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Revenue Uncertainty and the Choice of Tax Instrument during the Transition in Eastern Europe

A temporary import surcharge may be the most effective way to mobilize resources in Eastern Europe.

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Summary findings

Go examines the eroding tax base facing transitional economies by employing a framework that allows risk factors in assessing tax instruments.

In an uncertain world, he asks, which tax instruments should be used? He examines Eastern Europe's revenue problem, including the implications for public revenue of different causes of uncertainty—and investigates which taxes are "better" at generating revenue. He defines a "better" tax as one that has greater stability in a risky environment (that is, less variation in generating a target revenue) and has the least adverse impact on the economy (for example, on consumption).

Go employs the framework to explain much of the output and revenue fall in transitional economies. The terms-of-trade shocks from the collapse of the CMEA trade as well as the rigid but uncertain economic responses in transitional economies are all important factors.

The results of his model indicate that import tariffs are more effective than other traditional tax instruments in raising revenue, especially if real revenue is defined in dollar terms (the price anchor). The contraction in domestic output and prices and the devaluation of the real exchange rate needed in the transition are significant reasons that favor imports as a tax base over other revenue sources. To emphasize the transitory nature and reversibility of the policy recommendation, import tariffs should be implemented in the form of a temporary uniform import surcharge.

This conclusion seems to hold whether the government formulates tax policy with correct or incorrect expectations. But the choice of revenue target matters. All tax instruments will do almost equally well if the commonly used tax-to-GDP ratio is the target. But it is a misleading measure since the ratio does not reflect the immense erosion of domestic tax bases in the economy and how real revenue in absolute level may actually be decreasing rapidly as a result.

The revenue decline and uncertainty can also be viewed as a necessity toward downsizing the large state sector and in redirecting trade away from former nonmarket partners. The results emphasize that restoring revenue should never lead to maintaining subsidies toward nonprofitable state enterprises or other public spending no longer relevant in a market system. Doing so will only lead to unreasonably high taxation.

No less important is moving assets out of collapsing sectors, privatizing them, and making them productive again.

This paper — a product of the Public Economics Division, Policy Research Department — is part of a larger effort in the department to develop tools for analyzing tax policy. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Carlina Jones, room N10-063, extension 37699 (37 pages). August 1994.

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Revenue Uncertainty and the Choice of Tax Instrument During the Transition In Eastern Europe

Delfin S. Go[1]

1. Introduction

As Eastern European economies undertake reforms on all fronts in their transition to market-based systems, their public revenues are not just falling, they are becoming more uncertain. The decline and increased uncertainty in revenue have several inter-related sources, including such factors as fundamental changes in the structure of the economies, steep output declines, difficulties in privatizing state enterprises, the collapse of traditional export markets, severe terms-of-trade shocks, nascent tax systems and

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[1]Public Economics Division, Policy Research Department (PRDPE), the World Bank. This paper is part of PRDPE's effort to develop tools for analyzing tax policy. Thanks are due to Shantayanan Devarajan, Alan Gelb, and Richard Bird for their valuable comments, to Pekka Sinko for his able assistance in the numerical implementation of the framework, and to Shankar Acharya and Christine Wallich for suggesting the topic.

administrations etc. (See, for example, Fischer and Gelb [1990], Gelb and Gray [1991], and Bruno [1993]). Inflation and accounting/amortization rules in the initial phase of reform also affect revenue generation through their impact on profits and profit taxes (see Shaffer [1993] for the case of Poland.) Compounding the revenue problem is the need to overhaul the entire tax system. However, introducing a market-based tax system takes time while governments critically need revenue to operate in the transition.

In an uncertain world, which tax instruments should be used? This paper examines the revenue problem in Eastern Europe, looks at the implications for public revenue of different causes of uncertainty, and investigates which taxes `better' at generating revenue. While it is possible to raise revenue from alternative tax instruments, a `better' tax is defined as one that has greater stability in a risky environment (i.e., lesser variation in revenue) and smaller adverse impact on the economy (e.g. on consumption). While firm estimates of revenue are impossible in economies undergoing fundamental transformation, it is important to understand how the transition will affect revenue and how much variation in tax intake each factor can generate.

Efforts to appraise financial flows and economic performance of these countries are stymied by the lack of reliable data and the practical problem of modifying statistical information not immediately comparable to those in market economies (see Marer *et. al.* [1992]). Also, because the underlying economic relationships are changing rapidly during the transition, parameters - such as the responsiveness of import demand and export supplies to terms-of-trade shocks - are inherently unstable and a range of possibilities may exist. In order to produce plausible illustrations of the revenue performance, this paper develops a simple analytical and accounting framework that imposes little data requirement but also incorporates the significant factors of change - such as unpredictable terms-of-trade shocks and shifting economic parameters.

The analysis brings revenue uncertainty in greater focus much like a financial appraisal of a risky

project. For each set of conditions identified, a risk assessment with a measure of the dispersion and likelihood is made regarding what would happen to public revenue or how high a tax rate would be needed among alternative instruments. Certainly, the usual way of measuring a single revenue potential for each new tax is inappropriate. Such an approach assumes a stable environment, which is clearly not the case in Eastern Europe. In looking at tax policy in transitional economies, point estimates of revenue of the most likely or the best and worst scenarios have a rather small chance of occurring. To determine the rate of taxation, e.g. a sales tax, what matters is not just the likely tax rate but the variance generated by the postulated uncertainties. Where conditions are very risky, the fiscal policy required (e.g. in choosing among alternative tax instruments) to achieve stabilization and other macro goals may be quite different from those cases in which revenue circumstances are more secure.

Among recent studies of Eastern European transitional economies,[2] very few look at temporary revenue measures. Holzman [1991] addressed public finance issues in a changing political environment, including transitory tax measures. McKinnon [1991 & 1992] also emphasized the problem of generating revenue by looking at temporary measures, including distortionary taxes like import tariffs. This paper investigates whether such recommendations (import tariffs) are supported by a more systematic revenue analysis.

The outline of the paper is as follows. In section II, the revenue performance in 5 Eastern European countries - Bulgaria, former Czechoslovakia, Hungary, Poland, and Romania - is briefly reviewed. Taking the former Czechoslovakia as a case in point, section III describes the framework and the treatment of features of a transitional economy and uncertainty of public revenue. In section IV, a few simulations are performed and interpreted. Section V offers some conclusions and suggestions for further research.

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[2]Most studies concentrate on the practical issues of tax design without serious revenue analysis. An index of selected articles, papers and books on transition economies is compiled in a special issue of *Transition*, a newsletter about reforming economies published by the World Bank.

2. Revenue Performance in Eastern Europe

2.1. Public Revenue

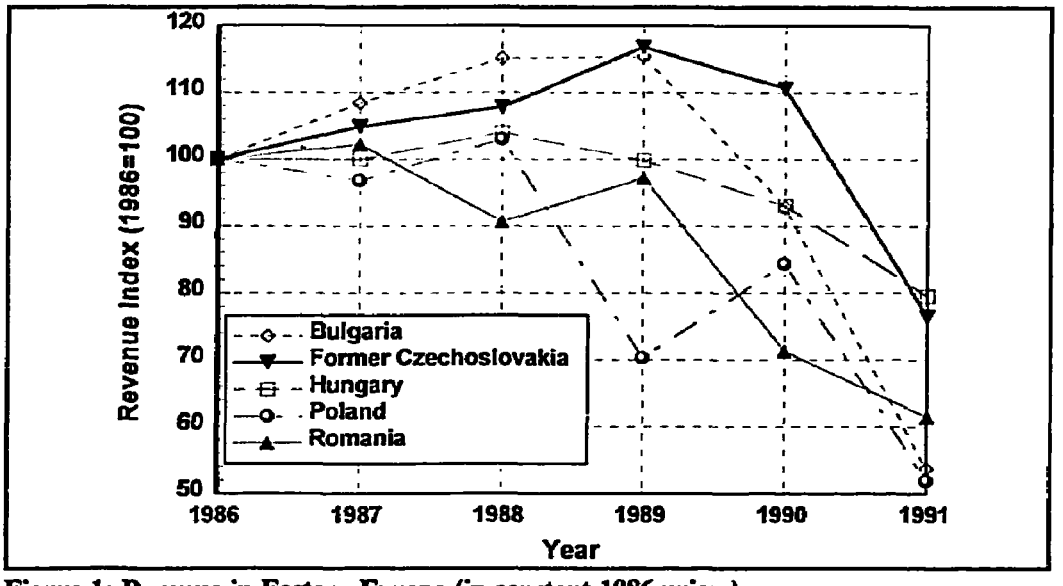

Figure 1: Revenue in Eastern Europe (in constant 1986 prices)

Current revenues of governments in Eastern Europe, after adjusting for inflation, are falling rapidly (see Figure 1). In some cases, revenues during this transition can only buy half of what they used to buy before the collapse of the centrally planned economies. As percent of the peak revenue in 1988/89, the revenue figures reported in recent years (expressed in constant 1986 prices) are only: 36.9 percent in Bulgaria (1992); 64.2 percent in the former Czechoslovakia (1992); 76.4 percent in Hungary (1991); 50.4 percent in Poland (1991); and 63.2 percent in Romania (1991).

An important reason for the decline in revenue is the collapse of output. The dismantling of the Council for Mutual Economic Assistance (CMEA) in Eastern Europe has led to the disappearance of traditional export markets, while the prices of inputs such as fuel and raw material imports have soared. The resulting external shocks has caused widespread output declines (see Rodrik [1993]).

Moreover, while prices have been liberalized and the subsequent stabilization efforts have been impressive, the structural change sought in the production system has been slow. The speed of adjustment is hampered by institutional and legal difficulties, such as the privatization of large enterprises, the introduction of property rights, new accounting system etc. A slower privatization and structural adjustment in turn implies that a large segment of supply is unable to respond efficiently to liberalized prices. Thus, the expanded tax bases promised by a more productive market economy have largely not been realized (see Sachs [1991] and Zou [1993]).

Figure 2 reports the contraction of the general tax bases, as measured by the gross domestic product (GDP). Compared to the peak in 1989, real GDP in 1992 has shrunk on average by about a quarter: 37.5 percent in Bulgaria; 22.6 percent in the former Czechoslovakia; 14.1 percent in Hungary; 18.1 percent in Poland; and 32.3 percent in Romania. To be sure, the extent of decline of output may be overstated because of measurement problems. It could be claimed that the pre-reform output was largely

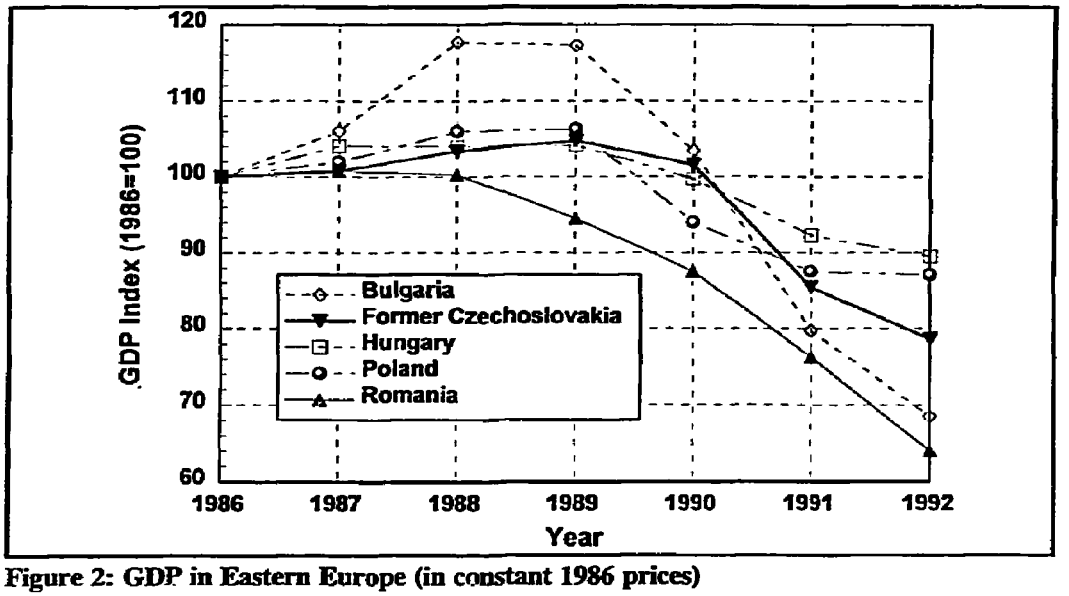

Figure 2: GDP in Eastern Europe (in constant 1986 prices)

inflated while the post-reform production is understated. For example, Berg [1993] estimated that real output decline in 1990 was more in the range of 7 to 8 percent rather the official 12 percent in some countries (a factor of 0.67). Despite the correction however, this is still a sizable drop for a single year.

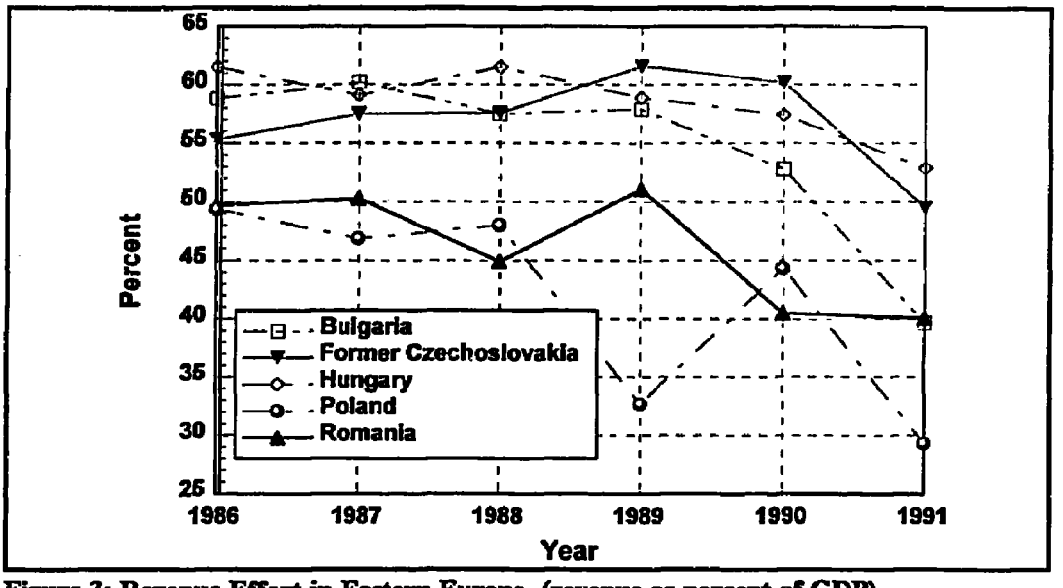

Figure 3: Revenue Effort in Eastern Europe (revenue as percent of GDP)

While the disintegration of traditional revenue bases accounted for much of the revenue problem, it did not explain all. The revenue effort in each country, as measured by a simple ratio of public revenue to GDP, suggested a significant decline in the overall collection performance as well (see Figure 3). The collection rate fell rapidly in a few years: from 60.2 percent (1987) to 34.2 percent (1992) in Bulgaria; 57.6 percent (1988) to 49.5 percent (1991) in the former Czechoslovakia; 61.5 percent (1988) to 52.9 percent (1991) in Hungary; 48.0 percent (1988) to 29.2 percent (1991) in Poland; and 51.1 percent (1989) to 40.1 percent (1991) in Romania.

The radical change in the underlying tax bases has engendered collection problems in several ways. Value added of services is rising as the distribution system is decentralized. The scale of enterprises is also shrinking as the service sector grows and as the large socialized enterprises are broken up and privatized.

The number of individual tax payers, including self-employed entrepreneurs, are therefore multiplying. These shifts to services, smaller enterprises, and individual tax payers will make it generally harder for the governments to collect taxes.

Hence, a significant factor is the organization of a new tax administration oriented towards collecting revenues from numerous private firms and individuals in the transitional economies. This is necessary because market-based taxes, unlike previous differentiated turnover taxes and discretionary profit remittances, need to be fixed, transparent, and enforceable on a decentralized market economy. Before the tax system become fully operative however, collection efforts suffer. Privatization, which encourages tax avoidance, also compounds the problem.

An important source of revenue, profit remittances from state enterprises, is being replaced by direct taxes which have uncertain revenue prospects. Where profits used to be transferred completely to the states in the socialist regime, only a portion can be claimed with the new corporate tax. Moreover, profits are falling in the transition and the share of profits going to interest payments - generally not taxed - may be increasing. In the attempt to spur the growth of private firms, governments in Eastern Europe have also given generous tax exemptions, e.g. to foreign investors.

The introduction of market-based indirect taxes also has required a shift away from very high turnover taxes to more reasonable and explicit tax rates.

2.2. Collapse of the CMEA Trade

The disintegration of exports to the CMEA region and its impact on output and public revenue is an important focus in the analysis. To model it correctly, the extent of decline is briefly reviewed here. Because of the problems of calculating the right exchange rates for the CMEA trade, it has been difficult

to assess the recent historical export performance in Eastern Europe. Figure 4 shows exports in 5 countries using preliminary estimates in Marer *et. al.* [1992] from 1986 to 1990, extrapolated to 1992 using data from the IMF *International Finance Statistics*. These figures are very tentative and should be used with care, specially the data points of 1991-92. Nevertheless, it is evident that - there was almost a total collapse of exports in Romania and a huge drop in Bulgaria; a smaller decline is registered in the former Czechoslovakia registered; and slightly better performance were reported in Poland and Hungary.

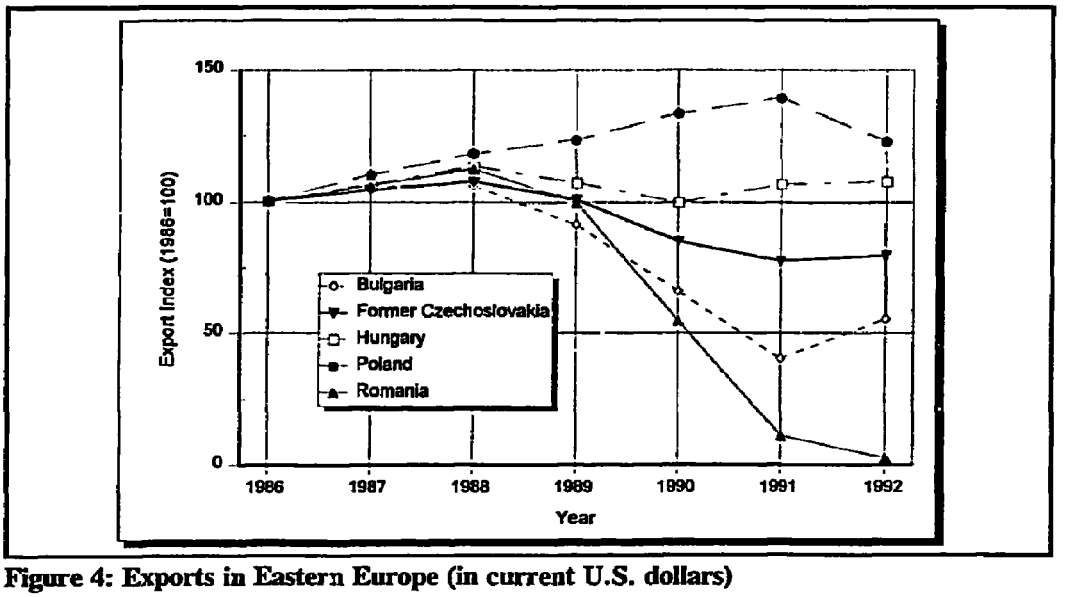

Figure 4: Exports in Eastern Europe (in current U.S. dollars)

Figure 5 displays the shares of CMEA trade in exports. The shares are generally and rapidly declining. The two countries having difficulties switching away from CMEA trade, Romania and Bulgaria, are also the ones experiencing the most difficulties in their total export performance. The share of CMEA exports still fell dramatically in the other countries: from 53% to about 5% in the case of Poland, 58% to 15% in Hungary, and 60% to 22% in the former Czechoslovakia. .

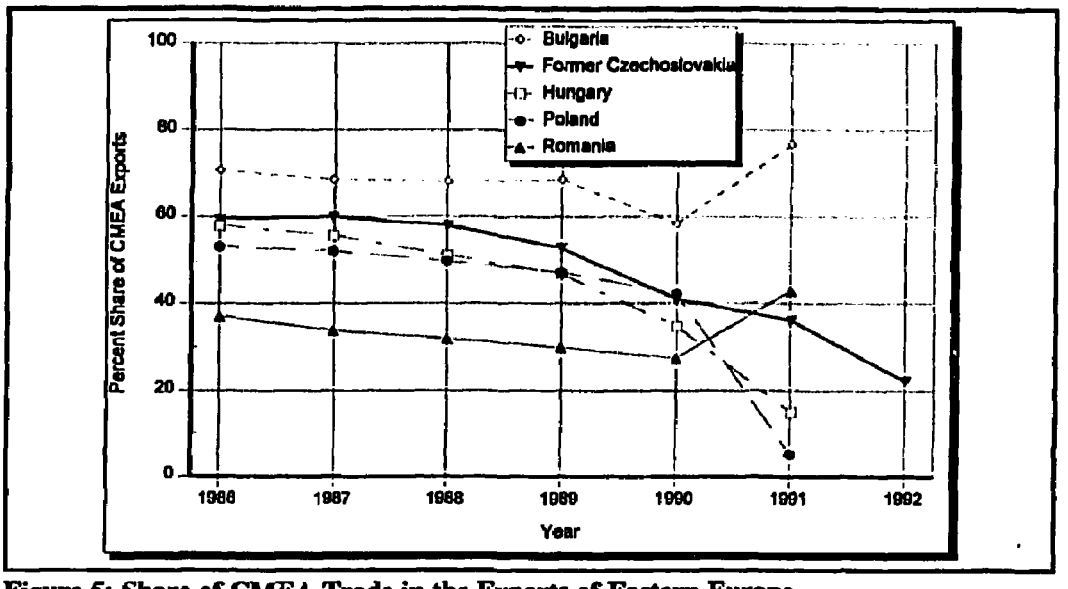

Figure 5: Share of CMEA Trade in the Exports of Eastern Europe

3. The Framework

Two elements are important in the analysis. First, given the severe data constraint in Eastern Europe, the framework (a tax model) needs to be simple in the sense that it makes use only of available national income accounts and revenue information, while capturing at the same time the minimum, essential features of an open economy. The model employed in this paper is a modified version of the 1-2-3 general equilibrium model presented in Devarajan, Lewis and Robinson [1990 and 1993]. It is a simple one-country, two-activity and three-commodity model. In the original setup, a single open economy engages in the production of two goods, a pure domestic good and a pure export good, with a constant elasticity of transformation between the two. The domestic good also competes with imports in the domestic market

but with an elasticity of substitution that is finite. The modified version adds features of a transitional economy (e.g. treatment of CMEA exports) and various taxes into the model.[3]

Second, to highlight revenue uncertainty and introduce risk analysis in the simulations, the framework permits the sampling of random variables pertaining to key parameters or exogenous shocks. The Monte Carlo method (as well as the Latin Hypercube technique) is employed as in Go and Sinko [1994].[4] Using this approach, alternative tax instruments and their revenue impact, encompassing many "what-if" scenarios, can be compared regarding the range of tax rates required - What is the most likely rate needed? What is the dispersion or variance? What are the relative welfare effects of different taxes? And what tax policy covers an acceptable risk?

The salient features of the framework are discussed below. To carry out the model, data from any Eastern European country may be used. Mainly because of data availability, a Czechoslovakia-like economy with 1989 as the base year is employed for illustrations (see Table 1). However, the conclusions are drawn and applied to transitional economies in general. A list of equations appears in the appendix. A reference such as `A2' means equation `2' in the list.

3.1. Production and CMEA Exports

To account for the importance of CMEA trade in the framework, gross output in the economy, GDP, is defined as the sum of exports to the CMEA region, exports to the rest of the world excluding

[3]Denizer and Gelb (1992) also use a simple general equilibrium framework with dualistic (rural-urban) structure to look at transformation issues in Mongolia.

[4]Go and Sinko [1994] implements Monte Carlo sampling method in a simple tax model of an open economy (Sri Lanka). A discussion of the statistical inference and confidence set in the context of CGE models and simulations when parameters are uncertain can be found in Abdelkhalek and Dufour (1993).

CMEA trade, and domestic goods (equation A1). CMEA exports, taken as exogenous, are important risk factors subject to uncertain market loss or price collapse. Their production has a set price and a fixed-coefficient technology of labor and capital, reflecting its non-market nature (equation A2-A3). Net output, defined as GDP less CMEA exports, is a CES function of primary inputs and is dependent on output and input prices (equation A4-A6). The production of net output must also be allocated between domestic goods and non-traditional exports (rest of the world) based on a constant elasticity of transformation (equation A8-A10).

In the setup, a fall in CMEA exports releases labor and will lead to a fall in real wage in order to maintain employment (equation A7). Prices of net output and domestic goods will fall. Net output shifts outward, absorbing excess labor and increasing non-traditional exports (Figure 6). The extent of the shift and how much new exports will grow depend on how much of the freed resources are reallocated, the relative price of domestic goods and exports, and the CET elasticity. However, even if net output increases, GDP may still fall because the installed capital used in the production of CMEA exports is fixed.

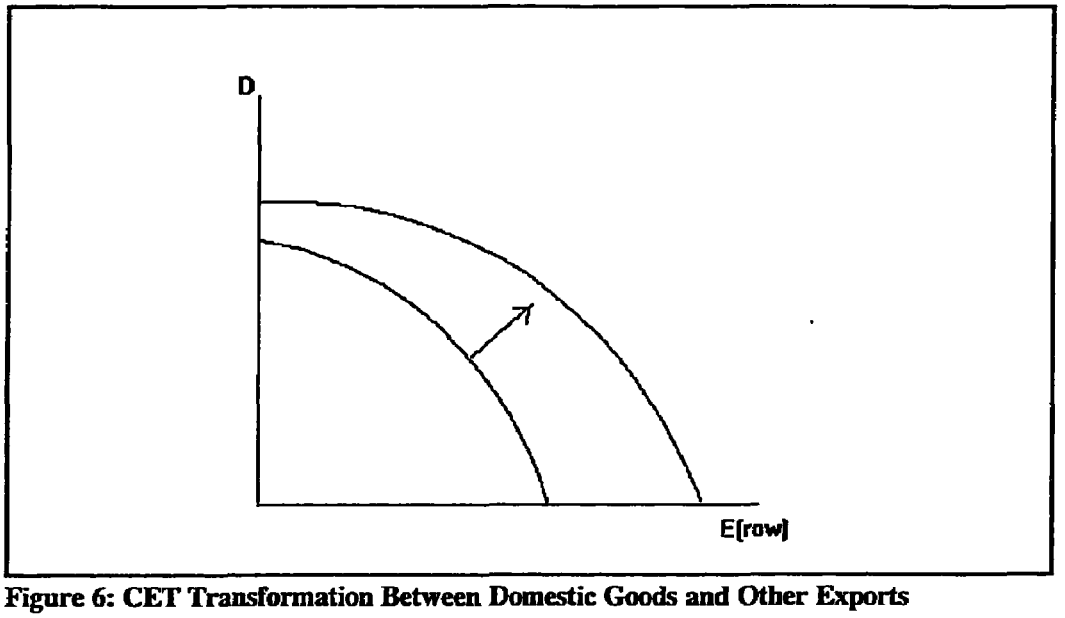

Figure 6: CET Transformation Between Domestic Goods and Other Exports

Redistributing that capital mimics the effects of privatizing assets, i.e. making them productive again.[5] Alternatively, it is possible to postulate that some of the lost output is prolonged and supported (hoarded?) by government out of social concerns, thus indirectly subsidizing wage earners and socialized enterprises with the prospects of a runaway fiscal deficit.

3.2. Taxes and The Rest of the Model

Tax revenue consists of the major types of direct and indirect taxes - domestic indirect taxes (sales/excise/VAT), import tariffs, export duties, payroll tax, income tax on capital and other income. The rest of the framework follows the standard 1-2-3 design. Imperfect substitution characterizes the competition between domestic goods and imports. This is reflected in the CES (Armington) function between domestic goods and imports (equation A11-A13). The CMEA shock on the import side may be addressed by a rise in import prices. Personal income is the total of factor income (net of tax) from labor and capital plus transfers from the government and abroad (equation A14). A simple Keynesian-type consumption function defines consumption at market prices (inclusive of sales tax) as a fixed proportion of personal income after tax (equation A15). Current account balance (equation A16) is the residual of imports less exports at world prices, adjusted for grants and remittances from abroad. Domestic demand (equation A17) consists of private consumption, investment, and government consumption. Public savings are endogenously determined in the government budget (equation A19) as the balance of tax revenues (equation A18) plus foreign grants (exogenous) less government consumption (exogenous) and transfer to the household (exogenous). By Walras' law, the savings-investment identity ($I = Sp + Sg + Sf$) is implied

[5]If data are available, output can also be distinguished in terms of socialized and private enterprises so that the effects of privatization can be looked at more directly. It will not change the qualitative results of the paper however.

by the above equations. Foreign savings (Sf = eB) are presently fixed, so that the model is savings-driven.[6]

3.3. Risk Factors

Each uncertainty is defined by a normal probability distribution, $N(\mu,\sigma,min, max)$, with mean μ and standard deviation σ.[7] The distribution is truncated with a minimum (*min*) and a maximum (*max*) limit to rule out extreme and infeasible values. Several sources of risk can be defined in the framework:

1) *Key parameters* like the trade elasticities: A high CET elasticity, for example, corresponds to a more responsive and greater capacity to export when relative price are more attractive. The elasticity of substitution between domestic goods and imports is another potential risk factor. A value of less than one implies that the real exchange rate will depreciate during an import price shock so that additional exports are encouraged to pay for the more expensive imports. This is usually the case in developing countries and may be the case in transitional economies (see Devarajan *et. al.* [1993].)

2) *Exogenous shocks* like the collapse of the CMEA markets and the rise in import prices as described above.

3) *Adjustment cost* in moving assets from the declining sector to the rest of the economy.[8]

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[6] The nominal exchange rate (fixed at 1.00), hence implicitly the world prices of foreign goods, is the numeraire in the model.

[7] Other probability distributions, such as log-normal, uniform, poisson, beta etc., are also possible.

[8] Another possible risk factor is the collection problem associated with the introduction of market-base taxes during the transition. This factor will create a wedge between statutory and effective taxes but may not add to the analysis. For this reason, it is not included in the simulations. It should be understood that tax rates in the simulations refer to collection rates.

4. Simulations

4.1. Trade Shocks

The first experiment deals with two uncertain trade shocks - a sharp decline in CMEA exports and an increase in import prices. CMEA exports are expected to decrease from 21 percent of GDP at factor prices to 10 percent - a market loss of about half the original size. This market loss may vary by a standard deviation of 0.025 (1/4 of the expected value). Its range has an upper limit equivalent to the base year level (not permitted to rise) and a lower bound equivalent to 5 percent of GDP, i.e., N(0.10, 0.025, 0.05, 0.21). Import prices (base year = 0.95) are expected to rise by 30% with a maximum and minimum gain of 47% and 21%, respectively, i.e., N(1.24, 0.05, 1.15, 1.40). These shocks are comparable to those observed in the Section 2.2.

In addition to the trade shocks, economic responses as defined by the trade and output elasticities also vary. The parameters chosen are generally on the low side, reflecting the economic rigidity of a transitional economy in reallocating resources: the elasticity of transformation between domestic goods and exports is assumed to be N(0.50, 0.02, 0.30, 0.90); the elasticity of substitution between domestic goods and imports is defined as N(0.80, 0.02, 0.50, 1.10); and, the elasticity of substitution between labor and capital in net output is N(0.60, 0.02, 0.30, 0.90).

Monte Carlo sampling is used to draw good distributions of the risk factors. About 300 iterations and simulations are made. In each iteration, values of the shocks and parameters are sampled randomly from the above probability distributions and a solution is computed. The results for key variables are reported in Table 2, which shows their expected levels, standard deviations, and various percentile values.

The experiment mimics the collapse of CMEA trade in a changing environment. The pattern of

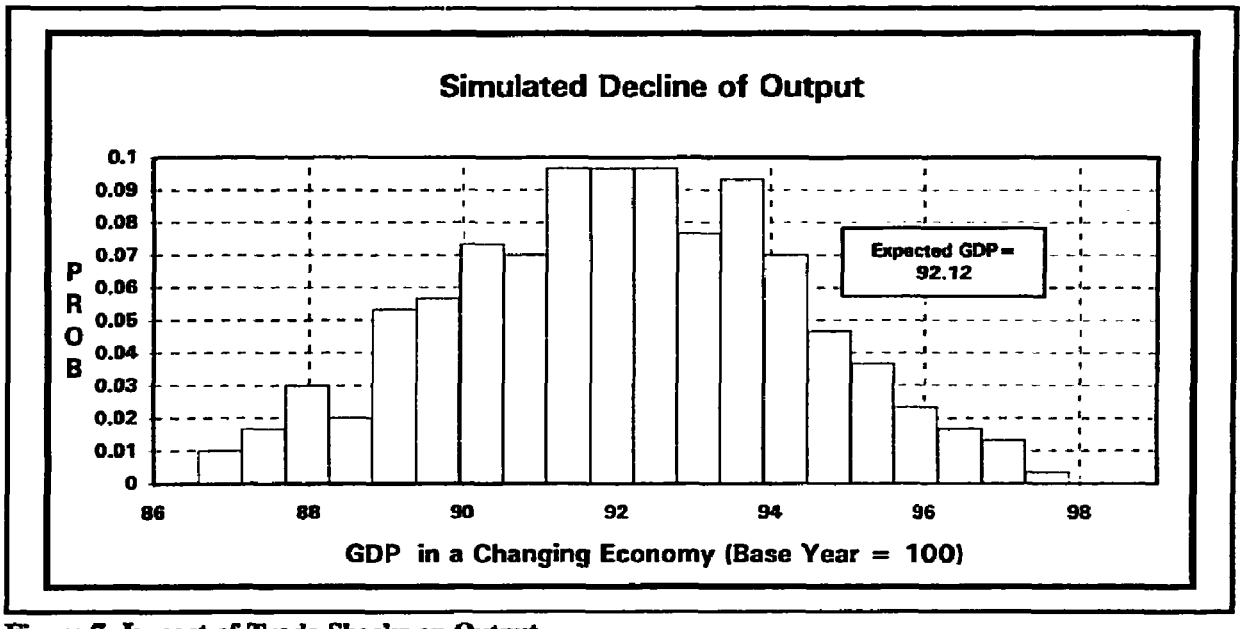

Figure 7: Impact of Trade Shocks on Output

output and revenue decline in Eastern Europe is duplicated in Figure 7 and 8, respectively. Real output is expected to decline by about 8 % (μ). Tax revenue, on the other hand, is expected to fall by 22 % (μ).[9]

The effects of uncertainty in the outcomes are reflected in several ways. A straightforward statistical interpretation indicate that the risk of output deviating $\pm$ 2.2 percentage points (one standard deviation) around the mean is 68.3 percent. The chance of output declining anywhere between 8 to 14 percent (bottom half of the distribution) is 50 percent. The average deviation of the revenue fall is higher than output. The likelihood of revenue falling by $\pm$ 4.2 percentage points (1σ) around the expectation is about two-third and by $\pm$ 8.4 percentage points (2σ) is about 95%. There is an even risk that tax revenue may fall from 22 to 31 percent.

The scenario above assumes that real wage is flexible and labor is free to move from the collapsing sector to the rest of the economy. This assumption leads to the following - net output will increase by 7.8 percent (μ) $\pm$ 1.6 percent (σ) while exports to non-CMEA region will rise by as much 21.8 percent (μ)

[9]Tax revenue is reported in real terms. See Section 4.2, Case I, for definition and discussion.

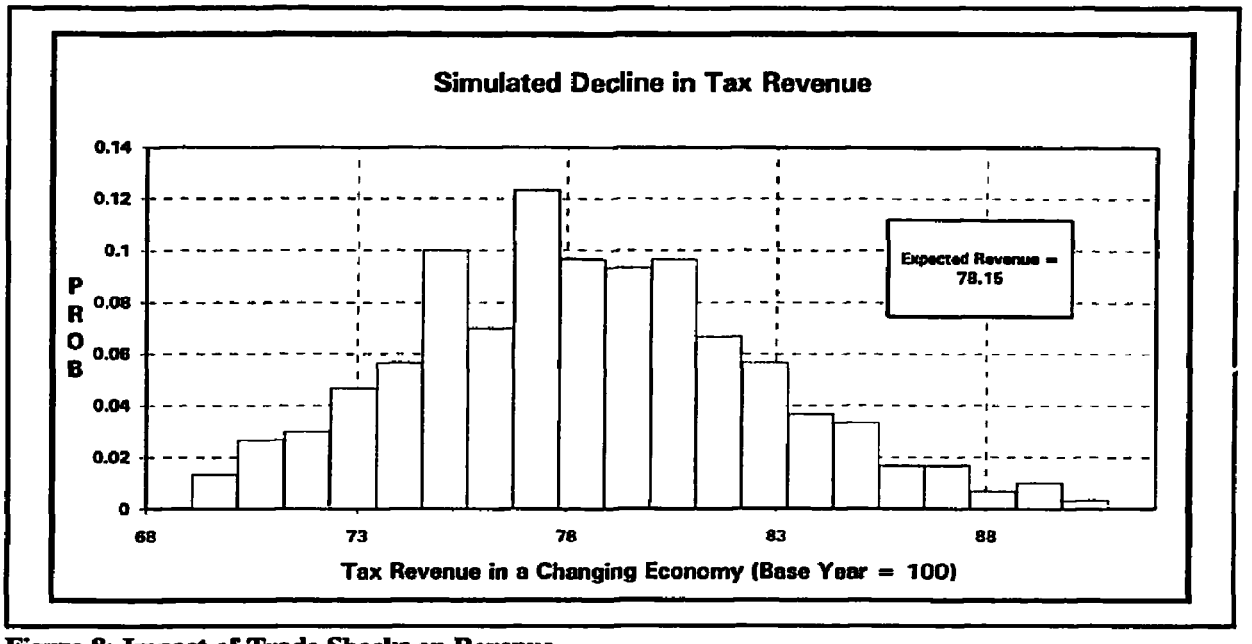

Figure 8: Impact of Trade Shocks on Revenue

± 4.4 percent (σ). If the assumption is to be violated, the rise in net output and other exports may be reversed; the fall in GDP and tax revenue will be much more than reported.

The scenario assumes conservatively that exports to the CMEA region will shrink by half. If the collapse of the CMEA trade is near total, the expected fall in real GDP can reach 18% in magnitude. Consumption and investment will contract on average by 16% and 49%, respectively. Such a general breakdown of tax bases can lead to a 38% fall in tax revenue. Hence, raising revenue remains a critical problem in transitional economies.

4.2. Which Tax to Raise?

What if the government tries to raise or maintain revenue? Which tax instrument is better in an uncertain world? The once-off systemic change in Eastern Europe will eventually require a new, market-based tax system. However, introducing a market system is a slow process and not all reforms can be

implemented at once due to legislative, political, administrative, and other institutional bottlenecks. Because of the serious revenue problem in the transition, governments have to view and sequence prospective reforms by their short-term impact on revenue as well. Abstracting from the institutional issues and assuming that the current revenue structure can be converted to market-based taxes without problems, this section examines three types of taxes - domestic indirect tax (e.g. sales/excise/VAT), import tariff, and capital income tax - under three reasonable possibilities. In the first case, the government tries to maintain revenue by fine tuning individual taxes in response to the shocks. In the second case, the government has to set tax policy in advance and guesses correctly the distributions of the shocks and parameters; however, it uses an alternative but commonly-used revenue target, the tax-to-GDP ratio. In the third case, the government guesses wrong.

Case I: The Government Maintains Revenue

In an economy experiencing severe trade shocks, what is the appropriate revenue target (R)? The open-economy framework used here takes the nominal exchange rate (er) as the price anchor and defines real revenue as R/er. Thus, maintaining revenue or equal yield means keeping this ratio constant (at the base year level). Since the model deals only with relative prices and keeps er fixed (i.e., no nominal inflation), maintaining revenue should be interpreted to mean that revenue is keeping pace with nominal devaluations of the exchange rate. To compare taxes, a broad indication of welfare is aggregate consumption. This is because the framework is a static one (no dynamic decision on savings) and all income (after fixed rates of sales tax and savings) is consumed on one aggregate good. Investment, which is driven by available savings, is also affected by the uncertain public revenue. The main findings (presented as $\mu \pm \sigma$) regarding the distribution of tax revenue, consumption, and investment are

summarized below:[10]

Case I: Maintaining Revenue

Tax Instrument	Ave. Tax Rate	Consumption	Investment
1) Dom. Indirect Tax (22.0)*	39.2 ± 4.1	77.5 ± 3.3	80.9 ± 2.6
2) Import Tariff (6.0)*	31.1 ± 6.4	83.4 ± 2.2	71.6 ± 3.5
3) Capital Income Tax (32.0)*	72.8 ± 9.8	73.9 ± 4.5	85.9 ± 2.8
Base-Year Level		100	100

*Figures in parenthesis refer to tax rates in the base year.

The tax rate needed is quite high for each instrument. For example, the expected rate of domestic indirect taxation is 39.2 percent (an increase of 78.2 percent); 31.1 percent for import tariffs (an increase of 4.9 times from the low base); and about 73 percent for capital income tax (an increase of 2.3 times).

The variation around the expected rate is substantial, ranging from 4.1 to 9.8 percentage points. The highest variance is in the capital income tax, which also has the highest expected tax rate. To be able to cover 95 percent of the revenue contingencies, the average rate of corporate tax will have to be raised by two standard deviation, which, at the tax rate of 92.4 percent however, is extremely high. Import tariffs has the next highest variance but the lowest expected rate. Even at one standard deviation higher than the mean, the average import tariff (at 37.5 percent) is lower than the expected rate of domestic indirect taxes. Normally, one would expect that domestic indirect taxes would be lower because of the broader base in the domestic market. Here, a 40 percent sales/VAT rate, or the 47 to 50 tax needed for a 95 percent likelihood, is very high indeed.

[10]Table 3 to 5 in the appendix present the results in greater details.

The effects on consumption has a similar story. Import tariffs cause the least decline in consumption, followed by domestic indirect taxes, and capital income taxes.[11] The impact on investment, on the other hand, is the reverse of consumption because, in part, with less consumption more savings are invested. The effects on revenue and consumption seem to suggest that import tariffs are good *temporary* tax measures. Such a recommendation is made by McKinnon [1991]. If collection problems are allowed to raise the nominal rates,[12] McKinnon's suggestion of a cascading tariff with a top rate of 100 percent, to be gradually brought down to a uniform and low rate over 5 years, seems within range and reasonable.

The pattern of results points to tax issues peculiar to transitional economies. Two factors are critical: the trade shocks and the choice of Armington elasticity. The collapse of the CMEA exports reduces the base of domestic taxation by its deflationary impact on output, domestic prices, and factor prices. The import price shock when combined with an Armington elasticity of less than one (because of its plausibility in transitional economies) also tends to reinforce this effect. Figure 9, for example, illustrates the impact of a 10% import price shock on the rate of change in domestic prices, $\hat{P}_D$, with alternative Armington elasticity, σ, and CET elasticity, Ω, in a 1-2-3 framework.[13] The fall in domestic prices relative to world prices is an indication that the real exhange rate must fall in the transition so that output switching can occur and non-CMEA exports can be pushed while keeping the current account balance from deteriorating. Under the circumstances, import tariffs are favored to maintain real revenue

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[11]Although strictly not comparable, the average consumption in simulation 1 (the no tax case) is 88.3 with a standard deviation of 1.4.

[12]It is possible to add less than 100 percent collection rates for various taxes in the framework. This may change the nominal rates of taxes but will not affect the results.

[13]Disregarding taxes, the underlying relationship is $\hat{P}_D = \hat{\pi}_m \cdot \frac{(\sigma-1)}{(\sigma+\Omega)}$, where $\hat{\pi}_m$ is the change in import prices. See Devarajan, Lewis, and Robinson (1990 & 1993) for the algebraic derivation and discussion.

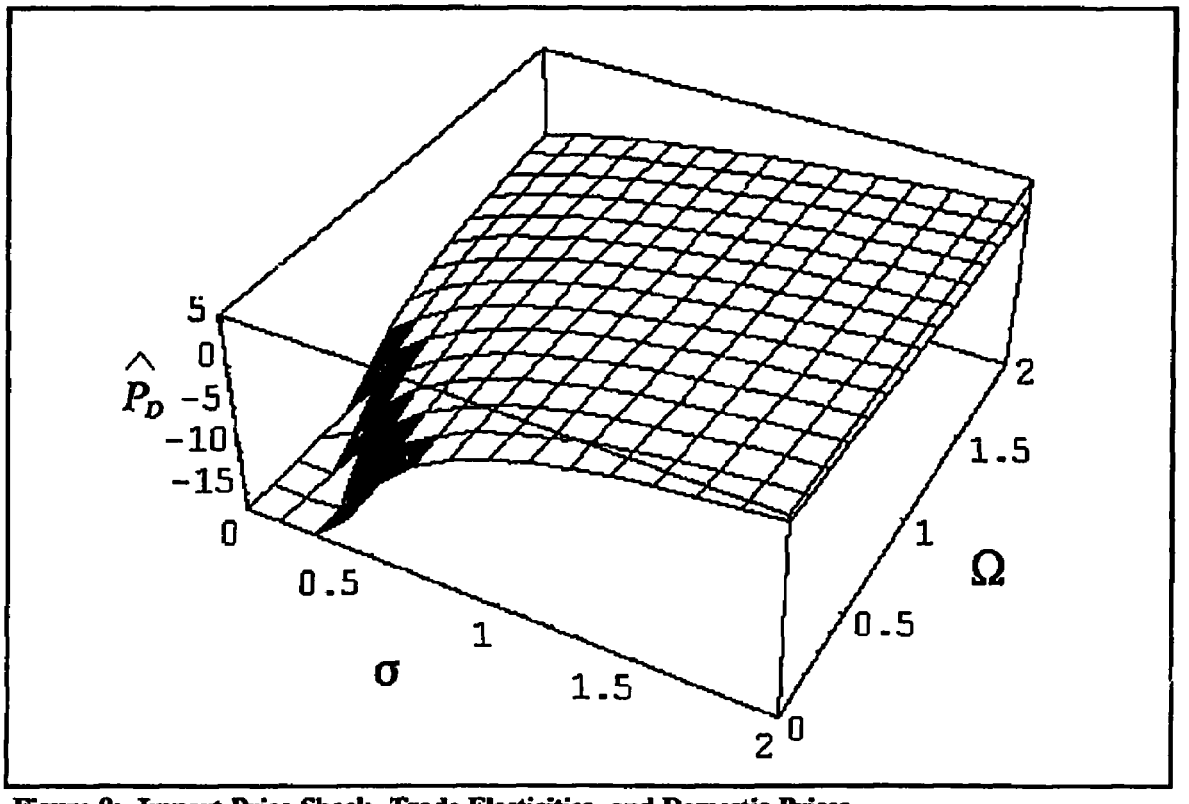

Figure 9: Import Price Shock, Trade Elasticities, and Domestic Prices

defined in dollar terms (price anchor). The traditional corporate tax base, i.e., profits of state-owned enterprises, is shrinking so rapidly that any attempt to restore revenue from this source will require excessive taxation. Likewise, the fall in output and domestic prices diminishes the revenue potential of domestic indirect taxes. Moreover, import tariffs provide at the margin some protection of factor income from the contractionary impact of trade shocks; hence, it will allow for greater consumption relative to domestic taxes, which either reduce consumption directly (direct taxes) or indirectly by increasing the cost of consumption (domestic indirect taxes).

The above result is striking in the sense that, without bringing in the issue of administrative ease, imports tariffs are still favored because of the type of shocks and trade elasticities postulated in the transition. Note that this is not an argument for imposing high and permanent import tariffs, which have become synonymous with excessive protection, inefficient production, and rent-seeking behavior. In the

long run, other factors become important: market orientation may finally take hold and supply, operating more responsively to price signals, can expand rapidly. In that situation, domestic taxes will tend to have a broader base and greater efficiency in generating revenue. Until the immense erosion of domestic tax bases are reversed, however, import tariffs can play a vital role.

Case II: The Government Guesses Correctly

In this experiment, the government needs to prepare tax legislation in advance but does so with correct expectations. Tax policy, which can only be defined once and at a single rate, is set at the expected values of the shocks and parameters. However, there are risks around the expected shocks and parameters. The issue is whether such variation may generate effects that favor certain taxes: some taxes may be more stable (e.g. in revenue); the expected revenue may be different when risks are introduced (i.e., the relationships are highly non-linear.) In addition, the government looks at another revenue target, the tax-to-GDP ratio, and plans to raise the ratio by 5 percentage points from 59.2 percent in the base year to 64.2 percent. Using expected values of the shocks and parameters as defined in Section 4.1, the tax rate required are as follows: domestic indirect taxes need to be changed from 22.0% in the base year to 25.7 %; import tariffs, from 6.0 % to 13.5 %; capital income tax, from 31.7 % to 40.3 %. Fixing each new tax rate in turn, the risk factors are introduced altogether and simulations are conducted repeatedly using Monte Carlo sampling.

The results, shown below, indicate that consumption is slightly higher in the import-tariff case. Hence, investment is also less with reduced savings when compared to the other two tax instruments. However, the differences are numerically small. This is also true the revenue target - the tax/GDP ratio. The results are generally stable when the Monte Carlo sampling is increased from 300 to 500 iterations.

Thus, when the government formulates its fiscal policy with correct expectations, it appears that it does not matter which tax instrument is chosen.

Case II: The Government Guesses Correctly

Tax Instrument	Tax/GDP	Consumption	Investment
1) Dom. Indirect Tax	64.69 ± 0.15	85.71 ± 1.36	69.38 ± 4.38
2) Import Tariff	64.25 ± 0.19	86.58 ± 1.36	67.89 ± 4.23
3) Capital Income Tax	64.23 ± 0.18	85.21 ± 1.37	69.98 ± 4.44
Memo: Base-Year Level	59.24	100	100

However, the tax-to-GDP ratio is a misleading revenue target when the tax base is shrinking. In fact, real revenue as measured by ***Rev/er*** is (82.8 ± 4.1) for domestic indirect taxes, (85.0 ± 4.6) for import tariffs, and (82..8 ± 4.4) for capital income tax. While the increased tax efforts as measured by the tax-to-GDP ratios are attained, real revenue levels in terms of ***Rev/er*** are significantly below the base-year 100 but higher than the 78.14 in the no tax policy case in Section 4.1. Moreover, import tariffs still appear better in generating real revenue. On the other hand, if ***Rev/er*** is the target instead and held fixed, the tax-to-GDP ratios will vary. Hence, it does matter which revenue target is used.

Case III: The Government is Overly Optimistic

Achieving a particular tax-to-GDP ratio or a real revenue target as in Case II requires absolutely correct expectations - not just of real GDP, but also about the external shocks, the responsiveness of the

economy, and how they may affect relative prices (e.g. the real exchange rates between domestic and foreign goods), and various components of GDP that utimately determine revenue generation by individual tax instruments. This is often a heroic assumption. Governments in Eastern Europe are confronted by pressing reforms in all fronts and are just learning GDP accounting properly. What if simplistic and wrong assumptions are made in the budgetary preparations? Do import tariffs minimize the downside risks relative to other taxes?

Take the case in which the government anticipates the external shocks correctly but the economy is less responsive that what government originally expected. In particular, Case II is repeated: the government formulates the same tax policy given the same expectations about the shocks and parameters; however, except for the Armington elasticity, all expectations are correct; the correct Armington elasticity is only half of what is anticipated and has greater standard deviation. i.e., σ is changed from N(0.80, 0.02, 0.50, 1.10) to N(0.40, 0.05, 0.25, 0.90). The results are summarized as follows:

Case III: The Government is Overly Optimistic

Tax Instrument	Tax/GDP	Rev/er	Consumption	Investment
1) Dom. Indirect Tax	65.21 ± 0.29	72.51 ± 4.84	83.99 ± 1.64	65.12 ± 5.25
2) Import Tariff	64.23 ± 0.20	74.62 ± 4.81	84.51 ± 1.78	64.26 ± 5.38
3) Capital Income Tax	65.28 ± 0.32	72.08 ± 4.80	83.49 ± 1.61	65.83 ± 5.30
Memo: Base-Year Level	59.24	100	100	100

The tax-to-GDP ratios are similar to those in Case II. The results suggest that the target of raising the ratio by 5 percentage points is still achievable and appear comparable for alternative tax instruments.

As in Case II however, the tax-to-GDP ratios do not reflect the underlying and severe changes in the economy. Real revenues in fact are now all lower than in Case II. Morever, import taxes still do better. Consumption levels are also down but less with imports. Investment, driven by savings, have the reverse story like in Case II. In all variables, the risks or standard deviations are higher.

Another source of possible error is the government's forecasts about the external shocks. For example, if the collapse of the CMEA exports and the rise in import prices turn out to be higher, e.g. near 80% and 60%, respectively (instead of the projected 50% and 30%, respectively) and everything else the same as above, real revenue will fall to much lower levels but with less decline in the import-tariff case: 59.1 in the domestic indirect tax case; 61.4, import tariffs; 59.2, capital income tax.

4.3. Downsizing the State Sector

The simulations so far sidestrack some fundamental questions - Whether public expenditures in transitional economies are already `optimal'? Whether they should be at all financed by high taxes? And whether other measures, such as privatization, will help? These issues are examined next.

The extremely high tax-to-GDP ratios resulting from keeping the current revenue structure instantly confirm that tax policy should never be divorced from the expenditure function of government. As the former socialist countries move towards market-oriented economies, public expenditures also need to be examined, cut back, and restructured. Any attempt to finance current levels is not sustainable and will only lead to reasonably high taxes, as demonstrated above. One single item like government transfers and subsidies, for example, can take up 45 % of gross value added at factor prices (see Table 1.) Just eliminating a third of the revenue demanded for that item alone, even while giving up non-tax revenue, will reduce the required tariff rate in Case I from 31.1 % to a much lower 8 %.

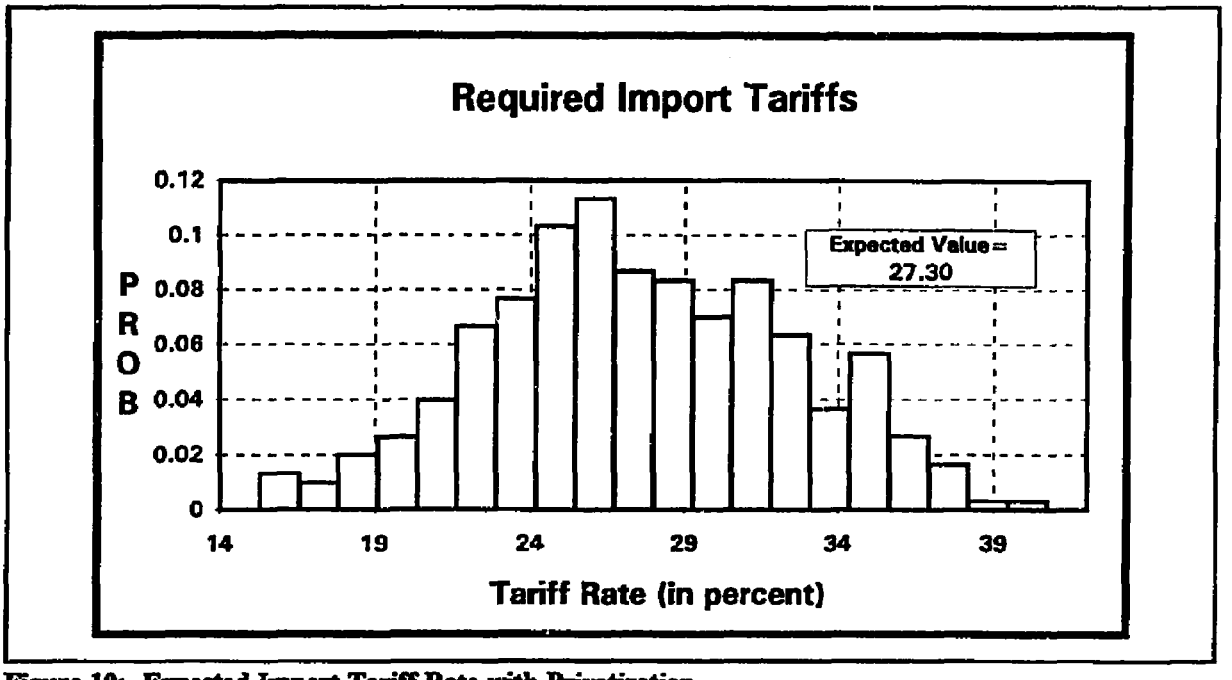

Figure 10: Expected Import Tariff Rate with Privatization

No less important is to move assets out of the collapsing sector, privatizing and making them productive again (see, for example, Blanchard *et. al.* [1991]). The next experiment shows that even if there are substantial but uncertain adjustment costs in the order of 25 % with a standard deviation of 10 %, the benefits of `privatizing' assets quickly are still substantial (at least the portion associated with the output loss). The resulting expansion of the market base will reduce the imposition of additional taxes. [14] Looking at the tariff instrument again, Figure 10 shows the distribution of the tax rate with such a privatization scheme; the average rate falls to 27.3 percent. It should be recalled that the starting point of this result is the expectation that the CMEA market will shrink by only 50 percent, a very conservative scenario. If the loss is total and if, in addition, a significant portion of output from socialized enterprises cannot be sold in the domestic market, then the gains of privatization will considerably be more. Since

[14]It is entirely possible that privatization will not lead to an expnasion of the tax base initially because of collection and evasion problems. Such possibility reemphasizes the need for temporay tax measures like an import surcharge.

privatization is intricately associated with the reduction of government subsidies, their combined effects on public finance further make the issue of reducing the state sector critical.

5. Conclusions

The purpose of this paper is to formulate a framework for making revenue assessments and for examining alternative tax instruments in a changing environment. The model is used to explain much of the output and revenue fall in transitional economies. The terms-of-trade shocks from the collapse of the CMEA trade as well as the rigid but uncertain economic responses in transitional economies are all important factors.

Insofar as a new tax system will take time to institute and revenue is critical in the transition, the results indicate that import tariffs are more effective than other traditional tax instruments in raising revenue, especially if real revenue is defined in dollars terms (the price anchor). The contraction in domestic output and prices and the devaluation of the real exchange rate needed in the transition are significant reasons that favor imports as a tax base over other revenue sources. To emphasize the transitory nature and reversibility of the policy recommendation, import tariffs should be implemented in the form of a temporary, uniform, import surcharge.

The above conclusion seems to hold whether the government formulates tax policy with correct or incorrect expectations. The choice of revenue target, however, matters. All tax instruments will do almost equally well if the commonly used tax-to-GDP ratio is the target. It is a misleading measure, however, since the ratio does not reflect the immense erosion of domestic tax bases in the economy and how real revenue in absolute level may actually be decreasing rapidly as a result.

The revenue problem and uncertainty can also be viewed as a necessity towards downsizing the

large state sector from the previous control economy and as a consequence of redirecting trade away from former non-market partners. Hence, the results emphasized that restoring revenue should never lead to maintaining subsidies towards non-profitable state enterprises or other public expenditures no longer relevant in a market system. Doing so will only lead to unreasonably high taxation. The outcome hinted at the importance of privatization in expanding the tax base and reorienting or cutting public expenditures. Furthermore, policy uncertainty, i.e., the likelihood of success (or reversal) and the credibility of reform, although not examined here, is an important risk factor by itself. Some of these issues are best investigated further in a dynamic stochastic framework. Future research will examine policy uncertainty, privatization, and the likelihood of reform success as determinants and risk factors in investment and growth.

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	Bil. Kcs.	Output=1
1 National Accounts		
Output (Value Added)	840.46	1.00
Wages	479.06	0.57
GDP at market prices	977.76	1.16
Private Consumption	390.14	0.46
Public Consumption	253.94	0.30
Investment	292.00	0.35
Exports	371.25	0.44
Imports	329.57	0.39
2 Tax Revenue		
Sales & Excise Tax	125.80	0.15
Import Tariffs	11.50	0.01
Export Duties	0.00	0.00
Payroll Tax	107.20	0.13
Personal Income Tax	59.00	0.07
Capital Income Tax	137.00	0.16
Total	440.50	0.52

	Bil. Kcs.	Output=1
3 Fiscal Account		
Revenue	484.10	0.58
NonTax	37.90	0.05
Current Expenditure	443.90	0.53
Goods & Services	253.94	0.30
Interest Payments	22.07	0.03
Transfers & Subsidies	167.93	0.20
Capital Expenditure	61.60	0.07
Fiscal Balance	-21.40	-0.03
4 Balance of Payments		
Exports - Imports	41.68	0.05
Net Profits & Dividends	0.00	0.00
Interest Payments	0.00	0.00
Net Private Transfers	0.00	0.00
Net Official Transfers	-14.91	-0.02
Current Account Balance	26.77	0.03
External Debt	324.52	0.39
Debt Service Payments	50.03	0.06

Table 1: Data of the Former Czechoslovakia, 1989

Table 2: Terms-of-Trade Shocks

Simulation Statistics (Base Year = 100%)								
Iterations: 300								
Variable:	GDP	Exports (other)	Domestic Good	Imports	Net Output	Consump-tion	Invest-ment	Tax Revenue
Minimum =	86.80%	109.53%	100.63%	54.03%	102.91%	84.70%	54.95%	68.83%
Maximum =	97.76%	133.12%	103.35%	73.98%	110.96%	91.93%	76.77%	90.71%
Mean =	92.12%	121.83%	102.24%	62.69%	107.68%	88.27%	65.82%	78.15%
Std Deviation =	2.17%	4.37%	0.43%	3.70%	1.56%	1.37%	4.21%	4.17%
Variance =	0.05%	0.19%	0.00%	0.14%	0.02%	0.02%	0.18%	0.17%
Skewness =	-4.57%	-15.62%	-41.49%	11.34%	-26.86%	-7.24%	-7.88%	24.26%
Kurtosis =	258.57%	276.69%	327.32%	261.11%	275.40%	258.18%	255.60%	278.35%
Percentile Values								
6Perc =	88.39%	114.35%	101.52%	56.75%	104.96%	86.03%	59.13%	71.38%
10Perc =	89.23%	116.40%	101.69%	57.89%	105.62%	86.39%	60.02%	72.84%
15Perc =	89.79%	117.37%	101.79%	58.91%	106.01%	86.81%	61.15%	73.84%
20Perc =	90.19%	118.24%	101.85%	59.54%	106.37%	87.05%	62.06%	74.53%
25Perc =	90.52%	118.95%	101.96%	60.03%	106.64%	87.35%	62.95%	74.97%
30Perc =	90.91%	119.62%	102.02%	60.52%	106.88%	87.52%	63.61%	75.69%
35Perc =	91.30%	120.20%	102.09%	60.98%	107.10%	87.70%	64.10%	76.51%
40Perc =	91.59%	120.66%	102.15%	61.33%	107.33%	87.82%	64.53%	76.99%
45Perc =	91.88%	121.27%	102.24%	62.01%	107.54%	88.04%	65.10%	77.41%
50Perc =	92.22%	121.93%	102.28%	62.55%	107.75%	88.31%	65.73%	77.88%
55Perc =	92.40%	122.63%	102.33%	63.07%	107.95%	88.50%	66.57%	78.47%
60Perc =	92.71%	123.03%	102.40%	63.65%	108.14%	88.63%	67.01%	79.06%
65Perc =	92.99%	123.52%	102.43%	64.18%	108.36%	88.83%	67.45%	79.53%
70Perc =	93.38%	124.26%	102.47%	64.73%	108.56%	89.08%	68.42%	80.34%
75Perc =	93.64%	125.13%	102.53%	65.36%	108.80%	89.24%	68.94%	80.82%
80Perc =	93.99%	125.64%	102.61%	65.93%	109.04%	89.52%	69.70%	81.64%
85Perc =	94.40%	126.33%	102.68%	66.69%	109.34%	89.65%	70.11%	82.43%
90Perc =	94.92%	127.39%	102.76%	67.26%	109.68%	90.05%	71.25%	83.55%
95Perc =	95.61%	128.97%	102.88%	69.14%	110.12%	90.51%	72.72%	85.28%

Table 3: Raising Revenue from Sales Tax (Revenue-Neutral Simulation)

Simulation Statistics (Base Year = 100% except Sales Tax)
Iterations: 300

Variable:	GDP	Net Output	Exports	Domestic Good	Imports	Consumption	Investment	PD	Sales Tax Rate
Minimum =	86.83%	109.67%	109.03%	100.34%	52.66%	69.55%	73.34%	60.13%	28.06%
Maximum =	98.01%	129.89%	132.59%	103.34%	74.39%	87.39%	85.97%	85.07%	50.16%
Mean =	92.12%	120.72%	121.80%	102.27%	62.71%	77.46%	80.88%	70.69%	39.25%
Std Deviation =	2.14%	3.76%	4.29%	0.44%	3.66%	3.32%	2.57%	4.58%	4.15%
Variance =	0.05%	0.14%	0.18%	0.00%	0.13%	0.11%	0.07%	0.21%	0.17%
Skewness =	-2.71%	-19.92%	-15.62%	-56.59%	3.52%	8.34%	-30.10%	33.75%	3.60%
Kurtosis =	261.41%	279.59%	274.53%	382.59%	289.08%	277.06%	273.66%	292.56%	267.23%
Percentile Values									
5Perc =	88.46%	114.15%	114.64%	101.49%	56.82%	71.97%	76.24%	63.15%	32.35%
10Perc =	89.23%	115.55%	116.26%	101.69%	57.83%	73.17%	77.57%	64.89%	33.80%
15Perc =	89.82%	116.76%	116.98%	101.82%	58.84%	74.01%	78.18%	65.92%	34.83%
20Perc =	90.26%	117.58%	118.10%	101.90%	59.63%	74.38%	78.67%	66.88%	35.79%
25Perc =	90.70%	118.08%	118.87%	102.00%	60.01%	75.22%	79.12%	67.56%	36.27%
30Perc =	90.93%	118.61%	119.41%	102.06%	60.53%	75.60%	79.48%	68.07%	36.90%
35Perc =	91.28%	119.43%	120.29%	102.15%	61.23%	76.15%	79.84%	68.91%	37.58%
40Perc =	91.55%	119.96%	120.91%	102.21%	61.79%	76.45%	80.29%	69.20%	38.18%
45Perc =	91.87%	120.52%	121.45%	102.27%	62.20%	76.99%	80.63%	69.66%	38.64%
50Perc =	92.11%	121.04%	121.97%	102.30%	62.71%	77.50%	81.03%	70.18%	39.37%
55Perc =	92.43%	121.45%	122.51%	102.37%	63.31%	77.76%	81.32%	70.76%	39.73%
60Perc =	92.68%	121.85%	122.86%	102.41%	63.64%	77.98%	81.68%	71.50%	40.23%
65Perc =	93.06%	122.08%	123.50%	102.45%	64.26%	78.65%	82.05%	72.13%	40.92%
70Perc =	93.37%	122.80%	124.03%	102.50%	64.90%	79.43%	82.43%	73.08%	41.35%
75Perc =	93.58%	123.21%	124.72%	102.56%	65.24%	79.92%	82.71%	73.79%	42.01%
80Perc =	93.95%	123.79%	125.54%	102.64%	65.96%	80.25%	83.02%	74.43%	42.52%
85Perc =	94.40%	124.55%	126.06%	102.71%	66.38%	80.88%	83.60%	75.45%	43.88%
90Perc =	94.91%	125.41%	127.46%	102.80%	67.08%	81.88%	84.25%	77.03%	44.61%
95Perc =	95.59%	126.77%	128.74%	102.93%	68.53%	82.73%	84.98%	78.69%	46.37%

Table 4: Raising Revenue from Import Tariffs (Revenue-Neutral Simulation)

Simulation Statistics (Base Year = 100% except Tariff Rate) *Iterations: 300*								
Variable:	GDP	Net Output	Exports	Domestic Goods	Imports	Consump-tion	Invest-ment	Tariff Rate
Minimum =	89.12%	103.28%	107.66%	101.81%	51.08%	78.18%	63.41%	15.23%
Maximum =	97.62%	110.99%	124.25%	106.72%	70.77%	88.90%	79.59%	46.39%
Mean =	93.15%	107.74%	116.42%	104.64%	60.35%	83.41%	71.63%	31.07%
Std Deviation =	1.75%	1.55%	3.17%	0.96%	4.06%	2.22%	3.49%	6.37%
Variance =	0.03%	0.02%	0.10%	0.01%	0.16%	0.05%	0.12%	0.41%
Skewness =	-4.35%	-19.30%	-4.12%	-31.78%	16.34%	2.72%	-15.55%	16.98%
Kurtosis =	248.29%	259.58%	258.70%	277.07%	251.08%	250.25%	244.64%	250.80%
Percentile Values								
5Perc =	90.03%	105.04%	111.27%	102.95%	53.59%	79.69%	65.44%	21.32%
10Perc =	90.75%	105.64%	112.20%	103.26%	55.13%	80.57%	66.56%	22.70%
15Perc =	91.17%	106.03%	112.84%	103.66%	56.84%	81.12%	67.68%	24.05%
20Perc =	91.59%	106.38%	113.45%	103.77%	56.87%	81.40%	68.66%	25.22%
25Perc =	91.88%	106.63%	114.05%	103.99%	57.33%	81.77%	69.21%	26.37%
30Perc =	92.19%	106.89%	114.80%	104.17%	57.91%	82.12%	69.72%	27.32%
35Perc =	92.50%	107.19%	115.17%	104.34%	58.43%	82.44%	70.27%	28.47%
40Perc =	92.73%	107.40%	115.71%	104.48%	59.26%	82.83%	70.72%	29.00%
45Perc =	92.96%	107.60%	116.05%	104.62%	59.60%	83.12%	71.23%	29.78%
50Perc =	93.16%	107.78%	116.37%	104.68%	60.09%	83.44%	71.70%	30.81%
55Perc =	93.38%	107.97%	116.88%	104.80%	60.62%	83.67%	72.11%	31.41%
60Perc =	93.63%	108.13%	117.19%	104.92%	61.32%	84.01%	72.46%	32.62%
65Perc =	93.86%	108.41%	117.65%	105.05%	61.84%	84.25%	73.19%	33.26%
70Perc =	94.12%	108.63%	118.02%	105.18%	62.35%	84.60%	73.92%	34.42%
75Perc =	94.43%	108.83%	118.58%	105.32%	63.18%	84.92%	74.37%	35.25%
80Perc =	94.71%	109.07%	119.21%	105.45%	63.93%	85.30%	74.64%	36.63%
85Perc =	95.06%	109.45%	119.88%	105.56%	64.83%	85.91%	75.41%	37.80%
90Perc =	95.46%	109.74%	120.81%	105.86%	65.69%	86.50%	76.04%	39.73%
95Perc =	95.89%	110.24%	121.42%	106.14%	67.19%	87.03%	76.95%	42.48%

Table 5: Raising Revenue from Capital Income Tax (Revenue-Neutral Simulation)

Simulation Statistics (Base Year = 100% except Capital Income Tax - tk)
Iterations: 300

Variable:	GDP	Exports	Domestic Good	Imports	Net Output	Consumption	Investment	PD	tk
Minimum =	86.95%	109.95%	100.71%	53.02%	103.15%	63.44%	76.72%	60.51%	48.69%
Maximum =	97.51%	131.58%	103.18%	73.24%	110.95%	85.14%	92.27%	83.99%	96.19%
Mean =	92.11%	121.82%	102.24%	62.82%	107.68%	73.93%	85.88%	70.58%	72.75%
Std Deviation =	2.17%	4.39%	0.40%	3.81%	1.55%	4.47%	2.77%	4.78%	9.80%
Variance =	0.05%	0.19%	0.00%	0.15%	0.02%	0.20%	0.08%	0.23%	0.96%
Skewness =	-6.17%	-12.58%	-59.99%	-1.45%	-25.07%	0.04%	-41.01%	27.83%	7.02%
Kurtosis =	253.63%	283.52%	382.34%	278.36%	271.75%	260.68%	310.90%	276.97%	258.04%
Percentile Values									
5Perc =	88.39%	114.32%	101.58%	56.62%	105.01%	66.07%	80.87%	63.09%	56.73%
10Perc =	89.13%	116.27%	101.71%	57.82%	105.62%	67.78%	82.24%	64.13%	60.29%
15Perc =	89.74%	117.10%	101.85%	58.85%	106.03%	68.85%	83.00%	65.11%	62.04%
20Perc =	90.20%	118.15%	101.92%	59.58%	106.38%	70.03%	83.53%	66.44%	64.26%
25Perc =	90.57%	118.89%	102.00%	60.29%	106.64%	70.98%	84.01%	67.17%	66.07%
30Perc =	90.94%	119.47%	102.08%	60.81%	106.89%	71.49%	84.36%	67.95%	67.05%
35Perc =	91.27%	120.19%	102.13%	61.34%	107.12%	72.27%	85.04%	68.70%	68.44%
40Perc =	91.60%	120.68%	102.16%	61.66%	107.33%	72.76%	85.42%	69.06%	69.81%
45Perc =	91.86%	121.19%	102.23%	62.24%	107.53%	73.23%	85.79%	69.66%	70.83%
50Perc =	92.19%	121.99%	102.28%	62.71%	107.74%	74.09%	86.21%	70.40%	72.44%
55Perc =	92.46%	122.56%	102.32%	63.39%	107.93%	74.68%	86.50%	71.02%	73.78%
60Perc =	92.76%	122.99%	102.36%	63.72%	108.14%	75.19%	86.78%	71.75%	74.88%
65Perc =	93.06%	123.65%	102.44%	64.46%	108.34%	75.91%	87.08%	72.44%	76.31%
70Perc =	93.34%	124.12%	102.47%	64.96%	108.56%	76.43%	87.36%	73.07%	78.12%
75Perc =	93.60%	124.93%	102.52%	65.49%	108.80%	76.81%	87.81%	73.65%	79.27%
80Perc =	94.03%	125.46%	102.57%	65.96%	109.05%	77.52%	88.24%	74.12%	81.40%
85Perc =	94.35%	126.67%	102.62%	66.97%	109.32%	78.52%	88.69%	75.69%	83.38%
90Perc =	94.85%	127.71%	102.73%	67.63%	109.67%	79.58%	89.21%	76.65%	85.82%
95Perc =	95.56%	129.19%	102.80%	68.95%	110.17%	81.51%	90.29%	79.11%	89.00%

Appendix

A.1. Equations of the Model

(1) GDP

$$P_Y\, Y = P_X\, X + P_\xi(1+\sigma)\xi$$

(2) CMEA Exports ξ

$$\xi(1+\sigma) = min(\alpha_L L_\xi,\ \alpha_K K_\xi)$$

(3) Cost of ξ

$$P_\xi(1+\sigma)\xi = P_L\, L_\xi + r_\xi K_\xi$$

(4) Net Output X

$$X = \alpha_x\left[\beta_x K_x^{-\rho_x} + (1-\beta_x)L_x^{-\rho_x}\right]^{\frac{-1}{\rho_x}}$$

(5) Factor Demand in X

$$\frac{K_x}{L_x} = \left[\frac{\beta_x P_L}{(1-\beta_x)r_x}\right]^{\frac{1}{1+\rho_x}}$$

(6) Cost of X

$$P_x = P_L\frac{L_x}{X} + r_x\frac{K_x}{X}$$

(7) Labor Market

$$L_X + L_\xi = L$$

(8) CET Transformation

$$X = \alpha_t\left[\beta_t E^{\rho_t} + (1-\beta_t)D^{\rho_t}\right]^{\frac{1}{\rho_t}}$$

(9) E/D Ratio

$$\frac{E}{D} = \left[\frac{(1-\beta_t)P_E}{\beta_t P_D}\right]^{\frac{1}{1+\rho_t}}$$

(10) Net Output Price

$$P_X = P_E\frac{E}{X} + P_D\frac{D}{X}$$

(11) Supply of Goods

$$Q = \alpha_q\left[\beta_q M^{-\rho_q} + (1-\beta_q)D^{-\rho_q}\right]^{\frac{-1}{\rho_q}}$$

(12) M/D Ratio

$$\frac{M}{D} = \left[\frac{\beta_q\, P_D}{(1-\beta_q)P_M}\right]^{\frac{1}{1+\rho_q}}$$

(13) Supply Price

$$P_Q = P_D \frac{D}{Q} + P_M \frac{M}{Q}$$

(14) Personal Income

$$\begin{aligned} Y_H &= P_L(1-tl)L \\ &+ (r_x K_x + r_\xi K_\xi)(1-tk) \\ &+ TR\ P_Q + RE\ er \end{aligned}$$

(15) Personal Consumption

$$C_N = \frac{c_s Y_H (1-ty)}{P_Q(1+ts)}$$

(16) Current Account Balance

$$\begin{aligned} B &= \pi_M M - \pi_E E \\ &- \pi_\xi \xi - FT - RE \end{aligned}$$

(17) Domestic Demand

$$Q = C_N + I + G$$

(18) Tax Revenue

$$\begin{aligned} Rev &= tm\ \pi_M\ M\ er \\ &+ te(P_E E + P_\xi \xi) + ts\ P_Q\ Q \\ &+ tl\ P_L\ L + tk\ r_x\ K_x \\ &+ tk\ r_\xi K_\xi + ty\ Y \end{aligned}$$

(19) Government Budget

$$\begin{aligned} Sg &= Rev - P_Q(1+ts)G \\ &- TR\ P_Q - \sigma P_\xi \xi + FT\ er \end{aligned}$$

(20) Price Indices

$$\begin{aligned} P_y &= (1-\lambda)P_X + \lambda\ P_\xi \\ P_M &= \pi_M(1+tm)er \\ P_E &= \frac{\pi_E\ er}{1+te} \\ P_\xi &= \frac{\pi_\xi\ er}{1+te} \end{aligned}$$

(21) Capital Stocks

$$\begin{aligned} K_\xi &= K0_\xi\left(\frac{\xi}{\xi 0}\right) \\ K_x &= K_\xi + (1-\theta)(K0_\xi - K_\xi) \end{aligned}$$

A.2. Parameters & Scalars

α_q	-	shift parameter in Q
α_t	-	shift parameter in CET
α_x	-	shift parameter in X
β_q	-	share parameter in Q
β_t	-	share parameter in CET
β_x	-	share parameter in X
B	-	current account balance
c_S	-	expenditure share
ξ	-	exports to the CMEA region
er	-	exchange rate
FT	-	foreign transfers to government
G	-	government consumption
$K0_\xi$	-	base year capital in ξ
$K0_X$	-	base year capital in X
L	-	labor supply
λ	-	weight of CMEA exports
ρ_q	-	exponent in Q
ρ_t	-	exponent in CET
ρ_x	-	exponent in X
RE	-	remittances from abroad to households
Rev	-	tax revenue
σ	-	production support from government
θ	-	adjustment cost
te	-	export duty
tk	-	tax on capital income
tl	-	paroll tax
tm	-	import duty
ts	-	sales/excise tax
ty	-	tax on personal income
TR	-	transfers from government to households
π_ξ	-	world price of CMEA exports
π_E	-	world price of other exports
π_M	-	world price of imports

A.3. Variables

C_N	-	consumption
D	-	domestic good
E	-	export good
I	-	investment
K_ξ	-	capital in ξ
K_X	-	capital in X
L_ξ	-	labor demand in ξ
L_X	-	labor demand in X
M	-	import good
P_ξ	-	price of CMEA exports
P_E	-	price of other exports
P_M	-	import price
P_D	-	domestic price
P_L	-	wage
P_Q	-	supply price
P_X	-	net output price
P_y	-	GDP deflator
Q	-	supply
r_ξ	-	return to K_ξ
r_x	-	return to K_X
Sg	-	government savings
X	-	net output
Y	-	GDP
Y_H	-	personal income

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