Technological Gaps:
Quantitative Evidence and Qualitative Arguments

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One element that characterizes most national statistics today is their comparative basis. It is commonplace to argue that the only way for a country to assess its performance in science and technology is by comparing its efforts to those of the past, or to those of other countries. Indeed, most national policy documents start by drawing a picture of the world context or of their main competitors, often illustrated with statistics. The OECD is no exception to this rule. As an international organization, the OECD has always looked at science and technology policies within a comparative framework. A given country was distinguished, categorized and evaluated either against other countries, or according to standards or norms, the latter being those of the "best-performing" country. Today, this philosophy of examining policy manifests itself through studies on best practices, benchmarking exercises and scoreboards of indicators.

The OECD ranking exercises conducted over the period 1963-2000 were documented in the previous chapter. This paper documents another such exercise, one that had a strong influence on European science and technology policies and statistical work: the measurement of technological gaps between Western Europe and the United States of America. In the 1960s, French bureaucrats and journalists launched a debate on the American domination of European science and technology. Echoing UK Prime Minister Harold Wilson, [1] J.-J. Salomon (under the pseudonym J.-J. Sorel), head of the Science Policy Division at the OECD Directorate for Scientific Affairs (DSA), summarized the debate in the following terms: [2]

[1] Wilson warned "of an industrial helotry under which we in Europe produce only the conventional apparatus of a modern economy, while becoming increasingly dependent on American business for the sophisticated apparatus which will call the industrial tune in the 70's and 80's": H. Wilson, cited in J.-J. Servan-Schreiber (1968), *The American Challenge*, translated from the French by R. Steel, New York: Atheneum House, p. 78.
[2] J.-J. Sorel (1967), Le retard technologique de l'Europe, *Esprit*, November, pp. 755-775.

> The technological development of the United States will thus be the mark of a new stage of growth (and power) to which the European countries, despite their progress, will find themselves threatened with not being able to attain (p.761). [The real debate] is on the consequences in the medium and the long term, which could lead to a difference of scale between the scientific and technical business in the United States and in Europe, that is, in the threat of domination that it contains. For industrialized countries, it is perhaps on the field of science and of technology that their future independence will be decided (p. 774).

The OECD took part in the debate with an important quantitative analysis aimed at documenting the issue. Between 1965 and 1970, an experimental international statistical comparison, nine sector studies, one analytical report and a synthesis were published. This was the first exercise to compare countries based on several science and technology indicators in order to draw policy conclusions. The OECD synthesis opposed, to a certain degree, the French fears: the gap was not technological – this was only an effect – but institutional and cultural.

At about the same time, the government of the United States also undertook its own analysis of the problem and concluded similarly: "The problem of the technological gap is only partly technological. Psychological, political, economic, and social factors are probably more important", stated the US Interdepartmental Committee on the Technological Gap (known as the Hornig Committee).

This paper looks at the debate and the statistics used to support the case for technological gaps. It is divided into four parts. The first traces the origins of the concept of technological gaps to the debate on productivity gaps in the 1950s. The second part examines the French discussions regarding discrepancies in science and technology between Western Europe and the United States. It was these discourses which politicized the debate and which introduced it into the field of science and technology. The third part presents the OECD results and conclusions arising from a two-year study on the issue. This latter part, using a document specifically declassified for the current analysis, looks at the US reaction and response to the debate.

The Productivity Gap

In 1948, the United States launched the European Recovery Program (ERP) or Marshall Plan, aimed at participating in the reconstruction of Europe. Five billion dollars were devoted "to stimulate greater efficiency in European industrial production through the introduction of American production techniques, styles of business organization, and labour-management partnerships. The vehicles for achieving this goal included a variety of technical-assistance projects, engineering schemes, and productivity surveys that were launched in Europe with the aid of American experts (…)". [3] For the Americans, the panacea for European economic recovery was to increase productivity. [4] The productivity movement, originally launched by the Marshall Plan, was amplified by Great Britain. [5] In 1948, L. Rostas, a statistician in the British Board of Trade (Department of Trade and Industry) published an influential report comparing the productivity of British and American industry, and showing a considerable disparity or gap in favour of the United States in most of the twenty or more industrial sectors studied. [6] At the same time, the newly-created British Advisory Council on Science Policy (ACSP) set up a group of industrialists, trades union representatives, scientists and engineers to report on how science and technology could best contribute to increasing the nation's industrial productivity. The (Gibbs) report stated that in the short run, research could have little immediate effect on productivity levels. [7] The effort should be focused on inculcating a rational, scientific approach in industry, and by adapting operations research methods that had been so successful during the war. These would also be the solutions favoured by the

[3] M. J. Hogan (1987), *The Marshall Plan: America, Britain, and the Reconstruction of Western Europe, 1947-1952*, Cambridge: Cambridge University Press, p. 142.
[4] C. S. Maier (1977), The Politics of Productivity: Foundations of American International Economic Policy After World War II, *International Organization*, 31, pp. 607-633; D. Ellwood (1990), The American Challenge and the Origins of the Politics of Growth, in M. L. Smith and M. R. Peter (eds.), *Making the New Europe: Unity and the Second World War*, London: Pinter, pp. 184-199; D. W. Ellwood (1997), The Marshall Plan and the Politics of Growth, in R. T. Griffiths, *Explorations in OEEC History*, Paris: OECD, pp. 99-107.
[5] A. King (1992), *The Productivity Movement in Post-War Europe*, 18 pages, unpublished.
[6] L. Rostas (1948), *Comparative Productivity in British and American Industry*, National Institute of Economic and Social Research, Cambridge: Cambridge University Press.
[7] Advisory Council on Scientific Policy (1948), *First Annual Report*, Cmd 7465, London.

British Committee on Industrial Productivity, [8] and by the Anglo-American Council on Productivity which participated actively in the organization of the US Technical Assistance and Productivity Program of the ERP.

To manage and distribute the American aid, European countries set up the Organization for European Economic Co-Operation (OEEC) in 1948 at the request of the United States. The following year, the Council of the OEEC set up a group of experts (WP3), which led to a regular program on productivity supervised by a committee for Productivity and Applied Research, which was set up in 1952. A year later, the OEEC established the European Productivity Agency (EPA) as a condition for receiving the second aid program (after the Marshall Plan expired) from the United States ($100 million). By 1955, the EPA had an operational staff of 200, representing some 45% of the OEEC's total operational staff. [9]

When the EPA was first set up, European economic recovery was practically completed, but "the original attitude of mind still persisted. The tendency was still to try above all to make up the ground lost in Europe (…). The high productivity of American firms was due to their operating conditions as much as to their technical advances. (…)". [10] The EPA therefore continued the kind of projects initiated by the ERP. According to R. Grégoire, director of the EPA, over the period 1953-58 three phases characterized the Agency. [11] The first he called technological, and it was driven by the "illusion that the United States had discovered, thanks to the war, so many new processes, so many new production methods, that to bridge the gap it would above all be necessary to strive to make up for this technological advance" (p. 208). In a study on the role which American investments had played in assisting the post-war economic recovery of Western Europe, the OEEC summarized this view as follows: "The United States capital [carried] with it

[8] See *First Report of the Committee on Industrial Productivity*, Cmd. 7665, London: HMSO, 1949; *Second Report of the Committee on Industrial Productivity*, Cmd. 7991, London: HMSO, 1950.
[9] W. A. Brusse and R. T. Griffiths, Exploring the OEEC's Past: The Potentials and the Sources, in R. T. Griffiths (ed.), *Explorations in OEEC History*, Paris: OECD, p. 27.
[10] OEEC (1959), *Report of Working Party no. 26 of the Council*, C (59) 215, p. 5.
[11] R. Grégoire (1958), L'Agence Européenne de Productivité, in G. Berger et al., *Politique et technique*, Paris: Presses universitaires de France: 197-218. For the kind of projects initiated by the Agency, see OECD (1965), *Répertoire des activités de l'EPA, 1953-1961*.

improved technology, efficient production and sale methods, patents, management, skilled personnel and fresh ideas, all elements from which the economies of the most advanced European countries can derive higher productivity". [12] The belief in American technology led to missions to the United States, the diffusion of scientific and technical information (conferences, centers, digests, surveys), and activities on cooperation in applied research.

The second phase of the EPA was motivated by the idea that it was managerial and social factors that were responsible for productivity: "the difference between the average productivity of American businesses and that of European businesses can be mostly explained by a better conception of business management and a better social climate" (p. 212). The EPA therefore decided that it should "concentrate mainly on management problems and the improvement of co-operation between management and labour". [13] This led to missions and conferences of experts, but also to the setting up of training centers on management and national productivity centers, conferences on the administration and organization of research, the inculcating of scientific methods in industry (operational research), the development of productivity measurement techniques and surveys on the attitudes of labour toward technological change. [14]

The last phase, according to Gregoire, saw a return to technological considerations: "we seem to have discovered (…) the extraordinary deficiency of technical personnel in Europe" (p. 216). Indeed, Europe was now afraid "of being outdistanced by the United States and the USSR". [15] By 1957-58, it was recognized that "new technological developments were important elements in determining the long-term rate of growth". [16] "The strictly narrow concept of productivity, which was appropriate to the economic situation when the Agency was created, should now give way to a wider concept",

[12] OEEC (1954), *Private United States Investment in Europe and the Overseas Territories*, Paris, p. 31.
[13] OEEC (1959), *Report of Working Party No. 26 of the Council*, C (59) 215, p. 5.
[14] A. King (1992), The Productivity Movement in Post-War Europe, *op. cit*.
[15] Boel (1997), The European Productivity Agency, 1953-61, in R. T. Griffiths, *Explorations in OEEC History*, Paris: OECD, pp. 99-107, p. 117.
[16] OEEC (1959), Report of Working Party no. 26 of the Council, *op. cit*. p. 6.

claimed the OEEC working party (WP26) on the future of the EPA. [17] According to several people and organizations, however, the emphasis should continue to be placed rather on management factors. [18] In fact, two groups of countries struggled on this issue at the EPA. One group was concerned with "traditional" activities, which were those pertaining to increasing productivity (the Nordic group of countries, plus Belgium), the other group with problems relating to science and technology, notably the training of scientific and technical personnel (France, Italy, US, OEEC Secretariat). [19] But for WP26, it was clear that science and technology "should be given relatively more importance in the future Agency programmes than they have had in the programmes of the EPA". [20] Indeed, the OEEC had also been starting to become more active in the field of science and technology for some years, [21] mainly because "the future development of the European economy demanded increased numbers of highly trained scientists and technologists". [22]

The *rationale* of WP26 concentrated on comparing European and American performance: "Between the highly developed, science-based industries of the United States and the explosive development of Russian technology, Europe sits uneasily. (…) True, Europe has the great advantage of the tradition and maturity of its scientific institutions, and particularly those for fundamental research. (…) But this is not enough. (…) Europe has, as a region, been slow to exploit in production the discoveries of its laboratories." [23] "It is

[17] *Ibid*. p. 8.
[18] See R. F. Kuisel (1988), L'American Way of Life et les missions françaises de productivité, *Vingtième siècle*, 17, January-March, pp. 21-38; R. F. Kuisel (1993), The Marshall Plan in Action, in *Le plan Marshall et le relèvement économique de l'Europe*, symposium held at Bercy on March 21, 22 and 23, 1991, Comité pour l'histoire économique et financière de la France, pp. 335-357.
[19] B. Boel (1997), *The European Productivity Agency: Politics of Productivity and Transatlantic Relations, 1953-61*, Ph.D. Dissertation, Department of History, Copenhagen: University of Copenhagen, 1997, p. 70.
[20] OEEC (1959), Report of Working Party no. 26 of the Council, *op. cit*. p. 8.
[21] Four areas characterized the early activities of the organization: 1) creation of an atmosphere of public understanding (for which it organized conferences on the administration and organization of research, and the improvement of basic education), 2) provision of scientists and engineers (for which a working party on shortages was set up, countries reviewed and international surveys conducted); 3) co-operation in applied research (roads, water, ships, metal, etc.), and 4) dissemination of scientific information (by networking with the national information centers involved – among other things through STI from Eastern Europe, and SME; by conducting surveys on industrial needs).
[22] R. Sergent (1958), *Coopération scientifique et technique: note sur les activités de l'OECE*, Memorandum, January 22.
[23] OEEC (1959), *A Programme for European Co-operation in Science and Technology*, C/WP26/W/4, p. 2.

no longer possible for each of its constituent countries to undertake the amount of research necessary for its security and prosperity". [24] But "most of our governments have evolved little in the way of a coherent national science policy, while the concept of scientific research and development as an important and integral feature of company investment is foreign to the thought of most of European industry". [25] The working party proposed merging the EPA Committee of Applied Research (CAR) and the OEEC Committee of Scientific and Technical Personnel (STP) under a Committee of Scientific Research (CSR), and the setting up of a 7 to 10-year program based on the Wilgress report. [26]

Indeed, in 1959, Dina Wilgress was asked by the Secretary-General to visit member countries to discover their approaches to science and technology. He reported: "It is in Western Europe that most of the great scientific discoveries have taken place (…) but in the race for scientific advance, the countries on the Continent of Europe stood comparatively still for more than two decades while the Soviet Union and North America forged ahead". [27] The sources of the problem were many: the educational system was "better fitted for turning out people trained in the liberal arts than in science and technology"; there were prejudices against those who work with their hands, and few applications of the results of science; there were also lack of resources for science, too great an emphasis on short-run profits and not enough on investment for the future, small-sized firms not so science-minded, and inadequacy of university facilities and technical training.

It was in this context that the newly created OECD (1961) turned to the promotion of national science policies. To better enlighten these policies, the OECD would conduct R&D surveys and economic studies of science, and borrow the EPA notion of the

[24] *Ibid*. pp. 2-3.
[25] *Ibid*. p. 3.
[26] See also: OEEC (1959), *Report of Working Party no. 26 of the Council*, C (59) 215; OEEC (1959), *Work in the Scientific Sector*, C/WP26/W/22; OEEC (1961), *Preliminary Draft of the Programme of the Committee for Scientific Research*, EPA/AR/4185.
[27] OECD (1959), *Co-operation in Scientific and Technical Research*, C (59) 165, p. 14. Officially published in 1960.

productivity gap, which became, mainly under the influence of the French, the technological gap.

French Ambitions

The 1960s was a period when the French opposed the Americans on every front: politics, business and culture. [28] During this period, France was also the first European country to denounce a technological gap between Western Europe and America: in 1964, P. Cognard, from the French *Direction générale de la recherche scientifique et technique* (DGRST), extended the then-current debate on American domination to science and technology with a kind of "manifesto" published in the journal of the Directorate, *Le Progrès scientifique*. He was followed, three years later, but in a more subtle way, by Jean-Jacques Servan-Schreiber, editor of the weekly *L'Express*. Both men alerted the public to the danger of political and economic dependence on the United States if something were not done rapidly in science and technology on the European continent.

A Political Manifesto

Cognard started his "manifesto" as follows: [29] "Numerous are those who think that (…) Europe is on the point of making up for its slowness compared to the United States (…). [Unfortunately, they are basing themselves] on a somewhat outdated conception of productive wealth, dating back to an age when the classical factors of production were built only on capital, manpower and primary materials" (p. 2). For Cognard, "a new step in the industrial revolution is underway which will be marked by a systematic use of scientific progress in industry" (p. 9).

According to Cognard, the American superiority in science and technology "risks creating a science gap to the benefit of the United States" (p. 2), "a loss of balance from

[28] R. Kuisel (1993), *Seducing the French : The Dilemma of Americanization*, Berkeley: University of California Press.
[29] P. Cognard (1964), Recherche scientifique et indépendance, *Le Progrès scientifique*, 76, September, pp. 1-15.

which our economic freedom of action could suffer" (p. 6), and risks creating two categories of firms: the pioneers and the followers (p. 11). "He who has technological superiority is master" (p. 11):

> We are permitted to fear several difficulties in the future, of which the first have appeared or will appear in all new or high-tech industries, that is, all industries in which first expansion, and then survival, are intimately conditioned by scientific concentration and a very significant innovative power (…). The industry of the latter part of this century will be a refined industry or "grey-matter" industry (…). These will be businesses with considerable laboratories and brain-power, working in complete symbiosis with the greatest scientists, with the firm idea of rapidly drawing from research and from the latest advances in basic science all the elements likely to prompt the greatest possible innovation in their productions (p. 8).

Cognard concluded his essay as follows: "Certainly it would be absurd to systematically oppose oneself to the introduction into a country of a foreign firm which brings in a superior technology and thus contributes to economic progress and to improvement of the standard of living in the welcoming country (…). Nevertheless, we do not well see how a Nation could maintain its political independence if such penetration becomes generalized, and if a large part of its means to design and to produce are subordinated to the technical and economic decisions of foreign firms (p. 14).

The American Challenge

Servan-Schreiber's book was a best-seller for several weeks. [30] As Arthur Schlesinger reported in his foreword to the English edition: "In France no book since the war, fiction or non-fiction, sold so many copies in its first three months" (p. vii). According to Servan-Schreiber, American firms were seizing power within the European economy with foreign investments that "capture those sectors of the economy most technologically advanced, most capable to change, and with the highest growth rates" (p. 12). "Fifteen years from now it is quite possible that the world's third greatest industrial power, just after the United States and Russia, will not be Europe, but American industry in Europe" (p. 3).

[30] J.-J. Servan-Schreiber (1968), The American Challenge, *op. cit*.

For Servan-Schreiber, electronics was symptomatic of the situation: "Electronics is the base upon which the next stage of industrial development depends (…). A country which has to buy most of its electronics abroad will be in a condition of inferiority" (p. 13), and will remain "outside the mainstream of civilization" (p. 14). "It is a historical rule that politically and economically powerful countries make direct investments (and gain control) of less-developed countries" (p. 12).

Echoing Cognard, Servan-Schreiber framed the problem as a dilemma: [31] "Restricting or prohibiting investments is no answer, since this would only slow down our own development" (p. 17): "We must admit once and for all that American investment brings important, and even irreplaceable, benefits" (p. 24). "Yet if Europe continues to sit passively as US investments flood the Continent, our whole economic system will be controlled by the Americans" (p. 17). Conclusion: "If American investment is really part of the phenomenon of power, the problem for Europe is to become a great power" (p. 27).

For Servan-Schreiber, however, American investments were only part of the problem. [32] In fact, the success of Americans was due to a number of factors, like firm size and capital availability, and above all, high R&D investments, federal spending, higher education and new methods of organization and management. "The American challenge is not basically industrial or financial. It is, above all, a challenge to our intellectual creativity and our ability to turn ideas into practice" (p. 101). For Servan-Schreiber, European countries needed to create a real common market ("only on a Europe-wide level, rather than a national one, could we hope to meet the American challenge" (p. 111)) and develop a European technological community by way of a real European science policy (not based on the politics of "fair return" according to each country's financial contribution).

[31] The same argument was repeated by Servan-Schreiber on pp. 26, 38-39.
[32] For a good analysis of the problem of American investment in France, see: A. W. Johnstone (1965), *United States Direct Investment in France: An Investigation of the French Charges*, Cambridge: MIT Press.

The OECD Study on Technological Gaps

It was in this context, that the second OECD Ministerial conference on science held in 1966 asked the Secretariat to study "national differences in science and technical potential" between Member countries. [33] The OECD had, in fact, recently published an experimental international statistical comparison adding fuel to the debate (by documenting an R&D between the United States and Western Europe), [34] and was completing the analysis of its first international survey data on R&D, to be publish in 1967, the preliminary results of which were presented to the ministers. [35] The latter survey would concentrate on the discrepancies between the United States and European countries. It showed that the United States' GERD (Gross Domestic Expenditures on R&D) was highest in absolute terms as well as per capita (p. 15), and that it had the most scientists and engineers working on R&D (p. 17): "There is a great difference between the amount of resources devoted to R&D in the United States and in other individual member countries. None of the latter spend more than one-tenth of the United States' expenditure on R&D…nor does any one of them employ more than one-third of the equivalent United States number of qualified scientists and technicians", reported the OECD (p. 19).

The context within which the OECD introduced its report on R&D was the then-current debate on technological gaps. The organization refused, however, to use either the term "debate" or "gaps": "It is hoped that this report will contribute to the clarification of existing public discussions on this matter, in particular in connection with technological disparities between member countries" (p. 5), that is, between the United States and Western Europe.

A year later, however, the OECD published *Gaps in Technology*. [36] The project started at the end of 1966 and was, according to the OECD, "the first time that a study on the

[33] OECD (1966), *The Technological Gap*, SP(66) 4.
[34] C. Freeman and A. Young (1965), *The R&D Effort in Western Europe, North America and the Soviet Union*, Paris.
[35] OECD (1967), *The Overall Level and Structure of R&D Efforts in OECD Member Countries*, Paris.

technological differences between Member countries has been undertaken". [37]. For the OECD, the analysis of the problem could not "be further advanced without intensive study in specific industrial sectors". [38] To this end, a working group was set up, chaired by Jacques Spaey from Belgium, and composed of representatives from France, Germany, Italy, Norway, the United Kingdom and the United States, to answer the following three questions: [39]

- What are the differences between Member countries in their scientific and technical potential?
- What is the nature of the differences?
- What action is appropriate to ensure that Members' potential will be increased?

At the suggestion of the United States, industrial sectors were chosen for specific studies, and a check-list sent to Member countries in early 1967 to obtain information on the economic performance of each industrial sector, on the role of R&D and innovation in their economic performance, and on factors which stimulate or hinder R&D and innovation. [40]

As a result, the OECD produced three types of documents: a synthesis report, [41] an analytical report, [42] and six sectoral studies. [43] Overall, the OECD collected information on three related aspects of the problem of technological disparities: 1) differences in the development of national scientific and technological capabilities; 2) differences in performance in technological innovation; 3) economic effects of 1 and 2.

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[36] OECD (1968), *Gaps in Technology: General Report*, Paris.
[37] OECD (1967), *Gaps in Technology Between Member Countries: Check-List*, DAS/SPR/67.3, p. 2.
[38] OECD (1966), *Differences Between the Scientific and Technical Potentials of the Industrially Advanced OECD Member Countries*, DAS/SPR/66.13, p. 2.
[39] OECD (1966), *Working Group on Gaps in Technology Between Member Countries*, DAS/SPE/66.16.
[40] OECD (1967), Gaps in Technology Between Member Countries: Check-List, op. cit.
[41] OECD (1968), Gaps in Technology: General Report, *op. cit.*
[42] OECD (1970), *Gaps in Technology: Comparisons Between Countries in Education, R&D, Technological Innovation, International Economic Exchanges*, Paris.
[43] Scientific instruments, electronic components, electronic computers, plastics, pharmaceuticals, non-ferrous metals.

With regard to science and technology capabilities, the OECD looked at graduates, the migration of scientists and engineers, and R&D. Concerning the production of graduates, *Gaps in Technology* found that "the United States appears to put relatively much more emphasis on pure science than on technology [while] the European effort in technology surpasses the United States' effort in both relative and absolute terms" (p. 12). Turning to the migration of scientists and engineers, the OECD stated: "Europe has lost in recent years approximately 2,000 scientists and engineers annually", but the report immediately added: "significant rates of emigration are, however, limited to a few countries only, and they are, moreover, concerned with one-way flows only" (p. 12). But it was the statistics from the first international survey on R&D that was the main variable used here: "in 1964, the United States devoted 3.4% of GNP to R&D, the economically-advanced European OECD countries together 1.5%, the European Economic Community 1.3%, Canada 1.1% and Japan 1.4%" (p. 13). The largest disparity in R&D was found to be in industry: "no firm in any European country has an R&D programme of this magnitude" (more than $100 million per annum) (p. 13). In basic research, "the United States has a strong position in most fields of fundamental research, but above all in fields where heavy capital and maintenance expenditures, and a large number of highly qualified scientists (above Ph.D. level) are necessary…European fundamental research units are generally smaller." (p. 13). Government funding of R&D was also higher in America: "the United States devoted four and a half times as much public money to R&D as industrialized Western Europe", although it is highly concentrated in defense, space and nuclear energy (p. 13). "While it has not been the aim of the United States policy to support industries or products directly for commercial purposes, the indirect commercial effects have been considerable" (p. 14).

On the second item – innovation –, the conclusions were similar in tone: "Firms based in the United States have had the highest rate of original innovation over the past 15 to 20 years. Of the 140 innovations studied, they have originated approximately 60%. United States firms also have the largest share of world exports in research-intensive product groups (about 30%), and the largest monetary receipts for patents, licensing agreements, and technological know-how (between 50 and 60% of total OECD receipts)" (p. 15).

"One conclusion that appears irrefutable: United States firms have turned into commercially successful products the results of fundamental research and invention originating in Europe. Few cases have been found of the reverse process" (p. 17).

With regard to the diffusion of innovation, the report found that the "the United States have the highest level of diffusion of new products and processes, but many other member countries have had higher rates of increase in the diffusion of new products and processes over the past 10 to 15 years. However, rates of increase in diffusion have been much higher in Japan…" (p. 17). But above all, for the OECD, "differences between member countries in performance in originating innovations do not appear to have had any [negative] effects on member countries' overall economic growth performance" (p. 18).

Finally, with regard to the economic impacts (or outcomes) of science and technology, the OECD looked at two indicators. Firstly, flows of technology: "The United States' receipts for patents, licenses, etc., account for 57% of total receipts in OECD countries" (p. 19). Secondly, trade statistics showed that "the United States tends to have a trading advantage over other member countries in newer, more sophisticated products" but, again, "there is no indication that the United States advantage in those goods where scientific capability and innovation skills are important has had deleterious consequences for other countries" (p. 18).

Overall, in the view of the OECD, the causes of the gap were not R&D *per se*: "scientific and technological capacity is clearly a prerequisite but it is not a sufficient basis for success…The market – size and homogeneity, including that portion made possible by Government procurement – is in fact a very important factor conditioning the realization of scientific and technological potential…Nevertheless, a broader market would, in and of itself, not solve the problem." (p. 23), because other factors are equally important, among them: size of firms, role of government support, industrial rather than public support, economic climate, educational and social environment, and management.

The conclusions of the OECD study were reinforced by a second study contracted to Joseph Ben-David. [44] Using several indicators, [45] Ben-David documented a gap in the development of (applied and) fundamental research between Europe and the United States, and suggested that the origins of the gap went back to the beginning of the 20th Century: to the failure in Europe to develop adequate research organizations and effective entrepreneurship in the exploitation of science for practical purposes. Briefly stated, European universities were not oriented enough toward economic and social needs: academics still considered science essentially as a cultural good. To change the situation would, according to Ben-David, require long-term policies involving structural changes.

The American Reaction

For the Americans, the problem of Europe was a management problem – applying available technology – and their position may even have influenced the OECD conclusions. D. F. Hornig, special assistant for Science and Technology, and appointed in November 1966 by President Johnson to study the issue, stated: [46] "McNamara said it was a management gap, some of us said it was an education gap, but Pierre Masse in France, I think put it together best. He said, "It all adds up to an attitude gap". We educate more people; we educate them to a higher level; we find our management is more enterprising…". To clarify the issue, his colleague I. L. Bennett, assistant director at the OST (Office of Science and Technology), suggested in the newspaper *Le Monde*: [47] "what I advise is an organized and concerted initiative to demystify the gap…It is only in making the distinction between the real facts and the illusions engendered by an emotional reaction or by political opportunism that we can define the real dimensions of the problem…To this end, we have supported with all our heart the major study on industrial sectors which is underway at the OECD".

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[44] OECD (1968), *Fundamental Research and the Universities: Some Comments on International Differences*, Paris.
[45] Balance of trade in technological know-how, technological inventions, publications, Nobel prizes.
[46] Transcript, D. F. Hornig Oral History, Interview I, 12/4/68, by D. G. McComb, Internet Copy, Lyndon Baines Johnson Library, p. 29.

In general, American officials tended to dismiss the technological gap with Europe as a non-problem, or at least as a problem that the US government can do little to help solve. While admitting that the United States is ahead of Europe in computers, electronics, aviation and space, Americans pointed out other areas where the United States is behind – metallurgy, steel and shipbuilding. They also noted the German superiority in plastics, the Dutch preeminence in cryogenics, and the positive balance of trade for the European Economic Community in synthetic fiber. "If the Atlantic Community nations are really at a technological disadvantage vis-à-vis the United States today, how have most of them managed to outstrip the United States in production growth and in expansion of their foreign trade during the last decade?" [48]

The views of R. H. Kaufman, vice-president of the Chase Manhattan Bank, were representative of the American position. At a conference organized by the Atlantic Institute in Rome in 1968, he suggested: [49] "Much of the confusion regarding technology stems from conflicting definitions" (p. 15). By this, Kaufman meant that innovation did not originate solely, or even mainly, in R&D, but that management, marketing and the use of technologies were, for example, equally important. According to Kaufman, there were more lags than a gap: "A gap suggests an inequality at one point in time – a vacuum that must somehow be filled. However, this is not completely accurate, for there has never been a uniform technological level between peoples…Leads and lags are normal phenomena [and] change hands many times" (p. 17).

"There is nothing new about Europe being technologically behind the United States in a number of fields", wrote Kaufman. "What is new is the mounting concern about a current

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[47] I. L. Bennett (1967), L'écart entre les États-Unis et l'Europe occidentale est un fait réel qu'il importe avant tout de définir, *Le Monde Diplomatique*, February, p. 5.

[48] *Science* (1966), Hornig Committee: Beginning of a Technological Marshall Plan?, December 9, pp. 1307-1309.

[49] R. H. Kaufman (1970), Technology and the Atlantic Community, in The Atlantic Institute, *The Technology Gap: US and Europe*, New York: Praeger, pp. 13-101. The Atlantic Institute has published extensively on Western Europe/United States economic relationships since 1966: C. Layton (1966), *Trans-Atlantic Investments*, Atlantic Institute; Atlantic Institute (1966), *Atlantic Cooperation and Economic Growth I*, report of a Conference held at Fontainebleau; Atlantic Institute (1966), *Atlantic Cooperation and Economic Growth II - Planning for the 1970s*, Report of a Conference held in Geneva; A. T. Knoppers (1967), *The Role of Science and Technology in Atlantic Relationships*, Atlantic Institute.

or potential threat that these technological lags may pose for Europe, in particular, as well as for the whole world" (p. 22). "Europe's technological lags have been confined to certain industries; and up to now, they have hindered neither the region's economic growth, nor its balance of payments, nor its capacity to innovate." (p. 22).

But "why is there such a wide disparity between these findings and the strong feeling of many Europeans", asked Kaufman (p. 37)? He offered three explanations. Firstly, the "popular tendency to extrapolate developments in the spectacular industries [like computers and electronics] to the rest of the economy" (p. 37). Secondly, "the inadequate appreciation of the significance of the diffusion of technical knowledge across the Atlantic" (p. 40), that is, the inevitable international aspects of knowledge that manifest themselves in technology flows (patents and licenses) and foreign direct investments. Thirdly, social and political concerns: "European opinion is concerned that the world's productive effort may be undergoing a reallocation, with all advanced techniques and productivity improvements emanating from the United States…Many Europeans resent the fact that US companies dominate certain of their industries" (p. 47). Other aspects of European anxieties identified by Kaufman related to the brain drain – a "highly emotional term invented by the British" (p. 48) – and to the nuclear age, where "a strong technological base is conducive to military power" (p. 49). "The lag is being used as an excuse to make improvements in Europe's educational structure, its management practices, its salary scales for scientists and engineers, its industrial structure through mergers and consolidations, and its expenditures for instrumentation in R&D departments. And, of course, Britain has used the problem to bolster its case for joining the EEC" (European Economic Commission) (p. 50).

For Kaufman, the real causes of the European technological lag were: economic (labour shortage, small market, small companies, lack of competitive climate), technological (emphasis on basic rather than applied research), management (bad training of managers, lack of commercialization), policies (tax policy, patent system), and social (attitudes toward business, educational system) (pp. 52-80).

Other American authors offered similar analyses. For R. R. Nelson, [50] gaps between US and Europe were a long-standing phenomenon that had existed for over one hundred years, but concern was "greatly sharpened in the early post World War II years when, as a result of the war, disparities between US and European economic capabilities were particularly great" (p. 12). "What is new is a far sharper awareness of the situation, and, among at least some Europeans, a relatively new deep-seated concern about its significance" (p. 15). Nelson offered four basic reasons for European concern: trade, international direct investment, science, and military strength (pp. 15-19). These "led some people to view certain consequences as inseparable – loss of foreign policy autonomy in certain key respects, reduced national control over the domestic economic system, and a threat to national economic well-being and growth" (p. 19). But, "to a considerable extent the power of the European economy to produce goods and services is as high as it is because of the technological progressivity of the United States" (p. 21). For Nelson, the debate was rather political: "Not being behind technologically in the most revolutionary fields has been, or is becoming, an aspect of national sovereignty" (p. 33), and equivalent to "assigning high value to independence options, and underestimating the price" (p. 34).

R. S. Morse from MIT held similar views: [51] "Discussions about the technological gap are often undertaken by individuals who understand neither science and technology nor the problem associated with its application" (p. 84). "The United States has a greater total capability in advanced technology than any other country, but there is little evidence that such technology, per se, is solely responsible for its economic growth rate or standard of living" (p. 84). "If there is some gap between the US and Europe to which Europeans should direct their attention, it is not the technological gap, but rather a management gap" (p. 85-86). Moore then goes on to list a number of factors that seemed fundamental to rapid progress: cooperative environment (between university, government and business),

[50] R. R. Nelson (1967), *The Technology Gap: Analysis and Appraisal*, P-3694-1, RAND, Santa Monica, California. See also: R. R. Nelson (1971), World Leadership, the Technological Gap and National Science Policy, *Minerva*, 9 (3), pp. 386-399.
[51] R. S. Morse (1967), The Technological Gap, *Industrial Management Review*, Spring, pp. 83-89.

personnel mobility (between sectors), attitude of top management, new enterprises, venture capital and competition. [52]

Several Europeans agreed with the diagnosis. C. Freeman, author of the first OECD analyses of international statistics on R&D, concluded: [53] "To describe or to understand a "technology gap", one must go beyond comparisons of R&D inputs" (p. 464): "it is clearly possible to have a highly productive R&D system but a disproportionately small flow of economically successful innovations and a slow rate of diffusion" (p. 464), because "successful innovations often demand management qualities of a higher order" (p. 466). In accordance with these specifications, Freeman concluded: "there are some grounds for believing that, both in the Soviet Union and in Britain (though for rather different reasons), the flow of profitable innovations and the speed of their diffusion has been somewhat disappointing in relation to the input of resources into growth-oriented R&D, and probably also in relation to the output of R&D" (p. 465).

J.-J. Salomon also admitted that there were disparities between the United States and Europe: [54] "If there is a greater aptitude among American businesses to take advantage of the products of research, it is due to factors of design and of management as much as, if not more than, to factors of measurement…The technological gap is in large part a managerial gap".

J.-P. Poullier, consultant at the French National Center for Information on Productivity in Business and co-author of an influential study by Edward Denison which calculated that education and technology were responsible for 60% of the differences in growth rates between America and Europe, [55] concluded what only a European could have publicly

[52] For more and similar arguments from Americans, see J. B. Quinn (1966), Technological Competition: Europe vs. USA, *Harvard Business Review*, July/August, pp. 113-130; G. E. Bradley (1966), Building a Bigger Atlantic Community Market, *Harvard Business Review*, May/June, pp. 79-90; A. Kramish (1967), *Europe's Enigmatic Gap*, P-3651, RAND, Santa Monica, California; J. Diebold (1968), Is the Gap Technological?, *Foreign Affairs*, January, pp. 276-291.
[53] C. Freeman (1967), Research Comparisons, *Science*, 158, 27 October, pp. 463-468.
[54] J.-J. Sorel (1967), Le retard technologique de l'Europe, *op. cit*. p. 764.
[55] E. E. Denison and J.-P. Poullier (1967), *Why Growth Rates Differ: Postwar Experience in Nine Western Countries*, Washington: Brookings Institution.

said: [56] "If a major objective of Europe is to catch up with the income and productivity of the United States, a high degree of emulation of the American pattern is unavoidable, for economics responds to a certain rigor and discipline. Europe may choose not to pay the price America paid, but then it must accept without infantile recriminations a level of income second to that of the United States. Frankly stated, a large number of comments and explanations of the technological gap are unworthy of the great cultural and intellectual environment on which Europeans like to pride themselves" (p. 125).

Finally, A. Albonetti, director of international affairs and economic studies at the National Committee for Nuclear Energy (CNEN), using several statistics, "demonstrated" that there was a gap between Europe and the United States, but over time "there exists a parallel trend which tends to minimize this gap" and "scientific research is, for the time being, rather confined to the smoothing of this disparity". [57]

The above authors were only some of the individuals who took part in the debate, and only the first to analyze the issue. [58] In the 1980s and 1990s, scholars would continue debating the issue, although with new theoretical frameworks.[59]

The Official Response

[56] J.-P. Poullier (1970), The Myth and Challenge of the Technological Gap, in The Atlantic Institute, *The Technology Gap: US and Europe*, New York: Praeger, pp. 105-132.
[57] A. Albonetti (1967), The Technological Gap: Proposals and Documents, *Lo Spettatore Internazionale Rome* (English edition), Part 1, vol. 2 (2-3), p. 264.
[58] For other authors of the time who held the same discourse, see: E. Moonman (ed.) (1968), *Science and Technology in Europe*, Harmondsworth: Penguin; R. Gilpin (1968), *France in the Age of the Scientific Estate*, Princeton: Princeton University Press; C. Layton (1969), *European Advanced Technology: A Programme for Integration*, London: Allen and Unwin.
[59] For the recent literature, see: *Research Policy*, special issue, 16, 1987; J. Fagerberg (1994), Technology, and International Differences in Growth Rates, *Journal of Economic Literature*, 32, pp. 1147-1175; J. Fagerberg, B. Verspagen and N. von Tunzelmann (1994), The Economics of Convergence and Divergence: An Overview, in *The Dynamics of Technology, Trade and Growth*, Hants: Edward Elgar, pp. 1-20; J.

The constant talk about technological gaps, including at the OECD, strongly angered the United States, and had at least two impacts on the American government. Firstly, the US President created a committee to study the issue and report rapidly to him on actions to be taken. Secondly, the Department of Commerce (DOC) started publishing a series of statistics on technology-intensive industries, which gave rise to indicators on high technology.

The Interdepartmental Committee on the Technological Gaps

In November 1966, the US Government set up an Interdepartmental Committee on the Technological Gap to examine the problem of disparities between the United States and Western Europe. [60] The committee had discussions with key European governmental, industrial and university leaders, consulted what little empirical literature there was on the subject, cooperated with the OECD working group, above all on the sector studies, and conducted a survey of American direct investments in Europe. It delivered its report to the President in December 1967. [61]

The interdepartmental committee admitted that there was a technological gap: disparities in R&D (p. 5) and innovation (pp. 6, 10-11) between the United States and Europe, and American "control" (80%), by way of direct investment, of European technology-intensive industries (p. 13-14). However, the committee added that there is a growing consensus between ourselves and the Europeans on the real nature of the technological gap" (p. 3): "the problem of the technological gap is only partly technological. Psychological, political, economic, and social factors are probably more important" (p. i). "The Europeans are coming to understand that they need to solve a complex series of

Fagerberg and B. Verspagen (2002), Technology-Gaps, Innovation-Diffusion and Transformation: An Evolutionary Interpretation, *Research Policy*, 31, pp. 1291-1304.

[60] The committee was composed of representatives from the following organizations: Department of State, Department of Defense, Department of Commerce, NASA, Council of Economic Advisers, Atomic Energy Commission. In addition, observers from three organizations were invited to attend the meetings: the Department of the Treasury, the Department of Justice, and the Special Representative for Trade Negotiations.

[61] *Report of the Interdepartmental Committee on the Technological Gap*, Report submitted to the President, December 22, 1967, White House. Declassified 10-07-2002 (National Archives).

problems involving education, productivity, capital markets, managerial attitudes and procedures, economies of scale, mechanization, restrictive business practices, and generally inefficient work habits" (p. 16).

For the committee, "the technological gap problem is a current manifestation of the historical differences between Europe and the United States in aggressiveness and dynamism, reflecting the American frontier past and its restless quest for progress and change" (pp. ii and 12). It is "one aspect of the broad disparities in power and economic strength between the United States and a fragmented Europe which will be a recurrent problem for a long time to come" (p. iii). Briefly stated, the position of the committee was the following:

- The European lag in technological know-how is largely in a few sectors of advanced technology or technology-intensive industries;
- An economically more significant lag is in European abilities to utilize available technology;
- This lag is due to a number of long-standing structural factors such as under-investment in education, less aggressive and skilled management, less profit-oriented social customs and work habits, slowness in industrial modernization, small size of firms and national markets, conservative investment attitudes, lack of mobility and an inadequate number of highly trained personnel.

According to the committee, Europeans actually faced a dilemma: "European countries are anxious to benefit to the maximum extent from US technological advances while avoiding the possibility of American technological/industrial domination. This combination of aims has resulted in an ambivalent approach. On the one hand, they are considering essentially protective measures. On the other, they would like the broadest access to the results of US government-financed R&D" (p. 9).

What did the committee recommend as the American strategy? Its suggestions were first of all motivated by the fact that "although European concerns about the technological gap

may be exaggerated, they may nonetheless result in European counteractions to discriminate against American firms or products and in other measures that would pose political and economic difficulties for the United States" (p. iii). "This political sensitivity must be taken seriously" (p. 10). "The continuing problem for the United States is to assure that movement toward Europeanism does not develop into a force with political and economic goals that are inimical to those of the United States" (p. 19). "Our policy planning should deal with the possibility that some European countries react to the prospect of American industrial take-over and technological domination by imposing restrictive measures" (p. 20).

The committee was also motivated by another idea: "the only long-range cure for the disparities problem lies in actions which must be taken by Europeans themselves (…). There is little that the US government can or should do by way of direct assistance" (p. 73). But "this does not mean inaction on our part" (p. 72), added the committee. The committee suggested to adopt the attitude of a friendly neighbor: "the US government must view the problem as an important one and adopt a posture and policies that do not feed the exploitation of these concerns abroad" (p. 5). "The United States can play a significant complementary role – primarily through promoting scientific and technological cooperation and through the mutual reduction of obstacles to the flow of technology and related trade" (p. 73). Among other things, the United States should (p. 74ss.):

- Stress that the United States and Europe have a joint stake in technological and economic progress; that our future prosperity is mutually interdependent; and that all stand to gain by promoting an open technological market, the international flow of scientific and technological advances, as well as management and organizational skills.
- Acknowledge (in low-key) that there is a United States-European gap in ability to utilize technological know-how, and to a certain extent in technological know-how per se, but the basic actions to strengthen Europe must be taken by the Europeans themselves.

- Cooperate in R&D activities with Western Europe.
- Emphasize that the technological gap issue reveals an essential need for effective integration of Western Europe.

High Technology Indicators

At the request of the interdepartmental committee, the Department of Commerce conducted one of the first surveys of American investments and operations in Europe. The report served as a background document to the final report of the committee, and was entitled *The Nature and Causes of the Technological Gap between the United States and Western Europe*. [62] As a follow-up, the committee recommended that the Department of Commerce "conducts on a continuing basis in-depth analytical studies on the economic and technological questions related to technological disparities and to the international flow of technology, trade, and investments" (p. v). The Department of Commerce indeed responded with further studies and reports that brought to the scene the concept of high technology and the decline of the United States in these industries. M. T. Boretsky, director of the Technological Gap Study Program (1967-69) at the Department of Commerce, launched the research program.

The concept of high technology goes back to early OECD work – and before. Up to then, the OECD defined "research-intensive industries" as those that had a high R&D/sales ratio. [63] Boretsky used three measures to construct his category of high technology products: [64] R&D, S&T manpower, and skills. The following were thus identified as "technology-intensive products": chemicals, non-electrical machinery, electrical machinery and apparatus (including electronics), transportation equipment (including

[62] As recommended by the committee, the document was to be published if possible prior to the OECD ministerial meeting (March 1968), but never was. Furthermore, the copy accompanying the final report has been lost.
[63] OECD (1963), *Science, Economic Growth and Government Policy*, Paris, pp. 29-33.
[64] M. Boretsky (1971), *Concerns About the Present American Position in International Trade*, Washington: National Academy of Engineering, pp. 18-66; M. Boretsky (1975), Trends in US Technology: A Political Economist's View, *American Scientist*, 63, pp. 70-82; *Science* (1971), Technology and World Trade: Is There Cause for Alarm, 172 (3978), pp. 37-41; M. Boretsky (1973), *US Technology: Trends and Policy Issues*, Revised version of a paper presented at a seminar sponsored by the Graduate Program in Science, Technology and Public Policy of the George Washington University, Washington.

automobiles and aircraft), scientific and professional instruments and controls. The industries responsible for these products represented 14% of GNP in the United States, employed 60% of all scientific and engineering manpower and performed 80% of non-defense industrial R&D.

Borestsky's calculations showed that in the early 1970s the United States was in danger of losing its preeminence in advanced technologies, particularly those that are important in world trade. American exports of technology-intensive manufactured products were leveling off, according to Boretsky. This was so mainly because of the narrowing of the gap with other OECD countries, and because of faster growth rates in these countries. Ironically, "if, in the 1960s, any country's economically-relevant R&D performance could be described as having had the characteristics of a gap, the description should have been accorded to the United States rather than to the major countries of Europe, or to Japan", concluded Boretsky. [65]

The Department of Commerce continued to develop and improve on the indicator in the following years, [66] and use of the indicator soon spread to other countries and to the OECD. [67] In the 1980s, the indicator became a (highly-contested) indicator of much value to official statisticians and governments.

Conclusion

[65] M. Boretsky (1973), US Technology: Trends and Policy Issues*, op. cit*. p. 85.
[66] R. K. Kelly (1976), *Alternative Measurements of Technology-Intensive Trade*, Department of Commerce; R. K. Kelly (1977), *The Impact of Technological Innovation on International Trade Patterns*, Department of Commerce; Department of Commerce (1983), *An Assessment of US Competitiveness in High Technology Industries*, International Trade Administration; L.A. Davis (1982), *Technology Intensity of US Output and Trade*, US Department of Commerce, Washington; L. A. Davis (1988), *Technology Intensity of US, Canadian and Japanese Manufacturers Output and Exports*, Department of Commerce.
[67] B. Godin (2002), *Measuring Output: When Economics Drive Science and Technology Measurements*, Montreal: CSIIC.

Technological gaps have been one of the principal historical factors that have influenced national and international work on science and technology policies and statistics. Everyone has found something in the data to document their own case. Numbers were cited by the pro-gap theorists – mainly Europeans who reminded people that the United States' effort was much above Europe's at 3.4% of GNP – by the skeptics who proposed the idea that the American superiority was due only to defense (62% of R&D), and not civil R&D, and by the Americans themselves: US performance came mainly from the efforts of industry on development (over 65% of R&D), which Europe could emulate.

These comparisons led to the current practice of ranking countries, and of assessing their performance against that of the United States. Whether the statistics helped shape policy agendas and priorities remains to be documented, but it certainly shaped political discourses, policy documents and analytical studies. It is probably inevitable that international comparisons and, above all, international statistics, lead to such discourses. Emulation between countries, mimicry and convergence probably have to be accepted as indirect effects of statistical standardization. And indeed, the OECD had a major influence on the most recalcitrant country: the United States. Following the OECD study on technological gaps, the United States began nourishing some fears and apprehensions of its own. [68] Today, such fears are qualified as a case of "statistical myopia": there was in fact no long-run slowdown. [69] "There has undoubtedly been a protracted fall off from the early postwar peak and it certainly was pronounced. But it is that peak which looks like the aberration, and the decline from it may well prove to be a return to historical growth rates in labor productivity". [70]

[68] Besides Boretsky, see: H. Brooks (1972), What's Happening to the US Lead in Technology, *Harvard Business Review*, May-June, pp. 110-118. For an analysis of the debate, see: R. R. Nelson (1990), US Technological Leadership: Where Did It Come From and Where Did It Go, *Research Policy*, 19, pp. 117-132; R. R. Nelson and D. Wright (1992), The Rise and Fall of American Technological Leadership: The Postwar Era in Historical Perspective, *Journal of Economic Literature*, 30, pp. 1931-1964.
[69] M. Darby (1984), The US Productivity Slowdown: A Case of Statistical Myopia, *American Economic Review*, 74, pp. 301-322.
[70] M. Beaumol (1986), Productivity Growth, Convergence, and Welfare: What the Long-Run Data Show, *American Economic Review*, 76 (5), p. 1081.

The technology gap issue also had an important impact on the emergence of a European science and technology policy. [71] Together with the Action Committee for a United States of Europe founded by Jean Monnet, France was an aggressive promoter for a European science policy. What the French had in mind, however, "was not merely cooperation in science and technology but eventually a common policy toward American economic policies and, especially, investments". In 1965, the French proposed two studies as a first step toward a common policy. "The first was to be a comparison of public and private civilian scientific research programs already carried out by members of the EEC [European Economic Community]. Presumably, such an inventory would provide the basis for a European division of scientific labor. Secondly, the French proposed that there should be a determination of which industrial sectors of the EEC countries were most vulnerable to foreign competition or takeover, due to the inadequacy of their research effort vis-à-vis that of outside countries, namely the United States". [72] In October 1967, the European science ministers selected six areas of cooperation in science and technology, and agreed that concrete steps be taken to develop a science policy for the EEC.

Besides policy, the technological gaps debate also considerably influenced the statistical work of the EEC, to the point that it is the European Commission which most faithfully pursues work on productivity and technological gaps between Europe and the United States today, within its annual *Innovation Scoreboard* [73] and its annual *Competitiveness report*, among others. [74] As early as 1963, at the request of Monnet's Action Committee, a study was contracted to RAND on the organization and financing of research in the six EEC countries. The study, echoing early OECD studies, concluded that although the rate of increase of R&D expenditures in every nation of the European Commission was rising at several times the rate of growth of the GNP, "the effort in the Common Market

[71] R. Gilpin (1968), France in the Age of the Scientific Estate, *op. cit*. pp. 415-420; L. Guzzetti (1995), *A Brief History of European Union Research Policy*, European Commission: Brussels, pp. 35-38.
[72] R. Gilpin (1968), France in the Age of the Scientific Estate, *op. cit*. p. 418-419.
[73] CEC (2000), *Innovation in a Knowledge-Driven Economy*, COM(2000) 567.
[74] EC (2001), *European Competitiveness Report*, Luxembourg.

countries is still about half of that of the United States or the USSR" (p. vi). [75] Forty years later, the European Commission still holds the same discourse: "The average research effort in the Union was only 1.8% of Europe's GDP, as against 2.8% in the United States and 2.9% in Japan. What is more, this gap seems to be on the increase". [76]

[75] A. Kramish (1963), *R&D in the Common Market vis-à-vis the UK, the US, and the USSR*, Institut de la Communauté européenne pour les études universitaires, RAND, P-2742, Santa Monica, California.
[76] CEC (2000), *Towards a European Research Area*, COM(2000) 6, 18, January, pp. 4-5.