Shift to Individual Farming and the Productivity Growth of Transition Agriculture

Marian Rizov

Institute for International Integration Studies, Trinity College Dublin
LICOS Center for Transition Economics, Katholieke Universiteit Leuven

Abstract

We analyze the impact of individualization on productivity growth within an augmented neo-classical growth model framework. Our estimation results using a panel data covering 15 transition countries over the period 1990-2001 and applying a GMM-IV estimator support the view that the shift to individual farming, as well as the overall economic reforms, have positively contributed to the productivity growth of transition agriculture.

Key words: agriculture, individual farming, productivity, economic transition
JEL classification: D20, L23, Q1

Paper prepared for the 2004 Annual Meeting of
the American Agricultural Economics Association,
Denver, Colorado, August 1-4, 2004

Shift to Individual Farming and the Productivity Growth of Transition Agriculture

Introduction

A current policy objective of the governments in transition economies is to increase productivity and growth. Recent country assistance strategies and structural adjustment loans from the World Bank (e.g., World Bank 2001a and 2001b) have pushed these governments to reduce subsidies and price interventions, and impose hard budget constraints by letting the private sector control production and marketing.

Economic reforms have induced important output and productivity changes in the agricultural sectors of transition economies as well. However, there are large differences across countries with respect to productivity growth, measured as the growth of agricultural output per worker, and the corresponding scope of farm restructuring and shift to individual farms, defined as the share of total agricultural land cultivated individually. For example, cumulative productivity growth, after ten years of reforms in Czech Republic is 85% with corresponding level of individualization at 26%. While in Albania the individualization level is 90% but the cumulative productivity growth is less than 10%, for the same period. Furthermore, in many countries there is even decline in agricultural productivity while individualization remained low. In Russia, for example, there is almost 30% cumulative decline of output per worker while the share of individual farming is only 13% and collective farms still dominate (see table 1).[1] Thus it is not unambiguously clear from the raw statistical numbers if individualization helps productivity growth in transition agriculture.

There are only a few studies related to the impact of individualization on agricultural performance in transition countries. Macours and Swinnen (2000a and 2000b) and Lerman (2000 and 2001) in their analyses of output and productivity changes in agriculture during transition find mixed evidence. Furthermore, there is an ongoing institutional debate concerning the effects of individualization as a policy for restructuring former socialist countries' agriculture. On the one hand, consultants and international institutions, such as the World Bank support individualization of agriculture as reform policy that leads to higher productivity by solving incentive and organizational problems of collective farming (e.g., Deininger 1993 and 1995). On the other hand, a number of local policy makers are not convinced in the usefulness of the shift to individual farming and blame this policy for fragmentation and disorganization along the supply chain.[2] Therefore contributing to this important for agricultural reforms debate is timely and requires more thorough investigation. Clearly, shifting production from collective to individual farms merits attention also because it has much wider implications beyond agriculture, specifically for rural development, land use and the environment as a whole.

In this paper we analyze the impact of individualization on agricultural productivity growth within a (Solow) growth model framework and closely following Rizov (forthcoming). This approach allows us to circumvent criticisms on the grounds of lack of theoretical and objective criteria for inclusion of various explanatory variables (e.g., Durlauf and Quah; Brock and Durlauf). In particular, this criticism seems relevant for the transition growth analyses as major variables affecting growth (e.g. investment) are often excluded from the estimations. Furthermore, in the empirical analysis using a generalized method of moments (GMM-IV) estimator and panel data covering 15 transition countries over the period 1990-2001 we are able to control for unobserved country-specific effects and endogeneity of the variables.[3] Our estimation results are robust to various assumptions and support the view that the shift to individual farming has positively contributed to the productivity growth in agriculture during the first decade of transition.

The heritage of transition agriculture and hypothesis

Land reform and farm restructuring are important components of economic reforms because agriculture's share in transition economies has traditionally been much higher than in the market economies. The former socialist countries were also more agrarian than non-socialist countries with comparable levels of income per capita. In the pre-transition decade of 1980s, the mean share of agriculture in GDP for former socialist countries was 21%, compared with 14% for non-socialist countries with similar per-capita income.

A common trend in former socialist countries pre-reform was that in the 1980s growth rates (for both GDP and agricultural output) were significantly lower compared with similar non-socialist countries. In fact this was a continuation of a trend that began in the 1960s: the annual growth rates of agricultural production, e.g., in the USSR as a whole dropped from 4% in 1966-1970 to 1% in 1981-1985. This was a particularly alarming trend because investment in agriculture continued at relatively high and increasing levels: Soviet agriculture's share in total investment increased from 21% in 1966-1970 to 24% in 1981-1985 (Cook; Lerman et al.). New investments in agriculture were thus producing decreasing marginal returns and failed to sustain sectoral growth.

Economic growth in agriculture, as well as in the whole economy, was accomplished mainly through increasing the use of inputs and capital, and not through productivity increases (Ofer). Johnson and Brooks who analyze the technical efficiency of socialist agriculture using data for all fifteen republics of the USSR over 1960-1979 period show that the productivity level of socialist agriculture was substantially lower than that in market economies.[4] The partial productivity of agricultural land in former socialist countries, as measured by the gross output of agricultural products per hectare, was somewhat higher than the partial productivity of land in market economies. However, socialist and market agriculture differed primarily in the productivity of agricultural labor. For instance, labor productivity was lower by a factor of ten or more in the USSR compared with the US and Canada. This low productivity of agricultural labor is clearly a reflection of the very high labor use.

The centrally planned environment, which insulated the farms from market signals, imposed central targets as a substitute for consumer preferences, and allowed farms to function indefinitely under soft budget constraints without proper profit accountability, was the main cause of inefficiency of socialist agriculture (Kornai). Besides, efficiency was never an objective in socialist agriculture: meeting production targets at any cost was the main priority. Yet the inefficiency of socialist agriculture also can be attributed to two "micro-level" factors, which sharply distinguished socialist agriculture from agriculture in market economies: exceptionally large farm sizes and collective organization of production (Lerman et al.).

The strategy of agricultural transition in former socialist countries aimed to improve the efficiency and productivity of agriculture by replacing the institutional and organizational features of the command economy with attributes borrowed from the practice of market economies (Lerman 1999). The ideal transition agenda formulated in the early 1990's envisaged a transformation from collective to more efficient individualized agriculture as the ultimate goal. Individual farmers, once established as independent entities, would engage in land-market transactions to optimize the size of the holdings given their managerial skills and availability of resources (e.g., Binswanger et al.; Deininger 1995; Lerman 1998; Mathijs and Swinnen 1998; Rizov et al.; Rizov 2003). This process would lead to increase in efficiency and productivity, and ultimately result in growth of incomes.

Therefore, the goal of this paper is to analyze the impact of the shift of land to individual farms on productivity growth in agriculture. The hypothesis is that individualization would positively influence agricultural productivity due to the higher efficiency of the individual family farm organization. Besides, individualization may have also an indirect effect on agricultural productivity growth resulting from more efficient reallocation of resources across farm organizations. We test empirically this hypothesis in the next section within a Solow endogenous growth model framework.

Methodology and data

The Solow growth model and dynamic panel data estimation

In the Solow model growth in output per worker depends on the initial output per worker ($q(0)$), the initial level of technology ($A(0)$), the rate of technological progress (a), the savings/investment rate (s), the growth rate of the labor force (l), the depreciation rate (d), the share of capital in output (k), and the rate of convergence to steady state (C). The model predicts that a high savings/investment rate will affect growth positively, whereas high labor force growth (corrected by the rate of technological progress and the rate of depreciation) will have a negative effect on growth.[5] The model is specified in the following way:

$$\begin{aligned}\ln q(t) - \ln q(0) = &-(1-e^{-Ct})\ln q(0) + (1-e^{-Ct})\ln A(0) + at \\ &+ (1-e^{-Ct})\frac{k}{1-k}\ln(s) - (1-e^{-Ct})\frac{k}{1-k}\ln(l+a+d).\end{aligned} \tag{1}$$

Possible estimation techniques for this model are cross-section regressions using averaged data for long periods (e.g., Barro; Mankiw et al.; Sala-i-Martin) or a dynamic panel data approach (e.g., Islam; Caselli et al.). Single cross-section growth regressions have several disadvantages: (i) the time series are reduced to a single observation means and not all available information is used; (ii) it is very likely that single cross-section regressions suffer from omitted variable bias; (iii) one or more of the regressors may be endogenous. Within a dynamic panel data framework (e.g., Hansen; Arellano and Bond) it is possible to account for unobserved country specific effects and allow for endogeneity of the regressors. Therefore we take this approach in estimating the impact of individualization on the growth of gross agricultural output per worker (GAO^w). The panel data model takes the following form:

$$g_{it} = \alpha + \beta q_{it-1} + \gamma x_{it} + v_i + \varepsilon_{it}, \quad (2)$$

where g_{it} denotes the growth rate of GAO^w for country i (i=1,…I) in time t (t=2,…T), $q_{it\text{-}1}$ is the level of GAO^w at the beginning of each period, and x_{it} is a vector of regressors such as investment rate and population growth, following the Solow model. Furthermore, as in most empirical studies that are based on more general models we include a range of other socio-economic variables (see further). These variables are either initial values or average values over each time period. The time-invariant unobserved country-specific effects and the random error term are denoted v_i and ε_{it}, respectively.

From (1) and (2) the dynamic panel data model can be rewritten in the following way:

$$q_{it} - q_{it-1} = \alpha + \beta q_{it-1} + \gamma x_{it} + v_i + \varepsilon_{it}, \quad (2')$$

$$q_{it} = \alpha + \beta^* q_{it-1} + \gamma x_{it} + v_i + \varepsilon_{it}, \quad (3)$$

where β*=(β+1).

In order to address inconsistency problems due to (i) omitted unobserved time invariant country effects (Hsiao), (ii) small number of time-series periods, T (Nickell), and (iii) correlations between regressors and v_i and/or ε_{it} we apply the first differenced GMM estimator. Taking first differences of (3) eliminates the country specific effects v_i,

$$\Delta q_{it} = \beta^* \Delta q_{it-1} + \gamma \Delta x_{it} + \Delta\varepsilon_{it}. \quad (4)$$

Assuming that error terms are independent across countries and serially uncorrelated (E[$\varepsilon_{it}\varepsilon_{ip}$]=0 for $p \neq t$) and that the initial conditions satisfy E[$q_{i1}\varepsilon_{it}$]=0 for $t \geq 2$, the values of q_{it} lagged two periods or more are valid instruments in the first differenced growth equation. This is so because $q_{it\text{-}2}$ and earlier values are generally correlated with $\Delta q_{it\text{-}1}$ but not with $\Delta\varepsilon_{it}$.

Thus, $q_{it\text{-}1}$ is predetermined with respect to ε_{it}, i.e. shocks to GAO^{w} in one time period are not correlated with initial GAO^{w} of this time period.

If the regressors x_{it} are strictly exogenous (E[$x_{it}\varepsilon_{ip}$]=0 for all p,t) then all the past, present and future values of x_{it} are valid instruments in each of the differenced equations, even if the x_{it} are correlated with ν_i. However, it is likely that some of the regressors in our model, e.g. policies and policy outcomes, may not be strictly exogenous. There may be a feedback mechanism where past shocks to GAO^{w} are correlated with current policies and/or outcomes. Maintaining the assumption that current shocks to GAO^{w} are uncorrelated with current policies/outcomes would mean that E[$x_{it}\varepsilon_{ip}$]≠0 for $p<t$ and E[$x_{it}\varepsilon_{ip}$]=0 for $p\geq t$. Following Arellano and Bond we can then use values of the predetermined x_{it} lagged one period or more as valid instruments in the first differenced growth equation.

If a regressor is endogenous then we have to allow for correlation between the current value of this regressor and current shocks to GAO^{w}, as well as feedback from past shocks to GAO^{w}, i.e. E[$x_{it}\varepsilon_{ip}$]≠0 for $p\leq t$ and E[$x_{it}\varepsilon_{ip}$]=0 for $p>t$ only. In this case, valid instruments in the differenced equations are values of the endogenous x_{it}, lagged two periods or more.

Finally, we have to address the issue of how to treat time-invariant country-specific characteristics such as initial conditions, type of land reform adopted, etc. If we include measured time-invariant country characteristics (w_i) in the analysis the growth equation (3) becomes: $q_{it} = \alpha + \beta * q_{it-1} + \gamma x_{it} + \delta w_i + \nu_i + \varepsilon_{it}$.

Since the measured country-specific characteristics (w_i) may be correlated with the unobserved country-specific effects (ν_i) and/or the error term (ε_{it}) we estimate the model in two steps, similarly to Blanchflower et al. and Battese and Coelli, in order to evaluate the impact of country-specific observed characteristics on GAO^{w}. First, we estimate equation (3) without including the measured country-specific characteristics, w_i, i.e., we replace ν_i*=δw_i+ν_i for ν_i. In the estimation we allow $q_{it\text{-}1}$ and x_{it} to be correlated with ν_i* so that there is no "omitted variable bias" resulting from omission of w_i. The consistent GMM estimates $\bar{\beta}*$ and $\bar{\gamma}$ are then used to calculate the residuals of equation (3). In the second step we regress these residuals on the measured country-specific characteristics, w_i:

$$(q_{it} - \bar{\alpha} - \bar{\beta} * q_{it-1} - \bar{\gamma} x_{it}) = \delta w_i + (v_i + \varepsilon_{it}) . \quad (5)$$

The OLS levels estimation of equation (5) will generate a consistent estimate of δ iff all w_i characteristics are uncorrelated with v_i which is a very strong assumption. Therefore we cannot attach much casual significance to the estimate of $\bar{\delta}$. The advantage of this two-step procedure, however, is that we obtain consistent estimates of the β* and γ coefficients which is the major goal of our analysis.

Data and variables

Our empirical analysis focuses on the experience of a selected sample of 15 transition countries[6] for which comparable agricultural sector annual data are available over the period 1990-2001.[7] However, data is not available for all countries for all years, thus making the panel unbalanced. As the sample covers selected countries of the Balkans, Baltics, Central Europe and the CIS, and includes the most up-to-date information available, we are able to also test whether the main conclusions from previous studies related to (agricultural) sector performance are still valid after more than ten years of transition.

We measure productivity growth in agriculture in terms of growth of the gross agricultural output per worker, GAO^w. According to the Solow model it seems more appropriate to use per worker rather than per capita variables, because the model is based on a production function and not every person from the country's population contributes to production. Contrary to previous empirical studies that focused on average changes in the early years of transition (e.g., Macours and Swinnen 2000a and 2000b; Lerman 2000), we consider year-on-year changes in GAO^w. By looking at growth rates in agricultural production per worker in each country at a given point in time we are able to capture the high heterogeneity across countries as it appears from table 1.

We explain GAO^w growth in terms of the main factors identified in equation (1), i.e., the initial level of GAO^w, the changes in the agricultural labor force (adjusted for the rate of depreciation and the rate of technological progress) and the savings/investment in the sector. In addition, we control for initial conditions and general economic reforms. Thus the impact of the factor in the focus of this analysis - the individualization of agricultural production – can be isolated.

GAO^w is measured in purchasing power parity adjusted US dollars and was calculated by using the initial, 1990 level of agricultural GDP obtained from EBRD database and the FAO annual output index over the period 1990-2001. The annual data for agricultural labor force is from countries' National Statistics and ILO. Due to lack of any other more appropriate measure, we proxy the savings/investment rate, s by the ratio of output and input agriculture-specific prices. This ratio is a good proxy for the gross margin that is closely related to the availability of internal funds. Under conditions of imperfect financial market and credit constraints the sensitivity of investment to internal financing is shown to be high (see e.g., Fazzari et al.). The average labor force growth rate, l was computed as the difference between the natural logarithms of agricultural labor force at the end and beginning of each year.

It is implicitly assumed, as in other panel data studies (Islam; Caselli et al.) that the rate of technological progress is common to all countries and allowed for unobserved differences in the initial level of technology. Assuming that the level of technology is common to all countries can be justified for the economies in transition by the fact that there were explicit policies towards equalization of countries within the former COMECOM.

We recognize that the diffusion of new technology is likely to be costly and takes a considerable period of time (e.g., Kershenas and Stoneman). Furthermore, if the diffusion of new technology is not costless and instantaneous, we may want also to allow for different rates of technological progress in different countries. However, due to lack of data we have to maintain the standard assumption of a common rate of technical change as in a number of previous studies. Note that our controls for progress of reforms and restructuring ameliorate this restriction to certain extent. Thus, like it is common in the literature (e.g., Islam; Mankiw et al.; Caselli et al.), the natural logarithm of the sum of labor force growth and 0.05 (for constant technological progress and depreciation rate) is calculated for $ln\ (l+a+d)$.

Further, we augment the model with a control variable measuring effects of general economic reforms as well as with the measure of individualization. Progress in general economic reforms (REFORM) is measured as the average of the EBRD indicators for price and trade liberalization, and small-scale privatization.[8] These indicators capture the extensiveness of the so-called "first phase" reforms, which are necessary condition for the successful implementation of institutional reforms.

Finally, we measure the extent of farm restructuring by looking at the share of total agricultural land that is used in individual (private) farms (INDIVID). This is the variable of main interest in our analysis. We use data from countries' National Statistics and Macours and Swinnen (2000a) as the values were calculated in natural logarithms.

Country-specific time-invariant characteristics are eliminated in the first differenced GMM estimator, as we showed in equation (4). Therefore, in a second (auxiliary) step of the analysis we regress the residuals, calculated from the consistent GMM estimates, on the fixed country-specific observed characteristics. These characteristics are measured by two synthetic indexes of initial conditions.[9] These indexes summarize a number of variables describing the status of former socialist countries' economies at the beginning of transition. The first index (IC1) can be interpreted as a measure of inherited distortions. Positive values of this index indicate lower initial distortions. The second initial conditions' index (IC2) captures the degree of development of the economy. Higher values of this index characterize countries with higher initial development and thus better initial conditions.

Results and discussion

The results of GMM-IV estimations based on the Solow growth model as specified in equation (1) are reported in table 2. All regressions include time dummies (not reported as well as the constant), which were found to be jointly significant in every regression. There is no second order serial correlation (the m_2-test) and the Sargan test does not reject the validity of instruments in all specifications. The left hand side variable is the change in the logarithm of real per worker agricultural output (GAO^w).

First, a regression corresponding to the textbook Solow model was run (results in column (1)). All variables are significant at the one per cent level and have the expected signs. The negative coefficient on initial GAO^w as in most published work is interpreted as conditional convergence while investment is positive and growth of labor force is negative as suggested by the Solow model.[10] The implied speed of convergence (C) is quite high at about seven per cent per annum, not surprising for the case of economic transition. It seems that the most important determinant of the growth in agricultural productivity is the reduction in excess labor, which is interpreted as an indicator of passive restructuring while active restructuring is defined as new investment (Coricelli and Djankov).

Next, we run regressions augmented with measures of progress in economic reforms and of individualization of agricultural production in order to assess their effects on productivity growth. In column (2) results of an augmented version of the Solow model, with a measure of general economic reforms (REFORM), are reported. The results of the base regression hold while the coefficient of the reform variable is significant at the five per cent level and positive as expected. REFORM is a synthetic indicator of policy outcomes and reform policies adopted, measuring the advancement in general economic reforms. As in other studies it is interpreted as an important condition for successful restructuring of the agricultural sector (Macours and Swinnen 2000a and 2000b; Lerman 2000 and 2001). We recognize that the impact of reforms is affected by policy choices and initial conditions. It is not the goal of our analysis, however, to distinguish between these effects. In the second (auxiliary) step of the analysis we test for the direct impact of initial conditions on productivity growth.

Individualization of agricultural production is an important indicator of restructuring in agriculture. It is the major outcome of the agriculture-specific land reform policies adopted. Some countries adopted the restitution method (mainly central European and Balkan countries, except Albania, Poland and Slovenia) while others distributed property rights through paper shares (CIS). Albania stands out as the only country in our sample that followed the approach of distributing land in the form of physical plots. Poland and Slovenia do not fall into any of these three categories because they started the transition with large proportions of land already in individual farms, and did not introduce any substantial land reform afterwards. The importance of these land reform choices is in the fact that they have resulted in different magnitude of the shift of land to individual farms (INDIVID). Thus by assessing the impact of individualization on productivity growth we can provide an implicit evaluation of the success of land reform policies adopted.

Results in column (3) from estimating a Solow model augmented with INDIVID show that individualization is important for productivity growth. The coefficients on the base variables are as in previous model specifications, with respect to sign and magnitude while the coefficient on the individualization variable is positive and significant at the one per cent level. This result is important because we find a positive effect of individualization in a dynamic model controlling for investment and changes in the labor force, which are the most important factor of the agricultural sector transformation during the period of analysis.[11]

In column (4) we report results from a Solow model specification augmented with both REFORM and INDIVID. Again the results from the base specification are maintained and the impact of both REFORM and INDIVID is positive and significant. The speed of conditional convergence (*C*) doubled when both economic reforms and restructuring of farms through individualization are implemented. This result is robust to alternative treatments of INDIVID as exogenous or endogenous.

Previous studies (Macours and Swinnen 2000a and 2000b; Falcetti et al.) have emphasized the importance of initial conditions in determining performance during transition. Their results show that the impact of initial conditions is stronger with respect to gross output while it is vague with respect to labor productivity. In a similar to several studies manner, including the ones mentioned above, we test for the impact of initial conditions (IC1 and IC2) on productivity growth in a second step of our analysis. As specified in equation (5) we regress the residuals, calculated from the GMM-IV estimation (column (4)), on the initial conditions IC1 and IC2. The results are presented in table 3 and show that the initial conditions do not affect productivity growth at any reasonable level of significance.

Conclusion

In this paper we address the question whether individualization of agricultural production as measured by the share of total agricultural land used in individual farms helps productivity. The main result that individualization does positively affect productivity growth is robust to alternative treatments with respect to endogeneity assumptions. Advantage of our approach is that we analyze this relationship within the well-defined theoretical framework of the augmented Solow growth model. Furthermore, using panel data and a first differenced

GMM-IV estimator we are able to obtain consistent coefficient estimates and to control for endogeneity and unobserved country-specific effects.

Our results have a number of important policy implications. First, we cast light on an important institutional debate concerning the appropriateness of policies aiming at individualization of agriculture in transition economies. Applying a robust theoretical and empirical framework we are able to qualify so far inconclusive results of other studies (Macours and Swinnen 2000a and 2000b; Lerman 2000 and 2001) and prove that the shift to individual farms has had a positive impact on productivity growth in transition countries. Second, investment and the reduction in excess labor, which are associated with active and passive restructuring, respectively (Coricelli and Djankov) are found to be very important determinants of the productivity growth in transition agriculture. Third, our analysis confirms previous findings (Macours and Swinnen 2000a and 2000b; Falcetti et al.) that economic reforms positively affect productivity while differences in initial conditions do not have important impact after more than ten years of transition.

Notes

[1] Macours and Swinnen (2000b) identify three patterns according to agricultural performance, measured by gross agricultural output (GAO) and agricultural labor productivity (ALP), of transition countries. *Pattern I (CSH)*: a strong decline in GAO coincides with a strong increase in ALP. This is the pattern followed by Czech Republic, Slovakia and Hungary. *Pattern II (RUB)*: a strong decline in GAO coincides with a strong decline in ALP. Russia, Ukraine and Belarus are typical examples, but also e.g. Moldova, Kazakhstan, Kyrgyzstan, Azerbaijan and Tajikistan fit within this pattern. *Pattern III (CVA)*: a strong increase in GAO coincides with an, albeit slower, increase in ALP. Examples are China, Viet Nam, and also Albania.

[2] There is also a view that individualization of agricultural production leads to subsistence farming, which is seen as a survival strategy and usually associated with low productivity (Kostov and Lingard and Sarris et al.).

[3] All previous studies of agricultural sector performance apply pooled or cross-section regressions (Macours and Swinnen 2000a and 2000b; Lerman 2000 and 2001). There are also several studies analyzing technical or total factor productivity across farm types but only in a few transition countries and using, not always representative, farm survey data (e.g., Mathijs and Swinnen 2001; Davidova et al.; Gorton and Davidova).

[4] The gap between productivity levels of the Soviet agriculture and agriculture in market economies reached 100%-150% depending on the particular estimation scheme used.

[5] In the augmented version of the Solow model investment in human capital is an additional determinant of growth in output per worker. For a detailed discussion on the Solow model refer for example to Mankiw et al. and Barro and Sala-i-Martin.

[6] The sample includes: Albania, Belarus, Bulgaria, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Poland, Romania, Russia, Slovak Republic, Slovenia and Ukraine.

[7] The main data sources were the National Statistical Offices, FAO, OECD, EBRD, and the World Bank**.**

[8] See chapter 2 of the EBRD Transition Report 2002 for a detailed definition of these indicators.

[9] These indexes are based on a principal component analysis. See Box 2.1 of the EBRD Transition Report 1999 and the Technical Note to chapter 4 of the EBRD Transition Report 2002 for more details.

[10] Results reported are under the assumption that all right-hand site variables are predetermined. Versions of the regressions where investment and growth in labor force are assumed endogenous were also run but the results were not importantly different. These alternative treatments are available upon request.

[11] Assessing the sensitivity of this result to alternative assumptions about endogeneity of the individualization variable show that results reported are robust.

References

Arellano, M. and S. Bond, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies* 58 (1991): 277-97.

Barro, R., "Economic Growth in a Cross Section of Countries," *Quarterly Journal of Economics* 106 (1991): 407-43.

Barro, R. and X. Sala-i-Martin, *Economic Growth*, McGraw-Hill, New York, 1995.

Battese, G. and T. Coelli "A model of technical efficiency effects in a stochastic frontier production function for panel data," *Empirical Economics* 20 (1995): 325-332.

Binswanger, H., K. Deininger and G. Feder, "Power, distortions, revolt and reform in agricultural land relations", Ch. 42, 2659-2772, in J. Behrman and T. Srinivasan (eds.) *Handbook of Development Economics*, vol. III, Elsevier Science, 1995.

Blanchflower, D., A. Oswald and P. Sanfey, "Wages, profits and rent-sharing," *Quarterly Journal of Economics* 111 (1996): 227-251.

Brock, W. and S. Durlauf, "Growth empirics and reality," *World Bank Economic Review* 15 (2001): 229-272.

Caselli, F., G. Esquivel, and F. Lefort, "Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics," *Journal of Economic Growth* 1 (1996): 363-89.

Cook, E., "Agriculture's role in the Soviet economic crisis", pp. 193-212, in M. Ellman and V. Kontorovich (eds.) *The Disintegration of the Soviet Economic System*, Routledge, London,1992.

Coricelli, F. and S. Djankov, "Hardened budgets and enterprise restructuring: Theory and an application to Romania," *Journal of Comparative Economics* 29 (2001): 749-63.

Davidova, S., M. Gorton, T. Ratinger, K. Zawalinska, B. Iraizoz, B. Kovacs, and T. Mizik, "Variations in Farm Performance: Evidence from the CEECs and Existing EU

Member States”, *Working Paper* 2/11, IDARA project QLRT-1999-1526, http://www.agp.uni-bonn.de/agpo/rsrch/idara/idara_e.htm, 2002.

Deininger, K., “Cooperatives and the breakup of large mechanized farms: Theoretical perspectives and empirical evidence”, World Bank Discussion Paper 218, World Bank, Washington, DC, 1993.

Deininger, K., “Collective agricultural production: A solution for transition economies?” *World Development* 23 (1995): 1317-1334.

Durlauf, S. and D. Quah, “The new empirics of economic growth,” in J. Taylor and M. Woodford (eds.) *Handbook of Macroeconomics*, North-Holland, 1999.

Falcetti, E, M. Raiser and P. Sanfey, “Defying the odds: Initial conditions, reforms and growth in the first decade of transition,” *Journal of Comparative Economics* 30 (2002): 229-50.

Fazzari, S., R. Hubbard and B. Petersen, “Financing constraints and corporate investment,” *Brookings Papers on Economic Activity* 1 (1988): 141-195.

Hansen, L., ”Large sample properties of generalized method of moments estimators,” *Econometrica* 50 (1982): 1029-1054.

Hsiao, C., *Analysis of Panel Data*, Cambridge University Press: Cambridge, M.A, 1986.

Gorton, M. and S. Davidova, “Farm productivity and efficiency in the CEE applicant countries: A synthesis of results,” *Agricultural Economics* 30 (2004): 1-16.

Islam, N., “Growth empirics: A panel data approach,” *Quarterly Journal of Economics* 110 (1995): 1127-1170.

Johnson, D. and K. Brooks, *Prospects for Soviet Agriculture in the 1980’s*, Indiana University Press, Bloomington, IN, 1983.

Kershenas, M. and P. Stoneman, “Technological diffusion”, pp. 265-297, in P. Stoneman (ed.) *Handbook of the Economics of Innovation and Technological Change*, Blackwell, Oxford, 1995.

Kornai, J., “The soft budget constraint”, *Kyklos* 39 (1986): 3-30.

Kostov, P. and J. Lingard, “Subsistence farming in transitional economies: Lessons from Bulgaria”, *Journal of Rural Studies* 18 (2002): 83-94.

Lerman, Z., “Does land reform matter? Some experiences from the Former Soviet Union”, *European Review of Agricultural Economics* 25 (1998): 307-330.

Lerman, Z., “Land reform and farm restructuring: What has been accomplished to date?” *American Economic Review* 89(2) (1999): 271-275.

Lerman, Z., “From Common Heritage to Divergence: Why the Transition Countries are Drifting Apart by Measures of Agricultural Performance”, *American Journal of Agricultural Economics* 82(5) (2000): 1140-1148.

Lerman, Z., “Agriculture in Transition Economies: From Common Heritage to Divergence.” *Agricultural Economics* 26(2) (2001): 95-114.

Lerman, Z., C. Csaki, and G. Feder, “Land Policies and Evolving Farm Structures in Transition Economies”, mimeo, (2002).

Macours, K. and J. Swinnen, “Causes of Output Decline in Economic Transition: The Case of Central and Eastern European Agriculture”, *Journal of Comparative Economics* 28 (2000a): 172-206.

Macours, K. and J. Swinnen, “Impact of Initial conditions and Reform Policies on Agricultural Performance in Central and Eastern Europe, the Former Soviet Union, and East Asia”, *American Journal of Agricultural Economics* 82(5) (2000b): 1149-1155.

Mankiw, G., D. Romer and D. Weil, "A contribution to the empirics of economic growth", *Quarterly Journal of Economics* 107 (1992): 407-37.

Mathijs, E. and J. Swinnen, "The economics of agricultural decollectivization in East Central Europe and the Former Soviet Union", *Economic Development and Cultural Change* 47 (1998): 1-26.

Mathijs, E. and J. Swinnen, "Production efficiency and organization during transition: An empirical analysis of East German agriculture", *Review of Economics and Statistics* 83(1) (2001): 100-107.

Nickell, S., "Biases in dynamic models with fixed effects", *Econometrica* 49 (1981): 1417-1426.

Ofer, G., "Soviet economic growth 1928-1985", *Journal of Economic Literature* 25(4) (1987): 1767-1833.

Rizov, M., "Endogenous production organization during market liberalisation: Farm level evidence from Romania", *Economic Systems* 27 (2003): 171-187.

Rizov, M., "Does individualization help the productivity of transition agriculture?", *Agricultural Economics* (forthcoming).

Rizov, M., D. Gavrilescu, H. Gow, E. Mathijs and J. Swinnen, "Transition and enterprise restructuring: The development of individual farming in Romania", *World Development* 29(7) (2001): 1257-74.

Sala-i-Martin, X., "I just run two million regressions", *American Economic Review* 87 (1997): 178-83.

Sarris, A., T. Doucha, and E. Mathijs, "Agricultural restructuring in Central and Eastern Europe: Implications for competitiveness and rural development", *European Review of Agricultural Economics* 26(3) (1999): 305-329.

World Bank, "Structural adjustment loans",

http://www4.worldbank.org/sprojects/Browse.asp?cat=region&Reg=ECA, (2001a).

World Bank, "Country assistance strategies",

http://www.worldbank.org/html/pic/cas/cpinlist1.htm, (2001b).

Table 1 Land reforms, farm restructuring and the changes in agricultural indicators over the 1990 – 2000 period

Region	Country	Performance indicators in 2000[a]		Farm restructuring/Individualization [b]			Land reform	
		GAO^{w} [c]	GAO [d]	Pre-reform	1995	2000	Progress index [e]	Procedure [f]
CEE	Czech Rep	170	73	1	21	26	90	R [4]
	Hungary	236	77	13	46	51	90	R
	Poland	88	92	76	82	84	90	-
	Slovakia	130	62	2	7	9	80	R
Balkans	Albania	110[1]	116[1]	3	96	90[1]	80	DP [5]
	Bulgaria	62[2]	67[2]	14	51	56[2]	80	R
	Romania	79	91	14	71	85	80	R
	Slovenia	115	117	83	93	94	90	-
Baltics	Estonia	138	42	4	53[3]	61	90	R
	Latvia	64	38	4	80[3]	89	90	R
	Lithuania	76	65	9	66	87	90	R
CIS	Belarus	85	57	7	11	14	20	DS [6]
	Kazakhstan	72[2]	56[2]	0	5	24[1]	50	DS
	Russia	69	62	2	9	13[1]	50	DS
	Ukraine	54	55	6	16	18[1]	60	DS

Notes: [a] Cumulative index (1990=100); [b] Share of total agricultural land used in individual farms; [c] GAO^{w} = agricultural labor productivity; [d] GAO = gross agricultural output; [e] Progress index (max=100) of land reform; [f] Dominant form; [1] Data for 1998; [2] Data for 1999; [3] Data for 1996; [4] R = restitution; [5] DP = distribution of plots; [6] DS = distribution of shares.

Sources: EBRD, FAO, ILO, National Statistics, WB

Table 2 GMM Solow model estimations of productivity growth in agriculture (GAO^w)

Dependent variable: GAO^w growth								
Variables	(1)		(2)		(3)		(4)	
$\ln(q_{t-1})$	-0.0699	***	-0.0830	***	-0.1180	***	-0.1508	***
	(0.0158)		(0.0161)		(0.0183)		(0.0268)	
$\ln(s)$	0.1164	***	0.1587	***	0.1514	***	0.1577	***
	(0.0369)		(0.0359)		(0.0333)		(0.0330)	
$\ln(l+a+d)$	-0.6955	***	-0.6794	***	-0.7237	***	-0.7772	***
	(0.1339)		(0.1246)		(0.1200)		(0.1165)	
lnREFORM	-		0.0686	**	-		0.0654	*
			(0.0319)				(0.0343)	
lnINDIVID	-		-		0.0597	***	0.0492	**
					(0.0228)		(0.0213)	
m_1	0.00		0.00		0.00		0.00	
m_2	0.13		0.13		0.16		0.15	
Sargan test	0.87		0.96		0.90		0.90	

Notes: Standard errors robust to general heteroskedasticity are reported in parentheses under the coefficients; ***, ** and * denote 0.01, 0.05 and 0.10 level of significance, respectively; for m_1 and m_2 and the Sargan test *p*-values of the null hypothesis for valid specification are reported; the number of observations is 107 for 15 countries.

Table 3 Second-step estimation of the impact of initial conditions on GAO^w

Variables	**Coefficient**	**Std. Error**
IC1	0.0056	0.0122
IC2	-0.0193	0.0167
Adj. R^2		0.29