Supply Responses in the Economies of the Former Soviet Union

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December 2000. Revised October 1999
Discussion Paper No. 2000/09

Abstract

Output decline has been a feature of the transition economies in the initial post-communist period, including in those countries that belonged to the former Soviet Union. However, explanations for the decline and its persistence have not been easy to find, and mostly they have focussed upon domestic factors in each economy. The theory of disorganization introduced the idea that disrupted supply chains following the demise of central planning might have a role in the explanation of output decline. This paper extends that idea to distinguish between supply from domestic sources, and supply from abroad. Using data for Ukraine and Kazakhstan, the paper finds - contrary to expectation - that the disruption of supplies from hard currency markets was more significant in explaining output decline in these countries than disruption of supplies from CIS partners. This suggests that institutional weaknesses in the areas of international banking, trade insurance, and the like, have been very important factors.

Keywords: trade, transition economies, CIS, disorganization, output decline.
JEL classification: F14, P27.

Acknowledgements

The authors are grateful to the Foreign and Commonwealth Office for the financial support which helped support the research reported in this paper. The views expressed herein are the authors’ personal views and do not represent any official position of the Foreign and Commonwealth Office.
1. Introduction

"The main change affecting consumer goods in Kazakhstan since the breakup of the USSR is that we can no longer get reliable supplies of cheap, good quality, long-lasting Russian goods like cotton shirts and trousers and we have to buy poor quality, shoddily-made Chinese and Turkish artificial fibre ones."


According to the 1998 EBRD Transition Report, real GDP in 1998 in the CIS as a whole was 55 per cent of its 1989 level. For Ukraine, it was 37 per cent of its 1989 level and, for Kazakhstan, it was 63 per cent. Apart from Latvia and Lithuania, among non-CIS transition economies only Bulgaria and FYR Macedonia have had a fall in real output of over 30 per cent. Indeed, in the two years between 1994 and 1996, real GDP fell by 22 per cent in the CIS, by 32 per cent in Ukraine and by 19 per cent in Kazakhstan.¹

The very large and sustained reductions in output in CIS countries are clearly due to a large number of factors. Similarly, there is as yet little or no sign of any sustained or major upturn of the kind experienced in the Central European and Baltic economies. It is, however, very difficult to argue that the either the initial reductions in output or the lack of output recovery in the CIS economies are entirely due to inadequate demand. That then raises the following questions:

1) Why has output continued to fall for so long in the CIS economies and how much of this is due to supply-side factors rather than demand factors?
2) What are the main impediments to supply-side recovery by industries and firms in CIS countries over the next few years?

One of the most potentially important supply-side factors seems to us to be the interruption of input chains for the production of industrial and, in particular, of manufactured goods as discussed in Blanchard and Kremer (1998). They denote this as the economics of disorganization, which is an extremely apt description of supply and trading relationships in the CIS in the mid-1990s. Our concern in this paper, however, is with the impact on supply chains arising from the creation of multiple new countries with separate currencies following the dissolution of the USSR at the end of 1992.²

¹ See EBRD Transition Report 1998 Table 3.1 and similar for previous years. De Melo, Denizer and Gelb in Blejer and Skreb (1997) produce very similar figures, although Mundell, in the same volume, reports rather larger estimates of the declines in GDP for all the transition economies, e.g. 26 per cent for the Slovak Republic, 33 per cent for Bulgaria and Romania, 51 per cent for Kazakhstan and 54 per cent for Ukraine.
² Strictly, the USSR was formally dissolved, as a political entity, on Christmas Day 1991, but the successor states remained in a unified rouble zone for some time thereafter, and for most CIS countries it was only in late 1992 or even in 1993 that separate currencies started to be established.
The dissolution of the rouble trading system and the collapse of the FSU planning apparatus has been accompanied by the absence of an effective market and contractual basis for production and trading across the region. This suggests to us that the impact on CIS countries from the fracturing of pre-1992 trading and planning structures is likely to be a highly significant factor in explaining the degree and the pattern of output reductions across industry in CIS economies – particularly for Russia's neighbours. Reinforcing this is the associated disruption in the region's hard (i.e., convertible) currency trade. The relevant institutions supporting such trade – the foreign trade bank, specialised foreign trading companies, and the like – were mostly based in Moscow. Thus when the Soviet Union split up the successor states were left with virtually no institutional framework through which to conduct convertible currency trade. In many cases there was also the practical problem of a lack of convertible currency reserves at Republic level.

The quotation at the head of this paper may at first glance look very strange. The claim that Russian consumer goods and clothing are of particularly high quality is not one that is frequently made, at least outside the CIS. However, the quotation provides a good indication of the potential problems outlined above.

Imagine a Kazakh clothing company that used to be supplied under the Plan with material from Uzbekistan and zip fasteners from Russia which were inputs into the manufacture of trousers and other forms of clothing. After 1992, how are the managers of this clothing company supposed to renew and sustain their trading relationships with the company's input suppliers? In what currency should they trade? How should they handle issues of trade credit? Most significantly, if the suppliers of zips are unwilling or unable to continue supplies, how should the managers of the clothing firm find a new supplier? How, if they found a new supplier, should they arrange contract terms, credit arrangements, etc.? These problems would be difficult enough. But they would be an order of magnitude more severe if the inputs in question were sourced from countries trading in convertible currencies or if the former CIS trading partners shifted to convertible currency trading.

For a firm in a typical West European or OECD economy, however, these problems are ordinary, routine, run-of-the-mill problems. There are many ways in which an equivalent clothing firm could find a new supplier of zip fasteners and agree prices, contract terms, etc. But, the problems are only routine because the firms operate in market economies where there is a whole array of legal and economic institutions that underpin competitive trading and supply relationships. In developed market economies, a new supplier can readily be found via telephone and trade directories, market contacts, and now by the Internet. There is a vast set of standard contracts and a developed, stable commercial law structure including effective

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3 The quotation is from a conversation with one of the authors of this paper in Astana in July 1998.
law courts to enforce contracts or, in the case of economic failure, to provide effective workout between creditors and debtors. Finally, there are safe, efficient and well-functioning banks and financial markets to provide the necessary credit and settlement arrangements. This allows a company readily to find new input suppliers from either domestic suppliers or from imports.

Even in Central Europe and the Baltic states, the geographic proximity to West European countries and the re-establishment of traditional trading links with neighbouring states would provide the equivalent Polish or Estonian clothing company with quite good opportunities to find and contract with an alternative supplier of zips. This, of course, assumes sufficient currency convertibility and exchange rate stability to support such trade – an assumption which is quite reasonable for these countries. Nevertheless, the large declines in output observed in Latvia and Lithuania seem, at least in part, to reflect trade-related dislocations with CIS countries (e.g., the Latvian pharmaceuticals firm which depended on semi-finished inputs from a CIS partner and whose output collapsed in 1993 when the flow of these inputs dried up).

Whatever the problems of the managers of our hypothetical Polish or Estonian clothing manufacturer faced with finding new suppliers of zip fasteners, they would seem to pale into insignificance relative to a Ukrainian or Kazakh equivalent. For the latter were faced with:

- the sudden disappearance of the old planning regime and its associated supply arrangements;
- the collapse of the Rouble zone and all previous institutional intra-USSR trading relationships and structures (and the practical significance of this point was seriously underestimated by all concerned at the start of transition);
- engaging in convertible currency trade in circumstances where neither local banks nor other elements of the institutional infrastructure had much relevant experience;
- operating in a new country, which (with the exception of Russia) has never been an independent operating state or polity;
- trying to establish market relationships with no commercial law framework, commercial courts, bankruptcy law, etc.;
- trying to function in monetary frameworks with weak, non-convertible currencies and very high (and variable) inflation rates and exchange rates;
- facing industrial structures which had for decades encouraged very limited numbers of suppliers across the USSR as a whole and which had discouraged competition and new entry;
- trying to operate in highly embryonic market frameworks with little or no experience of management other than via the Plan (or at least, around the edges of the Plan).

In these circumstances, it would hardly be surprising that our hypothetical Ukrainian or Kazakh clothing firm would be forced to contract output very sharply or even to close when
faced with an interruption to supplies of a key input. While disruption of these key input supplies would be a serious matter whether the inputs formerly came from another CIS country or from Western sources, in the latter case it might prove difficult to find alternative suppliers until the supporting infrastructure was in place, with such mechanisms as trade credit, efficient and reliable means of making hard currency payments, and an adequate framework of commercial law were in place. Conversely, with CIS partners, initial disruption might be ameliorated by resort to barter and other informal, non-monetary trading mechanisms, and inherited trust from the Soviet period might permit many transactions to continue even in the absence of properly developed institutional supports. With both types of trading relationship, though, the initial disruption to input supplies must have been severe.

The issues outlined above form the subject matter of this paper. In Section 2, we discuss the economic issues involved. We cover, firstly, the economic issues arising from the breakup of the CMEA trading structure, the disintegration of inter-republican trade within the FSU, and the associated disruption of convertible currency trade; and secondly, the theory of the economics of disorganization and its application to this problem where the focus is on the disruption of trading links rather than domestic input suppliers. In Section 3, we discuss how we approach our empirical analysis, including the handling and matching of the necessary input-output data and the disaggregated data for industrial output. In Section 4, we report the results of our regressions for Kazakhstan and Ukraine. Section 5 provides some short concluding comments and suggestions for further research.

2. CIS Trade Since 1992 and the Economics of Disorganization

2.1. Inter-CIS Trade and the Role of Supply Factors

The breakup of the CMEA as it affected the countries of Central and Eastern Europe was the subject of a number of papers in the early 1990s, including frequently cited papers by Rodrik (1992 and 1993), Rosati (1993), Hamilton and Winters (1992). The consensus of that literature was that: (a) the CEE countries would (and did) face moderately serious short-term reductions in trade and output – particularly Bulgaria; but that (b) these reductions would be (and were) more than offset by the growth in trade with EU countries.

The subsequently confirmed expectation was that the growth in exports to the EU would be a major source of growth. Thus, Rollo and Stern (1992) projected annual real export growth of 8–10 per cent for CEE countries on their Optimistic scenario. The 1998 EBRD Transition Report shows annual export growth for 1994–97 in excess of 10 per cent for all the CEE and
Baltic countries except Slovenia and Bulgaria (around 7 per cent), with export growth rates above 20 per cent for Estonia and Hungary.4

The degree of optimism towards the CIS states has been consistently lower, particularly for CIS states other than Russia. This was reflected in the comments by Hughes (1992) in his discussion of Hamilton and Winters. Senik-Leygonie and Hughes (1992) subsequently estimated the potential impact of trade disruption on CIS countries. Their analysis covered:

(i) *trade imbalances within the USSR*. Only Russia and Ukraine had trade surpluses ($21 billion and $2 billion respectively) in their trade with the rest of the Union, and all the other Republics had deficits ($6 billion for Kazakhstan). Hence, balance of payments problems were likely to constrain output in many Republics, at least in the short-run, since imbalances (notably deficits) at Republic level could no longer be offset against those of other Repubublics within the USSR as a whole;

(ii) *terms of trade effects*. Most Republics (but not Ukraine or Kazakhstan) were projected as losing out in total trade and in inter-Union trade (much the larger component), not least because of the impact of changing oil and gas prices relative to all other prices (energy had been priced well below world market levels); and

(iii) *trade disruption effects*. The impact on gross output from a 50 per cent fall in inter-Republic trade was estimated on the assumption that all imports were complementary to domestic production. The results of the simulation suggested large effects – a 25 per cent fall in gross output for Russia, 30 per cent for Ukraine, 31 per cent for Kazakhstan and up to 40 per cent for Kyrgyzstan.5

Of these effects, it is the last that comes closest to the concerns of this paper. In particular, the non-substitution assumption reflects the specificities involved in CIS trade and production. However, as Senik-Leygonie and Hughes recognise, the assumption is far more credible for industrial sectors than for natural resource or agricultural sectors. Hence, our analysis concentrates on the impact of supply disruption on the distribution of declines in the output of industrial sectors.

The Senik-Leygonie and Hughes paper postulates hypothetical reductions in trade between the successor states of the USSR (i.e., CIS plus the Baltics). Michalopoulos and Tarr (1994) estimate that, between 1990 and 1993, inter-Republic trade fell by 67 per cent from $189bn in 1990 to $62bn in 1993. For Ukraine the fall was 72 per cent but Kazakhstan, with a 45 per cent reduction, had the smallest proportional fall in inter-Republic trade.

In addition, FSU trade with the rest of the world fell by 48 per cent in US dollar terms over the same period – by 55 per cent for Ukraine and 16 per cent for Kazakhstan. However,

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Senik-Leygonie and Hughes did not estimate the likely impact of such a decline in convertible currency trade on domestic production in each country. Nevertheless, given their assumptions about complementarity between domestic and imported inputs, the orders of magnitude involved cannot be greatly different from their intra-Republic estimates reported above.

Mundell (1997) uses the Michalopoulos and Tarr estimates to compute the loss in the volume of output from trade effects. This is divided into:

(i) terms of trade effects; and
(ii) multiplier effects – from both demand and supply.

For Russia, the terms of trade effects are positive. For Ukraine and Kazakhstan, they are both negative but the multiplier effects are much larger – 5 times larger for Ukraine and 10 times for Kazakhstan.

These multiplier effects include both demand-side effects from the feedback effect of the fall in exports and supply-side effects from forced reductions in imports and resulting bottlenecks. However, Mundell's data set did not allow him to disentangle the supply from the demand impacts. He does, though, demonstrate how the output contraction varied. More industrialised and more open economies had larger output reductions. The former is clearly suggestive of supply-induced problems. Again, however, the focus was on the impact of intra-Republic effects, not on the impact of convertible currency trade disruption.

These studies do, though, provide some indication of potential supply dislocations from the collapse of inter-FSU trade. However, both are based on data from the early 1990s. Most of the 1990s inter-FSU trade contraction took place during the period 1990–93, with the volume of inter-Republic exports falling by 56 per cent and of imports by 48 per cent (Michalopoulos and Tarr, 1997). There was, however, a further substantial fall in 1993–94. The volume of inter-FSU exports fell by another 34 per cent and imports by 37 per cent. There then followed a slight recovery in 1994–95.

Ukraine experienced a continuous decline in inter-FSU exports and imports so that, by 1995, their volumes were (respectively) 27 per cent and 25 per cent of the 1991 level. For Kazakhstan, the main shock was in 1993–94. During that year, the volume of Kazakh inter-FSU exports halved, while for imports the volume fell by 57 per cent. Some recovery in 1994–95 meant that the volumes of inter-FSU exports and imports in 1995 were, respectively, 45 per cent and 32 per cent of their 1991 levels (Michalopoulos and Tarr, 1997).

Data from the IMF Direction of Trade Statistics 1998 shows no major change in inter-FSU trade volumes 1995–97. The most noteworthy developments were a 15 per cent increase in exports from Russia and a 31 per cent increase in Ukrainian inter-FSU imports. The latter implied an increase in the Ukraine deficit on inter-FSU trade from $3.8bn in 1995 to almost
Michalopoulos and Tarr identify various factors behind the inter-FSU trade contraction and stagnation. The key factors that they discuss are:

(i) problems in payments and payment arrangements for trade between the FSU states;
(ii) large shifts in the terms of trade;
(iii) export restraints – including export taxes, export quotas with high tax equivalents and exchange rate convertibility conditions that penalised exports;
(iv) the continuation of state trading companies and monopsony purchasers of exportables; and
(v) an erratic framework of regional trade preferences plus continuing and variable discriminatory trade measures.

Michalopoulos and Tarr place particular emphasis on (iii). Their 1997 paper suggests some decline in anti-export policy biases in the period 1993–95, but also some emergence of protection against competing imports.

What is most interesting from the above is the following two points. First, although CEE countries suffered the large adverse shifts in their terms of trade, they (particularly the Visegrad countries) did not face the payments arrangements problems nor did they adopt the anti-trade micro-economic policies of the FSU states – indeed they mostly adopted strongly pro-trade policies. Hence, the problems for firms in the CEE countries in adjusting to demand and supply shocks were much less. Second, nothing could be more guaranteed to exacerbate the problems from specificities in imported inputs than a policy of variable and discriminatory anti-export measures. It is difficult to envisage a more difficult environment for FSU firms to operate in than a policy of managed trade with an anti-export bias. This particularly applies to firms in economies with high pre-1993 trade shares in GDP, distant from European markets. In hard currency markets, this trading environment would be especially damaging as most Western partners would not tolerate trade without the protection of adequate and reliable payment arrangements and a proper framework of commercial law affording effective protection both to property and to commercial contracts.

The discussion above shows how vulnerable firms in FSU states could be to interruptions in the supply of key imports and how much more difficult it was for them to resolve supply problems than for Central European firms. The problems would clearly be most acute for imported inputs with a high level of specificity, e.g. because of only one or two potential suppliers. Moreover, due to serious institutional weaknesses, the negative impact of trade disruption on domestic production would be especially hard to accommodate or circumvent in the case of key inputs purchased from countries trading in convertible currencies.
This specificity is at the heart of the economics of disorganization and is the area that we pursue in the rest of this paper. The theory behind the economics of disorganization is discussed below, but we introduce our discussion with a particularly telling example of how trade issues and problems over specific imports interacted to induce major supply contractions.

2.2. Trade and Economic Disorganization: An Example – Hay Balers in Kyrgyzstan

The saga of the Soviet hay baler company, based in Kyrgyzstan provides a classic example of how the interaction between trade constraints and the economics of disorganization operated in practice to lead to major contractions in output and employment.6

By 1990, the Bishkek Agricultural Plant’s factory was the only producer of hay baling machinery in the whole of the USSR and Comecon. Its capacity was some 30,000 units per annum – mostly balers for compacted square bales, but with a line for machines for round bales. The markets for the balers were primarily in the western USSR. The factory had been established in Czarist times near Lugansk to make agricultural machinery. The oldest part of the factory was the foundry which seemed to date from the late 19th century. The factory had been moved at Stalin’s order to Bishkek (Frunze), ahead of the German invasion of the Ukraine in about 1942. The plant became a major employer in Bishkek (around 15,000). Not merely did it supply jobs, its process heat boilers provided much of the surrounding district where its workers lived with heat and hot water; and in addition, the plant provided the area with schooling, health services and pensions.

By 1990, the factory was a dreadful museum piece. There was little or no light, uneven floors, no safety equipment and liquid iron flowing into casting bays. In addition, annealing furnaces had gaping holes as there was no finance to pay for repairs. Temperatures were regulated by changing the volume of gas burned since burning more gas was much “cheaper” than repairing or replacing the capital equipment. By 1992, sales of finished balers had collapsed by 50 per cent. Despite this, production was being maintained by manufacturing all units to the stage of virtual completion. Balers were being assembled except that they could not build into the balers the hydraulic rams needed to compress the bales of hay. The hydraulic rams arrived from only two suppliers – one in Tomsk (Russian Federation), the other in Tallin (Estonia).

Estonia’s move to independence and a dollar-linked economy meant that supplies of hydraulic rams from this source had to be paid promptly and in dollars. Those from Tomsk were to be bought in roubles with little insistence on speedy payment. But, with no dollars, purchases of

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6 We are grateful to Dr Brian O’Connor for this example and for the narrative of the field-work on which we draw heavily in this section.
rams from Tallin collapsed and Tallin had previously supplied 50 per cent of all the parts needed. Tomsk was unable to increase its production of rams. Hence overall completions and sales of balers fell by 50 per cent. The factory site therefore became littered with semi-completed balers implying a massive stock of work-in-progress – supported by an increasing amount of very risky credit – so that storage space was nearly exhausted.

In spite of desperate attempts to diversify (e.g. into household cookers, washing machines, clothes dryers and hair dryers), the factory closed its doors in 1994. Dr O'Connor, seeing it during this period, was struck by similarities with the descriptions in the Neville Shute novel, *On the Beach*, when the remaining population of the world in Australia hangs on grimly to life as the nuclear cloud comes nearer. The plant was probably doomed once the USSR and its planning system disintegrated. Its location relative to its markets, and the level of transport costs it suddenly had to face, would probably have been enough to force closure, even without the low levels of productivity. Nevertheless, it seems clear that the inability to finance continued purchases of Estonian baler-rams precipitated early closure and gave little opportunity to reallocate any useable assets and experience into new or modified activities.

It is far from obvious that the Bishkek Agricultural Plant could not have found outlets for economically viable sales of machinery, e.g. to neighbouring Central Asian countries. It is not even obvious that the exports of the hydraulic rams by the Estonian company were uneconomic in the short-run, had suitable trade credit arrangements been feasible. However, the inability to continue imports of a relatively small but crucial input from Estonia – or to find alternative sources of supply – meant that early closure became inevitable.

In the language of the economics of disorganization, the *specificity* of the hydraulic rams in the production of hay balers and the failure to find a new and stable contractual basis for the rams imported from Estonia seem clearly to have accelerated the rundown of the company. The economics of disorganization had combined with the trade constraints resulting from inadequate institutional development supporting hard currency trade to enforce early closure and a permanent and irreversible loss of capacity that may well have been greater than necessary.

### 2.3. The Economics of Disorganization

The concept of the economics of disorganization as applied to transition economies was set out in the second of Olivier Blanchard's 1995 Clarendon Lectures. A full theoretical exposition was set out in Blanchard and Kremer (1997), which also gave some initial empirical tests of the theory as applied to CIS economies. (For reasons that will become apparent below, the concept is far more relevant to the CIS countries than to the countries of Central and Eastern Europe.)

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2.3.1. The Blanchard and Kremer Model

The basic ideas involved are both straightforward and clear. Following Blanchard and Kremer (henceforth, B&K), they are as follows:

- under central planning, there was a complex set of highly specific supply relationships with firms, with many inputs being provided by only one supplier;
- specificity was sustainable through the coercive power of the state manifested through the central planning apparatus enforcing the production and delivery of goods;
- as the powers of the state and the central planner waned from the late 1980s, so the opportunities arose for enterprises to use the power arising from specificity in bargaining with the enterprises whom they supplied and from whom they purchased;
- after 1992, enterprises were forced to bargain directly with other enterprises, but with no strong expectation that new supply links would be long-term in nature.

The key point is 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”.8 This argument can be demonstrated in theory:

- either via incomplete contracts, where specificity plus new private opportunities give rise to a “hold-up” problem;
- or via asymmetric information where supplier enterprises have information on alternative sales opportunities, information that is unavailable to purchasing enterprises;
- or via co-ordination failures, either resulting from payments problems (e.g. where supplying enterprises encounter difficulties over getting paid and are concerned that they will have to wait until the purchaser is paid for his sales), or from key managers or workers leaving the firm. Such co-ordination failures can be severe when specialist inputs from convertible currency sources are required, since the quality/technical level of these inputs might be decisive for the marketability of the final product. Note that the Baltics, especially Estonia, were effectively hard currency suppliers from 1992 or 1993 onwards.

Of course, these approaches are by no means mutually exclusive and some elements of each may have been present in the CIS economies of the mid-1990s. Furthermore, the standard ways in which Western firms would address these problems (e.g. via the use of long-term contracts or via payment commitments) were massively more difficult for other than the largest CIS companies such as Gazprom or the largest and strongest oil companies.

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The specific prediction for FSU economies that emerges from all three variants of the B&K theory is that \textit{the decline in output should be larger the greater the complexity of the input chain}. The complexity of the input chain here refers to the number and relative size of inputs. Hence, output should fall significantly further for industries with many, small inputs than for industries where the input chain is dominated by one or two large inputs (unless it turned out that the latter were sourced from only one or very few firms).

This prediction arises because:

(i) the incentive to maintain previous trading relationships and establish new formal or informal contracts is larger for dominant inputs (e.g. cloth for clothing or coal for iron and steel); and, conversely,

(ii) with many small inputs, the probability that there will be one input which will suffer supply interruption from contractual breakdown rises sharply with the number of small inputs.

In consequence, B&K test their theory by regressing the decline in output over the period 1992–94 by industry, using a dataset of 308 industries in 9 countries, on an index of complexity plus some control dummy variables, including country dummies. B&K define their complexity index, $C_j$, for sector $j$, as 1 minus the Herfindahl index of input concentration, so that:

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

The set of input coefficients, $a_{ij}$, are taken from the 1990 “125-sector” input-output table for Russia (with industry, the most relevant part of the table, accounting for 100 sectors), scaled so that each column sums to unity. The regression results show large, highly significant ($t$ values of 11–12) and robust coefficients on complexity for the declines in industrial output. Summarising the results, a one-standard deviation increase in complexity is associated with around a 3–5 per cent larger fall in the output of the industry relative to the average.

\textbf{2.3.2. Extension of the Model to Cover Inter-CIS and non-CIS Trade}

B&K do not explicitly consider trade and traded inputs in their modelling, although the disruption of trade between CIS countries is mentioned in the text.

In what follows, we concentrate on separating out the effect of input complexity arising from imported inputs from the effect of complexity due to other inputs. Given USSR-wide economic planning, imports from other FSU countries are likely to be no less specific than non-imported inputs. Imports from non-FSU countries are also likely to be highly specific because of their technical and quality characteristics that could rarely be matched from domestic sources of input supply.

As well as being highly specific, imports from other FSU countries, especially those in the CIS (i.e. excluding the Baltics, which moved rapidly to a convertible basis for all trade, and quickly established the necessary institutions to support that), were very likely to suffer
disruption because of the collapse of the Rouble zone and its associated trading and credit
arrangements. Moreover, the further away the exporting supplier, the greater the potential for
alternative, new trading opportunities (e.g. Estonian firms supplying Scandinavia) and the
greater the scope for breakdowns in expectations and informal contractual relationships.

Imports from outside the CIS (incl., to an increasing extent, those originating in the Baltics)
became very problematic, too. Most CIS countries had little or nothing of banks familiar with
foreign exchange transactions since most such business formerly passed through Moscow.
Likewise, institutions to provide trade insurance, credit guarantees, and to protect normal
business contracts scarcely existed and have been slow to develop and become effective.
Hence key supplies from outside the region, even from former socialist partners of Central
and Eastern Europe quickly became extremely hard to sustain.

Building on B&K, therefore, we wish to test the hypothesis that input complexity associated
with imported inputs has had a greater effect on the decline in output than complexity in
domestic inputs. Within the category of imported inputs, our initial position is that we cannot
say whether these effects should be larger for intra-CIS inputs or for inputs originating
outside the FSU. We would also postulate that the complexity effects should decline over
time, since firms should be able to make alternative arrangements for their inputs in due
course, even if this might entail new firms being created to provide the supplies more locally
than formerly.

These hypotheses are tested for two CIS countries, namely Kazakhstan and Ukraine. In the
next section, we discuss how the datasets needed to do so were assembled from the 1990
input-output tables, the associated trade data, and the available, albeit somewhat limited data
on disaggregated industrial output trends during the 1990s. We then report our regression
results.

Our perspective is explicitly an *ex ante* perspective, implying that we ask how, in the
circumstances of 1993 or 1994 and with the information at their disposal at that time, we
would expect firms in individual sectors to have behaved in setting their output levels. This is
quite different from an *ex post* approach in which we would seek to explain an observed
output loss in terms of a variety of supply and demand factors.

3. The Data

For each of the countries studied here, the following types of data were available: (a) 1990
input-output table; (b) table of import flows; (c) trade table showing the composition of
imports into each sector by CIS and non-CIS markets; and (d) output data for various years.
We discuss each in turn, and then explain how the complexity measures used in the
regression analysis were computed, drawing on and extending the discussion of the previous section. Finally, we remark briefly on a couple of other variables employed in the regressions.

3.1 Description of Data

(a) 1990 input-output tables
For both Ukraine and Kazakhstan, 125-sector input-output tables were available, tabulating data on intersectoral flows for 1990 in 1990 producer prices. These tables were the last large ones produced from data of the Soviet period, and their structure reflects the MPS accounting systems that prevailed then.9 Specifically, this means that the treatment of services is not particularly satisfactory, with distinction being made between so-called productive and unproductive services. The former are services supplied to other production sectors (e.g. freight and other distribution services), the latter are mostly services to the population (e.g. passenger transport). These features of the tables are not really material to the present study, since our focus is on the 100 or so sectors that comprise production, as broadly defined by the UN to include extraction, industry, agriculture and construction. Given our hypotheses, these are the sectors that we expect to be most affected by the lines of argument we adduce based on the theory of disorganization. It is also these sectors where we expect traded inputs, both from CIS and non-CIS partners, to be most relevant.

(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. These flows are in current, i.e. 1990, rouble prices, and must therefore be subject to numerous distortions due to the complex trade-related taxes, subsidies and other restrictions that were still in place. Nevertheless, since we have no data to enable us to make proper adjustments of these flows, either to world market prices or to a consistent basis in terms of domestic producer prices (and it is arguable, in any case, which of these would be best), the table has to be accepted for present purposes in unadjusted form.

(c) Trade tables
The third table for each country shows, for 1990, the structure of imports and exports by detailed sector and by trade direction, the trade flows being measured both in US dollars and in terms of 1990 domestic currency (Roubles). This table, on the imports side, distinguished between imports directly into final demand (e.g. imported final consumption goods) 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

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9 This is not the place for a detailed exposition of alternative national accounting methodologies. Suffice to say that under the communist system the prevailing national accounting model was the Material Product System, hence MPS. In contrast, the prevailing system in most of the world (including, now, in the transition economies), is the UN recommended System of National Accounts, hence SNA. For further details and a comparison of the two systems, see Ivanov and Homenko (1995).

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to intermediate imports from the CIS and intermediate imports from the rest of the world. In this way, it was possible from these matrices to compute the complexity measures referred to in the following sub-section, specifically in equations (3)–(6).\footnote{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}

\textit{(d) Output data}\n
Rather to our surprise, this component of the data required for this study proved to be the most problematic. This is partly because, in order to test the hypotheses referred to above, it was necessary to obtain annual output data by sector for as many years as possible between 1990 and the present. However, during the relevant period all countries in the region have introduced major changes in their industrial classifications, partly, but not only, in conjunction with general moves towards the adoption of SNA national accounting principles. In addition, all countries have experienced a burst of severe inflation around 1993/94. Even in Kazakhstan this gave rise to two years (1993 and 1994) in which inflation, measured in terms of consumer prices, exceed 1500 per cent. In Ukraine, the situation was even worse, with inflation in 1992 of around 2700 per cent, and in 1993 of more than 10,000 per cent (see the EBRD's Transition Report 1998). Hence even if we could get them, detailed output measures based on deflating values of output using price indices (the usual method of calculating real output indices), would be extremely unreliable. Unfortunately, these high inflation years are also just the years expected to be most critical in terms of our hypotheses, making it especially important to have a more reliable measure of output change.

Instead of the conventional approach, therefore, we resorted to available annual data on the output of many individual commodities, expressed in physical units. The problem with this data is that in its raw form it was not directly matched to particular input-output sectors. We therefore had to make judgements in order to assign products to sectors and hence construct a dataset for each country containing output data and complexity measures for the same sets of sectors. Due to gaps and inconsistencies in the data, we were only able to match up the output data with the input-output data for a limited number of sectors in each country, which explains the numbers of sectors referred to in the estimations reported below.

Finally, with regard to the output data, a conceptual observation should be made. In most western studies, it would be usual to study the output changes by sector in terms of changes in the respective sectoral contributions to GDP, or value added. Here we do not adopt this approach. Instead, we measure output as gross output in the sector concerned, since that seems to us to correspond most closely to the way in which we discussed the economics of
disorganization, and the associated complexity measures. To illustrate the distinction being made here, for the sake of clarity, consider the sector, ferrous metallurgy. Value added in the sector would be measured as the sum of wages, profits and other income flows generated as a result of productive activity in the sector; whereas gross output is simply a measure of total production which might be in either physical units (tons of steel, and the like) or current values (output valued in producers' prices). The latter, gross output, is the approach used in this study.

3.2 Complexity Measures

The simplest way of thinking about these, leaving aside the detailed problems of rearranging the various input and trade matrices to match up the rows and columns correctly, as outlined above, is as follows. We start with the basic equation:

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

(2)

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 (2) are represented by the row vectors, \( r^T \), \( r^A \), \( r^C \) and \( r^N \), in obvious notation. Hence, clearly, \( r^T = r^A + r^C + r^N \). From equation (2), several complexity measures extending the original definition set out in (1) can be defined. We considered the following four measures, each defined and normalised carefully to ensure that it must lie in the range \([0, 1]\).

1) Domestic coefficients

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

\[ C_i = 1 - \sum_i \tilde{A}_{ii} \hat{\rho}_i^2 \]
This is, in essence, the original Blachard-Kremer indicator. As is evident from its formulation, this is only a first round measure, in that the complexity associated with a given sector depends only on the vector of input coefficients associated with that sector. However, one could well argue that second round effects might also be important,\(^\text{11}\) in order to pick up the effects of complexity on the individual inputs that go to produce the output of the given sector. The following simple approach indicates how we have sought to measure these second round effects in terms of complexity in domestic inputs. Let \( H' = (H'_1, \ldots, H'_n) \) be the row vector of first round Herfindahl indexes, i.e. each term is one of the sums in (3). Then define the second round Herfindahl indexes in the natural way:

\[
K' = H' + H'A
\]

Since the elements of \( K' \) can take values in \([0, 2]\), to construct a second round complexity measure that lies in the range \([0, 1]\), for the sake of comparability with other indicators, it is necessary to introduce a scaling factor. This gives rise to the second round complexity measures:

\[
D' = 0.5 \left( 2 - K' \right)
\]

(2) **CIS imports**

Similarly, define \( \tilde{M}^c = M^c \left\{ r^c \right\} \). Then the second complexity measure can be written:

\[
C_2^c = 1 - \sum_i \left( \tilde{M}^c_{ij} \right)^2
\]

(3) **Non-CIS imports**

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

\[
C_3^n = 1 - \sum_i \left( \tilde{M}^n_{ij} \right)^2
\]

\(^{11}\) Additional rounds might also be important, but we do not go beyond second round effects here.
(4) Decomposition of total flows

It may be considered more satisfactory, conceptually, to have an index of complexity that simultaneously picks up all three aspects of the concept embodied in the previous three, and to do so in such a way that an overall measure of complexity can be decomposed into components in a fairly intuitive manner. We sketch here a possible way of achieving this more demanding objective. First, define

\[ \tilde{A} = A(\tilde{r}^c, \tilde{r}^f), \quad \tilde{M} = M(\tilde{r}^c, \tilde{r}^f), \quad \text{and} \quad \tilde{M}^n = M^n(\tilde{r}^c, \tilde{r}^f). \]

Thus all coefficients are normalised with respect to the overall column totals, rather than, as above, with respect to the corresponding sub-totals. Then the natural way of defining a complexity indicator is:

\[
C_f^i = l \cdot \sum_j (\tilde{A}_{ij} f^2 - \sum_j (\tilde{M}_{ij} f^2 - \sum_j (\tilde{M}_{ij}^n f^2)
\]

This expression can be related back to the three previous indicators, though not in a very transparent or elegant way. More directly, though, the three sums on the right hand side of (6) are clearly picking up the three identified dimensions of complexity, namely due to domestic coefficients, CIS trade relationships, and non-CIS trade.

In terms of these indicators, the hypotheses we wish to test amount to running regressions of output changes on complexity measures and other variables, in which we expect to find significant coefficients on indicators (3), (4) and (5), the last two effects being larger and/or more significant than the first.

3.3 Other variables

Two additional variables were employed in the regressions reported in the next section, aside from the output changes and complexity measures already discussed. The first of these was a measure of capital intensity for each sector. This was defined as a dummy variable, taking the value zero for sectors with “low” capital intensity, unity for sectors with “high” capital intensity. The assignment of sectors to these categories was based on knowledge of the corresponding sectors in Western economies. The reason for including such a variable, albeit one measured in such an imperfect and subjective manner, is to pick up the possible impact of technological level on early transition output changes. We expect, for instance, that in a sector with low capital intensity, most inputs will tend to be technically simple or standardised, and hence relatively easy to substitute either domestically or through changes in trade. Conversely, in sectors categorised as having high capital intensity, some inputs are likely to be highly specialised and/or technically sophisticated, and therefore quite difficult to substitute if normal supply links are disrupted. These considerations suggest that in a regression of output change on complexity, with capital intensity present as an additional (dummy) variable, the coefficient on the latter should be negative.

The second additional variable is a measure of relative price changes, essentially the same as that used by Blanchard and Kremer. The variable used here is the set of world-to-domestic
price ratios assembled by Senik-Leygonie and Hughes (1992) in their study of industrial competitiveness across the former Soviet Union. Since the ratios differ considerably by sector, the variable gives at least an initial indication of the extent of relative price changes that could be expected to occur following the initial price and trade liberalisation at the start of transition. Sectors with relatively high world-to-domestic price ratios could expect to gain from liberalisation, so there would be an expectation that such sectors would be able to maintain output more effectively than those with low ratios. Sectors with high ratios ought to have become more profitable and hence be more able to finance their input requirements; other sectors might be more constrained, quite aside from impact of complexity per se. We would therefore expect the coefficient on the proposed relative price variable to be negative (sectors with high ratios associated smaller output declines).

4. Regression Results and their Interpretation

We are now in a position to proceed to formal hypothesis testing. To begin with, we simply replicate the original Blanchard-Kremer analysis using our data. Accordingly, we regress the output change over the period 1991–95 (variable $dq_{9195}$) on the Blanchard-Kremer complexity measure ($bk1$), a country dummy ($country$), the durability measure ($dur$), and the world-to-domestic price ratio ($wdratio$). The regression also included a constant term ($constant$). The country dummy (Kazakhstan = 0, Ukraine = 1) was included to enable us to combine the data for Ukraine and Kazakhstan in the same regressions, in view of the rather low number of observations for each country (i.e. low degrees of freedom). The regression was performed, as were all the subsequent ones reported below, with adjustments for the heteroskedasticity of the error term using the Huber correction. Results are presented in Table 1, below.

The results of Model one provide some degree of support for the original Blanchard-Kremer hypothesis, as the coefficient on the complexity measure is significant and of the correct sign. The country dummy is also significant, indicating that the regression line shifts significantly between observations for the Ukraine and those for Kazakhstan. The results of the other two coefficients are not so satisfactory however, in that the signs or significance contradict our null hypotheses: the coefficient on the world-to-domestic price ratio is negative but insignificant, and the coefficient on the durability variable is significant but positive. A possible explanation of the latter result, offered tentatively at this point pending further investigation, is that capital intensive sectors might use fewer intermediate inputs 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.

This regression was also run using the complexity indicators including second round effects, either separately or jointly with the first round indicator. Neither of these regressions yielded
any especially interesting results, at least in part due to the high correlation between first round and second round indicators. Hence no results are formally presented here. Likewise, regressions were performed using different dependent variables, namely output changes over different sub-periods such as successive years. However, in most cases these results, too, were extremely uninformative and mostly not significant. Hence we were unable, using the present dataset, to test the part of our hypothesis suggesting that the impact of trade disruption on output decline, as measured by the trade-related complexity indicators, should have decreased over time.

In Model 2 we perform a similar regression to that of Model 1, but with the addition of our own complexity measure based on inputs purchased through CIS trading links (cisind). The results suggest that a significant degree of collinearity exists between the complexity indicators, as although our adjusted goodness of fit measure improves, the coefficient associated with our CIS trade complexity measure is insignificant, although of correct sign. Moreover, the Blanchard-Kremer complexity measure maintains its hypothesised negative sign, but is rendered insignificant. The coefficient of the durability variable is found to be slightly more significant than in Model 1, although it remains of unexpected sign. The world-to-domestic price ratio, however, is still of the correct sign, but continues to be insignificant.
Table 1. Regression Models with Complexity Indicators (Standard Errors in Parentheses)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
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<td>–26.6974*</td>
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<td>(9.0837)</td>
<td>(9.5392)</td>
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<tr>
<td>nonind</td>
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<td>47.1239***</td>
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</tbody>
</table>

Notes: All reported standard errors are Huber corrected.
*, ** and *** represent significance at the 10, 5 and 1 per cent levels respectively.
Model 3 substitutes our third complexity indicator, that based upon non-CIS trade linkages \((nonind)\), for the CIS trading links complexity indicator introduced in Model 2. The introduction of the non-CIS trade complexity indicator results in a substantial increase in our adjusted goodness of fit measure, thus suggesting that we have incorporated a highly significant explanatory factor. This is supported by the extremely large and highly significant coefficient found upon the non-CIS trade complexity indicator, which completely dominates that of the Blanchard-Kremer measure as the latter is still of negative sign but loses significance. This clearly supports the apparent collinearity of the Blanchard-Kremer indicator and our trade complexity measures, and suggests that the non-CIS indicator is a superior measure. More generally, the superiority of Model 3 over those previously discussed is illustrated by the increased significance of the durability indicator, although its sign continues to contradict our null hypothesis. However, the world-to-domestic price ratio remains of correct sign but is insignificant.

In an attempt to circumvent the collinearity of the Blanchard-Kremer indicator with our trade indicators, Model 4 eliminates the Blanchard-Kremer indicator from Model 3, replacing it with the CIS trade complexity indicator. Nonetheless, the coefficient of the CIS trade measure is found to be insignificant, suggesting that collinearity perhaps exists between the trade-based indicators also, whilst those of all other independent variables remain of identical sign and significance as in Model 3.

The robustness of this result is illustrated in Model 5, which incorporates interactive slope dummies associated with each independent variable \((i.\ast)\) — hence rather than restricting our model such that the regression line is permitted only to shift across countries, we allow for differential slopes to be associated with each independent variable. The results show that these interactive variables are individually insignificant. Moreover, application of the standard F-test to jointly test the linear restrictions of constant slopes across countries fails to reject the null hypothesis that the coefficients of the interactive variables are jointly insignificant. Despite the interactive variables, the results reveal that our complexity measures are unaffected both in terms of sign and significance. Furthermore, our durability variable becomes marginally less significant than before, but is still of incorrect sign, whilst our world-to-domestic price ratio becomes significantly negative as hypothesised. This would appear to suggest that although the interactive variable associated with the world-to-domestic price ratio is insignificant, it may act in such a way as to filter out a degree of 'noise' thus rendering the price ratio significant. Nonetheless, although this interpretation indicates that the price ratio coefficient is perhaps the least robust of our independent variables, the inclusion of an interactive county dummy cannot be supported on the basis of tests of its individual and joint significance.

Consequently our final regression, Model 6, eliminates the insignificant CIS trade complexity measure, together with the interactive dummies of Model 5. As a result we find a remarkably well-defined and parsimonious model. The previous results are found
to be robust to the choice of complexity indicator, such that the durability coefficient is significant at the one percent level but of a sign which contradicts our null hypothesis, while the world-to-domestic price ratio reverts to being of the correct sign but insignificant. However, the most striking features of this model are the overall explanatory power, together with the size and significance of the coefficient associated with the non-CIS complexity indicator. That non-CIS trade complexity is found to be such a significant factor in explaining the output drop experienced by our transition economies is, at first glance, surprising. We offer a potential explanation in the concluding section of our paper.

5. Conclusions and Further Research

The aim of this paper was to study output declines in CIS economies during the 1990s, from the standpoint of the Blanchard-Kremer theory of disorganization. We extended the original complexity indicator referring to domestic intermediate inputs by adding two further indicators related to intra-CIS trade and non-CIS trade respectively. Our expectation was that these trade-related indicators would prove to be significant in explaining output declines, and that input complexity in CIS and non-CIS trade would prove to be more significant in explaining output change than the complexity of domestic input supplies.

Empirical analysis using quite detailed data on Ukraine and Kazakhstan was used to explore these hypotheses, with extremely interesting results. The basic supposition that complexity indicators would have explanatory power in terms of contributing to an understanding of output change was confirmed, for our dataset, by the results of our first model. Our analysis however, clearly illustrated the collinearity which exists between the Blanchard-Kremer complexity measure and our trade-based measures, hence precluding their joint inclusion in regression analysis. Most surprisingly, our analysis found that the most significant complexity indicator of all was that associated with non-CIS trade. Since this is exactly contrary to much of the conventional wisdom concerning the impact of trade disruption, it calls for further discussion and an exploration of possible explanations. This discussion also opens up some novel questions for further research that we note at the end of this concluding section.

In relation to Western trade, it is not very likely that supply problems per se could explain much of the observed disruption experienced in domestic production. It is surely more likely that problems in relation to that direction of trade should be attributed either to legal/institutional shortcomings in the CIS countries seeking to engage in Western trade, or to deficiencies of the payments mechanism in place to finance such trade, as suggested at various points above. Difficulties in these areas would have made it hard for Ukraine and Kazakhstan to sustain some of the trade they needed to maintain production in parts of the economy. On the institutional side, weaknesses in areas like business contracts and their protection might well have prevented some firms from continuing even their established input supplies. Especially in the early 1990s, once the
relevant all-Union institutions of the former USSR disintegrated, many business links would have been left “high and dry”. Until the individual successor states established corresponding institutional infrastructure to take on the former all-Union obligations, and developed them in ways suited to the individual countries, many contracts must simply have lapsed due to the general economic and political uncertainties of the period. As EBRD (1998) points out in the sections on individual transition countries, some of this crucial institution building has proceeded extremely slowly, especially in terms of making the new structures operate effectively.

Exactly the same situation would have arisen in the financial domain, with all-Union banks, payment arrangements, and other financial agreements, based in or largely negotiated in Moscow before 1991, having to give way to many separate national-level structures and systems, most of which simply did not exist in the early 1990s. Both in Ukraine and Kazakhstan, the development of alternative systems has again been rather slow, not only in terms of establishing the basic institutions themselves, but also in terms of establishing an appropriate regulatory environment within which they should operate. That is far more difficult, and in many important respects is still not in place.

Hence on a priori grounds one can see reasons for the possible importance of non-CIS trading links, and for the CIS countries’ remarkably strong sensitivity to the disruption of these economic linkages as shown by the empirical analysis reported above. However, it is apparent that we do not fully understand the mechanisms involved in this sensitivity, and further research is needed in order to identify and clarify the most important factors. Such research could make an important contribution in the design of future economic policies and reform strategies in the countries concerned.

References


