ICL and the American Challenge

British Government Policies for the Computer Industry, 1949–1985

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Introduction

Over the last 40 years, the policies of successive U.K. governments toward the computer industry have had two broad aims:

- Defense of the balance of payments
- Maintenance of a strategic information-technology industry

These aims have not always been explicitly stated, and over time and different governments the relative balance between them has shifted.

By the late 1940s it was becoming clear that computers and electronic data processing would become significant economic activities, perhaps of a similar magnitude to pharmaceuticals, aerospace, electronics, or office machinery. While the United Kingdom had maintained a reasonable position in the first three of these industries, it had always been a net importer of advanced office machinery. It was recognized by some that special measures would therefore be needed to ensure a successful computer industry, and this was to be the principal task of the National Research Development Corporation (NRDC), which was established in 1949.

While the existence of a national information-technology industry had significant economic benefits for the balance of payments, there was also a political objective in ensuring that the United Kingdom had a world-class indigenous computer industry. The reasons for this have never been quantified, but they relate to feelings of national pride, arguments about spin-off, and the need for self-sufficiency in defense procurement. To quote a Ministry of Technology memorandum:

> To fail to produce an indigenous industry would expose the country to the possibilities that industrial, commercial, strategic or political decisions made in America could heavily influence our ability to manufacture, to trade, to govern or to defend.[1]

For Labour governments, in particular, there has been a strong emotional commitment to ICL as a "national champion" computer manufacturer.

The NRDC: An Early Policy Failure, 1949–1963

The Postwar Scene

The early history of British computers has been well documented.[2] Among the major European countries, the United Kingdom was the least damaged physically and economically by World War II. This, and the electronics leadership established during the war, enabled Britain to make the most rapid progress of any European country in developing the newly invented stored-program computer.

From the close of World War II, the British defense ministry (the Ministry of Supply) and the Department of Scientific and Industrial Research (DSIR) were keen to establish a national computer project so that universities and government research organizations could have the benefit of this powerful new tool. In the event no less than three major computer centers were established by 1946: at Cambridge University, Manchester University, and the National Physical Laboratory. Each of these centers had a prototype computer working, or on the verge of working, during 1949.

In the mid-1940s, it had never been envisaged that there would be a demand for more than two or three large scientific machines in the United Kingdom, but by about 1950 it was evident that there would be a significant market for electronic computers. As a result three firms tentatively entered the computer market by manufacturing one of the three British research computers, in a classic example of technology transfer. Thus the electrical engineering and electronics firm Ferranti started to manufacture and market the Manchester University computer, and English Electric began to produce the National Physical Laboratory's machine. The bakery firm of Lyons—a leader in modern management techniques—also began a partnership with Cambridge University to make the LEO computer. Leo Computers Limited was formed in 1955 to produce LEO II, based on the successful LEO. By this time several other firms had come into the computer market, some of them as a direct result of the stimulus of the NRDC.

Two firms that had *not* entered the computer field, however, were the punched-card machine manufacturers—the British Tabulating Machine Company (BTM), the licensee of IBM in Britain and the Commonwealth, and Powers-Samas, a one-time licensee of Remington Rand. The reason for their not entering the computer market in the early 1950s was both understandable and rational. At this time, the market for computers was perceived as being a small one—selling "mathematical

instruments" to a largely technical market. The punched-card machine manufacturers, long used to selling or renting a high volume of relatively low-cost machines, did not see electronic computers as being an appropriate business into which to make a major entry. In addition, in October 1949, BTM and IBM had decided by mutual consent to break their long-standing agreement and to go into open competition worldwide. BTM was thus burdened with a massive research and development (R&D) program in conventional punched-card machinery merely to keep abreast of IBM. Powers-Samas, also exposed to competition from IBM for the first time, was in much the same position.[3]

The NRDC

The National Research Development Corporation (NRDC) was established in May 1949 under the Development of Inventions Act of 1948, with the stated aim of fostering the patenting and commercial exploitation of British inventions.[4] The first managing director of the NRDC was Lord Halsbury, a research administrator of great experience. On its formation, the NRDC acquired the Manchester University patents for the Williams Tube memory, and one of Halsbury's first tasks was to negotiate a license for IBM in New York, which needed the memory for its Defense Calculator (later sold as the IBM 701). Halsbury came away from IBM convinced that it was only a matter of time before they produced a commercial data-processing computer.

So that Britain should not be left behind in developing a data-processing computer industry, in December 1949 Halsbury brought the punched-card machine manufacturers and the electronics companies together at a roundtable conference to try to persuade them to work together to develop a data-processing machine. Unfortunately, Halsbury was unable to convince the punched-card machine manufacturers that they lacked electronics expertise; nor could he convince the electronic companies that they lacked marketing know-how. All the manufacturers preferred to go their own separate ways. Halsbury[5] recalls being told at the time by the managing director of the British Tabulating Machine Company: "You haven't got what you wanted, but you may have started something that will bear fruit." "Sixteen years later," Halsbury notes, "the fruit dropped off the tree. Too little, too late." That the transformation came too late is borne out by the contrast with U.S. office-machine firms, such as Remington Rand, Burroughs, and NCR, which all acquired fledgling computer companies in the early 1950s in order to bring in electronics and computer expertise. These firms later became major players in the mainframe computer business.

Failing in the initial attempt to create a major data-processing computer initiative, Halsbury spent the remainder of the 1950s on piecemeal efforts to bring what strength he could to the industry with his very limited resources of £5 million. For example, the NRDC helped Ferranti cope with the early commercial risk of entering the computer business by guaranteeing the sales of its Mark I* computer. A

development contract was made with Elliott Brothers to develop packaged circuit technology. This technology was subsequently used in the Ferranti Pegasus computer, whose design was specified, and whose sales were guaranteed, by the NRDC.

In most respects Halsbury was unique in the higher echelons of government science policy in his unwavering vision of computing as the growth industry of the future. However, he did make a major error of policy implementation by focusing on large prestige computer projects at the expense of bread-and-butter data-processing computers and peripherals. One failed project, for example, was a large tape-based data-processing computer, the EMI 2400, which the NRDC intended to be competitive with the IBM 7000 series. Only three, rather unreliable, computers were ever delivered. The NRDC also diverted its limited resources into sponsoring not one but *two* giant computer projects, the EMI 3400 and the Ferranti Atlas. These sponsorships took place against a backdrop of growing political concern about the prestigious U.S. giant computer projects, the IBM Stretch and the Univac LARC in 1956–1958. In the event, the EMI 3400 never saw the light of day, and although the Atlas was a superb technical success, it came to the market too late in 1964 to be a commercial success.[4]

A second major policy error was the failure to recognize the magnitude of the challenge that the switch to transistor electronics represented. While Britain had been a leader in thermionic-tube electronics in the 1950s, transistor electronics was a completely new area in which experience in the old technology counted for very little. Leadership in transistor electronics called for the same order of commitment to R&D that had produced Britain's preeminence in pulse electronics during World War II. This commitment was never given, nor was it even within the financial scope of the NRDC.

The First Merger Wave, 1959–1963

Another major policy shortcoming of the NRDC was its inability to "pick a winner" into which it could pour, undiluted, its limited resources. The barriers to entry into the computer business in the mid-1950s were already sufficiently low so that there was no shortage of electronics and control companies, such as Elliott Brothers, STC, Decca, GEC, and Plessey, that were willing to enter the field. In this respect, the NRDC in sponsoring several other firms just made the oversupply situation worse. By 1959 there were in the region of ten British computer manufacturers competing for a very small domestic market and an even smaller export market. Probably none of the British firms was making money from computers, and several firms had already left the computer business of their own volition.[6]

The watershed for the British computer industry really came with the announcement of the IBM 1401 computer in October 1959. The 1401 captured the U.S. data-processing computer market to an extent that took IBM by surprise, and exceeded all forecasts: a thousand orders were taken in the first few weeks following the announcement, and the machine went on to sell a total far in excess of 10,000 installations.[7] The success of the 1401 has often been attributed to the model 1403 chain printer that accompanied it; printing at 600 lines per minute, it enabled a single

1401 to replace four conventional punched-card accounting machines. But at least as much of the 1401's success was due to the fact that it was an integrated system, whereas other manufacturers, in the United States as much as in Britain, had yet to offer computers that were an integrated system of processor, peripherals, and software.

Another effect of the IBM 1401 launch was that it transformed the computer industry from one that had been based on the sale of high-cost capital electronic goods in low volumes, to one selling relatively low-cost machines in a much higher volume. The selling organizations of the traditional business-machine manufacturers were well adapted to this new market environment; whereas the electronics and control manufacturers who had prospered in the earlier conditions now found themselves in a market in which it was much more difficult to compete.

Each firm in the British computer industry was thus faced with the same decision: whether to stay in the industry for the long haul, or to get out while the going was good. The overall result of these individual decisions was the first merger wave of 1959–1964 (see Fig. 1). In 1959 the two punched-card machine manufacturers, BTM and Powers-Samas, merged to form International Computers and Tabulators (ICT) in order to compete more effectively against IBM. ICT lacked electronics expertise, however, so it bought out the computer interests successively of GEC, EMI, and Ferranti. In a parallel merger move, English Electric decided to complement and enhance its electronics expertise by buying up the data-processing computer manufacturer Leo Computers in 1963, and by incorporating the microelectronics know-how of Marconi the following year. By 1964 there were just three companies remaining: ICT, English Electric-Leo-Marconi (EELM), and Elliott Automation.

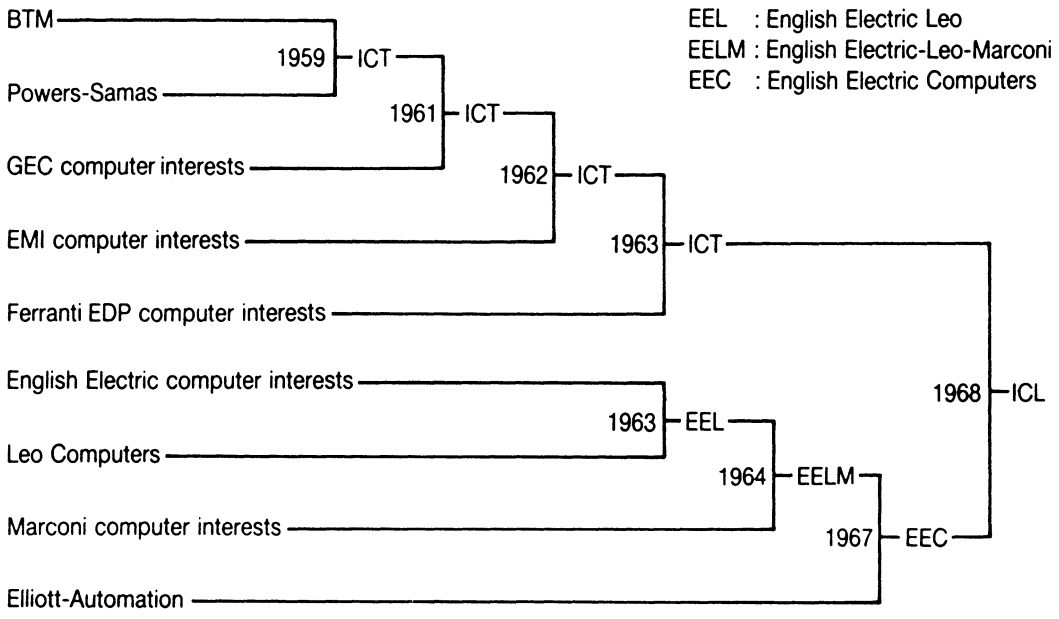

Figure 1. Evolution of ICL, 1959–1968.

The Formation of ICL, 1964–1970

System/360: The American Challenge

The IBM System/360, announced on April 7, 1964, was a compatible family of third-generation computers. The line consisted of six distinct processors and 40 peripherals, which were intended to replace all of IBM's current computers, except the smallest and the largest. The R&D cost of System/360 was reported to be $500 million, a figure that was nearly twice the annual revenue of the entire British computer industry. The scale of the announcement was entirely unprecedented, and all the evidence is that it took the rest of the industry largely by surprise.[8]

System/360 completely changed the computer market, and there were essentially three responses that a manufacturer could make: to develop an IBM-compatible line of computers; to develop a non-IBM-compatible line; or to move into a "niche" area, such as very large or small computers. ICT never seriously considered going into a niche market, as this was incompatible with being Britain's leading mainframe manufacturer. Likewise, IBM-compatibility was seen to be a poor competitive strategy for ICT. The only logical argument for a user buying an IBM-compatible computer in preference to a machine manufactured by IBM, it was felt, was because it had a better price/performance ratio, or technical superiority. ICT doubted if it could achieve this superiority, but in any case there was a deep cultural resistance toward slavishly following the IBM line.

ICT thus decided to develop its own compatible range of computers, the 1900 series, which was based on an existing Canadian design, the Ferranti-Packard 6000. An important advantage of using an existing design was that it allowed you to reduce the development lead time very considerably. The 1900 series was launched in September 1964, based on a line of seven distinct processors and a total of 27 different peripherals. The first production model was delivered in January 1965, only four months after the 1900 series announcement. The short lead time of the 1900 series proved to be a major competitive advantage over System/360, for which U.K. deliveries did not take place until spring 1966.

Turning to Britain's other major EDP-computer manufacturer, English Electric, planning activity began on a line of third-generation machines soon after the merger with Leo Computers had taken place in April 1963. These plans were initially focused on an entirely new range that was known internally as "Project KLX." With the announcement of System/360 and the 1900 series during the course of 1964, however, the pace and scale of innovation increased, and it was clear within English Electric that there was a need to contain development costs within realistic bounds. As it happened, English Electric had a long-standing technology-sharing agreement with RCA, so it decided to abandon the KLX project and take up the option of manufacturing RCA's IBM-compatible Spectra 70 series under license.

The Labour Government and Industrial Policy

The decisions of ICT and English Electric to independently embark on their own third-generation computer lines took place against a backdrop of growing political concern at the increasing dominance of the high-technology industries by multinational companies with headquarters in the United States. This mood was captured admirably by J.-J. Servan-Schreiber's popular book *The American Challenge*,[9] which was a best-seller in both France and England.

When Harold Wilson's Labour Government came to power with a slim majority in October 1964, one of its first acts was to establish a Ministry of Technology (Mintech), which was envisaged as an organization to "guide and stimulate a major national effort to bring advanced technology and new processes into British industry."[10] Wilson placed the British computer industry at the very top of Mintech's agenda:

> My frequent meetings with leading scientists, technologists and industrialists in the last two or three years of Opposition had convinced me that, if action was not taken quickly, the British computer industry would rapidly cease to exist, facing as was the case in other European countries, the most formidable competition from the American giants. When, on the evening we took office, I asked Frank Cousins to become the first Minister of Technology, I told him that he had, in my view, about a month to save the British computer industry and that this must be his first priority.[11]

Accordingly, in November 1964, the newly appointed Minister of Technology held talks with both ICT and English Electric, in what was to be the first of many attempts to persuade the companies to bring together their computer interests. But these talks came to nothing, mainly because the development of their third-generation lines had passed the point of no return, and their incompatibility meant it would not be possible to gain any significant economies of scale from a merger.

In March 1966 the Wilson Government was reelected, more determined than ever to revitalize Britain's industrial base. The role of the Ministry of Technology was expanded, and a new organization, the Industrial Reorganization Corporation (IRC), was given the mission of "promoting industrial efficiency and profitability and assisting the economy of the UK".[12] Working with the IRC, the Ministry of Technology commissioned an independent report into the possibility of a merger between ICT and English Electric-Leo-Marconi. But the report confirmed the companies' view that a merger was not a practical possibility while they were developing their third-generation lines, and that a union would not become practical until the time came to produce a new line in the 1970s.

The Ministry therefore decided to deal with the rationalization of the British computer industry in two stages: first the rationalization of the process-control computer industry, and second that of the EDP-computer industry. The former proved relatively straightforward and English Electric absorbed Elliott Automation in June 1967. The new English Electric subsidiary was named English Electric Computers Limited.

The ICL New Line

It now remained to rationalize the EDP sector of the industry. In April 1967, the minister and his technical advisors once again called a meeting with the top management of ICT and English Electric to persuade them to merge their EDP computer interests. Mintech accepted that the main impediment to a merger was the incompatibility of the current lines, and therefore offered *inter alia* a nonrepayable grant in the region of £25 million toward the development of a new line of computers for delivery in the early 1970s.

If ICT and English Electric had moved decisively, an early merger would no doubt have been achieved, but the terms of the merger were not agreed upon until early 1968, and the delay—each company hoping for marginally better terms—was to prove disastrous. During the autumn of 1967, the U.K. economic climate had worsened dramatically, culminating in the devaluation of the pound in November 1967 and the public expenditure cuts of January 1968. A government subvention of the order of £25 million was now seen as politically unacceptable, and the Treasury was thinking in terms of about half that amount—in fact, £13.5 million was eventually provided. But the merger plans were now so far advanced that there was no going back. On March 21, 1968 the Minister of Technology presented a white paper on the computer merger to the House of Commons, and ICL was vested on July 9, 1968. ICL was the largest non-American computer manufacturer, with a workforce of 34,000.

The New Range development created a mild euphoria in the newly formed ICL: it was regarded as a once-in-a-lifetime opportunity that was eagerly grasped. The project was very much in the spirit of the 1960s, and captured the national mood in a manner similar to, though milder than, the one the Concorde had. However, the reduced R&D subvention meant that the New Range development was underfunded from the start, which led to a financial crisis in the 1970s. Moreover, the logistical and financial implications of developing a complete new line *ab initio* had not really been thought through, so that a project that was intended to take 3 years eventually took well over 5 years, and it was not until 1974–1976 that the complete line was available. Serious as the delays were from a marketing viewpoint, the biggest difficulty was in keeping the project viable through the various policy shifts during the 1970s.

The 1970s and 1980s: Shifting Policies

The Political Dimension

To understand British information-technology policy in the last 20 years, it is necessary to appreciate the economic and political outlooks of successive U.K. governments, that is, under Edward Heath, Harold Wilson, and Margaret Thatcher:

- Conservative Government (Edward Heath), June 1970–October 1974
- Labour Government (Harold Wilson, James Callaghan), October 1974–May 1979
- Conservative Government (Margaret Thatcher), May 1979–November 1990

The Heath Government started off in a strong noninterventionist style, which was partly a reaction to the policy failures of the Wilson Government of 1964–1970. This noninterventionist resolve, however, was strongly undermined during the economic recession of 1971–1972. The Labour Government of Harold Wilson, which was returned to office in 1974, continued the strong interventionist policy of the 1960s, but also turned increasingly to demand-side measures to stimulate the use of information technology. Finally, the Conservative Government of Margaret Thatcher, which came into office in 1979, was far more robustly noninterventionist than any previous government, and was neutral or even negative to the computer industry. It did, however, have a strong demand-side orientation.

By the early 1970s, computers and the computer industry had become controversial political issues, and the subject of much open discussion. The major political forum for debate was the Select Committee of Science and Technology, a nonparty parliamentary body that met to conduct inquiries into the government's science and industrial policy in various fields. Two inquiries into the computer industry were held, one in 1969–1971 and one in 1972–1973. These inquiries generated several thousand pages of evidence that are a superb source for the history of the computer industry and government information-technology policy.[13] Unfortunately, political concern over information technology was not sustained at the level of the early 1970s, and there were no further select committee inquiries until 1988, a period of 15 years.[14] This will make the analysis of policy between 1975 and 1985 somewhat daunting until State papers become available under the 30-year rule.

Policies Toward ICL and the Computer Industry

As already noted, the Heath Government, elected in June 1970, was doctrinarily noninterventionist toward industry, and one of its first acts was to disband the Industrial Reorganization Corporation and to narrow the scope of the Ministry of Technology and rename it the Department of Industry. The nonparty select committee on the computer industry was highly critical of the government's attitude, however, arguing that more rather than less support should be given to the computer industry. This is important, because it indicates that in 1970–1971 there was a consensus in favor of state intervention in the computer industry, notwithstanding the government's noninterventionist policies.

The British computer industry was soon caught up in the 1970–1971 computer recession. This was the same recession that saw the withdrawal of the U.S. industrial giants RCA and General Electric from the data-processing computer field. By summer 1971, ICL was in crisis and forced to lay off workers and review its R&D program for the New Range. Initially, the government refused assistance, and obliged the company to consider a merger with a U.S. company, such as Univac or Burroughs. When the government was forced to rescue Rolls Royce from financial collapse in 1972, however, its "lame-duck" policy was weakened.[15] The government eventually agreed to a loan of £27 million to ICL which was to be repaid out of profits. This enabled the New Range development to continue.

The reelection of Wilson's Labour Government in October 1974 coincided with ICL's best-ever years, and it needed no direct help to successfully launch the

New Range. Much criticism had been leveled at the Labour Government, however, because its computer industry policies were almost exclusively focused on ICL as the national champion mainframe manufacturer. It was argued that this fixation on ICL caused the government to neglect the minicomputer industry, so that British companies such as CTL and Arcturus had foundered. This criticism was partly redressed by the formation of the National Enterprise Board (NEB) in 1975, which enabled the government to attempt to "pick winners" and to invest in them directly, somewhat in the manner of a state bank. Besides investing in several fledgling and small information-technology companies, the NEB took a 25 percent share holding in ICL, and had a director on its main board. The NEB also financed the launch of two major companies, Inmos and Nexos. Inmos was formed in 1978 with the intention of restoring the United Kingdom's position in semiconductor manufacturing, initially producing memory chips. Some £115 million was provided between 1978 and 1980. The office automation company Nexos was formed in 1979, with initial funds of £40 million.[16]

With the election of the Thatcher Government in May 1979, the political pendulum once more swung toward nonintervention in industry. The NEB's shareholding in ICL was sold, and the NEB was itself heavily curtailed and merged with the NRDC to form the British Technology Group (BTG) in February 1981. Although funds were provided for the survival of Inmos and Nexos during the 1980–1981 recession, the government sold both companies as soon as was practical, Nexos in 1982 and Inmos to Thorn-EMI in 1984.

The noninterventionist policy of the Thatcher Government had its severest test in 1981 when ICL ran into a financial crisis. The government was caught in the dilemma of either making a policy U-turn, or allowing ICL to fall into U.S. hands. Eventually a brilliantly face-saving solution was found by which the government guaranteed bank loans of £200 million. This enabled ICL to survive without any direct financial assistance from the government (although it can be argued that the government underwrote some hefty insurance).

Competition, Protection, and Procurement

So far, I have only considered the positive aspects of industrial policy that were aimed at helping ICL to become competitive by enabling it to undertake long-term R&D, and to adopt a longer term view of the industry than would have been possible under ordinary commercial conditions. A second, and much more controversial, policy, however, was that of protecting ICL through procurement policies aimed at maintaining its dominance of the U.K. market.

Up to the late 1950s a procurement policy had been largely unnecessary, because British computers had generally been price-competitive with American machines, and the postwar "Buy British" attitude made a home-produced article generally preferable, all other things being equal. In the 1960s, however, with the arrival of second-generation computer systems, British machines became far less competitive. While private industry frequently bought superior U.S. machines, the public sector—that is, national and local government, defense, quasi-government or-

ganizations, education, and nationalized industries—were pressured to buy British. Even so, between 1962 and 1967, the sales of British-produced computer systems fell from 80 percent to 45 percent of the domestic market.[17]

During the 1960s, the government's procurement policy had never been formally documented, and its unofficial status was "shrouded in mystery."[18] The 1970 Select Committee on Science and Technology, however, succeeded in prizing out of the Civil Service Department its unpublished guidelines for computer purchase:

1. To acquire large computers (those more powerful than Atlas) by single tender action from I.C.L., subject to satisfactory price, performance and delivery dates.
2. To acquire smaller computers by single tender action (normally from I.C.L.) when they are intended to lead-in to the use of a large computer of the same family or where there are other reasons for seeking compatibility or flexibility by the use of machines of the same family, subject to the same proviso about price, performance and delivery.
3. In all other cases, including large computers where I.C.L. are unable to meet all the conditions specified in (1) above, to seek competitive tenders from not less than 3 firms, . . . allowing preference in favour of any British machine provided that there is no undue price differential as compared with overseas supplies, that the British machine is technically suitable and that no undue delay is involved.[19]

Clearly, rule 1 was designed to protect the large, prestige computer market; this would help ensure the survival of ICL's top-end machines, which were considered an essential marketing requirement of a compatible range. Rule 2 was intended to ensure that small and first-time users became locked into an ICL range rather than a U.S. one. And, finally, rule 3 ensured that even when ICL could not supply a suitable machine, a U.S. alternative could not be chosen without considerable bureaucratic obstacle. The effect of the procurement policy was that between 1969 and 1971, ICL's share of government orders rose from 69 percent to 90 percent.

Not surprisingly, U.S. manufacturers complained about the preference given to ICL. Honeywell, in particular, pointed out that its machines used more British components than ICL's, and it had a factory in Scotland that it had set up in the expectation of receiving orders from the public sector, in accordance with Mintech's stated policy that "machines made in Britain by subsidiaries of foreign firms are regarded in this context as British."[20] On the other hand, as further evidence presented to the subcommittee revealed, U.S. manufacturers were well protected by the Buy America Act, and the French, German, and Japanese governments were each protecting their own computer industries. In fact, ICL's view was that the procurement policy was something of a distraction, since the government accounted for a mere 15 percent of national computer orders. In the United States, government orders accounted for perhaps one-third of the overall market. If the British Government merely increased its demand in proportion, it would be of more value to ICL than the procurement policy.

There was also a view from economic commentators outside the industry that the competitiveness of British industry generally was being damaged by having unsuitable computers foisted on it. In the light of the hostile attitude to the procurement

policy, which in any case damaged ICL's image, the procurement guidelines were generally relaxed from the mid-1970s. And following the privatization programs of the Thatcher government, and a move away from mainframe-based computing, its importance diminished further.

Conclusion. Policy Analysis: Success or Failure?

It was stated at the beginning of this chapter that British policies toward the computer industry had two broad aims: the defense of the balance of payments, and the maintenance of a strategic information-technology industry.

The balance of trade is the easiest policy aim to quantify. Table 1 shows the import–export performance of the U.K. information-technology industry over the period 1965–1985, in 5-year intervals. There was a persistent trade deficit in information-technology goods throughout this period, although as a proportion of the total market the deficit has shown an improving trend. What is not clear, however, is the extent to which intervention in the British computer industry has affected these figures. For example, it is well known that IBM tends to maintain a net input–output trade balance in whatever country it operates. Consequently, if ICL had not existed, its products would have been largely substituted for by those of IBM, and the effect on the balance of trade would have been small, and possibly even favorable. Indeed, the policy emphasis on the balance of payments was probably misplaced. A program directed primarily at increasing the per capita consumption of computers in Britain, instead of merely improving the balance of payments, might have been a blunter yet far more effective policy instrument.

So far as maintaining a strategic national computer industry is concerned, there were both policy successes and failures. A national mainframe industry was successfully maintained, and at an astonishingly low direct cost of £40 million. (And if one takes into account the profit realized in the sale of the government's share holding in ICL in 1979, there was no cost at all.) But there were unquantifiable indirect costs due to the procurement policy that obliged the public sector to use sub-state-of-the-art computers. The industrial policy was much less successful in fostering the mini- and microcomputer industries: the former because it was overshadowed by ICL in the mid-1970s, and the latter because investment went into the semiconductor industry (i.e., Inmos), instead of supporting a personal-computer industry.

TABLE I. U.K. Balance of Trade in Information Technology, 1965–1985

	1965	1970[a]	1975	1980	1985
Imports (£ millions)	18.6	111	383	1080	3919
Exports (£ millions)	7.2	52	242	936	3314
Balance (£ millions)	−11.4	−59	−141	−144	−605

[a]Nine months.

Sources: Select Committee on Science and Technology, 1971 and 1973,[15,16] and the Trade and Industry Committee, 1988.[14]

Probably the main failure of the computer policy, however, was tactical rather than strategic, that is, it was the failure to realize that there could never be a once-and-for-all solution to the ICL problem. If it had been understood in 1968 that ICL would always need a drip-feed of cash for R&D, and financial support to get it through cyclical recessions in the computer industry, then the policy might have been more decisive: either giving no support at all, and allowing the industry to fall into U.S. hands, or supporting ICL handsomely so that it could compete much more strongly in terms of technology.

Since 1982 there has been no direct government investment in the computer industry, and a diminishing concern over its sovereignty. During the last 3 years, ICL has been sold to Fujitsu; Inmos has been sold to Italian and French interests; and several major players in the U.K. software and services industry have been allowed to fall into French and U.S. ownership. The importance of having a strategic information-technology industry has become a smaller political concern in recent years, for it is now understood that no nation's computer industry can be independent of Japan or the United States for its supply of semiconductor chips and software. While a substantial information-technology R&D activity remains in Britain, strategic control has unquestionably been lost. It is far from clear whether this actually matters or not.

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