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**SOURCES OF AGRICULTURAL PRODUCTIVITY GROWTH
IN CENTRAL ASIA**

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SOURCES OF AGRICULTURAL PRODUCTIVITY GROWTH IN CENTRAL ASIA

Zvi Lerman and David J. Sedik

Abstract

The paper examines agricultural production and productivity growth in two Central Asian countries – Tajikistan and Uzbekistan. Both countries are characterized by a significant shift of resources from the traditional Soviet model of collective agriculture to more market-compliant individual and family farming. In both countries, the beginning of the policy-driven switch to family farming around 1997 coincided with the beginning of recovery in agriculture, namely resumption of agricultural growth after a phase of transition decline since 1991. In addition to growth in total agricultural production, we also observe significant increases in productivity of both land and labor since 1997. These observations suggest that productivity growth may be attributable to the changes in farming structure in Central Asia. To check this conjecture we assess the sources of growth by applying the standard Solow growth accounting methodology. Using time series of country statistics for farms of different organizational forms, we decompose the growth in output into growth in the resource base (extensive growth) and growth in productivity (intensive growth). Solow growth accounting clearly shows that, first, much of the growth at the country level is attributable to increases in productivity rather than increases in resources and, second, the increases in productivity in family farms (especially household plots) outstrip the increases in productivity in former collective and state farms. These findings confirm that the recovery of agricultural production in Central Asia has been driven largely by productivity increases, and it is the individual farms that are the main source of agricultural productivity increases.

Keywords: agricultural productivity, agricultural growth, family farms, corporate farms, comparative performance, agrarian reforms, transition countries, Central Asia, Tajikistan, Uzbekistan

JEL classification: P27, P31, P32, Q15, R14

Introduction

One of the items on the agricultural reform agenda in former Soviet republics forming the Commonwealth of Independent States (CIS) involves transformation from the traditional corporate farms to substantially smaller family or individual farms. This transformation is motivated by the theoretical incentive analysis of farms of different organizational forms in market economies, which suggests that family farms can be expected to achieve higher levels of productivity and efficiency than corporate farms (Allen and Lueck 2002).

Tajikistan and Uzbekistan embarked on the process of land reform in 1991-1992, immediately after gaining independence. However, the first years were characterized by hesitant and indecisive progress, largely attributable to lack of experience with the huge task on hand. In Tajikistan in particular further difficulties were created by the civil war that raged in this country until 1997. After 1997-98, however, both countries began to implement resolutely a comprehensive program of land reform and farm restructuring that culminated in a massive shift of agricultural land and agricultural production to small individual and family farms. These achievements of land reform in Tajikistan and Uzbekistan are particularly remarkable because the two countries are generally regarded as slow reformers and are assigned low ranks for their reform performance by international organizations (Csaki and Kray 2005).

The ultimate goal of land reform in all transition countries is to increase the incomes and the standard of living of their large rural populations, which rely on agriculture for a substantial part of the family budget. Every CIS transition country attempts to achieve this goal by encouraging growth in the agricultural sector and, whenever possible, improving farm productivity. In this paper, we accordingly analyze agricultural growth and productivity improvements in two specific Central Asian countries. The analysis is based on official country statistics of Tajikistan and Uzbekistan, the sources for which are listed under References at the end.

Agricultural development

Agricultural development in Tajikistan and Uzbekistan, as represented by changes in Gross Agricultural Output (GAO), exhibits four distinct stages (**Figure 1**) – robust Soviet growth (up to 1980), stagnation during the Gorbachev period (1980-1990), transition decline (from 1991 to 1996-97), and finally recovery (since 1997-98). The transition decline that began in 1990-91 exhibited the classic features of decline observed in all post-Soviet countries: the disintegration of the traditional Soviet agricultural system, with its rigidly planned supplies of inputs to and purchases of outputs from collective and state farms at fixed prices, caused a dramatic fall in agricultural production after 1991. This fall in production was largely due to the fall in the use of purchased inputs, including feed, machinery, and fertilizers, and the shrinkage of the livestock herd as a production resource.

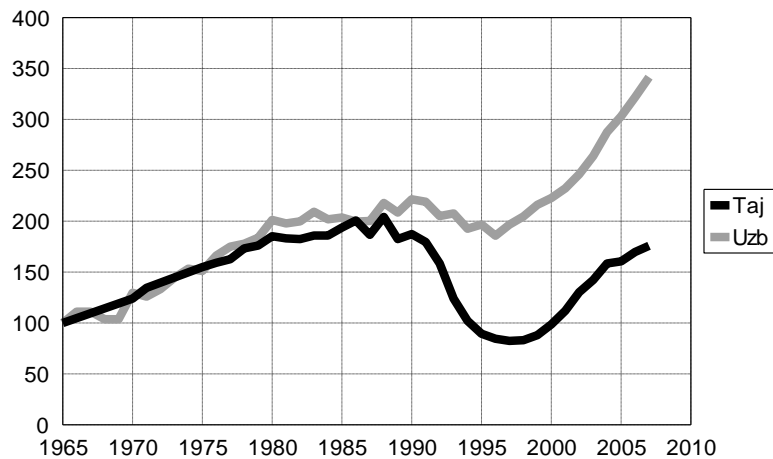


Figure 1. Growth of agricultural production in Tajikistan and Uzbekistan, 1965-2007 (GAO in percent of 1965).

The transition decline was much more pronounced in Tajikistan than in Uzbekistan. By 1997 agricultural production in Tajikistan had fallen to levels not seen since the early 1960s. The perception of the transition decline in the 1990s was undoubtedly all the more negative because it was preceded by decades of steady agricultural growth during the Soviet period, as the GAO index in both countries doubled between 1965 and 1988, despite the relative slowdown during Gorbachev's rule in the 1980s.

Changes in farm structure and land tenure since independence

Soviet agriculture was characterized by co-existence of two farm structures: large collective and state farms (“farm enterprises” or “agricultural enterprises”), which represented the formal commercial farm sector, and very small subsistence-oriented household plots, which constituted the “private” sector all through the Soviet era. Land reform processes in all CIS countries substantially enlarged the household plots through land allocation programs and in addition created a new private sector of so-called “peasant farms”, which by design were larger and more commercially oriented than the traditional household plots. The farm structure in almost all CIS countries today is characterized by the existence of three farm types that span the entire spectrum of sizes: large corporate farms (“enterprises”) that succeeded the former collective and state farms; mid-sized peasant farms; and small (albeit enlarged) household plots that survived the Soviet regime. Household plots and peasant farms are classified as individual or family farms. By contrast, the successors of agricultural enterprises are referred to as corporate farms.¹

Up to 1990, Soviet agriculture in Tajikistan and Uzbekistan, as in all other former Soviet republics, was characterized by total dominance of large collective and state farms, which controlled over 90% of both agricultural and arable land in the pre-reform era. The dominance of large agricultural enterprises began to wane when serious land reform measures were launched in the second half of the 1990s (after 1997-98; the bottom layer in **Figures 2, 3**). The share of arable land in enterprises dropped steadily from the Soviet level of over 90% to around 20% in 2007. Much of this land shifted to new emergent farm structures – the so-called peasant farms, which now control

¹ There is a potential for terminological confusion among individual farms. In Tajikistan, peasant farms are called “dekhkan farms” (“dekhkan” or “dehqan” is literally a peasant in Central Asian languages). In Uzbekistan, on the other hand, peasant farms are called “fermery” in Uzbek or “fermerskie khozyaistva” in Russian, while the term “dekhkan farms” today designates the small household plots cultivated by the rural population at large. Regardless of the specific name used, the two types of individual farms are subject to different laws in the two countries.

60% of arable land, more than double what remains in corporate farms. The remaining 10%-20% of arable land is in household plots – the traditional private agriculture carried over from the Soviet era. Their share also increased markedly through allocation of additional land in the process of land reform (again at the expense of agricultural enterprises).

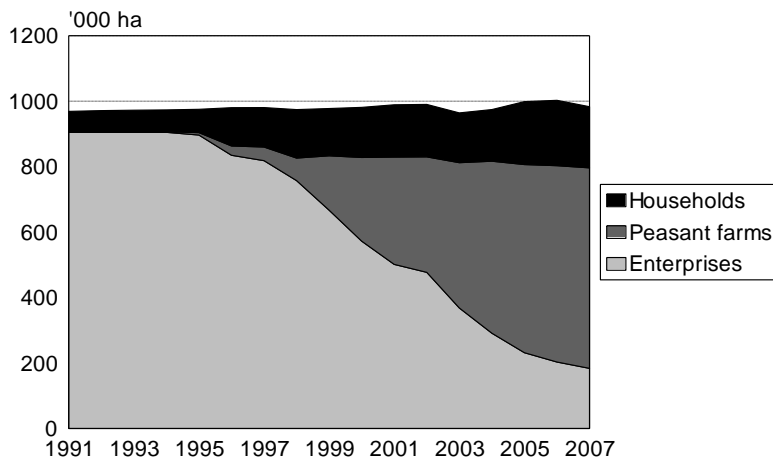


Figure 2. Use of arable land by farms of different organizational forms in Tajikistan, 1991-2007 (million hectares).

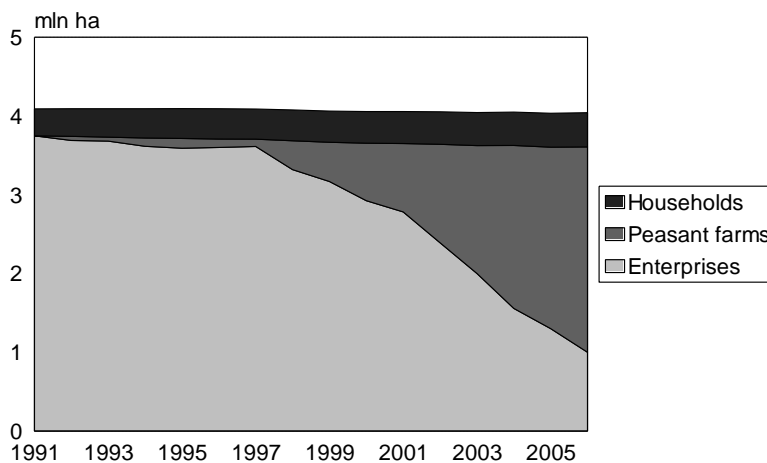


Figure 3. Use of arable land by farms of different organizational forms in Uzbekistan, 1991-2006 (million hectares).

The changes in land holdings are presented for selected years in **Table 1**. The share of the individual farming sector – both household plots and peasant farms – increased from about 3% to 30% in agricultural land since 1991. The share of individual farms – both household plots and peasant farms – in arable land rose from less than 10% to around 80%, but it is the newly created peasant farms that now control most of the arable land in Tajikistan and Uzbekistan. Pastures are still largely managed by agricultural enterprises, which is reflected in their higher share of

agricultural land, especially in Uzbekistan (agricultural land includes pastures as well as arable land).

Table 1. Structure of land use by farm type 1991-2007

	Agricultural land			Arable land		
	Enterprises	Peasant farms	Household plots	Enterprises	Peasant farms	Household plots
Tajikistan						
1991	98	0	2	95	0	5
1995	98	0	2	93	1	6
2000	64	32	4	63	29	8
2007	30	64	6	19	62	19
Uzbekistan						
1991	98	0	2	92	0	8
1995	97	1	2	88	3	9
2000	94	4	2	72	18	10
2006	68	29	3	25	65	11

Changing structure of agricultural production

The differential changes in the distribution of land across farms of different organizational types have led to striking changes in the structure of agricultural production, especially after 1997-1998. The production in enterprises shrank dramatically from around 40% in 1997 to less than 10% in 2007. The production in household plots remained fairly stable at close to 60% of the total. The production in peasant farms took up the slack released by the shrinkage of enterprises, increasing from 3% in 1997 to about 30% in 2007. We clearly see from **Figures 4, 5** that agricultural production has in fact shifted from enterprises to peasant farms since 1997: the decrease in production in agricultural enterprises (bottom dark gray layer) has been compensated by a corresponding increase in production in peasant farms (black layer above it), while the household plots (top light gray layer) have retained a dominant – and relatively constant – share throughout the entire period despite their small share in arable land.² The observed shift in production from enterprises to peasant farms is consistent with the shifts in arable land in **Figures 2, 3**.

²The changes in production structure by farm type in **Figures 4, 5** reflect primarily crop production, as in livestock production, the household sector is a clear leader, with over 90% of the output over time.

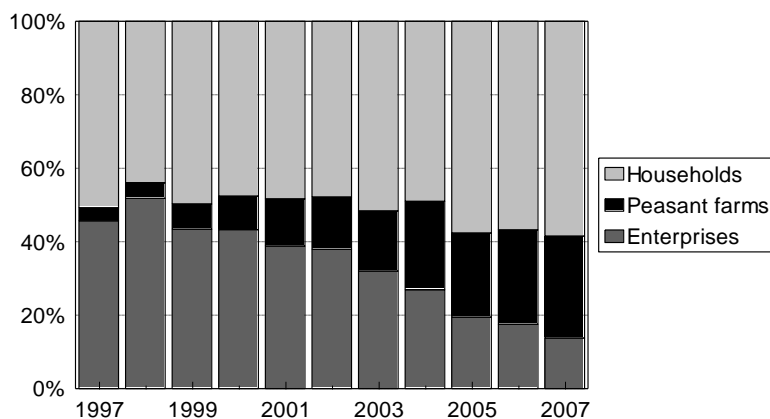


Figure 4. Structure of agricultural production (GAO) by farm type in Tajikistan, 1997-2007

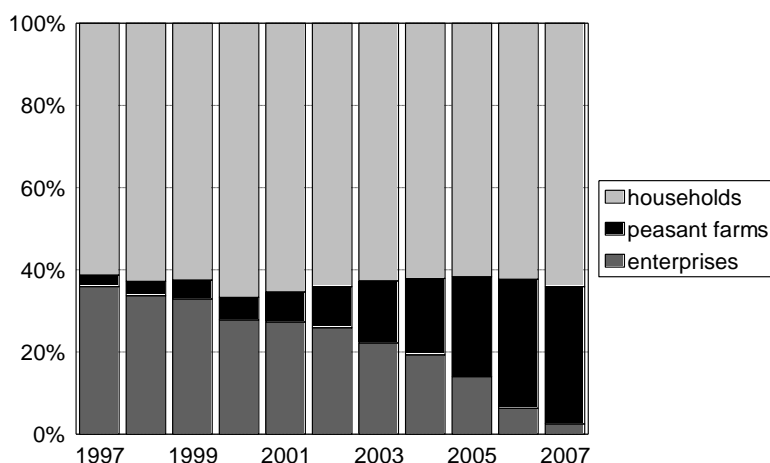


Figure 5. Structure of agricultural production (GAO) by farm type in Uzbekistan, 1997-2007.

Table 2. Structure of agricultural production by farm type 1997-2007

	Tajikistan			Uzbekistan		
	1997	2002	2007	1997	2002	2007
Agricultural production						
Enterprises	46	38	14	36	26	3
Peasant farms	3	14	28	3	10	33
Household plots	51	48	58	61	64	64
Crop production						
Enterprises	52	35	14	63	43	2
Peasant farms	4	22	35	4	18	57
Household plots	44	43	50	33	40	41
Livestock production						
Enterprises	13	5	3	10	9	4
Peasant farms	0	1	3	1	2	4
Household plots	87	94	94	89	89	93

Recovery of agricultural production

The transition decline changed to recovery around 1997, and both countries registered impressive growth in agricultural production, which rose between 1997 and 2007 by more than 90% for Tajikistan and nearly 70% for Uzbekistan (black curve in **Figures 6, 7**). This growth was

driven entirely by the individual sector, i.e., household plots and peasant farms, as the corporate sector (agricultural enterprises) continued its general decline after 1997 (gray curve in **Figures 6, 7**).³ The process of agricultural reform encouraging and emphasizing transition from the traditional large-scale enterprises to individual farms – both peasant farms and enlarged household plots – has produced remarkable results in terms of production growth in agriculture. This effect of agricultural growth spurred by individualization of agriculture is not unique to Tajikistan and Uzbekistan: it is observed also in other CIS countries that have encouraged transition to individual farming.

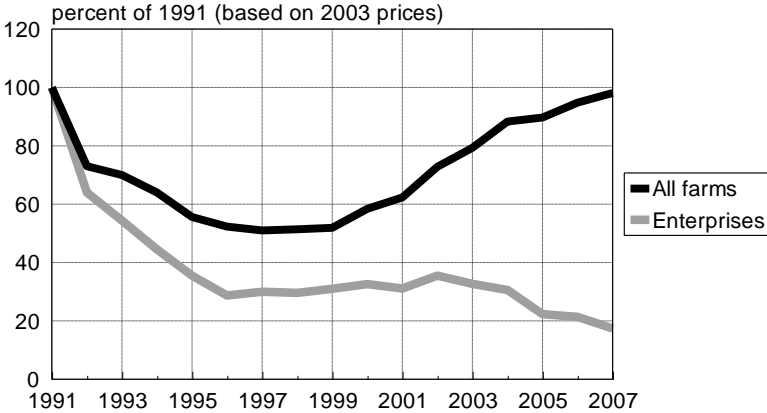


Figure 6. Growth of agricultural production for all farms and agricultural enterprises in Tajikistan, 1991-2007 (GAO in percent of 1991, based on constant prices).

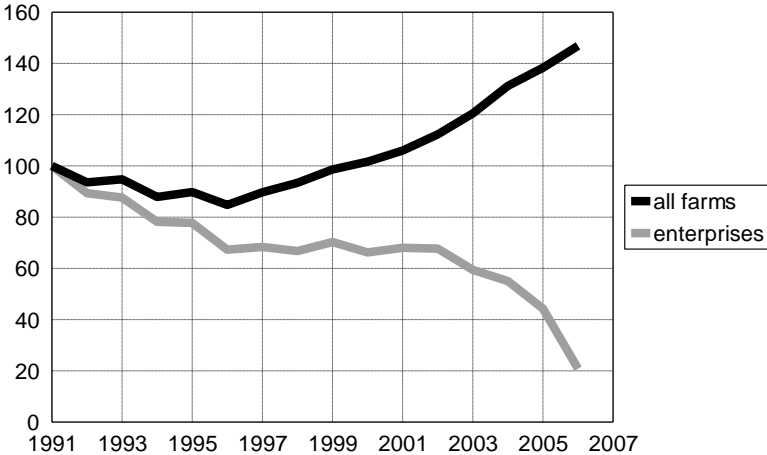


Figure 7. Growth of agricultural production for all farms and agricultural enterprises in Uzbekistan, 1991-2006 (GAO in percent of 1991, based on constant prices).

³ **Figures 6, 7** show the agricultural production curves for all farms and for agricultural enterprises only, as the curve for individual farms rises so steeply that it simply goes off the vertical scale.

Productivity gains after 1997

Growth in agricultural output can originate from increases in the resources utilized (so-called extensive growth) or from increases in the efficiency with which resources are employed (intensive growth). For example, the value of crop production can increase as a result of increases in sown area, increases in the productivity with which farms utilize land, or a combination of these two factors. Likewise, growth in the value of livestock production can derive from increases in livestock inventories, increases in the productivity with which farms make use of livestock (e.g., milk yields achieved by dairy farmers), or a combination of the two. The rationale behind agrarian reform has always been the potential productivity gains due to the transfer of land and other assets from collective and state farms to individual farms. Therefore, an important indicator of the success of reforms is the presence or absence of productivity increases as a source of recovery.

Productivity can be calculated in physical units, as the number of kilograms produced per hectare (for crops) or per cow (for milk). More generally, agricultural productivity is calculated in aggregated value terms as partial productivity of land (aggregated value of agricultural output per hectare of agricultural land) and partial productivity of labor (aggregated value of agricultural output per agricultural worker, including self-employed peasants).⁴ **Figures 8, 9** show the three curves that constitute the basis for value-based productivity calculations: agricultural production (gray curve), agricultural land in use (thin black curve), and agricultural labor (thick black curve). The curves span the period 1980-2007 and they are all normalized to index numbers with 1980=100, thus eliminating problems due to differences in units of measurement.

⁴More sophisticated measures rely on total factor productivity (TFP), which aggregates the partial measures into one index that allows for the entire basket of resources and inputs used in agriculture. TFP is technically difficult to calculate, however, as it requires estimation of the production function to obtain the weights for the aggregation of inputs.

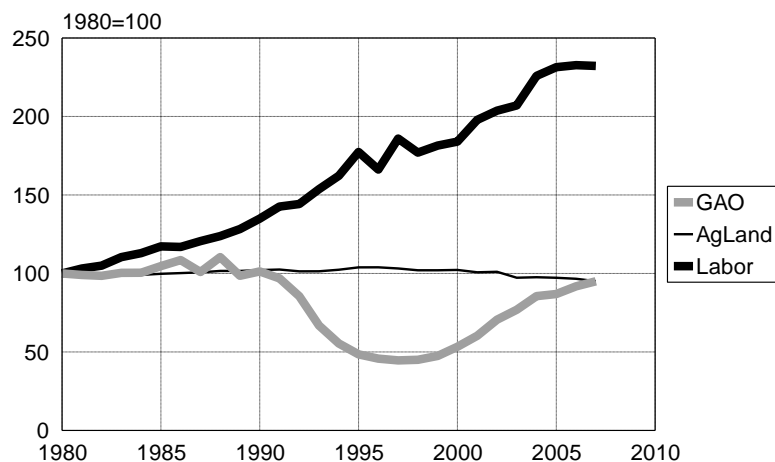


Figure 8. Basic data for productivity calculations: GAO, agricultural land, and agricultural labor for Tajikistan, 1980-2007 (index numbers in percent of 1980).

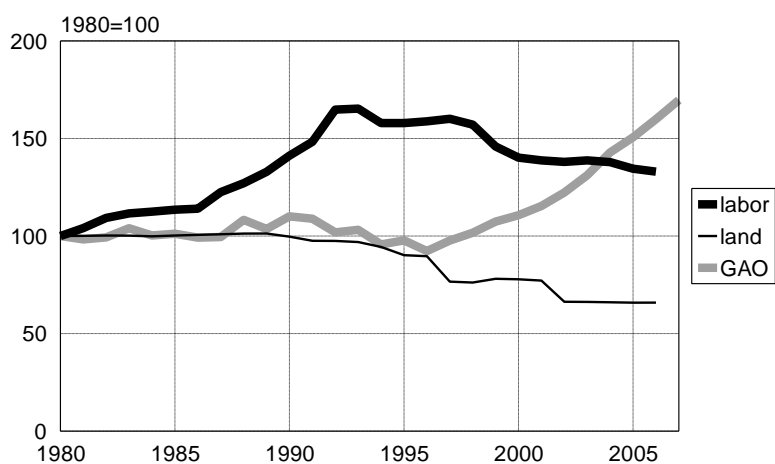


Figure 9. Basic data for productivity calculations: GAO, agricultural land, and agricultural labor for Uzbekistan, 1980-2007 (index numbers in percent of 1980).

In both Tajikistan and Uzbekistan, agricultural output (GAO) has increased dramatically since 1997, while agricultural land has remained generally constant (in Tajikistan) or even declined (in Uzbekistan). This essentially means that the partial productivity of land increased, almost doubling (in constant prices) between 1997 and 2007 in both countries (**Figure 10**). Agricultural labor, unlike agricultural land, showed steady increase in Tajikistan since 1980, but its increase lagged behind the growth in agricultural output after 1997 and as a result the productivity of agricultural labor also increased between 1997 and 2007, although more moderately than the productivity of land (**Figure 10**). In Uzbekistan, the steady increase of agricultural labor during the Soviet period changed to moderate decline after 1990 (**Figure 9**), which combined with growth in agricultural production led to a robust increase in partial productivity of labor after 1997 (**Figure 11**).

Agricultural reforms in Tajikistan and Uzbekistan are thus seen to have had a highly beneficial outcome, producing robust growth in both production and productivity. Another dimension that needs to be checked in future work is the impact of these processes on rural incomes and the wellbeing of the rural population.

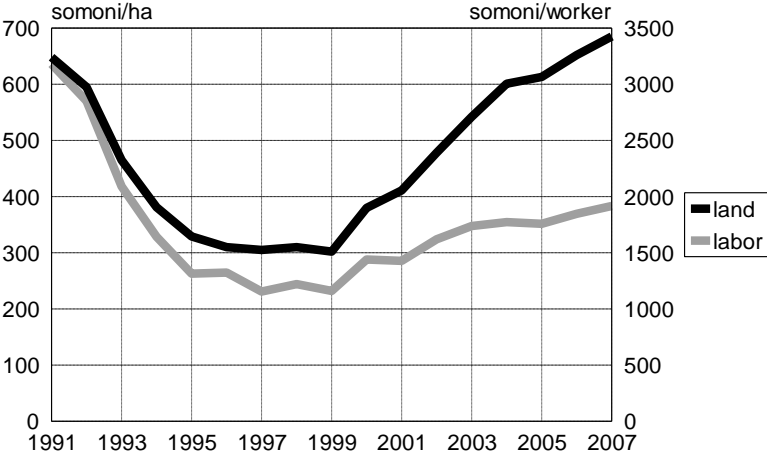


Figure 10. Productivity of land and labor in Tajikistan, 1991-2007 (GAO per hectare of agricultural land and per agricultural worker, all farms, somoni per ha in constant 2003 prices).

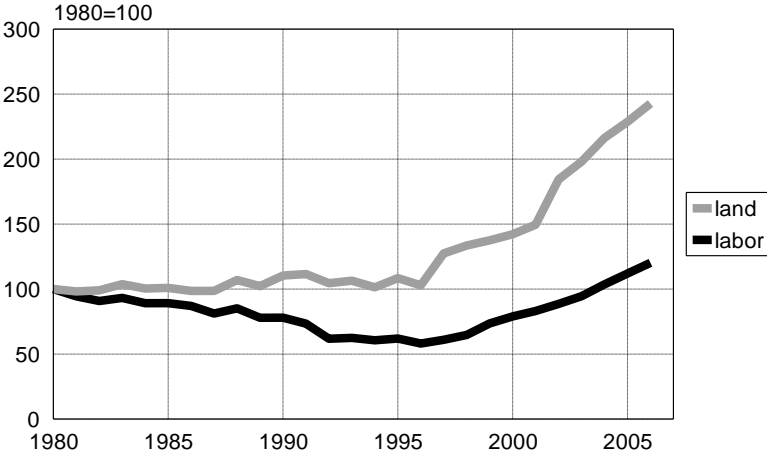


Figure 11. Productivity of land and labor in Uzbekistan, 1980-2006 (GAO per hectare of agricultural land and per agricultural worker, all farms, in percent of 1980).

The case for land reform and the potential yield improving effects can be seen in **Figure 12** which shows (for Tajikistan) the huge differences in productivity of land between household plots on one side and enterprises and peasant farms on the other. Household plots – the undisputed individual farms in all CIS countries – consistently achieve much higher levels of land productivity: agricultural land in household plots is utilized 20 to 50 times more productively than in farms of other types. Further redistribution of land to household plots could substantially increase average productivity in agriculture, thus leading to a large increase in agricultural production.

Figure 12 also illustrates that farms of all three types in Tajikistan achieved increases in land productivity since 1999. While growth in agricultural production was driven entirely by the individual sector (see **Figure 6**), the growth in land productivity appears to be driven by farms of all organizational forms. At the same time it is noteworthy that peasant farms in Tajikistan are not doing better than agricultural enterprises on average. This puzzling result may stem from the fact that at least one-third of the peasant farms in Tajikistan are not really individual farms at all: they are collective dehkan farms (partnerships) created in the process of reorganization of traditional farm enterprises and their incentives are closer to those of corporate farms than individual farms. Many of these collective dehkan farms were only cosmetically reorganized and the management structures have remained unchanged (FAO 2004). Under these circumstances we should not be surprised that the productivity of peasant farms in Tajikistan, taken as a heterogeneous group, is not different from that of the farm enterprises they succeeded. Future analytical efforts should attempt to separate the performance of individual dehkan farms from collective dehkan farms in Tajikistan.

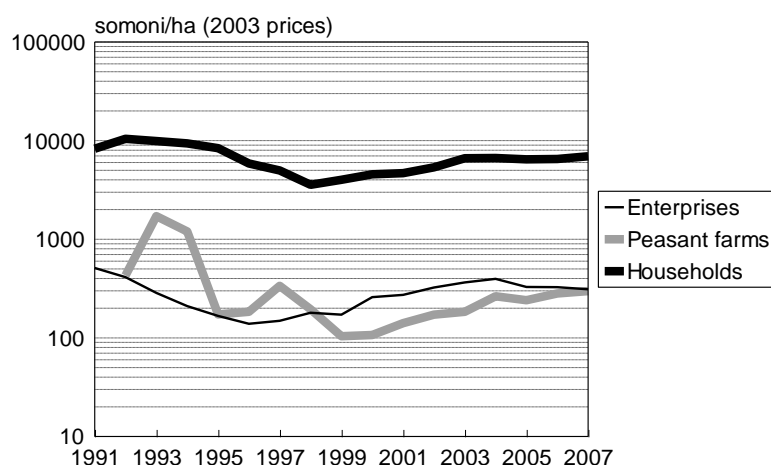


Figure 12. Productivity of land by farm type in Tajikistan, 1991-2007 (GAO per hectare of agricultural land, by type of farm, somoni per ha in constant 2003 prices, log scale).

Productivity as a source of production growth

To assess the sources of growth since 1997, we applied the standard Solow growth accounting methodology, which separates growth in output into two components: growth in the resource base (extensive) and growth in productivity (intensive). **Tables 3, 4** show the change in the

value of crop production (in constant prices) since 1997 and the corresponding change in the resource base (represented by the sown area). The growth in production not accounted for by the change in the resource component is by definition the contribution from increases in productivity. The decomposition in **Table 3** shows that 55% of growth in crop production in Tajikistan is attributable to increases in land area, while the remaining 45% can be attributed to increases in productivity. The numbers for livestock production are essentially the same (57% due to change in herd size, 43% due to changes in productivity).

For Uzbekistan as a whole, the increase in aggregate value of crop production was achieved in parallel with a decrease in sown area (**Table 4**). In other words, growth in agricultural output occurred despite a decrease in resources, and this may be interpreted as indicating that the entire change in output (100%) was attributable to productivity, with no contribution whatsoever from change in resources.

There are large differences in the contribution of productivity growth by farm type and by country. Yet individual farms seem to be associated with larger productivity changes: household plots and peasant farms in Uzbekistan achieve implied productivity change of 1.6-1.7 (compared with 1.4 for enterprises), and in Tajikistan household plots – individual farms par excellence – achieve an implied productivity change of 2.1 (peasant farms in Tajikistan are a heterogeneous groups consisting of both individual and collective dehkan farms, which may account for their lower productivity change component: see the previous discussion in connection with **Figure 12**).

Table 3. Changes in output and resources in crop production for farms of different types in Tajikistan, 1997-2006 (2006/1997, times)

	Tajikistan	Agricultural enterprises	Peasant farms	Household plots
Aggregate value of crop production	2.0	0.6	17.2	2.3
Sown area	1.1	0.4	16.7	1.1
Implied productivity change	1.8	1.3	1.0	2.1
Contribution of change in resources to change in production (%)	55	78	97	48
Percent of aggregate crop production in 2006 (%)	100	14	36	50

Table 4. Changes in output and resources in crop production for farms of different types in Uzbekistan, 1997-2007 (2007/1997, times)

	Uzbekistan	Agricultural enterprises	Peasant farms	Household plots
Aggregate value of crop production	2.04	0.04	19.83	1.84
Sown area	0.86	0.03	11.45	1.17
Implied productivity change	2.4	1.4	1.7	1.6
Contribution of change in resources to change in production (%)	0	70	58	64
Percent of aggregate crop production in 2006 (%)	100	2	57	41

Tables 3, 4 confirm that the recovery of agricultural production in Tajikistan and Uzbekistan has been driven to a considerable by productivity increases (intensive growth), less by changes in resources (extensive growth). They also confirm that the majority of productivity change contributing to GAO growth has come from individual farms (household plots and peasant farms in Uzbekistan; household plots only in Tajikistan) rather than from corporate farm types.

Conclusion

The empirical results of this paper have important implications for the ongoing policy debate between the supporters of large corporate farms, who continue to advocate economies of scale, and the supporters of smaller family farms, who emphasize the advantages of individual incentives. This debate is not limited to Central Asia, and it is relevant also for the rest of the CIS. The results will hopefully inform this ongoing debate and incrementally add to the growing body of evidence that highlights the performance advantages of family farms in transition countries.

The analysis in this paper is based on aggregate country statistics. Ongoing work not reported here utilizes cross-section data from several farm surveys conducted in Tajikistan and Uzbekistan by international organizations (Asian Development Bank, FAO, UNDP, USAID, World Bank) between 2003 and 2008. From these survey data we intend to calculate partial land and labor productivity, total factor productivity (based on both accounting data and the production function approach), and technical efficiency scores for farms of different organizational forms. We believe

that these future results will demonstrate that, contrary to established convictions among decision makers in Central Asia and the rest of the Commonwealth of Independent States (CIS), the large corporate farms (former collectives) are not more productive than the smaller family farms.

Moreover, some subsectors of the individual farm sector (specifically, the small household plots) are resoundingly more productive than the large corporate farms. These anticipated findings for two Central Asian countries will reinforce recent results for Ukraine (Lerman et al. 2007), Moldova (Lerman and Sutton 2008), Russia (Lerman and Schreinemachers 2005), and the United States (Ahearn et al. 2002), which demonstrate that large (corporate) farms do not perform better than small (family) farms.

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