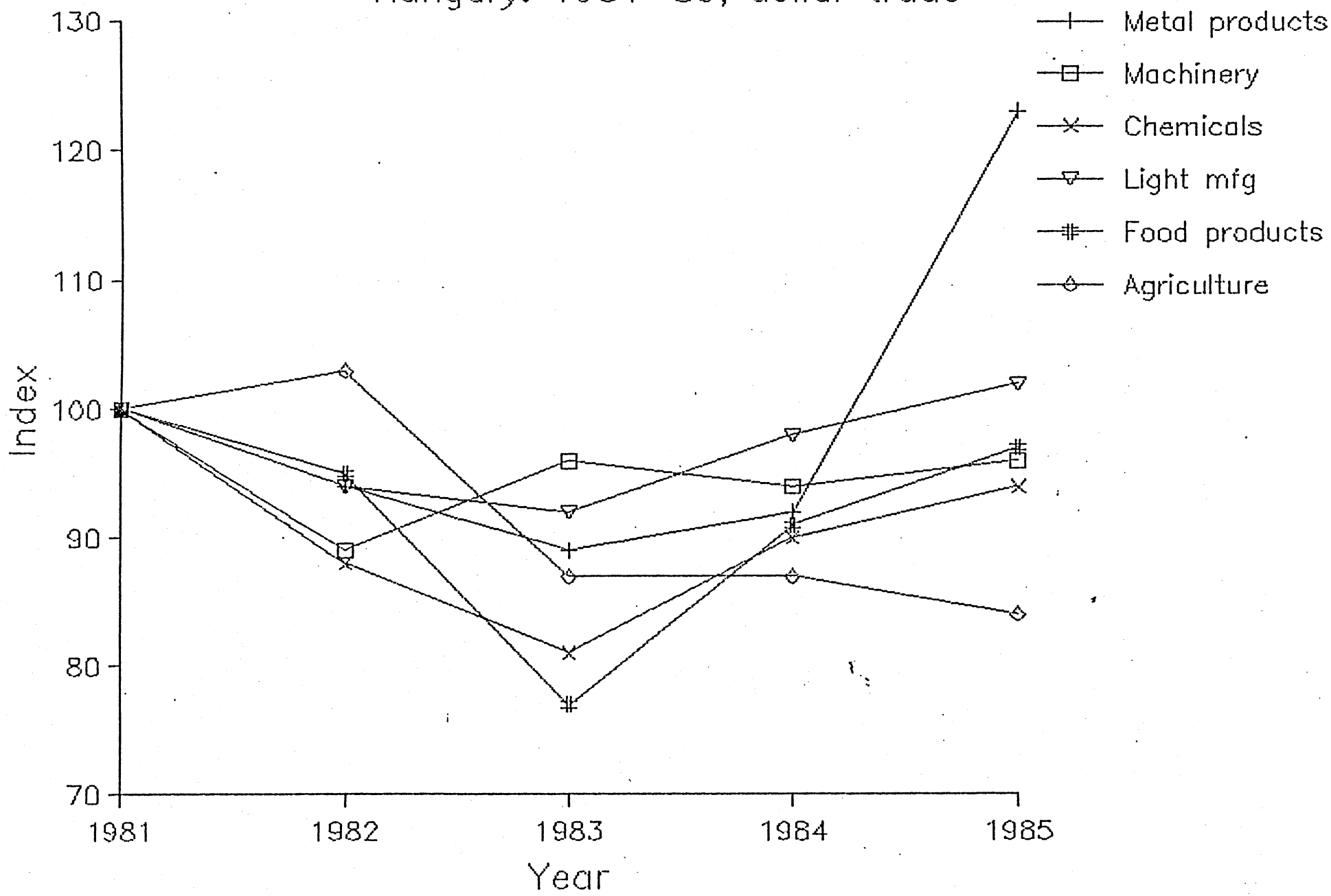


Figure 4, cont.

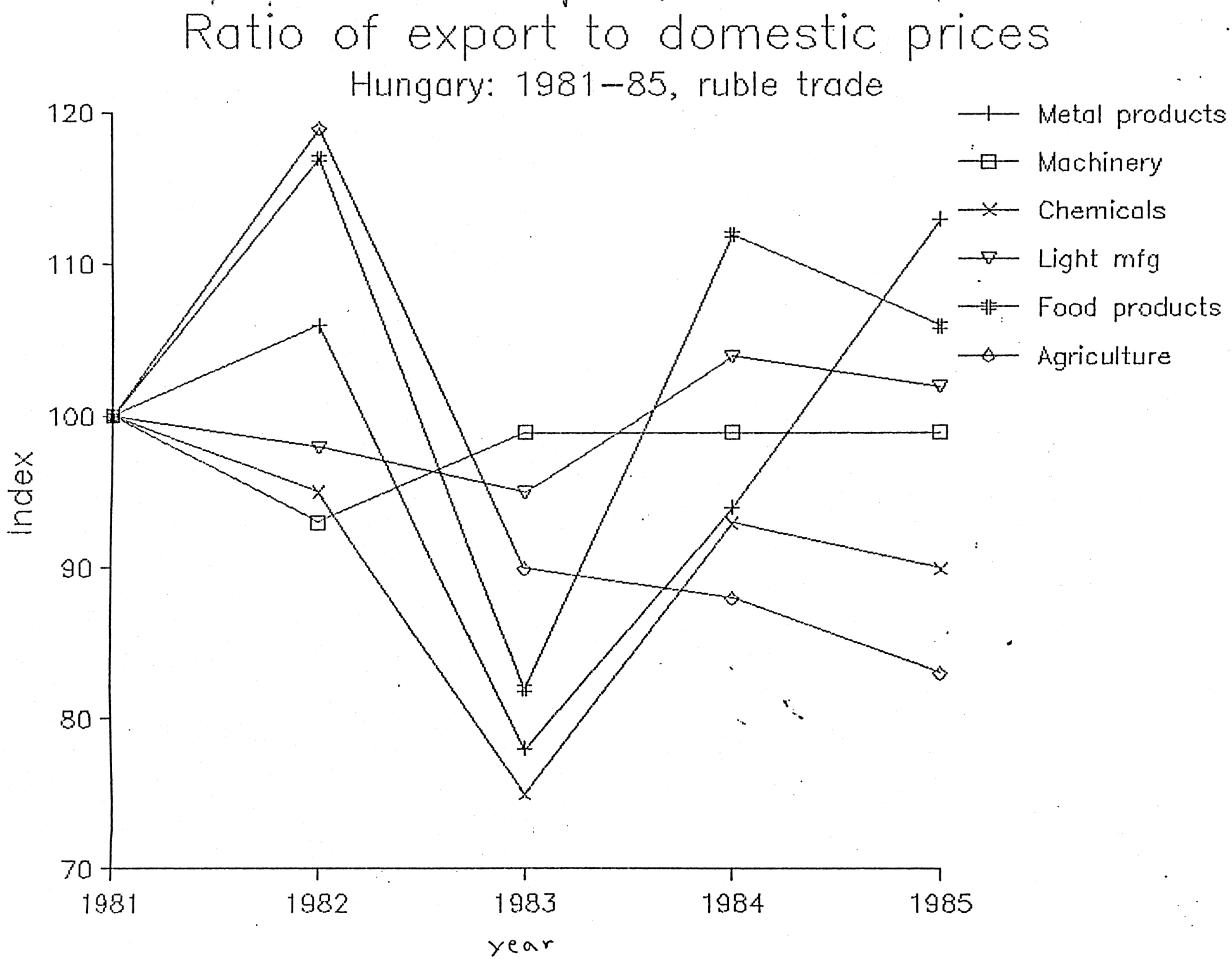


Table 2

Import Rationing Indicators
Hungary: Base Run

Ratios (percent)	Year 1981	1982	1983	1984	1985
Import rationing rate	100.0	94.1	92.0	91.2	92.3
VQR/value added	.0	7.9	10.6	11.2	9.0
Capacity utilization	100.0	97.0	96.1	95.8	96.4

Notes:
Import rationing rate = ratio of actual to desired imports.
VQR = aggregate value of quantity rationing rents.

to 100 percent in 1981, fell to 91.2 percent in 1983. While this degree of rationing seems moderate when compared to, say, Turkey in 1978, it still has a significant impact on the economy because the overall trade share is so high.[19] The total value of the chaseable rents, or value of quantity rationing (VQR), represents 8-11 percent of total value added. Distortions of this magnitude generated significant windfall gains and losses across sectors, and must have led to misallocation of resources. In the model, capacity utilization is specified as a function of these rents, and generates losses of 3-4 percent of real value added.

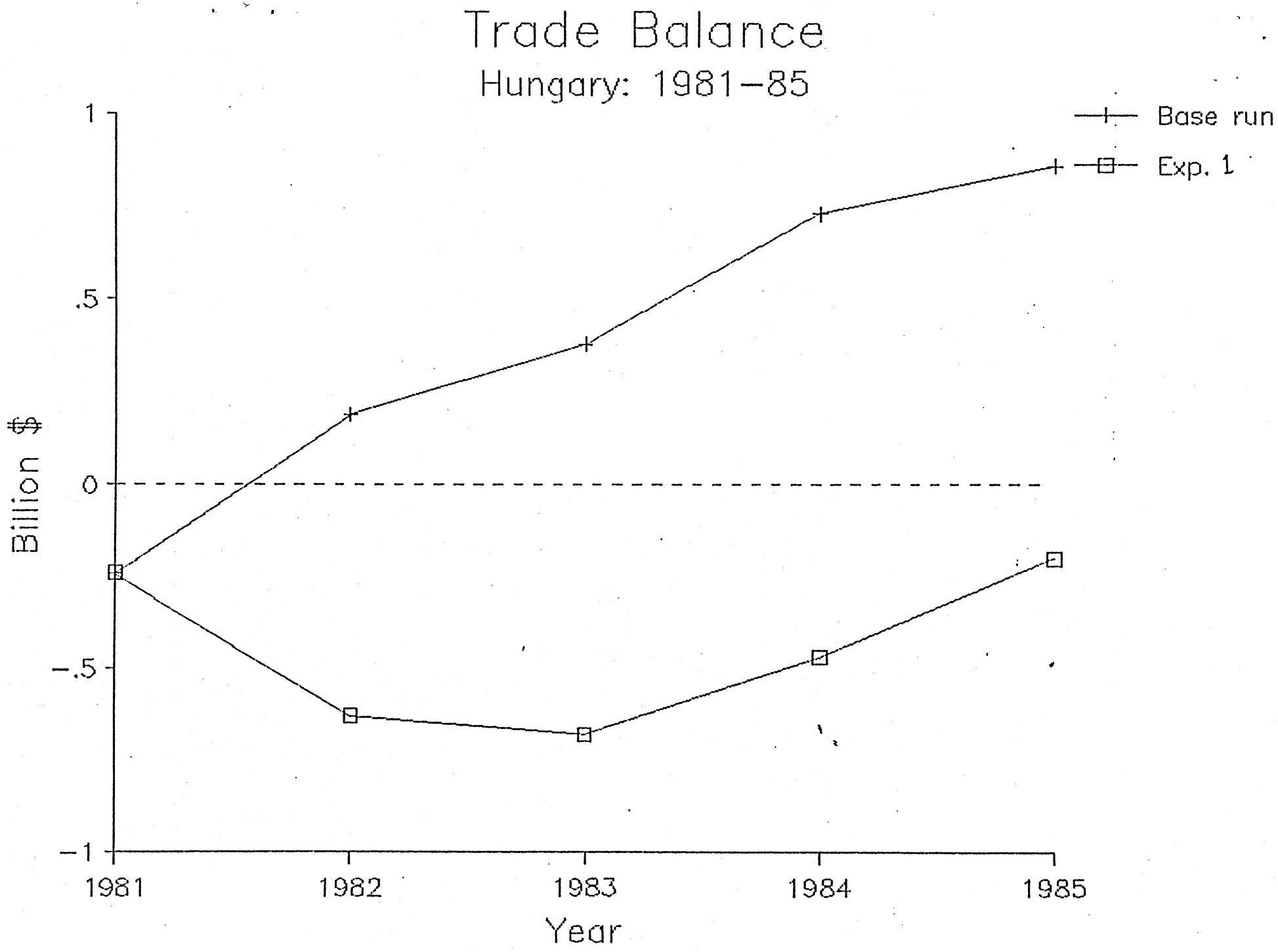
Foreign Capital Inflows

To measure the impact of foreign exchange shortages, we performed an experiment in which the exchange rate was specified exogenously at the same values as in the base run, and foreign capital inflows were determined endogenously to achieve an equilibrium balance of trade. Exports were also maintained at their base-run values. The results of this experiment are shown in Figure 5. Instead of moving to a trade surplus in 1982, the economy maintains a deficit throughout the period. The cumulative difference is $4.14 billion, or about a billion dollars a year from 1982.

The billion dollars a year represents the additional foreign capital inflows that would have been required to support the policy of maintaining a roughly constant real exchange rate without resorting to quantity rationing. The failure of export growth was clearly important to this result. Note, however, that the common IMF advice of devaluing to maintain a constant price

[19]See Dervis and Robinson (1982) and Lewis and Urata (1983) for similar calculations for Turkey.

Figure 5


Trade Balance
Hungary: 1981–85
Base run
Exp. 1
Billion $
1
.5
0
–.5
–1
1981
1982
1983
1984
1985
Year

level deflated exchange rate would have been badly off the mark for Hungary in this period. The Hungarians did maintain a roughly constant real effective exchange rate during this period, relative to the 1981 equilibrium exchange rate. However, maintaining an equilibrium real exchange rate would have required major real devaluations.

The elimination of quantity rationing, which is part of experiment 1, leads to a significant improvement in growth. In the base run, the growth rate of real GDP in the 1981-85 period is 2.7 percent a year. In experiment 1, it rises to 3.9 percent. This increase in output, of course, also increases the demand for imports and thus contributes to the increased capital inflows implied in the experiment.

Equilibrium Exchange Rates

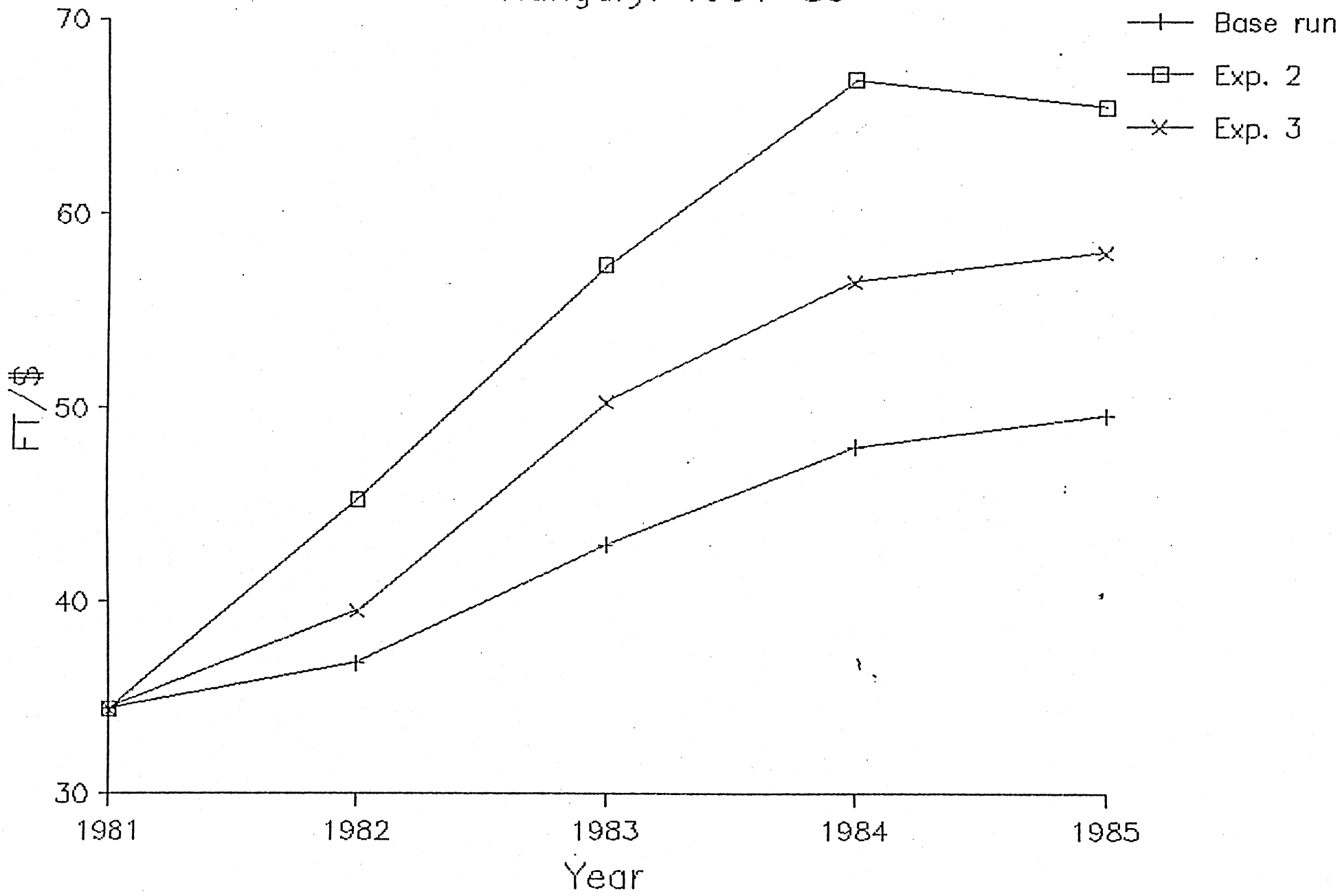
Assuming a fixed exchange rate and allowing the balance of trade to be determined endogenously is a very unrealistic assumption for Hungary during this period. In the next two experiments, we instead assume that foreign capital inflows are fixed exogenously and that the exchange rate adjusts to achieve equilibrium. In experiment 2, we assume the same exports as in the base run. In experiment 3, we assume that exports respond to price incentives and that they are determined endogenously.

Figure 6 shows the time sequence of equilibrium nominal exchange rates for the two experiments, along with the historical rates from the base run. The differences are dramatic. In 1984, the equilibrium exchange rates are 66.9 FT/$ for experiment 2 and 56.6 FT/$ for experiment 3, compared to the actual value of 48 FT/$ --devaluations of 39 and 18 percent, respectively. In

Figure 6

Nominal Exchange Rates

Hungary: 1981–85



comparing these exchange rates, one must remember --as discussed above-- that they are conditional on the assumptions that the domestic price index and the balance of trade are unchanged. Thus one cannot conclude that a devaluation of 39 percent in 1984 would have sufficed to equilibrate the foreign exchange market. The model does indicate the incentive problems that arise when the real exchange rate is out of equilibrium and the effect on the structure of incentives, production, and trade of achieving the correct rate, even though it ignores the macroeconomic problems policy makers face in trying to achieve the correct rate.

In experiment 3, the economy is assumed to adjust exports according to price incentives. Table 3 shows the sectoral changes in real exports in experiment 3 compared to the base run. Overall, aggregate real exports are modestly higher, ranging from 1.5 to 4.8 percent over the base run. The reason for only a moderate increase in exports is that exports in the base run were higher than they should have been, given the underlying price incentives, because of quantitative targets. The changes in the exchange rate in experiment 3 essentially correct the incentive bias against exports evident in the base run, effectively making the actual exports "incentive compatible." The somewhat greater increase in the dollar value of exports is due to compositional changes, with increased exports in sectors where dollar prices are higher.

The changes in the structure of exports are dramatic. Metal products and machinery increase their shares, while chemicals and food products decline. These changes arise in an assumed international environment in which Hungary is able to sell all it exports at the exogenously specified world prices. Since ruble exports are fixed exogenously, all these structural changes are assumed

Table 3

Changes in Export Structure
Experiment 3: Flexible Exchange Rate with Export Response

Sector	Percent Deviation from Base Run 1982	1983	1984	1985
Metal products	16.9	7.4	7.3	34.4
Machinery	6.0	18.4	17.7	12.2
Chemicals	3.7	-18.0	-11.1	-15.6
Light mfg.	3.4	2.9	4.3	2.0
Food products	4.4	-11.2	-8.1	-8.8
Agriculture	8.0	-2.7	8.3	4.9
Productive services	-9.7	8.5	-7.1	-11.0
Total real exports	4.8	2.0	3.0	1.5
Total $ exports	5.1	3.0	4.2	3.0

to occur through shifts in trade with the west. While it is feasible to model exports with international demand functions as well as domestic supply functions, such a treatment requires empirical work on Hungarian export markets that is not currently available. The CGE model indicates the importance of changes in export structure. Testing the reasonableness of the model's results requires further analysis, preferably at a more micro level.

Investment

As part of its program of macroeconomic adjustment, Hungary cut back on investment dramatically in 1984. The share of fixed investment in GDP dropped by 3.5 percentage points (from 25.1 percent in 1983 to 21.6 percent in 1984). In most semi-industrial countries, such a cutback in investment would also decrease import demand since a large share of capital goods is imported. To see if Hungary would display a similar effect, we did an experiment which was identical to experiment 1 except that we kept the investment share of GDP at its 1981 value in every year. From Table 1, the implication is that the investment share is 3.5 percentage points higher in 1984 than in the base run.

The results indicate the effect on import demand is minor. Total imports fall very slightly, by 0.5 percent in 1984, but there are some significant changes in composition. Imports of investment goods rise, while those of food and agriculture fall. The shift in the composition of demand also affects the agricultural terms of trade, with agricultural prices about 4 percentage points lower in the high-investment experiment. Higher investment implies less consumption, and consumption is more food intensive, so the shift in structure leads to a fall in food demand.

Restraining investment thus does not have a significant effect on aggregate import demand in an environment with no rationing. However, it is clearly easier to impose import rationing in the investment goods sectors, where the government has more direct controls over investment plans. Investment restraint is a logical part of an import rationing regime. Indeed, evidence from the Hungarian case indicates that investment restraint was a critical ingredient in overall import rationing for two reasons. First, by imposing the major share of import cutbacks on capital goods, available foreign exchange would be used to keep up the flow of imported intermediate inputs required to maintain production. Consumer imports were severely rationed, but such rationing is much less disruptive of production than severe rationing of intermediate inputs would have been. Second, investment cutbacks were consistent with the objective of maintaining real consumption levels, despite macroeconomic austerity. The link between investment restraint and consumption is suggested by the simulation results, which produce an aggregate consumption level in 1984 that is about 5 percent lower in the high-investment experiment.

Summary

The simulation experiments indicate that a number of countervailing forces were at work in Hungary during the 1981-85 period. It would have required about a billion dollars a year in additional funds to avoid the need for any adjustment, which represents over a ten percent increase in annual imports. The adjustment mechanism chosen was to ration imports, without attempting any real devaluation of the exchange rate. The exchange rate policy led to further

quantity controls designed to maintain export levels in the face of deteriorating incentives.

All these quantity controls led to a variety of distortions in both import and export markets. On the import side, the difference between the cost of rationed imports at the official exchange rate and their value to demanders amounted to about 5-7 percent of GDP, or about a quarter of the import bill. In the model, these distortions imply decreases in capacity utilization of around 4 percent, significantly lowering growth.

The experiments indicate that an active exchange-rate policy, including aggressive devaluation to maintain price incentives, would have improved performance. There are, however, a number of qualifications to this result. The model assumes that such a policy could have been implemented while still maintaining macroeconomic balance and controlling inflation. Under the prevailing economic mechanism, it is also not clear that an active exchange-rate policy would have been as effective as the model predicts. As discussed earlier, in a regime of soft budget constraints, the price mechanism is less effective, and the CGE model probably overstates the responsiveness of the economy to changes in incentives.

Finally, one should note that the Hungarians also introduced a major reform in the price system during this period designed to bring domestic prices of tradables in line with world prices. During this transition phase, they were apparently reluctant to introduce additional shocks to relative prices, as well as an inflationary shock, that would have resulted from aggressive devaluation. The Hungarians chose to emphasize macro control and to postpone adjustment in the structure of production and trade. While understandable during

this period, such an approach is incompatible with their stated goal of introducing further reforms in the economic mechanism in the coming years.

5. Conclusion

In terms of methodology, the development and use of CGE models for Yugoslavia and Hungary demonstrate the feasibility of adapting the CGE framework to incorporate the important institutional features of socialist economies. In this adaptation, the models have evolved a long way from their neoclassical, Walrasian antecedents. Variants of both models specify rules of enterprise behavior that attempt to capture the stylized facts characterizing behavior in the two economies. The models also allow neoclassical disequilibria in both import and export markets, and specify rationing rules --which differ in the two models-- in the presence of disequilibrium prices. The Hungary model separates ruble and non-ruble trade, incorporating two exchange rates. The Hungary model also allows fixprice sectors, with quantities adjusting rather than prices. Both models also permit a variety of macroeconomic specifications to achieve savings-investment and balance-of-trade equilibria.

There are a number of areas where there is need for further methodological work in applying CGE models to socialist countries. Some of these areas reflect the lack of accepted theoretical explanations, rather than any computational problems. For example, the treatment of the labor market is inadequate. The models tend to overstate the ease of adjusting sectoral employment and clearing the aggregate labor markets. In both economies, enterprises appear to see tradeoffs between changes in employment and capacity utilization that are not captured in these models. The difficulty is that we do not yet have a

theoretical description of enterprise behavior that is exact enough to permit incorporation into an empirical model.

While the models are far from Walrasian, they still reflect their Walrasian roots. In particular, they do not capture macroeconomic interactions among variables such as the price level, the exchange rate, interest rates, and monetary aggregates. These models do not incorporate asset markets and can only capture macro interactions through what are essentially ad hoc "macro closure" specifications. The problems of incorporating macro features such as asset markets into CGE models is an area of active research, but the current state of the art is still quite crude.[20] The models are best applied to problems in which relative prices, incentives, and economic structure provide the focus of the analysis.

There are many difficulties in developing economywide models of socialist countries. To be realistic, such models must deviate from the Walrasian, neoclassical paradigm. But such deviations lead to methodological problems. In a wider context, Shoven and Whalley (1984, p. 1046) state the problem very well:

> Because of the difficulties in accomodating a wide range of empirical phenomena in model building, there is often a tendency to depart from the essential structure and to graft on ad hoc portions of the model not rooted in traditional theory. ... Unfortunately, the problem is, the models that make major departures from known theoretical structures can become difficult to interpret. The conflict between modeler's desires to build realistic models which seek to capture real features of the policy issue at hand, and to stay within the realm of developed economic theory is something that seems to be increasingly apparent in some of the more recent models.

While neat, applying a clean theoretical model in a situation where its assumptions are not satisfied cannot yield valid welfare analysis or sensible

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[20]See Robinson and Tyson (1984) for a methodological discussion of the issues involved. Lewis (1985) has built a CGE model of Turkey that incorporates a simple set of asset markets and endogenizes interest rates and inflation.

empirical results. Realism requires a more "structuralist" approach that attempts to incorporate non-neoclassical behavioral relations and institutional structures characteristic of these countries. The conflict is real, but we tend to view this situation as a challenge to theorists rather than as a criticism of applied modelers. At this time, the lag between a new theoretical specification and our ability to implement it in an empirical model is probably shorter than in any previous time in the history of economics. The challenge is to provide theoretical models of socialist practice that capture the stylized facts and that are complete enough to permit empirical estimation and inclusion in an economywide model.

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