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The Uzbek Growth Puzzle

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After the breakup 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 surprised 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 constitutes a puzzle. It then attempts to resolve the puzzle by extending the model in a way that encompasses competing hypotheses of what makes Uzbekistan's output path unusual. The main result is that Uzbekistan's performance can be accounted for by a combination of low initial industrialization, its cotton production, and its self-sufficiency in energy. [JEL: O53, P24, P27, P52]

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 other countries of the former Soviet Union (hereafter BRO; see Table 1). Total cumulative output loss was only 59 percent of 1991 output by 1995 and 89 percent by 1997—as opposed to 126 and 207 percent, respectively, for the BRO average. Output estimates based on electricity consumption—sometimes regarded as preferable because they better capture informal sector output—indicate that

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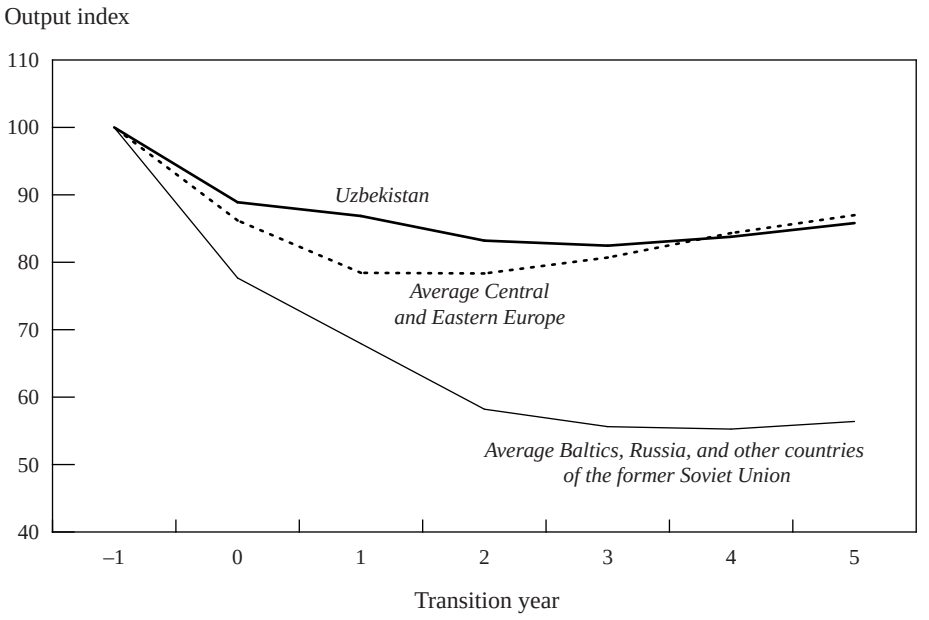
Table 1. Baltics, Russia, and Other Countries of the Former Soviet Union (BRO): Output Paths

	Official Data[1]								Electricity-Based Data[2]		
	Output Index (1991 = 100)						Cumulative Loss[3]		1991 = 100		Cumulative 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, Kaufmann, and Shleifer (1997); author's calculations.
[3]In percent of 1991 output (sum of differences between 1991 level and levels in 1992 through 1995 or 1997).

Figure 1. Output Paths in Transition Time (Pre–Transition Year = 100)[1]



[1]Transition time refers to years since the beginning of transition (defined as transition year 0). This is assumed to be 1992 for the Baltics, Russia, and the other countries of the former Soviet Union; 1990 for Poland, Hungary, and the former Yugoslavia; and 1991 for the remaining Central and Eastern European transition economies.

these differences may be exaggerated,[1] but they corroborate the finding that Uzbekistan's output decline was far milder than that in the other countries. Uzbekistan appeared to resume 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. Finally, it is worth noting that Uzbekistan's transitional recession was mild not only relative to the BRO average but also relative to the average of the Central and Eastern European transition economies (see Figure 1).

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—policies that have been widely credited with contributing toward milder transitional recessions and quicker and stronger recoveries.[2] In Uzbekistan, liberalization has proceeded hesitantly and with occasional reversals—in particular, with regard to

[1]This is driven by a larger downward bias to official output measurement in the other 14 countries due to faster informal sector growth; see Taube and Zettelmeyer (1998).

[2]Berg and others (1999); de Melo and others (1997); Havrylyshyn, Izvorski, and van Rooden (1998); Hernández-Catá (1997); Fischer, Sahay, and Vegh (1996a and b); Sachs (1996); Åslund, Boone, and Johnson (1996); Selowsky and Martin (1997); Wolf (1997); and World Bank (1996).

its external regime—and structural policies have concentrated on public investments that aimed at substituting energy and industrial imports, along with an extensive system of transfers to the largely state-controlled industrial sector.[3] At the same time, the output decline was arrested relatively quickly following limited stabilization, in spite of macroeconomic imbalances that re-emerged in late 1996 and 1997. Puzzling or not, what explains this 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.

The paper proceeds in two steps. First, it asks if there really is a puzzle. Obviously, structural reforms and macroeconomic policies may not be the only—or perhaps even the main—determinants of output in transition. Other variables, such as initial conditions, also matter. The question is whether Uzbekistan's performance is still puzzling once these variables are taken into account in the context of a standard cross-country regression model. Second, to the extent that standard explanatory variables *cannot* fully explain Uzbekistan's output path, what are alternative explanations? This is addressed by extending the basic regression model in a way that seeks to encompass competing hypotheses of what could have contributed to Uzbekistan's unusual output path.

The main result is that the Uzbek growth puzzle can be "resolved" in an accounting sense after controlling for its low degree of initial industrialization, production of agricultural commodities (including cotton), and the energy balance. Public investment, which has also been cited as a possible reason for Uzbekistan's relative success, seems to have little or no explanatory power. One interpretation of these results is simply that favorable initial conditions, rather than policies, should be credited with Uzbekistan's output performance. An alternative interpretation is that Uzbekistan's policy of subsidizing the official industrial sector was relatively successful in mitigating the output decline, given a low degree of industrialization to begin with, because it could be financed through export proceeds from agriculture and because of the availability of domestic energy. In this view, the *combination* of go-slow policies with favorable initial conditions achieved a result that eluded other former communist countries that tried similar approaches, but ran into financing constraints much earlier.

I. Is There A Puzzle?

This section of the paper is based on a panel regression model of the main determinants of output growth during transition estimated by Berg and others (1999) using data for 26 transition economies.[4] The model is flexible in that it has a very general dynamic structure, does not assume that policies and initial conditions necessarily have the same effects on the private and the state sectors, and considers a large number of potential determinants of growth, which are reduced using a general-to-specific methodology. These include *macroeconomic variables* (fiscal

[3]For details, see IMF (1998, 1997).

[4]Berg and others also discuss other variants of the model, which have similar implications as the version used here.

balance and inflation, instrumented using IMF program targets); *structural reform indices* (constructed by de Melo and others, 1996a, b, and updated using the reform indices of the EBRD *Transition Reports*); *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 some other *controls*, including a dummy for wars.

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 the Baltics, Russia, and other countries of the former Soviet Union, again excluding Uzbekistan, and (3) Uzbekistan. "Year zero" is defined as the year in which central planning ended (1992 in Uzbekistan and the BRO and 1990 or 1991 in the remaining transition economies in the sample; see note to Figure 1). In addition to showing the residuals in each group as the difference between fitted and actual growth, the table shows the average of the absolute residuals across countries in the transition and BRO groups, respectively. This permits a comparison of the absolute magnitude of the residual for Uzbekistan with that of a "typical" transition country.

The main results from the table are as follows. First, the model correctly predicts a higher growth for Uzbekistan in the first two years of transition relative to the average, that is, a smaller output decline. Consequently, we can get *some* insights into the relatively good Uzbek output performance during 1992–93 by looking into what drives the model's predictions (see below). Second, the model *systematically underpredicts* Uzbek growth. The underprediction is particularly impressive for 1994 (year 2 in transition time), when the model predicts a large collapse in output that did not materialize. As a result, the total regression residual for Uzbekistan (as measured by the cross sum of the five annual absolute residuals) is much larger than that for the typical transition country or BRO economy (28.7 versus 18.5 and 17.0, respectively). A Chow test for predictive stability confirms that this difference is much larger than what could reasonably be attributed to chance.[5]

Based on the model by Berg and others, it thus certainly seems justified to speak of an "Uzbek growth puzzle." To resolve this puzzle, one must look beyond this model. Before doing this, however, we seek to understand the variables that drive the existing 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 (Table 3).

Table 3 decomposes the fitted values for Uzbekistan and the group of remaining 14 countries into the contribution of the main groups of explanatory variables.[6] 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 both fronts,

[5]The null hypothesis of no structural break is rejected at the 5 percent level (p-value: 2.7 percent).

[6]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. See Zettelmeyer (1998) for a more detailed decomposition.

Table 2. Uzbekistan and Transition Economy Average: Fitted and Actual Growth Paths Based on the Model by Berg and Others

(in percent per year)

	Transition Time					
	0	1	2	3	4	5
Average of transition countries excluding Uzbekistan						
Actual growth	–21.3	–12.5	–9.8	–1.5	1.6	2.6
Fitted growth	–20.9	–12.7	–9.1	–1.6	1.7	3.4
Residual	–0.4	0.2	–0.7	0.1	0.0	–0.8
Average of absolute residual	3.3	3.1	4.2	3.1	3.3	2.4
Average of the Baltics, Russia, and other countries of the former Soviet Union Union, 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	. . .
Fitted growth	–15.6	–6.4	–18.9	–4.7	0.0	. . .
Residual	4.5	4.1	14.7	3.8	1.6	. . .
Absolute residual	4.5	4.1	14.7	3.8	1.6	. . .

Uzbekistan performed worse than the average of transition economies, according to Table 3. This is not surprising, since the Berg and others cross-country model associates fast reforms with faster output recovery, based on the experience of most other transition economies. Instead, Table 3 attributes the relatively good performance of Uzbekistan in the first two years of transition to unusually favorable initial conditions, which more than offset the unfavorable impact of slow structural reforms and macroeconomic imbalances in that period. An unbundling of these initial conditions shows that this is mainly driven by one variable, "overindustrialization," which captures the degree of industrialization at the beginning of transition relative to the industrialization typical for a market economy in the same range of GDP per capita.[7] According to the dataset of de Melo and others (1997), from which the data documenting initial conditions were taken, Uzbekistan's industry share was actually *smaller* than what would have been expected based on its GDP per capita. Thus, according to the standard model, Uzbekistan did better than the average transition

[7]More precisely, "overindustrialization" is defined as the difference between the actual share of industry in the country in 1989 and the share that would have been predicted on the basis of the country's per capital income. The latter is obtained as the fitted value from a regression of industrial share on per capita income in a large sample of *market* economies. For more details, see de Melo and others (1997) and references cited therein.

Table 3. Uzbekistan and Transition Economy Average: Decomposition of Fitted Growth (Berg and others Model)

(in percent per year)

	Transition Time				
	0	1	2	3	4
Average of Baltics, Russia, and other countries of the former Soviet Union, excluding Uzbekistan					
Fitted growth	–24.7	–14.6	–12.3	–4.1	0.1
Macroeconomic policy	–2.6	1.0	–0.7	0.3	0.6
Structural reforms	3.7	4.0	5.6	9.4	10.5
War	–3.0	–3.0	–0.7	–0.2	–0.2
Constant	–8.9	–8.9	–8.9	–8.9	–8.9
Initial conditions	–13.9	–7.8	–7.6	–4.8	–2.0
Trade dependency	–8.2	–5.5	–2.9	–0.2	2.5
Overindustrialization	–8.5	–5.6	0.0	0.0	0.0
Urbanization + agriculture	4.1	–1.9	–3.7	–3.7	–3.7
Other[1]	–1.3	5.3	–1.1	–0.9	–0.8
Uzbekistan					
Fitted growth	–15.6	–6.4	–18.9	–4.7	0.0
Macroeconomic policy	–4.3	0.0	–3.5	0.0	2.2
Structural reforms	0.6	–0.5	–0.6	7.3	7.3
War	0.0	0.0	0.0	0.0	0.0
Constant	–8.9	–8.9	–8.9	–8.9	–8.9
Initial conditions	–3.0	2.9	–5.9	–3.3	–0.6
Trade dependency	–8.0	–5.6	–3.2	–0.8	1.5
Overindustrialization	3.4	2.1	0.0	0.0	0.0
Urbanization + agriculture	5.5	–0.6	–1.3	–1.3	–1.3
Other[1]	–3.9	7.0	–1.3	–1.1	–0.8

[1]Initial macroeconomic imbalances (estimated repressed inflation in the five years prior to transition; deficits and inflation in the last year prior to transition), pre-transition structural reforms, and a dummy for the resource-rich countries (Azerbaijan, Russia, Kazakhstan, and Turkmenistan).

economy in the first two years mainly because it was less industrialized in the first place, and as such had a smaller share of output that was vulnerable to collapse after the end of central planning.

However, Uzbekistan's lack of industrialization would only have retarded, but not eliminated, the output collapse according to the model by Berg and others. Since the destructive effect of "overindustrialization" is concentrated in the first two years, the comparative advantage afforded by Uzbekistan's initial economic structure should mostly have been lost after that period.[8] Aside from low

[8]This is what explains the peculiar time path of the "initial conditions" line of Table 3 for Uzbekistan, which contrasts with the nicely upward-sloping path for the BRO average. In year zero, Uzbekistan's "underindustrialized" initial state mitigates but does not quite offset the negative impact of the remaining initial conditions, whereas in year one the latter is slightly more than offset. In year two, the offsetting effect disappears.

initial industrialization, the remaining initial conditions measured by Berg and others do not show Uzbekistan in a substantially better position than the other countries. In light of the downward trend to output (reflected in the regression constant), which the model by Berg and others attributes to the transition phenomenon over and above what is attributable to individual variables, and Uzbekistan's failure to offset this trend by more vigorous market-oriented reform policies, the model would have predicted the output decline to set in with a vengeance in year three. But this did not happen.

II. Explaining the Uzbek Growth Puzzle: Econometric Findings

To shed some light on the remaining "growth puzzle," this section extends the model of the previous section to encompass several "explanations" of the growth puzzle that have been suggested in the past. In particular, it includes variables reflecting the dollar value of cash crops and natural resources (including energy and non-ferrous metals), as well as the energy balance; and capital expenditure of the general government, as a measure of public investment.[9]

The extension of the basic model to include public investment variables is motivated primarily by the Uzbek government's view that its strategy of diversifying economic output away from agriculture and raw materials and toward the industrial sector, with a view toward substituting imports, has been a crucial factor in explaining Uzbekistan's relative success.[10] In addition to attracting some foreign direct investment (FDI), much of this import substitution and industrialization strategy took the form of government-directed and financed capital investment. Indeed, capital expenditures of the general government have been relatively high, 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).

Two stories motivate the extension of the model by agricultural commodities and natural resource variables beyond the proxies already used by Berg and others.[11] First, production of these goods, which could either be sold for hard currency or may have reduced the need for hard currency imports, could have allowed Uzbekistan to relax the tight external financing constraint, and corresponding import constraint, that was typical for other economies in the region. As a result, Uzbekistan may have been in a better 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 (see IMF, 1997, paragraph three). The second story is closely related, but focuses more on the self-

[9]This variable was used in spite of problems with cross-country consistency (its exact definition depends on national fiscal authorities, and may vary from country to country) because gross fixed capital formation in the public sector, which is taken from the national accounts, is not available for Uzbekistan and several other transition countries in our sample. See Zettelmeyer (1998) for the exact definition and sources of the new data used in this section.

[10]See the official publication, "Islom Karimov Steers Uzbekistan on its Own Way" (1997).

[11]Namely, the share of agriculture in GDP prior to transition and a dummy for large raw material producers: Russia, Kazakhstan, Azerbaijan, and Turkmenistan. Thus, the natural resource dummy used by Berg and others lumps Uzbekistan with the resource poor countries.

sufficiency and not so much on the foreign exchange implications of domestic energy production. This view stresses 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.[12] 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, may have played a special role that would gradually fade as markets developed and trade was redirected to countries outside the former East bloc.

The remainder of the paper proceeds in two steps. First, the new variables are given a maximum chance of "resolving" the Uzbek growth puzzle by not only adding them to the model by Berg and others used before, but by redoing the general-to-specific model selection methodology in the presence of these variables.[13] We see which, if any, of the new variables survive the selection process, and whether or not the "growth puzzle" re-emerges in the context of the revamped model. Second, we test the hypothesis that the improvement in the model's ability to fit the Uzbek experience is due to the fact that the new variables are merely proxying an "Uzbekistan effect," which we still have failed to properly identify. This is achieved by checking the robustness of the earlier results.

The Growth Puzzle Revisited

The following compares fitted growth paths for Uzbekistan and the average of other BRO economies based on models derived through an analogous procedure as the model used so far, that is, beginning with a very wide set of variables—which now include the commodity, energy, and investment variables discussed above—and then simplifying (eliminating or restricting variables) in the same basic order as Berg and others.[14] To deal with the problem that energy production is probably endogenous to same-year industrial activity, and thus to output, first lags are used, either directly or as instruments. 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. The set of surviving variables was somewhat sensitive to variations in the order of elimination, and in particular, there are two alternative final models with different statistically significant sets of the new variables. The coefficients for these two sets are shown in Table 4 (see Appendix for the full models).

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

[13]The presence of the new series may have a bearing on which other variables (in particular, within the set of initial conditions) enter the final model and how they enter it. Repeating the model selection process rather than simply tacking on the new variables thus allows a more precise estimation of the new coefficients and improves the fit of the model.

[14]For a complete list and definition of the variables introduced, including those that did not survive the elimination process, see Zettelmeyer (1998). Note that the output growth data was also revised model by Berg and others that 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.

Table 4. Energy and Agriculture Coefficients in Two Variants of Extended Model

(dependent variable: real output growth, in percent)

Model	Variables	Coefficient	t-value
A	Cotton production value ($ per capita)	0.050	2.394
	Energy self-sufficiency index (lag)[1]	2.727	1.704
	Energy exports index (lag)[1]	–2.878	–2.030
B	Cotton production value ($ per capita)	0.062	3.133
	Value of non-cotton agricultural commodities ($ per capita)	–0.047	–3.246
	Energy exports index (lag)[2]	–3.384	–2.448

Note: A and B also differ with respect to some variables not shown in the table. For the full models, see Appendix, Table A1.

[1]Defined as the ratio of energy production over energy consumption (both in energy units) if this ratio is smaller than one and as one if the ratio is bigger than one. First lags were used to avoid endogeneity (see footnote 8)

[2]Defined as the difference between the ratio of energy production over energy consumption and the energy self-sufficiency index. First lags were used.

Table 4 shows a positive effect of cotton production and a negative effect of non-cotton agricultural production (mainly wheat), although only the former is robust across the two variations of the model. One interpretation could be 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] Energy self-sufficiency has the expected positive sign in model A, but was insignificant and eliminated in model B. In contrast, the model finds a negative effect of energy *exports* in both variations. The last two findings contradict the view that energy production matters mainly as a way of generating cash, but are 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. This said, the negative coefficient on energy exports remains something of a puzzle, though perhaps a puzzle with precedents.[16]

Public capital expenditure did not survive as a determinant of growth in either version.[17] This could be because this variable is truly unrelated to growth in transition, perhaps because the state tends to direct investment to the wrong

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

[16]Two well-known examples for the actual or potential counterproductiveness of resource riches are the Dutch disease and the negative impact of large natural resource endowments in long-term growth regressions. On the latter, see Sachs and Warner (1995).

[17]Because public investment data was not available for the whole sample, the capacity of this variable to explain growth was explored in the context of a general-to-specific exercise performed on a subsample. After finding that public investment was not significant (even when ordered at the end of the elimination process) the exercise was repeated on the whole sample without controlling for public investment. Models A and B are based on this second exercise.

Table 5. Uzbekistan and Transition Economy Average: Fitted and Actual Growth Paths

(in percent per year)

	Transition Time				
	0	1	2	3	4
Model A					
Average of Baltics, Russia, and other countries of the Former Soviet Union (BRO), 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
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
Model B					
BRO Average, 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
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

industries.[18] Alternatively, it is possible that the variable is so mismeasured (in the sense of cross-country inconsistencies; see footnote 9) that any positive effect is biased toward zero and undetectable.

The next step is to see how well the two models explain the Uzbek output path. Table 5 is the equivalent of Table 2 for models A and B.

As Table 5 shows, the ability of the two models to fit the Uzbek growth experience is almost the same, with very similar paths of residuals for Uzbekistan. Both models still have some difficulty in explaining why Uzbek output declined so little in 1994 (transition year 2) and why it began to recover in 1996 (transition year 4).[19]

[18]The conventional interpretation that public investment crowds out private investment through a macroeconomic (interest rate) effect is less plausible here, as both models A and B control for the fiscal balance.

[19]Note that the ability of models A and B to predict the Uzbek recovery in 1996 is slightly worse than that of the model by Berg and others (the latter predicted zero growth; the models above slightly negative growth). As a matter of model mechanics, this is just an artifact of the fact that 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. From Table 4, it is clear that the latter has a negative impact on fitted growth for 1996. The question what drives the modest turnaround in growth in 1996 can thus not be answered based on the regression model used in this paper, and is addressed in a companion paper (Taube and Zettelmeyer, 1998), by examining sectoral growth patterns.

However, the main result from the table is that, based on the criteria used in Section I to decide whether a "growth puzzle" existed, *the Uzbek growth puzzle vanishes*. First, the residuals for Uzbekistan are no longer all on one side; that is, some are positive and some are negative. Thus, Uzbek growth during transition is no longer systematically underpredicted. Second, as is apparent from comparing the lines showing absolute residuals, the model now actually does *somewhat better* in fitting the Uzbek path than it does in fitting the path of the average BRO economy. Given that the model was extended by including variables suspected to contribute particularly to explaining the Uzbek experience, this is perhaps not surprising. Note, however, that the ability of the model to explain growth in the BRO economies other than Uzbekistan is still at least as good as in the model used by Berg and others.

As one would expect, the much milder output decline in Uzbekistan relative to the average BRO country is now attributable to both the initial conditions group (maintaining the same definition as in Table 3) and the new set of energy and agriculture variables (Table 6). As in Table 3, Uzbekistan's macroeconomic and structural policies would *ceteris paribus* have lead to a lower output path relative to the average for the Baltics, Russia, and other countries of the former Soviet Union. This is more than offset, however, by the effect of cotton production and (in model A) energy self-sufficiency, as well as by more favorable initial conditions (as before, mainly low industrialization). The relative advantage imparted by the initial conditions is again concentrated in the first two years, but the positive impact attributed to the new variables is much more sustained.

Robustness

Before concluding, a methodological caveat needs to be addressed. Suppose that the Uzbek puzzle was in fact attributable to some yet unidentified variable that happened to be correlated with the "new variables" identified in the previous section, merely because they take on unusual values for Uzbekistan. Then, this could generate the results of the previous section. To take an extreme example, suppose that Uzbekistan were the sole transition economy producing cotton. Then, the inclusion of cotton production in the regression model would amount to including an Uzbekistan dummy, which we know would be highly significant and resolve the "puzzle"—even if the mildness of Uzbekistan's output decline had entirely different causes. Fortunately, this possibility can be tested by re-estimating the model after excluding Uzbekistan from the sample and seeing how this affects the outcome (Table 7).

Table 7 sends a mixed message. With one exception, all the energy and agriculture coefficients in Table 7 lose 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 estimated effect of the energy and agriculture variables is driven by the Uzbek "outlier." But while the coefficients drop in value, they are, in economic terms, still quite close (between 50 and 80 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

Table 6. Uzbekistan and Transition Economy Average: Contributions of Major Groups of Variables to Fitted Growth

(in percent per year)

	Transition Time				
	0	1	2	3	4
Model A					
Average of Baltics, Russia, and other countries of the former Soviet Union (BRO), excluding Uzbekistan					
Fitted growth	–22.3	–12.7	–12.5	–3.2	–1.1
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 + constant	–28.5	–21.7	–26.1	–20.1	–17.4
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					
Fitted growth	–10.0	–2.2	–8.9	–0.2	–2.2
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 + constant	–18.3	–13.1	–24.6	–19.7	–19.9
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
Model B					
BRO average, excluding Uzbekistan					
Fitted growth	–22.2	–13.2	–12.6	–3.9	–1.4
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 + constant	–23.3	–17.6	–20.1	–14.3	–12.0
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 agri. commodities	–1.5	–1.9	–1.5	–1.7	–1.9
Energy	–0.9	–0.9	–1.0	–0.7	–0.7
Uzbekistan					
Fitted growth	–11.5	–0.5	–8.4	0.2	–1.4
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 + constant	–13.6	–7.8	–16.6	–11.5	–11.5
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 agri. commodities	–0.9	–0.8	–0.9	–1.3	–1.3
Energy	0.0	0.0	0.0	0.0	–0.8

Table 7. Energy/Agriculture Coefficients With and Without Using Uzbek Data

(dependent variable: real output growth, in percent)

		Full Sample		Excluding Uzbek data	
Model	Variables	Coefficient	t-value	Coefficient	t-value
A	Cotton production value ($ per capita)	0.050	2.394	0.025	0.79
	Energy exports index (lag)	–2.878	–2.03	–1.651	–0.887
	Energy self-sufficiency index (lag)	2.727	1.704	2.186	1.266
B	Cotton production value ($ per capita)	0.062	3.133	0.045	1.408
	Value of non-cotton agricultural commodities	–0.047	–3.246	–0.046	–3.109
	Energy exports index (lag)	–3.384	–2.448	–2.592	–1.411

shown in Table 7 could well be consistent with the hypothesis that they are alternative estimates of the same underlying coefficient. This is confirmed by a Chow test for predictive stability, which is nowhere near a rejection of the null of structural stability (p-values of 75 and 85 percent for Models A and B, respectively).

On this basis, one should be inclined to take the previous results seriously, that is, go with the coefficients that were estimated on the whole sample. However, the possibility remains 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 estimation based on the whole sample could thus give misleading estimates of the true coefficients 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, consider the fitted values that would arise if the coefficients from the regression on the sample *excluding* Uzbekistan are used (Table 8).

Does the growth puzzle re-emerge when using coefficients estimated on a subsample that excludes the Uzbek experience? It depends. Based on Model A, the finding that the model underpredicts Uzbek growth year after year still holds; based on Model B, this finding is true in four out of five years. However, the sum of absolute residuals for Uzbekistan is only insignificantly higher than that for the average BRO economy in Model A (19.3 versus 18.6), while Model B still does better at fitting the Uzbek growth path than that of the average BRO economy (14.2 versus 17.6). Thus, 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 on a sample that entirely ignores the Uzbek experience.

III. 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 near self-

Table 8. Uzbekistan and Transition Economy Average: Fitted and Actual Growth Paths Using Coefficients Estimated Excluding Uzbekistan

(in percent per year)

	Transition Time				
	0	1	2	3	4
Model A					
Average of Baltics, Russia, and other countries of the former Soviet Union (BRO), 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
Model B.					
Average of Baltics, Russia, and other countries of the former Soviet Union (BRO), 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

sufficiency in energy. The relative importance of these factors, in particular the latter two, remains uncertain. 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, no statistically significant effect of public capital expenditure on growth performance could be detected in a wide cross-section of transition economies; and 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 controlled for the agriculture and energy variables mentioned above (along with standard initial conditions and policy indices), but *not* for public investment and other Uzbek policy idiosyncracies such as import substitution.

Several caveats remain. First, the negative results regarding the role of public investment and the failure to reject structural stability in the extended model could be

attributable to lack of power due to noisy data. Second, even accepting that the findings regarding public investment are correct, there remains an ambiguity in how to interpret the relative roles of policies and initial conditions in explaining the mildness of Uzbekistan's transitional recession. One interpretation is simply that Uzbekistan did relatively well because favorable initial conditions—broadly defined to include energy and cotton production—more than offset the effects of bad macroeconomic and structural reform policies. This interpretation would stress the finding that Uzbekistan's macroeconomic and reform policies are shown to contribute less to growth, *ceteris paribus*, than in other transition economies, as well as the failure to detect a structural break between the observations for Uzbekistan and the remainder of the sample, which suggests that the assumption of homogeneous policy effects across countries is justified. However, it is possible that the estimated effect of the energy and agriculture variables does not just reflect the availability of natural resources as such, but the impact of sectoral policies that tended to go along with these variables (controlling for macroeconomic stabilization and liberalization). Moreover, it remains true that the effect of energy and agriculture is weaker if Uzbekistan is excluded from the sample. On this basis, an alternative interpretation of the results is that Uzbekistan did relatively well in terms of aggregate output because it managed to mitigate 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 developing the energy sector for domestic uses. While some other countries tried similar policies, particularly at the beginning of transition, these may have been less viable because they violated financing constraints at an earlier stage.

As a result, there is no easy answer to the question of whether Uzbekistan could have done better by pursuing more vigorous liberalization and reform policies from the beginning. In the model used in this paper, faster reform would have led to higher growth through the measured macroeconomic and structural policy variables, reflecting mainly the positive impact of reforms on the newly developing private sector. However, if the interpretation is right that the contribution of the energy and agricultural variables reflect a *combination* of natural resources and the way in which they were exploited, then taking away part of this package—state control and cross-subsidization, which in the model go along with low structural reform indicators—might have led to a bigger output collapse, at least temporarily.

In conclusion, while the results stress the importance of favorable initial conditions in explaining Uzbekistan's relative success, they allow for the possibility that this success was also related to Uzbekistan's sectoral policies, particularly during the early transition years. This need not imply that these policies were optimal given the circumstances,[20] and even less that they should be continued. As the economic and social turmoil that resulted from the breakup 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.

[20]Given the disincentives to production implicit in Uzbekistan's policy approach (including in the agriculture sector), it is hard to imagine that Uzbekistan's approach was optimal even from the narrow perspective of the aggregate output effects of policies, that is, ignoring environmental and broader welfare issues. However, this is not a conclusion that can be narrowly based on the findings of this paper.

APPENDIX

Table A1. Models A and B

		Model A		Model B	
Variable	Definition	Coefficient	t-value	Coefficient	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:

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 ($t = -2,-1, 0, 1, \ldots T_i$,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 ($t \geq 0$) and 1 in pre-transition years ($t < 0$); $s \equiv 1-d$ (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 0 else; $Oj = 1 - Dj$ (for all countries).

For a detailed explanation of the econometric methodology and motivation underlying the variable definitions, see Berg and others (1999). 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 Berg and others (1999); de Melo, Denizer, and Gelb (1996); and de Melo, Denizer, Gelb, and Tenev (1997).

For discussion and sources of the energy variables in the table, see text and Zettelmeyer (1998). The 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.

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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