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EXTENDING THE ECONOMICS OF DISORGANIZATION

Alan A Bevan
London Business School
Saul Estrin
London Business School
Paul G Hare
Heriot-Watt University
Jon Stern
London Business School

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CIS-Middle Europe Centre
London Business School

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Many of the states of the former Soviet Union have experienced a dramatic collapse of output during transition, which has not yet been reversed in a sustainable way. The economics of disorganization, proposed by Blanchard [1995] and tested empirically by Blanchard and Kremer [1997], reasons that this phenomenon can be explained by specificity of inputs and the breakdown of traditional domestic supply linkages. We replicate the Blanchard-Kremer study for Ukraine and Kazakhstan, and also find that longer and more complex domestic supply chains are associated with greater reductions in output. When we extend their analysis to incorporate measures of the complexity of CIS and non-CIS trade however, we find that complexity of non-CIS trade is the significant factor in explaining the output collapse. We therefore argue that the disintegration of COMECON and the requirement of hard currency trade, are equally, if not more, significant in explaining the output declines experienced by Ukraine and Kazakhstan.

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Contact details:

(Bevan)
London Business School
Sussex Place
Regent’s Park
London NW1 4SA
United Kingdom
Telephone: +44 (0)171 262 5050
Facsimile: +44 (0)171 724 8060
E-mail: abevan@lbs.ac.uk

(Estrin)
London Business School
Sussex Place
Regent’s Park
London NW1 4SA
United Kingdom
Telephone: +44 (0)171 262 5050
Facsimile: +44 (0)171 724 8060
E-mail: sestrin@lbs.ac.uk

(Hare)
School of Management
Heriot-Watt University
Riccarton
Edinburgh EH14 4AS
United Kingdom
Telephone: +44 (0)131 451 3483
Facsimile: +44 (0)171 451 3498
E-mail: p.g.hare@hw.ac.uk

(Stern)
London Business School
Sussex Place
Regent’s Park
London NW1 4SA
United Kingdom
Telephone: +44 (0)171 262 5050
Facsimile: +44 (0)171 724 8060
E-mail: jstern@lbs.ac.uk
I. INTRODUCTION

One of the most striking features of the transition process has been the dramatic drop in output experienced by the transition economies. In 1998 real GDP in Central and Eastern Europe and the Baltic States was 99 percent of its 1989 level, compared with a remarkable 55 percent of its 1989 level in the CIS (see EBRD [1998]). Moreover, while output has been on an erratic but upward path in Central Europe since 1994, the decline has not yet been reversed in a sustainable way in most of the former Soviet Union. Explanations for this phenomenon abound and one of the most innovative is contained in Blanchard’s 1995 Clarendon lectures (Blanchard [1997]) and tested empirically in Blanchard and Kremer, henceforth BK, [1997]. BK argue that a complex set of highly specific supply relationships existed between firms under central planning; specificity being sustainable as a result of state enforced delivery and production of goods. Hence, as the powers of the state and the central planner waned from the late 1980s, specificity enabled enterprises to exercise bargaining power over the enterprises from which they sourced, and/or to which they sold, inputs.

After 1992, enterprises were forced to bargain directly with other enterprises, with little or no expectation that the links would be long-term. BK argue that “the emergence of new private opportunities can lead to a collapse of production in the state sector, and to a sharp reduction in total output”. This could occur by virtue of incomplete contracts, asymmetric information (where supplier enterprises have information on alternative sales opportunities, but purchasing enterprises do not) and/or co-ordination failures, resulting from either payments problems or from key managers or workers leaving the firm. This hypothesis is testable. It suggests that the output drop will be larger in industries where supply chains are
longer and more complex. BK test this theory by relating the decline in output 1992-1994 to an index of complexity plus some control variables, using a dataset of 308 industries in nine CIS countries. Their regression results show large, highly significant and robust coefficients on complexity for the declines in industrial output. A one-standard deviation increase in complexity is found to be associated with a c.3-5% larger fall in the output of the industry relative to the average.

However, their measure of complexity ignores the disruption likely to be caused by the disintegration of the socialist trading bloc (COMECON) and, perhaps even more seriously, the collapse of internal trade within the Rouble area which accompanied the unpredicted and poorly managed disintegration of the Soviet Union into its constituent parts during 1991. The declines in output in some Soviet republics were much larger than in Russia itself, and, given that most republics were more open than Russia, this seems likely to be associated with the specificity of inputs from other Soviet republics, and from COMECON countries. In this paper, we seek to isolate the independent effects of complexity in inputs, both from the former Soviet Union and more generally (particularly COMECON inputs in most cases), to establish a link between the scale of the output drop in different republics and the exposure to intra-FSU and intra-COMECON trade.

We test this hypothesis for two important CIS countries, Kazakhstan and Ukraine. We replicate the results of the original BK study for both countries. When the complexity measure is decomposed to take account of both CIS and non-CIS trade, it is the latter which is found to be the significant factor explaining the decline in output in both countries. The findings therefore support the relevance of both the complexity explanation, and of international trade, in determining the output drop by sector in two FSU economies.
In the following section, we outline the model before summarising the data employed and reporting the results. We conclude in the fifth section.

II. COMPLEXITY MEASURES

We start with the basic equation:

\[ T = A + M^c + M^n \]

where \( T \) is an \( n \times n \) matrix of total input coefficients (each column therefore showing the total inputs of each produced good needed to produce the output of the sector corresponding to that column); \( A \) is the corresponding matrix of domestic input coefficients; \( M^c \) gives import coefficients associated with CIS imports; \( M^n \) the import coefficients associated with non-CIS imports. The corresponding column totals of the matrices in (1) are represented by the row vectors, \( r_T, r_A, r_C \) and \( r_N \), in obvious notation. Hence, \( r_T = r_A + r_C + r_N \). From equation (1), several complexity measures can be defined. We considered the following measures, each defined and normalised to ensure that it must lie in the range [0, 1].

(1) Domestic coefficients

Define \( \tilde{A} = A \{ \hat{A}^A \}^{-1} \) where the “hat” notation denotes forming a diagonal matrix from the corresponding vector. Then the relevant complexity measure for sector \( j \) takes the form:

\[ C_j = 1 - \sum \{ \tilde{A}_y \}^2 \]

This is, in essence, the original BK indicator. It is only a first round measure, as the complexity associated with a given sector depends only on the vector of input coefficients with that sector.
(2) **CIS imports**

Similarly, define \( \tilde{M}^c = M^c \{ \tilde{r}^c \}^{-1} \). Then a second complexity measure can be written:

\[
C_j^2 = 1 - \sum \{ \tilde{M}_{ij}^c \}^2
\]

(3) **Non-CIS imports**

Likewise, define \( \tilde{M}^n = M^n \{ \tilde{r}^n \}^{-1} \). Then the third complexity measure can be written:

\[
C_j^3 = 1 - \sum \{ \tilde{M}_{ij}^n \}^2
\]

These are the three complexity measures which we apply in our empirical work.

### III. THE DATA

For Kazakhstan and Ukraine, the following data were available: (a) 1990 input-output table; (b) table of import flows; (c) trade table showing import composition into each sector by CIS and non-CIS markets; and (d) output data for various years.

**(a) 1990 input-output tables**

For both countries, 125-sector input-output tables were available, tabulating data on intersectoral flows for 1990 in 1990 producer prices. We focus upon the 100 or so sectors that comprise production, as broadly defined by the UN to include extraction, industry, agriculture and construction. These are the sectors that we expect to be most affected by the theory of disorganization. Additionally, we expect traded inputs, both from CIS and non-CIS partners, to be most relevant to these sectors.
(b) Tables of import flows

Corresponding to the input-output tables, we also have import matrices for each country for the same year (1990) and for approximately the same sectoral classification, in current (i.e. 1990) rouble prices.

(c) Trade tables

The third table for each country shows, for 1990, the structure of imports and exports by detailed sector and trade direction, the trade flows being measured both in US dollars and Roubles. This table, on the imports side, distinguished between imports directly into final demand and imports of intermediate products, and within the latter category, between imports from CIS partner countries and imports from the rest of the world. Hence data from this table could be used to convert the matrices of import flows referred to in (b) into separate matrices referring to intermediate imports from the CIS and from the rest of the world. Thus, from these matrices, we could compute the complexity measures referred to in equations (2)-(4). 4

(d) Output data

We measure output as gross output in the sector concerned, since that seems to us to correspond most closely to our discussion of the economics of disorganization, and the associated complexity measures. We utilise annual data on the output of many individual commodities, expressed in physical units. 5
IV. REGRESSION RESULTS AND THEIR INTERPRETATION

As in BK, our regressions include two additional variables, reflecting the degree of capital intensity for each sector and a measure of relative price changes. Our capital intensity measure was defined as a dummy variable, taking the value zero for sectors with “low” capital intensity, unity for sectors with “high” capital intensity. We expect, for instance, that in a sector with low (high) capital intensity, most inputs will tend to be technically simple (sophisticated) or standardised, (highly specialised) and hence relatively easy (difficult) to substitute either domestically or through changes in trade. Consequently we expect the coefficient to be negative. Our relative price change variable is the set of world-to-domestic price ratios assembled by Senik-Leygonie and Hughes [1992] in their study of industrial competitiveness across the FSU. Sectors with relatively high world-to-domestic price ratios ought to have become more profitable under liberalisation and hence more able to finance their input requirements; thus it would be expected that they could maintain output more effectively than those with low ratios. We would therefore expect the coefficient on the proposed relative price variable to be negative.

We estimate two models on our data sets. Model 1 replicates the analysis of BK by regressing the output change over the period 1991-95 (variable dq_9195) on the BK complexity measure (bk1), a country dummy (country), the durability measure (dur), and the world-to-domestic price ratio (wdratio). The country dummy (Kazakhstan = 0, Ukraine = 1) was included since we combine the data for Ukraine and Kazakhstan in the same regressions. Regressions were performed with adjustments for heteroskedasticity of the error term using the Huber correction and are reported in Table 1 for Kazakhstan and Ukraine.
Table I: Regression Models with Complexity Indicators (standard errors in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>bk1</td>
<td>-26.6974*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(14.0539)</td>
<td></td>
</tr>
<tr>
<td>cisind</td>
<td>2.0772</td>
<td>2.0772</td>
</tr>
<tr>
<td></td>
<td>(9.0837)</td>
<td>(9.0837)</td>
</tr>
<tr>
<td>nonind</td>
<td>-46.8838***</td>
<td>-46.8838***</td>
</tr>
<tr>
<td></td>
<td>(7.7768)</td>
<td>(7.7768)</td>
</tr>
<tr>
<td>country</td>
<td>11.2919*</td>
<td>14.0251**</td>
</tr>
<tr>
<td></td>
<td>(5.9202)</td>
<td>(5.3810)</td>
</tr>
<tr>
<td>dur</td>
<td>20.9028*</td>
<td>24.0352***</td>
</tr>
<tr>
<td></td>
<td>(10.5909)</td>
<td>(8.5915)</td>
</tr>
<tr>
<td>wdratio</td>
<td>-8.4988</td>
<td>-7.5760</td>
</tr>
<tr>
<td></td>
<td>(9.1098)</td>
<td>(6.6660)</td>
</tr>
<tr>
<td>constant</td>
<td>-47.1239***</td>
<td>-40.5330***</td>
</tr>
<tr>
<td></td>
<td>(15.6603)</td>
<td>(9.2538)</td>
</tr>
<tr>
<td>R-bar²</td>
<td>0.1989</td>
<td>0.3770</td>
</tr>
<tr>
<td>N</td>
<td>57</td>
<td>57</td>
</tr>
</tbody>
</table>

All reported standard errors are Huber corrected
* , ** and *** represent significance at the 10, 5 and 1 percent levels respectively

The results of model 1 largely replicate the findings of the Blanchard-Kremer study. The coefficient on the complexity measure is significant and of the predicted sign. The country dummy is also significant and positive, reflecting the significantly larger decline in output in our Ukrainian sectors than those of Kazakhstan. The control variables are less satisfactory however: the coefficient on the world-to-domestic price ratio is insignificant, and the coefficient on the durability variable is significant but positive. A possible explanation of the latter result is that capital intensive sectors might use less intermediate input relative to gross output than less capital-intensive sectors. With capital effectively substituting for intermediate inputs in this way, a high measured complexity does not seem
to imply such vulnerability to supply disruptions as in a less capital-intensive sector.

Model 2 replaces the BK complexity measure with our measures of complexity in CIS trade \((cisind)\) and non-CIS trade \((nonind)\). This specification leads to a large increase in the overall explanatory power of the regression. The country dummy and durability variables retain the same sign as in model 1, but are of increased significance, while the world-to-domestic price ratio remains insignificant. CIS trade complexity is found to be insignificant in explaining changes in output over our sample period, although this may in part be due to a degree of collinearity between the trade-related complexity measures. Nonetheless, the size and significance of the coefficient associated with the non-CIS trade complexity measure is striking\(^7\), and bears out our hypothesis that the importance of import complexity exceeded that of domestic complexity in explaining the output drop in some of the Former Soviet Union.

\[\text{V. CONCLUSIONS}\]

We have sought to explain the decline in sectoral industrial output in two of the large former Soviet Union republics, Kazakhstan and Ukraine. Our results confirm the research on the complexity explanation hypothesis carried out by Blanchard and Kremer. They also highlight the critical role of trade in explaining the output drop. The results indicate that the great depth of the recession in the former Soviet Union, and its extended length, may be related to the disintegration of the COMECON and Rouble trading areas associated with the fragmentation of the Soviet Union, and the failure to put in place alternative credit and payment systems for international trade.
However, interestingly, the findings suggest that it is trade with non-CIS countries, primarily within COMECON, that may have been the main supply constraint in Ukraine and Kazakhstan, more than trading links with Russia or other CIS countries. One possible explanation is that COMECON countries supply particularly crucial components, for example parts for machinery and equipment. Also the emergence of barter as a payment system throughout most of the FSU may have acted to alleviate disruption of trade between the former Soviet republics, but this was not possible because hard currency was required to finance continued trade links with the former members of COMECON in central Europe.

LONDON BUSINESS SCHOOL
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HERIOT-WATT UNIVERSITY
LONDON BUSINESS SCHOOL AND NERA
REFERENCES


NOTES

1 Blanchard and Kremer (1997), page 1094.

2 Computed $t$-values are around 11-12.

3 The BK measure for sector $j$ is defined as 1 minus the Herfindal index of input concentration, so that:

$$C_j = 1 - \sum_i a_{ij}^2$$

4 In practice, the programming of these calculations was rather messy as the third matrix for each country was not set out according to exactly the same sectoral classification as the other two, with some rows being in a different order, some breaking down input-output rows into two or more components (hence requiring re-aggregation), others combining input-output rows (hence requiring aggregation of the input-output table to achieve consistency across all the data).

5 Unfortunately this raw data was not directly matched to particular input-output sectors so we constructed our own dataset for each country by assigning products to sectors. Gaps and inconsistencies limited the number of sectors in each country for which we could match the output data with the input-output data, hence reducing the number of sectors in the estimations reported below.

6 The assignment of sectors to these categories was based on knowledge of the corresponding sectors in Western economies.

7 In addition, the robustness of these results was illustrated by the failure to reject the joint insignificance of interactive country dummies in supplementary regressions.