THE IMPORTANCE OF PROPERTY RIGHTS FOR ECONOMIC OUTCOMES: LESSONS FROM THE TRANSFER OF PRODUCTIVE ASSETS FROM COLLECTIVE TO PRIVATE OWNERSHIP IN BULGARIAN AGRICULTURE

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Abstract

The design of the agricultural reform in Bulgaria in the early 90-es provides researchers with a natural experiment for testing the effect of the protracted absence of clearly defined property rights on economic outcomes. Special rules governing the restitution of orchards made one group of crops, namely fruits, more susceptible to the negative effects of poorly defined property rights, resulting from delayed land reform. Our empirical analysis shows that the decline in agricultural output was steepest for crops in the fruits group, which we attribute to the differential effect of the property rights vacuum in the early stages of transition.

JEL classifications: P26, Q15, D23

Introduction

The effect of property-rights rules on economic outcomes has long been a subject for research. In an early classic study, Davies (1971) found that ownership rights affected efficiency in Australia's airline market; Australia's privately owned airline was significantly more efficient than its publicly owned airline. Agnello and Donnelley (1975) found that property-rights rules mattered to outcomes in the fisheries; U.S. states that imposed common property rights in oyster beds promoted disinvestment and over exploitation compared to those states offering exclusive lease arrangements to oyster beds. More recently, Li, Rozelle, and Scott (1998) have shown that longer-term rights to use land encourage land-saving investment while Mendelsohn (1994) has shown how poorly defined property rights, and even small probabilities of land-user eviction, lead to wasteful deforestation. Thus, whether on land, in the air or in the sea, property rights and their characteristics matter for economic outcomes.

The steep output declines in most Central and Eastern European (CEE) countries in the early stages of transition (World Bank, 2002, p. 5)—a period characterized by protracted transfer of productive resources from collective to private ownership—has reignited academic interest in the importance of property rights for economic outcomes. In an influential study of the patterns of transition, De Melo, Denizer, and Gelb (1996) examine output and inflation outcomes in CEE countries in the early stages of transition. Using the Cumulative Liberalization Index (CLI)[2] over the period 1989-1994 to capture the intensity and duration of policy reforms, the authors conclude that "…rapid reform is preferable to slow reform, given the breakdown in the central planning apparatus." (De Melo et al., 1996, p. 27). Furthermore, the ongoing debate on the comparative advantages and disadvantages of different privatization methods[3] center around their potential to establish clear-cut property rights that would foster economic incentives. An important strand of this literature examines the choice of land reform policies in CEE countries (Lerman, Csaki, and Feder, 2002, Chapter 2; Swinnen, 1999; Swinnen, Buckwell, and Mathijs, 1997; Szelenyi, 1998; Swinnen, 1997).

At the start of the transition, most of the land in CEE countries with the exception of Poland and former Yugoslavia, was farmed collectively by large state farms and cooperatives[4] (Lerman, Csaki, and Feder, 2002, pp. 23-26). In the first years of transition, all CEE countries instituted policies for privatization/decollectivization of agricultural

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[2] Constructed as a composite measure of the extent of policy reforms in the areas of internal markets, external markets, and enterprize privatization. Summing up the CLI values for a country over a period of time ensures that slow reformers receive lower ranks than countries that liberalize early on.

[3] For an *ex post* review of country experiences see World Bank, 2002, Chapter 7.

[4] In the former, all productive assets belonged to the state, whereas in the latter they were jointly owned by the members of the cooperative, who were not, however, allowed to leave voluntarily.

production,[5] most of which were based on restitution of the land to its owners prior to the nationalization/collectivization. In practice, however, the return of the land to its previous owners proceeded slowly in the course of the following years, mired in technical and organizational difficulties (Lerman, Csaki, and Feder, 2002, p. 73). Over the same period, agricultural production fell sharply in all CEE countries. Between 1989 and 1992, the cumulative decline in gross agricultural output (i.e. crops and livestock) was respectively 5% in Albania, 18% in Bulgaria, 22% in the Czech Republic, 29% in Hungary, 17% in Poland, 15% in Romania, and 25% in the Slovak Republic (OECD, 1998). In an important article, Macours and Swinnen (2000) identify the spell of poorly defined property rights, resulting from delays in land reforms, as a contributing factor to the observed declines in agricultural output in the early stages of transition:

> "A slow privatization process prolongs the uncertainty of property rights. As long as property rights are uncertain, markets cannot develop and the decapitalization of agriculture continues through the liquidation of productive assets, including the slaughtering of livestock, and a reduction of investment and maintenance." (Macours and Swinnen, 2000, p. 179)

In the empirical part of the paper, however, Macours and Swinnen attribute the observed output declines to a combination of adverse changes in the terms-of-trade and climate conditions, and the effects of: (i) privatization— prior to the transition agricultural organizations faced with soft budget constraints used excess amounts of inputs. Under such conditions, privatization would lead to a more efficient allocation of resources that would initially lead to a fall of output, but over time would boost productivity; (ii) uncertainty associated with the institution of major policy changes (i.e. the heighten risk associated with policy changes increases marginal costs of inputs, which leads to a decrease of output, but does not affect the production efficiency); (iii) the disruption caused by the change in cultivation methods – from large-scale collective to individual farms. None of these factors captures the hypothesized negative effect on agricultural output of the spell of poorly defined property rights resulting from delays in land reforms.

In this paper, we isolate and test the significance of the effect of the protracted absence of clearly defined property rights on economic outcomes in transitional countries, using the Bulgarian experience as a case study. Section I reviews the rules governing the transfer of property rights in Bulgarian agriculture and their practical implementation. Section II argues that the Bulgarian experience provides researchers with a natural experiment for testing the effects of poorly defined property rights on economic outcomes. Section III presents the results from the statistical tests of the hypothesis in univariate setting. In Section IV we perform regression analysis of the hypothesis in a demand-supply

[5] For a review of past and current agricultural policies in CEE countries see OECD, *Agricultural Policies in Emerging and Transition Economies. Monitoring And Evaluation*, various issues.

framework that satisfies the *ceteris paribus* condition embedded in the tested hypothesis. Section V summarizes the main conclusions of the paper.

I. Property-Rights Rules in Bulgarian Agriculture During the Transition

The Law on Agricultural Land Ownership and Agricultural Land Use (LALOALU) and the Rules for Implementation of LALOALU (Rules) were adopted in 1991 and subsequently frequently amended. Their main objective was the return (restitution) of agricultural land to the individuals (or their heirs), who held title on it following the land reform of 1946 but prior to the collectivization (Buckwell, Davidova and Trendafilov, 1994, p. 57-61). A 1992 amendment in both acts also provided for the parallel liquidation (dissolution) of the Labor-Agricultural Co-operatives (LACs) – the organizations that previously managed the land.[6] Under the new provisions, the management of LACs was transferred to externally appointed Liquidation Councils whose responsibilities were to: (1) establish the total value of LAC's non-land assets and based on this appraisal, lowered by the value of LAC's debts to the government, banks, other firms and individuals, determine the monetary equivalent of the share[7] of each member of the co-operative in LAC's non-land assets; (2) auction all LAC's assets to the members of the co-operative, who bid among themselves with the paper value of their respective shares in LAC's assets; (3) sell in an open auction the assets not claimed by the members of the co-operative and remit the received cash to them, effectively completing the liquidation of LAC (Rules for Implementation of LALOALU, Articles 48, 48a, 49, 49a).

Importantly, the Law on Agricultural Land Ownership and Agricultural Land Use and the Rules for Implementation of LALOALU put the restitution of land cultivated with fruit-bearing trees under a different regime than the land used for growing other agricultural crops. In particular, Article 56, Paragraph 7 of the Rules stipulates that the owners of land, currently planted with fruit-bearing trees, can enter into possession only after paying the Liquidation Council the value of the trees on their property. In addition, Article 18 of LALOALU forbids the new owners to destroy the trees before the end of their depreciation schedule and mandates that they perform all agro-technical and agro-chemical procedures necessary for the trees' maintenance.

In design, the processes of restitution and liquidation should have evolved in parallel. In practice however, the return of land proved to be extremely complex and slow:

> "By June 1993, the MLCs [Municipal Land Councils] had issued 1,346,604 certificates recognizing, in one form or another, ownership of claimants on about 4.2 million ha (75% of area claimed). Outside the mountainous and semi-mountainous regions, the ownership of a particular

[6] For a detailed description of the different pre-reform agricultural organizations in Bulgaria see Davidova, Buckwell and Kopeva, 1997, p. 24-27.

[7] The relative size of the shares of the members of the co-operative is determined by a formula that gives equal weights to the amount of land that they have contributed and their length of service in the co-operative (Rules for Implementation of LALOALU, Article 50).

> area could only be recognized after land surveys and the creation of a land division plan. In fact, only about 4000 such decisions enabling restoration of ownership were issued. These covered 18,000 ha (0.3% of the claimed area). In the mountainous and semi-mountainous TBSs [territory belonging to a settlement], the old land boundaries either still existed or they could easily be restored. Thus, land surveys were not necessary and 400,000 certificates were issued recognizing the ownership claimed on 533,000 ha (9.6% of claimed land). Thus, in total, not more than 10% of the area claimed could be said to be restored by mid-June 1993. …The land restitution procedure is complicated by the issue of final title to land. By the end of June 1993, only 580 final titles to land had been issued on 550 ha, with an average area of 0.9 ha." (Buckwell, Davidova and Trendafilov, 1994, p. 62-63).

Thus, the hurried liquidation of the old agricultural organizations and the delayed restitution of the land created a property rights vacuum. In the interim period, the land was managed by the Liquidation Councils, which either cultivated it by mobilizing the members of the co-operative or temporarily leased it to individuals who had claims on land in the same geographic location, but the exact boundaries of their plots had not yet been determined. Regrettably, neither the lessees, nor the Liquidation Councils had any incentives to invest or maintain the capital that existed on the land (irrigation systems, trees, etc.). This was due, in part, to their short planning horizon (Buckwell, Davidova and Trendafilov, 1994, p. 65), and in part to the unstable macroeconomic environment. The annual rate of inflation in the period 1991-1997 remained above 50%, nominal interest rates were extremely high (in the range of 37% in 1995 and 192% in 1996 for the discount rate), the real per capita income shrunk significantly and the domestic currency rapidly depreciated (IMF, 1996, p. 6 and 43; IMF, 2000). The combination of these factors made the prospect of locking money in fixed assets, such as trees, extremely unattractive. Thus, the owners of land planted with trees had much higher incentives than their peers to fully depreciate the capital on their land (through negligence or outright sabotage) before the final transfer of title occurred:

> "Land restitution has proceeded rapidly in the primary fruit-growing regions. Many new landowners have acquired orchards that are in very poor condition (many trees are long overdue for replacement), partly because of neglect by the liquidation Councils. To add insult to injury, the new owners are required to compensate the liquidation Councils for the orchards' value. In theory, the owners will get some of their payments back when the liquidation Councils finish distributing collective assets. In the meantime, they cannot make enough money from the sale of fruit to cover these debts. In response, some owners are destroying the orchards, replanting the land with grain or other crops perceived as being more profitable." (Cochrane, Schmitz and Bojnec, 1994, p. 49).

II. Tested Hypothesis

The design of the agricultural reform in Bulgaria provides researchers with a natural experiment for testing the effect of the protracted absence of clearly defined property rights on economic outcomes. As seen in Section I, the hurried liquidation of the old agricultural organizations and the delayed restitution of the land created a spell of poorly defined property rights. Furthermore, special rules governing the restitution of land cultivated with fruit-bearing trees made one group of crops, namely fruits, much more susceptible to the negative effect of poorly defined property rights on agricultural output. We can, therefore, test for the presence, sign and magnitude of the effect of poorly defined property rights on

economic outcomes by examining the groupwise differences in the decline of output from different groups of crops (fruits, vegetables and cereals)[8] during the transition in Bulgaria. Under the null hypothesis of no such effect, everything else being equal, the pairwise differences between the declines of output from the three groups of crops should be statistically insignificant. If the null hypothesis is rejected at a prespecified level of confidence, we can proceed testing the hypothesis that the decline in the output of fruit is the largest among all analyzed groups of crops.[9]

III. Univariate Analysis

In our analysis, we use data for the period 1979-1996.[10] The turning point in the political and economic development of Bulgaria was the ousting from power of the long-time leader of the Bulgarian Communist Party Thodor Zhivkov in November 1989 (for a review of the political developments in Bulgaria in the period 1989-1994, see Swinnen, 1997). Thus, we use the 1979-89 data as a yardstick for evaluating the performance of the Bulgarian agriculture in the transition.[11]

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[8] Industrial crops (e.g. sunflower seeds, groundnuts, seed cotton, etc.) have been screened out of the present analysis, because of the different nature of interaction between this agricultural sub-sector and the industrial sector of the economy, which substantially complicates any comparative analysis between industrial crops and the other types of crops.

[9] Production of other crops was also negatively affected by the protracted spell of poorly defined property rights but to a lesser extent. Besides fruits, which production depends crucially upon capital (trees) specific to the land, cereals are also highly capital-intensive crops. Their melioration, cultivation and harvesting require the use of heavy machinery (tractors and combines). However, this capital equipment is not affixed to specific parcels of land and so it was exposed to a lesser extent to the negative effects of poorly defined property rights (as it could have been kept under key or sold much faster than the land). Vegetables, on the other hand, are the most labor-intensive crops, despite the fact that they also require some capital equipment in the form of irrigation systems and greenhouses. Consequently, vegetables production should be least affected by the chaos of transition.

[10] The source of all agricultural and meteorological data is the Statistical Yearbook of the Republic of Bulgaria, published by the National Statistics Institute. The macroeconomic data is from the IMF's publication "World Economic Outlook."

[11] The ten-year span of the reference period assures that it adequately reflects the pre-transitional situation in the agricultural sector, in light of the high year-to-year variability in agricultural production. The last year covered in our analysis is 1996, as the decapitalization in the sector, caused by the lack of clearly defined property rights, took place in the first years of transition and then gradually subsided (i.e. while the number of tractors and combines used in agriculture steadily declined in the period 1990 and 1995 for an overall drop of close to 54 percent, 1996 was the first year following the start of the restitution program that witnessed an increase in their numbers. In that year nearly all land was already under private cultivation).

Over the seven years following the start of market reforms in Bulgaria, the average annual production of fruits, cereals and vegetables fell by 43, 20 and 14 percent from their respective pre-transitional values (Table 1). On the supply side, the differential collapse in aggregate output from the three groups of crops can be traced to declines of similar magnitudes in productivity (i.e. average crop yield) and in the case of fruits – to a decrease in orchards' acreage. In agreement with the hypothesis put forth in this paper, the different transfer rules may have indeed yielded differential output effects during the transition.

Table 1. Bulgarian Agricultural Production During the Transition

Indicators	Average 1979-89	1990	1991	1992	1993	1994	1995	1996	Percentage difference between post and pre-transitional averages
Agricultural output [a/]									
- Cereals	8091	8013	8872	6497	5629	6388	6492	3357	-20
- Vegetables	1856	1789	1736	1679	1164	1645	2053	1147	-14
- Fruits	824	797	453	548	296	315	422	469	-43
Land under collective and private cultivation [b/]									
- Cereals	20477	20069	22042	21824	22269	22701	21025	17468	3
- Vegetables	1248	1173	1220	1287	1065	1336	1683	1109	2
- Fruits	667	559	569	584	590	540	498	489	-18
Average crop yield from land under collective and private cultivation [c/]									
- Cereals	298	301	315	249	197	232	246	160	-19
- Vegetables	1234	1263	1232	1209	957	1032	1064	920	-11
- Fruits	651	641	363	416	293	233	259	472	-41
Real producer prices [d/]									
- Cereals	10133	10110	3895	7301	4606	2480	1620	n.a	-51
- Vegetables	18119	20951	7794	14595	9854	5241	3450	n.a	-43
- Fruits	20730	21586	8627	17175	11491	6187	4017	n.a	-44

Source: National Statistical Institute, the Food and Agriculture Organization of the United Nations, and authors' estimates.

[a/] Combined output in thousand tons from the agricultural crops in our sample representing each group of crops: Cereals – wheat, rye, barley, oats, and maize; Vegetables – tomatoes, green peppers, onions, green beans, potatoes, and melons; and Fruits – apples, pears, plums, cherries, apricots, and peaches.
[b/] Thousand of dekars.
[c/] Average yield in kg/dekar among crops from each group of crops.
[d/] 1995 leva per metric ton.

To evaluate the statistical significance of the observed differences in the average output decline, productivity loss and change in the amount of cultivated land across the three groups of crops, we use Repeated Measures ANOVA in testing the equality of group means (Table 2).

The Repeated Measures Analysis of Variance is appropriate when the dataset includes more than one realization of a variable for the same subject (e.g. yearly values of total output from a given crop). In testing the equality of group means, the Repeated

Measures ANOVA accounts for the fact that the intertemporal values of variables for an individual crop are likely to be correlated, by explicitly modeling the covariance structure of these intertemporal values.[12]

Given the nature of the raw data—the annual production of crops included in our sample ranges from several thousand (e.g. rye, pears, etc.) to several million (e.g. wheat, maize, etc.) tons per year—such analysis requires the use of a measure of agricultural output which values are of comparable scale across crops. We construct such measure by transforming the output series for each crop in our sample into an index with a base equal to the average output from that crop prior to the transition (the other variables are transformed in a similar manner).[13] The comparison of the group means of these indices over the period 1990-96, using Repeated-measures Analysis of Variance, shows that the average output decline among crops belonging to the fruits' group is larger[14] than those among crops from the cereals' and vegetables' groups. The observed differences in the average output declines among fruits, cereals and vegetables were caused by statistically significant differences in the average yields derived from the different types of crops, with fruits experiencing the biggest average loss of productivity. The observed changes in the amounts of land cultivated with the three groups of crops were not statistically significant.

The performed statistical analysis rejects the null hypothesis of no significant differences in the output declines from three groups of crops. Moreover, the statistically significant differences in the average output declines among fruits and vegetables, and fruits and cereals are plausibly explained by our analysis of the special rules governing the restitution of orchards that made them more susceptible to the negative effect of poorly defined property rights on agricultural output.

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[12] In our analysis, we assume the most general form of the covariance matrix, estimating different covariance parameters for each pair of equally spaced-out intertemporal values.

[13] The choice of a base for the indices reflects the high year-to-year variability in agricultural production, which precludes us from using the values of agricultural output from different crops in one particular year as reference values. The reason for this is that if the latter are not representative of the annual production from each crop in our sample, the resulting pooled series of output indices for fruits, vegetables and cereals will exhibit spurious dynamics.

[14] In the following discussion, statements on differences in group means of variables are based on repeated measures ANOVA F-tests of the equality of group means. The use of terms "larger", "smaller" and, the likes of, imply that our statistical analysis has shown that the reported differences in group means are statistically significant at the 90% level of confidence.

Table 2. Repeated-Measures ANOVA Analysis

Indicators / Year	Group means							F-statistics in repeated measures ANOVA tests of the differences in group means			
	1990	1991	1992	1993	1994	1995	1996	C, V & F	C & V	C & F	V & F
Index of agricultural production from land under collective and private cultivation (average 1979-89 output=100)								3.54 (0.06)	0.37 (0.56)	3.16 (0.11)	7.67 (0.02)
- Cereals	105	110	98	79	90	77	47				
- Vegetables	89	95	102	68	95	133	75				
- Fruits	100	66	79	44	52	57	63				
Index of land under collective and private cultivation (average 1979-89 amount=100)								1.00 (0.39)	0.00 (0.95)	1.20 (0.30)	1.27 (0.29)
- Cereals	96	104	106	107	106	93	82				
- Vegetables	91	93	101	82	100	132	89				
- Fruits	83	85	89	90	84	76	75				
Index of average crop yield from land under collective and private cultivation (average 1979-89 yield=100)								9.10 (0.00)	0.99 (0.35)	7.76 (0.02)	18.26 (0.00)
- Cereals	108	106	93	72	85	84	58				
- Vegetables	101	108	104	80	91	96	79				
- Fruits	100	61	70	50	41	44	78				
Index of real producer prices (average 1979-89 real producer prices=100)								0.67 (0.53)	0.92 (0.36)	1.39 (0.27)	0.14 (0.72)
- Cereals	100	39	65	46	25	16	n.a.				
- Vegetables	115	43	81	55	29	19	n.a.				
- Fruits	102	41	81	54	29	19	n.a.				

Numbers in parenthesis are P-values.

IV. Multivariate Analysis

In the preceding section, we have established the presence of statistically significant differences in the average output declines among fruits, vegetables, and cereals. To be able to attribute conclusively these differences to the differential effect of poorly defined property rights on different groups of crops, however, we need to account for other factors affecting agricultural production in a demand-supply framework that would satisfy the *ceteris paribus* condition embedded in our tested hypothesis.

Review of empirical literature

Previous studies of the causes of agricultural output declines in CEE countries in the early stages of transition were based on cross-country data either in a point of time or in a panel (Macours and Swinnen, 1999; Macours and Swinnen, 2000).

Following the pioneering work of De Melo, et al. (1997), Macours and Swinnen (1999) use a cross-section of transitional countries to analyze the importance of initial conditions, reform policy choices, and policy outcomes for the realizations of the gross agricultural output (GAO) after 5 years of reforms. The OLS-estimated GAO supply function is in a semi-log form and includes as explanatory variables the ratio of producer prices to input prices, the share of land cultivated by individual farms, and a dummy variable for whether effective use rights on the land were restored during the reform period. The authors do not discuss the demand side of the system.

Macours and Swinnen (2000) use panel data on CEE countries over the period 1989-1995 to estimate with OLS a semi-log supply function for aggregate output from five crops (wheat, maize, barley, sugar beet, and oilseeds), aggregated using world market prices. Explanatory variables are the lagged value of the ratio of producer prices to input prices; the share of land cultivated by individual farms; the share of privatized land; the share of land newly cultivated by individual farms in the current and preceding years; the rainfall in the period March-June; and a dummy variable for whether major policy changes took place during the year that captures the impact of uncertainty. The OLS estimation is justified by the use of a lagged terms-of-trade term, based on the assumed adaptive expectations of agents.

Model specification

In this paper, we estimate separate supply functions for cereals, vegetables, and fruits, using Two-Stage Least Squares (TSLS) that allow identification of the supply function in a system of simultaneous demand and supply equations. The selection of explanatory variables is based on the work of Macours and Swinnen (1999 and 2000), country reports on Bulgarian agriculture, and analysis of the data. As seen in Table 3, the across-the-board decline in agricultural output in Bulgaria was accompanied by a significant deterioration in the terms-of-trade between agriculture and the rest of the economy. Average real producer prices of fruits, vegetables and cereals all fell precipitously, with cereals faring worst.[15] This suggests that the demand schedules for fruits, vegetables and cereals alike were subjected to common negative external shocks - the loss of CMEA export markets and the decline in domestic purchasing power (Table 3 and IMF, 1996, p. 4-5; Begg and Meurs, 1998, p. 260-265).

[15] Throughout most of the period, there was a partial export ban on cereals that combined with government monitoring of retail margins on basic food products depressed the prices of agricultural commodities (IMF 1996, p. 5).

Table 3. Demand and Supply Factors Affecting Agricultural Production in Bulgaria

Indicators	Average 1979-89	1990	1991	1992	1993	1994	1995	1996	Percentage difference between post and pre-transitional averages
Supply Factors									
Land under private cultivation (%)									
- Cereals	13	17	26	26	28	42	46	97	622 [a/]
- Vegetables	46	54	66	78	89	93	93	99	116 [a/]
- Fruits	3	4	5	16	23	46	50	97	2992 [a/]
Average annual temperature [b/]	11.4	12.2	10.8	11.6	11.4	12.9	11.5	11.0	2
Average annual precipitation [c/]	543	418	618	405	464	463	684	553	-5
Demand Factors									
Real per capita GDP [d/]	112	116	103	95	93	95	97	87	-13
Exports (mln. USD)									
- Cereals	74	27	53	78	13	5	124	4	-41
- Vegetables	181	59	36	50	22	40	40	33	-78
- Fruits	103	41	15	19	20	68	36	26	-69

[a/] Percentage difference between the 1996 and the pre-transitional average values.
[b/] Degrees Celcius.
[c/] Millimeters/sq. meter.
[d/] Thousands 1995 leva.

Furthermore, Table 3 reveals substantial differences in the organization of agricultural production of fruits, vegetables and cereals prior to the transition and its evolution thereafter. Over the period 1979-89, on average 46 percent of the land planted with vegetables was cultivated by individual farmers under contract with agricultural co-operatives, while the corresponding figure for cereals was 13 percent, and only 3 percent for fruits. Different dynamics of transfer of land from collective to private cultivation can induce differential output responses (see discussion later in the section).

Therefore, in our regression analysis we use data on 16 agricultural crops[16] and on selected meteorological and macroeconomic variables over the period 1990-95 [17] to estimate the following supply functions for cereals, vegetables, and fruits:

[16] In the original dataset, the cereals group was represented by wheat, rye, barley, oats, and maize; the vegetables group – by tomatoes, green peppers, onions, green beans, and melons; and the fruit group – by apples, pears, plums, cherries, apricots, and peaches. The selection of agricultural crops reflects data availability. In the course of the regression analysis, potatoes were removed from the cereals group, due to implausible (i.e. outlier) values of real producer prices. The removal of potatoes from the cereals group did not affect the main findings of our analysis.

[17] The data series on producer prices end in 1995.

$$OUTPUT_{it}^{j} = \alpha^{j} + \beta^{j}.REALPRC_{it}^{j} + \gamma^{j}.SHPRIVCULT_{it}^{j} + \delta^{j}.RAIN_{t} + \varphi^{j}.TEMP_{t} + \varepsilon_{it}^{j} \quad (1)$$

$j \in [Cereals, Vegetables, Fruits]$
$t \in [1990, 1991, ..., 1995]$
$i \in [\text{wheat, rye, barley, oats, maize}]$, for $j = Cereals$
$i \in [\text{ tomatoes, green peppers, onions, green beans, melons}]$, for $j = Vegetables$
$i \in [\text{apples, pears, plums, cherries, apricots, peaches}]$, for $j = Fruits$

The definitions and measurement-units of the dependent and explanatory variables[18] in the original dataset were:

OUTPUT – crop output (thousand tons).
REALPRC – Real producer prices (1995 leva per metric ton). Deflated using CPI.
SHPRIVCULT – share of land under private cultivation (%).[19]
RAIN – Average annual precipitation[20] (millimeters per square meter).
TEMP – Average annual temperature[20] (degrees Celsius).

The endogenous variables in (1) are OUTPUT and REALPRC. In the estimation of (1) with TSLS, we use as instruments all exogenous explanatory variables ($SHPRIVCULT_{it}^{j}$ t,

[18] The source of all data is the National Statistical Institute in Bulgaria, except for the data on producer prices that comes from the FAOSTAT database of the Food and Agriculture Organization of the United Nations.

[19] Prior to 1989, most of the land classified as being under private cultivation was land owned by the agricultural co-operatives, which had been leased to their members. Starting in 1990, this category began to reflect the temporary leasing of plots of land by the Liquidation Councils to individuals, who had claims on land in the same geographic location, but the exact boundaries of their plots had not yet been determined. Later on, most of the land under this category constituted plots returned to their owners without issuance of final title to the land.

[20] The National Statistical Institute reports data on the average annual precipitation and temperature at a number of meteorological stations in Bulgaria. We first take a simple average of these values by agricultural region (Bulgaria is divided in three agricultural regions - Northern Bulgaria, Southern Bulgaria, SouthWestern). We then calculate the weighted average of these regional means, using as weights each region's share in the total arable land in Bulgaria.

$RAIN_t$, $TEMP_t$), the lagged endogenous variables ($OUTPUT^j_{it-1}$ and $REALPRC^j_{it-1}$), and the real per capita GDP (thousand 1995 leva per annum).[21]

As mentioned earlier, the annual production of crops included in our sample ranges from several thousand tons per year (e.g. rye, pears, etc.) to several million (e.g. wheat, maize, etc.). Given the pooled nature of the dataset and the fact that our analysis focuses on groupwise differences in output declines rather than on the fixed effects associated with individual crops, we first have to ensure that the values of our measure of agricultural output are of comparable scale across crops. We construct such measure by transforming the output series for each crop in our sample into an index with a base equal to the average output from that crop prior to the transition (i.e. in the period 1979-1989). All explanatory variables are also transformed in a similar manner to enable easy interpretation of OLS coefficients.[22] Macours and Swinnen (1999 and 2000) make similar normalization of the raw data, noting that it helps eliminate heteroskedasticity in the data and "…reduces possible measurement biases due to different statistical methods in the different countries or due to omitted country-specific variables like climate or soil quality" (Macours and Swinnen, 2000, p.185).

We estimate (1) in levels rather than in log or semi-log form, because the rationale of the latter in the current context is questionable. Traditionally, regressions have been estimated in log form as a convenient way of casting the OLS coefficients as one period growth elasticities. Taking logs of variables that are already normalized around their pre-transitional averages, however, renders the normalization irrelevant for the interpretation of regression coefficients. In our regression analysis, the normalization of the dependent and explanatory variables is paramount in allowing us to use regression coefficients to compare post with pre-transitional outcomes in the Bulgarian agriculture. Therefore, the estimation of (1) is in levels rather than logarithmic or semi-logarithmic form.

Expected signs of regression coefficients

Given that the estimated regressions represent supply functions for fruits, vegetables and cereals, we expect a positive association between agricultural output and real producer prices. In our analysis, we deflate producer prices by CPI, instead of using the index of prices of inputs in agricultural production as per (Macours and Swinnen, 1999 and 2000). Whereas,

[21] In the initial stages of our exploratory analysis, we also used the real exchange rate of the Bulgarian Lev to the US Dollar, estimated using the respective GDP deflators, as an instument. It was later removed from the set of instuments, as it had little explanatory power on real producer prices but introduced multicollinearity, by being negatively associated with real per capita income. The removal did not affect the main findings of our analysis.

[22] The indices of climatic conditions have bases equal to their respective average values over the entire sample period (i.e. 1979-1995), as these variables were not affected by the chaos brought by the transition.

the index of input prices[23] in agriculture published by OECD for each transitional country can be useful in cross-country analysis, it is not meaningful in a sectoral analysis within a country. The reason for this is that the index reflects the average use of inputs in all agricultural sectors, whereas the intensity of their use varies substantially depending on the nature of the crops.

Climatic conditions (i.e. higher average temperatures and increased rainfall) are expected to have a positive effect on agricultural output.

On theoretical grounds, the effect of the transfer of land from collective to private cultivation on agricultural output in Bulgaria is indeterminate. The extreme segmentation of agricultural land resulting from the restitution process, and the absence of developed market infrastructure deprived private farmers in Bulgaria of the economies of scale and the ample financing enjoyed in the past. Also, throughout most of the period private farmers did not have final title on the land. Without such title, they were not able to sell their land or use it as collateral for bank loans. These factors can be expected to reduce the agricultural output of land transferred from collective to private cultivation. On the other hand, private cultivation with exclusive claim to output provides farmers with incentives that might increase output. When Chinese collectives leased plots of land for private cultivation, output increased dramatically. Thus, the effect of transfer of land into private cultivation is an empirical issue (see Lerman, Csaki, and Feder, 2002 for a review of experiences in other transitional countries).

The effect of the spell of poorly defined property rights, resulting from delays in land reforms, on agricultural output in Bulgaria would, instead, be captured by differences in the constant terms in the three regressions. The constant terms in the three supply functions show how the average post-1989 output would have compared to its pre-transitional average values, if the other explanatory variables are held constant. We have already established that special rules governing the restitution of land cultivated with fruit-bearing trees have made one group of crops, namely fruits, much more susceptible to the negative effect of poorly defined property rights on agricultural output. Therefore, if this effect is significant factor for the observed output decline, we would expect that the constant term in the supply function for fruits to be smaller than the constant terms in the other two supply functions, reflecting the non-random and all-encompassing nature of the negative effect of poorly defined property rights on agricultural output.

Regression analysis

Table 4 presents the output from the TSLS estimation of the supply functions of fruits, vegetables and cereals in Bulgaria in the period 1990-1995. All pooled variables used in the regression analysis were tested for stationarity using the Augmented Dickey-Fuller test

[23] OECD's input prices index is a composite measure of the prices of combined fodder, nitrogenous fertilisers, phosphate fertilisers, herbicides, fungicides, tractors, and combines (see OECD, 2000, p. 161).

and in all cases the hypothesis of the presence of an unit-root was rejected at the 95% level of confidence. All reported standard errors of regression coefficients are adjusted for the presence of general heteroskedasticity in regression residuals inherent in cross-sectional models. The three regressions are estimated independently of one another, as *a priori* there is no reason to believe that the effect of explanatory variables would be the same for fruits, vegetables and cereals. All explanatory variables are retained in the final specification of the regressions to facilitate the comparison between them.

As seen in Table 4, the constant term in the supply function for fruits is the smallest of the three constants, with the difference between it and the constants in the supply functions for vegetables and cereals being statistically significant at the 99 percent level of confidence (the constant in the supply function for fruits is the only one that is statistically different from zero at any of the conventional confidence levels). This result reinforces the findings of the univariate analysis in the preceding section, by showing that even after accounting for various supply and demand factors influencing agricultural production, we are able to show that the supply of fruits in the early stages of transition in Bulgaria fared worst relative to other crops. Therefore, we can attribute with high degree of confidence the much steeper decline in fruits' output to the stronger effect that the spell of poorly defined property rights had on orchards, as a result of the special rules governing the restitution of land cultivated with fruit-bearing trees.

Turning to the other explanatory variables, we note that the regression coefficients in front of climatic conditions have the expected positive signs in all three regressions, but are statistically significant only in the supply function for fruits.

The transfer of land from collective to private cultivation, on the other hand, has a negative effect on agricultural output, the latter being statistically insignificant from zero in the cereals supply function. Thus, inefficiencies of private farming during the early stages of transition in Bulgaria more than offset any output gains associated with improved incentives.

None of the structural explanatory variables enters significantly in the regression of the supply of cereals. This comes as no surprize given the fact that cereals were the most heavily regulated among agricultural commodities -bread being the national staple food - with numerous restrictions on their export, ceilings on retail margins, special producers' incentives, etc. Instead, cereals' output is strongly correlated with its value in the preceding period, reflecting government's efforts to ensure the national food balance in each year, by adjusting its regulations and level of subsidies to producers. The ad hoc addition of the lagged output as an explanatory variable does not change the above comparison of the constant terms in the three regressions, as without it the constant term in the supply function for cereals is still statistically insignificant at any conventional level of significance.[24]

[24] The exact value of the constant was 61.4 with standard error of 178.3.

Table 4. TSLS Estimation of Supply Functions of Fruits, Vegetables, and Cereals in Bulgaria, 1990-95

Regressors / Dependent variables	Index of production (average 1979-89 output=100)		
	Cereals	Fruits	Vegetables
Constant	7.03	-273.4 *	-38.3
	(138)	(128)	(144)
Index of real producer prices (average 1979-89 real producer prices=100)	0.05	0.77 *	-0.37
	(0.31)	(0.24)	(0.21)
Index of land under private cultivation (average % private 1979-89=100)	-0.006	-0.004	-0.37 *
	(0.01)	(0.003)	(0.08)
Index of air temperature (average annual temperature 1979-96=100)	0.22	2.15 *	1.61
	(1.01)	(0.88)	(0.86)
Index of precipitation (average annual precipitation 1979-96=100)	0.13	0.91 *	0.57
	(0.4)	(0.41)	(0.54)
Lagged index of production (average 1979-89 output=100)	0.49 *	-	-
	(0.17)		
Data points	30	36	30
Adjusted R-squared [a/]	0.21	0.51	0.22
Durbin-Watson	1.93	1.98 [b/]	2.28
AR(1)	-	0.40 *	-
	-	(0.16)	-

Numbers in parenthesis are White heteroskedasticity consistent standard errors of regression coefficients.
* Statistically significant at the 95% level of confidence.
[a/] Not using OLS. R-squared is not bounded in [0,1].
[b/] After correction for first-order correlation in regression residuals.

V. Conclusion

Detailed analysis of the legislative basis of land reform in Bulgaria suggests that it provides researchers with a natural experiment for testing the effects of poorly defined property rights on economic outcomes. Different treatment for land cultivated with fruit-bearing trees in the process of restitution in Bulgaria made fruit production much more susceptible to the negative effects of poorly defined property rights on agricultural output. In both univariate and multivariate setting (i.e. controlling for various demand and supply factors), we are able to show that as a result the decline in agricultural output was steepest for crops in the fruits group. Therefore, the Bulgarian agricultural experience shows that property rights and their characteristics matter to economic outcomes.

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