3 A Model of Price Liberalization in Russia

Jonathan J. Morduch and
Alan M. Taylor

3.1 Introduction

While the world focused on the hasty disassembly of the Soviet Union, the people of the Russian Republic focused on the next revolutionary transformation: the radical reform of their economic system. On 2 January 1992 the government eliminated most price subsidies, allowing prices to be determined by market forces. As a result, most prices paid by consumers rose dramatically. While the price increases were politically unpopular, elimination of subsidies was necessary to avoid the collapse of the food sector.[1] While such a collapse was averted, the liberalization still ignited impassioned debates in the Kremlin and in households and firms throughout the republic. The debates have had special charge since, in the short run, many have faced hardships as a result of the liberalization, while, over the longer run, the ability to sustain better living conditions hinges on the establishment of a price structure which rapidly conveys accurate information about the changing economy.

Despite these concerns, there has been little concrete analysis of even the most basic elements of the liberalization: how relative prices change and how these changes affect the purchasing power of different segments of the population. This work presents analysis designed to help address these issues, with particular focus

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[1] Other elements of the stabilization program included privatization of land and enterprises, imposition of a value-added tax, convertibility of the ruble, and monetary and fiscal discipline.

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on the food sector. Our aim is: (i) to aid in the understanding of relative price movements in the first few months following the liberalization; (ii) to show the (often non-obvious) consequences of policy alternatives; and (iii) to demonstrate a modelling strategy which can be used in considering price liberalizations in other contexts. The model identifies changes in prices, real income, and consumption between approximately June 1991 and March 1992, but the mechanisms described have continued to play a role in the "middle" stage of reform in Russia and in other formerly socialist economies.

The modelling exercise begins by recognizing of the magnitude and complexity of the proposed policy changes and their relation to the economy. With a reform so fundamental, success and failure have many dimensions, and policies have multiple direct and indirect effects, attenuating and intensifying tendencies through their interaction. For example, although two commodities might not be substitutes for each other in demand, removal of the price subsidy for one will affect the price of the other through a change in the household's full income (cash income plus the sum of subsidies). While considering each effect is quite straightforward on its own, consideration of all the pieces simultaneously is not feasible without a computer. To this end, we have designed a computable mathematical model which allows interactions between up to twelve main markets for consumer commodities and allows simulation of both full and partial price liberalization, exogenous supply shocks, and government income transfer programs. We consider the effects on three separate income groups within the population.

In large part, the liberalization served to collapse the many channels through which consumers made purchases into one "free" market. Prior to liberalization, most consumers bought a fraction of purchases at subsidized prices from state stores, another fraction at subsidized prices at cooperative stores, and another fraction on "free," unsubsidized markets.[2] Thus *average prices* paid for a given good were always less than the "free" *market prices*, but, after the elimination of subsidies, the two concepts of price came into line. This distinction, while elemental, has often been blurred, and our analysis shows that tracking changes of average and market prices provides a simple way to characterize the distributional impacts of the liberalization.

At the same time that we have incorporated these degrees of complexity, we have kept the model as simple as possible without too greatly compromising its

[2] Below we discuss other important channels which operated before the liberalization.

usefulness. We view the model as a tool, not a replacement, for the policymaker, and an important aim of the exercise is to help policymakers build intuition about the workings of the economy.[3] One source of the relative simplicity is our exclusive focus on short-term demand movements. Supply is assumed to be fixed at current levels or changed exogenously, and returns to factors are also constant (although wages can be changed exogenously as well). These limitations arose in response to the needs of policymakers who were concerned primarily with how well the country would survive the early phase of the reforms. At the same time, by carefully setting out the pieces of the present model, we have anticipated issues which have arisen in consideration of longer term changes.

Several non-obvious conclusions emerge from this exercise. Notably, the impact of the price liberalization on different segments of the population depends critically on the distribution of transfers which accompany the liberalization. First, while the removal of subsidies meant increased *average prices* paid by consumers, *market prices* actually fell immediately after the liberalization. The decline in market prices stemmed from demand contractions in the wake of declining effective purchasing power caused by the elimination of subsidies. Second, due to subsequent price effects, the poor and other vulnerable groups would have been hurt by biasing relative compensation toward wealthier groups, even if absolute transfers to the poor had been held constant; we show that, in general, only a targeted scheme biased toward the poor can adequately protect low-income groups from the adverse effect of liberalization on their welfare.[4]

Third, the richer groups fared relatively well after liberalization, and, in this way, the liberalization intensified inequality. Before the reform, richer groups made relatively more of their purchases at market prices, even though they generally had ample access to goods at subsidized prices as well. On the other end of the spectrum, poorer groups, which had relied heavily on price subsidies, were hit hard by the liberalization and gained little from declining market prices. Since most market prices fell with liberalization, the rich saw an increase in their relative

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[3] Thus we have made all the assumptions as clear as possible, and we have written a relatively user-friendly version of the model for use on a personal computer. In the resulting model it is easy for users to change any or all parameters in order to simulate different economic environments and to conduct sensitivity analyses. Once parameters and policy changes have been selected, the system can be solved in less than a minute.

[4] On the other hand, it may be argued that since many of the poorer groups had ample diets before liberalization, a decline in their consumption levels may be tolerable from a policy perspective.

purchasing power.[5]

The paper is organized in five sections. The next section describes the key elements of the model, detailing the impact of price reform on a single market with a single, representative consumer. Here, we pay particular attention: to (a) the role of rationing; (b) the role of partial and full liberalization; and (c) ways to consider the non-linear effects of large changes in incomes and prices. In Section 3.3 we consider price reform when there are many markets and many consumers. In Section 3.4 we present simulations based on data suggestive of Russia in 1991 and the proposed policy changes. Concluding comments and extensions are discussed in Section 3.5.

3.2 Price Liberalization in a Single Market with a Representative Consumer

While the motivation for constructing a model is that interactions between markets are important, much intuition can be gained by first examining price liberalization in a single market with a homogeneous population (or, equivalently, with a single, representative consumer). Both of these assumptions are relaxed in Section 3.3.

In the next section we consider a typical market before the liberalization. Here, we focus on characterizing the effects of rationing on consumer demand. We then consider a typical market after the liberalization, focusing on the effects of full and partial liberalization. Next we discuss strategies to address large policy changes; the boldness of the liberalization raises the possibility of highly non-linear responses to changes in prices and quantities, and these non-linearities must be either incorporated in the choice of parameters or embedded in the structure of the model. Finally, we outline several caveats to be borne in mind before moving on to consider the more general model of Section 3.3.

Characterizing Rationing

Obtaining food and other basic commodities had involved a complicated process in Russia. Under the former regime, the total consumption of a typical good was the sum of quantities obtained through a variety of channels at a variety of prices (or shadow prices). Some was bought at state stores at subsidized prices. Some was obtained through the workplace. Some may have been purchased through cooperatives. Some was produced on private plots. Another part might have been

[5] These effects partially offset the tax burdens which have fallen particularly heavily on the richer groups, and the conclusions should be considered in the context of the net changes in cash income which emerge from all the tax and transfer policies implemented alongside price liberalization.

obtained through barter. And still more was purchased at "free market" prices through the *kolkhoz* (collective) market. In 1988, state markets accounted for 71% of total retail sales, cooperative markets accounted for 26% and *kolkhoz* markets accounted for less than 3%.[6]

The multiplicity of channels stems from the fact that households faced restrictions on the quantities which they could purchase from any particular source. But because many channels existed, households were often able to satisfy total demands. As a result, despite the presence of rationing in some markets, *marginal* purchases were often made without restrictions; that is, there was no excess demand at prices on the marginal market. Most often the marginal market was the *kolkhoz* (collective) market, in which prices were determined by market forces—and we have built the model around this assumption.[7] In considering the channels, for now we will concentrate on the state and *kolkhoz* markets only, although in the actual model we allow a third channel (purchases from cooperatives). Households will be in one of two situations: either they face rationing on the margin (they have no access to the *kolkhoz* market) or rationing is infra-marginal (marginal purchases are made from the *kolkhoz*). We take these situations in turn.

Rationing on the Margin

When households face rationing on the margin, they would like to purchase more goods than permitted at the going prices. Thus, up to a point, prices can rise or fall without affecting the quantities demanded. Unlike the situation with infra-marginal rationing, markets do not clear here and a modelling strategy based on market-clearing equations might appear inappropriate.

However, this need not be. Following Rothbarth's discussion of the uses of virtual prices, Neary and Roberts (1980) showed that the demand problem under rationing can be recast and placed within a market-clearing framework. Neary and Roberts show that the basic tools of demand analysis can be used without modification if instead of working with observed prices we work with *virtual prices* and *virtual income* (defined as prices and income which would have to prevail without rationing in order to induce households to purchase the same quantities as

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[6] It is likely, however, that the size of *kolkhoz* markets has been underestimated in the official data; see Morduch, Brooks, and Urinson 1993.

[7] Although *kolkhoz* markets reflect monopoly power on the part of sellers, prices are still determined by market forces and prices still reflect the opportunity cost of purchases on subsidized markets. Thus these prices are the appropriate ones to use in the analysis, as described below.

they do under rationing). This allows the use of equations in which markets "clear" at virtual prices.

A difficulty with this approach is that since virtual prices are not observed, they must be estimated. This is a modelling exercise in itself, requiring specific assumptions about the functional form and parameters of the demand system. While such an exercise may be necessary in investigating price liberalizations elsewhere, it was not deemed to be critical in analyzing demand for most goods in Russia. Aggregating across the Russian Republic, all groups make at least some purchases of most goods on the *kolkhoz* markets so that the assumption of infra-marginal rationing provides a reasonable starting point for the present analysis. However, where goods are generally not available through *kolkhoz* markets (for example, fish, sugar, and oil), we have estimated virtual prices.

For simplicity of exposition, then, we assume below that all rationing is infra-marginal—but the equations hold when marginal purchases are rationed instead. In that case one can just substitute virtual prices for *kolkhoz* prices (p^k) in all equations and proceed without further modification.

Infra-Marginal Rationing

As discussed above, while households purchase goods through a variety of channels at a variety of prices, it is the price of their marginal purchases which is critical for the present purpose. While households may face constraints in the amount of goods which they can purchase through official channels at subsidized prices, if they do not face constraints in the total amount of purchases which can be made, they are infra-marginally rationed. Here we give careful consideration to the income transfer implicit in the price subsidy, but beyond this accounting, the fact of rationing does not enter the basic analysis.

Essentially, although households face a complicated pattern of non-linear prices, we can treat prices as if they were linear (at p^k) by appropriately augmenting income to account for the implicit subsidy.[8] The problem to be solved by the model is then just how to determine the new set of prices which will occur for marginal purchases. Together with changes in full income (defined below), these prices are all that is necessary to determine changes in quantities demanded.

The calculation of full income is thus critical. We define "full" (or virtual)

[8] See Hausman 1985 for discussion of a similar procedure used in analyzing the effect of taxes on labor supply.

income (Y^f) as cash income (Y) plus the income transfer implicit in the subsidy.[9] This implicit transfer equals the difference between the subsidized purchase price of rationed goods (p^s) and the opportunity cost, the *kolkhoz* price (p^k), multiplied by the quantity purchased at the subsidized price (D^s):

$$Y^f = Y + (p^k - p^s)D^s. \tag{1}$$

This implicit transfer corresponds to the shaded rectangle in Figure 3.1. We turn now to how full income changes under price liberalization.

Full and Partial Price Liberalization

Whether or not rationing is infra-marginal, following the discussion above, we begin by assuming that markets clear (at p^k with full income Y^f). Thus, supply is equal to demand for the given good:

$$D(p^k, Y^f) = Q. \tag{2}$$

As discussed above, quantities demanded are solely a function of *kolkhoz* prices and full income. Taking the logarithm and then differentiating equation (2) yields:

$$\hat{D} = \epsilon^p \hat{p}^k + \epsilon^Y \hat{Y}^f = \hat{Q}. \tag{3}$$

where ϵ^p is the (uncompensated) price elasticity and ϵ^Y is the income elasticity. A hat above a variable denotes percentage changes (dX/X).[10]

If we consider the short run, so that there are no changes in supply, then

$$\hat{Q} = 0 \Rightarrow \hat{p}^k = -\frac{\epsilon^Y}{\epsilon^p}\hat{Y}^f. \tag{4}$$

Equation (4) captures the essence of many results in the model. Most significantly, we see how the percentage change in the price is related to the percentage change in full income. Since $\epsilon^p \leq 0$ and $\epsilon^Y \geq 0$ (assuming that the good is not inferior), the relationship is positive: when full income falls, so does the price. Given the elasticities, the determination of price movements is just a matter of determining full income movements. For example, if $\epsilon^Y = 0.3$ and $\epsilon^p = -0.2$, a 10% decline in full income leads to a 15% drop in the *kolkhoz* price. If instead the income

[9] Cash income includes wages, salaries, gifts, and pensions plus (explicit) transfers received directly from the government. All prices and income in the model are net of taxes.

[10] Strictly, the analysis which follows is only appropriate for investigating very small, or local changes. This issue, and strategies to address it, are discussed below.

Figure 3.1
Full Liberalization, Complete Elimination of Subsidy

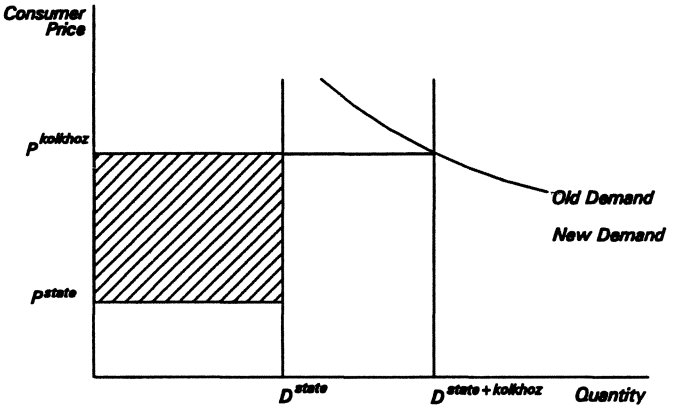
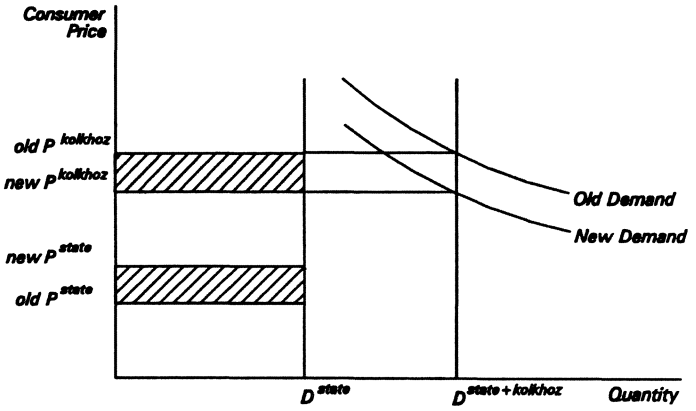


Figure 3.2
Partial Liberalization, Reduction of Subsidy



elasticity is 0.4, the 10% decline in full income results in a 20% price drop. This simple example shows the importance of choosing reasonable elasticities; when elasticities are not known with much confidence, it will be important to conduct sensitivity analyses to ascertain how price changes vary over a range of parameter choices. While elasticities are inputs to the model, any change in full income is calculated within the model. We turn to that now.

Full Liberalization

Full liberalization entails completely eliminating subsidies, taking away from households the implicit income transfer. Thus, full income falls by the full amount of the subsidy:

$$\hat{Y}^f = dY^f/Y^f = [dY-(p^k-p^s)D^s]/Y^f. \tag{5}$$

Here, dY reflects exogenous changes in cash income, such as wage supplements made by the government to offset some of the effects of the price reform. Note that in Russia cash income will be affected both positively by transfers and negatively by taxation. Thus dY reflects *net* income augmentation.

Partial Liberalization

When liberalization is partial, part of the subsidy is retained, so full income falls less far than under full liberalization. Assuming that the household purchases the same quantity of the commodity on the subsidized market, the implicit income transfer is changed to the extent that subsidized prices and *kolkhoz* prices move:

$$\hat{Y}^f = [dY + (dp^k-dp^s)D^s]/Y^f. \tag{6}$$

These changes reflect the upper and lower shaded rectangles in Figure 3.2. While dY and dp^s are exogenous, dp^k is endogenous, so part of the change in full income is endogenous when liberalization is partial. This contrasts with the case of full liberalization above, where the change in full income is entirely exogenous.[11]

[11] Note that we assume that, under partial liberalization, households remain constrained at the former quantity restriction, D^s.

Large Policy Changes

The approach that we have outlined is quite general in that we do not require assumptions about the functional form of the utility function. The data requirements are also relatively parsimonious; the minimum data required is knowledge of current prices and quantities consumed and estimates of price and income elasticities. Since we begin by only assuming that markets clear (at *kolkhoz* or virtual prices), the model does not have to be calibrated to match theoretical constraints and weights used in optimization routines. The fact that the model does not need to be recalibrated for each new set of base date makes repeated experimentation with different parameters both simple and quick.[12]

However, these attributes are counterbalanced by the restriction that the analysis above is only truly appropriate for very small (indeed, infinitesimal) changes. This poses a large problem in considering the Russian price liberalization, possibly the most radical change in pricing policy attempted in world history. Below we discuss three ways to address issues bound up with large changes, and we ultimately argue for solving the model iteratively in many small steps. We leave consideration of other approaches to future work.

ARC ELASTICITIES VERSUS POINT ELASTICITIES

Since the point elasticities used above are based on derivatives, they are only appropriate for analyzing local changes. When analyzing larger changes, predictive performance can be improved by using arc elasticities, reflecting changes between fairly distant points on the demand curve. A problem is that choice of the appropriate distance requires an assumption about the extent of the price change—but this is what we are trying to estimate in the first place. Moreover, careful choice of arc elasticities requires an assumption about the specific functional form of the utility function which gives rise to the demand curve. Still, use of arc elasticities may yield reasonable approximations when analyzing large changes—without requiring modification of model structure. The apparent advantages of this approach are the maintenance of simplicity and transparency, but these benefits are obtained by making hidden (extra-model) assumptions. Perhaps more problematic, new arc elasticities must be calculated each time substantially different policies are simulated.

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[12] See Ahmad and Stern 1991 for an application of local analyses to tax reform and Braverman, Hammer and Gron 1987 and Braverman, Hammer, and Morduch 1987 for applications to pricing policy in Brazil and Hungary, respectively. See Deaton 1984 for a general theoretical argument.

EMBEDDED NON-LINEARITIES

The need for recalculating elasticities is avoided by a second approach. Here we could take the other tack, embedding non-linear responses to price and income changes within the model structure. However, this requires specific assumptions about functional form, and it risks moving the model closer toward being a "black box" in which it is difficult to relate inputs to results. In addition, computable general equilibrium models equipped to address large changes often require calibration of the data and model parameters with each change in base levels. This makes it more difficult to complete sensitivity analyses and comparisons of alternative scenarios. More important from a policy perspective, the greater complexity required by this approach means that the model builder is generally the only user of the model, and it is difficult to construct such models in the limited time horizon allowed for operational work.

ITERATIONS ON LOCAL CHANGES

Having weighed the concerns above, our compromise approach is to retain the linear structure of the basic model but to analyze a series of small changes, updating prices, incomes, and quantities at each iteration (specifics are described in Section 3.3). In this way we maintain the flexibility of the linear model while accommodating substantial shifting of budgets which leads to non-linearities. The usefulness of the results will depend on how good an approximation the iterative approach is to the actual process of making decisions, and sensitivity analysis of changes in the number of iterations should be done. It would be worthwhile to compare results based on the three approaches in future research.

Other Considerations

While we have accommodated considerable complexity, there is much from which we have abstracted. In this section we briefly describe the implications of considering only a subset of household consumption items, the effects of hoarding and speculative behavior, and supply and factor market effects.

Since we are focusing on small changes from given base levels, we have not had to specify adding-up constraints. This means that we can obtain sensible results without considering all commodities unrelated in demand. However, because inter-dependence is driven by both price and income effects, the results will be biased if we do not consider carefully *all* changes in implicit income transfers. To minimize this problem, the set of goods included in the demand system was chosen

partly to account for important budget items which receive large subsidies. But due to computational constraints, we have left out some important subsidized items, for example, clothing. However, we suspect that the resulting biases will not be large. This is because the removal of subsidies on clothing (which decreased full income) was counterbalanced by short-term shifts out of clothing in the budget (increasing the amount of full income available for purchasing the included items). The two effects roughly wash each other out, and this would have been exactly so if the previous expenditure on clothing (at low, subsidized prices) equaled the new expenditure (at higher, market prices).

Along the same lines, we do not treat the consumption-saving decision explicitly. Rather, savings are determined residually: households first choose new consumption levels, and the difference between income and expenditures is saved (or borrowed). This is a reasonable approximation of behavior during this period of relative hardship in Russia, where maintenance of current consumption levels has been of prime importance for most people.

We also abstract from some forces which matter in the very short run—notably the speculation and hoarding which marked the weeks immediately preceding and following the liberalization. These forces fueled demand and drove up prices. However, as consumers better gauged the expected new price structure and started to draw down their caches, rather than build them up, prices began to fall, *ceteris paribus*, offsetting the initial price rises fueled by speculation. This is one reason we stress that our results should be viewed as being most appropriate to changes occurring in the "medium short run," approximately two to three months after the liberalization was enacted.

By taking the current level of supply as fixed (or changeable exogenously), we have abstracted from how changes in prices and incomes affect factor markets and, through them, production. After the liberalization, wages were bid up in response to the price rises, and while we can capture this by exogenously increasing cash income, we do not explicitly model the effect of wage increases on production costs and thus on prices. Nor do we capture the effect of price movements for goods which are inputs into the final production of other goods. However, neither of these concerns should be critical in the limited time horizon that we are analyzing—although they will matter significantly beyond the short run.

3.3 Price Liberalization in Many Markets with Many Consumers

In this section we generalize the analysis of Section 3.2 to consider price liberalization when there are H consumers, $h = 1,\ldots, H$, purchasing J commodities through $S+1$ possible channels. We assume that the $S+1$st channel is the *kolkhoz* market and that purchases on the other S channels are made at subsidized prices. As before, total supply of each good (Q_i) equals total demand at *kolkhoz*/virtual prices (p_j^k)and full income (Y_h^f):

$$D_i = \sum_{h=1}^{H} D_{ih}(p_1^k, p_2^k, \ldots, p_J^k, Y_h^f) = Q_i \quad \text{for } i = 1, 2, \ldots, J, \tag{7}$$

where the total demand for a given household (D_{ih}) equals the sum of infra-marginal purchases at subsidized prices (D_{ih}^s) plus purchases on the marginal market (D_{ih}^k):

$$D_{ih} = \sum_{s=1}^{S} D_{ih}^s + D_{ih}^k. \tag{8}$$

and full income equals cash income (Y_h) plus the sum of implicit subsidies across commodities and channels:

$$Y_h^f = Y_h + \sum_{j=1}^{J}\sum_{s=1}^{S} (p_j^k - p_j^s) D_{jh}^s. \tag{9}$$

Log differentiation yields equations for percentage changes in demand:[13]

$$\hat{D}_i = \sum_{h=1}^{H} \omega_{ih} \hat{D}_{ih} = \sum_{h=1}^{H} \omega_{ih} [\sum_{j=1}^{J} \epsilon_{ij}^p \hat{p}_j^k + \epsilon_i^Y \hat{Y}_h^f] = \hat{Q}_i \quad \text{for } i = 1, 2, \ldots, J, \tag{10}$$

where the fraction of total demand of a good purchased by a household is

$$\omega_{ih} = D_{ih} / \sum_{h=1}^{H} D_{ih}, \text{ where } \sum_{h=1}^{H} \omega_{ih} = 1, \tag{11}$$

and the percentage change in income is given by

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[13] While we have tried to keep theoretical restrictions to a minimum, we impose symmetry of the Slutsky matrix on the demand system. That is,

$$s_{ij} = \epsilon_{ij}^p + \alpha_j \epsilon_i^Y = \epsilon_{ji} + \alpha_i \epsilon_j^Y = s_{ji}$$

where s_{ij} is the compensated elasticity of demand for good i with respect to the price of good j and α_i gives the population weighted average budget share of good i. Accordingly, half of the cross-price elasticities are calculated so that:

$$\epsilon_{ij}^p = \epsilon_{ji} + \alpha_i \epsilon_j^Y - \alpha_j \epsilon_i^Y.$$

$$\hat{Y}_h^f = \{dY_h - \sum_{j=1}^{J}\sum_{s=1}^{S}[L_j^s(p_j^k - p_j^s)D_{jh}^s - (1-L_j^s)(dp_j^k - dP_j^s)D_{jh}^s]\}/Y_h^f. \quad (12)$$

The degree of liberalization is captured by L_j^s, a dummy variable which equals one if the market for good j through channel s is completely liberalized. When L_j^s equals zero, there is partial liberalization (and if $dp_j^s = 0$ for all s while $L_j^s = 0$, there is no change in market j at all). Substituting equation (12) into equation (10) and taking endogenous terms to the left hand side and exogenous terms to the right hand side yields:[14]

$$\sum_{j=1}^{J}\hat{p}_j^k\{\epsilon_{ij}^p + \sum_{h=1}^{H}\sum_{s=1}^{S}\omega_{ih}\epsilon_i^Y p_j^k(1-L_j^s)D_{jh}^s/Y_h^f\} = \hat{Q}_i - \sum_{h=1}^{H}\omega_{ih}\epsilon_i^Y\hat{Y}_h^{fx}, \quad \text{for } i = 1, 2,..., J, \quad (13)$$

where we have simplified by denoting the percentage change in full income due to exogenous factors as:

$$\hat{Y}_h^{fx} = \{dY_h - \sum_{j=1}^{J}\sum_{s=1}^{S}[L_j^s(p_j^k - p_j^s)D_{jh}^s + (1-L_j^s)dP_j^s D_{jh}^s]\}/Y_h^f. \quad (14)$$

Putting equation (13) into matrix format yields a system of J equations which can now be solved via matrix inversion:

$$\begin{bmatrix} \epsilon_{11}^p + \sum_{h=1}^{H}\sum_{s=1}^{S}\omega_{1h}\epsilon_1^Y p_1^k(1-L_1^s)D_{1h}^s/Y_h^f & \cdots & \cdots \\ \cdots & \cdots & \cdots \\ \cdots & \cdots & \epsilon_{JJ}^p + \sum_{h=1}^{H}\sum_{s=1}^{S}\omega_{Jh}\epsilon_J^Y p_J^k(1-L_1^s)D_{Jh}^s/Y_h^j \end{bmatrix} \begin{bmatrix} \hat{p}_1^k \\ \cdots \\ \hat{p}_J^k \end{bmatrix} = \begin{bmatrix} \hat{Q}_1 - \sum_{h=1}^{H}\omega_{1h}\epsilon_1^Y\hat{Y}_h^{fx} \\ \cdots \\ \hat{Q}_J - \sum_{h=1}^{H}\omega_{Jh}\epsilon_J^Y\hat{Y}_h^{fx} \end{bmatrix}. \quad (15)$$

After solving for the endogenous changes in *kolkhoz*/virtual prices, changes in demands and full income for each household can be derived from equation (10).

[14] Note that we have gained considerable simplification by assuming that price elasticities are equal for all households. Generalizing this assumption is straightforward but tedious.

When the model is solved iteratively, the absolute changes in the policy variables (exogenous changes in supply, cash income, and full income) are first divided by the chosen number of iterations. In the first step, the percentage changes in the policy variables are calculated using the original base levels, but subsequent percentage changes are calculated using the new levels computed after each step.

3.4 Base Data and Simulation Exercises

We now describe how the multi-market model of the Russian food sector is implemented and present some illustrative simulation exercises.

Base Data

Table 3.1 displays the base data for the simulations. The base data were chosen in consultation with experts at *Gosplan*.[15] First we consider base consumption levels by channel for ten goods and three income groups. The three channels are the state market, the cooperative market, and the *kolkhoz*/free market. The ten goods are the following products and aggregates (in the given units), with abbreviations as indicated:

Meat:	meat and meat products (kilograms);
Milk:	milk and milk products (milk equivalent liters);
Eggs:	eggs (number of eggs);
Fish:	fish and fish products (kilograms);
Sugar:	sugar (kilograms);
Oils:	vegetable oils (kilograms);
Pota:	potatoes (kilograms);
Vegs:	vegetables (kilograms);
Fruit:	fruit (kilograms);
Bread:	bread (kilograms).

While we do not consider them explicitly here, an important extension would be to consider alcohol purchases and an "other goods" residual category. The three income groups are "low," "middle" and "high." In places where an "average" is indicated across income groups this denotes a population-weighted arithmetical average.

We next consider base income and price data. The state buying price ("State buy") is not used in this model, but could be used in a simple extension of the

[15] *Gosplan* refers to the former planning ministry of the Soviet Union.

Table 3.1
Base Data

	Meat (kg)	Milk (l)	Eggs (#)	Fish (kg)	Sugar (kg)	Oils (kg)	Pota (kg)	Vegs (kg)	Fruit (kg)	Bread (kg)
Consumption per person annual: state market										
low	30.7	226.0	129.0	6.2	18.0	5.3	60.7	44.5	14.6	90.5
middle	47.2	253.0	151.0	12.0	27.0	6.0	61.4	58.0	25.7	87.0
high	57.0	253.0	154.0	20.0	23.0	8.0	37.4	42.8	21.6	95.0
average	46.7	249.0	149.0	12.6	25.1	6.2	57.2	53.7	23.5	89.4
Consumption per person annual: cooperative market										
low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
middle	7.9	42.1	25.3	1.7	0.0	0.0	10.2	9.7	4.3	0.0
high	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
average	5.5	29.5	17.7	1.2	0.0	0.0	7.2	6.8	3.0	0.0
Consumption per person annual: kolkhoz/free market										
low	3.4	25.2	14.4	0.0	0.0	0.0	6.8	5.0	1.6	0.0
middle	7.9	42.1	25.3	0.0	0.0	0.0	10.2	9.7	4.3	0.0
high	37.0	169.0	103.0	0.0	0.0	0.0	56.1	64.2	32.4	0.0
average	12.2	61.5	37.1	0.0	0.0	0.0	17.5	18.3	8.7	0.0
Prices (rubles)										
State buy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State sell	7.0	0.7	0.3	1.5	2.4	3.0	1.0	1.0	3.0	1.2
Coop	14.0	0.7	0.3	1.5	3.5	6.0	1.5	4.0	6.0	1.2
Free/virtual	25.0	2.0	0.7	1.7	5.0	12.0	1.5	5.0	12.0	1.2
Base demand elasticities										
with respect to price of: Meat	−0.50	0.02	0.06	0.02	0.00	0.01	0.00	0.00	0.00	0.00
Milk	0.00	−0.20	0.04	0.00	0.00	0.00	0.00	0.00	−0.02	0.00
Eggs	0.05	0.05	−0.20	0.01	0.00	0.00	0.00	0.00	−0.01	0.00
Fish	0.00	0.01	0.01	−0.30	0.00	0.00	0.00	0.00	−0.02	0.00
Sugar	0.00	0.00	0.00	0.00	−0.40	0.00	0.00	0.00	0.05	0.00
Oils	0.00	0.01	0.00	0.00	0.00	−0.20	0.00	0.00	0.01	0.00
Pota	0.00	0.01	0.00	0.00	0.00	0.01	−0.10	0.00	0.01	0.00
Vegs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−0.70	0.12	0.00
Fruit	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.10	−0.80	0.00
Bread	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−0.10
with respect to income:	0.50	0.20	0.20	0.30	0.20	0.20	0.02	0.30	0.50	0.10

Income levels

	Total earnings per capita (rubles)	Population share
low	1,200	0.13
middle	2,700	0.70
high	6,000	0.17
average	3,066	

model to calculate the impact of changes in subsidies on the fiscal balance of the state. The state selling price ("State sell") is the purchase price for consumers in state markets. The cooperative price ("Coop") is the consumer price in cooperative markets. The "Free/virtual" price represents either the *kolkhoz*/free market price or the estimated virtual price, as appropriate (see Section 3.3).[16]

We consider the distributional consequences for three groups within society: a small poor population (13% of the total), a large middle group (70%) and a high-income group (17%).[17] Before the liberalization, their total annual nominal income per capita was assumed to be 1,200, 2,700, and 6,000 rubles, respectively, not inclusive of the value of food or other subsidies. Table 3.2 shows that once food subsidies are considered, full income increases by 52%, 43%, and 24% for each group. The proportionate importance of food subsidies is thus greatest for the poor, even though the rich receive a greater absolute amount of subsidy.

Table 3.2 also shows that when cash income is increased by 50% at the same time that subsidies are eliminated, the poor group's full income (not deflated by the price increase) falls by 29%, and when cash income is doubled, their full income falls by just 5%. However, increases in cash income, as for example in wage and pension escalators, help the richer groups more, since relatively more of their full income comes from wages and pensions. Thus, subsidy elimination coupled with a doubling of wages and pensions *increases* the full income of the richer groups by half, while the poorest group suffers a slight income loss under the same policy. The implications of these price and income changes are the subject of the simulations discussed below.

Next we consider all the information on demand elasticities necessary to solve the model. Price and income elasticities are exogenous to the model and are estimated independently. The task is made somewhat simpler by invoking Slutsky symmetry to derive the upper-diagonal terms of the price-elasticity matrix, as explained above (Section 3.4). Lacking appropriate raw data, the elasticity estimates for the simulations were again chosen in consultation with economists at *Gosplan*.[18]

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[16] The prices are not necessarily those in Moscow or St. Petersburg; for example, the *kolkhoz* prices are based on November 1991 mid-point prices in 70 cities in Russia.

[17] This paragraph and the next draw heavily on Morduch, Brooks, and Urinson 1993.

[18] The model also derives summary statistics to provide statistical checks to verify the base data. The derived figures include implied budget shares for each income group by good; implied shares of purchases by channel; implied average consumer prices for each income group (weighted by the quantity consumed from each channel); and implied subsidy levels as a share of expenditure.

Table 3.2
Benchmark Data: Income and Subsidies

Income group	Cash income (rubles)	Value of subsidies (rubles)	Full income (rubles)	Percentage change in full income after removal of subsidies and money income increase by:		
				0%	50%	100%
low	1,200	1,337	2,537	−53	−29	−5
middle	2,700	2,049	4,749	−43	−14	+14
high	6,000	1,938	7,938	−24	+13	+51

Simulation Exercises: Policy Options

With the base data presented in Table 3.1, we move on to Table 3.3 to view the model in action (a wider set of policy simulations is considered in Morduch and Taylor 1992). Prices for each good may be set free (full liberalization) or set at some new fixed level (partial liberalization). Supplies may be augmented by the release of stocks or by imports. Income transfers may be set for each of the three income groups to provide a compensation scheme. These transfers may arise from augmented wages in enterprises, increased state pensions or direct payments, but are thought of as a simple "helicopter-drop" of money.

Lastly, the model may be solved in arbitrarily many iterations. In almost all examples, ten iterations are used. The qualitative results are robust to increasing the number of iterations, but coarse, even nonsensical, results may result from insufficient iteration.

COMPLETE ELIMINATION OF SUBSIDIES WITHOUT COMPENSATION

The policy simulations which we consider here center on the role of increasing transfers which accompanied the price reform. First we consider the results in Table 3.3, in which all subsidies have been eliminated and no compensation has been made. Under this scheme, the removal of all subsidies from food constitutes a large negative income effect on all consumers. Consequently, *ceteris paribus,* we expect market prices for most goods to fall, which is indeed the case. We find price declines for all goods between 24% and 70%. In some cases, these declines even bring the new free market price below the level of the base state prices: this is the case for milk, eggs, fish and bread. These price changes are summarized in the Laspeyres price indices shown below (base index level is 1.0); the market price

Table 3.3
All Prices Free; No Compensation

Price changes

		Old price (rbls.)			New market price (rbls.)	Percent change from old market price	Percent change from old state price
		State	Coop	Market			
Meat	(kg)	7.00	14.00	25.00	9.60	−62	37
Milk	(l)	0.65	0.65	2.00	0.60	−70	−10
Eggs	(#)	0.26	0.27	0.70	0.20	−66	−11
Fish	(kg)	1.50	1.50	1.70	1.00	−38	−30
Sugar	(kg)	2.40	3.50	4.00	3.70	−26	55
Oils	(kg)	3.00	6.00	12.00	7.00	−42	133
Pota	(kg)	1.00	1.50	1.50	1.10	−30	6
Vegs	(kg)	1.00	4.00	5.00	3.80	−24	278
Fruit	(kg)	3.00	6.00	12.00	8.40	−30	179
Bread	(kg)	1.19	1.19	1.19	0.70	−42	−42

	Meat (kg)	Milk (l)	Eggs (#)	Fish (kg)	Sugar (kg)	Oils (kg)	Pota (kg)	Vegs (kg)	Fruit (kg)	Bread (kg)
New consumption per person annual: all sources										
low	30.4	241.0	137.0	5.8	17.2	5.1	67.2	46.2	14.4	93.1
middle	61.1	334.0	200.0	13.4	26.8	5.9	81.8	76.2	33.1	96.7
high	104.0	441.0	268.0	21.3	24.1	8.4	94.0	114.0	59.9	97.3
average	64.5	340.0	204.0	13.7	25.1	6.2	82.0	78.8	35.2	89.4
Percent change in consumption										
low	−10	−4	−4	−7	−4	−4	0	−6	−11	−2
middle	−3	−1	−1	−2	−1	−1	0	−2	−3	0
high	11	5	5	7	5	5	0	7	11	2
average	0	0	0	0	0	0	0	0	0	0

Income and welfare

Cash income

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	1,200	1,200	0	1,200	1,107	−8
middle	2,700	2,700	0	2,700	1,800	−33
high	6,000	6,000	0	6,000	7,131	19
average	3,066	3,066	0	3,066	2,407	−21

Full income (cash and subsidies)

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	2,538	1,200	−53	2,538	2,510	−1
middle	4,749	2,700	−43	4,749	5,648	19
high	7,938	6,000	−24	7,938	12,542	58
average	5,004	3,066	−39	5,004	6,414	28

Laspeyres indices

	Market price	Avg. price	Qty.
low	0.48	1.08	0.927
middle	0.48	1.08	0.980
high	0.48	0.84	1.086

index falls to 0.48, and new average price indices are (1.08, 1.08, 0.84) by income group.

We also can see detailed consumption data on the impact of the change which suggests that low income consumers lose most (up to 11.2%), middle income consumers lose a little (up to 3.2%) and high income consumers gain (up to 11.1%). These welfare changes are verified in the summary Laspeyres quantity indices (base 1.0) calculated for each group: (0.927, 0.980, 1.086).

That the low income group loses and the high group gains follows from the fact that supplies are fixed (so some consumers can only gain at the expense of others) and the tendency of lower income groups to purchase more through state channels. When state subsidies are removed, the negative income effect is much greater for the groups most reliant on the subsidized channels.

COMPLETE ELIMINATION OF SUBSIDIES WITH COMPENSATION BIASED TOWARD THE POOR

Since poorer groups are adversely affected by a full liberalization without a compensation scheme, we now explore the implications of a set of income augmenting transfers biased toward the poor. As argued above, a proposal to raise all income across the board would be futile: since supplies are fixed, a general increase in the price level will result, and, as in the above no-compensation scheme, the poorer groups most reliant on subsidized channels will lose out. Thus, we first experiment with a policy where poor incomes are doubled (a 100% income gain in the low income group) and other incomes are raised by half (a 50% gain in middle and high income groups). This is, of course, a narrowly targeted relief scheme: recall that the low income group is only 13% of the population.

With nominal income transfers in place, we expect a much higher price level to result. This is indeed the case: Table 3.4 shows that now market prices fall between 4% and 20%, and, except for bread, the new market price is above the former state price, by up to 378% in the case of vegetables. This poor-biased policy is effective in protecting the welfare of the low income group: their consumption levels do not decline. In this case only the middle group loses, and, once again, the high income group enjoys large gains. The summary Laspeyres indices indicate a new market price index of 0.87 and average price indices of (2.15, 1.95, 1.54) by income group. Quantity indices are (1.008, 0.972, 1.082) by income group which confirm the gain of low and high groups at the expense of the middle group.

Table 3.4
All Prices Free; Compensation 100%-50%-50%

Price changes

		Old price (rbls.)			New market price (rbls.)	Percent change from old market price	Percent change from old state price
		State	Coop	Market			
Meat	(kg)	7.00	14.00	25.00	21.20	−15	203
Milk	(l)	0.65	0.65	2.00	1.60	−20	141
Eggs	(#)	0.26	0.27	0.70	0.60	−17	114
Fish	(kg)	1.50	1.50	1.70	1.60	−8	5
Sugar	(kg)	2.40	3.50	4.00	4.70	−6	97
Oils	(kg)	3.00	6.00	12.00	11.00	−9	266
Pota	(kg)	1.00	1.50	1.50	1.40	−6	41
Vegs	(kg)	1.00	4.00	5.00	4.80	−4	378
Fruit	(kg)	3.00	6.00	12.00	11.40	−5	278
Bread	(kg)	1.19	1.19	1.19	1.10	−9	−9

	Meat (kg)	Milk (l)	Eggs (#)	Fish (kg)	Sugar (kg)	Oils (kg)	Pota (kg)	Vegs (kg)	Fruit (kg)	Bread (kg)
New consumption per person annual: all sources										
low	34.5	253.0	144.0	6.2	18.1	5.3	67.5	49.8	16.4	35.3
middle	60.4	332.0	199.0	13.3	26.7	5.9	81.7	75.6	32.8	86.4
high	104.0	440.0	268.0	21.2	24.0	8.3	94.0	113.0	59.7	97.0
average	64.5	340.0	204.0	13.7	25.1	6.2	82.0	78.8	35.2	89.4
Percent change in consumption										
low	1	1	6	1	1	1	0	1	1	0
middle	−4	0	−1	−2	−1	−1	0	−2	−4	−1
high	11	4	4	6	5	4	0	6	10	2
average	0	0	0	0	0	0	0	0	0	0

Income and welfare

Cash income

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	1,200	2,400	100	1,200	1,117	−7
middle	2,700	4,050	50	2,700	2,578	−5
high	6,000	9,000	50	6,000	5,859	−2
average	3,066	4,677	53	3,066	2,922	−5

Full income (cash and subsidies)

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	2,538	2,400	−5	2,538	2,751	8
middle	4,749	4,050	−15	4,749	4,642	−2
high	7,938	9,000	13	7,938	10,319	30
average	5,004	4,677	−7	5,004	5,361	7

Laspeyres indices

Market price	Avg. price	Qty.
0.87	2.15	1.008
0.87	1.95	0.972
0.87	1.54	1.087

Complete Elimination of Subsidies with Compensation Biased toward the Poor and Middle Income Groups

It will be remembered that the middle group is a large share of the population, at 70%, and since they lose in the above scenarios, it is interesting to ask what might happen when a 100% income gain is extended to this group, as well as to the poor. We would expect transfers to this large group in the population to have profound effects on the structure of prices and welfare outcomes, and this is certainly confirmed by this policy exercise.

In this case, shown in Table 3.5, with yet more cash income in circulation, a still more inflationary outcome results. We find all market prices rising, between 6% and 36%, and all new market prices above the former state levels, by between 11% and 432%. The summary price indices are 1.22 for market prices, and (2.83, 2.83, 2.00) for average prices by income group.

Since the poor and rich have received no extra compensation whilst the middle have gained, relative to the previous example, we expect these two groups to lose as the middle group gains. Consumption patterns confirm that overall the low group loses now, although the high group, less adversely affected by subsidy removal, still gains a little. Significantly, the middle groups manages a slight gain too. The summary quantity indices are (0.944, 1.005, 1.004), and these illustrate that the large middle group can only make even modest gains at a relatively large cost to smaller groups: in this case, the poor.

Supply Shocks

A second set of policy exercises explores the impact of adverse supply shocks in the three compensation scenarios. A set of plausible supply shocks is shown in Table 3.6, ranging from a 20% decline in oil supply to a 1% decline in bread supply. These figures represent diminished production, impaired distribution of goods and wastage. In all cases we examine the impact of these new scarcities on a fully liberalized price structure.

Under a scheme without compensation, shown in Table 3.7, added scarcities serve to raise the general price level and raise individual prices in line with the scarcity of the given good relative to the previous case where no supply shocks apply. The new market price level index is 0.95 and average price indices are (1.93, 1.84, 1.41) by group. Quantity indices suggest that adverse supply shocks without compensation will still harm the low income group most, and the high income group least, and the actual indices are (0.801, 0.839, 0.926). The general

Table 3.5
All Prices Free; Compensation 100%-100%-50%

Price changes

		Old price (rbls.)			New market price (rbls.)	Percent change from old market price	Percent change from old state price
		State	Coop	Market			
Meat	(kg)	7.00	14.00	25.00	31.80	27	355
Milk	(l)	0.65	0.65	2.00	2.70	36	309
Eggs	(#)	0.26	0.27	0.70	0.90	29	233
Fish	(kg)	1.50	1.50	1.70	1.90	13	28
Sugar	(kg)	2.40	3.50	4.00	5.30	7	122
Oils	(kg)	3.00	6.00	12.00	13.50	12	350
Pota	(kg)	1.00	1.50	1.50	1.60	8	63
Vegs	(kg)	1.00	4.00	5.00	5.30	6	432
Fruit	(kg)	3.00	6.00	12.00	13.10	9	335
Bread	(kg)	1.19	1.19	1.19	1.30	11	11

	Meat (kg)	Milk (l)	Eggs (#)	Fish (kg)	Sugar (kg)	Oils (kg)	Pota (kg)	Vegs (kg)	Fruit (kg)	Bread (kg)
New consumption per person annual: all sources										
low	31.3	243.0	139.0	5.9	17.4	5.1	67.2	47.0	14.8	93.5
middle	63.4	338.0	203.0	13.7	27.0	6.0	81.9	77.7	34.4	87.2
high	94.4	423.0	257.0	20.0	23.0	8.0	93.6	107.0	54.2	95.2
average	64.5	340.0	204.0	13.7	25.1	6.2	82.0	78.8	35.2	89.4
Percent change in consumption										
low	−8	−3	−3	−5	−3	−3	0	−5	−8	−2
middle	1	0	0	0	0	0	0	0	1	0
high	1	0	0	0	0	0	0	0	0	0
average	0	0	0	0	0	0	0	0	0	0

Income and welfare

Cash income

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	1,200	2,400	100	1,200	849	−29
middle	2,700	5,400	100	2,700	3,104	15
high	6,000	9,000	50	6,000	4,495	−25
average	3,066	5,622	83	3,066	2,969	−3

Laspeyres indices

	Market price	Avg. price	Qty.
low	1.22	2.83	0.944
middle	1.22	2.83	1.005
high	1.22	2.00	1.004

Full income (cash and subsidies)

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	2,538	2,400	−5	2,538	1,960	−23
middle	4,749	5,400	14	4,749	4,410	−7
high	7,938	9,000	13	7,938	7,349	−7
average	5,004	5,622	12	5,004	4,591	−8

Table 3.6
Supply Shocks, Percent of Base Supply

Meat	Milk	Eggs	Fish	Sugar	Oils	Pota	Vegs	Fruit	Bread
−15	−10	−5	−10	−15	−20	−10	−15	−25	−1

pattern of consumption shows that the low income group experiences the most severe cutbacks in all goods.

Table 3.8 illustrates that even a poor-biased compensation scheme leaves the high income group least harmed by the adverse supply shocks, as in Table 3.4 when these shocks were absent. The bias to the poor comes now at the expense of the middle group, which experiences the biggest decline in consumption levels. Quantity indices are now (0.872, 0.832, 0.923) and the outcome is seen to be more inflationary than the previous example, as expected. The market price index rises to 2.19 and average price indices to (4.95, 4.27, 3.22) by group.

Finally, Table 3.9 illustrates that, as in Table 3.5, compensation of the middle group comes at the expense of both low and high groups. The 100%-100%-50% scheme is more inflationary, but, with their incomes better protected, the large middle group has a large impact on the price level, depressing the welfare of the other groups. Quantity indices are now (0.817, 0.861, 0.856) and the new market price index jumps to 3.80. By group, average price indices rise to (8.91, 7.78, 5.15).

3.5 Conclusions

It should be reiterated that these results pertain only to changes in the relatively short term. This has enabled us to abstract from otherwise important interactions between demand, supply and factor markets. Moreover, the model has been designed to facilitate understanding of the key market forces, and we have not modelled important short-term phenomena like hoarding and speculation. We also abstract from monetary expansion as a source of inflation and changes in the general price level. Furthermore, the analysis pertains to a region typical of the Russian Republic and masks important regional differences within Russia. These simplifications have allowed us to focus on several important mechanisms which characterize price liberalizations. In particular, we have shown that, while not obvious at first glance, the distributional impact of price liberalization hinges on policies regarding compensation and interactions between key markets. These

Table 3.7
All Prices Free; Adverse Supply Shock; No Compensation

Price changes

		Old price (rbls.)			New market price (rbls.)	Percent change from old market price	Percent change from old state price
		State	Coop	Market			
Meat	(kg)	7.00	14.00	25.00	19.50	−22	179
Milk	(l)	0.65	0.65	2.00	1.80	−6	182
Eggs	(#)	0.26	0.27	0.70	0.50	−33	73
Fish	(kg)	1.50	1.50	1.70	1.40	−20	−9
Sugar	(kg)	2.40	3.50	4.00	5.70	14	137
Oils	(kg)	3.00	6.00	12.00	21.40	78	613
Pota	(kg)	1.00	1.50	1.50	3.90	158	287
Vegs	(kg)	1.00	4.00	5.00	5.10	3	414
Fruit	(kg)	3.00	6.00	12.00	12.80	7	327
Bread	(kg)	1.19	1.19	1.19	0.80	−35	−35

	Meat (kg)	Milk (l)	Eggs (#)	Fish (kg)	Sugar (kg)	Oils (kg)	Pota (kg)	Vegs (kg)	Fruit (kg)	Bread (kg)
New consumption per person annual: all sources										
low	25.8	217.0	130.0	5.2	14.6	4.1	60.4	39.2	10.7	92.2
middle	51.9	301.0	190.0	12.0	22.8	4.8	73.6	64.7	24.8	85.9
high	88.9	397.0	255.0	19.1	20.5	6.7	84.6	97.3	45.0	96.3
average	54.8	306.0	193.0	12.4	21.3	5.0	73.8	66.9	26.4	88.5
Percent change in consumption										
low	−24	−13	−9	−16	−18	−23	−10	−20	−34	−3
middle	−17	−10	−6	−11	−15	−20	−10	−16	−27	−1
high	−5	−6	−1	−4	−10	−16	−10	−9	−17	1
average	−15	−10	−5	−10	−15	−20	−10	−15	−25	−1

Income and welfare

Cash income

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	1,200	1,200	0	1,200	623	−48
middle	2,700	2,700	0	2,700	2,088	−23
high	6,000	6,000	0	6,000	4,265	−29
average	3,066	3,066	0	3,066	2,237	−27

Laspeyres indices

Market price	Avg. price	Qty.
0.95	1.93	0.801
0.95	1.84	0.839
0.95	1.41	0.926

Full income (cash and subsidies)

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	2,538	1,200	−53	2,538	1,259	−50
middle	4,749	2,700	−43	4,749	2,833	−40
high	7,938	6,000	−24	7,938	6,295	−21
average	5,004	3,066	−39	5,004	3,217	−36

Table 3.8
All Prices Free; Adverse Supply Shock; Compensation 100%-100%-50%

Price changes

		Old price (rbls.)			New market price (rbls.)	Percent change from old market price	Percent change from old state price
		State	Coop	Market			
Meat	(kg)	7.00	14.00	25.00	44.70	79	538
Milk	(l)	0.65	0.65	2.00	8.30	324	1,172
Eggs	(#)	0.26	0.27	0.70	1.30	93	396
Fish	(kg)	1.50	1.50	1.70	2.00	20	37
Sugar	(kg)	2.40	3.50	4.00	7.10	42	196
Oils	(kg)	3.00	6.00	12.00	33.30	178	1,011
Pota	(kg)	1.00	1.50	1.50	5.60	275	462
Vegs	(kg)	1.00	4.00	5.00	6.40	29	544
Fruit	(kg)	3.00	6.00	12.00	17.10	43	471
Bread	(kg)	1.19	1.19	1.19	1.20	1	1

	Meat (kg)	Milk (l)	Eggs (#)	Fish (kg)	Sugar (kg)	Oils (kg)	Pota (kg)	Vegs (kg)	Fruit (kg)	Bread (kg)
New consumption per person annual: all sources										
low	29.3	228.0	137.0	5.6	15.4	4.3	60.7	42.4	12.3	94.3
middle	51.3	299.0	189.0	12.0	22.6	4.7	73.6	64.2	24.6	85.5
high	88.5	396.0	254.0	19.1	20.4	6.7	84.6	96.9	44.9	96.1
average	54.8	306.0	193.0	12.4	21.3	5.0	73.8	66.9	26.4	88.5
Percent change in consumption										
low	−14	−9	−4	−9	−14	−19	−10	−14	−24	−1
middle	−18	−11	−6	−12	−15	−21	−10	−16	−28	−2
high	−6	−6	−1	−4	−10	−16	−10	−9	−17	1
average	−15	−10	−5	−10	−15	−20	−10	−15	−25	−1

Income and welfare

Cash income

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	1,200	2,400	100	1,200	485	−60
middle	2,700	4,050	50	2,700	3,340	24
high	6,000	9,000	50	6,000	2,792	−53
average	3,066	4,677	53	3,066	2,255	−26

Laspeyres indices

Market price	Avg. price	Qty.
2.19	4.95	0.872
2.19	4.27	0.832
2.19	3.22	0.923

Full income (cash and subsidies)

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	2,538	2,400	−5	2,538	1,097	−57
middle	4,749	4,050	−15	4,749	1,852	−61
high	7,938	9,000	13	7,938	4,115	−48
average	5,004	4,677	−7	5,004	2,138	−57

Table 3.9
All Prices Free; Adverse Supply Shock; Compensation 100%-100%-50%

Price changes

		Old price (rbls.)			New market price (rbls.)	Percent change from old market price	Percent change from old state price
		State	Coop	Market			
Meat	(kg)	7.00	14.00	25.00	36.90	48	427
Milk	(l)	0.65	0.65	2.00	25.60	1,212	3,835
Eggs	(#)	0.26	0.27	0.70	2.20	227	743
Fish	(kg)	1.50	1.50	1.70	2.50	49	69
Sugar	(kg)	2.40	3.50	4.00	7.90	59	231
Oils	(kg)	3.00	6.00	12.00	41.90	249	1,296
Pota	(kg)	1.00	1.50	1.50	7.00	370	605
Vegs	(kg)	1.00	4.00	5.00	7.10	43	614
Fruit	(kg)	3.00	6.00	12.00	19.60	63	553
Bread	(kg)	1.19	1.19	1.19	1.50	22	22

	Meat (kg)	Milk (l)	Eggs (#)	Fish (kg)	Sugar (kg)	Oils (kg)	Pota (kg)	Vegs (kg)	Fruit (kg)	Bread (kg)
New consumption per person annual: all sources										
low	22.6	219	132.0	5.3	14.7	4.1	60.5	39.9	11.1	92.5
middle	53.9	304	193.0	12.3	23.0	4.8	73.7	66.0	25.8	86.3
high	80.3	380	244.0	18.0	19.6	6.4	84.2	91.3	40.7	94.2
average	54.8	306	193.0	12.4	21.3	5.0	73.8	66.9	26.4	88.5
Percent change in consumption										
low	−22	−12	−8	−14	−17	−22	−10	−19	−31	−3
middle	−14	−10	−5	−10	−14	−19	−10	−14	−25	−1
high	−14	−10	−5	−10	−14	−19	−10	−14	−25	−1
average	−15	−10	−5	−10	−15	−20	−10	−15	−25	−1

Income and welfare

Cash income

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	1,200	2,400	100	1,200	269	−78
middle	2,700	5,400	100	2,700	3,732	38
high	6,000	9,000	50	6,000	1,749	−71
average	3,066	5,622	83	3,066	1,829	−40

Full income (cash and subsidies)

	Nominal			Real: avg. price deflator		
	Base	New	Percent change	Base	New	Percent change
low	2,538	2,400	−5	2,538	632	−75
middle	4,749	5,400	14	4,749	1,421	−70
high	7,938	9,000	13	7,938	2,369	−70
average	5,004	5,622	12	5,004	1,480	−70

Laspeyres indices

	Market price	Avg. price	Qty.
low	3.80	8.91	0.817
middle	3.80	7.78	0.861
high	3.80	5.15	0.856

results yield several broad conclusions concerning the implications of full and partial liberalization, and various compensation schemes, as well as the consequences of adverse supply shocks.

First, since subsidy removal involves a negative income impact on all groups, liberalization, *ceteris paribus,* will entail a general decline in the market price level. Thus, pre-reform market prices in no way give an accurate prediction of the stable post-reform price structure. Indeed, unless inflationary monetary policy or some other forces, such as hoarding or speculation, serve to drive up prices in the interim, an uncompensated full price liberalization should entail a post-reform price level well below the pre-reform free-market price level. In this regard, our model is obviously to be viewed as an analysis of the stable post-reform price structure since it does not account for temporary destabilization due to hoarding and speculative transactions. The time-horizon is therefore best envisaged as around two or three months, looking forward to a time when the considerable stocks hoarded have been run down, and when speculative activity has ceased: at such a time prices should begin to fall from their currently inflated level during the immediate post-reform confusion.

Second, our policy analysis suggests that only a targeted compensation scheme, biased to the poor, can adequately protect low income groups from the adverse effects of liberalization on their welfare. Expressed as a proportion of their pre-reform full income, the subsidies to the poor were considerably larger than in any other group; consequently, subsidy removal is most acutely felt by this group as a negative income effect, and, in a zero-sum game where supplies are fixed, the low income group will necessarily suffer more whilst the rich gain. Indeed, the middle group loses in some small measure when not compensated too, reflecting their relatively heavy reliance on subsidies. Obviously, a flat compensation scheme (say, doubling all incomes) is futile in such a zero-sum scenario: raising the general price level and not redistributing income still leaves the low group much worse off, and consumption outcomes little changed.

Third, the consumption outcomes are very sensitive to the amount of compensation granted the middle group. Since the group is relatively numerous (a 70% share of population) changes in their demands have large impacts on the price level. Thus, extending a biased compensation scheme to this group effectively undoes the compensation of the poor, as well as harming the high income group. This suggests that widespread compensation schemes which include the middle classes must be carefully designed to take this sensitivity into account.

Finally, and somewhat surprisingly, the subsidy system exacerbates inequalities in its impact both before and after liberalization. When in place prior to liberalization, richer groups were well-placed to take advantage of subsidies, relative to the poorest groups. When the subsidies were removed, however, the liberalization generated a much larger negative proportional income effect on poorer groups, since these groups relied more on subsidies as a share of their full income. Thus, given the size of wage increases which accompanied the liberalization and largely benefitted better-off workers in enterprises, the non-poor groups tended to fare relatively better than the poor.

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