Technical Progress and Soviet Economic Development

EDITED BY
RONALD AMANN AND JULIAN COOPER

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JULIAN COOPER

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List of Contributors

RONALD AMANN is Professor of Soviet Politics and Director of the Centre for Russian and East European Studies, University of Birmingham, England (CREES).

GARY K. BERTSCH is Sandy Beaver Professor of Political Science at the University of Georgia, USA. During the 1984–5 session he was a Visiting Fulbright Scholar in the Department of Politics, University of Lancaster.

DANIEL L. BOND is a Senior Vice President of Wharton Econometric Forecasting Associates, Washington, DC, USA.

JULIAN COOPER is Lecturer in Soviet Technology and Industry at CREES, University of Birmingham.

DAVID A. DYKER is Lecturer in the Department of Economics and the School of European Studies at the University of Sussex.

MALCOLM R. HILL is a Senior Lecturer in the Department of Management Studies, University of Technology, Loughborough.

RICHARD McKAY is a Research Associate, also in the Department of Management Studies, Loughborough University.

ANTHONY RIMMINGTON is a doctoral student at CREES.

PAUL SNELL is a doctoral student at CREES.

VLADIMIR SOBELL, formerly at St Antony's College, Oxford, is now a researcher with the Czechoslovak Service of Radio Free Europe.

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Introduction

Since the late 1950s there has been a general slowdown in the rate of Soviet economic growth. The phenomenon is now well known to Western specialists on the Soviet economy. Its broader implications, with regard to the difficulty of allocating resources between competing policy objectives and the political tensions which arise from this process, have been analysed by Seweryn Bialer, Abraham Becker, Philip Hanson and many others. At the heart of the problem is the failure of the central planning mechanism, which took shape in the 1930s under Stalin's political direction, to promote rapid technical progress. Technological development has, of course, taken place in the USSR during the past two decades, but not at a sufficiently high rate or sufficiently broadly to override the effects of growing resource scarcity; to express the problem in Soviet parlance – a successful transition has not yet been made from the stage of '*extensive* development' to one of '*intensive* development'. In most industries a substantial technology gap still separates the Soviet Union from the advanced Western countries. Mr Gorbachev himself has characterized this as 'problem number one' for the USSR, and in a key-note address to a special Central Committee Conference in June 1985 reaffirmed that:

> The Party views the acceleration of scientific and technical progress as the main direction of its economic strategy, as the main lever for the intensification of the national economy and for raising its efficiency; and hence, for the solution of all other economic and social issues. These tasks are so pressing that action has to be taken without losing any time.

Although it would be quite wrong to view the present Soviet difficulties in crisis terms, one nevertheless gets a strong sense that the country under its new leader is moving towards a series of crucial decisions, which will determine the shape of Soviet development for years to come. For those of us with a special interest in Soviet science and technology, therefore, it seemed an appropriate moment to take stock of the situation and to establish a basis for interpreting the significant policy objectives and organizational changes which are likely to be announced at the next Party Congress in early 1986.

In the Autumn of 1984, some months before Gorbachev took over formally as General Secretary of the Party, a Symposium on Soviet Science and Technology was held at Birmingham University under the joint auspices of the

Centre for Russian and East European Studies (CREES) and the Department of Extramural Studies. The symposium was unusual in that half the participants were academics and the other half were professional analysts drawn from the British Government and defence community. The intention which lay behind the symposium was to bring the academics into closer discussion with fellow specialists, who shared common concerns and who were both consumers and critics of our published work. It was clearly understood at the outset that those participating on the government side would be doing so as individuals and not as official representatives and, moreover, that the subject matter for discussion would be confined entirely to what was available in openly published sources. The various chapters in this book are revised and updated versions of the papers presented at the symposium.

The chapters fall into one of two major but related themes. First, there is a group of chapters concerned in various ways with Soviet technological *performance*, a longstanding interest of researchers at CREES. Amann's introductory chapter reviews recent evidence about Soviet technical progress on the basis of a wide range of criteria, and poses some of the general issues which are taken up in later chapters. Cooper presents some detailed results arising from his recent work on the Soviet defence sector, hitherto considered to be an exception to the general run of civilian research and development and to some extent pursued at its expense. Hill and McKay evaluate Soviet performance in two traditional sectors (machine tools and electric motors) while Snell and Rimmington extend the range of existing case-studies into the crucial spheres of electronics and biotechnology where very little work, using Soviet sources, has been done to date. A second group of chapters attempts to evaluate the various options which the Soviet Government might explore either singly or jointly, in order to *improve current performance* and thus to accelerate the tempo of scientific and technical progress. Of the possible external solutions, Bertsch looks at the present and future prospects for acquiring advanced Western technologies, while Sobell examines the extent to which co-operation within the Soviet bloc itself might help to stimulate more rapid technological development. From an internal perspective, Dyker analyses the likelihood, given past experience, that institutional reform will have any significant or durable impact. Finally, Bond puts the whole discussion in its broader context and advances a number of bold forecasts of Soviet economic performance to the end of the present decade.

Although the chapters in the volume have a thematic coherence, the reader will soon discover that the general line of interpretation is not consistent throughout. There was widespread disagreement throughout the discussions which took place at the symposium, and this indeed, was one of its most valuable and enjoyable aspects. On the whole, and broadly for the same reasons (endemic bureaucratic rigidity – short of a truly radical reform – which affects both domestic technology and the diffusion of foreign imports), Amann, Dyker, Sobell and Bertsch are inclined to be relatively pessimistic about Soviet prospects, though all would accept that modest improvements could take place as a result of incremental reform, combined with a greater sense of political purpose. However, none of these changes would be likely to transform Soviet technological performance in a fundamental way. This view is consistent with

the previous work of the Birmingham group and is widespread among Western specialists. However, other chapters in the book advance, in varying degrees, strongly revisionist views, which challenge previous thinking on the subject. Instead of the Soviet defence sector existing in a 'world of its own' and acting as a drag on the civilian economy, Cooper emphasizes the strong links which exist between the two sectors, regarding the former as a potential dynamo of good industrial practice. Snell details the impressive list of microprocessors which are described in current Soviet literature and observes that even the undoubted copying of Western designs presupposes an advanced technological capability; moreover, bit-slicing is seen as a viable substitute or supplement to large scale integration (LSI). Rimmington describes the development and manufacture of single cell protein within the framework of what is probably the world's largest microbiological industry, and explains the overall policy context. Hill and McKay, by means of a detailed analysis of state standards, demonstrate that some basic traditional technologies are on a par with those in the West: electric motors exhibit comparable performance over a range of criteria; the initial alignment accuracies of Soviet general-purpose machine tools are also comparable to those in the West, though they are prone to lower levels of reliability and durability in use. The debate here is not simply an inevitable difference in perspective between the generalists and the particularists (Bond is firmly in the camp of the optimists) but centres on a clash of conceptions and judgements which have not yet been definitively resolved by empirical evidence. Detailed monitoring and analysis of Soviet policies and performance over the next five years will tell us a good deal more and may clarify some of these issues. It will be a crucial time for the USSR.

The editors and authors would like to thank all the participants at the Symposium and the following individuals, in particular, for their comments and criticisms: Mr Peter Smith (Ministry of Defence), Wing Commander Mike Grigson (RAF), Mr Graham Kidd (ICI Agricultural Division), Dr Daniel Franklin (*The Economist*), Dr Christopher Davis (CREES, University of Birmingham), Dr Martin Cave (Department of Economics, Brunel University) and Mr Jonathan Stern (Joint Energy Programme, Royal Institute of International Affairs). Any faults are, of course, the responsibility of the authors themselves. But they would certainly have been more numerous without the informed comment from which we all benefited. We would also like to thank the Royal Air Force for supporting the Symposium on the services side: particularly Air Commodore Tony Mason and Group Captain Tim Garden (Director of Defence Studies, RAF) for their generous help and encouragement of a novel event, which could not easily be handled through the normal channels. Mrs Jane Hamilton-Eddy (Ministry of Defence) was equally helpful in coordinating the participation of government research staff. A degree of administrative flexibility was demonstrated – not a notable feature of the bureaucratic machine we were studying! The Department of Extramural Studies provided first-class organizational support for the Symposium, and special thanks are due to its Director, Mr R. Sawers and to Mrs Ann Hollows, who made many of the detailed arrangements. Individual authors acknowledge the help they have received from various research foundations in their own chapters but it is

appropriate here to express a general acknowledgement to the Economic and Social Research Council (ESRC) for its consistently generous support of the work on Soviet science and technology carried out at CREES. Finally, we would like to express our sincere thanks to Sandra Cumberland and her colleagues Lesley Woolley and Julie Cant in the CREES office for the very efficient way in which they have helped us to prepare this material for publication. In this matter, as in others, power rests ultimately in the hands of the secretariat.

Ronald Amann
Julian Cooper
June 1985

Postscript

Since the book went to press a number of key officials mentioned in the book have been replaced, including Tikhonov, Chairman of the USSR Council of Ministers, by N. I. Ryzhkov; Smirnov, Chairman of the Military-Industrial Commission, by Yu. D. Maslyukov; Dmitriev, Head of Defence Industry Department of the Central Committee, by O. S. Belyakov; Shokin, Minister of the Electronics Industry, by V. G. Kolesnikov; and Rychkov, Head of the Main Administration of the Microbiological Industry, by V. A. Bykov.

1

Technical Progress and Soviet Economic Development: Setting the Scene

RONALD AMANN

In a book published in 1977, which was based on data extending to the mid-1970s, my colleagues and I reached the conclusion that, with the notable exceptions of some priority sectors, Soviet technological performance was inferior to that of the advanced Western industrialized countries and, more controversially, that the USSR had demonstrated no strong signs of catching up during the previous 15–20 years.[1] Progress had certainly been made, but in most of the sectors studied the technology gap had not been closed; instead, the USSR found itself chasing a rapidly moving target. In 1982, with the benefit of data extending to the late 1970s, this broad judgement was confirmed in a second book and an attempt was made to explain the reasons for this unsatisfactory performance.[2]

Much has happened since these two books were published. Technological inertia has come to be seen, both among Western analysts and in the USSR itself, as perhaps *the* crucial constraint on future Soviet economic development. This has given rise to some interesting Western writings and, on the Soviet side, to a number of unusually frank and penetrating analyses, which began to appear in the press and economic journals towards the end of the Brezhnev era. One could discern in these latter writings a degree of frustration and impatience: a feeling that for too long the process of economic and political decision-making had been locked on 'automatic pilot' and that the time had come for the restoration of manual controls by a more vigorous leadership. The purpose of this introductory chapter is to assess some of the recent evidence with particular reference to (1) technological performance; (2) the reasons for it; and (3) the feasible options for improving it. These general themes are pursued in greater depth throughout the remaining chapters of the book.

The pessimism of the 'Birmingham group' did not escape criticism from academic colleagues in the West, especially during the first stages of our work. While accepting the usefulness of a disaggregated case-study approach, some readers were put off by the artificiality of calculating technological leads and lags in precise numbers of years. To a large extent we would agree with this criticism. The sectoral assessments of relative technological level are more approximate than they might seem, but, on the other hand, there is no alternative to the systematic assembly of data on diffusion of new technologies and comparative dates of first commercial production. We were keenly aware

that in the aggregate this could yield only a general indication of performance, no matter how scrupulous we tried to be in the selection of the sample. Other readers, focusing on Soviet achievements in space exploration, on the technological basis of Russia's formidable military power and on the enormous scale of the Soviet support for research and development in both expenditure and manpower terms, found it hard to accept that the overall picture could be quite as black as we had painted it. Perhaps the most sophisticated objection to our conclusions was that they appeared to be out of line with a well established international pattern of technological development whereby backward nations, taking advantage of their ability to borrow cheaply, would inevitably catch up with the most advanced countries in the long term.[3] Leaving aside what one means by 'the long term', this argument probably underplays both the specific institutional features of the Soviet system, adversely influencing its capacity to absorb foreign technologies, and the impact of a quantum leap between major phases of technological development, which could reopen gaps between leaders and followers. Arguably, it is precisely such a prospect which greatly concerns Soviet leaders at the present time as they observe the rapid development of electronics and biotechnology in the West and weigh its political and economic consequences for themselves.

Despite the reservations of the sceptics, some of which we would accept ourselves, it would seem that in the light of economic trends in the late 1970s and in the first half of the 1980s the conclusions of the Birmingham group have been broadly right. Although we did not explicitly predict the marked slowdown in the rate of economic growth during this period (much of which is the result of non-systemic factors) the phenomenon is consistent with our analysis and conclusions. Moreover, our central notion that there exist powerful institutional impediments to future technical progress, which can not be easily overcome because of *deep historical influences*[4] on popular attitudes and organizational behaviour, anticipated the main elements of the internal reform debate which got underway during the early Andropov period.[5] In particular, if one ignores the Marxist terminology, the parallels between our conclusions and the position advanced so forcefully by Tatyana Zaslavskaya are quite striking.[6]

Given our general view that the behavioural characteristics of the Soviet economic system are rooted in history, I would not expect that the creation of new planning bodies or superficial amalgamations designed to strengthen the link between science and production or the rearrangement of the incentive structure would necessarily lead to a sustained acceleration of technical progress. Incremental reforms of this kind would encounter a force-field of resistance from officials at all levels of the system, who had assimilated the established rules of the game and had perfected various survival skills. Thus, if we had been forced to predict the likely pattern of Soviet technological development during the first half of the 1980s on the basis of our previous knowledge of institutional performance, the outlook would not have seemed especially bright. What are the facts now available?

TECHNOLOGICAL PERFORMANCE

There is a spectrum of indicators of technical progress ranging from aggregated but rather indirect ones at one end to more direct but potentially unrepresentative ones at the other. No one indicator is sufficient in itself, and in attempting a general assessment of recent Soviet technological performance one is looking for a substantial degree of consistency between these various measures.

Aggregated economic indicators

The most general and aggregated indicator of all is the annual average rate of economic growth. According to Western estimates Soviet GNP grew on average by 6–7 per cent in the 1950s, 5 per cent in the 1960s and 3 per cent in the 1970s. It is unlikely to rise much above 2 per cent in the 1980s.[7] According to the latest plan fulfilment results available at the time of writing, the slight improvement which took place in 1983, perhaps as a result of Andropov's campaign to tighten up on work discipline and the fulfilment of contract deliveries, began to lose momentum once again in 1984.[8] Of course there are many climatic and environmental factors which depress growth rates but it is interesting to note that one of the most outspoken observers of the Soviet scene, Academician V. Trapeznikov, has discounted the influence of weather and the depletion of sources of energy and raw materials in the most accessible areas of the country and has laid the blame squarely on an inadequate rate of technical progress – and particularly on the failure of unimaginative central planners to appreciate its true importance.[9]

If overall economic growth is too gross an indicator to provide a satisfactory perspective on the pace of technological development, it follows that a better approach would be to focus on the effectiveness by which resources are used: on the various measures of productivity, which form an integral part of the Soviet objective of 'intensive development' towards which they are constantly striving. As the official Soviet figures show (see table 1A.5) there has been a marked decline in the annual rate of growth of labour productivity during the last decade or so. It is currently running at about 2.5 per cent, less than half the going rate in the early 1970s and in some industrial sectors such as ferrous metallurgy the decline has been particularly steep. Given the declared objective of the planners that future economic growth must rest exclusively upon greater productivity, this trend must be distinctly worrying.

Trends in labour productivity certainly do reflect the rate of technical change in the economy, embodied in new capital and in the growing skills (know-how) of the labour force, but they are also influenced by other factors such as the size of the capital stock, its intensity of utilization and the motivation of workers. These are not, strictly speaking, part of 'technical progress'. Similar drawbacks also apply to the use of capital productivity as an indicator of technical progress. Here, the size and qualifications of the work-force, the utilization of plant and the infrastructural costs associated with the procurement of fuels and raw materials are all important determinants of capital productivity, which do not

necessarily depend upon rapid technical progress. On the other hand, technical progress would clearly have a major influence on this indicator if, as often happens, new Soviet equipment did not meet the best world standards. The fact that the annual retirement rates of obsolete plant and equipment in the USSR are on average about half those in the USA,[10] while the slow introduction and assimilation of new capital stock as a result of design failures and construction delays often leads to 'moral obsolescence', would also have a potent impact. In fact, during the last 20 years capital-output ratios in the Soviet Union have more than doubled, signifying a marked decline in capital productivity.[11] Because of the slow growth of the labour force, the introduction of new automated capital equipment has often simply meant that new jobs have been created which have remained unfilled. The substitution of capital for labour as a source of productivity has thus proved difficult.[12]

Since the growth of labour productivity and capital productivity at any given point in time depends upon the relative proportions of labour and capital, a more satisfactory measure of technical progress is one which analyses total factor productivity. According to US government analysts, the rate of growth of total factor productivity in the USSR after 1973 declined at an average rate of 0.8 per cent per annum.[13] A recent CIA assessment shows that the annual average growth rate of total factor productivity of GNP picked up slightly in the last few years, but is still either negative or negligible.[14] Of course, crude estimates of total factor productivity and its growth over time once again contain a large number of non-technological influences (negative influences such as natural resource exhaustion and bad weather, and positive ones such as improvements in labour quality due to educational advance, changes in the balance of employment between agriculture and industry, economies of scale and effects of planning reforms). But in principle some or all of these influences can be allowed for in the calculation, leaving a residual which approximates to 'technical progress'. No doubt these adjustments are subject to error and must remain controversial but they are well worth attempting. We have summarized some of the major works in this field in one of our previous books.[15] In a more recent attempt to measure what he calls 'technical progress proper' (TPP) the distinguished American economist Abram Bergson concludes that by the mid-1970s the annual rate of growth of TPP in the USSR had fallen to 0.16 per cent; this performance in Bergson's opinion was 'within the range of Western experience but inferior to that of Western countries at a comparable stage of development.'[16]

Indicators of the recent slow rate of technical progress in the USSR, contained in these aggregate economic measures, receive further confirmation when we examine the pattern of Soviet foreign trade. It is a characteristic of highly advanced countries that value-added manufactures form a substantial proportion of their total exports; exports of machinery and equipment are particularly prominent. At the present time, however, only 6 per cent of Soviet hard currency exports are accounted for by sales of machinery and equipment, a proportion which has remained more or less unchanged since 1970. Approximately two-thirds of Soviet hard currency earnings are derived from energy

exports, oil in particular accounting for about one half of the total. By contrast, machinery and equipment currently account for nearly one quarter of hard currency *imports*, a slight decline since the mid-1970s when the impact and political significance of the East European debt began to be felt.[17] Even more worrying from the Soviet and East European view is the emergence of newly developed countries as serious exporters of manufactured goods to the established industrial countries of the Organisation for Economic Cooperation and Development (OECD). The share of Eastern Europe in OECD imports of machinery and equipment, for example, increased from 0.1 to 0.7 per cent during the 1970s, while the share of only six newly industrialized countries (NICs) rose from 0.1 to 4.1 per cent during the same period.[18] The fear of some Western governments during the detente era that exports of advanced plant and equipment to the USSR and the other countries of the Council for Mutual Economic Assistance (CMEA) would eventually 'boomerang' back in the form of increased manufactured exports on Western markets have proved groundless up to the present time. Instead, the USSR now faces the challenge of raising the quality and novelty of its products in order to maintain its position.

More direct general indicators of technical progress

The annual Soviet statistical handbook, *Narodnoe Khozyaistvo SSSR*, contains a series of statistics which relate directly to the rate of technical progress. They have been ignored previously by Western researchers mainly because the statistical categories are somewhat vague, it is difficult to relate them to any comparable Western figures and thus there is a shrewd suspicion that the figures could be inflated arbitrarily in order to make Soviet performance look as good as possible. On the other hand, as Vladimir Kontorovich has pointed out,[19] the long-term trends could still be interesting, perhaps *especially* because of the upward bias one would expect to encounter.

The Soviet figures (presented in tables 1A.1–4 (see pages 26–30)), cover the whole of the latter part of the research–production cycle: invention, innovation, diffusion and incremental improvement. Compared with achievements in scientific research, these are the phases of development where it is generally thought that the USSR exhibits relative weakness as a result of discontinuities between different phases of development and lack of incentives. Ideally, the figures in value terms should be systematically adjusted for inflation but without a suitable price index this is very difficult to do; in any case, the main point in looking at these statistics is to discern the relative balance between the growth of innovation activity and its economic impact (both of which would have to be deflated). The general picture that emerges from the statistics is extraordinarily striking and consistent. There has been a continuous absolute decline since the early 1960s in the creation of prototypes of new machines and equipment, especially in the more advanced science-based industries (table 1A.1). Though growth rates in terms of physical units will have been restrained to some extent by the 'sophistication factor' (the tendency towards higher development costs per prototype at higher levels of technological advancement) it is unlikely that

this factor can account entirely for this remarkable trend. Table 1A.2 deals with the next stage in the research–production cycle: the introduction of new technologies into the economy and their economic impact. Once again one can see a fall in the rate of growth of these measures since the first half of the 1970s, even in value terms (though the relatively more rapid decline of the physical indicator here gives some credence to the unit cost argument). The most startling trend to emerge from table 1A.2, however, is the relatively steep decline of the impact indicators, expressed in terms of labour savings from new technologies and their annual economic effect. This suggests a growing ineffectiveness of industrial innovation. If it were not for the slight peak in performance in 1983 the annual economic effect from the introduction of new technologies would have come to rest at zero growth; presumably, if one allowed for the exaggerated estimates of economic effect, which are an endemic feature of the Soviet R and D system, the position would appear even worse.

Though the distinction between the coverage of tables 1A.2 and 1A.3 is not absolutely clear, for practical purposes we can treat the former as relating to the first-time introduction of new technologies, while the latter deals with their subsequent diffusion throughout the economy. It would seem, therefore, that despite a slight acceleration in the rate of diffusion in the latter half of the 1970s the general trend over the last 15 years has been downwards. In the crucial technological areas of machine-building and chemicals, growth rates have become negative (the high 1971–5 figure for chemicals is almost certainly influenced by substantial imports of plant and equipment from the West). It is possible that these figures could give a false impression if the Soviet planners had succeeded in concentrating resources on fewer objectives and thus in increasing the unit-value of industrial modernization schemes. However, there is no evidence that the phenomenon of *raspylenie sredstv* has been eliminated and, in any case, one would have expected that the current change in emphasis from new construction on green-field sites to modernization of existing plants would have tended to increase the number of units.

Table 1A.4 focuses mainly on the incremental improvements at the shop floor level, which are such an important aspect of technical progress in the West. This is where science interacts with production. In the course of fully mastering and modifying a new process fundamentally new technologies can begin to take shape. In the USSR, however, the long-term statistical trends would seem to cast some doubt on the vitality of these creative responses. Since the early 1970s there has been a fall in the growth rate of the number of improvements introduced, and a similar though less pronounced fall in expenditures on their implementation. More particularly, there was an abrupt decline in the growth of the economic effect of these measures at the end of the 1970s, corresponding to the general slackness and inertia which was characteristic of the final years of the Brezhnev era.

We might reasonably conclude from tables 1A.1–4, which almost certainly have an upward bias, that even if Soviet leaders were unsophisticated enough to believe their own official figures they would still have grounds for pessimism.