INTERNAL CURRENCY MARKETS AND PRODUCTION IN THE SOVIET UNION

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ABSTRACT

This paper considers the impact of macroeconomic and microeconomic policy tools on enterprise activities within an economy in the process of economic reform. Assuming a dual exchange rate regime and the type of increased enterprise autonomy introduced as components of partial economic reform as in the Soviet Union, policy changes induce shifts in production and hard currency allocation decisions. This paper considers the implications for: the supply of hard currency to internal auctions or interbank markets; the free internal price of foreign exchange; export volumes; the trade balance; the supply of goods available for internal consumption; and open and hidden inflation. The concentration of market power of producers in domestic industries and the design of currency auctions or interbank markets are key determinants, respectively, of the magnitude and direction of the enterprise responses to policy changes and external shocks.

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I. Introduction[1]

This paper models some of the institutional structures which constrain the activities of managers in exportables sectors in the Soviet Union. These managers determine the output of goods for sale internally and for export sale, and determine how much of their hard currency earnings will be supplied to auctions or interbank currency markets. The distortions introduced by certain institutional constraints and the competitive structure of markets warrant cautious adoption of standard views on the possible output and currency market responses of enterprises to policy changes. In particular, the choice of exchange rate regime and the design of currency auctions could introduce production distortions if large enterprises can exert monopoly power on the supply side of internal currency markets. Furthermore, the ability of a government to attract hard currency supplies to auctions or interbank markets is shown to depend on the system of taxation and the structure of surrender requirements on foreign currency earnings.

To develop these points, we model the types of choices faced by enterprise managers operating under a stylized dual exchange rate regime in a planned economy which has undergone partial economic reform. We derive the optimal response of production and currency allocation choices of mangers to a range of shocks, such as changes in the system of compensation for exports, in turnover taxes, in official production quotas, and in foreign prices for export goods. These policy changes have implications for the levels and destination markets of output, open and hidden inflation, external trade balances, the supply side of freely functioning internal currency auctions or interbank markets and for the internal "flexible" exchange rate.

Officials in economies undergoing economic reform sometimes express concern that the reduced regulation of foreign exchange flows will trigger a reallocation of a substantial portion of domestic production toward export markets, thereby exacerbating or creating domestic shortages. In this paper, it is shown that the direction and magnitude of production responses to shocks depend on the power of the producer to influence prices in the internal currency markets, possibly auctions, and in the internal goods markets. Thus, it is important to assess the implications of certain policy changes in the context of the full package of economic reforms. Indeed, if auctions or interbank markets in foreign currency are designed so that a few producers can exert supply-side monopolistic power in determining market clearing exchange rates, the direction of

2

effects from changing other policy parameters may be the opposite of that predicted by conventional economic wisdom. Furthermore, the competitive structure of internal goods markets (i.e., the ability of enterprises to exert monopoly power in internal goods markets in the form of price control) is an important determinant of the magnitude of output versus price responses to policy changes.

Although the model of this paper and the conclusions are discussed in the context of the Soviet Union, it should be recognized that the key points are of broader applicability to countries in the process of economic reform. Indeed, any country which adopts a dual exchange regime along with currency auctions or interbank markets should recognize that the market design conceivably could impart monopoly power to enterprises and lead to policy outcomes counter to those predicted by conventional wisdom.

While this paper focuses on the optimal responses of enterprises, a companion paper (in progress) confronts some of the tradeoffs among objectives faced by the government during a transition. Given the government's knowledge of the expected optimal behavior of enterprise managers in response to policy shifts and given the shifting weights on different objectives during a transition period, we apply calibration techniques to examine the trajectory of policies which maximize a stylized model of government utility.

The remainder of the paper is divided into four sections. Section 2 details some of features of the Soviet economy relevant to the theme of the paper. Section 3 solves the static optimization problem of the managers in the exportables sectors. Section 4 provides comparative statics results and determines the effects on production allocation and hard currency supplies to internal currency markets of changes in: the enterprise tax; turnover tax rates; official exchange rates; world market prices for exportables; government hard currency appropriation shares; production quotas; and official prices on production for quotas. The sensitivity of the results to the market power of producers in their industries and the structure of demand and supply to internal currency markets are stressed as important determinants of producer responses. Section 5 concludes.

II. Features of the Soviet Economy

Before turning to the details of the formal model, it is important to understand the institutional features in the Soviet Economy which motivate this joint analysis of goods markets and currency markets. Of particular interest for our purposes are the stipulation

3

of exchange regime operations, the composition of exports, the structure of compensation for exporting, and the separation in the accounting of foreign currency and rouble transaction related flows. Many of these features are common to other countries in Eastern Europe.

In 1991, the structure of "differentiated exchange coefficients" currently operational in the USSR is to be replaced by a more unified controlled exchange regime. The differentiated exchange coefficients previously applied to traded goods were an analog of multiple exchange rates and include several thousand coefficients broken down by different regions, currencies and commodities.[2] A intended movement away from multiple exchange rates was the message of the October 1990 decree by President Mikhail Gorbachev. In the aggregate economy, a new commercial rate is to replace the complex system of foreign currency coefficients: while some transactions are to be conducted at the old official rate, others are to be conducted at a tourist or personal exchange rate, and still others conducted at a "market rate" determined in hard currency auctions.[3] For an enterprise, the existence of a fixed official exchange rate and a "market" rate determined on currency auctions or in market exchanges suggest analogies with dual exchange rate systems. The design of these auctions or currency exchanges can significantly affect the magnitude of certain distortions of enterprise behavior.

The production scenario described in this paper is most applicable to enterprises producing exportable goods. For the Soviet Union, the key export sectors are machinery and equipment, fuels, and non-food raw materials. The commodity composition of Soviet exports in 1989, as reported by official Soviet sources, is shown in Table 1.

The raw materials sectors of the Soviet Union are a key source of foreign exchange earnings.[4] With respect to non-socialist countries, Soviet fuel exports accounted for over one third of Soviet export revenues. Non-food raw materials exports accounted for an additional one quarter of export earnings. Taken together, over sixty percent of Soviet hard currency revenues from the nonsocialist developed west and developing countries are raw materials related.[5] Exports to non-socialist countries

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[2]See Ershov (1990).

[3]London Times, Tuesday October 30, 1990 "Foreign Business Puzzles over Soviet Investment Decree."

[4]The Soviet foreign trade performance during the second half of the 1980s is detailed in PlanEcon Report no.20-21 vol.VI May 25, 1990.

[5]In the PlanEcon Report the official exchange rate used is much more favorable than internal rates on foreign currency transactions in the Soviet Union. Since the internal rates were close to 18 roubles per dollar, the share of nonsocialist trade in total trade is understated. These statistics may also be misleading since many of the transactions included in the aggregates may not be competitively priced.

4

account for almost forty percent of total Soviet exports. Fuels and non-food raw materials are also roughly sixty percent of the exports to socialist countries.

Table 1: Commodity Composition of Soviet Exports, 1989

	to non-socialist countries		to socialist countries	
	mil.dollars	% share	mil.roubles	%share
Exports, Total	42,133	100.0	42,227	100.0
Developed West	26,048	61.8	-	-
Developing Countries	16,085	38.2	-	-
Machinery & Equipment[1]	12,898	30.6	8,822	20.9
Fuels[2]	16,125	38.3	17,231	40.8
Non-food Raw Materials[3]	10,270	24.4	8,589	20.3
Foods	808	1.9	591	1.4
Industrial Consumer Goods	894	2.1	1225	2.9
Other Unspecified	1138	2.7	490	1.2

Source: PlanEcon (1990) Tables 6 and 8. Reconstruction by PlanEcon's staff based on Soviet 1989 Foreign Trade Yearbook and earlier issues of PlanEcon.
1: Machinery and Equipment includes investment machinery, including repairs and other services, plus arms exports; 2: Fuels include oil, both crude and products (nonsocialist 28.7/38.3), gas (7.1/38.3), coal, coke and electricity (2.5/38.3); 3: Non-food Raw Materials include metals and minerals (13.5/24.4), chemicals and fertilizers (3.7/24.4), and other raw materials (7.2/24.4).

Traditionally, almost all hard currency revenues generated by the export sales of enterprises have been appropriated by the central government in the Soviet Union. The act of appropriating export earnings is not unique to the Soviet Union. Many countries have had rigid foreign exchange surrender requirements.[6]   The Soviet and Eastern European systems have differed from these other countries in a fundamental feature: while all exporters recieve the domestic currency value of hard currency revenues

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[6]Surrender requirements are broadly applied in Eastern European economies. Quirk et al. (1987) details the surrender requirements of a range of countries outside of Eastern Europe, including Bolivia, Gambia, Ghana, Jamaica, Nigeria, the Philippines, Sierra Leone, South Africa, Uruguay and Zambia.

converted at a government determined rate, in the Soviet Union producers would be compensated for their exports at centrally determined rouble prices that were often unrelated to the world market prices. Enterprise reforms proposed or enacted since 1987 are intended to alter this mechanism by which enterprises are compensated for their export sales. Specifically, while the government still appropriates a significant share of foreign currency earnings, the earnings are valued in relation to world market prices and some residual hard currency is directly captured by enterprises. The managers of enterprises then can determine, subject to certain constraints, how the foreign currency will be utilized. We model the managers as choosing between retaining the hard currency for discretionary foreign currency expenditures or selling the hard currency in "free" internal markets, such as currency auctions or interbank markets.

In sum, our simplified representation of the Soviet economy focuses on the export sectors which produce enough output to fulfill "state orders" (government production quotas known as *goszakazy*), and then produce additional output for sale on external and internal markets. The net receipts of hard currency by these producers are determined by their export sales, adjusted for the share of hard currency earnings retained by the government and by the producers' expenditures on hard currency, imported inputs into the production process. The optimizing activity of these producers yields a supply-side driven model of goods and hard currency made available to internal markets. As previously noted, the structure of internal goods markets and internal currency markets are key determinants of the expected effects of policy changes within the institutional structure of the Soviet Union. This is especially important for predicting the impact of policy changes on production flows, internal currency auctions and the balance of trade.

The model embeds a number of premises about the extent of reforms in place in the Soviet Union. *First*, it is assumed that some price reforms have already been accomplished so that the internal currency prices of raw materials are closer to world levels than in the pre-reform period. This enables us to abstract from determining which industries will emerge with comparative advantages in production. *Second*, some reforms of enterprise activities are in place, including the imposition of "hard budget constraints": enterprises must generate revenues from output sales to cover their expenditures. However, banking reforms are not yet completed suggesting that the borrowing and lending activities of firms are rationed. This feature, along with the observation that enterprises have been engaging in extremely limited investment in new capacity and technologies, implies that intertemporal production and consumption

6

decisions are not important behavioral features.[7] Free capital markets are not yet in existence and the export and import of capital is extremely limited.[8] *Third,* free unimpeded trade in hard currencies is permitted with the Soviet Union, but enterprises are prohibited from making direct hard currency transfers to employees in the form of salaries. This distortion has two effects: i) hard currency supply allocation decisions remain the domain of enterprise managers; and ii) payments-in-kind rather than direct distributions are provided to workers if the enterprise chooses to retain hard currency rather that selling it internal currency markets.

III. Producer Behavior

The producer behavior detailed in this section applies to those industries that produce both for internal consumption and for export to foreign markets.[9] Managers in this sector choose, subject to certain constraints: 1) levels of production for sale externally; 2) levels of production for sale internally; and 3) the allocation of hard currency receipts across retained earnings and for sale to internal currency markets.

The production of a firm producing exportables is divided into three parts: Y is the government or quota portion of output; Y_h is the portion of output sold in the free internal *home* market; and Y_x is the portion of output sold as *exports* on the free external market.[10] The revenues from production are described as either primary rouble revenues, secondary rouble revenues or hard currency revenues. This distinction is important because regulations on separate accounting of rouble and hard currency flows make these flows nonfungible and introduce arbitrage opportunities. Despite the current and anticipated relaxed restrictions on production for export which allow firms more latitude

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[7]Thus, interest rates are not fundamental determinants of firm or consumer level activities. Nonetheless, the problem of distributing profits across consumption and investment could be appended to our model without modifying any of our results.

[8]The exchange rate regime in place in the USSR resembles a dual rate system. Numerous studies of the effects of policy changes under dual rates or in black market economies invoke intertemporal optimization models. Although static framework invoked is consistent with the lack of complete perfect capital markets observed in the current Soviet system, certain parameters of our model can be used to reflect intertemporal valuations.

[9]Clearly, sectors will differ from each other in terms of the structure of market demands, production expenditures, and specific policy measures applied by the central government. This is simply a matter of parameterizing the functions introduced in this section.

[10]During the late 1980s, the percentage share of total production distributed by the central government was quite high in the raw materials sector. While this share varies across regions and types of materials, for oil it remains almost everywhere more than 95 percent; for brown coal 70 percent, and for coke 95 percent and higher. The quota share of production is lower for other exportables.

7

in sales, the specific structure of export compensation still introduces a number of interesting distortions.

Primary Rouble Revenues: The primary rouble revenues of the producer are the sum of three components, each of which is related to the destination market of output. Quota production Y is sold at the government controlled, fixed, wholesale price, p.[11] Output quantity Y_h is sold in internal markets at p_h, the free internal wholesale price of the product. The firm is paid in roubles for quota production and for the goods sold in internal markets.

Although the firm realizes p_h as unit revenues on goods sold in internal markets, a wedge between consumer and producer prices is created by the existence of consumer turnover taxes represented by q. The internal market demand for raw materials is represented by the residual inverse demand function $p_h = p_h(Y_h, q)$.[12] The shape of this demand curve is denoted by its slope p_h': the general case of $p_h' < 0$ describes a market where producers have some market power in influencing the sale price in internal markets, while $p_h' = 0$ describes the special case of fixed prices in internal markets due to decree or infinitely elastic demand or highly competitive production.

Production for sale to external markets, Y_x, is transacted at world market prices. It is assumed that the producer is small in world markets, so that p^*, the foreign currency price of the export good, is exogenous to the firm.[13] Due to the institutional constraint that foreign currency must flow through official channels, the producer does not receive all of the hard currency generated by its export sales. Instead, it receives some government determined share of hard currency earnings and compensation in roubles, at the official exchange rate, for its hard currency earnings retained by the government. Define w as the share of hard currency revenues retained by the producer, and (1-w) as the share of hard currency revenues appropriated by the central government. The producers are compensated in roubles for this appropriation, where the compensation rate is the official exchange rate, e, in domestic currency per unit of foreign exchange.[14]

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[11]This price does not include the turnover tax accumulated by the central government in its resale of raw materials to other firms or individuals.

[12]The raw materials demand function is assumed to be smooth enough (continuously differentiable) to guarantee uniqueness of this representation. Note that this specification of the turnover tax is general enough to capture any type of shock to internal demand for raw materials.

[13]The assumption that the Soviet Union is a price taker in world markets is reasonable for most export goods, and for raw materials such as oil, natural gas, coal and metals sectors. It is less reasonable in the context of trade in diamonds and chromium.

[14]Previously, the hard currency retention rate could vary according to production levels within an industry and across industries. The exchange rate system was also complex, with different exchange rates

Taken together, this compensation structure yields "primary rouble revenues" of:
-- fixed revenues pY from quota sales;
-- revenues $p_h(Y_h)Y_h$ from free trade in internal markets;

-- rouble compensation for the portion of the total hard currency export revenues seized by the government. This compensation is

$$p^* Y_x (1\text{-}w) \, e \qquad\qquad (1)$$

Summing, total <u>primary rouble revenues</u> to the enterprise are:

$$R = pY + p_h(Y_h,q) \, Y_h + p^* e \, (1\text{-}w) \, Y_x \qquad\qquad (2)$$

The total gross hard currency receipts of the firm are given by equation 3:

$$R^* = p^* \, w \, Y_x \qquad\qquad (3)$$

Secondary rouble revenues are generated when some portion of the hard currency receipts of the firm are sold in internal currency markets in exchange for roubles.

<u>Production Costs</u>: In order to produce total output level Y ($Y = Y + Y_h + Y_x$), managers must undertake replacement "primary expenditures" in terms of both rouble goods and imported hard currency goods. These expenditure functions are, respectively, $E(Y)$ and $E^*(Y)$, and are assumed to be separable, continuous and differentiable.[15] Domestic currency expenses must be paid out of primary and secondary rouble earnings: foreign currency expenses must be paid out of remaining hard currency export earnings. Expenditure functions are assumed to reflect all necessary production costs, including: normal salaries,[16] depreciation charges in roubles and in hard currency, rental payments,

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and employee taxes.[17] These functions are the only mechanism in our model through which technological progress, input productivity shifts, or alterations in input mixtures can influence the equilibrium outcomes. [18]

The shape of the expenditure functions depends upon the industry under discussion. Throughout, it is assumed that marginal costs are positive, $E'(Y)>0$ and $E^{*'}(Y)>0$. In regions of diminishing returns, as generally characterizes the depletable resource sectors (fuels and non-food raw materials) and technologies with capacity constraints, the expenditure function will be convex to the origin, $E''(Y)>0$ and $E^{*''}(Y)>0$.

Co-evaluation of Rouble and Hard Currency Flows : Under the dual exchange regime, the different exchange rates are used for valuation of different foreign currency transactions. An official fixed exchange rate is used when the government calculates of the rouble value of appropriated export earnings. An official fixed rate also applies when the government computes taxes on foreign currency earnings retained by the enterprise. The exchange rate used for valuing other foreign currency related flows depends on the particular flow.

The hard currency earned by firms, R^*, is divided between three uses:

i) R_1^* is the amount be retained by the enterprise. This amount is at least as great as the firm's expenditures on imported inputs into production. These hard currency revenues (re-calculated at the official exchange rate **e** for taxation purposes) are included in the firm's taxable income. The after-tax revenues are applied toward the purchase of foreign currency valued investment or consumption goods or used to secure benefits for employees.[19]

ii) R_2^* is the amount sold by the firm in internal currency markets. The rouble receipts from these hard currency sales are referred to as secondary rouble revenues. These roubles can be combined with primary rouble

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[17]Other taxes include fixed fee resource or stumpage costs not included in the expenditure functions or our simplified model.

[18]While investment and intertemporal growth decisions are not explicitly modelled, the State can impose some minimal level of desired growth through Y requirements.

[19]For example, the managers can send workers abroad for professional education and training. While opportunities for consumption good expenditures are limited, opportunities of this second type are sufficiently large to absorb any additional revenues.

revenues to cover domestic currency expenditures on goods or capital or to pay workers salaries.[20]

iii) $E^*(Y)$ is the enterprise's expenditure on imported inputs into production. Therefore,

$$R^* = R_1^* + R_2^*; \qquad (4)$$

$$R_1^* \geq E^*; \qquad (5)$$

The value to the enterprise of holding retained earnings in excess of foreign currency costs $(R_1^* > E^*)$ is denoted by the exchange rate e_1. The value to the enterprise of selling hard currency in auctions or internal currency markets (R_2^*) is the price offered in internal markets for currency, e_2. This flexible exchange rate on internal market sales, e_2, is assumed to be higher (more depreciated) than the official conversion rate, e.

The enterprise recognizes that it may have some *market power* in internal markets for *both* exportables and hard currencies. In the context of foreign exchange markets, although the official exchange rate is exogenous to the firm, the free market price of foreign exchange declines as the supply of hard currency made available internally increases. This inverse relationship between the free market price and the hard currency supplied by managers, R_2^*, is expressed as:

$$e_2 = e_2 (R_2^*) \qquad (6)$$

$e_2'(R_2^*)$ represents the slope of the currency demand curve relevant to the firm.

In most countries, the activities of any single enterprise would not have a large effect on the exchange rate. This is also the case when currency auctions are run with government intervention in order to strictly control the supply of currency to internal markets: the enterprise may be faced with a value of e_2' close to zero.

However, when the government limits its intervention in internal currency markets, the value of e_2' can be considerably higher for large participants in the foreign exchange market. High values of e_2' are associated either with highly inelastic currency demand (which is unlikely in these economies during the reform process) or with the power of an enterprise to affect significantly flow supplies of hard currency to internal markets. Indeed, early currency auctions in the Soviet Union were characterized by

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[20]The discussion emphasizes the case of nonnegative R_2^*. However, the model itself does not preclude the possibility of negative R_2^*, whereby the enterprise buys rather than sells foreign exchange in these markets.

relatively few participants on the supply side, suggesting that each large participant had more than a marginal ability to influence internal auction prices.[21]

The Objective Function of the Firm's Manager : When both rouble and hard currency revenues are included in the same balance sheet, the taxable income of the enterprise is the sum of primary rouble revenues from sales, secondary rouble revenues from the auction or interbank currency market sales of R_2^*, the official valuation of revenues retained by the firm, $e(R_1^* - E^*(Y))$, minus expenditure on domestic inputs into production.

Defining T as the fixed profit tax rate, the net profit in exportables has two components:

i) the rouble part: $(1-T)(R + R_2^* e_2 - E(Y)) - Te(R_1^* - E^*(Y)) \geq 0$ (7)

where the latter term represents taxes paid on the government valuation of retained earnings, and,

ii) the hard currency part: $R_1^* - E^*(Y) \geq 0$ (8)

It is assumed that these flows are assessed by enterprise managers according to their rouble valuations. The conversion rate applicable for valuation purposes is determined by its investment or consumption value. For simplicity, the wedge between the auction price and the secondary value is denoted by ϕ (i.e., $e_1 = e_2 + \phi$). As will be discussed further below, the meaning of ϕ depends, in part, on the design of the internal currency markets. In general, ϕ refers to the additional purchasing power associated with holding foreign currency.

If participation in internal currency markets is sufficiently widespread, e_2 will be close to the black or parallel market exchange rate. In this case, ϕ can be small or even negative if it reflects only premiums demanded by money dealers or transactions costs on getting goods from abroad. However, if the sale price on foreign currency determined in official internal currency markets greatly differs from the shadow price of foreign

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[21]Our discussion of the demand side of the auctions or interbank markets basically assumes a separation of markets for foreign exchange transactions along the lines of the October 1990 decree of Gorbachev. However, if it were the case that internal currency markets were designed to integrate different types of flows, so that clandestine black markets and officially tolerated parallel markets are absorbed, the model would apply to flows related to: the export smugglers who remit hard currency earnings through the black market; the import smugglers who purchase hard currency in order to make payments; and tourists who sell hard currency internally to black marketeers.

exchange to the workers, the wedge represented by ϕ can be a large positive premium on holdings of foreign currency.

Therefore, the manager's objective is to maximize the value of combined net rouble and foreign currency after tax earnings:

maximize $\quad L = (1-T)[\, pY + p_h(Y_h,q)\, Y_h + p^*\, e\, (1-w)\, Y_x + R_2^*\, e_2\, (R_2^*) - E(Y)]$

$Y_h, Y_x, R_2^* \qquad + (e_2(R_2^*) + \phi)[R_1^* - E^*(Y)] - Te(R_1^* - E^*(Y)) \qquad (10)$

subject to

$$(1-T)[pY + p_h(Y_h,q)\, Y_h + p^*\, e\, (1-w)\, Y_x + R_2^*\, e_2\, (R_2^*) - E(Y)] \quad (11)$$
$$-Te[\, R_1^* - E^*(Y) \geq 0$$
$$R_1^* - E^*(Y) \geq 0 \qquad (12)$$

where $R_1^* = p^* w Y_x - R_2^*$. This structure has a number of interesting features. Among these are a tax haven effect and a possible knife-edge property of the hard currency allocation choice.

First, consider the role of the official exchange rate in the objective function. An official devaluation (e increase) increases the rouble return on exports, thereby generating greater export earnings. However, the devaluation also increases taxes on retained earnings, thereby leading to a shift away from retained earnings toward sales of hard currency on internal markets. If this increase in R_2^* can greatly worsen the terms of trade on exports (if e_2' is large enough), perverse output effects can occur. The exchange rate wedge also distorts the effects of marginal taxes. An increase in the producer profit tax lowers the return on both exports and internal raw materials sales, and decreases the tax haven appeal of retained earnings. This tax haven motive arises because tax payments are evaluated based on the official rate not the internal rate. A shift toward increased currency sales will depreciate the internal exchange rate (if e_2' is high), thereby inducing a shift in the relative price of imports and exports. Once the internal sales price also responds, the result of an increase in the tax rate becomes unclear.

The Hard Currency Allocation Choice: The value of R_2^* to the manager is $(1-T)e_2(R_2^*)$ whereas the value of R_1^* is $e_2(R_2^*) + \phi - Te$. If $(1-T)e_2(R_2^*) > e_2(R_2^*) + \phi - Te$, all hard currency earnings in excess of $E^*(Y)$ will be sold in internal currency markets and none would be retained by the firm. If the inequality is reversed, the enterprise will retain all of its excess hard currency and refuse to supply hard currency to internal currency markets. The knife-edge property of hard currency allocation decisions

13

implies that policy shifts might induce discrete jumps in the allocation of foreign currency (in excess of expenditures E^*) across R_2^* or R_1^*.

This inequality provides insights into how the design of the internal currency market is related to its survival or demise. Rearranging terms within the inequality, it is clear that the size of φ, the tax rate, and the wedge between the official rate and the internal market rate determine whether currency will be supplied to the internal markets. In general, let us assume that the internal rate is more steeply devalued than the free market rate, i.e. $e_2 - e > 0$. If $\varphi>0$, all foreign exchange earnings will take the form of R_1^f, with nothing supplied to auctions. The intuition is simple and corresponds to observed behavior in the few auctions conducted in the Soviet Union in the late 1980s: due to the high consumption and investment value of retaining scarce hard currency, and the lack of internal currency convertibility, enterprises attempted to purchase scarce imported investment resources or sent increasing numbers of workers abroad for training programs, resulting in internal currency auctions which were extraordinarily thin on the supply side. These early currency auctions were designed so that the wedge represented by φ was large and positive.

By contrast, consider the case where $\varphi <0$, implying that the currency auctions or interbank markets are defined broadly enough so that there is some economic penalty for holding retained earnings. Intuitively, one might think that such a penalty would shift all excess earnings to be sold in free internal markets. However, the distortions of the tax system create the potential for a counter-intuitive result.

If $\varphi <0$: $\qquad$ $\varphi >T(e_2-e)$ $\quad$ implies all R_2^* $\hfill$ (13)

$\qquad\qquad\qquad$ $\varphi <T(e_2-e)$ $\quad$ implies all R_1^*

The latter condition states that the tax haven distortion may dominate the penalty for holding retained earnings if the tax rate is high enough or the gap between the official and free market rate is high enough. In this case, these producers still would not participate in internal currency exchanges.

Due to this instability in the currency allocation choice, it is clear that incremental changes in tax rates, the official exchange rate or φ can lead to large shifts in the allocation of hard currency across usages. This instability depends, in part, on the extent that enterprise allocations can succeed at equalizing the marginal valuation of the two allocations.

Although unlikely, it is possible that the auction or interbank market is designed so that a single establishment can have a large effect on the exchange rate. This

14

possibility, actively discouraged by those IMF officials who encourage the establishment of free internal currency markets,[22] may enable enterprises to observe large enough e_2' that they can eliminate this knife-edge property by choosing an R_2^* which satisfies

$$(1-T)\, e_2(R_2^*) = e_2(R_2^*) + \varphi \cdot Te \tag{14}$$

This special case is referred to below as an interior solution for R_2^*. Otherwise, the choice of R_2^* is referred to as a margin solution.

<u>Optimum Choices of Enterprise Managers:</u> The optimal choices of enterprise managers are derived by replacing R_1^* by $R_1^* = w\, p^* Y_x - R_2^*$ and differentiating the objective function with respect to R_2^*, Y_h and Y_x. This yields the first order conditions:

$$\frac{\partial L}{\partial R_2^*} = (Te - \varphi) + [p^* Y_x w - E^*(Y) - T R_2^*]e_2' - T e_2(R_2^*) = 0 \tag{15}$$

$$\frac{\partial L}{\partial Y_h} = (1-T)\,[p_h' Y_h + p_h - E'(Y)] + (e_2(R_2^*) + \varphi - T e)(-E^{*'}) = 0 \tag{16}$$

$$\frac{\partial L}{\partial Y_x} = (1-T)\,[p^* e(1-w) - E'(Y)] + (e_2(R_2^*) + \varphi - T e)(w\, p^* - E^{*'}(Y)) = 0 \tag{17}$$

Equations (15) through (17) are relevant under the assumption that the optimal Y_h, Y_x and R_2^* are all interior solutions which maximize the objective function. Examination of the first order conditions and the Hessian matrix (see Matrix A in the Appendix) shows that the solutions for Y_h and Y_x clearly are interior maxima. For these variables , the second order sufficient conditions for an interior maxima[23] are always satisfied in a region of diminishing returns and are always satisfied under linear demand specifications ($e_2'' = p_h'' = 0$).

However, as emphasized in our discussion of the knife-edge properties of the currency allocation choice, interior solutions to the currency allocation choice are

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[22]See Quirk et al. (1987).

[23]A maximization of the objective function is achieved if the Hessian matrix is negative definite. The proof of negative definiteness is provided in the Appendix. Among the sufficient conditions for an interior maxima are $\varepsilon \cdot (1-T)(2p_h' + p_h'' Y_h) > 0$ and $(e_2')^2 (p^* w - E^{*'})^2 - \varepsilon\, (2Te_2' - e_2'') > 0$, where $\varepsilon = (1-T)E'' + (e_2 + \varphi - Te)E^{*''}$.

expected only under restrictive conditions which include the requirement that e_2' be large enough to equalize the marginal valuation of investing in R_1^* and R_2^*. *An interior maxima associated with R_2^* requires a high value of e_2' (in absolute terms) and a high profit tax rate.*[24]   When these conditions are not satisfied, R_2^* either will be set at the margin defined by $R_1^*=E^*(Y)$ where $R_2^*=wp^*Y_x -E^*(Y)$, or, at the margin defined by $R_2^*=0$, implying that all foreign currency revenues in excess of necessary expenditures are held as retained earnings and not offered for sale in interbank markets or currency auctions.

IV. Comparative Statics Results

The sensitivity of the optimal production levels and internal hard currency supplies to changes in exogenous policy variables and world market prices is signed by differentiating the first order conditions and conducting comparative statics exercises. In general, if hard currency allocation choices occur at the margins, the relevant comparative statics matrix is:

$$\begin{bmatrix} \delta Y_h \\ \delta Y_x \end{bmatrix} = [A]^{-1} [B] [u]' \tag{18}$$

where $[u] = [\delta T, \delta e, \delta p^*, \delta w, \delta Y, \delta \phi, \delta q]$. Matrices A and B are presented in the Appendix.[25] For the margin solution on R_2^*, the comparative statics results are examined only for the case where primary and secondary rouble revenues are sufficient to cover rouble expenditures, and in the region where there are no excess allocations to retained earnings. (This implies that $(1-T)e_2(R_2^*) > e_2(R_2^*) + \phi -Te$.) To generate the comparative statics results for R_2^*, we apply

$$\delta R_2^*/\delta[u] = \delta (wp^*Y_x -E^*(Y))/\delta[u] \tag{19}$$

The potential instability of this allocation is not emphasized in this analysis: for that result, one could simply concentrate on reversals of the inequalities of Equation 13.

    For the special case of an interior solution for R_2^*, the comparative statics results require solution of the system given by

[24]For the case of linear currency demand, $e_2 = g-hR_2^*$, the necessary conditions for an interior solution to R_2^* are $T > .50$ and $h > (-Tg+Te-\phi)/(1-2T)(p^*wY_x-E^*)$ respectively.

[25]The equations for each of the cells of the solution matrix are available upon request.

$$\begin{bmatrix} \delta R_2{}^* \\ \delta Y_h \\ \delta Y_x \end{bmatrix} = [A]^{-1} [B] [u]' \tag{18'}$$

These results are also discussed. As will be shown, if enterprises have the ability to significantly affect the internal exchange rate, the application of standard policy tools can lead to economic effects that run counter to conventional wisdom.

Production Response to Shocks

The effects of the shocks on the production for sale to the internal and external markets are summarized in Table 2. The shocks considered are changes in: the industry tax rate, T; the official foreign currency conversion rate, e; the world price of raw materials, p^*; the share of hard currency earnings retained by the government, w; the turnover tax paid by consumers, q; and the official production quota, Y.[26]

The direction of production responses to particular shocks often depends on the ability of the enterprise to affect the terms of trade on its exports by moving the internal market exchange rate. This implies that the mechanism for currency reform affects the implications of other policies in a program of economic reform. To capture the competitive feature of the auctions and interbank markets, consider the parameter e_2'. *Small* e_2' applies to firms which have relatively weak power in influencing the price of hard currency on internal markets: This arises due to high demand elasticity or its own small position relative to the flows supplied by other sources. *Large* e_2' pertains to inelastic currency demand conditions and to those exporters large enough in internal currency markets to have a significant effect on the shadow price of hard currency. Large e_2' also could arise when an interbank market is developed in the presence of very few competing independent commercial banks.

Consider the effect of an official devaluation on the production choice of an enterprise. A devaluation of the official exchange rate unambiguously stimulates production for export, and increases total output. This occurs because the devaluation increases the relative price of exportables. *For the case of low e_2' firms*, the reduction in output for domestic sales and increased production for export, yields a positive overall

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[26]The results are based on assumed general forms for the demand and production technologies and on the constraints provided in footnote 24 . It is also assumed that both internal goods' demand and internal currency demands are normal and differentiable, $e_2'<0$ and $p_h'<0$; p_h'' and e_2'' exist.

17

Table 2: **Effect of Shocks on Production for Export and for Internal Sales**

Shock	Production for Internal Sales		Production for Export		Total Production	
(+)	small e_2'	large e_2'	small e_2'	large e_2'	small e_2'	large e_2'
p^*	- (1)	? (1)	+ (b)	?	+ (c)	?
e	- (a)	+ (a)	+	+	+	+
w	-(d)	+ (d)	+ (e)	- (e)	+ (e)	- (e)
Y	-	-	+ (a)	- (a)	+	+
q	-	-	+ (a)	- (a)	-	-

$e_2"=0$ assumed for simplicity. "Small" defined below by $e_2' > (\#)$; "Large" defined by $e_2'<(\#)$.

Sufficient conditions for signing the comparative statics results are:

(a) $-\varepsilon 2T /E^{*'}(p^*w-E^{*'})$;

(b) $-2T(w(e_2+\varphi-e)+ (1-T)e) / w^2 Y_x p^*$;

(c) $-2T(w(e_2+\varphi-e)+ (1-T)e) / w Y_x(p^*w-E^{*'})$;

(d) $-2T(e_2+\varphi-e) /[\varepsilon Y_x w p^* + E^{*'}(p^*w-E^{*'})(e_2+\varphi-e)]$;

(e) $-2T(e_2+\varphi-e) /Y_x(p^*w-E^{*'})$;

? = ambiguous effect; + = increase; - = decrease. Total production=$Y+Y_h+Y_x$

(1) $\delta Y_h/\delta p^* <0$ if $w(e_2+\varphi-e) + (1-T)e - \varepsilon w Y_x<0$

effect on production. Therefore, although an official exchange rate devaluation is not contractionary in the aggregate, the official devaluation will increase the scarcity of the exportable goods in internal markets. By contrast, a depreciation of the official exchange rate triggers large e_2' firms to expand internal sales. Instead of offseting the increased rouble production costs by reducing output for internal markets, the enterprise chooses export levels to restore optimality by a combination of price (terms of trade) *and* quantity adjustment. A similar interpretation applies to the effects of increase world market prices of exports and increased retention of hard currency earnings.

An increase in the turnover tax on domestic sales unambiguously reduces output for internal distribution, and total enterprise production. This occurs because contraction

of internal demand lowers the relative price of sales in internal markets and leads to substitution away from internal production. For small e_2' firms, exports increase by this relative price effect. For large e_2' firms, the relative price effect is compounded by the exchange rate effect caused when reduced expenditures on imported inputs increase the currency supplied to auctions or interbank markets and appreciate the internal market rate. For profit maximization, the firm decreases exports to reduce the exchange rate effect.

Next, consider the effect of increasing the production order of the state (goszakazy). The first order effect is to increase expenditures denominated in both domestic and foreign currency. For low e_2' enterprises, production for export must be increased to meet the increase in required foreign currency expenditures. While this generates some additional primary and secondary rouble revenues, some contraction of production for sale to internal markets is necessary to mitigate the increase in marginal costs of production. When the enterprise can exert power in the currency market it reduces production for export and for internal sale. Since the total reduction in production is less than the expansion of state orders, the additional value of foreign currency for expenditures arises from the depreciation of the internal exchange rate which occurs when the enterprise contracts its currency supply to auctions.

Throughout, the effects of increasing profit tax rates are not straight-forward to sign. The production mix of the enterprise does not change if the firm holds no excess retained earnings. At this margin solution, the tax rate multiplies all revenues equally. By contrast, when the enterprise has large e_2' and satisfies the conditions necessary for an interior solution, an increased tax rate makes hard currency sales to internal markets relatively more attractive than retained earnings. The shift toward internal sales appreciates the internal market rate, thereby lowering the relative return on exports. This induces substitution toward production for internal sales.

The Influence of Market Power in Foreign Exchange Markets on Production Responses: The comparative statics results for production have shown that the *direction* of some responses to shocks are a function of the ability of the producer to influence the price of foreign exchange. In general, *when internal currency markets are competitive and firms are unable to significantly effect the terms of trade, the expected responses of the production mix to policy changes are fairly standard.* For example, an increase in the relative price of exports stimulates production of exports and contracts production for internal sales. An increase in the state orders for the product leads to a contraction of supply for internal markets, and an expansion of supply for export. This occurs

19

principally because the increased quota production requires increased expenditure on imported inputs, thereby stimulating production for export.

By contrast, *when e_2' is high*, either because currency demands are inelastic or because firms have the power to significantly influence the auction or interbank currency price, the optimal responses of managers can differ substantially. *These "large" producers can use their ability to influence the internal terms of trade to optimally distort their revenues from exporting.*

The Influence of Sectoral Market Power on Production Responses: The effectiveness of policy measures also depends on the extent of reforms undertaken to increase the competitive structure of domestic goods markets. Thus, while e_2' often determines the *direction* of an enterprise's response to shocks, p_h' often indicates the *magnitude* of the enterprise's response to shocks. Under high p_h' (in absolute value), internal prices for the good are highly sensitive to changes in its internal supplies. If internal prices are allowed to vary, high p_h' describes a situation of inelastic internal demand or monopolistic supply. This could arise under reform characterized by decontrolled internal goods prices without the break-up of large state monopolies. Low p_h' describes the situation of controlled internal sales prices, highly elastic internal demand, or highly competitive industries.

The effect of varying p_h' is quite intuitive. Consider, for instance, the effect of p_h' on the ability of a devaluation of the official exchange rate to influence the supply of goods to internal markets. As p_h' rises (in absolute value), an official devaluation (e increase) leads to smaller Y_h contractions for low e_2' firms and smaller Y_h expansions for high e_2' firms. The relative price effect of the official devaluation is reduced when p_h is very responsive, leading to a lower internal market supply adjustment. Likewise, increases in p_h' leads to declines in the responsiveness of Y_h to shifts in state orders, the turnover tax, foreign price shocks, and government hard currency appropriation rates. [27]

Implications for Open and Hidden Inflation:
Many policy-makers are concerned with the inflationary effects of the transition to a market economy. In our model, because of the exclusive concentration on the real shocks to the supply side of a partial equilibrium model, *any policies which contract production*

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[27]Although the internal goods market power of firms has a clear intuitive impact on Y_h responses to shocks, the impact on Y_x responsiveness is less transparent. For most cases, that analysis requires a comparison of price elasticities in goods markets and currency markets. It is clear, however, that increases in p_h' increase the responsiveness of Y_x to shifts in state orders.

of output for internal markets will directly cause "inflation", whether open or hidden. The model does not directly address the issue of inflationary pressures associated with shifts in demand or in money creation. Therefore, in this context, "inflation" is associated with price changes or scarcity due to real supply adjustment and not with purely monetary forces or demand induced pressures.

When producing firms are characterized by low power to influence foreign exchange markets, internal prices will increase when:

i) the official exchange rate is devalued;

ii) the share of hard currency revenues apppropriated by the government declines;

iii) the official quotas (state orders) increase (unless this output is distributed to the same internal markets);

iv) the turnover tax increases.

When exporting firms are large enough to significantly influence their terms of trade, "deflation" rather than "inflation" is associated with devaluation of the official exchange rate and decreased rates of hard currency appropriation by the central government.

If $p_h'=0$, as is the case under fixed prices offered enterprises supplying internal goods markets, the inflationary effects of shocks surface through the generation of shortages or surpluses. As noted, the conditions for hidden inflation are met whenever $\delta Y_h/\delta[u] < 0$, i.e. when internal availability of goods declines. Indeed, the comparative statics results show that the absolute value of Y_h responsiveness to shocks is greatest when $p_h'=0$.

"Open inflation" arises when $p_h' < 0$, i.e. when prices are free to respond to changes in goods supplied to internal markets. How sensitive is the to the specification of p_h' is the "inflation" associated with shocks? Alternatively stated, what is the link between competitiveness in production and the inflationary impact of policy measures? Define open inflation as

$$\Pi = \delta p_h/\delta[u] = p_h' \, \delta Y_h/\delta[u] \tag{20}$$

namely, the change in domestic goods prices triggered by a shock. p_h' operates through two channels in equation 20: as a direct multiplier of $\delta Y_h/\delta[u]$ and as a determinant of $\delta Y_h/\delta[u]$ since as p_h' rises the responsiveness of output Y_h to shocks declines. Differentiation of equation (20) yields:

$$\delta\Pi/\delta[p_h'] = \delta Y_h/\delta[u] \, \{-\epsilon \, (e_2')^2(p^*w)^2 / \det A\} \tag{21}$$

21

where the determinant of matrix A is positive (see Appendix) and ε represents a weighted increase in the marginal costs of production as output rises. Inspection reveaals that the bracketed term is always positive but less than one. This suggests that, as $p_h{}'$ rises, the inflationary impact of a shock increases although less than proportionately. Conversely, as $p_h{}'$ falls, the inflationary impact of a shock declines, although the output response to a shock rises. The extreme case of $p_h{}'=0$ is characterized by zero open inflation and full hidden inflation. As p_h tends toward zero, the result approximates the fixed price case, the perfectly competitive markets case, or the case of infinitely elastic demand in internal goods markets. In this case, shocks induce the greatest output effects and the weakest price effects.

<u>Policy Changes, Exogenous Shocks and Currency Sold in Internal Markets</u>
How do policy changes and shifts in the world market price of the export good affect the amount of hard currency supplied to interbank markets or currency auctions? As previously alluded, the answer strongly depends on the ability of an enterprise to affect the terms of its exchange by controlling the amount of hard currency it supplies to internal auctions. For small $e_2{}'$ enterprises, since managers cannot drive to equality the return from investing in retained earnings and the return from selling in internal currency markets, policy changes either incrementally change the amount of foreign exchange devoted to a single use or can switch which usage has the dominant return and lead to a complete reallocation of excess foreign currency earnings across usages.

Table 3 shows the effect of policy changes and external price shocks for two scenarios. It considers the effect of policy changes when:
   i) the enterprises find themselves at the margin defined by $R_2{}^*> 0$ and $R_1{}^* = E^*(Y)$;
   ii) enterprises have $e_2{}'$ large enough to equalize the returns on alternative uses of funds.
A third column of Table 3 considers whether the policy change increases or decreases the probability that a small firm will remain in the region of $R_2{}^*>0$, rather than shift to the region where $R_2{}^*=0$.

An increase in the world price of the export increases revenues from export activities and increases the supply of hard currency sold in internal markets. This leads to a fall (appreciation) of the internal exchange rate, reducing the premium between the auction and the official rate. This effect also occurs when the government increases the share of hard currency earnings retained by the firm. An increase in the turnover tax on internal alses of raw materials reduces total production, thereby lowing expenditure on

22

imported inputs, while increasing the exports of small firms and reducing the exports of large firms. The net effect in both cases is an increase in hard currency available for sale internally. This partial equilibrium framework predicts than an increase in the turnover tax will appreciate the free internal exchange rate and reduce the free market premium.

Table 3: **Shocks, Currency Sales and the Internal Exchange Rate**					
	Interior Solution (large e_2' enterprises)		Margin R_2^* (general case)		Effect on Likelihood Of Positive Supply to Internal Mkt
shock (+)	Effect on		Effect on		
	R_2^*	e_2	R_2^*	e_2	(probability of $R_2^*>0$)
p^*	increase	apprec.	increase	apprec	decrease (indirect)
e	increase[1]	apprec.[1]	increase[2]	apprec.[2]	increase (direct)
w	increase	apprec.	increase	apprec.	decrease (indirect)
Y	decrease	deprec.	ambiguous	ambiguous	increase (indirect)
q	increase	apprec.	increase[2]	apprec.[2]	none

Indirect effects on the margin porbability operate through small effects on the internal market exchange rate. Direct effects are first order effects from the conditions provided by Equation 13 in the text.

1: Sufficient but not necessary condition for $\delta R_2^*/\delta e>0$ is (with $e_2"=0$)

$e_2'<(1-T)T(2p_h'+p_h"Y_h)/(p^*)^2 w(1-w-T)$. For $\delta R_2^*/\delta e<0$, a necessary but not sufficient condition is $e_2'>-\varepsilon T/(TE^{*'}+(1-w-T)p^*)(p^*w-E^{*'})$.

2: This assumes that enterprises are small according to the smallness criterion given by the production equations and that for achieving a margin solution. Otherwise, the result is ambiguous.

In response to shocks large e_2' firms are more likely to exploit their market power in foreign exchange markets and not commit all excess foreign exchange earnings to internal currency auctions.[28]

[28]The table suggests that *an official rate devaluation will generally be associated with an appreciation of the internal exchange rate.* However, there may exist firms characterized by e_2' large enough to be at an interior R_2^* solution, but too small to satisfy the sufficient conditions on e_2' given in the discussion of production responses. Due to the possibility of perverse production response as firms exploit their ability to affect the terms of trade on exports, for a bounded range of e_2' *it is possible for the official rate*

Other studies have considered the effect of official devaluation on free market or dual exchange rates. However, our approach to the study of the effects of policy changes on the free market exchange rate differs from the more standard treatment in the literature on dual exchange rate regimes. Most models, including Dornbusch et al. (1983), Obstfeld (1986), and Lizondo (1987), emphasize the importance of portfolio allocation decisions for determining internal exchange rates. Instead, our specification takes currency demands as given and emphasizes a specific producer based channel for policy to affect hard currency supplies to internal currency auctions or interbank markets. The impact on internal exchange rates depends on the design of the auctions or interbank markets and on the extent of reforms undertaken within the economy. The static approach provides particularly clear insights which will remain valid unitl extensive banking and capital market reforms are accomplished in the Soviet Union and Eastern Europe.

The Trade Balance Effects of Shocks :   The *trade balance* effects of shocks differ across large and small e_2' firms. Define the sectoral trade balance as $p^*Y_X - E^*(Y)$, expressed in foreign currency. For *small e_2' firms*, improvements in the trade balance are triggered by increases in the world price of exports, official devaluations, increased official hard currency retention rates, and increases in the turnover tax on internal sales of the export goods. For *large e_2' firms*, in general it is difficult to determine categorically the effects of these shocks on the trade balance. The ambiguities arise because the changes in marginal revenues from exports do not clearly dominate the changes in marginal costs of imported intermediate goods.

V. Concluding Remarks

Using specific institutional features of the Soviet economy, it is shown that the extent of reforms in currency markets and goods markets are key determinants of the expected responses of optimizing enterprise managers to changes in macroeconomic policies. The exploitable *market power* of enterprises arises in two markets: the internal market in which output is sold and the internal market for hard currency.

Of central importance in determining the *direction* of output response to shocks is the ability of an enterprise to affect the exchange rate by choosing optimal sales of hard

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devaluation to be associated with a depreciation of the internal rate: firms can have large e_2' by production standards and respond to devaluation by increasing production for both domestic and foreign destinations, thereby increasing expenditure on imported inputs to the extent that the net foreign currency holdings available for distribution by the firm may decline.

currency earnings to internal currency markets. Under some conditions, a large enterprise may be able to affect significantly its terms of trade by participating in internal currency auctions or selling in interbank marketd. This feature can lead to unexpected substitutions and complimentarities between production for internal consumption and for export.

The *magnitude* of response to shocks of production for internal markets depends closely on the enterprises' ability to exert monopoly power and influence the price it receives on this good. The higher the price elasticity of response to an enterprises' behavior, the greater its ability to counter the effects of policy shocks by shifting the internal terms of trade in production. In other words, most policy changes will have the greatest effect on output for consumption at home rather than purely prices in home markets, when the reforms permit internal price flexibility accompanied by demonopolization of industry.

A puzzle to policy-makers in the Soviet Union and Eastern Europe has been the reluctance of enterprises to participate, on the supply side, in auctions of hard currency. The first condition for the success of such auctions or interbank markets is the establishment of internal currency convertibility. Given such convertibility, the willingness of enterprises to supply currency to these internal markets is clearly assoicated with the structure of after-tax returns from selling hard currency internally versus holding it as retained earnings. If all enterprises have low power to affect the internal exchange rate, there may be an instability in the supply of funds to auctions when there are changes in policy parameters such as the profit tax rate and the official exchange rate.

This instability is less likely if the internal currency markets are designed so that large enterprises are able to exert monopoly pricing power in supplying foreign exchange. If these firms participate in the auctions, an increase of hard currency supplied to internal markets and an appreciation of the internal exchange rate will generally be caused by: an official exchange rate devaluation, an increase in the enterprise's receipts of its hard currency earnings, an increase in world prices on the export good, and a reduction in state orders. While these policies are consistent with stabilization programs which seek to reduce the differential between free market and official exchange rates, the effectiveness of such policies depends on the extent to which reform has established free and competitive markets for both goods and currencies.

25

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Appendix A

Variable Definitions

e official exchange rate (roubles/ foreign currency)

e_2 free internal market exchange rate (roubles/foreign currency)

φ black market investment consumption value premium if positive; transactions cost and risk premium on purchases in the secondary goods market if negative.

Y production for state order (*goszakazy*)

Y_h production for sale in free internal markets

Y_x production for export sale

Y total production, $Y + Y_h + Y_x$

p unit price on production for state order

p_h unit price on production for sale in internal markets

p^* world market price of export good (in foreign currency)

q turnover tax (sales tax): per unit tax charged internal market consumers of good

w share of hard currency revenues from exporting available to the enterprise

T profit tax rate

$E(Y)$ domestic currency expenditures/costs for production level Y

$E^*(Y)$ foreign currency expenditure/costs for production level Y

R_1^* foreign currency earnings of firm retained for payment of $E^*(Y)$ and purchases of consumer goods/ foreign training, etc. for employees.

R_2^* foreign currency earnings of firm sold at internal hard currency auctions or in free internal currency markets

Appendix B

For the interior solution to $R_2{}^*$, Y_h, and Y_x, , the corresponding <u>Matrix A</u> is :

$$\begin{bmatrix} E^{*\prime}e_2{}' & E^{*\prime}e_2{}' - p^*we_2{}' & 2Te_2{}' - e_2{}''s \\ \varepsilon - (1-T)(2p_h{}'+p_h{}''Y_h) & \varepsilon & E^{*\prime}e_2{}' \\ \varepsilon & \varepsilon & -e_2{}'(p^*w-E^{*\prime}) \end{bmatrix} \quad (A1)$$

The bottom two rows of this matrix represent Matrix A in the text, and are those relevant for the solution to the general case where an interior solution for $R_2{}^*$ is not achieved.

<u>Matrix B</u> corresponds to $(T,e, p^* | w,Y,\phi,q)$ is partitioned as $[B_1 | B_2]$ below. Once again, the bottom two rows of these matrices are those relevant for the solution to the general case where an interior solution for $R_2{}^*$ is not achieved.

Matrix B1

$$\begin{bmatrix} e-e_2-R_2{}^* e_2{}' & T & Y_xwe_2{}' \\ -p_h{}'Y_h - p_h + E' +eE^{*\prime} & TE^{*\prime} & 0 \\ -ep^* + E' + eE^{*\prime} & (1-w-T)p^* + TE^{*\prime} & w(e_2+\phi-e) + (1-T)e \end{bmatrix} (A2)$$

Matrix B2

$$\begin{bmatrix} p^*Y_xe_2{}' & -E^{*\prime}e_2{}' & 1 & 0 \\ 0 & -\varepsilon & E^{*\prime} & (1-T)(p_h{}'{}^q Y_h + p_h{}^q) \\ p^*(e_2+\phi-e) & -\varepsilon & -(wp^*-E^{*\prime}) & 0 \end{bmatrix} \quad (A3)$$

where $\varepsilon = (1-T)E''+(e_2+\phi-Te)E^{*\prime\prime}$, and $s= p^*Y_xw-E^* - TR_2{}^* > 0$. For the case of interior solutions for all variables, the determinant of A equals

$$(1-T)(p^*w - E^{*\prime})(e_2{}')^2(p_h{}''Y_h + p_h{}')$$
$$+ \varepsilon [e_2{}''(1-T)(2p_h{}'+p_h{}''Y_h) s - e_2{}'(e_2{}'E^{*\prime}p^*w + 2T(1-T)(p_h{}' + p_h{}''Y_h))]. \quad (A4)$$

DetA < 0 is guaranteed by $\varepsilon > 0$ as in a diminishing returns production structure.
For the solution to the general case where an interior solution for $R_2{}^*$ is not achieved, the determinant of A is unambiguously negative when $\varepsilon > 0$.