Individual Farming as a Labor Sink:

Evidence from Poland and Russia

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Abstract
In Poland and Russia, small-scale individual farms employ more labor per hectare of land than large-scale corporate farms, without suffering from lower labor productivity. Individual farming is a labor sink for the rural population, and land policies promoting individualization of agriculture in transition countries can alleviate the social consequences of rural unemployment without sacrificing agricultural productivity.
Keywords: transition agriculture, agricultural employment, individual farming, corporate farming, land consolidation, farm restructuring

Introduction

In developing and developed countries, small-scale family farms are observed to use more labor per unit of land than large-scale corporate farms and consequently show a lower productivity of labor but a higher productivity of land. This phenomenon of higher intensity of labor use in individual farms is also observed for transition countries. Previous survey data, as presented in **Table 1**, have shown that individual (family) farms are characterized by a substantially higher "labor intensity" than corporate farms, i.e., large farm enterprises created from reorganizing collective and state farms in the process of economic reforms (Lerman 1998).

Table 1. Labor Intensity in Individual and Corporate Farms in CIS (workers per 100 hectares)

	Individual farms	Corporate farms
Russia (1994)	4	2.5
Ukraine (1996)	19	12
Moldova (1998)	120	30

Source: World Bank surveys for the period 1994-1998.

This is surprising in the transition context, because large corporate farms are generally believed to have inherited a large contingent of surplus labor, which needs to be channeled out of agriculture in the course of transition with the objective of increasing sectoral productivity and efficiency. Yet, the creation of individual farms – one of the modes for reorganization of former collectives in transition countries – would seem to increase rather than decrease the agricultural labor force. Earlier work has indeed shown that agricultural employment increased significantly during transition in countries such as Albania, Armenia, Georgia, and Romania, where agricultural land was distributed to the rural population for individual farming (Lerman 1998, 2000). Thus, instead of channeling labor out of agriculture, the breakup of collective farms into individual units acts as a labor sink that effectively stores labor in agriculture. This effect may be of concern to policy makers because additional labor leads to further deterioration of agricultural labor

productivity, at least in the short-run. We, on the other hand, argue that this effect has an important social impact in transition countries, where inadequate employment opportunities outside the farm sector may lead to serious social and political difficulties in case of massive exit of labor from agriculture.

This paper examines how individualization of agriculture affects labor intensity and efficiency of agricultural production. We test two hypotheses: that individual farms are characterized by higher labor intensity than corporate farms, and that despite higher labor intensity individual farms achieve productivity levels that are not lower compared with corporate farms. The analysis is based on a cross-sectional comparison of Polish and Russian provinces in 1997-99. It is perhaps appropriate to stress that, in our conceptual approach, the difference between individual and corporate farms is not one of size. Although individual farms on average are smaller than corporate farms, it is the difference in incentives to owners and labor between the two forms of farm organization that counts in the present context.

The paper starts with a short overview of theoretical considerations concerning labor in agriculture. It proceeds to give relevant background information about Poland and Russia. This is followed by an examination of empirical evidence regarding higher labor intensity of individual agriculture. We then present results of a productivity analysis, which has been carried out in both the production function paradigm and the technical efficiency paradigm. In the concluding section the results are related to social implications, which ultimately brings us to formulate some policy implications for transition agriculture.

Agricultural Labor in the Course of Transition

For our analysis of labor in transition agriculture, two basic questions emerge that have been extensively dealt with in general non-transition literature. The first question is why labor stays in agriculture despite its apparently lower productivity compared to the other sectors? The second question is why there is a difference in labor intensity between large and small farms? This paper focuses only on the detection and implications of the second phenomenon. Yet the two questions are interrelated and the present section briefly explains the link and provides some theoretical background for these issues.

In Poland, Russia, and many other transition countries, the share of people employed in agriculture exceeds this sector's contribution to GDP. This indicates that, in these countries, the productivity of labor in agriculture is substantially lower than in other sectors. An increase in agricultural labor productivity can be achieved through a combination of less workers per unit of land (i.e., lower labor intensity) and more output per unit of land (i.e., a better technology). The means to accomplish this are factor reallocation (e.g., lowering labor intensity by moving people out of agriculture) and technological change, with the optimal combination depending on the relative factor prices.

If markets in transition countries functioned perfectly, one would expect people to flow out of agriculture because of its lower productivity. Labor intensity would decrease, marginal productivity of agricultural labor would increase, and simultaneously marginal productivity of non-agricultural labor would decrease until the wage rates of the two sectors converge to reflect the marginal productivity of labor equal for both sectors.

This is not happening in Poland and Russia, and in fact most transition countries reveal the same problem. Although low agricultural productivity and associated low incomes should push people to leave agriculture, insufficient growth of the overall economy and the resulting high unemployment rates in the non-farm sectors constitute a barrier to out-migration. This is very similar to Schultz's (1945) observation of US agriculture in the 1930s: labor supply in agriculture increased considerably as a result of industrial unemployment during the Great Depression. In the transition context, agricultural employment has been shown to decline in countries where the overall economy grows faster than agriculture, i.e., GDP growth exceeds agricultural product growth (Lerman, Csaki, and Feder 2002, Ch. 3).

Before turning our attention fully to Poland and Russia, let us briefly address the issue of differences in labor intensity between farms of different organizational forms. Micro-economic theory explains this phenomenon by the absence of functioning labor markets, e.g., due to relative insulation of rural life, high transportation costs, and lack of information, peasant households cannot realize the opportunity of higher non-farm labor revenues. Since peasant farmers are unable to allocate their excess labor time (i.e., the labor time that is unused at the point where marginal product of labor equals the wage rate) to off-farm employment, they instead allocate it to farm work, decreasing their marginal productivity of labor below the wage rate. Corporate farms, on the other hand, use hired labor and are more flexible in their labor decisions. Consequently, they tend to use less labor per hectare and have a higher labor productivity that more accurately reflects the prevailing wage rate.

Sectoral Background

Poland is the largest Eastern European country outside the former Soviet Union, while Russia is essentially the core of the former USSR, dominating by its sheer size all the 20-odd transition countries in Europe and Central Asia. Judging by population and employment data, both Poland and Russia are agrarian countries. In Poland, 40% of the population is classified as rural and 27% of the labor force is reported as employed in agriculture. Russia is somewhat less agrarian, with 27% rural population and 13% agricultural employment. Despite its large share in employment, agriculture contributes less than 10% to gross value added in Poland and about 6% in Russia. Agriculture is thus tremendously important as a source of jobs for the rural population in both countries, but agricultural productivity is far below the average for the economy.

Russian agriculture was sweepingly and forcibly collectivized in the early 1930s, yet individual agriculture did not disappear. During the entire Soviet period, up to the dissolution of the USSR in the fall of 1991, small-scale family farming continued in the form of household plots cultivated by employees of collective farms and other rural residents. A Russian household plot averaged less than half a hectare, and in aggregate the individual sector controlled less than 3% of agricultural land prior to 1991. The land reform program initiated with the dissolution of the Soviet Union in November-December 1991 doubled the size of the average household plot and in addition created an entirely new sector of independent private or peasant farms with average holdings of 40 hectares. As a result of these processes, the share of individual producers in Russia increased from less than 3% to about 15% of agricultural land.

The Russian model of coexistence between large-scale collectives and small-scale individual farms characterized most of the former socialist countries in Europe and Central Asia during the Soviet era. Contrary to this general pattern, Polish agriculture was not subjected to sweeping collectivization after World War II and individual farms have consistently controlled about 80% of agricultural land in this country. The relatively high share of labor in Polish agriculture compared to Russia (and other countries in the former Soviet Union) thus appears to be associated with a higher share of individual farming. This observation provides a prima facie support for our conjecture and motivates further analysis of this issue.

Basic statistical information on agricultural employment and individual farming in Poland and Russia is available at the level of provinces: 49 "old" voivodships in Poland and 77 oblasts, territories (krais), and autonomous republics in Russia. The Russian data are for 1999 and are taken from official Goskomstat sources (2000, 2001). The Polish data are for 1997, which is the most recent year before the 49 provinces were amalgamated into 16 new administrative units, confusingly also called voivodships. The data for Poland are from GUS (1998). The provincial-level data used in our analysis of the labor-sink effect include the share of agricultural employment (in all individual and corporate farms in each province), the share of agricultural land controlled by individual farms, and the absolute level of agricultural land and agricultural labor in each province. The productivity analysis also uses data on value of regional agricultural product.

In both countries, there is considerable variability in the basic indicators across the provinces. In Russia, with its huge territorial expanses and relatively monolithic history, the variability is primarily due to agro-climatic reasons, although regional politics (e.g., legislative autonomy of the republics) play a certain role. The 77 Russian provinces are traditionally grouped into 12 regions – strictly by geographical location. We aggregated these 12 regions into five macro-regions, again by geographical location roughly from west to east, and then into two "super-regions" – the agriculturally fertile central and southern parts of Russia (designated as Europe) and the less fertile northern and eastern parts (designated as North+East). In Poland, the variability is due not only to agro-climatic reasons, but also to significant historical and social differences. The 49 voivodships are conventionally aggregated into eight "macro-regions," which reflect historical, cultural, and geographical differences in the Polish society. The regions roughly divide the country into three "vertical" strips: the western strip, the central strip, and the eastern strip. The western strip generally corresponds to the "Recovered Lands" transferred from Germany to Poland when World War II ended in 1945 (Eastern Pomerania and Silesia). Parts of the eastern strip shifted several times between Poland and the USSR during 1918-45. Only the central regions remained under Polish sovereignty throughout the 20th century.

The main labor and farming characteristics of the macro-regions are presented in **Table 2**. In Poland, the western regions are characterized by relatively high levels of urbanization, while the eastern regions, conversely, are relatively more rural. In Russia, the agriculturally fertile central and southern regions (Caucasus and Europe) have a higher share of agriculturally oriented rural population than the less fertile North and East. In both countries, the share of agriculture in employment naturally increases with the share of rural population. Thus, in the rural eastern regions in Poland agriculture accounts for more than 40% of total employment, whereas in the more urban western

regions agriculture employs less than 20% of the labor force. A gap in the same direction (although of smaller magnitude) is observed between the two super-regions in Russia.

The levels of individual farming (as measured by the share of individual farms in total agricultural land) are generally high in Poland. This is so not only compared to Russia and the rest of CIS, where agriculture largely remains non-individual, but even compared to other Central and Eastern European countries, such as the Czech Republic, Slovakia, Hungary, Bulgaria, and Romania. Yet by this measure also there is a clear polarization between the western regions and the rest of the country. In the North-West and the West, individual farms control less than 70% of agricultural land, whereas in central and eastern regions the share of individual farms is around 90% of agricultural land. History provides the accepted explanation for this phenomenon. The western parts of Poland were annexed from Germany after World War II and a large proportion of agricultural land in these regions, formerly owned by foreign nationals, was nationalized and used for the creation of large-scale state farms. As a result, the presence of individual farms in these regions is substantially smaller than in other parts of Poland, where Polish-owned land was never nationalized and individual farming received a strong boost through the partitioning of large estates immediately after the war.

Table 2. Main Labor and Farming Characteristics by Macro-Region

Macro-regions	Rural population, %	Share of labor in agriculture, %	Share of land in individual farms, %	Labor intensity, agricultural workers per 1000 ha*	Land sufficiency, hectares of land per rural resident*
Poland (1997)					
North-West	33.4	16.8	68.3	146	1.8
West	34.3	19.1	68.4	209	1.4
Center-West	39.8	22.6	79.2	422	0.8
Center	42.7	35.1	92.1	278	1.3
Center-South	43.7	29.5	82.1	224	1.4
North-East	47.9	43.1	88.4	188	2.1
East	58.7	51.9	91.5	298	1.5
South-East	56.9	44.8	89.6	546	0.8
Russia (1999)					
Caucasus	46.2	22.2	13.0	174	1.5
Europe	30.7	17.6	11.0	84	3.6
East	32.3	15.7	11.7	67	3.8
Far East	28.1	10.3	18.1	153	1.7
North	26.3	9.6	18.6	184	1.2
Super regions					
Europe	34.3	18.6	11.5	105	3.1
North+East	29.2	12.1	15.8	128	2.3

*Agricultural land for Poland; arable land for Russia.

In Russia, the variability in the degree of individualization is determined by regional politics, not by history. Individual farming is more widespread in the less fertile North and Far East than in the agriculturally fertile center. This observation may appear somewhat paradoxical at a first glance, and yet it is consistent with previous findings regarding the relationship between regional reform policies and the share of agriculture in regional product. It has been shown that the more agricultural regions in Russia tend to be more conservative, emphasizing the traditional collective agriculture at the expense of reforms that promote individual farming (Lerman, Csaki, and Feder 2002, Ch. 3). The

political bias toward the collective form of organization in agriculturally rich regions, where local authorities find it easier to extract rents and benefits from a relatively small number of large collective farms than from a multitude of family farms, explains the relatively low degrees of individualization in Russia's fertile center.

Labor Intensity and Individualization of Agriculture

The grouped regional data for Poland in **Table 2** show a positive correlation between the share of agriculture in employment and the degree of individualization in agriculture. The western regions with weak individual farming are characterized by low agricultural employment, while eastern and central parts of Poland, where private farming is more widespread, show higher levels of employment in agriculture. This tentative conclusion is corroborated by the cross-sectional data for all 49 voivodships: the share of agriculture in employment increases with the increase of individual farming, as measured by the share of individual farms in agricultural land (the correlation coefficient between the two variables is 0.68).

While this preliminary observation for Poland is consistent with our view of individual farms as a labor sink, no such direct correlation between the share of agriculture in employment and the degree of individualization is observed for Russia. Aggregated data for super-regions actually show an inverse relationship: the relatively high share of agricultural employment in the central super-region (Europe) is associated with a relatively low degree of individualization. We accordingly continue the analysis by examining the relationship between "labor intensity", i.e., the number of workers per hectare, and the share of individual farms in agricultural land. These two variables generally give the expected relationship for Russia's super-regions and macro-regions in **Table 2**: higher labor intensity is associated with higher individualization. Yet for Poland these variables do not show a clear pattern in regionally aggregated data. True, the western regions with their relatively small individual farming sector are characterized by low "labor intensity", and the South-East with a substantially higher share of individual farms in land is characterized by much higher "labor intensity". Yet the "labor intensity" in the central and eastern regions is comparable to that in the western regions despite a much higher level of individual farming. A similar, though less pronounced, departure from the general relationship is observed in Russia, where the Caucasus region has the highest labor intensity and only a medium degree of individualization.

Examination of the last two columns in **Table 2** suggests a possible direction for further analysis of labor intensity. We see that the regions with the highest labor intensity (South-East and Center-West in Poland; North and Caucasus in Russia) have the lowest "land sufficiency": less than 1 hectare per rural resident in Poland and up to 1.5 hectare in Russia. If there is not enough land, then we can naturally expect more rural people to be employed per hectare. Whether or not these people are employed efficiently is a different question to be dealt with in the next section. What concerns us in the present context is that they are employed on the farm and are not ejected into the unemployment pool.

To test the hypothesis that regions with a higher level of individual farming show higher labor intensity we use two regression models for Poland and Russia. One model examines labor intensity as a function of the share of individual farming in land, the total amount of farmland in the region, and the size of the rural population. The second model

converts farmland and rural population into a single variable – "land sufficiency" as measured by hectares of farmland per rural resident. The regressions were run separately for the two countries because of large differences in scale and in other factors. The regression results are presented in **Table 3**.

Table 3. Determinants of Labor Intensity

	Poland (1997)		Russia (1999)	
	Model 1	Model 2	Model 1	Model 2
	Workers per 1000 ha	Workers per 1000 ha	Workers per 1000 ha	Workers per 1000 ha
Intercept	59.1	371.6***	85.21128***	177.18256***
Share of individual farming (%)	2.54***	2.67***	3.68141**	2.37056*
Total farmland (1000ha)	-0.70627***	--	-0.04263***	--
Rural population (000s)	0.96949***	--	0.09980***	--
Land sufficiency (ha per rural resident)	--	-217.5***	--	-33.29669***
R-square	0.81	0.72	0.37	0.46

*** signif. at p=0.01; ** signif. at p=0.05; * signif. at p=0.1
Note: Agricultural land for Poland; arable land for Russia.

The results clearly show that for both countries in both models, the labor intensity increases with the increase in the share of individual farming when we control for total farmland and total rural population (or, alternatively, for land sufficiency in hectares per rural resident). Also we see that for a given level of individual farming, labor intensity decreases with the increase of land sufficiency. If more land is available per rural resident, this tends to reduce the number of workers per hectare (for a given level of individual farming). This conclusion based on model 2 is consistent with the results of model 1: if more land is available (for a given rural population), the labor intensity declines; if the rural population is larger (for a given amount of farmland), the labor intensity increases.

Figure 1 plots, for Poland, the relationship between labor intensity and the share of individual farming adjusted for the effect of agricultural land and rural population according to model 1. The diagram shows a clear increase in labor intensity with the increase in the share of individual farming when we control for land sufficiency of the rural population. Consistently with general econometric considerations, the slope of the fitted line in **Figure 1** is b=2.5, the same as the regression coefficient of the individualization variable in full model 1 (see **Table 3**). The same pattern is observed for Russia (with b=3.7), although the fit is somewhat poorer. That the effect is less strong for Russia can partly be attributed to our use of agricultural land in individual use as the variable measuring individualization; the difference between arable and agricultural land is much greater for Russia than for Poland and it is arable land on which most labor is employed. Similar regressions using the share of sown land under four major crops (grain, sunflower, potato and vegetable) in individual farms have shown very strong significant effects of the individualization factor on the labor intensity.

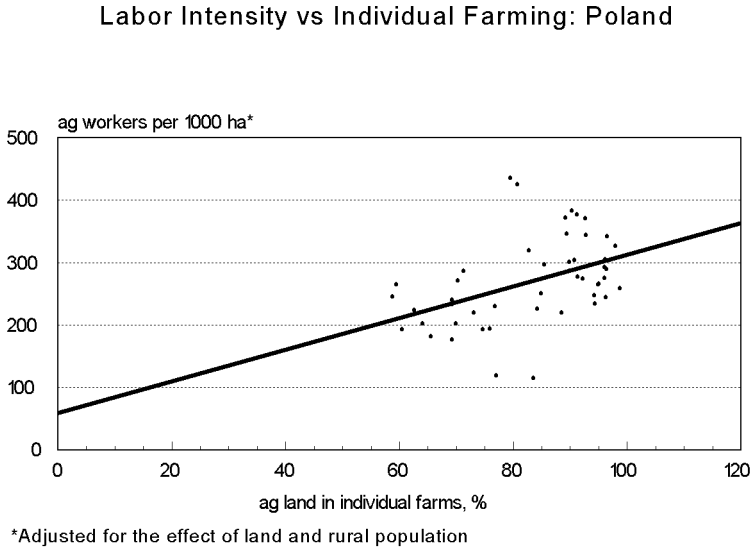

Figure 1.

Productivity Analysis

Having confirmed our first hypothesis of higher labor intensity in regions with a higher level of individualization, we now turn to our second hypothesis that regions with a higher level of individual farming do not show a lower efficiency of agricultural production. Unfortunately, no regional production data for Poland are available to test this hypothesis and we have to rely on data for Russia.

Production Function Approach

To establish the effect of individualization on agricultural productivity, we run two regression models in the Cobb-Douglas production function framework. Model A uses total agricultural production as the dependent variable and regresses it on total arable land, agricultural labor, the size of the livestock herd, and the individualization factor expressed as the percent of agricultural land in individual use (the variable pind_lnd). Model B uses agricultural labor productivity as the dependent variable and divides the factor variables by agricultural labor. The transition to per-worker variables is valid, because the full model (Model A) shows constant returns to scale. All variables are logged (except the individualization measure). The regression results are presented in **Table 4**.

Individualization of agriculture makes a positive and significant contribution ($p=0.01$) to both total agricultural production and labor productivity while controlling for total farmland, total labor, and the composition of production (as represented by the livestock herd). This shows that regions with higher individualization of agriculture perform better by measures of total agricultural output and agricultural labor productivity. The increase in labor productivity is observed despite the fact that labor intensity increases with the degree of individualization. In regions with a more prominent individual sector, output grows faster than agricultural labor. Despite acting as a labor

sink, individual farms appear to be more productive than corporate farms on the regional level when land, labor, and livestock are considered as the main factors of production.

Table 4. Production Function: Russia

Model A: Ln(ag product) = pind_lnd + ln(arable land) + ln(ag labor) + ln(livestock) (n=76)

Model B: Ln(ag product/ag labor) = pind_lnd + ln(arable land/ag labor) + ln(livestock/ag labor) (n=76)

Dependent:	Agricultural production			Agricultural labor productivity		
	Model A1#	Model A2	Model A3	Model B1	Model B2	Model B3
Intercept	4.41735***	4.05879***	4.26164***	11.00520***	10.64859***	10.84502***
Pind_lnd	--	0.01678***	0.01635**	--	0.01714***	0.01666**
Arable land	0.03583	0.08391	0.13567*	-0.03918	0.01215	0.06403
Ag labor	0.66179***	0.60517***	0.75076*	--	--	--
Livestock	0.20055*	0.21206*	--	0.24867**	0.25899**	--
R-square	0.8770	0.8888	0.8832	0.0574	0.1457	0.0840
F-value (signif)	171.12 (0.000)	141.92 (0.000)	181.54 (0.000)	2.22 (0.1155)	4.09 (0.0097)	3.35 (0.0407)

The hypothesis of constant returns to scale (sum of coefficients = 1) is not rejected at p=0.01.
*** signif. at p=0.01; ** signif. at p=0.05; * signif. at p=0.1
Note: Share of land in individual use (pind_lnd) in percent, ag product in million rubles, land in 1000 ha, labor in 1000s, and livestock in 1000 head of cattle.

These results are illustrated in **Figure 2**, which plots agricultural production and agricultural labor productivity against the level of individualization. The agricultural production line is based on model A3, i.e., it is adjusted for arable land and agricultural labor. The productivity line is based on model B3, which did not require any adjustment (the coefficient of land in this model is not significant). Exclusion of the three outliers with individualization higher than 30% does not affect the significance of the model and actually improves the R-square.

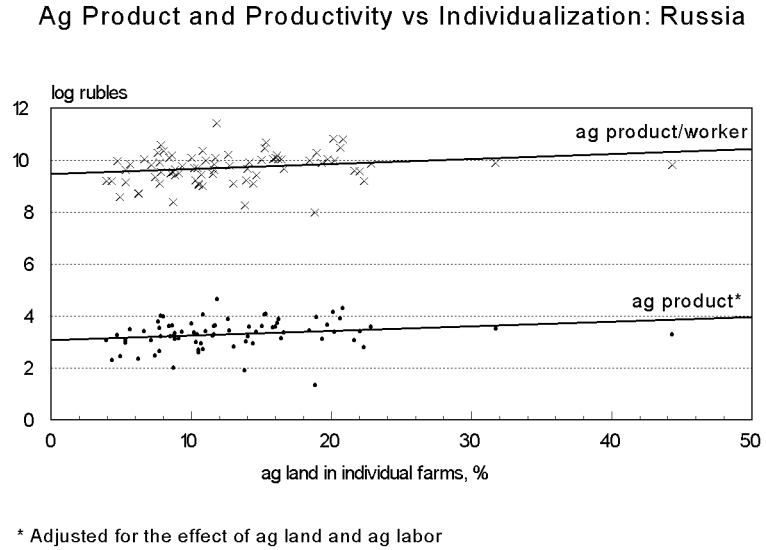

Figure 2.

Technical Efficiency

The production function analysis, which showed that labor productivity increases with increasing individualization, was supplemented with technical efficiency analysis conducted using two standard algorithms: the non-parametric Data Envelopment Analysis (DEA) and the parametric Stochastic Frontier Analysis (SFA). Both algorithms produce technical efficiency scores (with values between 0 and 1) that measure the closeness of the observation points to the empirical production frontier representing the best production bundles (input-output combinations) achievable in the sample. A technical efficiency score of 1 implies that the observation is on the production frontier. As the score decreases below 1, the observation corresponds to a less efficient production bundle.

The analysis was conducted using land and labor as the inputs and the value of agricultural production as the output (the equivalent of model A3 in production function analysis). The technical efficiency scores produced by the two algorithms were found to increase with the increase of the level of individualization in Russia's provinces. **Table 5** presents the mean technical efficiency scores for three individualization categories: up to 10% agricultural land in individual use; 10-20% agricultural land in individual use; and over 20% agricultural land in individual use. The mean technical efficiency scores increase monotonically as the level of individualization rises. In simultaneous pairwise comparisons, the differences are statistically significant between the first individualization category and each of the other individualization categories.

Table 5. Technical Efficiency Scores by Individualization Levels: Russia

Individualization category*	Number of observations	DEA	SFA
Up to 10%	27	0.53	0.61
10-20%	38	0.65	0.69
Over 20%	10	0.71	0.76

*Percent of agricultural land in individual use.

Conclusion

Using regional data for Poland and Russia, we have shown that the phenomenon of higher labor intensity in family farming also prevails in transition agriculture, where a priori we would expect former collective farms to suffer from excess labor. A cross-regional comparison convincingly showed that regions with a higher incidence of individual farming have a higher share of their total labor force in agriculture, i.e., individual farming acts as a labor sink for the rural population. Moreover, we demonstrated for Russia that regions with a higher level of individualization, while employing relatively more labor, achieve productivity and efficiency levels that are definitely not lower than those of regions with less individual farming.

In a sense, individual farming is a barrier against rural-to-urban migration. Such barriers have a negative connotation, as in developed market economies they are believed to perpetuate rural poverty. Yet in transition economies such barriers are not necessarily bad. As long as there are insufficient employment opportunities in urban areas, it may be beneficial to keep the rural population employed in agriculture. Low incomes from

individual agriculture may be better than no income at all for the urban unemployed. Preliminary results of some additional analyses indicate that higher regional unemployment rates lead to higher labor intensities in agriculture. We argue in effect that individual farming compensates for insufficient non-farm employment opportunities and creates a safety net for the rural population by ensuring a certain level of income, which may be low but is preferable to no income at all.

These conclusions lead to a clear policy advice to transition countries, and especially to CIS: as long as non-agricultural employment opportunities in towns and in rural areas remain undeveloped, land policies should be aimed to encourage individualization of agriculture. Very small individual farms may be inefficient (although the jury is still out on this question), but at least they provide employment and food – a basic safety net that the rural population desperately needs in the absence of adequate unemployment-benefit programs in transition countries. Not every transition country is Germany, which could afford to achieve dramatic improvements in farming efficiency in the new eastern states at the expense of forcing three-quarters of the labor force out of agriculture and putting it (at least temporarily) on social security (Koester and Brooks 1997). The average transition country should probably encourage the rural population to remain in agriculture, pending long-term development of non-agricultural employment opportunities. Our results seem to indicate that individual farming provides a good recipe for this strategy. The time to focus on farming efficiency will come when overall economic growth reaches levels that generate sufficient off-farm employment opportunities for the rural population.

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