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THE MEASUREMENT OF SCIENTIFIC
AND TECHNOLOGICAL ACTIVITIES

PROPOSED STANDARD METHOD OF COMPILING AND INTERPRETING TECHNOLOGY BALANCE OF PAYMENTS DATA

TBP Manual
1990

ORGANISATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT

RESTRICTED

Paris, July 1990

Proposed standard method of compiling and interpreting Technology Balance of Payments data

TBP MANUAL 1990

This Manual was prepared according to the recommendations made at the Seminar on the Technological Balance of Payments held at the OECD on 15th-16th December 1987. It was revised by a small group of experts and subsequently adopted by the Group of National Experts on Science and Technology Indicators at its annual meeting on 7th-9th December 1988. The Manual was finally approved by the Committee for Scientific and Technological Policy, which also recommended that it should be released for general distribution, at its 53rd session on 24th-26th October 1989. This Manual is derestricted on the responsibility of the Secretary General.

The Manual should serve as a standard method for surveys and data collection for trade in disembodied technology between countries which continue to be difficult to compare because of differences in coverage and in the grouping of categories of data. It also makes a contribution to the methodological work forming part of the indicators framework of the Technology-Economy Programme (TEP).

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PREFACE

By the early 1960s, science and technology and more especially research and development had been recognised as significant factors in economic growth. It was hence appropriate for the OECD to collect relevant data for use in national and international policy studies and reviews.

A pilot study of selected Member countries identified a number of types of series which could be used to measure scientific and technical activities including resources devoted to research and development, patent data, the balance of payments for licences and patents and data on the migration of scientists and engineers. All posed problems of international comparability and of interpretation. There was thus clearly a role for the OECD to conduct the co-operative process of developing a set of manuals which would set out the rules, conventions and practical guidelines to be observed which would allow scientific and technical activity to be measured as comprehensively as possible.

Given the central role then attributed to research and development, it was decided to begin by developing international methodological guidelines for surveys of the resources devoted to R&D. The first handbook in the series, the Frascati Manual was published in 1964 and regular OECD surveys were held thereafter. This manual has been revised and expanded on three occasions (1970, 1975 and 1980), and a fourth revision is currently under way.

Interest in the other measures of scientific and technological activities revived as it became obvious that the link between R&D and economic performance was more complex than had originally been thought. It was logical in a market economics approach to consider the benefits which could be generated by the output and impact of R&D. A number of workshops were held to discuss various measures of output (patents and the Technology Balance of Payments) and of impacts (trade in R&D-intensive products, productivity indices) which could be derived from existing traditional economic sources plus some entirely new type of data, notably bibliometrics and innovation surveys.

This work was forwarded by an experimental analysis of existing data in the OECD Science and Technology Indicators No.2, published in 1986 which discussed industrial R&D, patents, the TBP, and R&D intensive products in the context of productivity and trade performance. This revealed that whilst the patent and trade data could both be derived from international sources which guaranteed a reasonable degree of international comparability, with the technology balance of payments more complex problems had to be tackled.

Data were of course available for individual countries, but a number of difficulties became evident which made international presentation and cross-country comparisons extremely tricky. During a series of workshops and conferences arranged by the OECD between 1978 and 1987, particular reference was made to:

-- The lack of uniformity of national statistics, because of the range of bodies responsible for collating and presenting them;

-- The difficulty of gaining access to these statistics, and of interpreting them, because of the conventions applied in individual countries;

-- The need for sufficiently reliable and detailed data to assess the strengths and weaknesses of national economies, and their evolution;

-- The need to be able to evaluate the TBP by industry, type of transaction, type of transactor, partner country, etc.

In addition, while a range of data was available on national TBPs, there were undeniable limitations and their significance was thus considerably circumscribed.

It is accepted that technology is a very special area, and that administrative, fiscal and institutional considerations, and the influence of multinational corporations, tend to varying degrees (depending on the country and industry) to distort the apparent results and the conclusions that may be drawn.

Given the growing use of TBP statistics, however, agreement in principle was reached on the preparation of a proposed standard method for collecting and interpreting data on the technology balance of payments. The drafting of these guidelines was entrusted to Madame Bernadette Madeuf, lecturer at Paris University X, under the direction of the OECD Secretariat.

The TBP Manual clearly reflects the objectives that were set. It provides a clear and detailed definition of the types of transactions to be included in the TBP, and the characteristics of transactors and contracts (including the forms of payment, financial and non-financial). It proposes a survey and data collection method that is compatible with the definitions and reference frameworks. It considers the special problems posed by currency conversion and deflation in the area of TBPs, and solutions that may be applied in the short and longer terms.

Last, unlike the Frascati Manual, it contains a section on the interpretation of TBP data as S&T indicators.

From the standpoint of evaluating outcome rather than input, the TBP Manual is the first of the second-generation handbooks on the measurement of scientific and technical activity to be prepared by the OECD. It will be followed, probably in 1990, by an interim manual on the products of information technology (Information, Computer and Communications goods and services - ICC), and later by a manual dealing with surveys of innovative activity in industry.

As it stands, the TBP Manual makes a substantial contribution to overcoming many of the problems in correctly collating technology balance of payments data in most of the industrialised countries and in interpreting them as science and technology indicators.

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and Industry

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CHAPTER 1

OBJECTIVES AND SCOPE OF THE MANUAL

1. INTRODUCTION

1. Technology and the international diffusion of technology are central to the changes running through the world economy in our era. They are a factor in international competition and an incentive to co-operation between firms in different countries. Some of the reasons for this twofold role are long-standing, others more recent.

2. Of the historic reasons, the foremost is the link between technological development and industrialisation and its corollary, international diffusion of technology and countries' efforts to catch up economically. Access to technology has been, and still is, a prerequisite for industrial development. Those of the developing countries that have succeeded in achieving growth have also been those that have pursued or are pursuing an active policy of importing technology and have established effective machinery for co-operation.

3. This path is not open just to developing or newly industrialising countries (NICs); advanced countries too acquire technologies from abroad. It is virtually impossible, in fact, for nations to cover the entire spectrum of advances in scientific and technological knowledge. Some balance has to be struck between homegrown and imported technology.

4. These two factors that have long made the international diffusion of technology so significant are combined today with the far-reaching changes heralded by microelectronics and information technology, bio-engineering and new materials -- all prime ground for international competition and for co-operation between firms in different countries. The new technologies will hence trigger or accelerate readjustments in some industrial rankings, not simply among the advanced countries but between them and the NICs as well.

5. The way services, and trade in services, have expanded is also relevant, demonstrating the growing importance of the flow and utilisation of knowledge.

6. It can readily be seen, without going into these reasons in more detail here, that refining the measurement and analysis of international transfers of technology, and more generally the international circulation of technology, is imperative. That is the background to this review of the Technology Balance of Payments (TBP).

7. Chapter I will chiefly be concerned with problems of definition -- determining precisely what international transfers of technology and the TBP cover within the extensive area of technology flows.

2. TECHNOLOGY AND THE TRANSFER OF TECHNOLOGY

8. What is technology transfer? A definition is essential for any attempt to correlate the technological balance of payments and the international transfer of technology. Only then can we see what has to be measured, and decide whether the TBP is fully appropriate.

2.1. Technology

2.1.1. Definition

9. In French, the terms "technique" and "technologie" refer, strictly speaking, to two separate concepts: "technique" is defined as a body of methodical processes based upon scientific knowledge that are used in production, and "technologie" as the study of techniques, tools, machines and materials (1). Technology is thus placed higher, closer to science.

10. In the English language -- and French usage frequently adopts the same sense -- technology is understood as a set of techniques that are themselves defined as "a set of actions and decision rules guiding their sequential application that man has learned will generally lead to a predictable (and sometimes desirable) outcome under certain specified circumstances" (2).

11. The important point here is the operational and practical nature of technical knowledge. A distinction has long been drawn between science, knowledge of the laws of nature, and technique (or technology), which is the transformation and mastery of nature. What is more, their relationship was often taken to be one-way, from theoretical knowledge to practical application. But present-day experience, and the history of many branches of industry, provide examples, as N. Rosenberg (3) has noted, to show that the relationship between science and technology is by no means a one-way process: new developments, and the difficulties or limitations encountered in the use of processes or products, all raise questions that cannot be answered without further scientific understanding. Moreover, technology (in the strictest sense) is in itself a "body of knowledge about certain classes of events and activities" (4). This body of knowledge is capable of development without necessarily having recourse to science. At the same time -- and this is doubtless a major characteristic of the industrial development of the West -- there has been growing interdependence between scientific research and technological development over the past 100 or 150 years. The current development of the new technologies heightens that interdependence, and renders any distinction between science and technique very artificial.

12. If technology is included in the category of knowledge, we need to consider what its specific characteristics are, before turning to the issue of technology transfer.

2.1.2. Characteristics of technology

13. Describing the characteristics of technology will help us identify it within the vast general body of knowledge, and then establish a typology of the forms that the circulation of technology may take at international level.

14. As knowledge, technology ought in theory to exhibit the characteristics accorded in economic analysis to knowledge considered as a collective good: inexhaustibility, ubiquity and free transmission (5). In practice, as operational knowledge whose end-use is the production of goods and services, technology ceases to have these attributes of a collective good once it is appropriated, in the legal sense of the term, by means of a patent or through non-disclosure (secrecy).

15. The characteristics of technology may be divided into three major areas:

-- Utilisation (end-use);

-- Degree of generality/specificity;

-- Novelty and exclusivity.

2.1.2.1. Utilisation

16. A distinction should be drawn here between technology used for physical production, or industrial technology, and the technology needed for the supply of services. Production of all kinds, services included, is based on the application of knowledge. The expression "financial technology" is heard, for example, describing the skills and knowledge necessary for the application of banking methods.

17. The current growth of service activities and their production and sale at both national and international level have led some commentators towards an extensive conception of technology taking in industrial technology and also the knowledge necessary for management, marketing, financing, etc.

18. At the same time, a look at expert legal opinion and at current practice with industrial property rights prompts two observations:

-- Knowledge of this kind cannot be patented;

-- Novelty and exclusivity cannot easily be demonstrated, or protected, here. Consequently, legal specialists tend to exclude such knowledge from the domain of "know-how" (6).

19. Accordingly, the knowledge and skills necessary for the supply of services are not covered by the same transmission processes as industrial technology. In particular, no industrial property rights (patents) are involved.

20. Mention should be made at this point of the debate about patenting software. At present software is copyright as intellectual property in most countries. National authorities and international organisations are currently discussing the possibility of providing greater protection via patents. WIPO has several times convened a group of experts on legal protection for software in an effort to reduce the uncertainty that prevails in national legal systems over the industrial protection of software. But so far software as such, i.e., a computer program standing on its own and not incorporated in a broader process, cannot be patented; by contrast, certain types of software are indirectly patentable when they are part of an industrial operation, in other words when they represent a stage in the development of a patentable industrial process.

21. In conclusion, the important distinction to be made is between industrial technology that may be patented under certain conditions and non-industrial technology, including software, that cannot be patented but may be protected by copyright.

2.1.2.2. Generality/specificity

22. Within industry, technology may be classified by scope of application. It should be remembered that the scale on which a given technology can be used depends on its degree of accessibility. The scale of use, which is an intrinsic characteristic of technological knowledge, is hence linked to its degree of appropriation, which is a social characteristic.

23. A range of typologies, such as those proposed by G.R. HALL and R.E. JOHNSON (7), P. GABRIEL (8), J.B. QUINN (9) and J. GAUDIN (10), have been based upon the degree of generality/specificity of technologies. Generally a distinction is made between three categories of technology:

-- General sectoral technology comprising technical information common to enterprises in the same industry. Mastery of this basic technology gives a type of "entry pass" to the sector;

-- System-specific technology corresponds to knowledge developed by a firm in tackling certain problems. Such technology thus relates to a product or process (product or process engineering) and the firm possessing it has an advantage over its competitors;

-- Firm-specific technology covers all the skills that the firm has developed through its activities or acquired through experience, but which cannot be ascribed to any one particular activity. This is more diffuse, harder to pin down, than the previous category.

24. By and large the second and third types of technology are not disclosed. Protected by patents or kept secret by the firm, they cannot be transmitted without its approval.

25. These typologies emphasize, of course, the importance of one particular category of technological knowledge, know-how. Although not an easy concept to deal with, know-how may be defined as the body of knowledge and experience acquired for the application of a technique (11). It is accordingly an

aggregate of experience and experiment which cannot be formulated in its entirety and so cannot be transmitted solely by means of written documents. The important aspect here is that its transmission entails the direct involvement of the firm possessing the know-how. We should further note that firms are developing new forms of co-operation to swap information about know-how and non-patented processes (12).

2.1.2.3. Novelty and exclusivity

26. A third characteristic feature of technology is its degree of novelty, on which its exclusivity is largely based.

27. Whether we approach technological knowledge from the standpoint of origin -- application of previous scientific know-how or application of the methods of science to production problems (rationalisation) -- or of the competitive advantage that it bestows on its holder, novelty is a decisive component. Moreover, it is on that criterion that the patentability of technological knowledge is based, in conjunction with the contribution to an industrial achievement and origin in inventive activity.

28. Protected by patent or not, the novelty of a technology, which is an intrinsic characteristic, and its exclusivity, which is a social characteristic, both tend to decline during the diffusion process. As application widens, so use becomes more general and the technology itself becomes more routine.

29. This combined process of diffusion and more general use of given technology needs to be examined in greater detail. A distinction has to be made between process and product, and between applications technology and production technology.

30. The diffusion of a product, be it a capital good or an intermediate or final consumption good, is not the same as the diffusion of the process used to manufacture it. The two are quite distinct, and the first will either bring about the second automatically (as with a straightforward manufacturing process that is easy to copy and can be reverse engineered) or indirectly set it in motion (response of firms seeking access to the process, under a licensing agreement for example).

31. The products themselves, particularly industrial capital goods and household durables, "embody" two types of technological knowledge:

-- The knowledge required for their manufacture;

-- The knowledge required for their operation to produce further goods or services.

32. The second type, or applications technology, circulates at the same time as the goods. Any diffusion of capital goods to a growing number of users, accordingly, is also diffusion of their applications technology. On the other hand the diffusion of capital goods, or any other goods for that matter, does not involve the diffusion of the technology or process used to manufacture them.

2.2. The circulation of technology

33. Irrespective of differences in generality, novelty or exclusivity, one feature common to all technological knowledge is that its existence and transmission are dependent upon various vehicles. This is an initial criterion for classifying technology flows.

34. In addition, technology may be appropriated, in the legal sense of the term, by statutory means or secrecy. This is a second criterion for classifying technology flows.

2.2.1. Vehicles for technology flows

35. Technology is conveyed in one of three ways, via machines, equipment and products (capital-embodied technology), people (human-embodied technology) or written documents or audiovisual or other media (disembodied technology).

36. These vectors allow international transmission of technology through a variety of channels. Capital-embodied technology is transmitted through the sale of machinery and tools. Human-embodied technology circulates via training programmes, official technical co-operation and technical assistance among enterprises, and through congresses, seminars and personal contact. Technology as information in document form circulates via periodicals, engineering studies and consultancy services, and patent agreements.

37. These flows may of course combine to make up complex information packages of varying composition, referred to as "technology packages" (see Table 1.1).

38. Even classified by vehicle, there is still a wide variety of different technology flows. Some of the flows represent commercial transactions for which payment is made, while others are formal or informal processes for which there is no clear financial counterpart. A second criterion is therefore needed to help describe technology flows.

2.2.2. Degree of appropriation

39. Availability and ease of access depend upon the degree to which the technology has been appropriated by the firm using it. Use by third parties may be forbidden or restricted by property rights on the technology or because it is kept secret.

40. A distinction may thus be based on the "social form" (13) of the technology, i.e., the type and degree of appropriation to which it is subject. The social form will determine whether the technology is transmitted freely or as a commercial transaction. On the one hand we have "disclosed" technology, i.e., technology that is socially available with unrestricted access, on the other "appropriated" technology that is held or transferred under property rights or a special agreement. The latter category covers restricted information, patented knowledge, secret know-how and restrictive technical assistance. Transmission presupposes a commercial transaction with payment by the purchaser, e.g., a patent transfer or a licensing agreement.

41. By contrast, "disclosed" technology cannot in itself be the object of a commercial transaction. Its transmission depends on a vehicle, however, even when the information is readily available free of charge. Producing the vehicle has a cost for which payment may be required; the commercial transaction then addresses the vehicle, and the transmission of technology is a by-product. This is the case for trade in capital goods where the embodied technology is not covered by a separate transaction.

2.2.3. General typology of technology flows

42. Technology has been described in terms of intrinsic characteristics (utilisation, generality/specificity, novelty/exclusivity) and of the forms determined by its vehicle and its degree of appropriation. These intrinsic and formal characteristics may be combined to provide an overview of the international flows by which technology is transmitted, (table 1.1).

Table 1.1

INTERNATIONAL TECHNOLOGY FLOWS

VEHICLE	CHARACTERISTICS OF THE TECHNOLOGY			INTERNATIONAL FLOW	COMMERCIAL AND CONTRACTUAL TRANSACTIONS (combined flows)
	General sector-related	System-specific	Firm-specific		
I. PEOPLE	A	B	C	1. Education and training (A) 2. Personal contacts (A,B,C) 3. Professional mobility (A,B,C) 4. Technical co-operation (A,B) 5. Technical assistance between enterprises (B,C,F)	Official technical co-operation (1,2,4,6,7) Technical assistance agreements between enterprises (2,5,7,8,9,10)
II. DOCUMENTS				6. Congresses, seminars, conferences (D,E) 7. Technical literature: patent periodicals and documentation (D,E)	Contracts with companies and engineering consultancies (8,9,10 and possibly 11,12)
Disclosed technology	D	E	F(1)		
Appropriated and/or secret technology	G	H	I	8. Pre-feasibility and feasibility studies and projects (G,H,I) 9. Drawings, plans (G,H,I) 10. Detailed engineering drawings: rules and operating procedures (F,G,H,I)	Patent licences (5,7,8,9,10) Equipment sales and purchases (5,11) Direct investment in subsidiaries/joint ventures (1,2,3,5,8,9,10,11)
III. EQUIPMENT AND PRODUCTS	J	K	L	11. Machines, equipment, tools (J,K,L) 12. Turn-key plants, (J,K,L)	

1) When firm-specific technology is in this form the documents are for internal use only, or classified "secret", at the outset at least, by the nature of the technology. But the firm may of course disclose its documents when transferring technology to another firm.

43. Table 1.1 lists flows of varying form and content that help technology to circulate internationally. There are a multitude of forms, given that technology may be transmitted:

-- As the main purpose and explicit content of a commercial or non-commercial transaction (e.g. training, technical co-operation, licence); or

-- As the secondary consequence of a transaction whose main purpose is elsewhere (e.g., the sale of capital goods).

2.3. The international transfer of technology

44. The concept of technology transfer requires some further definition in order to identify it among the flows recapitulated above.

2.3.1. Functional approach

45. A functional approach to the items of technological knowledge necessary for the preparation and implementation of an industrial project (14) can identify the key factors in the international transfer of technology.

46. There are two distinct stages, pre-investment and construction, and operation:

-- The pre-investment and construction stage involves the technological knowledge required for:

  -- Market surveys and feasibility studies;
  -- Choice of the most appropriate technology;
  -- Engineering studies for the plant, including drawings and choice of equipment;
  -- Construction and installation of equipment;
  -- Development of process technology;

-- The operational stage involves the technological knowledge required for:

  -- Operation and management of the production units;
  -- Marketing;
  -- Improvement of processes through minor adjustments.

47. Among these, process technology (sometimes referred to as process engineering) is a key factor on which the operation of the projected new unit depends. It may be relatively formal, and embodied in a document, but it always includes a more or less significant portion of non-formalised know-how. The point to be stressed here is that process technology and know-how may be appropriated under industrial property law or by means of secrecy (15).

48. An enterprise that has such process technology and know-how in its possession may either use them itself for the purpose of production, or keep them as negotiable assets (patent portfolios, or process rights held by engineering consultancies). Any transfer of the technology will require that firm's active consent, not only for the property rights but also for the disclosure of know-how through courses and training sessions involving the staff of both enterprises. The transferor may also arrange to supply other items necessary for the project (studies, drawings, equipment, tools, etc.).

2.3.2. Definition of transfer

49. The criterion we shall use here to define the international transfer of technology and distinguish it from other technology flows will be that it must concern technological knowledge that is held exclusively by one enterprise, either under an explicit right or simply by non-disclosure. From a contractual standpoint the transmission of knowledge is covered by a licensing agreement or an agreement to communicate know-how (16).

50. This definition of the international transfer of technology is relatively narrow, and implies that the following conditions have been met:

- -- The transfer operation has an explicit (not secondary) technological content;
- -- The transaction involves contact between two enterprises, a transferor and a recipient, each identifiable as such;
- -- Formal ownership of the technology, or the right to use it, is transferred under commercial conditions.

51. The scope of this strict definition of transfer excludes the supply of a variety of technical services such as engineering services (studies, drawings), sales of equipment and other items that only incidentally include technology, flows of general technological knowledge (training) and flows for which no charges are made (official technical co-operation). All these flows fall under the more general category of international diffusion of technology.

52. One important comment is needed here. The proposed definition may appear somewhat over-restrictive. It does not fully reflect the matter as the purchaser sees it. For the purchaser, transactions which are not transfers in the strict sense (e.g., the purchase of capital goods or factories) may still involve the acquisition of machine-embodied technology which is a precondition of the manufacturing operations he intends to conduct. Taking in the purchaser's standpoint would give a broader definition of technology transfer.

2.3.3. Complex transactions

53. In principle, the international transfer of technology primarily concerns licensing agreements and agreements to communicate know-how. But in practice these form part of highly complex arrangements, particularly when the transfer is to enterprises operating in a less advanced economic environment than the supplier. The licensing agreement may then be supplemented by the supply of technical assistance, or the sale of equipment, engineering studies and possibly training.

54. The supply of a turn-key factory, or a product-in-hand or market-in-hand contract, is an example of a complex agreement. A number of contracts may be awarded to different suppliers (lead company, process patent-holder,

engineering consultancy, equipment supplier, construction firm, etc.), who may act in several capacities. In theory it should be possible to distinguish between these various components, but there is no guarantee that the wording of contracts or the payments for individual services will actually allow this to be done. The complexity of the practical transactions within which a transfer occurs raises one of the difficulties inherent in the TBP.

3. TBP AND THE TRANSFER AND CIRCULATION OF TECHNOLOGY

55. The international flows listed in Table 1.1 may be divided into four major categories:

- -- Transfers of technology relating to a technique or know-how covered by proprietary rights, which may be accompanied by technical assistance;
- -- Services with a technical content such as engineering studies, consultancy services, etc.;
- -- Sales of goods with a technological content which are used in the manufacture of other goods, i.e., capital goods;
- -- Diffusion of knowledge through channels that are free or practically free in that the technology is general (training and technical co-operation) or the transmission procedure is highly informal (e.g., personal contact).

56. As ideally defined, the TBP would be a record solely of international transfers of technology (ITT) in the strict sense. The balances now presented are far from this theoretical ideal; they include a range of other items. Their content is thus much broader than ITT alone. At the same time they are not a transcription of all the flows that make up the circulation of technology between countries. This ambiguous status accounts for a good number of the problems that arise in compiling and interpreting the TBP. The discussion below deals with the balances now presented and their relations with (i) the transfer of technology, (ii) the movement of technology, and (iii) the diffusion of science. Proceeding in this way will help prepare the ground for our definitions and recommendations in Chapter II.

3.1. TBP and the international transfer of technology

57. TBPs as currently based cover more than just the international transfer of technology. But some of the other payments they record cannot easily be taken out.

58. At present, TBP data compiled by the authority which handles balance of payments matters (the central bank or bank of issue), or a specialist department, broadly include (17) two major categories of financial flow:

- -- Flows arising from transactions relating to industrial property;
- -- Flows arising from the supply of services with a technical content.

59. The first category includes commercial transactions concerning patents, licences, techniques, processes and know-how, but also covers trademarks, designs and patterns. Sometimes it further includes (shown separately or not) transactions relating to intellectual property such as films, copyright material and software. Properly, the latter should all be excluded from the TBP.

60. The straightforward exclusion of transactions concerning trademarks, designs and patterns would pose problems. First, the licensing of a trademark may involve an actual transfer of technology, disclosure of a manufacturing or quality control process for example. Here we come up against the interdependence of the items included in the TBP. Second, licensing agreements addressing trademarks alone (with no transmission of technological know-how) seem insignificant compared with manufacturing licences. It therefore seems preferable to continue to record these transactions, but separately.

61. The second major category of transactions in the TBP covers the supply of services with a technical content and intellectual services of various types. These are generally:

-- Engineering studies, commissioned on their own or as part of an overall contract (turn-key plants, major works);

-- Technical assistance;

-- Training contracts between enterprises.

Management and administration, or even the financing of R&D carried out abroad (and vice versa), may occasionally be included as well.

62. None of these flows correspond to transfers of technology in the strict sense. Many, however, are combined with actual transfers, for example technical studies under a contract for the supply of a factory which also includes the transfer of a patented or secret manufacturing process. Another case is technical assistance under a licensing or know-how agreement.

63. Management and administration services, by contrast, are fairly remote from technology transfer.

64. In sum, the current scope of TBPs goes far beyond the international transfer of technology in the strict sense. Only transactions relating to industrial property (without trademarks, designs and patterns) should properly be included.

65. We are bound, given that it does not properly reflect technology transfer, to accept as well that the TBP cannot give a reliable measure of the circulation of technology or the diffusion of science. So the TBP cannot be used as an indicator of the international diffusion of technology and science unless it is supplemented by other items of information.

3.2. TBP and the international circulation of technology

66. Although the TBP includes items other than actual transfers of technology as such, i.e., services with a technological content, it is merely one of the component flows in the international circulation of technology. These flows are relatively heterogeneous and fall under a range of balance-of-payment headings.

67. The first point to note here is that the flows are complementary. A firm holding the rights to a given technology can exploit this advantage internationally in a number of ways:

-- Selling the technology, or the right to use it, to a non-related partner (technology transfer);

-- Selling the good in which the technology is embodied (export);

-- Transferring the technology to a subsidiary, in various ways.

Which option it chooses will depend upon the market and the competition, the novelty of the technology and its life expectancy, financial resources, existence of a network of subsidiaries, etc.

68. It is clear that the ranking or status of individual economies in international technology diffusion cannot be measured solely by the TBP. Account must also be taken of the various ways in which technology can circulate. For this purpose a range of other data, outlined below, need to be considered alongside the TBP.

69. Data on flows of direct investment and the activities of multinational enterprises:

Direct investment provides only a partial measure of trends in the development of foreign establishments owned by multinationals. But the really important aspect from the standpoint of the circulation of technology is the nature and scale of the activities of multinational firms. Of interest here, accordingly, are their turnover from offshore production, and its sectoral breakdown.

70. Data on trade in goods embodying technology:

In principle, the diffusion of technology is mainly due to trade in what are referred to as high-tech products. Within that range, however, special attention needs to be given to industrial capital goods.

71. International patent data:

Filing of international patents (European patent system), filing of patents abroad, filing of foreign patents. The system gives patentees sole rights to exploit their inventions, but it also requires publication. Technological knowledge is thus disclosed, even if patentees cover themselves by not publishing all the information needed

to apply it. At international level, the filing of a patent abroad is the first step towards exploitation by the patentee, either directly (export and production by a subsidiary) or indirectly (licensing agreement with a local firm). Information on international patent applications is a means of assessing the status of economies as diffusers, or recipients, of technology.

3.3 TBP and the diffusion of science

72. So far we have dealt largely with the international circulation of technology. Given, as already noted, that science and technology are closely interdependent, we cannot disregard the movement of scientific knowledge, difficult though this is to gauge.

73. The processes at work in the international diffusion of scientific knowledge are even harder to measure than with technology. This is because in principle science is disseminated free, apart from the cost of the vehicle, and because no systematic record (of a balance-of-payments type) is kept of the flows involved.

74. Nonetheless, three types of data would seem to be usable:

i) The circulation of scientific publications (journals in particular) and the analysis of bibliographical references;

ii) Migration of scientific workers (researchers and engineers);

iii) Scientific conferences and congresses and visits by scientists.

4. OBJECTIVES AND OUTLINE OF THE MANUAL

4.1. Objectives

75. The purpose of this manual is to improve the compilation and presentation of quantitative information on technology expenditure and receipts. Two areas have to be addressed:

-- More precise definition of the content of the TBP;

-- Greater uniformity in the compilation and presentation of data at international level.

76. The TBP is not, of course, meant to be a direct indicator of technological competitiveness. A statistical indicator is a tool for a specific analytical purpose; it is rarely just an unprocessed record of quantitative data. Statistics on trade (or production, or capital recovery), for instance, are not direct indicators of competitiveness (such as market share, rate of penetration of the domestic market, etc.). The same is true for the TBP.

4.2. Working definition of TBP

77. The relationship between the international transfer of technology and the TBP has been discussed in considerable detail. It should simply be noted here that improving TBP data will probably fail to provide an answer for three serious limitations (18) on the compilation side. In analysis, on the other hand, there still seems room for some further development.

78. The first limitation is with transfers of technology without a specific financial counterpart (intra-firm transfers within multinational enterprises, cross-licensing).

79. The second concerns the "total price" paid for technology by the recipient, bearing other forms of payment (charges for ancillary goods and services) in mind as well as the direct cost (e.g., royalties). The other payments, which can be identified elsewhere in the balance of payments, are not easy to reinstate systematically in the TBP.

80. The third limitation is in the distortion produced by differing national tax systems, tax havens and exchange controls. They all produce discrepancies between financial flows declared as technology transactions and actual transfers of technology.

81. In view of all these limitations, the TBP may be defined as a sub-division of the balance of payments used to collate invisible transactions relating to trade in technical knowledge (ITT). By definition, the partners in this trade are in different countries.

82. Confining the TBP to a record of transfers of technology in the strict sense does not seem desirable for the following reasons:

i) The supply of technical services, although not a transfer of technology in itself, is often associated with a transfer either as a necessary part of the agreement or as a useful adjunct;

ii) Transfer contracts are often complex and it may be difficult even for the partners to determine which of the various expenditures and receipts relate to the transfer and associated services.

4.3. TBPs as S&T indicators: interpreting the data

83. A precondition for using TBPs as science and technology indicators is that each country has to clarify what the balance includes. The items in the TBP must be defined as clearly as possible. That is an elementary requirement.

84. A further requirement is an adequate level of international harmonisation both of definitions of the TBP's scope and of compilation procedures. That is essential for cross-country comparison of TBP data. Harmonisation will not be achieved overnight, but it is one of the major objectives behind this manual.

85. Both these conditions relate to the compilation of TBP statistics. Additional conditions, or words of warning rather, apply to the interpretation of the data. These cautions are of two different kinds.

86. The first has to do with the unremovable limitations mentioned in paragraphs 76-79 above. To some extent the difficulty here is not confined to the TBP; it is present in any quantitative analysis based on the measurement of economic phenomena.

87. The second category of cautions is due to the incomplete match between the TBP and, first, technology transfer and, second, the diffusion of technology. The question was discussed at some length in the previous section, and we will merely summarise the main conclusions about using the TBP as an S&T indicator.

88. Interpretation of the TBP will typically involve analysing its internal structure by type of transaction and transactor, by geographical region, by branch of industry, and so on. It may also involve looking for trends over time and structural change, and attempting international comparisons. The possibilities are described more fully in the Annex, particularly in Section 1, Internal Analysis of TBPs. But use of the TBP is by no means confined to internal analysis.

89. As S&T indicators, TBP data first need to be supplemented by considering other international data, on trade in goods with a high technology content, filing of international patents and output of multinationals, all of which are essential in assessing the technological competitiveness of economies (the way these items mesh is discussed in the Annex, Section 2, Combined Analysis of Technological Competitiveness).

90. Supplementary information of another kind is also required in order to interpret TBPs and progressively improve them. In this case we need to extend our understanding of firms' behaviour when engaging in technology trade: how multinationals in particular proceed, why one way of exporting technology is chosen over others, and so on. These are questions that fall outside the scope of the TBP compilation surveys, and are not necessarily a matter for the TBP authority. (See the Annex, Section 3, Supplementary Analysis -- Surveys.)

4.4. Outline of the manual

91. The following points will be developed:

-- Transactions covered by the TBP (Chapter II);

-- TBP classification systems (Chapter III);

-- Survey and data collection methods (Chapter IV);

-- Currency conversion and deflation (Chapter V);

-- Interpreting TBP data as S&T indicators (Annex).

CHAPTER II

TRANSACTIONS COVERED BY THE TBP

92. As we saw in Chapter I, paragraphs 80 and 81, the purpose of the Technology Balance of Payments (TBP) is to report all intangible transactions relating to trade in technical knowledge and services with a technology content between partners in different countries.

93. Three basic conditions therefore determine whether a given transaction is to be included in the TBP:

-- The transaction must be international i.e., must involve partners in different countries;

-- The transaction must be commercial and involve a flow of receipts/expenditure between the partners;

-- The transaction must concern payments relating to trade in techniques and/or the supply of technological services.

94. Transactions to be included in the TBP will be identified in two stages. The first will be to set the boundaries of the TBP on the basis of criteria for the inclusion, or exclusion, of transactions; the second will involve classifying and defining the transactions to be included.

1. TBP BOUNDARIES

95. Some of the boundaries, or rather dividing lines, between the transactions to be included and those to be excluded are easier to establish than others. Below, starting with the clearest ones, we set out the distinctions between TBP transactions and:

-- Merchandise transactions;

-- Unilateral transfers;

-- Intangible financial assets;

-- Services.

1.1. Trade in merchandise

96. Some types of goods, such as industrial plant or computer hardware, are carriers of technical information. That is not only because their manufacture requires technical expertise, which is true of any product; the real reason is that in acquiring and using these goods the purchaser will activate the techniques that they embody. Quite understandably, therefore, the export/import of such goods is considered to be one of the ways in which technology circulates internationally.

97. More generally, trade in either consumption or capital goods produced by industrial sectors employing advanced technology (19) is also a component of the circulation of technical knowledge, that embodied during manufacture and, for capital goods, that implicit in their use. At the same time, of course, the circulation of knowledge does not occur on its own here, and is not the specific purpose of such trade.

98. Trade in goods, including high-tech goods, is excluded from the TBP. When appraising an economy's technological competitiveness, on the other hand, international trade in high-tech goods (20) is clearly one of the relevant factors.

99. Two comments are needed at this point. The first is that the delivery of a good may also include supplying a service such as training or technical assistance with installation or maintenance. There will then be a flow of technical knowledge, reported under the heading of services.

100. The second relates to composite transactions such as the supply of a turn-key plant (or a product-in-hand deal) where the sale of equipment may be coupled with basic or specialised engineering services during the pre-investment and installation stages, the licensing of a patent, and the disclosure of know-how. Composite arrangements of this kind have, it seems, become increasingly widespread in recent years (21). The preferred course is to identify the individual components and report them separately, so that the engineering services, licence and know-how transactions and possibly technical assistance can be included in the TBP. Given the composite nature of turn-key factory contracts, this is by no means an easy task, and clearly it will not always be possible to separate out the financial flows relating to the various aspects, tangible and intangible.

1.2. Unilateral unrequited transfers

101. The exclusion of unilateral transfers, even those with a technology component such as private or official technical co-operation and assistance and contributions to scientific organisations, is justified on two grounds.

102. The first is that such transactions have no commercial aims. This is not to say they are free. These services may be supplied without charge, but they are still the outcome of using real or financial resources which are a

cost, to the transferor at least. Unilateral transfers are taken at the estimated or market price of these resources, so they are not excluded because their value cannot be assessed; the reason is that they are not trade transactions.

103. The second reason has to do with the technology content of these transfers. It can be argued that services in the form of technical co-operation or assistance supply knowledge that is generic, i.e., generally in the public domain, not secret. In other words, it is not (or is no longer) the basis for unshared expertise that can directly generate gain.

1.3. Intangible financial assets

104. Documents embodying industrial property rights, such as patents and trademarks issued by a national or regional office, represent non-financial intangible assets. As such, they necessarily have several points in common with financial intangible assets:

-- They are transferable;

-- They can generate income flows (income from capital or from industrial property rights).

Despite these similarities, the two types of asset form two generally distinct categories.

105. Although the dividing line is clear, some transactions that primarily involve one type of asset also touch upon characteristic features of the other. Three examples deserve mention:

-- Direct investment;

-- Input of technology assets;

-- Capitalisation of royalties.

1.3.1. Direct investment

106. Commentators have long been aware of the relationship between direct investment and the transfer of technology assets, patented or not. Flows of technical knowledge inevitably occur between parent companies and subsidiaries, at the formation stage or later on. For some authors, in fact, the true characteristic of direct investment is to construct a "package" based substantially upon intangible assets that cannot be dissociated from the firm and are not easily negotiable; this is referred to as internalising (22). The process will cover both technological assets as such and special knowledge or skills in finance, say, or marketing. When technology is transferred it will not necessarily be under a formal licensing or know-how agreement between the parent company and the subsidiary.

107. Conversely, direct investment may involve acquisition of a firm with a range of technological assets; this may in fact be the main reason. In that

event the direct investment adds to the technological capital of the purchaser. A sort of transfer of technology, by no means easy to measure, takes place between the subsidiary and the parent company.

108. Whichever way round it works, direct investment has a technological dimension that unfortunately is hard to estimate. If the existence of this component is accepted, we must further accept that the flows of income which are the return on the direct investment (whether ploughed back in the subsidiary or not) include a non-quantifiable portion representing a return on assets in the form of technology.

1.3.2. Technology as an investment input

109. The second example, where movement of a financial asset and movement of a technological asset may overlap, involves a special case where the direct investment includes a technology input. Here it is clearcut that the investment consists either wholly or partly of a transfer of ownership of patents, licences or know-how. In exchange for these assets the investor receives equity to the value of his contribution.

110. The practice in this case is to record the technology input under direct investment, as a trade with no financial outflow.

111. In order to bring out the actual transfer of technology assets, the transaction must be reported in two stages. A transfer of technological assets with a dummy financial counterpart is reported in the TBP, and an offsetting entry is then made under capital, direct investment, in the balance of payments proper.

1.3.3. Capitalisation of royalties

112. The third problematic example concerns capitalised royalties. Here royalties from a licensing or know-how agreement are not remitted but converted into shares in the company which received the input. The process has certain similarities with the reinvestment of profits from a direct investment, increasing the assets already held by the investor. For that the list of standard balance-of-payments components given in the IMF Manual contains an entry for "reinvested earnings" under "direct investment income", with an offsetting entry for "reinvestment of earnings" under the heading "direct investment" in the capital item.

113. An equivalent reporting procedure based on a double-entry system would, in theory, be a possibility for reinvested royalties. In practice, however, it is doubtful whether the sums involved justify such a complex procedure (23).

1.4. Services

114. Services are where the dividing line is finest between transactions that should be included in the TBP and those that should not. There are a number of reasons:

-- First, the TBP by definition is a sub-division of the services item in the balance of payments;

-- Second, services as a whole encompass a series of heterogeneous items that do not meet any one simple definition;

-- Third, international trade in services is expanding, particularly trade in intellectual services requiring specific knowledge and skills. Drawing a dividing line for TBP transactions in this area is extremely complex.

1.4.1. Analytical matrix

115. For consistency services will be divided into four groups, using two criteria.

116. The first, which is conventionally used to classify services in the broad sense, separates income from the possession and utilisation of factors of production, or factor income, and non-factor services. The distinction is made in the list of standard components in the IMF Balance of Payments Manual, though it has not been clearly defined.

117. Factor income represents earnings from the ownership and use of factors of production -- capital, labour and natural resources. The flows thus include income from portfolio and direct investment (dividends and profits, and also interest on loans and bonds), and labour income (wages, fees, pensions and so on).

118. Non-factor services are the performance of a time-limited task or activity that helps to satisfy individual or collective needs other than through transfer of ownership of a tangible good (24). The item covers transport, insurance and communication, for example, and commissions and brokerage, engineering services, consultancy and banking as well. It is thus broad and expanding, given the increase in intangible production activities.

119. The resources needed are capital and labour, principally skilled labour. Consequently, the dividing line between labour income and non-factor services is not necessarily very clear when the service calls chiefly for labour and is mainly fee-paid -- for example, management services and professional and technical services as defined in the IMF Manual (25).

120. At all events, the distinction between factor income and non-factor services can be used to divide the broad category of services into two sub-divisions.

121. The second criterion further divides these two sub-divisions by making a distinction between items that relate to technology and those that do not. We can thus construct a two-by-two matrix (Figure 2.1).

122. Obviously, with the second criterion the problem is defining technology. Under the definition adopted in Chapter I, the term is not applicable to all types of knowledge or information. Information flows, via communications networks or between databanks (26), are not covered by "international transfers of technology", so this category of services will go into section 4 of the matrix presented in Figure 2.1.

123. Again under the definitions in Chapter I, the knowledge necessary for the performance of non-industrial services such as management, marketing, legal and economic administration, advertising and financial management will not be classified as technology-related (27). Activity of this type will also go into section 4 of the matrix.

124. Looking at all four parts of the matrix we find (see Figure 2.1.):

in Section 1

Income from the possession of technological assets protected under industrial property law, generated mainly through transactions involving:

-- Patents (outright sale, or licensing);
-- Inventions;
-- Know-how (a borderline case, since there is no explicit legal protection);

in Section 2

Income from the possession of non-technological assets that are protected either under industrial property law (e.g., trademarks and patterns) or under intellectual property law (e.g., films, recordings, copyright material, software);

in Section 3

Services with a technology content: technical assistance, technical studies, engineering services, consultancy, technical co-operation;

in Section 4

Intellectual but non-technology-related services -- marketing, administration, financial management -- and all other services (insurance, transport, etc.).

1.4.2. TBP and the classification of services

125. Clearly, as a heading under which transactions relating to trade in techniques are recorded, the TBP first and foremost records transactions relating to items classified in section 1 of the matrix (factor income related to industrial property rights). These items are unquestionably a key component of the TBP.

126. Conversely, items in section 4 are services that should not go into the TBP. With some, transport and insurance for example, there has never been any question of including them. Others, like management, are for convenience included in some current TBPs. But services of this type will be excluded from the list of standard TBP components.

127. With sections 2 and 3 the borderline between inclusion and exclusion is not so clear, and in fact cuts through both sections; it is the broken line in Figure 2.1.

Figure 2.1.

GENERAL CLASSIFICATION OF SERVICES (TWO-BY-TWO MATRIX)

	Technology-related	Non-technology-related	
Factor income	Transactions involving: -- Patents: sale and licensing -- Unpatented inventions -- Know-how (unpatented) (1)	Industrial property	Trademarks Patterns Designs
		Intellectual property (2)	Copyright Films Recordings Software
Non-factor services	(3) Technical assistance Technical studies Engineering, consultancy Research and Development	(4) Commercial assistance Managerial assistance Financial assistance Legal assistance	
	Contract work Repairs Major projects	Telecommunications, incl. use of databanks Advertising Insurance, transport, etc.	

Notes: a) Items in section 1 will go into the TBP.

b) The broken line in sections 2 and 3 separates items that should go into the TBP and those that should not (shaded areas).

c) Items in section 4 (shaded areas) will not be included in the TBP.

d) The classification is discussed in paragraphs 24-45.

128. Transactions listed in section 2 (non-technology-related industrial property, and intellectual property) do not as a rule belong in the TBP. We have seen, however, that trademark licensing may be accompanied by the transmission of technological knowledge (quality control, for instance). At institutional level, moreover, industrial property rights, whether they involve technology or not, are usually administered by a single agency.

129. Transactions involving non-industrial intellectual property (films, recordings, copyright materials), on the other hand, are to be excluded from the TBP. Overall, therefore, the TBP will have some items from section 2, but not others, notably industrial patterns and designs, excluding those whose value is due to commercial fashion or of a purely artistic nature.

130. Matters are similar with section 3, technology-related non-factor services. Some are specific and/or linked to the transmission of technology under section 1 operations; these will be included. Others, relating to non-specific technologies, will be excluded.

1.4.3 The problem of software

131. Trade in software, involving computer service firms, is expanding rapidly and merits close attention. Worldwide the market was worth $15 billion in 1985, and is expected to reach $50 billion by 1991 (28).

132. Some definitions of the TBP at present include trade in software alongside supply of know-how. This would seem justified inasmuch as software is an intellectual product. But not all these products are innovative or exclusive, and software is in fact a highly diverse sector.

133. The International Standards Organisation has defined software as "Intellectual creation comprising the programs, procedures, rules and any associated documentation pertaining to the operation of a data processing system. Software is independent of its carrier media" (29). A distinction may be made between packages of standard programs and custom software tailored to specific requirements.

134. The OECD (29) has made the following distinction:

-- Systems software, which includes operating systems, interpreters to translate the programs into symbolic language, and data management systems;

-- Applications software, for corporate accounting, production management, sales management, etc.

135. Software cannot usually be protected by patents, but may be covered by copyright. In other words, software is covered by intellectual, not industrial, property law.

136. Because computer programs are a special case and highly diverse, in particular in terms of novelty and general application, it would seem preferable to exclude software trade from the TBP, except where the software is protected as part of a patented process.

2. STANDARD COMPONENTS OF THE TBP

137. The standard components of the TBP will be listed and defined in the order in which they are shown in Table 2.2, at the end of this chapter.

2.1. Trade in techniques

138. The core of the TBP consists of transactions involving international transfers of technology, and may be termed trade in techniques. The transactions, which convey technological knowledge, are classified as follows.

2.1.1. Sale/purchase of patents

139. A patent is a right in law conferred by an official agency, national or regional (30). It gives the patentee a monopoly of the invention and its industrial or commercial exploitation, for a limited time (ranging from fifteen to twenty years) and within a given territory.

140. As an item of property, a patent can be assigned or transferred under licence (see paragraphs 144 and 145 below).

141. Against payment, a patent may accordingly be bought or sold either in whole or in part; in the latter case, the sale may cover one or more applications.

2.1.2. Sale/purchase of inventions

142. Some inventions are deliberately not patented by the inventor, and others are not patentable on legal grounds (examples, from different countries, are biological engineering and pharmaceutical products). These inventions have no protection under industrial property law, but they may be protected by non-disclosure (or secrecy).

143. As with patents, inventions may be bought or sold, against payment.

2.1.3. Patent licensing

144. Under the licensing process, the patentee (or licensor) authorises the licensee to exploit all or some of the applications of the patent. The licensing agreement is likely to contain clauses on sole rights, period and territory as well, obviously, as forms of payment.

145. The latter chiefly include:

-- Payment of a pre-set amount, either as a lump sum or by instalments. This may include an initial payment on signature of the licensing agreement, to cover the costs of initial disclosure and transmission of the technology;

-- Payment of royalties calculated on the basis of the use made of the licence or the end result (units produced, sales or profits). The term current royalties is used to describe royalties paid at periodic intervals and calculated as a percentage of the selling price or any other value agreed upon beforehand. However it may be defined, a royalty is simply a means of payment stipulated in a patent licensing agreement (31), and is not in itself a form of contract.

2.1.4. Contracts covering the disclosure of know-how

146. Know-how is rather a loose category. Intuitively it can be grasped easily enough, but a quick and simple definition that will satisfy everyone is hard to find. The main reason is that know-how is not industrial property, so the term has no legal definition. Lawyers have made attempts to pin down know-how by analogy with patents, however, and in particular to clarify the standing of know-how agreements (32). Without embarking on an exercise in semantics, we can describe a few characteristics of know-how about which there is general agreement.

2.1.4.1. Characteristics

147. Know-how is technical knowledge which can be transmitted but is not accessible to the general public and is not patented. Accordingly, the first aspect of know-how is that despite being unpatented it remains either undisclosed or secret.

148. Second, know-how consists of knowledge that has been built up during the application of a technique, which itself may or may not be patentable, for production or marketing purposes. This characteristic emphasises the "acquired experience" aspect of know-how; it is not just the description of an industrial operation, but also the outcome of trial and error, hands-on experience and practical skills.

149. A firm may, for instance, have developed know-how which forms a body of knowledge in itself, independent of any patent. In that case it can be transmitted as such, under a know-how disclosure agreement.

150. But know-how may also, for various reasons, be an adjunct to information contained in a patent. To cover itself, an enterprise may choose not to file all the knowledge needed to exploit its patent. In any event, many parts of know-how are not in themselves patentable.

151. The third aspect of know-how is its mixed composition. Know-how includes both precise data set out in documentation and less systematised information not necessarily presented in physical form.

152. In the first of these categories we find the description of processes, formulae, tool drawings, workshop and organisation plans, production blueprints, component and equipment lists, specifications of raw materials and components, test and inspection reports, and written instructions for the application of processes. The second category covers a complex and unwritten mixture of acquired skills, instructions for performing work and the results of experience whose transmission requires the active involvement of those who possess it.

153. It is clear from its characteristics that the transmission of know-how entails more than simply supplying material (information presented on paper, audio and video cassettes, diskettes, etc.); there is a process of education and induction too (33). A range of methods are thus employed -- workshop training, demonstrations and consultations -- which are as important as the documentation. These methods are often referred to by the blanket term "technical assistance".

2.1.4.2. Transmission

154. We need to consider two cases here:

- When know-how is communicated on its own, independent of any other agreement; and

- When it is transmitted as an adjunct to a patent agreement.

155. Although know-how cannot be protected by patent it can, like a patent, give rise to specific agreements -- unrestricted transfer, or (more usually) temporary licensing. The forms of payment are comparable to those found with patent agreements.

156. In the second case, which is very common, the communication of know-how accompanies a patent agreement (assignment or, more frequently, licensing agreements). The know-how side is then covered in the main contract, and payment may or may not be separate.

157. Transmission of know-how via the "induction" process, it should be noted, is covered by the technical assistance clause found in some technology supply contracts. The scope (basic and/or detailed engineering) and the duration of assistance tend to increase with the technology gap between supplier and purchaser. In agreements with developing country firms, accordingly, the know-how and technical assistance side may well take in the start-up of the industrial facility (and even production quality control) with, of course, the staff training that entails.

158. The borderline between transmission of know-how and technical assistance is not cut and dried, therefore. For clarity, however, it seems preferable here to consider only know-how and its transmission (possibly extensive), either accompanying a licensing contract or on its own. The knowledge making up know-how is intrinsically exclusive in a way that information supplied through technical assistance is not (34).

2.2. Transactions involving industrial property

159. The protection afforded by patent systems is not confined to technical knowledge. It extends to trademarks and industrial designs and patterns. Rights to industrial property of that kind may be the subject of transactions in the same way as patents, i.e., assigned or transferred under licence.

160. The most common transactions probably involve trademarks, particularly trademark licensing. Since they do not concern technical knowledge, such transactions are not classified as international transfers of technology. But the point has often been made that a trademark licence may be accompanied by a transfer of technical knowledge, relating to a formula or the exclusive composition of a product, for instance, or to quality control. Given that it is impossible to isolate the technology component, trademark licences cannot be omitted. Moreover, the case for inclusion is strengthened by the current spread of franchise agreements.

161. Franchising involves a variable mix of industrial property rights (trademarks, designs, patterns, logos and insignia), transmission of mainly commercial know-how and the provision of technical assistance. The purpose of the agreements is the distribution of goods or the supply of services and not, as in the case of patents, manufacturing. They are in fact complex arrangements focusing on the exploitation of an exclusive trademark. (For the proposed treatment of special cases, see also Table 2.4.).

162. It would be of interest to separate trademark transactions relating to trade in techniques (category 1) from plain trademark deals. As a rule, payments under composite contracts cannot be disaggregated, so the course we propose is to consider non-related trademark transactions alone here. The others will automatically go with trade in techniques.

2.3. Services with a technical content

163. This heading covers services that call for the supplier to make use of technical skills and help the user carry out a productive activity. This is not a transfer of technology in the strict sense, in that the technical skills

employed are not as a rule transmitted to the purchaser (35), only their result. The latter, however, does help the purchaser increase or mobilise his technological potential.

164. Inclusion of these transactions in the TBP, but as a separate item, is warranted on the following grounds:

-- The supply of such services may be included in composite contracts that associate them with technology transfer proper (patents, licences, know-how). Services and other items may thus be complementary and mutually reinforcing;

-- Even if the supply of these services is not strictly speaking a transfer of technology, it is still part of the flows that produce the international diffusion of techniques.

165. Transactions that fall under the heading "services with a technical content" include:

-- Preliminary technical studies and engineering work required for the design and preparation of industrial projects, including product definition, process and plant specification, general design and detailed drawings for the installation;

-- General technical assistance for industrial operation and maintenance, including staff training, secondment of technicians, consultancy services and assistance for quality control and trouble-shooting.

166. Payments for technical services will take the following forms:

-- One-off payment, described as fees or not;

-- Payments recurring in consecutive years, described as fees or not.

167. Note that transactions relating to commercial, legal, financial, administrative, organisation and managerial assistance are excluded. Major civil engineering contracts (construction of bridges, roads, non-industrial buildings), mineral and petroleum prospecting, contract work and repair activities, occasionally included in some countries' TBPs, are also excluded.

2.4. Industrial and technological R&D

168. The final heading covers flows to finance R&D performed outside the agents' country of residence. Taking a given country A, this will be R&D financed by residents of A and performed elsewhere, as well as R&D performed in A and financed by non-residents. The work must be industrial and technological R&D.

169. The financial flows relating to the relocated R&D seem largely of two kinds:

-- First, funds provided by multinational corporations to finance R&D performed by their subsidiaries (which may be manufacturing concerns,

or specialise in R&D), as well as funds which subsidiaries remit to their parent companies as an "entry fee" or advance payment for a subsequent tranfer of technology;

-- Second, financial flows between unrelated firms which have agreed to conduct joint R&D either in existing research facilities or in a subsidiary company they have set up together for that purpose.

170. There are other international flows of finance for R&D, involving official and private-sector agencies. The financing of scientific R&D (co-operation in science, contributions to intergovernmental research bodies such as CERN) is not included in the TBP, but some borderline cases have to be taken into account. Examples are flows relating to R&D performed jointly by private-sector concerns and university laboratories, whatever their status, and official financial contributions to co-operative projects on technology, such as the European Community programmes.

171. In TBP terms, these financial flows are somewhat special. Unlike all the other items in the TBP, these flows do not represent output from past R&D; they fund science and technology inputs. It can be argued that the financing is an entry fee, for the results of the R&D that is being paid for, and that it to some degree represents payment for output as well. Whether this is so or not, the twofold and possibly ambiguous nature of financing for R&D performed abroad, and outside financing for local R&D, needs to be borne in mind when TBP data are interpreted.

Table 2.2

STANDARD COMPONENTS OF THE TBP -- Summary (a)

1.	Trade in techniques			
	1.1 Transfer of patents [140,141,142]			
	1.2 Transfer of non-patented inventions [143,144]			
	1.3 Patent licensing [145,146]			
	1.4 Disclosure of know-how			
	-- on its own			
	-- adjunct to 1.1 or 1.3 [155,156,157,158]			
2.	Transactions involving trademarks, designs, patterns (sale, licensing, franchising) [160,161,162,163] (b)			
3.	Services with a technical content (c)	Adjunct to 1	Unrelated to 1	Total
	3.1 Technical studies and engineering work (project design and preparation) [164,165,166]			
	3.2 General technical assistance (industrial operation and maintenance) [164,165,166]			
4.	Industrial R&D performed abroad/financed from abroad [169,170,171]			

Notes: a) The numbers in [ ] show the paragraphs of Chapter II where the components are described.

b) When transactions involving trademarks, designs and patterns are part of a composite agreement including trade in techniques (category 1) or services (category 3) and the payments cannot be disaggregated, the flows are to be recorded in full under category 1 or 3.

c) The services that are an adjunct to trade in techniques (category 1) must, as far as possible, be separated from the technical services supplied on their own. Where this cannot be done, only the total will be shown against 3.1 and 3.2 (or category 3). For adjunct services, when contract payments cannot be disaggregated the flows are to be recorded in full under category 1, as for trademarks.

3. SOME PRACTICAL RULES FOR COMPILING THE TBP

172. We now present two summaries as a guide to TBP compilation:

- Table 2.3 lists criteria for distinguishing TBP items from other international transactions; while
- Table 2.4 outlines the way a number of special cases should be treated.

Table 2.3

ITEMS TO BE INCLUDED OR EXCLUDED:
CRITERIA FOR DISTINGUISHING TBP ITEMS FROM OTHER TRANSACTIONS

1.	What is the nature of the transaction?
1.1	Is it an international commercial transaction related to trade in techniques or technology?
2.	Is it trade in merchandise?
3.	Is it an unrequited transfer?
4.	Does it concern financial assets, e.g., direct investment, on input of technology assets or capitalisation of royalties?
5.	Does the transaction relate to services?
5.1	Does it relate to technology factor income (i.e., income from a technological asset protected under industrial property law)?
5.2	Alternatively, does it relate to non-technology factor income (i.e., income from a non-technological asset protected under industrial property law)? Is it thought to be a vehicle for technology transfer?
5.3	Does it relate to a non-factor service (i.e., not protected under industrial property law) with a technology content?
5.4	Can a predominantly technological aspect be identified?
5.5	Does it relate to a non-factor service with no technology content (i.e., intellectual services)?

Note: If the answer to questions 2, 3 or 4 is Yes, the transaction does not belong in the TBP. Items covered by question 4 can, all the same, help supplement TBP data in some cases.
If the answer to question 5.1 is Yes, the transaction belongs in the TBP. With questions 5.2, 5.3, 5.4 and 5.5, more care is needed. The technological aspect of the transaction must be clear and predominant. Table 2.4 deals with a number of special cases.

Table 2.4

TREATMENT OF SOME SPECIAL CASES

Transaction	Treatment	Comments
Merchandise, direct investment, etc.		
Trade in merchandise	Exclude	Imports and exports of goods, even high-tech goods.
Unilateral unrequited	Exclude	Such as private or official technical co-operation and assistance, and contributions to scientific organisations. Transactions with no commercial aims, whose content is generally in the public domain, not secret.
Direct investment	Exclude	Intangible in-house flows of know-how, very hard to dissociate from the firm's other assets. This item may be taken as supplementary TBP data when the technology aspect is thought to be substantial.
Input of technology assets	Exclude	Investment consisting wholly or partly of a transfer of ownership of patents, licences or know-how. Where the input is entirely technological the transaction could, in theory, be shown as a TBP item. Given the difficulty of obtaining confirmation, the recommendation is to exclude these transactions.
Capitalisation of royalties	Exclude	Non-remitted royalties are converted into shares in the company which received the input. Given the complex reporting procedure, the recommendation is to exclude these transactions.

Table 2.4 (continued)

Services		
Patents (sale/purchase) (licensing)	Include	Industrial property rights on technology.
Know-how (unpatented)	Include	Technology assets not protected under industrial property law.
Invention	Include	As above.
Trademarks (incl. franchising)	Include	Non-technological industrial property. Hard to separate from licensing and royalties in the balance of payments.
Patterns, designs	Include	Non-technological industrial property. Should only include items of an industrial character wherever possible, excluding those whose value is due to commercial fashion or of a purely artistic nature.
Films, recordings, copyright materials	Exclude	Only a small proportion of this item is technology-related.
Software	Exclude	The products are highly diverse, and the technology-related portion is hard to estimate; the recommendation is to exclude software, except where it is part of a patented process.
Other services		
Technical assistance	Include	General technical assistance to be included when the technical aspect is clearcut.
R&D	Include	Can be included when the R&D payment flow reflects a continuing flow of activity. It is a measure of both input and output.
Commercial, financial managerial and legal assistance advertising Insurance, transport	Exclude	The technology aspect is hard to identify.

Note: The list is not an exhaustive one.

CHAPTER III

CLASSIFICATION SYSTEMS

173. A number of systems can be used to classify data presented in the TBP. The first is the one we saw in Chapter II, based on the central purpose of transactions. At present it is unusual for national systems to collate all the data needed for the classifications proposed. In addition, the quality may vary, depending on whether the data relate to revenue or expenditure. All the classifications presented here thus presuppose improvements in the collection of data.

174. Other broad classifications could be based on the transactors themselves or on the contracts and forms of settlement, financial or other.

175. Before describing these systems, it should be noted that the survey unit is not the same as that used for classification. In their surveys, countries look at the transactor, not necessarily a firm, who either makes or receives a payment. The unit of classification is in fact the expenditure/receipts flow, broken down according to:

- Type of transaction (transfer of a patent, licensing, know-how or services);
- Transactor characteristics (see section I below);
- Contract characteristics (see section II).

1. CLASSIFICATION BY TRANSACTOR CHARACTERISTICS

176. TBP transactions involve at least two economic agents, one resident and the other non-resident, who are party to a contract.

177. We will use the definition of residents given in Chapter Three of the IMF Balance of Payments Manual. That definition, which may be referred to when necessary, is consistent with the United Nations' standardised System of National Accounts (SNA). The underlying concept of residence is based on the relationship of transactors (government, individuals, enterprises, etc.) to the territory of a given economy; transactors are deemed to be residents of the territory in which their principal centre of economic interest rests.

178. Classification systems based on the characteristics of transactors cover both resident and non-resident partners in TBP transactions; classification by geographical area, obviously, applies to non-residents only.

179. We shall look in turn at classification by institution and by geographical area and systems applicable to the enterprise sector.

1.1. Institutional classification

180. Receipts/expenditure recorded in the TBP are very largely financial flows between enterprises in the private sector or comparable agencies in the public sector. However, some types of transaction, particularly under international R&D programmes, may involve official research bodies or universities.

181. The simplest way of defining sectors would seem to be to follow the recommendations of the Frascati Manual (36). Reference to the same set of definitions will facilitate comparative analysis of R&D and TBP data.

182. The Frascati Manual identifies four major sectors:

-- Business Enterprise;

-- Government;

-- Higher Education; and

-- Private Non-Profit (PNP).

1.1.1. Business Enterprise

183. According to the Frascati Manual this sector includes "All firms, organisations and institutions whose primary activity is the production of goods or services for sale to the general public at a price intended approximately to cover the cost of production", together with "the private non-profit institutes mainly serving them" (37).

184. Along with private enterprises the sector includes in public enterprises which are the "industries of government".

185. A number of further classifications, described later on in the chapter, are relevant to this sector.

1.1.2. Government

186. The sector covers "All departments, offices and other bodies which furnish but normally do not sell to the community those common services which cannot otherwise be conveniently and economically provided and administer the state and the economic and social policy of the community" (38).

187. Government does not include public enterprises assigned to the business enterprise sector, or higher education institutions under public control. But it does take in non-profit organisations which primarily serve government or are wholly or partly financed by government.

188. The IMF Balance of Payments Manual recommends that international bodies which are political, administrative, economic, social or financial institutions rather than enterprises should be treated as part of foreign general government and not considered resident in any national economy.

1.1.3. Higher Education

189. This sector covers "All universities, colleges of technology and other institutes of post-secondary education, whatever their source of finance or legal status. It also includes all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education establishments" (39).

190. The System of National Accounts does not give higher education a heading of its own, but the OECD has made the distinction for R&D purposes. Should a separate TBP heading for ths sector seem of little value, or premature, higher education could be included in government.

1.1.4. Private Non-Profit (PNP)

191. This sector covers:

"-- Private or semi-public organisations which are not established primarily with the aim of making a profit (except for those controlled by institutions in the other sectors);

-- Private individuals or households" (40).

192. The sector consists primarily of voluntary associations and foundations, and institutes supported by them; they are maintained by fees, dues, donations and official grants. Private non-profit institutions that primarily serve another sector will be included under the appropriate heading (government, higher education, business enterprise).

193. The case for amalgamating PNP with government and higher education could be argued here on grounds of practicality. We should then have just two major sectors:

-- Business enterprise (largely the market sector);

-- Other transactors (government, higher education and PNP -- largely non-market).

1.2. Geographical classification

194. Non-resident transactors are classified by country of residence, regardless of the institutional category to which they are assigned.

195. Classifying them by geographical region or economic area (EEC, EFTA, OECD, etc.), or by development status (industrialised nations, NICs, etc.), would also clearly be feasible.

1.3. Sub-classifications relevant to business enterprise

196. Business enterprise may be further classified:

-- by industry;

-- related/non-related status;

-- and size.

1.3.1. By industry

197. For cross-country comparisons and analysis, units in the business enterprise sector are classified in the industry groups and sub-groups defined in the International Standard Industrial Classification of All Economic Activities (ISIC), the third revision of which is nearly complete (see Table 3.3 below).

198. When TBP data are compiled, firms may be classified according to national nomenclatures that, by and large, differ from country to country and also from ISIC. For cross-country purposes these nomenclatures can be matched to ISIC by means of conversion keys.

199. We should note here that classification by industry, using national nomenclatures or ISIC, is based on the enterprise's main economic activity, measured by share of total turnover (and possibly by share of workforce).

200. Classification by main activity raises problems of three different orders:

i) The first, which is not restricted to TBP, concerns enterprises (or groups) whose activities span several industries. There is no way round this drawback inherent in systems that classify business by main activity, other than to split the legal and economic entity up and assign given segments of the firm to the industries in which it operates;

ii) The second difficulty concerns possible discrepancy between the activity (or activities) of the reporting firm (and its partner) and the actual industrial area or product covered by the contract. One example is where an engineering consultancy (classified in services) is party to a transfer of industrial technology. The classification based on contract characteristics will need to cover this (see section 2.2. of this chapter).

iii) The third difficulty lies in determining the main activity of the foreign partner. In each economy, data for the TBP are collated from returns by resident enterprises. The latter may not be fully aware of the activities of their foreign partners. That may lead to discrepancies between the foreign partner's main activity, as reported, and its classification in the partner economy. For this reason it does not seem possible to recommend classification by industry for non-resident partners.

1.3.2. Related/non-related status

201. Given the scale on which technology is transferred by firms with foreign operations, we felt that a distinction should be made between non-related and related partner companies in order to identify the flows of receipts/expenditure between the parent company and subsidiaries of a multinational group. In this instance we need to look both at the status of the partners and at the type of transaction (intra-firm or not). All the possibilities set out in Table 3.1 can occur.

Table 3.1

POSSIBLE RELATIONSHIPS BETWEEN PARTNER ENTERPRISES

Resident enterprise \ Non-resident enterprise	Non-related company	Parent company B and its non-resident subsidiary	Subsidiary of A (1)
Non-related company	non-related	non-related	non-related
Parent company A and resident subsidiaries	non-related	non-related	intra-firm
Subsidiary of B (1)	non-related	intra-firm	non-related

(1) Subsidiary is taken in the broad sense here, either majority-controlled (over 50 per cent of the equity held by the parent) or with a minority holding (over 10, 20 or 25 per cent).

Note: The first question concerns the resident partner: is it non-related (NR), a parent company (P) or a subsidiary (S)?

When the answer is NR, there is no reason to proceed further. But when the answer is P or S, we need to ask whether the non-resident partner is NR, P or S (subsidiary of the same group).

1.3.2.1. Definition

202. A multinational enterprise (41) is one which controls production and/or marketing activities located in various economies. The first step towards formation of a multinational is direct investment, which shows, unlike portfolio investment, that the investor has a long-term interest in the transaction. The key words in this respect are "control" and "long-term interest". The concept of control, however, is not always clearcut.

1.3.2.2. Criteria

203. In cases where non-residents have a majority holding, i.e., more than 50 per cent of the equity in a local company (or residents, in a company abroad), it is relatively easy to demonstrate that there is a long-term interest and that control is being exercised. But with holdings of less than 50 per cent (minority holdings) we have to define our terms of reference more precisely. What criteria should we use in deciding that the financial link is not a portfolio investment but indication of a controlling interest?

204. The answer to this question has two aspects. In numerical terms we can set a threshold, generally between 10 and 25 per cent, above which the equity holding will be considered direct investment. We also need to look at the spread of shareholdings, to see whether a holding below that threshold confers effective management control.

205. As the IMF Balance of Payments Manual points out, there are difficulties in defining "direct investment". However, it adds that "these problems, serious through they may seem, do not necessarily have a corresponding importance for the validity and intercountry comparability of the statistics on direct investment" (42). The reason is that direct investment enterprises are for the most part subsidiaries controlled through a majority holding. Real borderline cases, where the dividing line between direct and portfolio investment is blurred, are not very frequent.

1.3.2.3. Application

206. What matters, for the TBP, is whether or not there is an investment link between firms that are parties to a contract, i.e., between the firms making and receiving payment. A useful distinction could be made between an enterprise's dealings with companies in which it has a majority holding (50 per cent), termed subsidiaries proper, and dealings with companies in which it has a minority holding (between our threshold and 50 per cent), which could be called associate companies.

207. As things stand, it would seem preferable for individual countries to define multinationals using the criteria that they now apply for data such as direct investment flows (virtually all countries) or statistics on trade in goods and services (some countries only). This approach would ensure that a harmonised definition is used for international intra-firm flows within each body of national statistics (definitions would not be standard for cross-country comparisons).

1.3.2.4. International harmonisation

208. Looking to the future, there are strong grounds for recommending that Member countries adopt a common approach, such as the Detailed Benchmark Definition of Foreign Direct Investment proposed by the OECD in 1983 (43).

209. According to this proposal:

i) A distinction should be made between subsidiaries (majority holding of at least 50 per cent), associate companies (equity holding of between 10 and 50 per cent) and branches (establishments with no legal personality);

ii) The minimum for associate company status would be 10 per cent of the equity or voting rights;

iii) Calculation of financial links would include both direct and indirect holdings (the latter through subsidiaries, i.e., multi-tier holdings), determined by full consolidation methods. Basically:

-- Subsidiary X of subsidiary Y of company N is considered to be a subsidiary of N;

-- If N and its subsidiaries control between 10 and 50 per cent of the shareholders' voting power in company K, or if N and its subsidiaries control less than 10 per cent, but have an effective voice in the management of K, then K is an associate company of N.

210. The OECD benchmark definition can be applied only if companies in Member countries draw up consolidated accounts on a worldwide basis; otherwise, the OECD recommends that United States practice should be followed (44).

1.3.3. By size

211. The size of an enterprise is understandably a factor that affects the scale of technology receipts and expenditure. It has been noted in most countries that contracts and the related financial flows are largely confined to a small number of enterprises.

212. Size can be gauged from financial data or from the workforce. Japan, for instance, and a number of other countries, have a wide range of criteria for classifying the enterprise sector in terms of size: equity, turnover, operation profit, total workforce and research staff. Most countires tend to use the last two items, as the simplest to collect and apply.

213. The size of firms is one factor which the European Communities took into account in the directive on the presentation and content of annual accounts and reports. Stricter obligations to present detailed statements of assets, financial position and operation results are imposed on the larger firms.

214. The Fourth Council Directive (78/660/EEC, amended in 1984) lists three criteria for this purpose: number of employees, net turnover and balance sheet total. There are three size categories, shown below with the 1984 ceiling for each criterion.

Small companies

i) number of employees: 50
ii) net turnover: ECU 3.2 million
iii) balance sheet total: ECU 1.55 million

Medium-sized companies

i) number of employees: 250
ii) net turnover: ECU 12.8 million
iii) balance sheet total: ECU 6.2 million

Large companies

where two of the last three limits are exceeded.

215. Given the likelihood of comparisons between technlogy trade and R&D data -- in which firms are as a rule classified by workforce only -- the number of employees could be recommended for the TBP as well. The following classification may be used (Table 3.2).

Table 3.2

SIZE GROUPS OF FIRMS ACCORDING TO NUMBER OF EMPLOYEES

Under 100
100 to 499
500 to 999
1 000 to 4 999
5 000 to 9 999
10 000 and above

216. Looking at the TBP on its own, it is probably preferable, in order to assess the significance of size, to collect data using very simple financial criteria that will allow cross-country comparisons. The following size groups, by turnover, may be used (Table 3.3).

Table 3.3

SIZE GROUPS OF FIRMS ACCORDING TO TURNOVER

Under US$ 50 000
US$50 000 to $499 999
US$500 000 to $4 999 999
US$5 000 000 to $49 999 999
US$50 000 000 and above

217. To allow comparisons of the degree of economic concentration and the volume of technology trade, it would further be of value to have data on TBP revenue and expenditure, by industry, for the 5, 10 or 15 firms with the largest turnover.

2. CLASSIFICATION BY CONTRACT CHARACTERISTICS

218. As discussed earlier in this chapter, one of the difficulties in compiling TBPs is the discrepancy between the unit for surveys (transactor) and the unit for classification, i.e., the contract or, more precisely, the financial or other flows(s) reflecting the transaction specified in the contract.

219. Contracts and related flows have already been classified on the basis of the transactions involved. It will be useful to consider other systems, based on:

-- Date and lenth of contract;

-- Type of product;

-- Procedures for payment.

2.1. Date and expected duration (new and existing contracts)

220. A large proportion of TBP transactions are long-term arrangements, not one-off buy-and-sell deals. Examples are licensing agreements or contracts for the provision of technical assistance. The duration of contracts is generally agreed beforehand.

221. For the purposes of analysis it is helpful to be able to relate the receipts/expenditure flows for a given period (a year for example) to the contractual event from which they arise. Here we need to know not just the date and expected duration of each contract, but also whether the receipts/expenditure relate to a new contract or an existing one.

222. A new contract is one concluded during the most recent reference period (generally a year in statistical practice). An existing contract is one that was signed before this period. Examining the differences between receipts/expenditure flows related to contracts signed during the most recent reference period and those for previous periods provides an insight into TBP dynamics. Growth in receipts/expenditure may be the result of more contracts, or of an increase in their "value", i.e., the level of the related payments.

223. One problem often cited is the contract that is renewed or extended, with or without a change in content. Such cases, which certainly represent no more than a tiny proportion of the total, should not stand in the way of overall classification into new and existing contracts.

224. The recommended treatment of repeat contracts is to classify them as new ones when changes have been made to the technology which is the basis or main purpose of the contract, and as existing ones otherwise. In other words,

whether or not the contract is new will depend in this case upon how innovating the technology is. The final say, as far as possible, will rest with the survey unit, i.e., the party to the contract. In borderline cases it will be reasonable to classify renewed contracts as existing ones.

2.2. Type of product

225. Just as firms are classified within an industrial nomenclature according to economic activity, contracts and receipts/expenditure flows can be categorised according to type of product. Classification by product will assist comparisons with other data, on trade in goods for instance.

226. It should be noted that this does not duplicate the classification of enterprises by economic activity. The latter addresses the main activity, and firms may perfectly well operate in a number of areas. Even if they have been correctly classified according to activity, moreover, the technology covered by the contract may well fall within a different industrial category. Examples here are engineering consultancies (classified under services) supplying services that may be used in productive industrial activities.

227. The criterion for allocating contracts, and related flows, by product is a key problem here. In theory, the object of TBP transactions is information, knowledge or training, i.e., an intangible good that falls within the category of services. Classifying this knowledge -- in the broad sense -- by product means looking at the industrial field to which it is being applied.

228. A useful basis for this approach may be found in the most recent Central Product Classification: Table 3.3 shows CPC matched to ISIC-Rev.3 and Rev.2.

229. Two comments are needed. First, even ISIC-Rev.3 unfortunately does not give sufficient cover to some new products or fields (biochemical engineering is one example). Second, the classification of contracts by product can effectively accommodate patents, licences or know-how relating to products, but manufacturing processes are another matter.

230. Processes can be dealt with in one of two ways. If the process is embodied in an item of equipment or a material, then the latter will dictate the heading under which it is classified. If the process cannot be so easily distinguished from its carrier (i.e., a formula or composition), then the product it is used to manufacture will be decisive.

2.3. Procedures for payment

231. The contracts recorded for TBP purposes will involve a variety of procedures for payment. Several categories will therefore be reviewed.

232. The first distinction that needs to be made is between monetary and non-monetary payment.

2.3.1. Monetary payment

233. In order to draw up a TBP, there must be flows of payments associated with technology-related transactions. If the payment takes a non-monetary form, or for some reason is included in another type of financial flow (e.g., with repatriated earnings), identification of a technology-related transaction depends largely on the good will of the reporting firms.

Table 3.3

CONCORDANCE TABLE BETWEEN ISIC REV. 3, ISIC REV. 2 AND CPC
REARRANGED FOR THE TECHNOLOGY BALANCE OF PAYMENTS(*)

Description	ISIC Rev. 3	ISIC Rev. 2	CPC
1. AGRICULTURE, FORESTRY & FISHING	Categories A&B (div. 01 to 05)	Major division 1 (div. 11 to 13)	Section 0 (div. 01 to 04)
2. MINING	Category C (div. 10 to 14 exc. 11)	Major division 2 (div. 21 to 29 exc. 22)	Section 1 (exc. div. 12,17 & 18)
3. Crude petroleum & natural gas extraction	Div. 11	22	12
4. TOTAL MANUFACTURING	Category D (div. 15 to 37)	Major division 3 (div. 31 to 39)	Sections 2 to 4 (div. 21 to 49)
5. Electrical machinery and apparatus	31	383 exc. 3832	46
6. Radio, TV and communication equipment	32	3832	47
7. Electronic components	321	part of 3832	471
8. Communication equipment	322	part of 3832	472 & part of 474
9. Television & radio receiving equip.	323	part of 3832	473 & part of 474
10. Instruments	33	385	48
11. Office and computing machinery	30	3825	45
12. Other machinery n.e.c.	29	382 exc. 3825	43 and 44
13. Transportation equipment	34 and 35	384	49
14. Motor vehicles	34	3843	491 and 492
15. Shipbuilding and repairing	351	3841	493 and 494
16. Railroad equipment	352	3842	495
17. Aircraft and space	353	3845	496
18. Other transportation equipment	359	3844 and 3849	499
19. Basic metals	27	37	41
20. Ferrous metals	271 and 2731	371	411 and 412
21. Basic precious & non-ferrous metals	272 and 2732	372	413 to 416
22. Fabricated metal products	28	381	42
23. Chemicals	24	351 and 352	34 and 35
24. Drugs and medicines	2423	3522	352
25. Basic chemicals	241	3511 essentially	34
26. Other chemicals	242 (exc. 2423) and 243	352 and part of 3513	35 (exc. 352)
27. Refined petroleum prods. & nuclear fuel	23	353 and 354	33
28. Rubber and plastic products	25	355 and 356	36
29. Food, Drink and Tobacco	15 and 16	31	21 to 25
30. Textiles, wearing, footwear & leather	17 to 19	32	26 to 29
31. Other manufacturing	36 and 37(?)	39	38 and 39(?)
32. TOTAL SERVICES	Categories E to Q (div. 40 to 99)	Major divisions 4 to 9	Sections 5 to 9 and divisions 17 & 18
33. Electricity, gas and water supply	Category E (div. 40 & 41)	Major division 4	17 and 18
34. Construction	Category F (div. 45)	Major division 5	Section 5 (inc. 53?)
35. Transport and storage	60 to 63	71	71 to 74
36. Post and telecommunication	64	72	75
37. Computer and related activities	72	8323	84
38. Research and development	73	932 and part of 8324	85
39. Architect., engineer. & other tech. act.	742	part of 8324	867
40. Other services	Cat. G, H, J, K (exc. 72, 73, 742), L to Q	Maj. div. 6, 8 (exc. 8323, 8324), 9 (exc. 932)	Div. 6,8 (exc. 84, 85 and 867) and 9
41. GRAND TOTAL	Categories A to Q	Major divisions 1 to 9	Sections 0 to 9

(*) Note: The rearrangement has been made in such a way as to stay as close as possible to the industrial classification of R&D (based on the CITI Rev. 2) as it appears in the Frascati Manual 1980 (Table III.1) and international OECD surveys on resources of R&D.

Source: OECD/DSTI

Reference documents:

ISIC Rev. 2: International Standard Industrial Classification of All Economic Activities. Series M No. 4, Rev. 2, United Nations, New York, 1968.

ISIC Rev. 3: Final draft of the Revised International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 3. Provisional ST/ESA/STAT/SER.M/4/Rev. 3/Add. 1 14th October 1988, United Nations.

CPC: Final draft of the Central Product Classification (CPC). Provisional ST/ESA/STAT/SER.M/77/Add. 1 -- 14th October 1988, United Nations.

234. Monetary payment may take various forms, depending on the transactions covered by the contract (see Chapter II, paragraphs 145, 155, and 166):

-- A pre-set amount, payable as a lump sum or by instalments;

-- Royalties, payable at agreed intervals;

-- Fees, as a single payment or at intervals;

-- Other forms are possible.

235. Royalties are further defined as a proportional payment based on a given economic value; consequently, the basis and rate of calculation must also be specified.

236. A further element to be noted is the currency used for invoicing/payment; it is not always the currency of the country of the supplier or the purchaser.

2.3.2. Non-monetary payment

237. Non-monetary payment may take several forms. For each, the reporting of non-monetary payment and the identification of the sums involved depends largely upon firms co-operating, and verification would seem difficult.

238. The main forms of payment to be noted are:

-- Information swaps (of which cross-licensing is a special case);

-- Product buy-back (countertrade);

-- Capitalisation of royalties; conversion of non-remitted royalties into equity capital.

CHAPTER IV

SURVEY AND DATA COLLECTION METHODS

239. One of the major stumbling blocks to the international harmonisation of TBP statistics at present is the diversity of the approaches to data collection. Some countries have just a brief section under services in the balance of payments, others conduct systematic and detailed reviews expressly to measure international transfers of technology. In addition, some use two, occasionally even three, sources of statistics, and the data are not always consistent. The variety of sources thus reduces the uniformity of data within a given country, as well as being detrimental to international harmonisation.

240. Given the way matters stand, our short-term goal must be to harmonise the definitions and frameworks of reference, rather than out-and-out standardisation of survey methods and administrative responsibilities; at the same time, our recommendations will seek to work in that direction. The recommendations also bear in mind the range of agencies currently engaged in collecting data on technology payments. At an appropriate point in section 2 of this chapter, tables summarise the types of data to be collected, for the two main collectors -- the central bank (or banking system) or a specialist agency (usually an official body).

241. Before considering the recommendations, we may usefully look more closely at some of the factors that have to be taken into account.

1. FACTORS TO BE CONSIDERED IN DRAWING UP THE RECOMMENDATIONS

242. The factors fall under three headings:

-- Diversity of aims and methods;

-- Market liberalisation;

-- Growth and concentration of trade in technology, and its "controlled" nature.

1.1. Diversity of aims and methods

243. Current data collection methods broadly take two lines of approach, reflecting the dual nature of technology receipts/expenditure as both an international payment and a partial indication of science and technology output.

244. The first approach tends to stress the international payment aspect, the flow to be included in the balance of payments. Here the central role in collection often rests with the agency (usually, but not exclusively, the central bank) responsible for compiling statistics on external payments.

245. The second concentrates more on technology payments as a science and technology (S&T) indicator. The agency that collects the data will then have responsibility, say, for R&D surveys, industrial property or the supervision of international licensing contracts as well.

246. Each approach has its advantages and disadvantages.

247. With the first, data are recorded

-- systematically;

-- indirectly;

-- and the focus is on payments (45).

248. The procedure is systematic in that all receipts/expenditure are recorded, not merely a sample. This is the case, in particular, when the record is provided by a central bank, or bank of issue, that centralises information received from other banks. The drawback to systematic records is that they are broad in scope and poor in detail.

249. The procedure is indirect because the foreign exchange flows entailed in receipts/expenditure transactions are, more often than not, reported to the central bank by the banks that act as authorised intermediaries. This introduces an intermediate step between the firm, which is the actual transactor, and the statistics agency responsible for collecting information.

250. Finally, the procedure focuses on the payment, not on the contract under which technology is transferred.

251. With the second approach, the procedure for collecting data is somewhat different. It tends to be:

-- partial (via sampling);

-- direct;

-- and the focus is on the contract (46).

252. The approach is partial in that it may be based on a representative sample, periodically tested and rebuilt. This is by no means a hard and fast rule, however. Examples are to be found of national recording procedures which, though not designed to provide balance-of-payments data, are nonetheless systematic (with mandatory returns by enterprises, for example).

253. Whether it involves samples or mandatory returns, the procedure is direct. The agency concerned has direct contact with the firm performing the international transactions.

254. The procedure, in general, does not focus just on the receipts/expenditure flow but on the contract, its purpose and specific provisions as well.

255. Presented in this way, the two lines of approach seem to be diametrically opposed; in practice, however, there is a fairly broad spread of data recording methods that covers nearly all possible combinations. We could have looked at one final characteristic, frequency of collection. It does not, however, seem a significant factor in defining the collection methods in present use.

1.2. Market liberalisation

256. This trend is relevant to our discussion in that it affects the ability of public authorities to persuade others of the value and necessity of collecting information on technology payments. In this respect, mention should be made of two mutually reinforcing trends:

-- Removal of exchange controls;

-- Liberalisation of trade.

1.2.1. Removal of exchange controls

257. Exchange controls are currently being relaxed or abolished by most of the countries which had earlier introduced them.

258. The relaxation or removal of exchange controls affords economic agents a greater degree of freedom in their financial transactions with foreign countries. Transactors are entitled to open foreign currency accounts, in their country of residence or abroad; they are no longer obliged to convert foreign exchange acquired abroad, and can purchase foreign exchange at any time without having to show that it is to pay for imports.

259. In other words, the purchase, possession and conversion of foreign exchange are no longer tied or confined to specific commercial transactions. This modifies the role played by banks as authorised intermediaries, and hence in notifying the central bank of transactions between resident enterprises and foreign firms.

260. Henceforth, resident enterprises can make foreign exchange payments (royalties, for example) using currency held in resident or non-resident accounts, without going through an authorised intermediary. Likewise, receipts of foreign exchange (from licensing agreements, for instance) may be retained in a foreign account for future investment or expenditure.

261. The breakdown of the link between movements of foreign exchange via authorised intermediaries and technology-related transactions raises questions about data collection from banks.

1.2.2. Liberalisation of trade

262. The trend towards the liberalisation of trade, and the impact that the Single European Act is likely to have on EEC countries after 1992, similarly raise questions about firms' voluntary reporting of the purpose of their foreign exchange transactions. With items that are largely intangible in nature, monitoring physical movement and border crossings can provide no reliable indication of international flows.

263. The collection of information will thus have to be based on specialised surveys and mandatory returns to the relevant agency.

1.3. Growth and concentration of trade in technology: its "controlled" nature

264. Three important features of TBP flows should be cited in support of the recommendations for data collection.

1.3.1. Growth

265. As with all international dealings in services, trade in knowledge or technical services is growing very rapidly, and faster than trade in goods.

266. The intrinsic intangibility of services coupled with diverging national definitions make assessment of the volume of trade in services a particularly hazardous exercise. That is doubly inconvenient in a period of high growth. As a result, a growing proportion of international trade is either inaccurately measured or not measured at all. This has far-reaching consequences for the analysis and assessment of the competitive position of economies.

1.3.2. Concentration

267. In most countries, technology-related receipts and expenditure are largely confined to just a few firms. Receipts generally tend to be more concentrated than expenditure. To take but a recent example, INPI reports that in 1986 97 companies in France accounted for 77 per cent of all technology-related expenditure, and just 62 companies accounted for 88 per cent of total receipts (47).

268. This concentration would seem to justify systematic surveys or mandatory reporting, rather than samples or polls.

1.3.3. The "controlled" nature of trade in technology

269. What we mean by "controlled" is that a large proportion of technology receipts/expenditure consist of financial flows and payments within multinational firms. In the most familiar case, the United States, such in-house flows account for approximately 80 per cent of receipts. Elsewhere intra-firm flows, though not quite on that scale, still make up a significant proportion of receipts, as studies have shown.

270. At present, despite awareness of this factor, only a few countries keep a separate record of receipts/expenditure flows between related companies. The remainder simply regard this type of information as highly desirable. We cannot propose sampling until the survey population has been fully identified from this standpoint, i.e., to show the breakdown into related and non-related companies.

2. CHOICE OF METHODS

271. Data collection methods can be described by reference to the parameters tabulated below.

272. The terms underlined indicate the course which seems preferable at this stage, given the characteristics of our investigation, the classifications proposed earlier and the factors that need to be taken into account. Obviously, some current procedures will be similar to the one recommended.

2.1. Returns by transactors

273. When initial responsibility rests with transactors there is a danger that returns will not always be forthcoming, unless perhaps they are made compulsory; and firms occasionally "forget" to make even mandatory returns.

274. If initial responsibility is to lie with the data collection agency, the first problem will be to identify the respondents. This can be done by combining the files compiled for R&D surveys (business enterprise + government + PNP + higher education) with data on firms which have foreign subsidiaries or are themselves subsidiaries of foreign companies. Any other source of information that will pinpoint firms with technology dealings may also be used.

2.2. Systematic cover

275. Despite the greater work and expense involved, systematic cover seems by far the best solution in view of the concentration of TBP transactions and their "captive" nature. We know that bias is likely in statistics for expenditure and receipts, for tax reasons among others, so sampling could be an unfortunate choice; no correction can be made for that particular bias. To put it another way, the laws of chance may provide a scientifically constructed sample that contains an unrepresentatively large number of firms understating (or overstating) their expenditure or receipts.

Table 4.1.

CHARACTERISTIC PARAMETERS OF DATA COLLECTION (a)

Parameters	Principal features	
Initial responsibility:	Transactor	Collector
Method:	Mandatory return	Survey
Cover:	Systematic	Partial (samples)
Collection:	Separate and specific	As an adjunct to a survey on R&D (or STI, etc.)
Focus:	Contract	Payment
Reporting of information:	Reported directly by transactor	Indirect reporting (e.g., via a bank)
Collection agency:	Public administration Central bank	(Agency under the industry or foreign trade ministry, for example, and dealing with industrial property, R&D, etc.)
Frequency:	Yearly	Quarterly

(a) Underlining: preferred procedure for TBP data collection.

2.3. Specific collection

276. The refinement of collection methods that we have recommended suggests the use of special surveys and returns solely for TBP purposes.

2.4. Focus -- contract and payment

277. The definitions of TBP transactions and the classifications proposed in Chapter III cannot be applied unless data are collected on payments (form, frequency, amount, currency, destination or origin, etc.) and contracts (date, duration, parties, purpose, type of product, etc.).

278. The collection of data through surveys or returns must therefore address not only the periodic payments arising from an agreement, but also the root of such payments, the contract itself, which is a one-off event (possibly repeated, if the contract is renewed).

2.5. Transactor reporting direct to collector

279. The grounds for preferring direct reporting are fairly obvious: time is saved, less information goes astray, additional details and confirmation are easier to obtain. With all these advantages, the direct method is not necessarily more expensive than indirect reporting, taking account of the intermediary's costs, explicit and hidden.

2.6. Collection agency

280. The best course here cannot be decided in a vacuum: it will depend on national practice and the innovations that administrations in Member countries are prepared to encourage.

2.7. Frequency

281. It would seem advisable for all types of data to be collected at least once a year.

2.8. Proposal for two-tier collection

282. As a practical measure to help harmonise methods and improve data collection, TBP input data could be designated essential, and needed immediately, or suitable for inclusion in a satellite account (see Table 4.2).

283. Data in the first tier call for systematic collection (preferably, but not exclusively, through direct reporting). They chiefly concern the transaction, the payment and the resident transactor. They are readily available to the transactor, who can report them to the collector (either the central bank or a specialist agency). They relate to:

- Type of transaction;
- Sum paid and currency of payment;
- Partner's country;
- Institutional sector of the resident partner;
- Industrial activity of the resident partner (if a firm);
- Related or non-related status.

284. Data in the second tier need not, to begin with, be collected quite so systematically. They could be drawn from surveys conducted less frequently than for the first type. They relate to:

-- Date and duration of the contract;

-- Industrial classification of the product;

-- Size of the partners;

-- Monetary and non-monetary arrangements for payment;

-- Identity of the non-resident partner (institutional sector and industrial activity, if a firm).

Table 4.2

SUMMARY OF ESSENTIAL TBP DATA (TIER 1)
AND SUPPLEMENTARY TBP DATA (TIER 2)

Essential data (systematic collection, by central bank or another agency)

1. Type of transaction (using Table 2.2)
2. Sum paid and currency of payment
3. Partner's country
4. Institutional sector of the resident partner
5. Industrial activity of the resident partner (if a firm)
6. Related or non-related status

Supplementary data (systematic collection or survey by specialist agency)

7. Date and duration of contract
8. Industrial classification of the product
9. Size of partners
10. Monetary and non-monetary arrangements for payment
11. Identity of the non-resident partner (institutional sector and industrial activity)

3. CLOSING REMARKS ON SOME PROBLEMS OF DATA COLLECTION

285. As with any data collection exercise, acquiring data for the TBP poses a variety of problems ranging from the costs involved, for both the collection agency and respondents, to failure to elicit replies, unreliable returns,

identifying and motivating respondents, consistency of information given in returns, etc. Rather than reviewing all of these relatively mundane difficulties, it seems more appropriate to address three specific problem areas:

-- Assessment of receipts/expenditure associated with cross-licensing agreements or payments in kind (countertrade involving products manufactured under licence);

-- Assessment of receipts/expenditure figures with a tax bias;

-- Cross-country comparability of returns regarding the same contract or payment.

3.1. Assessment of non-financial payments

286. A heading could be included in the survey questionnaires or returns for cross-licensing and for non-monetary forms of payment (countertrade); transactors could also be asked to make their own financial valuation.

287. Should respondents fail to give a valuation (through oversight or deliberate omission), the collection agency may have to make an assessment itself. In theory it can work from the standard practices in the particular industry; with periodical royalties under a licensing agreement, the payments can probably be estimated if the licensee's sales are known.

288. In practice, receipts are harder to assess. In the case of expenditure the value of the respondent's sales are known, given that he is a resident, and royalties can then be assessed as a percentage, usually between 5 and 10 per cent, of sales. In estimating a resident's receipts, the collector must know the value of sales by the non-resident partner(s) before he can calculate the monetary value of the royalties received. Without the co-operation of the resident firm, and perhaps the non-resident partners too, this task is obviously far from simple. By and large, having the collector make an assessment or estimate cannot be recommended for the time being.

3.2. Assessment of returns with a tax bias

289. Differing national tax systems are a major source of discrepancy between financial flows that are apparently technology-related and actual flows of technology. This is particularly true for receipts/expenditure flows between related companies, and is one of the criticisms most frequently levelled at the representativeness of TBPs.

3.2.1. Bias

290. We need to distinguish in our analysis between bias in the geographical orientation of flows and bias in the value of flows.

i) Bias in flow orientation.

291. As with direct investment earnings, flows of technology receipts may be directed towards countries where it is ultimately in the interest of

multinational enterprises to have a holding company. The latter serves to centralise shares held in geographically dispersed subsidiaries, and to build up a portfolio of patents which can be licensed to yield royalties.

292. Flows of technology receipts, as with earnings flows, should really be directed towards the parent company and be reported in the balance of payments of that economy. The diversion of financial flows to the holding company means that technology sales are:

-- overstated for the holding company's country; and

-- understated for the parent company's country.

ii) Bias in flow value.

293. Tax systems and special statutory provisions can similarly produce a bias in the value of flows reported. For instance, a ban on subsidiaries remitting technology royalties to the parent company, though they are allowed to make payments for technical assistance services, may mean that firms use the second course extensively.

294. Bias from tax systems occurs when technology royalties and repatriated earnings are taxed at different rates under the same system. We are here looking at the matter from the standpoint of the subsidiary and the country in which it is located. If royalties are taxed more (or less) heavily than repatriated earnings, the parent company may decide to under-invoice (or over-invoice) its subsidiary for technology services. To compound matters, the parent company may also decide to adulterate all the transfer prices. Both the payments by the subsidiary (or subsidiaries) and the receipts declared by the parent company will therefore contain a bias in relation to the actual value of the technology transfers involved.

3.2.2. Correction

295. Correcting this bias, desirable though it would be, is not easy.

296. With bias in flow orientation, receipts paid to a holding company in a tax haven could theoretically be reassigned to the parent company, but this course seems somewhat too radical to warrant recommendation. It would need to be applied firm by firm, what is more, and would presuppose accurate knowledge of the breakdown of receipts (in terms of both overall value and sectoral and geographical distribution) making their way to countries few of which are members of the OECD (in the Caribbean, for instance).

297. With bias in flow value, two types of correction can be applied. For expenditures, which will in all probability be declared by subsidiaries of multinational firms, looking at the tax system they report under should be enough to tell whether correction is required. It can be done by estimating the normal flow of royalties, given the subsidiaries' sales, in that particular industry. Correction of expenditure may be considered when royalties remitted to a parent company are taxed at a different rate to repatriated earnings, and when royalties can be charged against tax.

298. The matter is more complex with technology-related receipts, and calls for a greater degree of international co-operation. Let us take the receipts of firm X located in country A, which correspond to expenditure by associate firm Y located in country B and have been understated (or overstated) for tax reasons. A is an OECD Member country, but B is not. Before the collection agency in country A can correct the receipts of X (and other firms X', X'', etc.) from country B (and other countries C, D, E, etc.), it must familiarise itself with the tax systems applicable there in order to make a corrective assessment (or accept the returns from the parent companies). This course would seem to presuppose a minimum of co-operation between A and countries B, C, D, etc.

299. The collection agency in country A will then have to assess the value of receipts from subsidiaries in those countries on the basis of their sales and the customary royalty rate for that particular activity (to take the case solely of payment in royalty form).

300. This complex procedure could not be set in hand in the near future, so it is not a recommendation. On the other hand, if other agencies were to make corrections relating to technology receipts or expenditure (adjustment of returns for tax purposes, for instance), it seems highly desirable that they should inform the TBP collector.

3.3. Comparability of country data

301. At present, it is quite common for the same set of flows to have two completely different reported values, one as receipts in country X and the other as expenditure in country Y. The explanation lies in the differences in the way countries define TBP transactions.

302. It is reasonable to expect that the adoption of standard definitions will sharply reduce these discrepancies. But it would be too much to hope that they will disappear altogether, in view of:

- The interpretations that respondent firms will make of the definitions;
- Differences in countries' data collection methods;
- The estimates that respondents have to make, particularly for non-monetary payments;
- Errors in passing information on.

303. The way to keep any remaining discrepancies to a minimum would seem to be to encourage Member countries to exchange information. A substantial proportion of TBP data, the part dealing with receipts/expenditure flows within the OECD area, would thereby be double-checked.

CHAPTER V

CURRENCY CONVERSION AND DEFLATION

304. The comparison of TBP data for different countries and time periods poses two problems, conversion and deflation. Currency conversion means that all values are expressed in a single unit of account, regardless of the currency used for the original transaction. Deflation is a statistical procedure to eliminate variations arising from price movements.

305. This chapter will review the particular problems that currency conversion and deflation pose with TBPs, and solutions that may be applied immediately or over the longer term.

1. CURRENCY CONVERSION

306. The conversion of TBP data needs to be examined at two levels, country and international.

1.1. Conversion at country level

307. We will simply note here that expenditure and receipts relating to TBP transactions have, to start with, to be converted into the currency of the compiling country. Payments may be made in its currency, or in foreign currency, and the latter must be converted. The exchange rate may be the market rate at the time of payment, or an average market rate for a reference period (year, quarter), depending on national practice.

308. As with the balance of payments, the TBP may also be presented after conversion into an international monetary unit (usually the US dollar, or the SDR), in which case the country authorities follow their general balance-of-payments practice.

1.2. Conversion at international level

309. Cross-country comparison of TBPs requires conversion into a common unit of measurement, or unit of account.

1.2.1. Choice of currency

310. The first possibility is to use a national currency, generally the US dollar, as the unit of account. The exchange rate for conversion may be the current market rate or, better, a yearly (or quarterly) average of the observed market rate, such as the exchange rate calculated by the IMF.

311. The main drawback to a national currency as the unit lies in the fluctuations that market rates may show within relatively short periods. Wide swings, as between the US dollar and all other currencies over the past ten years, or between other currencies, will undermine the reliability of cross-country comparisons. One answer is to use a basket of currencies, such as the SDR, or else a moving average exchange rate.

312. The uncertainty is compounded when converting TBP values that have previously been deflated, i.e., expressed in constant prices for a reference year. Which exchange rate should be used to convert such data (for year t_n) in constant prices into national currency? Should it be the rate for the reference year (t_o), or the current year (t_n), or some other exchange rate (average for the period t_o-t_n)?

313. One conversion technique that will largely eliminate these uncertainties is to use Purchasing Power Parity (PPP) indices, although they may be held to be unsuitable for international transactions.

1.2.2. PPP index

314. Purchasing power parity is used for cross-country comparison of volume data relating, for example, to gross domestic product (GDP), investment (GFCF), or consumption, all economic constructs whose composition is not necessarily the same. A spatial price index is therefore needed to take account of the internal weighting of aggregates in terms of their individual components. For research and development, the Frascati Manual describes how an R&D currency converter can be established; it is a special PPP rate for domestic R&D spending (48).

315. PPP indices offer relative stability over given periods of time, in that they vary slowly in response to changes in the actual domestic purchasing power of the national currency and the unit of account, usually the US dollar.

316. The conversion index that is actually used in international transactions, however, is of course the exchange rate itself. All the statistics for international transactions, including TBPs, concern values traded on an international market where the purchasing power of individual currencies, as reflected in the current exchange rate, is immediately relevant. In other words, one of the decisive factors in each international transaction is the purchasing power of the currency in which payment is finally made. Despite fluctuations, for whatever reasons (trade imbalances and/or interest rate differentials), exchange rates express the international purchasing power of currencies at any given time.

317. All the same, if TBP data are converted on the basis of GDP PPP indices the product is something different, namely the actual volume of national resources (consumption, investment, etc.) lost (or gained) through the purchase (or sale) of technology. This concept, a tricky one to handle, may be used for cross-country comparison of TBPs with other national parameters such as resources allocated to R&D.

1.2.3. Recommendation

318. On the theoretical grounds outlined above, and for practical reasons, the recommended procedure is to use a market exchange rate (annual average, or moving average) to convert TBP data. This does not rule out exploratory use of GDP PPP indices for analysis and research purposes.

2. DEFLATION

319. The deflation of economic magnitudes relates to a quite different objective, allowing comparison of volume magnitudes in time by eliminating the effects of price changes. The broad purpose is to remove the valuation effect due to inflation in order to measure real growth (or negative growth). The standard method of doing this is to use a deflator, which is simply a price index.

320. The existence of time series for TBP data suggests that data could be adjusted for price changes in order to present "real-term" trends. Which deflator should be used for TBPs?

2.1. General deflator

321. The first option is to use the non-specific deflator that is applied in the national accounts, the GDP deflator. It is easy to determine, and is often used for R&D data.

322. The second option is to employ a deflation method based on price indices for imports and exports of goods and services. (In this case the practice of international bodies such as the UN, the OECD and the EEC could provide a model.)

323. The third option is to take wage indices, which may already be in use for trade in services. This approach is justified by the services component of the TBP (here too, reference could well be made to the practices of international organisations).

2.2. TBP deflator

324. A specific deflator, similar to that suggested for R&D (49), could be proposed for the TBP, although the cost might well prove prohibitive. Here we need to bear in mind the essential differences between the two major categories of transaction which the TBP records:

i) Earnings from the ownership of assets that can be likened to factor income, i.e., royalties from patent or know-how licences;

ii) Services with a technical content based on the use of intellectual labour.

325. Designing a TBP-specific deflator would entail finding an answer to three questions:

-- Should we use a single deflator, or two different deflators tailored to the categories of transactions?

-- If we have two, should we use a wage index for services with a technical content and a special index for factor income?

-- Should the special index for royalties be the same for a country's receipts and for its expenditures? A sophisticated answer might run on these lines:

i) On the expenditure side: royalties are often calculated as a percentage of sales (or turnover), so we could use the GDP deflator, or a price index for manufacturing industry (or just those industries that remit royalties);

ii) On the receipts side: remittances come from a number of countries, so the ideal solution would be to design a price index (for the manufacturing industry, for example) weighted according to each client country's contribution to the royalties total.

326. For the time being, design of a TBP-specific deflator is an experimental matter.

2.3. Recommendation

327. For the immediate future, the recommended procedure is to use the GDP deflator, a fairly general composite construct, or other deflators calculated from import and export price indices for goods and services, for the deflation of TBP data.

ANNEX

INTERPRETING TBP DATA AS S&T INDICATORS

1. A number of points, which we have already discussed at some length, need to be taken into account when analysing and interpreting TBP data:

i) TBP data serve a dual purpose, providing both a record of the international financial flows associated with the circulation of technology and a partial indication of science and technology output;

ii) Reporting international transfers of technology (ITTs) in the TBP, even with greater accuracy and international harmonisation, does not necessarily mean that ITTs and the relevant section of the TBP will fully match; there will still be cases where no expenditure can be identified for an ITT (cross-licensing, for instance, or a transfer between a parent company and its subsidiary) or where there is a divergence between supposedly technology-related expenditure and actual transfers of technology (as the result of tax bias, for example) (50);

iii) Given the variety of ways in which technology can circulate internationally, the TBP is not on its own a sufficient indicator of technology diffusion.

2. The descriptions that follow are very broad ones, and are not based simply on experimental work to date; they present an ideal picture of what could be achieved in the medium or longer term with improved data collection in line with the manual's recommendations. Some aspects of the suggestions may appear out of the question in the short term, given the current data position.

3. Three broad analytical approaches may be adopted:

-- Internal analysis of TBP data;

-- Combined analysis that incorporates other data to construct S&T output indicators (macroeconomic);

-- Analysis supplemented by specific surveys to identify transactor behaviour (microeconomic).

4. Given that any analytical approach to the interpretation of TBP data may have both a time dimension (comparison of different periods) and an international focus (cross-country comparison), these two factors will not be examined in every instance. They will only be discussed where they have a special bearing on the analysis.

1. INTERNAL ANALYSIS OF TBPs

5. Three basic aspects of TBP compilation have a decisive influence on the way in which data should be interpreted:

i) The TBP presents national data on flows of receipts and expenditure involving transactors resident in other economies;

ii) TBPs are composite records with two major categories, trade in techniques and services;

iii) The data are basically asymmetrical, particularly with regard to technology transfers.

6. In view of the last two aspects, analysis of the TBP must be approached at different levels.

1.1. Patent, licence and know-how transactions

7. The first category of transactions in the TBP is of particular importance since it deals with actual transfers of technology. By analysing the expenditure and receipts associated with these transfers, it is possible to identify the characteristics of international trade in techniques and the involvement of individual Member countries.

8. The asymmetry in receipts and expenditure is especially significant with technology transfers. The acquisition of patents, licences and know-how from foreign firms (or other non-resident transactors) is one way for a purchaser to obtain technological knowledge that he feels to be either useful or essential. Expenditure on technology is comparable in this respect to R&D spending and is to some extent an S&T input. Similarly, patent transfers, licensing contracts and know-how agreements are ways in which vendor firms can obtain a return on a technology asset. On the vendor's side, these transactions are exploitations of an S&T output. The receipts they generate are comparable in nature to earnings from exports or from subdiaries abroad.

9. The analysis of receipts and expenditure for technology transfers must take account of this asymmetry. It cannot focus exclusively on balances or import/export ratios. Receipts and expenditure must be analysed separately beforehand.

1.1.1. Structure

10. We can formulate a set of structural indicators for both receipts and expenditure. Either can be used for cross-country comparison and time analysis of structural changes in ITTs.

11. The indicators can be constructed from the characteristics of either transactions (contracts and payment flows) or transactors.

12. A number of aspects may thus be analysed on both the expenditure and the receipts side (our list runs from the simplest to the most difficult, in terms of data acquisition):

1) Distribution of transactions, under the headings patent transfers, invention transfers, licensing, know-how agreements;

2) Concentration of transfer transactions, by contract value (receipts, expenditure);

3) Geographical distribution, by country and country group;

4) Distribution of transactions by main industrial activity of national transactors;

5) Breakdown of transactions by sector (business enterprise, others) and transactor size;

6) Transfers between related companies, and between non-related companies, with combined geographical and sectoral distribution;

7) Relative proportions of new and existing contracts;

8) Breakdown of transactions by industrial product covered by the contract.

13. It will obviously be instructive to make a structural comparison of receipts and expenditure in the TBP. This will give a rough idea of any specialisation in international trade in techniques.

14. It is also clear that if the breakdown of transfers between affiliated and non-affiliated companies is available it is interesting to calculate the indicators proposed below. This possibility will not be repeated for each indicator as they are listed.

1.1.2. Trading position of economies

15. Payments for transfers of technology are asymmetrical, but appraisal of the position of individual economies in trade in techniques entails the construction of indicators in which receipts and expenditure are treated symmetrically.

16. For each economy and TBP in isolation, balances and import/export ratios can be calculated overall, by type of transaction, by type of transactor (institutional sectors, related and non-related companies), by industrial activity, by country or country group, and by country and industrial activity.

17. Comparison of geographical or geo-industrial import/export ratios for various economies would provide rankings in terms of technology transfers.

18. For the OECD area a further range of operations is feasible:

-- Share of intra-OECD trade in techniques in total OECD receipts and expenditures: overall, by type of transaction, by industry;

-- Each economy's export market share, i.e., share of total OECD receipts: overall, by type of transaction, by industry;

-- Each economy as an importer, i.e., share of total OECD expenditure: overall, by type of transaction, by industry;

-- The specialisation of each economy, relative to all OECD, by means of industrial specialisation indicators of the following type:

$$\frac{Xij/\sum_{j} Xij}{\sum_{i} Xij/\sum_{j}\sum_{i} Xij} = \frac{Xij/Xi}{Xj/X} \quad (51)$$

Where Xij = the flow of receipts for country j and industry i;
Xi = flow of receipts for industry i, all OECD;
Xj = flow of receipts, all industries, for country j;
X = flow of receipts, all industries, all OECD.

1.2. Other TBP transactions

19. The second category of TBP flows is a mix of transactions concerning non-technology-related industrial property, services with a technical content, and R&D performed abroad. Each component has to be dealt with separately.

20. The second and third components are most relevant in analysis of the international diffusion of technology.

21. Structural analysis by transactor, country, industry and so on (together with cross-country and time comparisons) of the kind used for patent and licence transactions (section 1.1.1.) can be proposed for services with a technical content. Each country's trading position can also be assessed with the same type of indicator (balance, export/import ratio, market share and so on -- see section 1.1.2.).

22. Flows of funding for R&D carried out abroad (or R&D carried out in the country and funded from abroad) can either be put with services and analysed at the same time, or treated separately. The latter procedure would be warranted by the special nature of the flows, which fund an S&T input rather than an output.

23. With separate analysis, a number of approaches can be suggested:

-- Comparisons of inflows/outflows relating to such R&D;

-- Proportions of multinational (in-house) and other flows;

-- Breakdowns: geographical, by industry, by size of firm, etc.

1.3. Overall structure and balance of the TBP

24. Analysis of the overall structure of the TBP is mainly concerned with the way receipts and expenditure are distributed across categories of transactions. Two types of information may be obtained:

-- The internal composition of receipts and expenditure;

-- Structural comparison of receipts and expenditure.

25. Comparison of the distribution of receipts and expenditure across the categories of transactions yields an indication of the relative weight of ITT flows. A comparison can also be made, from the standpoint of either receipts or expenditure, of the customers/suppliers for ITTs and for services with a technical content, with further breakdowns by related and non-related status, country and industry.

26. Structural comparison of receipts and expenditure, however, provides the greatest insight into the composition of the overall balance of the TBP.

27. This comparison has three aspects:

i) Weight of ITTs, i.e., the acquisition/sale of exclusive production techniques, in relation to other expenditure/receipts;

ii) Geographical movement (from/to) of purchases/sales;

iii) Distribution of receipts and expenditure by industry and by type of firm (related and non-related).

28. By setting these separate strands of analysis against the overall balance of the TBP we can link the payments surplus, deficit or equilibrium with the symmetry, or asymmetry, in receipts and expenditure.

29. It would be conceivable to categorise economies on the basis of their TBP balance and the internal structure of their receipts and expenditure. For instance, economies presenting a surplus due to ITTs (core transactions) could be labelled initiators; conversely, economies with a deficit from ITTs would be imitators. If the deficit is due primarily to technology-related services, the economies could be said to be delayed imitators; economies with an ITT deficit but a surplus due to services with a technical content (as is the case with France and Italy) could be viewed as processors.

30. This rough typology could be refined by incorporating the geographical aspects of trade, or the share of receipts and expenditure accounted for by related companies, or even conducting the exercise by industry: an economy that is an initiator in chemicals might turn out to be an imitator in computer science and a processor in other sectors.

31. This type of analysis clearly leads on to comparison with other data on international technology flows.

2. COMBINED ANALYSIS OF TECHNOLOGICAL COMPETITIVENESS

32. The TBP cannot, in itself, be taken as an indicator of the circulation of technology, or indeed technological competitiveness. The first reason, which we have already discussed, is that flows of technology between economies can take a multitude of forms; the second is that the technological competitiveness of a firm, and an economy, is a complex composite of technological and non-technological factors. By way of example, the successful launch of a new product needs technological knowledge and R&D but depends just as much on satisfactory negotiation of the subsequent manufacturing and marketing stages.

33. If the TBP is to be used as an indicator of technology diffusion and competitiveness, due consideration must be given to the asymmetry of expenditure and receipts. Balances must not be used prematurely, or exclusively.

2.1. Acquisition of technology and TBP expenditure

34. The flows of technology transfers and services with a technical content recorded as expenditures in the TBP represent one of the routes by which economies acquire technology. The other major routes are:

-- Producing home-grown technology through R&D;

-- Importing high-tech goods, particularly capital goods;

-- Foreign firms setting up subsidiaries for manufacturing

35. Comparison of the routes by which economies acquire technology helps gauge their propensity to import and determine where they stand in relation to the OECD countries as a whole.

36. The setting up of companies by foreign firms (or setting up companies abroad) is a complicated category to deal with for two reasons:

- It covers a range of elements which vary in technology content (acquisition of equipment, training, award of licences; for the relations between direct investment and the TBP see paras 15 to 22);

- It is difficult to measure as the capital flows entered in the balance of payments give only a poor picture of the industrial capital held and the stock data are often of mediocre quality.

37. Despite these difficulties, it would seem impossible to discuss technology acquisition or the technological competitiveness of nations economies without any reference to direct investment or to the setting up of subsidiaries.

2.1.1. Comparison of acquisition routes

38. Each route may be viewed against TBP expenditure, overall or by industry and by country. Analysis has to be comparative, in the absence of any absolute yardstick -- comparison with other industries, or their average; comparison with other economies, or their average.

39. For example, comparison of technology produced by industrial R&D carried out and financed nationally (together with R&D carried out abroad but financed by resident transactors) and imports of technology measured in terms of expenditure on TBP transactions relating to patents, licences and know-how (ITTs proper) can provide an indication of an economy's degree of technological autonomy, or dependence.

40. This comparison could be made overall, looking at the totals. But breaking it down by industry and country will bring out variations in autonomy or dependence according to activity and partner. Changes over time can be shown, of course, and cross-country comparisons drawn; in this area, trend and ranking movements are more meaningful than one snapshot measurement.

41. A similar type of comparison could be made of imports of TBP services and services of the same kind (mainly engineering consultancy) supplied by national firms. This could provide an indication of an economy's degree of openness and the trend over time, and could, for example, be based on the following import penetration ratio:

$$\frac{\text{imported technical services}}{\text{services supplied nationally + imported services}}$$

When calculated for Member countries as a whole, this ratio could indicate the growing internationalisation of the supply of services with a technical content.

42. With imports of high-tech goods, only those classified as capital goods actually involve the transfer of production technology. But all high-tech products, regardless of their purpose, can be held to be substitutes for acquisition of the technologies that their production entails. Overall, sectoral and geographical comparisons, with changes over time, are feasible here as well.

43. The acquisition of technology as a result of the establishment of subsidiaries by foreign multinationals calls for some clarification. First, for a number of reasons (reinvested earnings, local borrowing) inflows of capital are a poor measure of the contribution made by subsidiaries; it is hence preferable to take a yardstick such as their production or sales. Second, subsidiaries do not necessarily make use of new and exclusive production technology; we thus need to select industries where that is more likely, sectors with a high R&D content for instance.

44. Subject to those considerations, it would be possible to compare the breakdown of production from subsidiaries by industry and by parent companies' home country with the structure of ITTs measured by the TBP.

45. A less specific but more complex approach would be to gauge the proportions of foreign-produced technology acquired via various routes. This would entail using a structural indicator for technology imports that would weight together the following components:

-- Imported high-tech goods used by enterprises (capital goods);

-- Payments for transfers of technology;

-- Imported services with a technical content;

-- Foreign direct investment.

2.1.2. Ranking of economies

46. No hard and fast conclusions can be drawn from overall or structural comparisons of the individual routes by which technology is acquired. We cannot state (what criteria would we use?) that a given relationship between expenditure on technology transfers and national expenditure on R&D in a given economy or industry is proof of dependence on imported technology or, conversely, self-sufficiency.

47. One way to obtain a general criterion for determining the ranking of individual economies, or industries, is to calculate the average ratios for the OECD area. Three examples, among others:

Total expenditure on ITTs/Total R&D expenditure for industrial purposes;

Expenditure on imports of services with a technical content/Total national production of services with a technical content;

Total ITT payments/Total imports of high-tech goods for enterprises.

48. These average ratios would provide a reference point not just for analysis of the way in which each economy organises the acquisition of technology, but for cross-country comparison as well.

2.2. Diffusion of technology and TBP receipts

49. As with the acquisition routes, comparative or combined measurements of alternative and complementary ways of exporting technology can be suggested. The data are provided by:

-- Receipts for ITTs and services with a technical content in the TBP;

-- Exports of high-tech goods;

-- Subsidiaries abroad.

50. As in the previous example, two major types of analysis are possible: determination of the technology export profile of individual economies, and comparison of their relative position as centres of diffusion.

2.2.1. Comparison of diffusion routes

51. Categorising the routes by which national economies export technology comes down to determining the extent to which the forms such exports take are interchangeable or complementary, both overall and by industry. This means looking at the kind of link to be found between the geographical and sectoral composition of productive direct investment (measured by subsidiaries' output or turnover, rather than capital flows) and that of receipts for technology transfers. It could also mean seeing, both overall and by industry, whether transfers of technology and technical services set the pace for exports of high-tech goods and industrial packages, and vice versa.

52. Cross-country comparison of these links could form the basis for a typology of economies according to the pattern of their technology exports. From time changes in the importance of individual export routes, by industry, we could also build up a picture of the way that export patterns vary with the degree of maturity of technologies.

2.2.2. Ranking of economies

53. From a more general standpoint, a composite indicator of technology diffusion can probably be constructed on the basis of receipts for technology transfers, exports of services with a technical content, exports of high-tech goods and subsidiaries abroad. Justification for this composite indicator lies in the fact that firms make use of all these routes to exploit their technological advantage internationally. Accordingly, any evaluation of their technological competitiveness has to be based on the concept of total involvement advanced by S. LALL (52). Constructing a composite indicator of technology diffusion for an economy raises two problems (53), the field the indicator is to cover (all activity, or simply manufacturing industry) and the weighting of variables (size of the economy in terms of GDP or industrial value added, or in terms of its contribution to all exports, or industrial exports, for the OECD area).

2.3. Structural comparison of acquisition and diffusion

54. Cross-country comparison of acquisition and diffusion routes suggests an extension of the typology outlined in section 1.3. above (paragraph 28).

55. The typology could be based on both the relative weight and the balance of the various types of flow:

-- ITT, and TBP services with a technical content;

-- Trade in high-tech goods, particularly capital goods;

-- Production measuring the significance of directly owned subsidiaries.

56. The labels initiator, imitator and processor suggested to describe economies as a function of TBP balance and composition could thus be further refined by the dominant flow(s) in the acquisition and diffusion of technology: technology transfer, services with a technical content, direct investment and trade in merchandise.

3. SUPPLEMENTARY ANALYSIS -- SURVEYS

57. Many of the issues raised during the discussion on establishment and interpretation of TBPs warrant additional study. They are generally points showing that our knowledge and understanding of the behaviour of enterprises needs to be enlarged. The greatest insight into behaviour at microeconomic level is obtained from specific surveys. Below we consider the main areas where surveys seem necessary:

-- Behaviour of multinationals and its effects on intra-firm flows;

-- Complex contracts covering a number of transactions, not all of which belong in the TBP;

-- Degree of substitution and complementarity between acquisition and diffusion routes.

3.1. Behaviour of multinationals and intra-firm flows

58. The practices of multinationals are responsible for difficulties and errors in the compilation and interpretation of TBPs, particularly in the way they dissociate actual transfers of technology from technology payments, which results in unrequited transfers or mismatched entries.

59. Surveys on two major points would improve the collection and interpretation of statistical data.

60. The first concerns what we may call "technology management", and covers:

-- How technology is generated: degree to which R&D is centralised or entrusted to subsidiaries; share-out of responsibilities between units; R&D agreements with other firms;

-- How technology assets are managed: unit controlling the patents portfolio; procedure for passing new technology on to subsidiaries, and its rapidity; types of agreement and payment.

61. The second point is the effect that differences in national tax systems have on flows of technology payments. The problem here is the combined impact of:

-- Differences in the treatment of R&D expenditures, royalties and profits under a given tax system;

-- Differences between the way these items are treated under different tax systems;

-- International tax agreements (double-taxation agreements).

3.2. Complex contracts

62. The TBP records flows of expenditure and receipts, not contracts. But the latter in fact organise the way technology is passed on, by arrangements whose complexity varies. Analysis of this area should bring out causal links between various services and help approximate the concept of the total cost of a transfer transaction by bringing together the range of possibilities for payment available to the supplier enterprise.

63. The interdependence of flows may be approached at two levels:

-- Within the TBP itself, for example between a licensing or know-how agreement combined with the supply of consultancy services;

-- Between flows shown in the TBP as technical assistance and the sale of capital goods entered under merchandise exports.

3.3. Substitution and complementarity between acquisition and diffusion routes

64. This third point is partly an extension of the second, and consists of analysing the decisions, by the firm holding a technological advantage and the firm seeking to acquire a given technology, as to the route to take: straightforward transfer of technology, trade in merchandise, subsidiaries, etc.

65. The aim is to define the impact of the factors likely to influence the manager's decision. These factors are involved in:

-- The technology: novelty, complexity, exclusivity, durability;

-- The industry: destination of product, market size, type of competition and degree of concentration, nationally and internationally;

-- The firm: size, resources, monopoly, degree of multinational involvement, participation in research agreements, joint production;

-- The relevant national economy: size, resources devoted to R&D and, more generally, S&T potential, participation in free-trade agreements, size of the productive system, etc.

NOTES AND REFERENCES

(1) Definitions from the Petit Robert dictionary of the French language.

(2) An exemplary definition taken from R. NELSON, M. PECK and E. KALACHEK: Technology, Economic Growth and Public Policy, Brookings Institution, 1967. See also E. MANSFIELD.

(3) N. ROSENBERG: Inside the Black Box: Technology and Economics. Cambridge University Press. See Chapter VII: "How exogenous is science?", pp. 141-159.

(4) N. ROSENBERG, op. cit. p. 143.

(5) K.J. ARROW: "Economic Welfare and the Allocation of Resources for invention" in The Rate and Direction of Inventive Activity: Economic and Social Factors, National Bureau of Economic Research, Princeton University Press, 1962.

(6) See inter alia A. KREIS: La transmission de savoir-faire entre entreprises industrielles, Litec, Paris, 1987.

(7) G.R. HALL and R.E. JOHNSON: Transfer of US Aerospace Technology to Japan, in R. VERNON (Ed.): The Technology Factor in International Trade, N.B.E.R., 1970.

(8) P. GABRIEL: The International Transfer of Corporate Skills, Harvard University Press, 1967.

(9) J.B. QUINN: Technology Transfer by Multinational Companies, Harvard Business Review, November-December 1963.

(10) J. GAUDIN: Stratégie et négociations des transferts de techniques, Editions du Moniteur, 1982.

(11) Definition by Maître Matheley in J. GAUDIN: La Recherche de garanties, in R.F. BIZEC and T. DAUDET: Un code de conduite pour le transfert de technologie, Economica, 1980.

(12) See E. VON HIPPEL, The Sources of Innovation, Oxford University Press, 1988.

(13) Expression used by P.F. GONOD, whose definitions of "socialised" technology and "alienated" technology have been replaced with "disclosed" technology and "appropriated" technology. See P.F. GONOD: Les transferts technologiques, Colloque AFSE, Lille, 1974.

(14) For example, the approach proposed by C. COOPER; see also J. GAUDIN.

(15) Appropriation becomes more likely when the technology in question is more specific, more innovative and therefore more exclusive.

(16) That is to say licensing transactions in the broader North American sense of the term.

(17) The problem of the comparability of data from different origins has not been directly addressed here.

(18) B. MADEUF: "International Technology Transfers and International Technology Payments: Definitions, Measurement and Firms' Behaviour", in Research Policy No. 13, June 1984.

(19) OECD Science and Technology Indicators, No. 2: R&D, Invention and Competitiveness. See Part II, Chapter II, "Technological Performance and Industrial Competitiveness".

(20) Also termed goods with a high R&D content, or technology-intensive goods.

(21) See C. OMAN (1985).

(22) P.J. BUCKLEY & M. CASSON (1985), A.M. RUGMAN (Ed.)(1982), among others.

(23) It would seem feasible, for countries which so wish, to record technology royalties not remitted to/from another country in the TBP.

(24) So defined in Vocabulaire économique et financier, Y. BERNARD and J.C. COLLI, Seuil, 1986.

(25) Balance of Payments Manual, Fourth Edition, International Monetary Fund, 1977, paragraphs 332 and 339.

(26) The problems posed by the growth of transborder data flows have to be noted.

(27) Unlike in some very broad views of technology.

(28) Report by Mr. CHARLES MAGAUD to the Economic and Social Council for preparation of a statement on the future of EEC science and technology policy, 27th January 1988.

(29) Software: An Emerging Industry, OECD, Paris, 1985.

(30) I.e., the European Patent Office.

(31) Or a trademark licensing or know-how agreement.

(32) See, for instance, J. GAUDIN (1982), J.L. DELEUZE (1977), B. PHELIP (1977), A. KREIS (1987).

(33) A. KREIS (1987).

(34) Technical assistance will go in the services section of the TBP.

(35) One exception is when training staff are trained.

(36) The Measurement of Scientific and Technical Activities -- Proposed Standard Practice for Surveys of Research and Experimental Development, 4th Edition, (Frascati Manual 1980), OECD, Paris, 1981.

(37) Ibid, paragraph 87.

(38) Ibid, paragraph 101.

(39) Ibid, paragraph 117.

(40) Ibid, paragraph 109.

(41) Referred to as a "direct investment enterprise" in the IMF Balance of Payments Manual.

(42) IMF, op. cit., paragraph 414.

(43) OECD -- Detailed Benchmark Manual of Foreign Direct Investment, 1983. See, in particular, paragraphs 6-30.

(44) Ibid, paragraph 29.

(45) This is the case, in particular, for the records which central banks keep for the overall balance of payments.

(46) We have chosen these three characteristics to contrast with the previous approach. Many intermediate combinations are obviously found.

(47) INPI, Statistiques des échanges techniques entre la France et l'étranger (for 1986).

(48) See Frascati Manual, Chapter VII, section 7.2.

(49) Ibid Chapter VII, section 7.1.

(50) B. MADEUF: "International Technology Transfers and International Technology Payments: Definitions, Measurement and Firms' Behaviour", in Research Policy, No. 13, June 1984.

(51) Other indicators can be devised.

(52) S. LALL, "Monopolistic Advantages and Foreign Involvement by U.S. Manufacturing Industry", Oxford Economic Papers, 1980.

(53) See C. HUGUEL, "La diffusion internationale du progrès technique", doctoral thesis at Paris II University, 1980.

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