

The Economic Role of Russia's Subsistence Agriculture in the Transition Process

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Abstract. In this paper we analyze the role of subsistence-oriented agriculture in Russia in the 1990s. We start out by discussing the diverging economic effects of the growth of subsistence agriculture in Russia ever since the transition process started. The quantitative analysis of this sector's role is carried out by means of an applied computable general equilibrium (CGE) model applying a 1994 social accounting matrix (SAM) as base year data. The novelty of the paper is to disaggregate primary agricultural production not by products but by farm types, which enables us to distinguish their institutional and economic characteristics. The model also explicitly differentiates between marketed and subsistence consumption or formal and informal marketing activities of agricultural producers. We simulate two *ex post* and two *ex ante* experiments. The results of the first backward looking experiment highlight that Russia's subsistence agriculture was an important buffer against further agricultural output declines during transition and, hence, against food insecurity. A simulation, which looks into the effects of a devaluation of the Russian ruble shows that the financial crisis should have increased the relative competitiveness particularly of large-scale crop farms versus small-scale farms. Two forward-looking experiments indicate that efficiency enhancing institutional change would benefit both large-scale and small-scale farms alike. However, within small-scale agriculture a shift from subsistence to commercial agriculture would take place.

Keywords: Russia, transition, subsistence agriculture, CGE model, exchange rate, institutions

1 Introduction

From the socialist era, Russia inherited a dualistic structure of agricultural production. While the former collective sector was operating in large-scale production units—so-called *kolkhozi* and *sovkhozi*, i.e. the former collective and state, large-scale farms—a substantial share of agricultural production has been produced in small-scale production units. In the course of the 1990s the production share of the small-scale agricultural producers who were mainly subsistence-oriented was, according to official estimates, more than 50% (GOSKOMSTAT 2001). At the same time Russia's agricultural sector has been among those sectors in which the macroeconomic and economy-wide reforms of the first transition period has resulted only in partial restructuring and a long lasting drastic output decline.

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Because subsistence agriculture is an important feature in many transition countries, this phenomenon has received a lot of attention. The question that is much debated is “Is it good or is it bad?”² On the one hand, it is argued that in the transition process this sector has played a buffer role against food insecurity and thus prevented households from falling into absolute poverty (SEETH ET AL. 1997). LERMAN and SCHREINEMACHERS (2002) argue that small-scale individual farms employ more labor per hectare of land than large-scale corporate farms without suffering from lower labor productivity and have been a labor sink in rural areas of Russia in the 1990s. On the other hand, it is argued that the small-scale producers are a constant strain on the former collective farms. KOESTER and STRIEWE (1999) find that the private subsidiary plots (in Russian: *Lichnie Podsobnie Khozyaistva/LPH*-producers) in the Ukraine are actually ‘cross-subsidized’ because they obtain industrial and on-farm inputs from the collective farms in substantial amounts. Similarly, AMELINA (2000) showed that in Russia overt and covert benefits indeed explain why Russian peasants remain in collective farms.

Against the background of the increased relative importance of subsistence agriculture in Russia and the, to some extent contradicting, judgement of this sector’s role in the transition process, it is of interest to represent subsistence farms explicitly in models when conducting quantitative policy analysis. However, theoretically and empirically consistent economy-wide models that include subsistence agriculture are still rare in the case of transition countries. One possibility is to represent subsistence agriculture as a separate sector in an applied computable general equilibrium (CGE) model. In the past, such models have been used in numerous studies analyzing macroeconomic policies and strategies for the development of agriculture in developing countries in which subsistence agriculture plays a pivotal role (c.f. BAUTISTA AND THOMAS 2000; WOBST 2001). However, there are only few such CGE models for transition countries yet. For instance, BECKMANN and PAVEL (2001) have developed a stylized CGE model for Bulgaria with two production sectors and a household sector producing food. In this paper we present an applied CGE model that is characterized by a high disaggregation of the production side. The novelty of this paper is to disaggregate agriculture not by production sectors but by different types of farms. In so doing, we will be able to analyze quantitatively the role of subsistence agriculture in Russia’s transition process.

We start out in Chapter 2 with a discussion of the structure and trends in Russia’s agricultural sector in the 1990s. In Chapter 3 we provide a non-technical description of the modeling

2 In May 2001 a conference with the title “Subsistence agriculture in Central and Eastern Europe: How to break the vicious cycle?” took place in Halle/Saale, Germany (www.iamo.de).

framework and present the model's database in Chapter 4. We then discuss in Chapter 5 the results of four simulations and finish in Chapter 6 with the conclusions.

2 Russia's agro-food sector between decline and recovery

In the 1990s Russia's agriculture and food industries were particularly suffering from the transition process and the associated restructuring of the economy. The share of GDP produced in the agricultural sector dropped from about 16% in 1990 to 7% in 1998 while the sector's share in total employment dropped only from about 14% in the early 90s to about 13% at the end of the 90s (see Table 1). These facts indicate that Russia's agricultural development in the 90s was characterized by many inefficiencies and restructuring occurred very slowly. To a large extent this has been linked to the poor economic performance of the *kolkhozi* and *sovkhozi*. Before the financial crisis hit Russia's economy in 1998 about 90% of these large-scale operations were highly indebted and were making losses (see Table 1). Often 'soft budget constraints' exercised by regional administrations or politicians kept a substantial number of the large-scale farms which specialized either in crop or in livestock production operational.

Parallel to the decline of the large-scale sector, a shift in agricultural production has taken place towards the private subsidiary plots. These subsistence-oriented production units of the rural populace are typical for agriculture in most countries of the Former Soviet Union. In Russia, the subsidiary plots of the workers in the former collective farms are normally not bigger than 1 ha. The total number of these subsidiary plots in Russia in 1994 was estimated at 16.5 million (GOSKOMSTAT 1999: 217). Additionally, most urban households in Russia maintain a private individual family garden on the outskirts of the cities, the well-known *datchas*, where substantial amounts of food are produced as well. According to official estimates of the Russian Statistical Office, GOSKOMSTAT (1999: 217), the total number of such family gardens in 1994 was about 22.4 million. While GOSKOMSTAT takes the production of LPH farmers into account when estimating the country's gross agricultural output (GAO) it neglects production from the private gardens of urban households. In fact, the number and type of household plots and *datchas* varies significantly between regions in Russia and between the type and size of settlements. For instance, in a household survey of three Russian oblasts (Orel, Pskov, and Rostov), the share of households with access to some kind of a private garden in the capital of the region was much lower (77, 36, and 30%, respectively) than in other urban dwellings in the region (87, 58, and 54%). In the rural areas of these oblasts, all of which are located in the European part of Russia, almost all households had either access to a household plot or a private garden in all three regions (99, 97, and

100%) (THO SEETH 1997: 140). Based on the same survey average shares of own produced food in total household consumption were calculated. The respective data indicates that subsistence production was particularly important for the consumption of potatoes, vegetable and milk (subsistence share > 80%), and still significant for other product groups such as fruits, meat and sausages, eggs, and alcoholic beverages (subsistence share between 40 and 80%) (VON BRAUN ET AL. 2000). Despite the fact that a major share of GAO today is produced on such private subsidiary plots, during the 1990s no agricultural policies were directly targeted to subsistence-oriented agriculture in Russia. In June 1999, the Government of Russia (2000) acknowledged the relative importance of the small-scale sector in Russia's agricultural sector by discussing potential steps to stimulate the commercialization of this sector.

Table 1: Russia's agro-food sector in the transition period

	1985	1990	1993	1996	1998
Share of agriculture in GDP, in % ¹⁾	9 ²⁾	16	8	9	7
Agriculture's share in total employment, in %	-	14	15	14	13
Agriculture's share in investments, in %	15	16	8	3	3
Grain production, in million t	99	117	99	69	48
Mineral fertilizer used, kg/ha of sowed land	85	88	46	17	18 ⁴⁾
Output by type of user, in % of total output					
by agricultural enterprises	77	74	57	51	50 ⁴⁾
by private "family" farms	<i>n.a.</i>	<i>n.a.</i>	3	2	2 ⁴⁾
by private subsidiary plots and private gardens	23	26	40	47	48 ⁴⁾
Share of food in total imports, in %	<i>n.a.</i>	20	22	25	26
Agro-food trade balance, in \$US bn	<i>n.a.</i>	<i>n.a.</i>	-4.3	-8.4	<i>n.a.</i>
Average meat consumption, in kg per capita	67	75	59	51	48
Average PSE, in % ⁵⁾	81 ²⁾	69	-22	26	19

Notes: 1) Most figures are official estimates, which do not always take into account informal economic activities. 2) Value for 1980. 3) Value for 1986. 4) Value for 1997. 5) Negative PSE indicate taxation, positive PSE subsidization of producers. However, estimates of this indicator for transition economies have to be interpreted with particular caution. They rely on official data and the official exchange rate, to which they are extremely sensitive. In the case of Russia, on top of macroeconomic and sectoral policies, institutional developments have been decisive for the trend in both measures.

Sources: OECD 2001. GOSKOMSTAT 1999 and 2001.

Another type of farms that received a lot of attention with respect to Russia's efforts of restructuring the farm economy are fully privatized and newly created private farms. In 1994, 270,000 such farms were operating mostly as family farms (GOSKOMSTAT 1999).³ In relation to the former collective farms these private farms need to be categorized as small-

3 The restructuring of Russia's farm sector has received much attention and is discussed in various publications. Background information on the early pattern of agricultural restructuring can be found, for instance, in BROOKS and LERMAN (1994).

scale producers because their average size of land holdings does normally not exceed 45 ha. After 1994, the number of private farms stagnated because of detrimental institutional conditions for private entrepreneurship in the Russian countryside. Accordingly, the officially reported share of these private farms in GAO remained at about the same level it had already reached in 1994 (3%). While the former collective farms together produced approximately 80% of GAO in 1990, this share dropped to about 53% in 1994 and even below 50% prior to Russia's financial crisis in 1998 (GOSKOMSTAT 1999). By 1994, a share of about 44% of GAO was produced by the subsistence-oriented private subsidiary plots.

Another very recent trend in Russia's agricultural sector is the emergence of extremely large agro-holdings. They are characterized by a high degree of vertical integration, normally operate under more modern and western management, make use of private capital, and are very commercial. A survey of 16 of these "new operators" conducted in 2001 in seven Russian regions in the southern and, hence, most fertile area of the country revealed an average size of these holdings of 36,000 ha (RYLKO 2001). These "new operators" normally lease land from a "mother-farm" that used to be a collective farm, which involves complex contractual arrangements. First, the members of the former collective farms who received land shares when the land was formally distributed in the early 1990s had to accept the deal. Second, anecdotal evidence suggests that regional governments were supporting the creation of these new agro-holdings only if the new management helped in settling at least parts of the debts accumulated by these farms in the course of the 1990s. However, their legal status and operational system is still very diverse and Russian statistics does not publish any information on these farms yet because of which we cannot include them explicitly in our analysis. At the same time, this trend indicates that a land lease market is slowly emerging in Russia and that new institutional arrangements at the farm level might induce significant change in Russia's agriculture in the nearby future.⁴

3 Non-technical discussion of the general equilibrium model for Russia

3.1 The core elements of the model: producers, consumers, the government, and prices

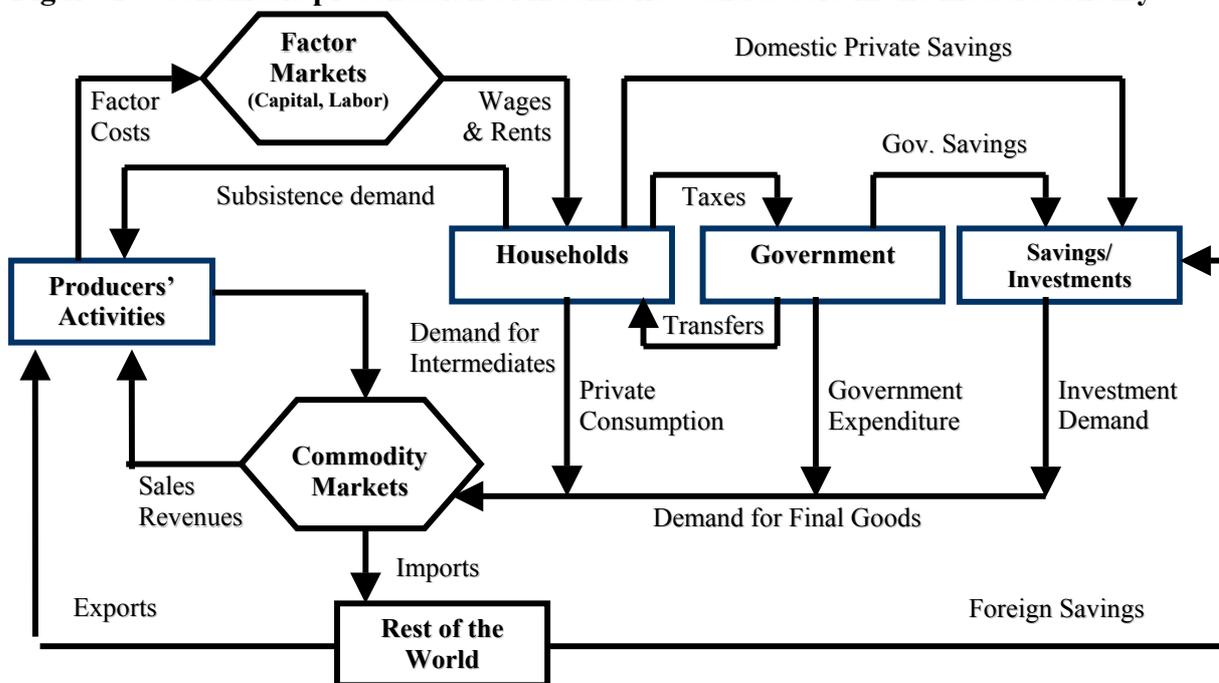
The CGE model for Russia is developed along the lines of models as described in LÖFGREN ET AL. (2002). To reflect some of the features characteristic for the Russian economy in transition we have modified the standard CGE model by reducing the full mobility of

4 Federal Law No. 101 on the *Circulation of Agricultural Lands* has passed the Duma and the Federation council and has been signed by President Putin in mid-2002. It will become effective in January 2003.

economic resources (see section 3.2). Hence, we combine standard neo-classical behavior with economic features that are the result of imperfect markets or structural rigidities, because of which our model could be best classified by “neo-classical structuralism” (ROBINSON 1989).

Figure 1 presents the actors and the income flow in the model economy. The major actors in the economy are: producers, one representative household, the central government, a savings/investments account, and the rest of the world. Some income flows are channeled through factor and commodity markets, where the respective monetary payment corresponds to a physical flow of productive factors or goods into the opposite direction. The factor markets receive payments from producer activities and make payments for wages and capital rents to households.

Figure 1: Schematic presentation of income flow and actors in the model economy



Note: Each arrow constitutes a payment from one economic agent to another economic agent.

The commodity markets “buy” products from the domestic producers (activities) and the rest of the world (imports) and, hence, make payments to both of them. These “commodity markets” represent the formal part of the economy and sell the assembled commodities to producer activities as intermediates and to final demand components as consumer goods. Hence, while the sector-specific activities can be perceived as an account for the ‘production unit or the producer’ representing a specific sector the commodity account can be perceived as the ‘market place’ through which the output of the respective sector is channeled to

consumption. Note that the producer activities and the commodity markets will be disaggregated into 20 different sectors out of which four represent the primary farm sectors. In our model, these four sectors can at least to some extent circumvent the formal commodity markets and instead sell their products to households directly to meet their subsistence demand for food products. This implies that there is an income flow associated with households' demand for subsistence production. However, the shadow prices at which the goods for subsistence demand are evaluated do not incorporate the marketing margin, which is part of the price for all goods channeled through the formal commodity markets.

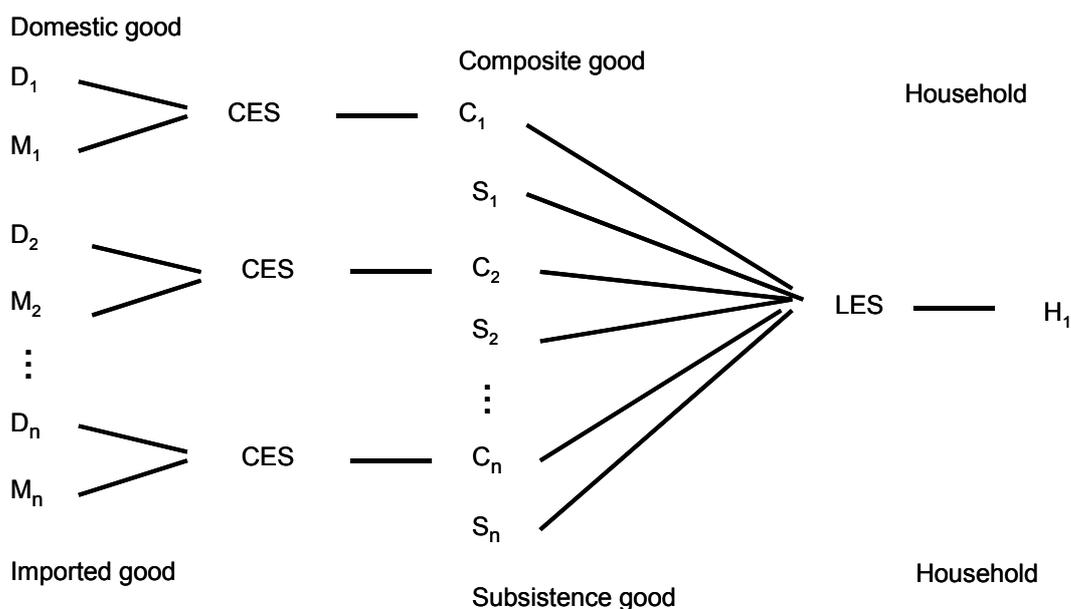
The behavioural design of the production side is standard and straightforward: Producers minimize their costs under the conditions of a neoclassical production function. On the production side all intermediates are used according to sectorally specified and fixed input output coefficients (IOC) for each unit of output. Substitution between labor and capital is specified with a constant elasticity of substitution (CES) function. Value-added prices are determined as the difference between sectoral unit revenues and unit costs for intermediates. Furthermore, it is assumed that producers maximize their revenues from domestic sales and exports under the restriction of a constant elasticity of transformation/CET function.

On the demand side non-standard features are combined with standard elements to adequately model the institutional peculiarities of household's food demand in Russia (Figure 2). Similarly as on the production side the general decision rule on the demand side is neoclassic in spirit: consumers maximize their utility under the restriction of a budget constraint. Final demand of households for consumption goods is determined through a linear expenditure system (LES) using fixed minimum expenditure quantities and fixed marginal expenditure shares. As mentioned in section 2, subsistence demand is an important component of total household consumption. Therefore, the LES demand system combines composite goods with subsistence goods. While the composite goods are *sold* via the commodity markets (valued at consumer prices), the subsistence goods originate directly from the agriculture and food-processing activities, because of which no marketing margins have to be paid (valued at producer prices). The marketed commodities are composite goods comprising of domestic and imported goods using a constant elasticity of substitution (CES) function. This represents the *Armington assumption*, which implies that home and foreign goods are imperfect substitutes.

Domestic prices for imported commodities are determined by respective world market prices, the exchange rate and tariffs. The model assumes perfectly elastic import supply (small country assumption). Consumer prices are the weighted average of domestic product and

import prices. Due to the LES specification, the model does *not* allow for direct substitution between (informal) subsistence demand and goods marketed via the (formal) commodity markets. However, depending on relative producer and consumer prices at which the two consumption categories are valued respectively, their relative quantities shift towards the more favorable category.

Figure 2: Nested functional forms on the demand side



Government receives revenues from import tariffs, export taxes, and indirect production taxes, as well as direct income taxes. Government demand is determined using fixed shares of aggregate real spending, while the budget surplus is defined as the difference between revenues and government demand for goods.

World market prices are exogenous, domestic import and export prices depend on world market prices, tariff and export tax rates, as well as the exchange rate. Prices for the composite demand and output good are determined by the weighted prices for imports and domestic goods and for exports and products for the domestic market. Changes in relative prices and substitution possibilities determine supply, demand and trade. If relative prices change, substitution can take place between factors of production, export supply and domestic supply, imports and domestically produced imperfect substitutes, and different commodities in demand. Export demand is price elastic, which is particularly important for Russia's energy sector. Domestic export prices depend on their respective *f.o.b.* prices in foreign currency (US\$), the export subsidy and the exchange rate. All prices in the model are determined as relative prices and no monetary market is explicitly modeled. Out of n prices in each sector (e.g., import price, producer price, etc.) $n-1$ prices are linear dependent from other prices.

Hence prices have to be defined in relation to some exogenously determined price. Here, the domestic sales price index is kept constant and used as the *numeraire*.

3.2 Modeling transition-specific features of Russia's economy

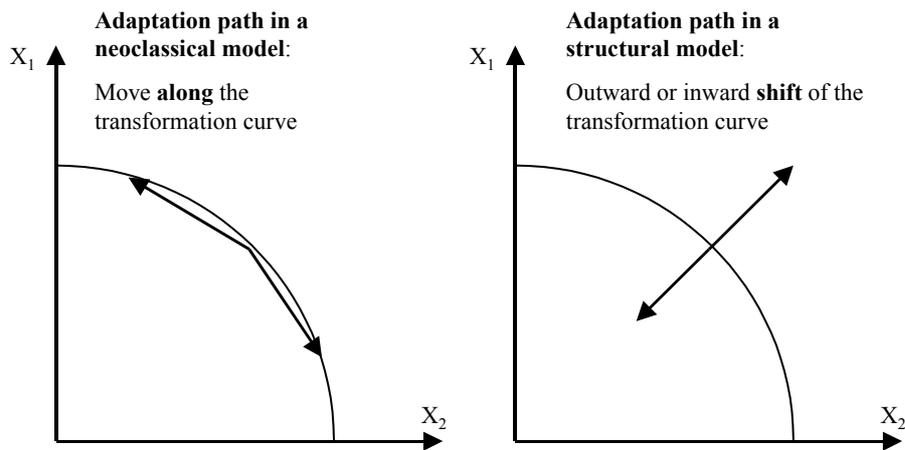
Various features of the Russian economy in transition imply that the use of a purely neoclassical model for economic analyses would be inappropriate. Therefore, we modified the standard neoclassical CGE model closures by incorporating various structural features such as imperfect or “sticky” factor markets. However, some of these rigidities have been of a temporary nature and were prevalent in the 1990s. After the financial crisis that hit Russia in mid-1998 the Russian transition process has become more sustainable and some of these rigidities are getting obsolete. Therefore, the model specification will differ between *ex post* (Experiments 1 and 2) and *ex ante* simulations (Experiments 3 and 4). An overview of the different closure rules for both types of experiments is provided in Table 2.

In Experiment 1 and 2 labor and capital markets are segmented, i.e. we differentiate between agricultural and non-agricultural labor and capital, respectively. Labor in the non-agricultural sectors is mobile across sectors. In the agricultural sectors total labour supply in the *ex post* experiments is characterized by full employment and labor demand is fixed in each of the four agricultural sectors. With this closure we attempt to capture one labour market feature that characterized Russia's agriculture in the 1990s: Most large-scale farms did not release labor in spite of being bankrupt, instead long-lasting arrears of monetary wage payments became common practice.

In the non-agricultural sectors we assume that unemployment can occur. Official estimates for 1994 indicate that the average unemployment rate in the Russian economy was 10.4%, which does not account for the substantial amount of hidden unemployment (GOSKOMSTAT 2001). The unemployment specification is incorporated in the *ex post* experiments through the fixing of the nominal wage rates, at which excess supply of labor allows to hire (release) labor if the profitability in a sector increases (decreases). Hence, total employment in these sectors is determined by demand, instead of being determined exogenously as it is the case in the neoclassical full employment specification. In the *ex ante* experiments (3 and 4) we drop the assumption of unemployment in all sectors, which increases the need to restructure the economy in response to exogenous shocks. The difference with respect to this closure between the *ex post* and the *ex ante* experiments implies the following: because the labor stock in non-agricultural sectors can be expanded in the *ex post* experiments the model solution can be located *below or above* the transformation curve as determined by the labor

and capital endowment in the base run (see Figure 3). In the *ex ante* experiments full employment of all resources is assumed because any exogenous shock can be adjusted for by a restructuring of the economy, and hence, a move *along* the transformation curve of the base run.⁵ Additionally, in the two *ex ante* experiments we assume a higher economy-wide flexibility in labor markets, i.e. we dropped the assumption of labor market segmentation and allowed for inter-sectoral mobility between the rural to the non-agricultural labor markets.

Figure 3: Adaptation of production to an exogenous shock in a neoclassical and in a structural model economy



Capital has been specified as follows: In the *ex post* experiments capital-markets are segmented between agriculture and non-agriculture, and in agriculture capital is sector-specific and fully employed while in the non-agricultural sectors it is fully employed and mobile across sectors. Capital in agriculture refers to land, machines and buildings. With respect to these production factors literally no shifts from the former collective farms to the subsistence sector have taken place in the transition process. Combines and tractors became obsolete as no spare parts were affordable anymore and were not shifted to subsistence agriculture. Furthermore, land was not shifted from the former collective sector to subsistence farms in spite of the fact that productivity of the former has plummeted in the course of the 1990s (e.g. SEDIK et al. 2000). Therefore, we did not allow for mobility of capital across agricultural sectors. In the two *ex ante* experiments we also increased the flexibility of capital markets: the assumption of segmented capital markets has been dropped.

Table 2: Overview of closures used in the experiments

		Ex-post experiments Exp. 1 and 2	Ex-ante experiments Exp. 3 and 4
Labor	Agriculture	Full employment, fixed in each	Full employment, fully mobile

⁵ For a more detailed discussion of the effects of this change in the model's closure see Wehrheim (2003).

		agricultural sector	
	Non-agriculture Segmentation ¹⁾	Unemployment, fully mobile Yes	Full employment, fully mobile No
Capital	Agriculture	Full employment, fixed in each agricultural sector	Full employment, fixed in each agricultural sector
	Non-agriculture Segmentation	Full employment, fully mobile Yes	Full employment, fully mobile No
Balance of Trade		Flexible exchange rate; fixed capital account balance	Flexible exchange rate; fixed capital account balance
Savings-investments identity		Aggregate investment constant share of absorption	Aggregate investment constant share of absorption

Notes: 1) ‘Segmentation’ implies that the respective production factor is not mobile between agricultural and non-agricultural sectors.

With respect to the macro-closures we have chosen a standard specification in order to keep the causality in the model economy straightforward. The balance of trade is equilibrated through a flexible exchange rate, as the Russian ruble has significantly adjusted to changes in the international competitiveness of the Russian economy in the second half of the 1990s (c.f. POGANIETZ 2000). With respect to final demand we have chosen the so-called “balanced closure” (LÖFGREN ET AL. 2002): the shares of private and government consumption and investment demand in total absorption have been kept constant. Furthermore, we have defined the price indices such that we will have a direct measure for the change in consumer welfare: by keeping the consumer price index fixed, total private consumption in our model is a good approximation of the equivalent variation in income.

3.3 Representation of four farm sectors in the data base of the model

The database of the model is based on a consistent data set for 1994. It is an up-date of an earlier version of the model, in which IOC were calculated based on an Input-Output-Table (IOT) for the Russian Federation for 1990 that was compiled for and published by the World Bank (1995; see WEHRHEIM 2003 for more details). This IOT for 1990 contained only one agricultural sector. The database was updated based on a social accounting matrix (SAM) with macroeconomic data for Russia for 1994 from IMF (1995). In the 1994 database of our model a total number of 20 sectors is distinguished. The agricultural sector represented in the IOT for 1990 was disaggregated into four different farm sectors. In that respect, the model is innovative by disaggregating Russia’s primary agricultural production into farm types that are distinguished by their institutional characteristics. We started out with the data that represented the aggregate sector ‘agriculture’ in the 1990 version of the model. Then, the respective IOCs for the agricultural sector were split into four agricultural sub-sectors: one

crop and one livestock sector, each representing the large agricultural enterprises (LAEs), i.e. the former collective farms. A third sector represents the subsistence-oriented household plot sector, which includes the production of urban citizens from private gardens. The fourth agricultural sector in our model represents the newly created private farms.

To adapt the database to 1994 the production share of agriculture in the 1990 IOT was split up between these four agricultural sectors using agricultural production data for 1994 (GOSKOMSTAT 1999). The input-output structures of the two sectors representing the large agricultural enterprises relate closely to those presented in the IOT for 1990. While the absolute value of expenditures for single intermediates was reduced in proportion to the decline in output of the LAE, the structure of the IOC remained more or less constant. Remaining imbalances were ruled out by a standard cross entropy procedure.⁶

The definition of input-output relations for the two small-scale sectors has been based on the observations made in Chapter 2. For instance, a stylized representation has been used to indicate the input-output-relations between the four farm types, departing from the revealed input-output structure in the IOT for 1990: both sectors representing the LAEs make payments to the LPH sector. For crop-producing LAEs, these expenditures account for 10.4% of the sector's total production costs, while they amount to 12.9% in the case of LAEs specialized in livestock production (see Table 3). The idea is to represent one striking feature of Russia's rural economy in transition in the data base: while the LAE crop producers make "payments" to their associated private subsidiary plots by leasing machines, transferring fertilizer and seeds, the LAE livestock producers are using feed as one major form of payment in kind to reimburse their workers for foregone cash income. These expenditures effectively increase the production costs of the LAEs and therefore constitute a burden that in reality is likely to contribute to the high share of unprofitable former collective farms. Such expenditures are normally based on informal contracts between the two parties and in many cases the recipients are both workers *and* members of the former collectives, many of which have 're-registered' as private stock companies. It is important to note that we replicate the respective cross-subsidization which is granted to the subsidiary plots as payments in kind by imposing an empirical observation on the input-output structure and not by changing any behavioral equation in the model: because the subsidiary plot holders do not pay for the inputs they receive from LAEs this effectively increases the costs of the latter. The LAE pay for *sales* made to the subsistence farms for which they do not receive anything in return.

6 The complete up-dating procedure is described in more detail in Author 1 (2003).

Table 4 provides an overview of the key features that characterize the structure of the four farm types in our model and, hence, points out the major differences among them. First, there are differences in size and input-output structure (columns 2-4). For instance, the share of intermediates is much higher in the two sectors representing the LAEs. This reveals the fact that these enterprises are more market-oriented, also with respect to inputs, at least when compared to the small-scale producers in the household sector and the private farms, which often suffer from insufficient access to input-markets due to various market imperfections (e.g. for the Ukraine: PERROTTA 1999). Additionally, about half of the intermediate inputs (10.9% of total production costs) used in the subsistence sector's production process, stem from the sector itself. In contrast, there are at least some private farms that attempted early on in the transition period to improve their efficiency by buying inputs and new machines from the market. Second, the four farm sectors rely on different marketing channels.

Table 3: Input structure of the four agricultural sectors in the model economy (in Trill. Ruble) for 1994

Sectors	LAE Crop	LAE livestock	LPH	Private farms
Electricity	0.35	0.56	0.46	0.10
Fuels	0.14	0.07	0.09	0.05
Metallurgy	0.01	0.01	0.01	0.00
Chemicals	1.29	0.04	0.34	0.09
Machines	0.69	0.49	0.26	0.11
Wood	0.11	0.28	0.21	0.03
Light manufacturing	0.22	0.44	0.35	0.13
Construction	0.23	0.44	0.37	0.32
Sugar refinery	0.00	0.02	0.00	0.00
Flour milling	0.00	0.96	0.01	0.00
Meat processing	0.00	0.18	0.00	0.00
Dairy processing	0.00	0.32	0.00	0.00
Other food	0.00	0.13	0.00	0.00
Animal feed	0.00	2.20	1.04	0.10
LAE ¹ AgriCrop	1.59	0.66	0.39	0.00
LAE AgriLive	1.10	3.52	0.43	0.02
LPH ² Subsistence	2.55	3.06	4.92	0.00
Private farms	0.11	0.15	0.01	0.21
Trade & Transport	0.54	0.47	0.11	0.00
Other services	2.37	0.95	0.13	0.00
Capital	8.49	4.43	22.96	1.09
Labor	7.21	7.52	6.70	0.69
Indirect taxes	-2.48	-3.13		0.00
Total Production Costs	24.54	23.78	38.80	2.95

Notes: 1) LAE: Large Agricultural Enterprises. 2) LPH: Household Plot Sector.

Source: Model data base.

While the two large-scale sectors channel most of their produce through the formal market, the two small-scale sectors do not. Particularly the household plot sector circumvents the formal market (see also Figure 1). The major share of “the produce” produced in the small-scale agricultural sector (64% in Table 4) does not reach the formal market. Instead households ‘buy’ the commodity directly from the activity account of the household plot sector. The share of the subsistence goods in total household demand in non-agricultural, non-food industry sectors has been kept at zero because reliable information about the share of self-produced goods for instance in the service sector were not available when the model was developed (see Table 5, column 7). Thus, no transportation, marketing or transaction costs occur for goods produced and consumed by households of the subsistence sector. These differences in the choice of marketing channels also imply different inter-sectoral linkages. For instance, the meat processing industry buys substantial amounts of the raw materials it processes from the LAE livestock sector (amounting to 36% of its expenditures for intermediates). The share of inputs the meat processing industry demands from the household plot sector accounts for only 6% of the sector’s total expenditures for intermediates, despite the fact that this sector represents more than 40% of total agricultural output in the model’s data base.

Table 4: Classification of agricultural producers in Russia and their major characteristics in the model (in %)

Type of farm	Share in GAO 1994 ¹⁾	Share of intermediates in total production	Share of intermediates from own sector	Share of production consumed by households	Agricultural policy	Trade
Large agricultural enterprises (LAE), specialized in crop production	27	47	11	1	High support with direct subsidies	Tradable good and import protection
Large agricultural enterprises (LAE), specialized in livestock production	26	65	21	1	High support with direct subsidies	Tradable good and import protection
Subsistence-oriented small-scale sector: household plots and private gardens	44	24	50	64	No direct subsidies	Non-tradable
Newly created, private farms	3	40	17	10	No direct subsidies	Non-tradable

Notes: 1) Share in GAO as reported by GOSKOMSTAT 1999 and according to Social Accounting Matrix on which model simulations are based.

Source: Data on economic characteristics from Social Accounting Matrix on which model simulations are based.

Third, only the large-scale agricultural enterprises receive support in the form of negative indirect tax payments from the government, which is not production neutral (see Table 3). Hence, if an exogenous shock would, for instance, result in a production increase in large-

scale agriculture this should also increase government expenditures. Fourth, only the large-scale sectors produce commodities that are internationally traded. Therefore any changes in terms of trade will directly affect the large-scale sectors. In contrast the two small sectors will be affected only indirectly, for instance, via income effects that might be a response to a change in the country's terms of trade.

To complete the picture, Table 5 provides a snapshot of the structure of the entire Russian economy in the base period of the model. The distribution of GDP at factor costs indicates that the four agricultural sectors together contribute only a share of about 10% to GDP. This share is higher than officially recorded because we are also taking the production of agricultural goods, which are produced by the urban populace in their private gardens into account. The primary agricultural sectors together employ a share of about 8% of the national labor force and about 11% of the capital available in the economy including most of the land.

Table 5: Empirical structure of the Russian economy in the model by activity in 1994 (in %)

<i>Sectors</i>	<i>GDP at factor costs</i>	<i>Total production</i>	<i>Labor force</i>	<i>Capital</i>	<i>Household market demand¹⁾</i>	<i>Household subsistence demand¹⁾</i>	<i>Exports</i>	<i>Imports</i>	<i>Absorption</i>
	<i>In % of national total</i>								
<i>Electricity</i>	3.4	3.7	1.1	5.3	3.5	--	3.5	0.5	3.4
<i>Fuels</i>	9.4	7.8	3.1	14.4	1.3	--	40.2	4.8	7.6
<i>Metallurgy</i>	2.7	5.7	1.5	3.6	0.2	--	18.2	4.9	5.7
<i>Chemicals</i>	1.8	3.0	1.5	2.0	2.7	--	13.7	11.5	4.0
<i>Machines</i>	7.8	11.5	9.2	6.7	1.5	--	12.8	19.2	13.1
<i>Wood</i>	2.1	2.6	2.1	2.1	1.0	--	4.0	1.7	2.6
<i>Light manufacturing</i>	3.7	7.1	3.2	4.1	14.2	--	2.6	13.9	8.4
<i>Construction</i>	12.1	11.9	17.6	7.9	3.6	--	0	2.5	10.9
<i>Sugar refinery</i>	0.1	0.2	0.1	0.2	3.8	0.2	0.1	6.7	0.9
<i>Flour milling</i>	0.3	1.8	0.3	0.4	8.3	0.4	0.2	7.7	2.5
<i>Meat processing</i>	0.3	1.7	0.2	0.5	8.8	0.5	0.2	8.4	2.3
<i>Dairy processing</i>	0.8	1.0	0.4	1.1	6.7	0.4	0.1	7.2	1.7
<i>Other food</i>	1.4	2.4	0.8	1.9	8.0	0.4	2.9	6.0	2.8
<i>Animal feed</i>	0.1	0.4	0.0	0.1	0	0	0	0	0.3
<i>LAE²⁾ AgriCrop</i>	2.6	2.2	2.7	2.5	0.4	0.1	0.4	1.5	2.4
<i>LAE AgriLive</i>	2.0	2.1	2.8	1.3	2.3	0.3	0.3	2.0	2.2
<i>LPH³⁾ Subsistence</i>	4.8	3.5	2.5	6.7	1.1	9.4	0	0	1.5
<i>Private farms</i>	0.3	0.3	0.3	0.3	0.1	0.2	0	0	0.3
<i>TOTAGR⁴⁾</i>	9.7	8.1	8.3	10.8	3.9		0.8	1.5	10.8
<i>TOTAGRIFOOD⁵⁾</i>	12.7	15.6	10.1	15	39.5	11.7 ⁶⁾	4.3	37.5	21.3
<i>Trade & Transport</i>	17.7	12.9	13.9	20.6	6.0	--	--	--	16.3
<i>Other services</i>	26.6	18.2	36.9	18.5	14.8	--	4.2	39.5	16.9
<i>TOTAL</i>	100.0	100.0	100.0	100.0	88.3	11.7	100.0	100.0	100.0

Notes: 1) In percent of total household consumption, i.e. market and subsistence demand. 2) LAE = Large Agricultural Enterprises; 3) LPH = Small-scale subsidiary plots of workers on Large Agricultural Enterprises. 4) TOTAGR = Total share of primary agricultural sectors. 5) TOTAGRIFOOD = Total share of all primary agricultural and food processing sectors. 6) The share of market and subsistence demand from all agri-food sectors together amounts to 51.2% of total household demand.

Additionally the structure of household demand is revealed. The data reveals the difference between households' market demand (from commodities markets) and subsistence demand (from activities). Households spend 51.2% of total consumption expenditure on the foods from the agro-food sectors composed of 39.5% market demand and 11.7% subsistence demand. Consequently, food prices are highly decisive for households' welfare. Furthermore, the data shown in column 8 to 10 of Table 5 reveal the trade structure and the structure of total absorption in our model. Together, the food industries and agriculture contributed only 4% to total national exports. The reverse holds true for imports: With almost 40% of total imports, the share of agriculture and the food industries was very high and reflects the high import dependence of these sectors in the transition period.

3.4 Parameters

The supply elasticities used in the model are synthetic in as far as they were not estimated empirically but instead are based on values used in other studies for comparable countries. They are lowest in the raw material producing industries (0.8) and highest in the machinery, light manufacturing industry and in the construction sector (1.5). An average value of 1.2 has been chosen for all other sectors. The sector-specific marketing margin coefficients deserve mentioning. Similarly to the production elasticities these coefficients were not estimated empirically. The margins are representing a wedge between the producer price and the price of either the good which is exported or sold domestically or in the case of imports a wedge between the *c.i.f.* import price and the domestic consumer price. They relate to the good, which in standard CGE models is provided from the ‘trade and transport’ sector no matter what kind of transactions were involved. We differentiate between marketing margins related to domestic, import, and export markets. Because of the dominant size of the domestic market, about 80% of the total value of the trade and transport sector was allocated to domestic trade activities. Depending on the relative weight we attributed to the specific marketing components, sectorally different coefficients were obtained. For instance, the coefficient for imports in the food industries (0.05) and for large-scale agriculture (0.04) is much lower than the one for the domestic good in the same sector (0.13 to 0.22), which discriminates domestically produced commodities. This distinction was made to reflect that institutional impediments hinder the marketing of domestic food products, while it has been much easier for importers to ship imported food commodities to the most peripheral consumers within Russia. Hence, these margins can also be interpreted as transaction costs. Another interesting stylized fact that can be incorporated into the model with this mechanism is the impediments to commercialization of the small-scale agricultural sectors. Both sectors are discriminated against with the highest domestic marketing margin (of 0.39) when marketing their sectoral output domestically.

Furthermore, in a trade focused model the trade elasticities matter.⁷ On the export side the CET determines the degree to which firms in net exporting sectors can be responsive to changes in the relative prices for the domestic good and the exportable. Because the fuel sector had with over 40% by far the largest share in total exports (see Table 5) the highest CET value was assigned to this sector (2.9). CETs for manufacturing sectors were set at 2.0

⁷ Sensitivity tests were carried out by changing the value of trade parameters. These tests showed that the model responds adequately to changes in the value of trade elasticities (CES and CET). Furthermore, the sensitivity tests indicated that the higher the elasticity values, the higher is the degree of restructuring that follows exogenous shocks.

and for food processing sector and the two large-scale farm sectors at 1.5. Generally, the share of imports in Russia's agro-food sectors was higher than in the non-agricultural sectors in 1994. Furthermore, these sectors were net importing sectors. Therefore, the CES values for the agro-food sectors are generally higher than the respective CET values and due to the lack of sector-specific estimates were set at 3.0.

4 Simulations: Effects of economy-wide shocks on subsistence agriculture

4.1 Experiment design

With the model discussed above we simulated four experiments, which will be suitable to reveal the diverging economic responses of subsistence agriculture in Russia to economy-wide shocks or reforms. The first two experiments are an *ex post* reflection of important economy-wide developments, which affected the development of agriculture in Russia in the 1990s. The third and fourth experiments are *ex ante* experiments that assess the likely effects of implementing economy wide, efficiency enhancing institutional changes in the marketing system.

The purpose of the two *ex post* experiments is to exogenously impose shocks which resemble partial observations about and developments in subsistence agriculture in Russia as we have discussed them in chapter 2 (e.g. subsistence agriculture is a labor sink) and analyse their economy-wide effects (e.g. inter-sectoral shifts in production, composition of imports and exports, etc.). By using the general equilibrium framework we are able to identify the underlying causes for various economic developments that actually have been observed in Russia's transition process (e.g. the changing role of subsistence agriculture in the past decade). One may argue that the results are based on a model that is too deterministic. However, it has to be stressed that the results are driven by a combination of theoretical and empirical features, which is a strength of applied CGE models. In fact, this empirically *and* theoretically consistent model of subsistence agriculture in Russia helps to identify a chain of arguments, which should facilitate the understanding of the restructuring of Russia's agriculture in the first transition period. Furthermore, the *ex post* simulations also provide some quantitative estimates that indicate the scope of the economy-wide effects of the transition-specific shocks on various variables such as sectoral production, consumption, etc. All of this could be important for the design of agricultural policies in Russia, but may be even more important in other countries with 'pre-transition' structures similar to those imposed on our model economy (e.g. Belarus or Uzbekistan).

With Experiment 1, we attempt to replicate the restructuring process that took place in the initial phase of the transition process: the output decline in large-scale agriculture combined with the increasing importance of subsistence agriculture, which became a labor sink. The gradual collapse of the agricultural large-scale sectors that was characterized by declining capital stocks as well as declining productivity led to declining production and sales, and finally to serious cash constraints for the operational business of the relevant enterprises. As a result, workers did not receive their salaries anymore and became desperate for alternative income sources. Consequently, we observe an unprecedented phenomenon of labor migration from these large-scale enterprises to small-scale, subsistence farming activities. We simulate these developments through an exogenous shock that consists of three elements: First, we reduce the total factor productivity in both large-scale farm sectors by 10%, which constitutes a negative or inward shift of the production function. This observation has been empirically substantiated by various studies that analyzed technical efficiency of former collective farms in Russia (e.g. SEDIK et al. 2000; VOIGT and UVAROVSKY 2001). Second, we include another feature that affected the development of the agricultural sector in Russia in the early transition period: a 15% decline in the capital stock used by large-scale agriculture that became obsolete. For instance, the total number of tractors, ploughs, or grain harvesters employed in agricultural enterprises declined between 1992 and 2000 by 42, 52, and 53%, respectively (GOSKOMSTAT 2001). Third, we impose the shift of labor from large scale to subsistence farms by exogenously shifting 20% of the sectoral labor demand in the two large-scale agricultural sectors into the small-scale subsistence sector. Thus, the restructuring of the agricultural labor market is replicated by activity-specific wages for agricultural labor reflecting different marginal revenue products of agricultural labor in large-scale and subsistence agriculture.

With Experiment 2 we look into the effects of another important economic event, which affected Russia's agricultural sector in the aftermath of the Asian financial crisis: the real exchange rate of the ruble was devalued. Therefore, we expose the economy to a 10% devaluation of the real exchange rate in this second experiment. In Experiment 3 and 4 we assess the effects of institutional change that enhances the efficiency of the Russian marketing system. The arguments behind these experiments refer to the observation that the lack of market institutions contributes to very high marketing margins and transaction costs in transition countries and are severe obstacles to better growth perspectives of the agro-food sector in transition countries in general (cf. FROHBERG and WEINGARTEN 1999) and in Russia in particular (SEROVA ET AL. 1999). Examples for institutions that could reduce both transaction and marketing costs are better contract security, improved food wholesale

facilities, or better market information systems. Due to the lack of empirical estimates which would quantify the effects of institutional change on marketing margins we assume in Experiment 3 and 4 *ad hoc* an economy-wide decline of 25% of foreign trade and domestic marketing margins, respectively.

4.2 Discussion of results

Experiment 1. The three counter-acting exogenous changes in Experiment 1, to which large-scale and small-scale agriculture are exposed, affect mostly agriculture. However, it is noteworthy how significant the economy-wide effects of these sector-specific alterations are given our unemployment specification in the non-agricultural sectors. The negative effects on the primary agricultural sectors result in a decrease of GDP at factor costs by 6.2% (Table 6). The economic contraction reduces the labor stock by more than 13% and results in a drop of consumer welfare, which is indicated by a 3.8% decrease of private consumption. Additionally, the reduction of total output in the economy increases the government budget deficit significantly indicating that without any exogenous policy change the drop in revenues is not compensated by sufficient cuts in expenditures. Hence, government consumption but also investment demand decline as well in response to the overall contraction of the economy.

Effects on agriculture. The effect of this first experiment on agriculture yields the expected negative effects on the two large-scale sectors, while subsistence agriculture benefits (see Table 7). The output increase in the subsistence sector by 8.8% (AgriLPH in Table 7) is not sufficient to compensate for the declining output in the crop and livestock large-scale agricultural sectors (-25.6 and -26.4%, respectively). In fact, this replicates the restructuring of Russian agriculture that took place in the early 1990s when the output decline in the large-scale livestock farms has been more pronounced than in the respective crop sector. The declining factor productivity and the depletion of the capital stock cause that the farm sector's exports decline further, while imports increase in both large-scale farm sectors significantly. Because of the output decline in large-scale agriculture the price for domestic raw materials increases as well. In response food industries substitute the domestic good with the foreign one – aggregate imports by all food industries rise by 8.5%. Thereby, the model also replicates the structural changes in food imports correctly: the import surge was much larger in the livestock sector as if compared with the crop sector. Imports of frozen poultry from the US became a famous substitute for the high levels of pork and beef formerly supplied to the

Russian population by the former large-scale livestock farms.⁸ Hence, in spite of the drop in domestic purchasing power and because of the loss in competitiveness of the domestic agro-food sectors imports rose substantially. Because we keep foreign savings constant in this experiment, the foreign currency needed for these additional exports have to be earned by an increase of exports. In fact, exports of the energy sector increase (i.e. oil and gas), which yields an increase in total exports in spite of the appreciation of the real exchange rate. Thereby the existing trade balance is preserved.

Furthermore, similarly to the developments in the 1990s, the production growth in subsistence agriculture is mainly used for own-household consumption, which increases by 11.3%. Hence, the production increase in subsistence production resulted also in an increase of marketed sales by this non-commercial sector. Indeed the so-called *kolchos-markets* played a major role in sustaining adequate access to important food crops in the 1990s in most Russian cities. Hence, at least in this respect, the weakness of one sector seems to determine the strength of another sector. The increase in own-household consumption also indicates that subsistence agriculture has indeed been a buffer for households against falling food insecure because of rising prices for food commodities produced in the domestic large-scale sector and imported food. In contrast, the increase in domestic output of subsistence agriculture does not translate into higher formal domestic sales because in this marketing channel higher transaction costs are encountered.

Experiment 2. While in reality the financial crisis, which hit the country in mid-1998, coincided with a nominal devaluation of the Russian ruble of about 80% and a real devaluation of more than 50% we are imposing a 10% devaluation of the real exchange rate only. The devaluation causes GDP at factor costs to decline by 2.1%. This decline is only possible because the non-agricultural sectors in our model economy can release labor (-4.9%). This is so in spite of significant restructuring of domestic production towards exports (57.4%) and away from producing for the domestic market, which is induced by the real devaluation. The increase of import prices, which is caused by the devaluation results in a parallel decline of imports of 15.5%. However, this restructuring is not significant enough to induce domestic growth. Part of the explanation for this reaction is the fact that under a flexible capital account system, a significant part of the marginal profit that is obtained from export expansion is exported to the rest of the world: foreign savings increases by 480.5%. This response also

8 In 2001 total poultry imports to Russia amounted to 1.39 million tons of which about 75% came from the USA. Between March and September 2002, Russia imposed an import ban on US poultry. Officially this was due to a dispute over sanitary standards, i.e. the discontent over the abusive use of disinfectants used by US farmers to conserve the poultry until being sold to consumers in Russia.

reflects what has been observed in the 1990s in Russia, when the earnings from the raw material exports were not reinvested into domestic industries but instead were withdrawn from the Russian economy and invested elsewhere. If the flexibility within the economy would be greater the incentives to invest into import substituting domestic industries should have been bigger.

Effects on agriculture. The response of the agricultural sectors to the real devaluation is mixed. The increased competitiveness of domestic production does not result in sufficient restructuring that would induce overall growth in Russia's agricultural sector. However, given the data and structure of our model, the large-scale crop sector benefits in as far as it can expand export production significantly by more than 300%—starting from a low absolute level in the base period—which contributes to an overall increase of domestic output in this sector by 5.6%. This replicates what happened in the aftermath of the financial crisis in 1998: Between 2000 and 2002 Russia became a net exporter of cereals and shipped about 7 million tons in 2001-2002 abroad (RMA 2002).

Table 6: Macroeconomic results of experiments, changes relative to base (in %)

	Base period value in trillion ruble	TFP shock	Devaluation	Foreign marketing margins	Domestic marketing margins
		change in comparison to base in %			
		EXP1 ^{b)}	EXP2	EXP3	EXP4
GDP _f ^{a)}	611.7	-6.2	-2.1	0	0
Exports	152.4	2.0	57.4	2.8	1.7
Imports	130.0	2.3	-15.5	3.2	2.0
Private consumption	227.1	-3.8	-18.0	1.5	4.4
Investments	181.6	-7.2	-23.5	1.2	4.3
Govnm. Consumption	173.4	-11.7	-21.9	0.8	3.6
Indirect taxes	12.5	9.8	-16.9	3.3	2.3
CPI	1.136	Fixed	Fixed	Fixed	Fixed
DPI	1.000	-0.5	-0.1	0.7	2.7
Exchange rate ^{c)}	1.000	-6.9	10.0 (Exog.)	-0.5	1.8
Govnm. Budget	-66.7	-15.3	-62.5	1.4	5.9
Foreign savings	-22.4	Fixed	480.5	Fixed	Fixed
Marginal prop. to save	0.5	-0.3	17.8	-0.1	0
Labor stock	246.3	-13.2	-4.9	Fixed	Fixed
Household indicators					
Market demand	227.1	-3.8	-18.0	1.5	4.4
Subsistence demand	30.1	11.3	-1.1	0.1	0.2
Total demand	257.2	-2.0	-16.0	1.3	3.9

Notes: a) TFP = Total Factor Productivity. GDP_f = GDP at factor costs; CIP = Consumer price index; DPI = Domestic sales price index. b) Experiment 1: decreasing total factor productivity in large-scale agricultural sector by 10% and shift of 20% of the labor force formerly employed in the large-scale sector to subsistence agriculture; depletion of capital stock in the large-scale sectors by 15%. Experiment 2: the economy is exposed to a 10% devaluation of the real exchange rate. Experiment 3: 25% decline in foreign trade margins. Experiment 4: 25% decline in domestic trade margins. c) A negative change of the exchange rate implies an appreciation while a positive change indicates a devaluation of the exchange rate.

In reality this increase in crop exports has been associated with the emergence of large agro-holdings in the fertile regions of southern Russia (see section 2). While the devaluation has paved the ground for these “new operators” they are working with new and modern technology bought with private capital. In an attempt to replicate this factor, we extended Experiment 2 with an additional exogenous capital infusion of 15% in both large-scale sectors. The results of this extended version of Experiment 2 imply an increase of domestic output from the large-scale crop sector by 10.2% while large-scale livestock sector increases output by 0.5% only. The subsistence sector would contract by 1.2 and private family farms by 2.7%. In this extended version of Experiment 2, agricultural exports from the large-scale crop sector increase by almost 400%. In conclusion, Experiment 2 highlights that improvements in the international terms of trade can indirectly affect subsistence agriculture in Russia by changing its competitiveness in relation to those farms that have the potential to trade their products internationally. Furthermore, the extended scenario of Experiment 2 indicates that the gains from increased export competitiveness of Russia’s crop sector could be realized more easily if complementary economic factors such as the availability of new capital improve.

Table 7: Quantity effects of experiments for agricultural sectors, changes relative to base (in %)

Variables	Sectors ¹⁾	Value in trillion ruble	TFP shock	Devaluation	Foreign marketing margins	Domestic marketing margins
		Base period	Exp. 1	Exp. 2	Exp. 3	Exp. 4
Exports	C <i>AgriCrop</i>	0.5	-92.5	332.2	2.8	-9.4
	C <i>AgriLive</i>	0.4	-36.6	10.2	1.1	4.5
	C <i>FoodIndu</i>	4.3	-41.7	44.6	8.5	7.9
Imports	C <i>AgriCrop</i>	2.3	57.6	-38.0	3.1	5.4
	C <i>AgriLive</i>	3.4	104.6	-55.1	4.4	2.9
	C <i>FoodIndu</i>	51.4	8.5	-27.3	3.3	1.2
Domestic output	C <i>AgriCrop</i>	24.5	-25.6	5.6	0.3	5.2
	C <i>AgriLive</i>	23.8	-26.4	-1.5	-0.2	5.0
	C <i>AgriLPHs</i>	38.8	8.8	-2.3	0.2	1.7
	C <i>AgriPriv</i>	3.0	0	-4.2	-0.4	0.7
Domestic Sales ²⁾	C <i>AgriCrop</i>	26.2	-19.5	-7.5	0.5	5.5
	C <i>AgriLive</i>	26.2	-13.5	-9.9	0.4	4.8
	C <i>AgriLPHs</i>	14.6	-0.4	-4.4	0.3	4.2
	C <i>AgriPriv</i>	2.7	1.3	-4.5	-0.4	0.7
Own-household Consumption	A <i>AgriCrop</i>	0.1	-1.6	-1.4	0.1	0.2
	A <i>AgriLive</i>	0.6	-1.4	-1.4	0.1	0.3
	A <i>AgriLPHs</i>	24.2	14.3	-1.0	0.1	0.2
	A <i>AgriPriv</i>	0.3	-12.6	-1.3	0.1	0.3
Labor force	A <i>AgriCrop</i>	7.2	-20.0 (Exog.)	12.6	0.7	11.7
	A <i>AgriLive</i>	7.5	-20.0 (Exog.)	-2.4	-0.3	8.0
	A <i>AgriLPHs</i>	6.7	44.0 (Exog.)	-9.8	0.8	7.7
	A <i>AgriPriv</i>	0.7	Fixed	-10.5	-1.0	1.7

Note: 1) Names of sectors: *AgriCrop*: Large agricultural enterprises specialized in crop production; *AgriLive*: Large agricultural enterprises specialized in livestock production; *AgriLPH*: Subsistence production on subsidiary plots and private gardens; *AgriPriv*: newly created and fully private farms. An “A” (“C”) in front of the sector name indicates that the respective results refer to the activity (“commodity”)account of this sector. 2) “Domestic sales” refer to that share of domestic output that is marketed via the commodity markets and, hence, via the formal marketing channel. In contrast “Own-household consumption” are direct sales of the respective sectors to household, which circumvent the marketing system (see text for further explanations of this feature).

Experiment 3. Because of relaxing the unemployment assumption in Experiment 3 and 4, the exogenous shock does not alter the labor stock employed in the economy. Given that the CPI is fixed, GDP at factor costs remains constant (see section 3). Reducing import and export trade margins favors both total exports and total imports, which increase by 2.8% and 3.2%, respectively. It is also noteworthy that the respective improvements in marketing possibilities are not compensated for by the slight appreciation of the real exchange rate by 0.5%. Instead, the efficiency enhancing restructuring increases consumer welfare: private consumption increases by 1.5%. Due to the “balanced closure” all other final demand components grow at a similar magnitude: investment demand by 1.2% and government demand by 0.8%. In contrast to Experiment 1 in which the economy was not as flexible as in this forward-looking experiment the major burden of adjustment is not achieved by an adjustment of the exchange

rate and, hence, external factors, but instead by more pronounced restructuring of domestic variables.

Effects on agriculture. Because the subsistence-oriented sectors are producing non-tradables by definition in our model, the effects of this experiment are limited on these sectors. Exports in the large-scale agricultural crop and livestock sector increase by 2.8 and 1.1%, respectively. However, imports increase in both sectors at higher rates (3.1 and 4.4%, respectively), which at first sight is surprising. Generally, the increase of both agricultural exports and imports alike indicates that the reduction of trade margins increases the efficiency of trade operations irrespective of the direction of trade. At the same time it reveals that without any further changes in the competitiveness of the domestic food industries the growth in domestic private consumption would be met to a large extent by an increase in imports. The effects of Experiment 3 on the subsistence sector are positive even though they are only of marginal magnitude. Domestic output, sales, and own-household consumption increase slightly because of the positive effects of this experiment on private consumption.

What would happen if not the foreign trade margins but instead the domestic marketing margins would be exogenously reduced by the same magnitude? This question is addressed in the next experiment.

Experiment 4. As mentioned in chapter 3.4 the major share of the total sum of marketing margins (79.3%) applies to domestic and not to foreign trade-related transactions. Therefore, this substantial efficiency gain translates into an increase of consumer welfare that is almost three times as big as in Experiment 3: private consumption increases by 4.4%, while government and investment demand increase by 3.6 and 4.3%, respectively. A significant share of this increase in domestic absorption is met by imports that increase by 2%. As a countervailing effect exports have to increase as well, because the increased demand for imports cannot be financed through increasing the negative foreign savings. Furthermore, it is noteworthy that institutional changes that would cause higher efficiency of the domestic marketing system would result in a pronounced increase in market demand of 4.4%, while the demand for the good from the subsistence sector would remain constant.

Effects on agriculture. Sectoral effects of this reduction in domestic costs of marketing are generally positive. Particularly the two large-scale agricultural sectors benefit from the improved marketing possibilities. However, similarly as in the previous experiment the positive effects on large-scale agriculture are not complemented by a subsequent decline in subsistence agriculture. The opposite is the case: subsistence agriculture increases domestic output by 1.7%. The major share of this output increase, however, is now marketed to the

final consumer via the formal food marketing system. Hence, the experiment indicates an important aspect: an increase in the relative competitiveness of the formal marketing system creates also incentives to commercialize subsistence agriculture. And, these results show that subsistence agriculture would not disappear in the short run if large-scale agriculture picks up again. It is also important to note that the strength of large-scale agriculture materializes in positive spillover effects for the subsistence sector. The reason for this causality is straightforward: as long as the forward linkages between the large-scale farms and the private subsidiary plots persist the latter will benefit from positive growth in the large-scale agricultural sectors. Additionally, the subsistence sector would also become more commercial if marketing possibilities within the domestic market improve.⁹ In the long run this might contribute to filling the gap between the small and the big farms in Russia.

5 Summary and conclusions

In this paper, we presented an applied general equilibrium model, which has been tailored to address the diverging role of subsistence agriculture in Russia's transition process. The novelty of the model is to distinguish various agricultural sectors not by production but by institutional characteristics. One of these farm sectors explicitly represents Russia's vast number of subsistence plots. We conducted a total of four experiments. Two of these experiments were simulating exogenous shocks (*ex post*) that occurred in the 1990s and two (*ex ante*) experiments were forward looking. For the *ex post* simulations we assumed a rather inflexible and short-run model economy while we increased the flexibility within the model economy in the two forward looking experiments.

With our empirically and theoretically consistent model we were able to analyse various aspects related to subsistence agriculture in Russia: First, the simulations enabled us to develop a chain of arguments, which should facilitate the understanding of the role of subsistence agriculture in Russia's transition process. Second, the simulations provided quantitative estimates which indicate the scope of the economy-wide effects of the transition specific shocks related to subsistence agriculture on various variables such as sectoral production, consumption, etc. Together these insights should help to rationalise the design of policies which can break the vicious circle subsistence-oriented agriculture has formed in Russia. The arguments developed with our model might be even more important for other CIS countries with similar 'pre-transition' structures of subsistence agriculture (e.g. Belarus or Uzbekistan).

⁹ This finding is also confirmed by BECKMANN and PAVEL (2001) who analyzed the prospects of subsistence agriculture in the case of Bulgaria.

Specifically, the results of Experiment 1 resembled the relative output growth in subsistence agriculture, on the one hand, and the relative output decline in large-scale agriculture, on the other. Both developments were observed in the 1990s. Furthermore, the model replicates that the output increase in small-scale agriculture yields increased subsistence consumption in spite of overall economic contraction, highlighting this sector's role as a buffer against diminishing food security. This is so because the shadow price of the good from subsistence production can be obtained at a lower price than the good from the large-scale farms. Therefore, we argue that the increased importance of subsistence agriculture in the transition period can be explained by rational responses of economic agents to changes in relative prices.

In a second experiment, we looked into the effects of a 10% real devaluation of the ruble. Due to various rigidities the (model) economy was not able to restructure sufficiently in response to this exogenous shock to induce economic growth. The overall income decline following the devaluation affected output in all agricultural sectors but the large-scale crop sector negatively. Because of the openness to trade this sector was able to increase exports significantly, which boosted domestic output. In contrast, the negative income effects were not buffered in the case of subsistence agriculture, which contracted. In fact, this replicates the developments in Russian agriculture in the aftermath of the financial crisis in mid-1998: various large-scale farms in the crop sector became competitive in world grain markets (RYLKO 2001). At the same time the total agricultural output share of subsistence farms fell from 59% in 1998 to 54% in 2000 (GOSKOMSTAT 2001). While the direction of these changes is in line with economic theory, the degree of the changes is rather low. This indicates that macroeconomic adjustments such as exchange rate alterations by themselves will not be sufficient to enhance the long run growth potential of either Russia's agro-food sector or the economy as a whole. Instead such macroeconomic reforms need to be complemented by institutional reforms (SEROVA ET AL. 1999; BERGLÖFT and VAITILINGAM 1999).

This view has been tested further with two forward-looking experiments with which efficiency enhancing institutional change has been simulated. The results actually hint at more differentiated effects depending on what kind of institutional change is modeled. A reduction in *domestic marketing margins* (Exp. 4) is likely to be more beneficial for Russia's agricultural sectors compared to a reduction of *marketing margins related to foreign trade activities* (Exp. 3). If only marketing margins related to foreign trade were reduced this would also enhance the possibilities for imports and boost agricultural imports, while the relative

competitiveness of domestic production would not be enhanced. Instead, institutional change that would yield a reduction of domestic marketing margins would induce more substantial and efficiency enhancing restructuring in the Russian economy. This would be associated with an increase in real incomes of consumers and a consecutive increase in private consumption. The latter would also translate into higher domestic demand for goods from small-scale agriculture that could then be marketed in larger proportions through formal channels. Therefore, the simulations indicate that enhanced economy-wide institutions could foster not only the competitiveness of Russia's large-scale farms but also the commercialization of the subsistence sector.

6 References

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