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The Uzbek Growth Puzzle

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Abstract

After the break-up of the Soviet Union, Uzbekistan's output fell less than in any other former Soviet Republic, and growth turned positive in 1996/97. Given the country's hesitant and idiosyncratic approach to reforms, this record has suprised many observers. This paper first shows that a standard panel model of growth in transition systematically underpredicts Uzbek growth from 1992-1996, confirming the view that Uzbekistan's performance consitutes a puzzle. It then attempts to resolve the puzzle by appropriately extending the model. The main result is that Uzbekistan's output performance was driven by a combination of low initial industrialization, its cotton production, and its self-sufficiency in energy.

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Both the official statistics and output estimates based on electricity consumption indicate that Uzbekistan's output fell much less than that of other former Soviet republics in the period 1992-1996. Moreover, it began to recover in 1996. In view of the country's hesitancy to engage in rapid market oriented reforms and sustained macroeconomic stabilization, this output record has puzzled foreign observers.

This paper first shows that Uzbekistan's output and growth performance indeed constitutes a puzzle in the sense that a cross-country model of growth in transition systematically underpredicts Uzbek growth from 1992-1996, even controlling for a standard set of initial conditions. It then attempts to resolve the puzzle by extending the model in a way that encompasses explanations which have been suggested in the past, both by foreign observers and by the Uzbek authorities themselves. Specifically, it examines the roles of (i) public investment, (ii) agricultural commodities and natural resource production.

The main findings are that the exceptional mildness of Uzbekistan's transitional recession can be largely accounted for by a combination of a low degree of initial industrialization, its cotton production, and its self-sufficiency in energy. In contrast, we find no evidence to support a major positive role of public investment. This need not mean, however, that Uzbekistan's relatively favorable output performance was unrelated to economic policies. One interpretation of the results is that a set of policies which failed in most other transition countries—namely supporting the industrial sector through credits and direct subsidies—was relatively successful in sustaining output during Uzbekistan's early transition years, as the subsidized sector was small to begin with and the availability of domestically produced energy and raw material exports relaxed the financing constraints which faced other countries.

I. INTRODUCTION

By any measure, the decline in output in Uzbekistan since the beginning of transition has been relatively mild. According to IMF data based on official statistics, 1997 Uzbek output stood at about 85 percent of its 1991 level, as compared to an average of 60 percent for the Baltics, Russia, and the other countries of the former Soviet Union (BRO) (Table 1). Total cumulative output loss was only 59 percent of 1991 output by 1995 and 89 percent by 1997; for the BRO average, the corresponding figures are 126 and 207 percent. Output estimates based on electricity consumption - sometimes regarded as preferable on the grounds that they better capture informal sector output - indicate that these differences may be exaggerated,[2] but they corroborate the finding that Uzbekistan's output decline was far milder than that in the other BRO countries. It is also worth noting that Uzbekistan's transitional recession was

Table 1. Baltics, Russia and Other Countries of the Former Soviet Union: Output Paths, 1992-1997

	Official Data 1/								Electricity-Based Data 2/		
	Output Index (1991 = 100)						Cumulat. Loss 3/		Output Index		Cum. Loss
	1992	1993	1994	1995	1996	1997	1991-95	1991-97	1994	1995	1991-95
Armenia	47	41	43	46	49	50	223	324	...	...	...
Azerbaijan	78	60	49	44	44	46	169	279	72	70	97
Belarus	90	83	73	65	67	74	88	147	67	60	108
Estonia	78	72	71	74	77	80	105	148	81	71	87
Georgia	55	41	36	37	41	45	230	343	44	44	173
Kazakhstan	95	85	74	68	68	70	79	141	70	64	92
Kyrgyz Republic	86	73	58	55	58	62	128	208	...	...	...
Latvia	65	54	56	56	57	61	170	252	67	67	121
Lithuania	80	67	59	61	64	67	133	202	57	53	154
Moldova	71	72	49	49	45	46	159	269	61	59	122
Russia	85	78	68	65	64	64	103	175	78	76	66
Tajikistan	71	63	50	43	31	32	173	310	...	...	...
Turkmenistan	95	85	69	64	62	47	87	179	...	...	...
Ukraine	90	77	60	52	47	45	121	228	73	68	83
Uzbekistan	89	87	83	82	84	86	59	89	85	82	51
BRO Average	81	72	62	59	59	60	126	207	68	64	106
excl. Uzbekistan	80	71	60	57	57	58	131	217	66	62	112

1/ Source: IMF, author's calculations.
2/ Source: Johnson, Kaufman and Shleifer (1997), author's calculations; see also Taube and Zettelmeyer (1998).
3/ In percent of 1991 output(sum of differences between 1991 level and levels in 1992 through 1995 or 1997).

[2] This is driven by a larger downward bias to official output measurement in the other BRO countries due to faster informal sector growth; see Taube and Zettelmeyer (1998).

mild not only relative to the BRO average but also relative to the average of the Central and Eastern European transition economies (CEE, see Figures 1 and 2). This is true regardless whether output is measured in calendar time (Figure 1) or "transition time" (Figure 2), where the output index for different countries is compared across similar years in the transition process.[3] Finally, note that Uzbekistan resumed positive growth in 1996 and 1997, ahead of other large BRO economies such as Russia and Ukraine which continued to decline in 1996 and were at best stagnant in 1997.

Observers are often puzzled by Uzbekistan's output performance, typically because they think that the country could have done much worse given its hesitancy to engage in rapid market oriented reforms and sustained macroeconomic stabilization, i.e. policies that have been widely credited with contributing towards milder transitional recessions and quicker and stronger recoveries.[4] In Uzbekistan, by contrast, structural reforms have generally proceeded hesitantly, while positive growth was achieved relatively quickly following some macroeconomic stabilization, and maintained against the background of macroeconomic imbalances that emerged in late 1996 and 1997.[5] Puzzling or not, the question is what explains Uzbekistan's relatively good performance. The fact that Uzbekistan did not follow standard market-oriented economic reforms makes this question all the more interesting, and poses a challenge to the standard policy prescription. In particular, one would want to know whether the relatively good past performance occurred *because* or *in spite of* the policies that were followed.

The purpose of this paper is two-fold. First, is there really a puzzle? Clearly, structural reforms and macroeconomic policies may not be the only—or perhaps even the main—determinant of output in transition. Other variables—in particular, initial conditions—also matter. The question is whether Uzbekistan's performance is still puzzling once one takes these factors into account with in the context of a cross-country regression model. Is the Uzbek growth performance unusual merely because some standard explanatory variables for growth in transition economies took on unusual values? In this case there would not be much of a puzzle, although, as stated before, one would of course like to see in what areas Uzbekistan was unusual. Alternatively, is it the case that even considering the values that standard explanatory variables took, we would not have expected the output path we are seeing? In that case, it would seem right to speak of a puzzle.

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[3] Specifically, transition —as defined by the collapse of central planning—is assumed to have begun in 1992 for the BRO countries, 1990 for Poland, Hungary and the former Yugoslavia, and 1991 for the remaining Central and Eastern European transition economies.

[4]Berg, Borensztein, Sahay and Zettelmeyer (1998), de Melo, Denizer, Gelb and Tenev (1997), Hernández-Catá (1997), IMF (1998), Fischer, Sahay, and Vegh (1996a, b), Sachs (1996), Åslund, Boone and Johnson (1996), Selowsky and Martin (1997), Wolf (1997) and World Bank (1996).

[5] See Taube and Zettelmeyer (1998) for details on Uzbekistan's policy approach.

Figure 1. Output Paths in Calendar Time (1989 = 100)

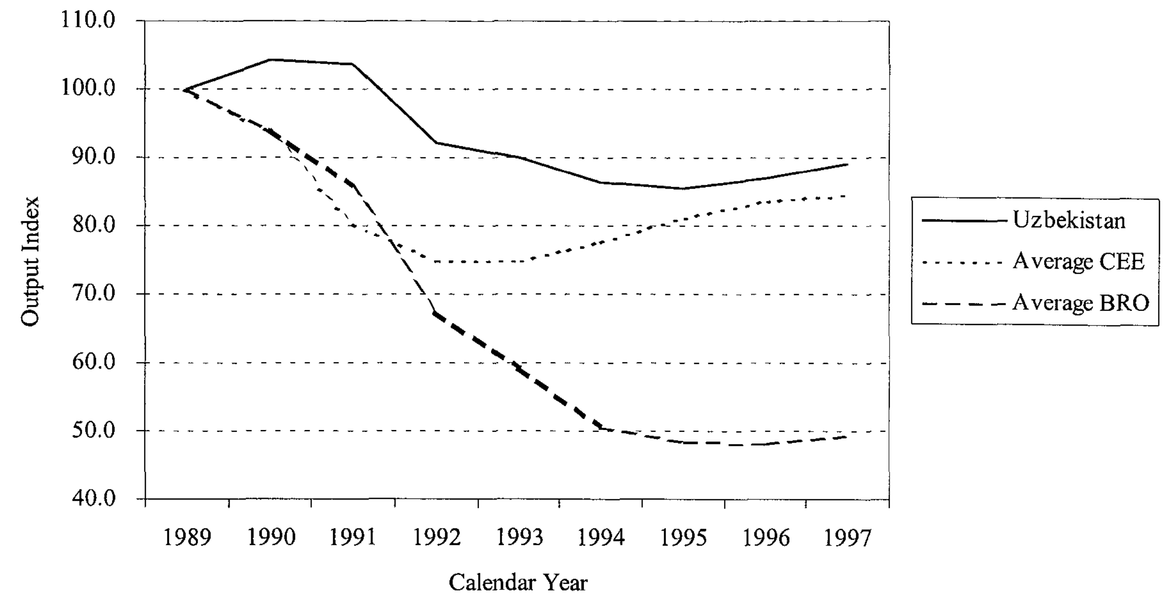
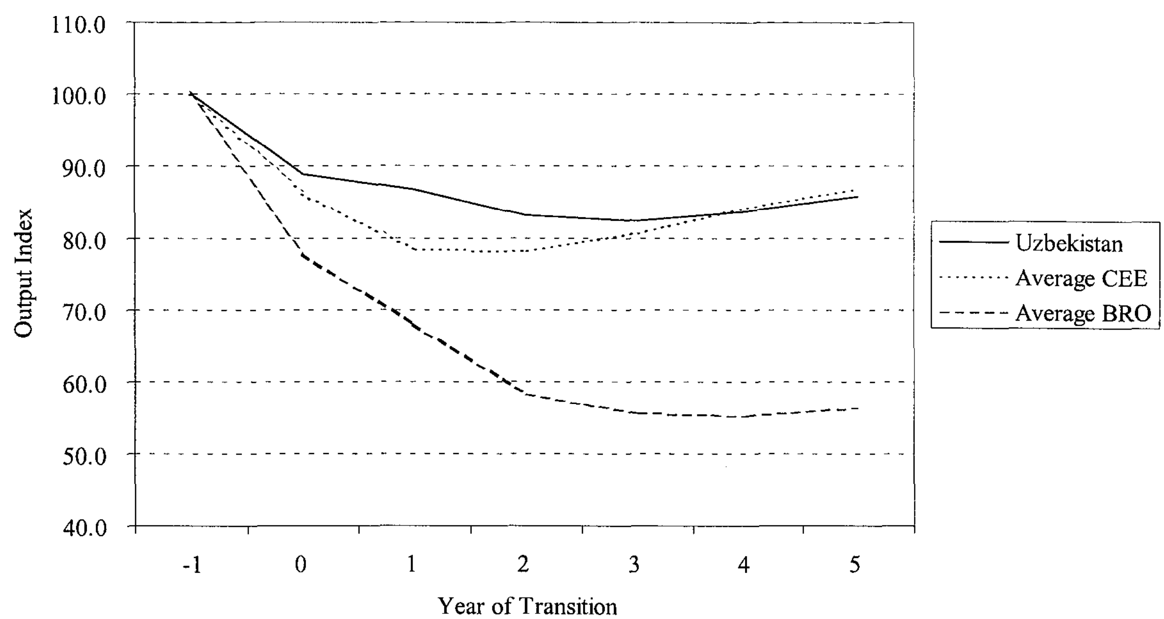


Figure 2. Output Paths in Transition Time (Pre-Transition Year = 100)



As will be apparent from Section II of this paper, the answer to the these questions is: "a mixture of both". In other words, the standard regression model explains part, but by no means all, of the difference between the Uzbek output path and that in other transiton economies. In that sense, a puzzle exists. This motivates the second purpose of the paper, namely to explore some additional hypotheses of what could drive the difference between the Uzbek growth path as it materialized and as it would have been expected based on the model of Section II. This is attempted in Section III, by extending the cross-country model in a way that takes into account additional factors that might have contributed to Uzbekistan's unusual output performance. The main result of the paper is that some of these additional factors—in particular, its cotton exports and its high degree of energy self-sufficiency—play an important role in resolving the Uzbek puzzle, but that the policy conclusions from this finding are not straightforward.

II. Is there a puzzle?

A. A Cross-Country Regression Model

Our results in this section of the paper are based on a recent panel regression model for 26 transition economies by Berg, Borensztein, Sahay and Zettelmeyer (1998) (referred to as BBSZ (1998) below) which attempts to estimate the main determinants of growth performance during transition, including policies and initial conditions. The model is flexible in three respects. First, it has a very general dynamic structure, which estimates up to three lags of the main policy variables and does not impose a constant effect of initial conditions across time (e.g., the effect of initial conditions is allowed to "die down" across time, if this is so suggested by the data). It also allows for the possibility that transition might have some exogenous "own dynamics" that is not captured by any of the economic right hand side variables. Second, the model does not assume that policies and initial conditions have the same effects on the private and the state sectors; it is parametrized in a way that allows to distinguish the private and public sector effects of the same policies and initial conditions. The overall effect on growth is just the weighted average of the two independent effects, using the estimated private sector share as a weight. Third, the model does not take a narrow view on which right hand side variables (in particular, initial conditions) are assumed to matter and which not, i.e. it starts off by considering a large number of potential determinants of growth simultaneously.

The cost of this flexibility is that one has a larger number of potential regressors which cannot be simultaneously estimated, with reasonable precision, based on a dataset of 26 countries and 5-6 years of observations. BBSZ (1998) address this problem by beginning with a very inclusive initial specification which is then simplified using a "general to specific" approach, in which statistically insignificant variables or groups of variables are eliminated in a certain order. The most general specification includes (see BBSZ for details):

i. **macroeconomic variables**: fiscal balance and inflation, instrumented using Fund program targets, with two lags each;

ii. **structural reform indices**, constructed by World Bank researchers[6] and updated using the reform indices of the EBRD *Transition Reports*, which separately capture price liberalization, external opening and privatization/private sector conditions, with three lags each;

iii. **initial conditions**, including variables capturing initial structure (overindustrialization, initial share of agriculture, trade dependency), initial PPP-adjusted income, initial macroeconomic distortions (as measured by measures of repressed inflation and/or inflation and fiscal balance in the year prior to the beginning of transition), the initial state of reforms and others.[7]

iv. a full set of **time dummies** to capture any "intrinsic dynamic of transition" unrelated to the variables listed so far;

v. some **other controls**, including a dummy for wars.

As described in BBSZ (1998), the order of elimination matters for the final results. The order used incorporates BBSZ's priors on which potential explanatory variables are likely to matter more and thus should be given a bigger chance to remain in the model by ordering them last as candidates for elimination. Broadly, the rule was to first attempt to eliminate the time dummies, then to reduce the set of relevant initial conditions, then to simplify among the macroeconomic variables and finally among the set of structural reform variables. However, the results are robust to certains variations of this order, see BBSZ for details.

Based on this procedure, BBSZ arrive at a relatively parsimonious regression model (referred to in their paper as model "gA").[8] Based on this model, we now attempt to answer the main questions raised in the introduction.

B. How Well Does the Standard Model Explain Uzbekistan's Output Path?

Table 2 compares fitted and actual growth in "transition time" (time since the end of central planning) for (1) an average of 25 transition economies excluding Uzbekistan, (2) an average of 14 BRO economies, again excluding Uzbekistan, and (3) Uzbekistan. "Year zero", i.e. the year in which central planning ended, is defined as 1992 in Uzbekistan and the other BRO countries and 1990 or 1991 in the remaining transition economies in the sample (see footnote 3 above).

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[6] See de Melo, Denizer and Gelb (1996) and de Melo and Gelb (1997).

[7] The initial conditions dataset is partly taken from de Melo, Denizer, Gelb and Tenev (1997).

[8] BBSZ also discuss other variants of the model, which have similar qualitative implications as the version used here.

Table 2. Uzbekistan and Transition Economy Averages: Fitted and Actual Growth Paths (in percent p.a.)

	Transition Time						
	0	1	2	3	4	5	6
	Average of Transition Countries excluding Uzbekistan						
Actual Growth	-21.3	-12.5	-9.8	-1.5	1.6	2.6	3.3
Fitted Growth	-20.9	-12.7	-9.1	-1.6	1.7	3.4	2.6
Residual	-0.4	0.2	-0.7	0.1	0.0	-0.8	0.7
Average of Absolute Residual	3.3	3.1	4.2	3.1	3.3	2.4	2.6
	Average of BRO Countries excluding Uzbekistan						
Actual Growth	-25.8	-14.1	-13.3	-3.9	-0.2	...	...
Fitted Growth	-24.7	-14.6	-12.3	-4.1	0.1	...	...
Residual	-1.1	0.5	-1.0	0.2	-0.3	...	...
Average of Absolute Residual	4.2	3.2	4.6	2.9	3.7	...	...
	Uzbekistan						
Actual Growth	-11.1	-2.3	-4.2	-0.9	1.6	2.2	...
Fitted Growth	-15.6	-6.4	-18.9	-4.7	0.0	...	...
Residual	4.5	4.1	14.7	3.8	1.6	...	...

The main results from the Table are as follows.

1. The "fit" of the model is considerably worse for Uzbekistan than for the average transition economy. This is true even if we do not allow positive and negative residuals to average across the other countries, i.e. when we take the average of the *absolute* residuals across countries (see line "Average of Absolute Residuals" and compare with "Residual" line for Uzbekistan). The overall average of absolute residuals (i.e. averaging over the transition years shown in the line) is 3.7 for the average BRO country and only 3.2 for the transition average, as compared to 5.7 for Uzbekistan. This said, the correlation between fitted and actual growth is about 0.78, which might still be considered reasonable.

2. The model *correctly* predicts a higher growth for Uzbekistan in the first two years of transition relative to the average, i.e. a smaller output decline. However, the model *incorrectly* predicts that Uzbekistan's output decline should have been larger than both the transition economy average or the BRO average beginning with the third year of transition (1994).

3. The model *systematically underpredicts* Uzbek growth. In *every single year*, Uzbekistan did better than the model would have predicted based on Uzbekistan's policies and the initial conditions accounted for by the model. The underprediction is particularly spectacular for 1994 (year 2 in transition time) when the model predicts a large collapse in output that did not materialize.

These results solicit two conclusions. First, *part* of the Uzbek growth performance *can* be explained by the model. In particular, the small magnitude of the initial decline is correctly predicted. As a result, we can get some insights into the relatively good Uzbek output performance during 1992-93 by looking into what drives the model's predictions, and this is the purpose of the next section. Second, it is definitely justified to speak of an "Uzbek growth puzzle": the standard model does much worse at explaining the Uzbek transition experience than that of the other transition economies, it systematically underpredicts Uzbek growth throughout the transition, and it contains one particularly glaring predictive failure for 1994. To resolve this puzzle, we need to look beyond the current model; this is the purpose of Section III.

C. What Drives the Fitted Growth Path?

We now try to understand what variables drive the model's (limited) capacity to explain Uzbek growth performance, and in particular the differences between the Uzbek fitted path and the average fitted path for the other transition economies. We proceed in two steps. First, we decompose the fitted growth paths into the contributions of the major groups of variables (Table 3).[9] Second, we further decompose those groups which appear to play the greatest role in understanding why Uzbek growth differed from the average growth path.

The main insight from Table 3 is that, to the extent that the standard model can explain Uzbekistan's output path in the first two years, it does *not* attribute Uzbekistan's relatively favorable performance to its macroeconomic policies and the (slow) pace of its structural reforms. On the contrary: relative to the average of the other transition economies, Uzbekistan actually conforms to expectations as far as the growth contributions of macroeconomic policy and structural reforms go. On both fronts, Uzbekistan performed *worse* than the average of transition economies, substantially so in the case of structural reforms. Thus, on this basis it is difficult to argue that Uzbekistan has actually benefitted from its "gradualist" approach. Taken by themselves, the above results would suggest that, on the contrary, Uzbekistan could have done much better by embarking on more decisive structural reforms from the beginning.

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[9] This decomposition is possible because the model does not contain lagged dependent variables. Thus, at any point in time, the fitted value of the model can be written as a linear combination of the independent variables. Tables 3 reproduces the main elements of this linear combination, which sum up to the fitted value.

Table 3. Uzbekistan and Transition Economy Average:
Contributions of Major Groups of Variables to Fitted Growth
(in percent p.a.)

	Transition Time						
	0	1	2	3	4	5	6
	Average of Transition Countries excluding Uzbekistan						
Macroeconomic Policy	-2.6	0.5	-0.5	0.8	0.9	0.3	0.4
Structural Reforms	5.2	5.9	8.1	11.3	11.7	13.3	14.1
Initial Conditions	-12.8	-7.7	-6.6	-4.1	-2.0	-1.3	-1.3
Constant	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
War	-1.9	-2.5	-1.2	-0.7	-0.1	0.0	0.0
	Average of BRO Countries excluding Uzbekistan						
Macroeconomic Policy	-2.6	1.0	-0.7	0.3	0.6	...	...
Structural Reforms	3.7	4.0	5.6	9.4	10.5	...	...
Initial Conditions	-13.9	-7.8	-7.6	-4.8	-2.0	...	...
Constant	-8.9	-8.9	-8.9	-8.9	-8.9	...	...
War	-3.0	-3.0	-0.7	-0.2	-0.2	...	...
	Uzbekistan						
Macroeconomic Policy	-4.3	0.0	-3.5	0.0	2.2	...	...
Structural Reforms	0.6	-0.5	-0.6	7.3	7.3	...	...
Initial Conditions	-3.0	2.9	-5.9	-3.3	-0.6	...	...
Constant	-8.9	-8.9	-8.9	-8.9	-8.9	...	...
War	0.0	0.0	0.0	0.0	0.0	...	...

The real reason for the relatively good performance of Uzbekistan in the first two years of transition, according to Table 3, is unusually favorable initial conditions. These *more than offset* the unfavorable impact of slow structural reforms and macroeconomic imbalances in that period. In the first two years, the more favorable initial conditions have the effect of dampening the output decline by around *ten percentage points* relative to the transition economy average. The favorable impact relative to average of the other BRO countries is even larger.

The next step is to attempt to unbundle the "initial conditions" and identify what exactly, according to the standard model, put Uzbekistan in a more favorable position. This is the objective of Table 4, which is based on the same regression as the previous table.

Table 4. Uzbekistan and Transition Economy Average:
Growth Effects of Major Initial Conditions
(in percent p.a.)

	Transition Time						
	0	1	2	3	4	5	6
	Average of Transition Countries excluding Uzbekistan						
Trade Dependency	-7.7	-5.7	-3.8	-1.9	0.0	0.0	0.0
Overindustrialization	-10.4	-6.3	0.0	0.0	0.0	0.0	0.0
Pre-Transition Structural Reforms	0.0	-3.3	-2.8	-2.3	-2.0	-1.2	-1.2
Urbanization	15.5	9.6	-0.3	-0.3	-0.3	-0.3	-0.3
Agriculture Share	-8.4	-6.7	0.4	0.4	0.4	0.4	0.4
Resource Rich Country Dummy	-1.1	-0.9	0.0	0.0	0.0	0.0	0.0
Initial Macroeconomic Imbalances	-0.8	5.6	0.0	0.0	0.0	0.0	0.0
	Average of BRO Countries excluding Uzbekistan						
Trade Dependency	-8.2	-5.5	-2.9	-0.2	0.0	...	...
Overindustrialization	-8.5	-5.6	0.0	0.0	0.0	...	...
Pre-Transition Structural Reforms	0.0	-1.4	-1.1	-0.9	-0.8	...	...
Urbanization	14.4	9.3	-0.1	-0.1	-0.1	...	...
Agriculture Share	-10.3	-11.2	-3.6	-3.6	-3.6	...	...
Resource Rich Country Dummy	-1.7	-1.7	0.0	0.0	0.0	...	...
Initial Macroeconomic Imbalances	0.3	8.3	0.0	0.0	0.0	...	...
	Uzbekistan						
Trade Dependency	-8.0	-5.6	-3.2	-0.8	0.0	...	...
Overindustrialization	3.4	2.1	0.0	0.0	0.0	...	...
Pre-Transition Structural Reforms	0.0	-1.3	-1.3	-1.1	-0.8	...	...
Urbanization	15.1	12.6	8.4	8.4	8.4	...	...
Agriculture Share	-9.6	-13.3	-9.8	-9.8	-9.8	...	...
Resource Rich Country Dummy	0.0	0.0	0.0	0.0	0.0	...	...
Initial Macroeconomic Imbalances	-4.0	8.3	0.0	0.0	0.0	...	...

Note: For details on individual variables and definitions, see BBSZ (1998).

Table 4 shows that the standard model attributes the performance difference between Uzbekistan and the average transition economy in the first two years of transition overwhelmingly to one variable: overindustrialization, which captures the degree of industrialization at the beginning of transition relative to the industialization typical for a market economy in the same range of GDP per capita. According to the dataset of de Melo, Denizer, Gelb and Tenev (1997), from which the data documenting initial conditions was taken, Uzbekistan was the least overindustrialized economy of any of the 26 transition economies in our sample. Thus, according to the basic model, Uzbekistan did better than the average transition economy in the first two years mainly because it was less industrialized in the first place, and as such the share of output that typically collapsed at the beginning of transition was much smaller.

A somewhat surprising result is that the relatively large share of agriculture of Uzbekistan does not exhibit an independent mitigating effect on the output decline. Other variants of the basic model did show some such effect, but it was not robust and in the version presented above it goes the "wrong way". The mechanics of this result is as follows. According to the estimation results of BBSZ, a large pre-transition share of agriculture is associated with a slower decline of the state sector, but also with a slower growth of the private sector at the beginning of transition. Depending on the exact magnitude of the estimated effects, one or the other effect can dominate. In the version presented above it is the retarding effect on private sector growth that is stronger.

Finally, note that the "resource rich country" dummy plays only a minor role in explaining the differences between Uzbekistan and the average transition economy at the beginning of transition. This runs counter to the intuition that Uzbekistan's energy resources might have given it an advantage in maintaining production during the transition. However, the dataset underlying Table 4 only distinguishes between "resource rich" countries, which is taken to mean the large natural resource exporters Russia, Turkmenistan, Azerbaijan and Kazakhstan, and the remainder—i.e. Uzbekistan is classified as not resource-rich. It turns out that after controlling for the remaining policy variables and initial conditions the four "resource rich" countries suffer somewhat larger collapses at the beginning of transition than the average, which is why the contribution of the "resource rich country" dummy to growth in the first two years is negative for the average transition and average BRO countries.

In summary, this section offers some interesting clues, including that the better than average performance of Uzbekistan at the beginning of transition cannot be attributed to its structural and macroeconomic policies—which, on their own, would have resulted in a worse than average growth record—but to its initial conditions, and in particular to its low degree of industrialization. However, the weaknesses of the basic model in adequately explaining the Uzbek case, in particular during the later years of transition, are also apparent. The dataset which underlies the model is too narrow to consider plausible explanations of Uzbek output performance during the whole period. Specifically, the share of agriculture variable used above contains no information regarding the *composition* of agriculture, including the presence of internationally tradable cash crops such as cotton or wheat. Similarly, the "resource rich country dummy" puts Uzbekistan in the same goup as countries who have no natural resources at all. This ignores the fact that Uzbekistan, while not being an energy exporter in the order of some other countries in the region, is an important exporter of non-ferrous metals such as gold and moreover might have benefited from its natural resource production *domestically*. These are issues which we attempt to address in the following sections of the paper.

III. Explaining the Uzbek Growth Puzzle: Econometric Findings

We now attempt to shed some light on the Uzbek growth puzzle by extending the model of the previous section so as to encompass "explanations" of the growth puzzle that have been suggested in the past. In particular, we include variables reflecting (i) cash crops and natural resources (including energy and non-ferrous metals), and (ii) public capital investment. In Uzbekistan, the latter is at the core of a government-led industrialization and import substitution program which is viewed by the Uzbek authorities as the key to the country's success in mitigating and reversing the output decline.[10] In contrast, the former is typically cited by foreign observers.[11]

We proceed in three steps. First, we inquire whether—and if so, which—of the new variables are *candidates* to resolving the growth puzzle by adding them to the model presented in the previous section. This gives us an indication of whether the new variables are likely to improve the fit of the model, and helps us decide among alternative variable definitions.[12] In a second step, we reformulate a statistical model analogous to that presented in Section II which includes those variables and examine whether and to what extent the growth puzzle still holds up. The rationale for repeating the model selection process rather than simply tacking on the new variables is that the presence of new data will have a bearing on which other variables (in particular, within the set of initial conditions) enter the final model and how they enter it; this allows a more precise estimation of the new coefficients and improves the fit of the model as a whole. The final step is to test the notion that Uzbekistan might be different from the remaining transition economies in ways that cannot be accounted for even by the extended model. This is achieved formally by conducting structural stability tests on the basis of this model.

A. Extending the Basic Model

Variables measuring public investment

As mentioned above, the extension of the basic model to include public investment variables is motivated primarily by the government's own view that its strategy of "diversifying"

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[10] For a more detailed account of the "Uzbek model" of economic development, see Taube and Zettelmeyer (1998). An excellent summary of the official Uzbek perspective is provided in the government publication "Islom Karimov Steers Uzbekistan on its Own Way".

[11] IMF(1997), paragraph 3.

[12] Experimenting with alternative variable definitions in these regressions implies a risk of data mining (a problem to which we will return below). However, as we shall see, trying alternative definitions is justified by the fact that our prior on how the new variables might affect growth do not uniquely pin down the ways in which these variables should be defined. Indeed, they point to competing definitions, particularly for the energy variables.

economic output away from raw materials and agriculture and toward the industrial sector, with a view toward substituting imports, has been a crucial or even the main factor explaining Uzbekistan's relative success. In addition to attracting some FDI, much of this import substitution and industrialization strategy has taken the form of government-directed and financed capital investment (see Taube and Zettelmeyer (1998) for details); indeed, capital expenditures of the general government have been relatively high in Uzbekistan, particularly in the later years (12.5 percent of GDP in 1995 and 11.5 in 1996, according to IMF calculations based on the Uzbek authorities' data). A natural way of accounting for this strategy is thus to include a public investment variable in our cross-country regression.

There are two candidate variables which could achieve this: gross fixed capital formation in the public sector, which is taken from the national accounts, and capital expenditure of the general government, which is based on the fiscal accounts. The former is preferable on the grounds that it both incorporates a broader concept of what constitutes the public sector (namely, public enterprises in addition to the general government), and—to the extent that the national accounts follow the United Nations SNA—a greater chance at achieving cross-country consistency. However, it was not available for over one third of our sample of 143 observations; for Uzbekistan, this data is missing altogether. This disqualifies the concept for our purposes. In contrast, general government capital expenditure is by now available for most transition economies via IMF staff country reports, although coverage of the earlier transition years tends to be patchy. In some cases, only central government cpaital expenditure was available, for those countries, an additional dummy was included into the regressions below. All in all (i.e. including observations for which central government capital expenditure was used) we were able to obtain 123 observations. The main drawback of this data is that consistency across countries is not assured, as public capital expenditure is composed of expenditure items whose definition depends on the national fiscal authorities and may vary across countries.

We expressed public capital expenditure (i) as a percentage of total expenditure; (ii) as a percentage of GDP; (iii) as a per capita (dollar) value. (i) and (ii) gave very similar results in practice; we thus limit ourselves to showing results based on normalizing by GDP and by population.

Variables measuring agricultural commodities and natural resources

Two stories motivate the extension of the model by agricultural commodities and natural resource variables that go beyond the crude proxies used in Section II. First, the production of these goods, which could either be sold for hard currency or may have eliminated the need for hard currency imports, could have allowed Uzbekistan to relax the tight foreign exchange constraint, and corresponding import constraint, that plagued other economies in the region. As a result, Uzbekistan might have been in a position to maintain production in traditional industries by purchasing inputs and capital goods that would otherwise have stopped flowing following the disintegration of the Soviet Union. The second story is closely related, but focuses more on the self-sufficiency and not so much on the foreign exchange implications of domestic energy production. This view stresses the fact that the centrally planned supplier relationships of the former Soviet Union could often not be quickly replaced by markets and international trade, particularly in the Central Asian republics.[13] Bilateral trade and barter arrangements, which were put in place in an attempt to maintain Soviet era goods and materials flows between the former Soviet republics, were unreliable and plagued by inter-republican non-payment problems, especially in the energy sector. In this setting, self-sufficiency in certain inputs, in particular energy, might have played a special role which it would gradually loose as markets developed and trade was redirected to countries outside the former East bloc.

These ideas lead us to include the following additional variables into the model of Section I:

- Since the model already controls for the share of agriculture in GDP, we concentrated on new agricultural variables that capture the dollar value of **agricultural commodities**—i.e., internationally tradeable cash crops. This is motivated primarily by the first story outlined above, which emphasizes commodities production as a way of relaxing the foreign exchange constraint. The quantitatively most important cash crops in transition economies have been cotton, wheat, and some other cereals. If the first story is right—i.e. production in these goods is important only because they either earn or avoid spending foreign exchange— *and* the various classes of crops are similar in terms of international marketability, then the appropriate variable to enter the model is simply the aggregate cash value of these commodities. If, on the other hand, there is something else going on beside the first story and/or the international marketability of the crops differs, then agricultural commodities production should enter the model in a more disaggregated way.

- The dollar values of nine main **non-ferrous metals** (Aluminium, Cobalt, Copper, Gold, Lead, Nickel, Silver, Tin and Zinc) were added to obtain a series representing the aggregate value of metal production. Since countries are quite specialized in their production of non-ferrous metals, we did not consider less aggregated versions of this series.

- Regarding **energy variables**, the first story suggests that only the normalized total dollar value of tradable energy products (gas, oil and coal) should matter. By contrast, the second story suggests that one should separately study an index of self-sufficiency in energy. One formulation which encompasses both stories is to include both energy *balance* and energy *self sufficiency* in the model. The former is defined as total energy production divided by consumption (in energy units), while the latter denotes

[13] This is closely related to ideas explored by Blanchard and Kremer (1997), who stress the break-down of specific relationships in the absence of fully developed markets as a main factor behind the output decline.

the degree (bounded at one) to which domestic production covers consumption.[14] If energy production matters only as a way of either earning foreign exchange or reducing its spending, than the coefficient on energy self-sufficiency should be insignificant while the one on energy balance should be positive and significant. Alternatively, one can estimate the self sufficiency index in the presence of the difference between energy balance and energy self-sufficiency, which constitutes an index of energy *exports*. If only the foreign exchange story matters, the coefficients on both indices should be insignificantly different from each other.

Two problems that arose in relation with the energy variables—one practical and one methodological—deserve brief mention. The practical problem was that energy data was available for all transition economies only through 1995, one year short of the end of the BBSZ sample (1996). The methodological problem was that, unlike the agricultural cash crop variables, energy production is probably endogenous to same-year industrial activity and thus to output, particularly if we believe the self sufficiency story which posits that energy may not be readily tradable at all times. As a result, we cannot use contemporaneous energy balance or energy production on the right hand side of our regression model. We attempt to resolve both problems by working with first lags of energy balance or energy production. We also tried other approaches, which involved either using instruments constructed as fitted values of lagged energy production, or using energy variables as initial conditions only, i.e. merely exploiting the cross-sectional variation among countries at the beginning of transition. These alternative approaches made no difference to our results, except for a moderate loss in precision when using energy production levels as initial conditions.

As datasources, we used the FAO's *Yearbook Production* (1991-1996 issues) for agriculture, the IMF's *International Financial Statistics* for commodity prices, the *World Metal Statistics Yearbook* 1997 for data on non-ferrous metal production and prices, and the UN *Energy Statistics Yearbook* (1992, 1993 and 1995 issues) for energy balances and energy production.

Regression results

Tables 5a and 5b show the results from adding public investment, agriculture and natural resource variables to the model in various definitions. In view of the problems with measuring dollar GDP, particularly early in the transition, all production values were scaled using population rather than GDP. Public capital expenditure was either normalized by GDP in local currency, i.e. expressed as a share of GDP (Column 1 of Table 5a), or by population after conversion into U.S. dollars using market exchange rates (Column 2 of Table 5b). Table 5a contains coefficients from regressions that include one of the two public expenditure measures and as a result had to be estimated on a reduced sample (see above). Table 5b repeats and further simplifies some of the specifications of Table 5a on the full sample but excluding the public investment variables.

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[14] Thus, the self-sufficiency index equals the energy balance (as defined above) if the latter is less than one and equals one if the energy balance exceeds one.

The strategy of the sequence of regressions summarized in Table 5a is to first add the agricultural and natural resource production values in their most aggregated form, which one would expect to matter if only the first (foreign exchange) story holds. The next step is to disaggregate the agricultural measure. Finally, we express energy in terms of energy balance rather than energy value, and go on to disaggregate that variable.

Table 5a. Results from Adding New Variables to Basic Model:
Regressions including public capital expenditure, reduced sample
(dependent variable: real ouput growth, in percent)

		(PCE as ratio of GDP)		(PCE as $ per capita)	
Model No.	Variable	Coefficient	t-value	Coefficient	t-value
I	AgcashVPC	-0.020	-1.744	-0.021	-1.805
	MetalVPC	0.103	3.126	0.108	3.300
	EnergyVPC-1	-0.014	-1.608	-0.014	-1.643
	Public Capital Expenditure (PCE)	0.233	1.180	0.006	0.575
II	WheatVPC	-0.030	-1.018	-0.035	-1.211
	CottonVPC	0.015	0.809	0.016	0.860
	OtherAgVPC	-0.079	-2.303	-0.078	-2.258
	MetalVPC	0.072	2.090	0.075	2.185
	EnergyVPC-1	-0.020	-2.289	-0.020	-2.289
	Public Capital Expenditure (PCE)	0.178	0.901	0.003	0.257
III	WheatVPC	-0.034	-1.145	-0.041	-1.382
	CottonVPC	0.025	0.958	0.028	1.047
	OtherAgVPC	-0.066	-1.874	-0.067	-1.862
	MetalVPC	0.052	1.442	0.053	1.482
	Ebal-1	-1.136	-0.889	-1.232	-0.950
	Public Capital Expenditure (PCE)	0.163	0.803	-0.001	-0.112
IV	WheatVPC	-0.034	-1.123	-0.040	-1.352
	CottonVPC	0.027	1.005	0.029	1.092
	OtherAgVPC	-0.060	-1.641	-0.060	-1.625
	MetalVPC	0.044	1.177	0.046	1.212
	Eexp-1	-1.700	-1.088	-1.805	-1.146
	Esuf-1	0.143	0.060	0.084	0.035
	Public Capital Expenditure (PCE)	0.160	0.786	-0.001	-0.096

Notes and Definitions:

1. The suffix "VPC" stands for "Value per Capita". All variables with this suffix are expressed in $/capita.
2. "AgcashVPC" denotes the value per capita of a broadly defined class of agricultural cash crops. For the precise composition, see appendix. "CottonVPC" and "WheatVPC" are two subitems within "AgcashVPC". "Other AgVPC" is a residual containing non-Wheat, non Cotton crop values.
3. Ebal and Esuf denote energy balance and energy sufficiency (see footnote 13); Eexp = Ebal—Esuf.

Table 5b. Results from Adding New Variables to Basic Model:
Regressions excluding public capital expenditure, full sample
(dependent variable: real ouput growth, in percent)

Model No.	Variable	Coefficient	t-value
V	WheatVPC	-0.059	-2.070
	CottonVPC	0.028	1.047
	OtherAgVPC	-0.018	-0.499
	MetalVPC	0.027	0.777
	Eexp-1	-1.601	-1.054
	Esuf-1	2.483	1.041
VI	WheatVPC	-0.065	-2.533
	CottonVPC	0.025	0.976
	MetalVPC	0.034	1.061
	Eexp-1	-1.494	-0.997
	Esuf-1	2.808	1.228
VII	WheatVPC	-0.054	-1.944
	CottonVPC	0.035	1.424
	OtherAgVPC	-0.029	-0.874
	Eexp-1	-2.087	-1.511
	Esuf-1	2.717	1.151
VIII	WheatVPC	-0.063	-2.451
	CottonVPC	0.034	1.385
	Eexp-1	-2.118	-1.536
	Esuf-1	3.447	1.562
IX	WheatVPC	-0.063	-2.451
	CottonVPC	0.034	1.385
	Eexp-1	-2.118	-1.536
	Ebal-1	3.447	2.179

Notes and Definitions: See Notes to Table 5a.

The main results from Tables 5a and 5b are as follows. Model I flatly contradicts priors based on the first story discussed above, as the coefficients of agricultural cash crops and energy are significant or borderline significant *with a negative sign.* The public expenditure variable, on the other hand, is insignificant. Model II suggests that it may have been wrong to aggregate agricultural production values into one variable, as the negative sign of the aggregate variable is driven by wheat and other non-cotton crops, while cotton exhibits a positive sign (although it is not significant). EnergyVPC remains negative and Public Capital Expenditure (PCE) remains positive but insignificant in this model.

Expressing energy by the energy balance ("Ebal") rather than production values (Model III) reduces its significance and that of MetalVPC without changing any signs. Consider, however, the consequences of splitting energy balance into two terms (Model IV), which capture the degree of energy self sufficiency ("Esuf") and the degree to which the country is an energy exporter ("Eexp", defined as the difference between "Ebal" and "Esuf"). The coefficients now have opposite signs, with "Esuf" positive and "Eexp" negative, although none of them is significantly different from zero. Nevertheless, a basic lesson from these sets of regressions appears to be that equality of the subcomponents of "AgcashVPC" and "Ebal" should not be assumed, i.e. that the Agriculture and Energy variables should enter in disaggregated form.

Based on this finding, we begin our second set of regressions—i.e. using the full sample but omitting the public investment variable—with the most diaggregated specification (Model V). The coefficients of Model V differ from those in Model IV mainly for the cases of "OtherAgVPC" and "Esuf-1", the former greatly drops in size and significance while the latter greatly rises. We simplify the model by deleting the two variables which exhibit t-values below 1 in Model V; i.e. "OtherAGVPC" (Model VI) and "MetalVPC" (Model VII). None of these steps has important implications on the remaining coefficients or t-values. However, if "OtherAgVPC" is dropped in Model VII, the two energy variables become borderline significant at the ten percent level and significantly different from each other. Finally, note that if Model VII is reparametrized in a way that includes energy balance rather than energy exports in the regression (Model VII), "Esuf" becomes significant at the five percent level. This constitutes a rejection of the hypothesis that energy balance or production values is all that matters, i.e. the first of the two motivating stories.

In summary, while the regression results in Tables 5a and 5b are not strong in the sense that many coefficients are insignificant when the variables enter the model jointly, they do offer a number of interesting findings with implications for the remainder of this paper:

- The coefficients on cotton and wheat production are significantly different and have different signs. One interpretation is that cotton was more internationally marketable and/or less subject to barter arrangements than wheat and thus more likely to lead to actual foreign exchange earnings. Also, in many transition economies wheat production went along with subsidies to consumers, while cotton earnings were often used to subsidize industry.[15] Alternatively, the result might be spurious, and just reflect correlation between being a cotton or wheat producer and other relevant economic characteristics which, in spite of our best efforts to include a wide range of other relevant variables in the model, we have not managed to control for.

- energy self-sufficiency and energy exports seem to have opposite effects, with a positive coefficient on the former and a negative one on the latter. This contradicts the view that energy production matters mainly as a way of generating cash, but is

[15] I thank Peter Keller for suggesting this interpretation.

consistent with the idea that there may have been a special advantage to having one's own inputs in a period when traditional interrepublican trade patterns were disrupted and new trade patterns had yet to be formed. However, the negative coefficient on energy *exports* remains something of a puzzle, although not a puzzle without precedents.[16]

- the contribution of public capital expenditure is particularly weak. Not only is it far from being significant, but with one exception its t-values are consistently lower than those of all other variables, and in some models it enters with the "wrong" sign. Again, one could think of two interpretations. One is that this variable is truly unrelated to growth in transition, perhaps because the state tends to invest in the wrong industries or because public investment crowds out private investment. Alternatively, one could argue that the variable is so mismeasured (in the sense of cross-country inconsistencies) that any positive effect is biased toward zero. Thus, our results can*not* be interpreted as a rejection of the hypothesis that public investment has had a positive effect on growth (indeed, the actual coefficient of the variable *is* in fact slightly positive in most specifications). However, neither do our findings support the idea that public investment is a major factor in explaining cross-country differences in growth performance.

On the basis of these findings, we adopt the following strategy for the remaining sections.

We resolve the trade-off between sample size and the inclusion of a public investment variable in favor of the former, i.e. we ignore public investment in the rederivation of the model that is presented in the following section and utilize the full sample. Arguments in favor of this approach include (i) the likely mismeasurement of public investment when central government capital expenditure is used; (ii) the results of Table 5a, which suggest that including public investment would not be very informative either way (i.e. that it would neither contribute significantly to explaining the growth puzzle nor imply a rejection of any such positive contribution). The disadvantage, of course, is that we can no longer see directly whether public investment contributes significantly to growth in transition. However, we can still test its *contribution to resolving the Uzbek growth puzzle* indirectly, as follows. First, we check whether the "puzzle" of Section II remains even after rederiving the model in the presence of the remaining new variables. If Uzbekistan's output success is driven by omitted policy variables, such as public investment, the growth puzzle should persist, *unless* these policies are highly correlated with one of the new variables we are including. However, to the extent that the omitted variables take on unusual values for Uzbekistan (as is true for public investment and import substitution), this possibility can in turn be tested by rerunning the model on a sample that excludes the observations for Uzbekistan and see whether this affects its ability to exaplain the Uzbek case. This done in the last section of the paper.

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[16] The actual or potential counterproductiveness of resouce riches is an old stylized fact in economics. Two well-known cases are the Dutch disease and the negative impact of large natural resource endowments in long-term growth regressions, see Sachs and Warner (1995).

B. The Growth Puzzle Revisited

We now present the fitted growth path for Uzbekistan and the average of other transition economies based on two models which were derived using an analogous procedure as the model presented in Section II, i.e. beginning with a very wide set of variables which includes the agricultural, metal and energy variables of Table 5 at their most disaggregated level (i.e., CottonVPC, WheatVPC, OtherAgVPC, MetalVPC, Esuf-1 and Eexp-1) and then simplifying (eliminating or restricting) variables in the same basic order as BBSZ[17] The new variables were simplified last, as they are of special interest in this paper and we want to give them a maximum opportunity of playing a role in the final model. We show the results from two rather than just one final model because the simplification procedure we use does not uniquely pin down the outcome; there is some leeway, for example, as to how the initial conditions can be simplified in the presence of the new agriculture and energy variables. As it turns out, this has a bearing on the coefficient estimates of these variables in the final specifications. The two specifications presented show the sensitivity of the coefficients to alternative admissible models (Table 6).

Table 6. Coefficients on New Variables in Two Variants of Extended Model
(dependent variable: real ouput growth, in percent)

Model	Variables	Coefficient	t-value
A	CottonVPC	0.050	2.394
	Eexp-1	-2.878	-2.030
	Esuf-1	2.727	1.704
B	CottonVPC	0.063	3.133
	nonCottonAgVPC	-0.047	-3.246
	Eexp-1	-3.384	-2.448

Notes and Definitions: nonCottonAgVPC = AgcashVPC-CottonVPC, see notes to Table 5a. Note that unlike the models shown in Tables 5a and 5b, models A and B are *not* entirely identical with respect to the independent variables not shown in the table. For the full models, see appendix.

Table 6 indicates that the positive effect of cotton production and the negative effect of energy exports are robust to statistically admissible variations in model specification. At the other extreme, MetalVPC is always close to zero and insignificant and could be eliminated. Note this was not obvious from the exercise of Table 5. Finally, non-cotton agricultural production value (including wheat) and energy self-sufficiency have the expected negative

[17] We also used revised growth data (BBSZ's model which was used in Part I is based on April 1997 data). While this had some effect on the estimated coefficients, it does not affect any of the conclusions of this section.

and positive signs, but they are not robust. The latter is positive and significant (although only at the ten percent level) in Model A; in Model B it was basically zero and entirely insignificant and was eliminated in the last simplification step prior to the final version shown.

The next step is to see how well the two models explain the Uzbek output path. Tables 7A and 7B are the equivalent of Table 2 for models A and B, respectively.

Table 7a. Uzbekistan and Transition Economy Average:
Fitted and Actual Growth Paths (Model A)

	Transition Time						
	0	1	2	3	4	5	6
	Average of Transition Countries excluding Uzbekistan						
Actual Growth	-19.0	-11.4	-8.9	-1.5	1.4	2.6	3.2
Fitted Growth	-19.1	-11.2	-9.2	-0.7	1.1	3.2	2.5
Residual	0.2	-0.2	0.3	-0.7	0.3	-0.6	0.7
Average of Absolute Residual	2.1	2.6	3.9	2.7	4.1	2.3	1.7
	Average of BRO Countries excluding Uzbekistan						
Actual Growth	-22.3	-12.9	-13.4	-4.1	-1.0	...	...
Fitted Growth	-22.3	-12.7	-12.5	-3.2	-1.1	...	...
Residual	0.0	-0.2	-0.9	-0.9	0.2	...	...
Average of Absolute Residual	2.3	3.2	4.8	3.1	5.2	...	...
	Uzbekistan						
Actual Growth	-11.1	-2.3	-4.2	-0.9	1.6	2.2	...
Fitted Growth	-10.0	-2.2	-8.9	-0.2	-2.2	...	...
Residual	-1.1	-0.1	4.7	-0.7	3.8	...	...
Absolute Residual	1.1	0.1	4.7	0.7	3.8	...	...

Table 7b. Uzbekistan and Transition Economy Average:
Fitted and Actual Growth Paths (Model B)

	Transition Time						
	0	1	2	3	4	5	6
	Average of Transition Countries excluding Uzbekistan						
Actual Growth	-19.0	-11.4	-8.9	-1.5	1.4	2.6	3.2
Fitted Growth	-19.0	-11.3	-9.2	-0.9	1.0	3.5	2.5
Residual	0.0	-0.1	0.3	-0.6	0.4	-0.9	0.7
Average of Absolute Residual	2.1	2.4	3.4	2.5	4.2	2.6	1.5
	Average of BRO Countries excluding Uzbekistan						
Actual Growth	-22.3	-12.9	-13.4	-4.1	-1.0	...	...
Fitted Growth	-22.2	-13.2	-12.6	-3.9	-1.4	...	...
Residual	-0.1	0.3	-0.8	-0.2	0.4	...	...
Average of Absolute Residual	2.3	3.1	4.1	2.9	5.3	...	...
	Uzbekistan						
Actual Growth	-11.1	-2.3	-4.2	-0.9	1.6	2.2	...
Fitted Growth	-11.6	-0.6	-8.4	0.2	-1.5	...	...
Residual	0.5	-1.7	4.2	-1.1	3.1	...	...
Absolute Residual	0.5	1.7	4.2	1.1	3.1	...	...

As Tables 7A and 7B show, the ability of the two models to fit the Uzbek growth experience is almost the same, with very similar paths of residuals for Uzbekistan. As is apparent from these paths, both models still have some difficulty in explaining why Uzbek output delined so little in 1994 and why it began to recover in 1996.[18] However, the main result from the Tables is that, based on the criteria we used in Section II to decide whether a "growth puzzle" existed, *the Uzbek growth puzzle vanishes*. The two main facts in Table 7 that justify this claim are, first, that the residuals for Uzbekistan are no longer all on one side; i.e. some are positive and some are negative. Thus, Uzbek growth during transition is no longer systematically underpredicted. Second, the model now does at least as well—in fact,

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[18] Interestingly, the ability of models A and B to predict the Uzbek recovery in 1996 is slightly worse than that of the model in Part I (the latter predicted zero growth, the models above slightly negative growth). This is an artefact of the fact that, according to UN data, the ratio between energy production and consumption sharply increases for Uzbekistan in 1995, making Uzbekistan an energy exporter according to the definition used in this paper. However, the coefficient on "Eexp-1" is significantly negative, reducing fitted growth for 1996. The question what drives the modest turnaround in growth in 1996 can thus not be answered in the context of the regression model used in this paper, but is addressed in a companion paper (Taube and Zettelmeyer (1998)), by examining sectoral growth patterns.

slightly better—in fitting the Uzbek path as it does in fitting the path of the average transition economy or the average BRO economy. In Model A, the average of absolute residuals is now 2.09 for Uzbekistan as compared to an overall average of 2.77 for the average transition economy, based on Model B, the corresponding averages are 2.12 and 2.67, respectively.

This leads to the question what drives the marked improvement in the model's fit for Uzbekistan. The answer, which is apparent from Tables 8A and 8B, is unsurprising.

Table 8a. Uzbekistan and Transition Economy Average:
Contributions of Major Groups of Variables to Fitted Growth (Model A)
(in percent p.a.)

	Transition Time						
	0	1	2	3	4	5	6
	Average of Transition Countries excluding Uzbekistan						
Macroeconomic Policy	-1.8	1.1	2.1	2.0	2.2	2.2	0.7
Structural Reforms	10.8	10.5	11.8	14.9	14.8	15.7	17.7
Initial Conditions	-8.4	-2.4	-4.2	0.3	1.9	2.6	1.4
Constant	-19.0	-19.0	-19.0	-19.0	-19.0	-19.0	-19.0
War	-2.1	-2.8	-1.4	-0.8	-0.2	0.0	0.0
New Variables	1.4	1.4	1.5	1.8	1.5	1.8	1.7
Cotton	0.4	0.4	0.5	0.6	0.2	0.0	0.0
Energy	1.0	1.1	1.0	1.3	1.2	1.8	1.7
	Average of BRO Countries excluding Uzbekistan						
Macroeconomic Policy	-1.3	2.3	2.2	1.6	1.9	...	...
Structural Reforms	9.7	9.0	11.0	13.6	13.6	...	...
Initial Conditions	-9.5	-2.8	-7.1	-1.1	1.6	...	...
Constant	-19.0	-19.0	-19.0	-19.0	-19.0	...	...
War	-3.4	-3.4	-0.8	-0.2	-0.4	...	...
New Variables	1.2	1.2	1.3	1.9	1.2	...	...
Cotton	0.7	0.7	0.9	1.0	0.4	...	...
Energy	0.5	0.5	0.4	0.8	0.8	...	...
	Uzbekistan						
Macroeconomic Policy	-5.8	1.1	0.5	0.8	0.7	...	...
Structural Reforms	7.8	3.3	7.7	9.8	10.9	...	...
Initial Conditions	0.7	5.9	-5.6	-0.7	-0.9	...	...
Constant	-19.0	-19.0	-19.0	-19.0	-19.0	...	...
War	0.0	0.0	0.0	0.0	0.0	...	...
New Variables	6.4	6.5	7.6	8.9	6.2	...	...
Cotton	3.9	3.9	5.0	6.2	4.1	...	...
Energy	2.5	2.6	2.5	2.7	2.1	...	...

Table 8b. Uzbekistan and Transition Economy Average: Contributions of Major Groups of Variables to Fitted Growth (Model B) (in percent p.a.)

	Transition Time						
	0	1	2	3	4	5	6
	Average of Transition Countries excluding Uzbekistan						
Macroeconomic Policy	-2.2	0.9	2.1	1.9	2.1	2.0	0.6
Structural Reforms	8.6	8.7	8.1	11.7	12.3	13.7	14.7
Initial Conditions	-13.8	-8.4	-8.3	-4.3	-3.0	-1.4	-1.0
Constant	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8
War	-1.7	-2.3	-1.1	-0.7	-0.2	0.0	0.0
New Variables	-2.1	-2.5	-2.1	-1.8	-2.5	-3.1	-4.1
Cotton	0.5	0.5	0.6	0.7	0.3	0.0	0.0
Non-Cotton Agric. Commodities	-2.0	-2.4	-2.1	-2.1	-2.4	-3.1	-4.1
Energy	-0.6	-0.5	-0.6	-0.4	-0.4	-0.1	0.0
	Average of BRO Countries excluding Uzbekistan						
Macroeconomic Policy	-1.8	2.1	2.2	1.5	1.7	...	...
Structural Reforms	7.1	6.9	7.4	10.2	11.3	...	...
Initial Conditions	-15.5	-9.8	-12.3	-6.6	-4.2	...	...
Constant	-7.8	-7.8	-7.8	-7.8	-7.8	...	...
War	-2.7	-2.7	-0.7	-0.2	-0.3	...	...
New Variables	-1.6	-1.9	-1.5	-1.1	-2.1	...	...
Cotton	0.8	0.8	1.1	1.3	0.5	...	...
Non-Cotton Agric. Commodities	-1.5	-1.9	-1.5	-1.7	- 1.9	...	...
Energy	-0.9	-0.9	-1.0	-0.7	-0.7	...	...
	Uzbekistan						
Macroeconomic Policy	-6.8	0.8	0.7	0.8	0.6	...	...
Structural Reforms	5.0	2.4	2.3	4.5	6.5	...	...
Initial Conditions	-5.8	0.0	-8.9	-3.8	-3.8	...	...
Constant	-7.8	-7.8	-7.8	-7.8	-7.8	...	...
War	0.0	0.0	0.0	0.0	0.0	...	...
New Variables	3.9	4.1	5.3	6.4	3.1	...	...
Cotton	4.8	4.8	6.2	7.8	5.2	...	...
Non-Cotton Agric. Commodities	-0.9	-0.8	-0.9	-1.3	-1.3	...	...
Energy	0.0	0.0	0.0	0.0	-0.8	...	...

Like Table 3 in Part I, Tables 7A and 7B suggest that Uzbekistan's relatively favorable growth performance happened not because, but rather in spite of its macroeconomic and structural policies. On both counts—particularly in the area of structural reforms—Uzbekistan's policies were worse for growth than in the average BRO economy and much worse than in the average transition economy. According to Tables 8A and 8B, the real reason for Uzbekistan's growth record were favorable initial conditions and its cotton and energy production. As was to be expected from the regression coefficients shown in Table 6, the main difference between Model A and Model B is that Model B attributes the Uzbek advantage exclusively to cotton, while in Model A cotton shares some of the credit with energy. The total growth advantage imparted by the new variables is about the same in both models: between five and eight growth points relative to the average transition economy, depending on the year. Finally, note the strong favorable impact of the initial conditions group, particularly in the first few years. A disaggregation of this group (not shown) indicates that this is due mainly to the variables capturing overindustrialization and share of agriculture.

Puzzle resolved? Before closing the book on the Uzbek growth puzzle, we must follow up on one major methodological and interpretational caveat which was referred to at the end of the previous section. In a way, the dramatic improvement in the model's ability to capture the Uzbek growth experience seems too good to be true. The concern is that cotton production and energy self-sufficiency might not actually be as important in mitigating the transitional recession as they seem in the model, but merely *seem* important because they are effectively proxying something about the favorable Uzbek experience which we have failed to measure in models A and B—for example, its public investment and import substitution policies. This could be the case if the agriculture and energy variables that make the model successful in fitting the Uzbek output path take on values that are so unique to Uzbekistan that they act in much the same way as an Uzbekistan country dummy variable would, i.e. that they absorb whatever special feature of this country is not being measured by the other right hand side variables. The next section examines whether this could be the case.

C. Structural Stability

The most straightforward way to decide whether the coefficients estimates of Table 6 are picking up an unmeasured Uzbekistan-specific effect is to re-estimate the model after excluding Uzbekistan from the sample and see how this affects the outcome. The results from this exercise are presented in Table 9, which extends Table 6.

Table 9. Energy/Agriculture Coefficients With and Without Using Uzbek Data
(dependent variable: real ouput growth, in percent)

		Full Sample		Excluding Uzbek data	
Model	Variables	Coefficient	t-value	Coefficient	t-value
A	CottonVPC	0.050	2.394	0.025	0.790
	Eexp-1	-2.878	-2.030	-1.651	-0.887
	Esuf-1	2.727	1.704	2.186	1.266
B	CottonVPC	0.062	3.133	0.045	1.408
	nonCottonAgVPC	-0.047	-3.246	-0.046	-3.109
	Eexp-1	-3.384	-2.448	-2.592	-1.411

At first impression, Table 9 seems to confirm our concerns. With one exception, all the energy and agriculture coefficients in Table 9 loose their statistical significance when estimated without the Uzbek sample points. They also drop in value. Thus, it is correct to say that the strength of the effect of the energy and agriculture variables is driven by the Uzbek "outlier".

Note, however, that while the coefficients drop in value, they are, in economic terms, still quite close (between fifty and eighty percent of the values based on the full sample). Moreover, the fact that they are estimated too imprecisely to be significantly different from zero cuts both ways—it implies that the old values are well within the standard error of the new values. Thus, the coefficients and t-values shown Table 9 could well be consistent with the hypothesis that they are alternative estimates of the same underlying coefficient. If this is true, Uzbekistan would still be an outlier, but a welcome one—one that is unusually informative about the role of certain economic variables and thus helps us estimate the coefficients for these variables more precisely.

A formal structural break test (Chow test for predictive stability[19]) can help us decide whether the two sets of coefficients should be regarded as representing alternative estimates of the same economic structure or not. The finding is that we are nowhere near close to a rejection of the null of structural stability. The value of the F(5, 103) distribution for Model A is 0.53 while for Model B we have an F(5, 101) value of 0.39. The corresponding p-values are huge: 0.75 and 0.85, respectively. In other words: under the null hypothesis that the true economic structures are the same, we would be expecting coefficient estimates that are statistically as far or even further from each other as the ones in Table 9 in 75 percent of the cases for Model A and 85 percent of the cases for Model B.

[19] See, for example, Maddala (1992), p. 174.

On this basis, we should be inclined to take the results from Section B seriously, i.e. go with the coefficients on the new variables that have been estimated based on the whole sample. However, a lingering doubt remains, which is that the structural stability test might have failed to reject the null merely because of a lack of informative data in the sample that excludes Uzbekistan, and that estimation based on the whole sample thus gives misleading estimates of the true coeffients on commodities and energy for the reasons discussed previously. To see what this "worst case" would imply for our ability to explain the Uzbek growth puzzle, we close this section by looking at the fitted values that would arise if we use the coefficients from the regression on the sample *excluding* Uzbekistan. To economize on space, we limit ourselves to comparing the results for Uzbekistan with those for the average of the BRO economies excluding Uzbekistan (Table 10).

Table 10. Uzbekistan and BRO Economy Average:
Fitted and Actual Growth Paths Using Coefficients Estimated Excluding Uzbekistan

		Transition Time				
Model		0	1	2	3	4
A		Average of BRO Countries excluding Uzbekistan				
	Actual Growth	-22.3	-12.9	-13.4	-4.1	-1.0
	Fitted Growth	-22.2	-12.7	-12.7	-3.4	-1.0
	Residual	-0.2	-0.2	-0.7	-0.7	0.1
	Average of Absolute Residual	2.4	3.2	4.8	3.1	5.2
		Uzbekistan				
	Actual Growth	-11.1	-2.3	-4.2	-0.9	1.6
	Fitted Growth	-11.9	-4.3	-12.0	-3.7	-4.3
	Residual	0.8	2.0	7.8	2.8	5.9
	Absolute Residual	0.8	2.0	7.8	2.8	5.9
B		Average of BRO Countries excluding Uzbekistan				
	Actual Growth	-22.3	-12.9	-13.4	-4.1	-1.0
	Fitted Growth	-22.3	-13.1	-12.8	-4.1	-1.3
	Residual	-0.1	0.2	-0.6	0.0	0.3
	Average of Absolute Residual	2.3	3.1	4.1	2.9	5.2
		Uzbekistan				
	Actual Growth	-11.1	-2.3	-4.2	-0.9	1.6
	Fitted Growth	-13.0	-1.6	-10.4	-2.0	-2.6
	Residual	1.9	-0.7	6.2	1.1	4.2
	Absolute Residual	1.9	0.7	6.2	1.1	4.2

Does the growth puzzle re-emerge when using coefficients estimated on a subsample that excludes the Uzbek experience? It depends. Based on Model A, we are back to the finding that the model underpredicts Uzbek growth year after year. Based on Model B, this is true in four out of five years. However, these underpredictions are not very large when compared to the average absolute residuals in the remaining BRO transition economies. In Model A above, the average of absolute residuals for Uzbekistan (3.87) is only insignificantly higher than that for the average BRO economy (3.72). Model B actually still is quite a bit better at fitting the Uzbek growth path than that of the average BRO economy (average of residuals 2.84 as compared to 3.53), and even the average transition economy (average of residuals 3.72, not shown). The conclusion is that the capacity of the model to explain the Uzbek experience improves decisively after including agricultural commodity and energy variables in the model *even if* the coefficients are estimated in a way that entirely ignores the Uzbek experience.

IV. Conclusion

This paper has two main findings. The first is that the exceptional mildness of Uzbekistan's transitional recession can be largely accounted for by a combination of its low degree of initial industrialization, its cotton production, and its self-sufficiency in energy. The relative importance of these factors, in particular the latter two, remains uncertain as it varies accross admissible alternative models. Second, it is unlikely that the government's public investment program and import substitution strategy (except where it related to the energy sector) has played an important role in achieving Uzbekistan's favorable output performance. Specifically, (i) no significant effect of public capital expenditure on growth performance could be detected in a wide cross-section of transition economies; (ii) the hypothesis that Uzbek growth obeys the same structural determinants as the other transition economies could not be rejected for a cross-country model that incorporates the agriculture and energy variables mentioned (along with standard initial conditions and policy indices) but did *not* control for public investment and other Uzbek policy idiosyncracies such as import substitution. It follows that any positive effect of these idiosyncracies on growth cannot have been large. In addition, the absence of a structural break between the observations for Uzbekistan and the remainder of the sample implies to the results from the cross-country model regarding the contributions of macroeconomic and structural reform policies to growth should be taken seriously. They suggest that Uzbekistan's favorable performance did not occur because, but in spite of these policies. In other words, the variables which drive Uzbekistan's relatively good output performance—cotton, energy self-sufficiency, and low initial industrialization—more than offset macroeconomic and structural policies which, *by themselves*, would have had detrimental effects.

These are fairly clear-cut results. At first sight, they would seem to have an equally clear-cut policy implication, namely that Uzbekistan could have done even better over the time period studied if it had implemented more vigorous structural reforms and pursued less distortionary and inflationary macroeconomic policies. However, this conclusion does not follow all that easily. The problem is that the conceptual experiment that motivates it—changing one set of growth determinants in the model, while maintaining another, namely the effect of initial conditions, cotton and energy, unchanged—might have no real life counterpart in the case of Uzbekistan. Certain policies might not be easily unbundled from the variables to which we attribute Uzbekistan's relatively favorable performance. One plausible interpretation of the results is that Uzbekistan did relatively well in terms of aggregate output because it was unusually effective at preventing the collapse of the (relatively small) industrial sectors by combining rigid state control with subsidies that were in large part financed by cotton exports, and by ensuring an uninterrupted supply of energy. If this interpretation is right, taking away one part of this package—subsidies and state control, which in our model go along with low structural reform indicators—would have led to a bigger collapse, at least temporarily, as would taking away the other part, i.e. cotton exports and the government-led development of the energy sector.

The broad question posed at the beginning of this paper, namely whether Uzbekistan's relative success occured because or in spite of its policies, thus does not have a clear answer on the basis of this paper, and in fact it might not be a very meaningful question. The more interesting question could be whether there existed an alternative policy package in which Uzbekistan's relatively favorable endowments and production structure would have been put to a better use than what effectively occured in the course of its first four or five transition years. In our mind, the answer is clearly yes, although it is not an answer that can be narrowly based on the results of this paper. To begin with, economic success should not be defined purely in aggregate output terms. The quality of output—including issues such as consumers' choice and environmental sustainability—also matters, and they were a prime casualty of Uzbekistan's agricultural and industrial policies. But even if one focuses exclusively on the aggregate output effects of policies, Uzbekistan could surely have done better by creating an environment that was friendlier to private sector entry and private production and marketing incentives, including, in particular, in the cotton sector.

In conclusion, while our results stress the importance of favorable circumstances in explaining Uzbekistan's relative success, they do not rule out that this success had something to do with Uzbekistan's policies, too. But this does not imply that these policies were optimal given the circumstances and even less that they should be continued. As the economic and social turmoil that resulted from the break-up of the Soviet Union subsides, it becomes ever harder to argue in favor of the extensive state control of economic decisions that has characterized the Uzbek experience so far.

Table A1. Models A and B

Variable	Definition	Model A Coeff.	Model A t-value	Model B Coeff.	Model B t-value
Constant	regression constant	-18.99	-5.69	-7.78	-2.14
Fbal	fiscal balance, in percent of GDP	0.81	5.37	0.91	6.27
lFbal	l* Fbal	-1.52	-3.31	-1.66	-3.76
Fbal-1s	(first lag of Fbal)*s	-0.07	-0.52	-0.06	-0.44
lFbal-1s	l*(first lag of Fbal)*s	-0.52	-1.18	-0.64	-1.50
Fbal-2s	(second lag of Fbal)*s	0.42	2.93	0.39	2.69
lFbal-2s	l*(second lag of Fbal)*s	-1.01	-2.73	-0.86	-2.31
Infa	natural log of (1+average inflation)	3.20	2.55	3.43	2.70
lInfa	l*Infa	-5.79	-1.78	-6.03	-1.79
LII	internal liberalization index	19.38	5.46		
lLII-1s	l*(first lag of LII)*s			38.97	3.02
DLII-1s	D[(first lag of LII)*s]	-19.74	-1.90		
DlLII-1s	D[lLII-1s]	54.77	1.73		
LIE	external liberalization index			33.13	4.97
lLIE	l*LIE			-64.84	-3.57
LIP-1s	(first lag of private sector conditions index)*s			-30.64	-3.21
lLIP-1s	l*LIP-1s			48.16	2.54
DLIP-2s	D[(second lag of pr. sector conds. index)*s]	-30.11	-2.38	-44.60	-2.84
DlLIP-2s	D[l*(second lag of pr. sector conds. index)*s]	50.57	1.73	92.00	2.50
Warupd	dummy variable for war or internal conflict	-11.81	-6.97	-9.48	-5.58
lGrIni0	l*(average pre-transition growth)*d	-14.95	-3.32	-18.51	-4.16
dFbal-1	d*Fbal-1	1.68	3.42	1.22	2.63
dlFbal-1	d*lFbal-1	-11.51	-4.84	-9.29	-4.16
dInfa-1	d*(first lag of Infa)	-38.42	-3.69	-36.92	-4.00
dlInfa-1	d*l*(first lag of Infa)	125.66	2.94	115.50	3.05
RepInfD1	pre-transition repressed inflation*D1	0.84	3.14	1.04	3.80
lRepInfD1	l*RepInfD1	-2.65	-2.81	-3.53	-3.79
NatRRD3	(resource-rich country dummy)*D3	-8.81	-4.81	-8.18	-4.91
UrbanD1	(pre-transition degree of urbanization)*D1	-0.46	-4.12	-0.60	-4.64
lUrbanD1	l*UrbanD1	2.67	3.45	3.36	4.05
TraddeptD2	(pre-transition trade dependency)*t*D2	-0.10	-3.99	-0.17	-5.65
TraddepO2	(pre-transition trade dependency)*O2			-0.15	-2.99
lUrbantD1	l*UrbanD1*t	-0.94	-2.18	-1.32	-2.89
AgSh89tD2c	(1989 share of agriculture in GDP)*D2*(t-2)	-93.76	-4.58	-73.44	-3.75
lAgSh89tD2c	l*AgSh89tD2c	478.01	4.71	399.11	3.97
lOverInd	l*(initial over-industrialization index)	20.19	3.24		
lOvIndtD1c	lOverInd*D1*(t-1)	177.65	3.97	202.09	4.34
CottonVPC	value of cotton production, $/capita	0.05	2.39	0.06	3.13
nonCottonAgVPC	value of non-cotton agricultural cash crops, $/cap			-0.05	-3.25
Ebal-1	first lag energy balance index	-2.88	-2.03		
Esuf-1	first lag of energy self-sufficiency index	5.61	2.79		
Eexp-1	Ebal-1 - Esuf-1			-3.38	-2.45

Notes on Table A1:

1. The notation conventions used in variable definitions are as follows:

- All variables are implicitly indexed by transition time t and country i.
- t denotes the transition year (t = -2,-1, 0, 1, ... T_i, where T_i is the last transition year in the sample for country i).
- d denotes a dummy variable that takes the value 0 in transition years (t≥0) and 1 in pre-transition years (t<0); s≡1-d (for all countries).
- D[...] denotes the first difference operator.
- The prefix l denotes the estimated share of the private sector in GDP.
- Dj denotes a dummy variable that takes the value 1 for t smaller or equal i and and 0 else; Oj = 1-Dj (for all countries).

2. For a detailed explanation of the econometric methodology and motivation underlying the variable definitions, see BBSZ (1998). For a discussion of the structural reform indices and initial conditions (pre-transition variables) used in model A and B, their sources and construction, see BBSZ(1998), de Melo, Denizer and Gelb (1996) and de Melo, Denizer, Gelb and Tenev (1997).

3. For discussion and sources of the Energy variables in the table, see text (section III.A). The two agricultural variables in the table were constructed as follows. "CottonVPC" is the value of cotton production per capita using cotton lint production data from the FAO *Yearbook Production*, 1991-1996 volumes, and price data (Liverpool Index) from the IMF's *International Financial Statistics*. "NonCottonAgVPC" is the aggregate production value of the following crops: Wheat, Rice, Maize, Sorghum, Soybeans, Groundnuts and Tobacco, using data from the same sources.

4. The standard regression statistics for the two models are as follows:

- Model A: R^2= 0.87, DW = 1.66, RSS = 2231.7 for 34 variables and 143 observations
- Model B: R^2= 0.88, DW = 1.96, RSS = 2070.1 for 36 variables and 143 observations.

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