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EUROPEAN ECONOMY

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Business investment
and the tax and financial environment

Energy and the economy:
a study of the main relationships
in the countries of the European Community

The foreign trade of the Community,
the United States and Japan

No 16 July 1983

'EUROPEAN ECONOMY' appears four times a year, in March, July, September and November. The November issue contains the Commission's proposal for the annual report on the economic situation in the Community. This report, which the Council adopts in the fourth quarter of each year, establishes the economic policy guidelines to be followed by the Member States in the year that follows. The November issue also contains the Commission's annual economic review, the background analysis to the proposed annual report. In March and July of each year, 'European Economy' gives a review of the current economic situation in the Community, together with reports and studies on problems of current interest for economic policy. The September issue presents a report on the Community's borrowing and lending activities in the preceding year.

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Abbreviations and symbols used

Countries

B	Belgium
DK	Denmark
D	Federal Republic of Germany
GR	Greece
F	France
IRL	Ireland
I	Italy
L	Luxembourg
NL	The Netherlands
UK	United Kingdom
EC	Total of the member countries of the European Community
EC 4	Federal Republic of Germany, France, Italy, United Kingdom
EC 9	European Community without Greece
BLEU	Belgo-Luxembourg Economic Union

Currencies

BFR	Belgian franc
DKR	Danish krone
DM	German mark
DR	Greek drachma
FF	French franc
IRL	Irish pound (punt)
LIT	Italian lira
LFR	Luxembourg franc
HFL	Dutch guilder
UKL	Pound sterling
ECU	European currency unit
USD	US dollar
SFR	Swiss franc
SDR	Special drawing right

Other abbreviations, etc.

BIS	Bank for International Settlements
cif	Carriage, insurance and freight
EAGGF	European Agricultural Guidance and Guarantee Fund
EAGGF	European Agricultural Guidance and Guarantee Fund
EIB	European Investment Bank
EMCF	European Monetary Cooperation Fund
EMF	European Monetary Fund
EMS	European Monetary System
ESA	European System of Integrated Economic Accounts
Euratom	European Atomic Energy Community
Eurostat	Statistical Office of the European Communities
fob	Free on board (valuation basis for exports or imports of goods)
GAB	General Agreement to Borrow
GDP (GNP)	Gross domestic (national) product
GFCF	Gross fixed capital formation
IMF	International Monetary Fund
LDC	Less-developed country
MTFA	Medium-term financial assistance
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
SOEC	Statistical Office of the European Communities
STMS	Short-term monetary support
VSTF	Very short-term financing mechanism
( )	Estimate
:	Data not available
s.a.	Seasonally adjusted
,	Decimal point
—	Not applicable
Ø	Average
∞	Infinity

Contents

Investment

List of tables

Business investment and the tax and financial environment[1]

Introduction

Since June 1982, the Commission has sent three communications to the Council, dealing respectively with the problem of investment, initiatives for promoting investment, tax and financial measures in favour of investment.[2]

These matters were brought to the attention of the European Council when it met in June and December of last year.

The subject of investment had already been highlighted in the Commission's proposal in the foreword to the fifth medium-term economic policy programme for an increase in the level of investment to ensure competitiveness, growth and, in the final analysis, employment, as one of the elements of a European strategy to end the crisis.

In more general terms, the communications are a response to the requirement for joint in-depth consideration of certain questions connected with what could be briefly termed 'supply policy' or 'adjustment policy', and for strengthening the links between national and Community structural measures.

The communication of June 1982 analysed the macro-economic factors affecting investment (growth; the variability of inflation, interest rates and exchange rates; public deficits, etc.), and identified possible support measures at national level (the restructuring of public budgets in favour of productive expenditure; the rationalization and improvement of public intervention in the form of regulations, tax measures and financial measures applying to firms) and at Community level (strengthening the internal market; support and control in specific areas including R&D, innovation, information technology; reinforcing Community lending instruments — this was the occasion for announcing the proposal to renew the NCI).

The communication of October 1982 went into further detail on:

(i) national structural action in the common interest, with the accent on three types of measure: improvement of self-financing and channelling of savings into productive investment; improving existing aid arrangements; increasing public expenditure in support of development;

(ii) Community structural action.

On the basis of a comparison of expenditure in Member States, the communication of April 1983 identified useful measures and steps that could improve the tax and financial environment of firms, leading to more resources for investment through self-finance and a larger supply of risk capital; it recommended that such measures should be adopted or reinforced, as a function of the specific situation in each country.

The following paragraphs deal in greater detail with some of the points raised in the April communication, and provide further information.

1. Taxation and self-financing

1.1 *The tax burden on firms*

Firms' self-financing capacity is determined first and foremost by the relative trends of prices and production costs; however, the burden of taxes is not irrelevant. Information on this subject will be found in Table 1 of COM(83)218.

The figures available refer to tax yields: in the absence of information on the extent of tax shifting, this gives no indication of the effective incidence. The figures relate only to incorporated companies (the profits of unincorporated businesses are included among the income of households).

OECD figures (which permit a comparison with the United States and Japan) show a slight increase in company taxes as a percentage of GNP, except in the Federal Republic of Germany and the United Kingdom. For the Community in 1980 the percentage of GNP taken by company taxes ranged from 1,3% in Greece to 3,5% in the United Kingdom (3,5% and 5,0% of GNP in the USA and Japan respectively).

The percentage share of company taxes in tax revenue (including social security contributions) in 1980 was 3,8% in Greece and 8,2% in the United Kingdom (9,6% in the United States and 17,9% in Japan) and declined slightly in all the Community countries between 1970 and 1980, except in Greece and Italy.

Clearly, a comparison in relation to GNP does not take account of profitability, nor of the relative size of the corporate sector, which can vary from country to country. Table 2 of communication COM(83)218 shows the changes between 1970 and 1979 (1980), in the ratio of current taxes on income and capital to the gross operating surplus of non-financial corporate and quasi-corporate enterprises.

This indicator shows an increase in the tax burden in the second half of the 1970s and in particular towards the end of

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[1] Written by I. Ventura of the Directorate-General for Economic and Financial Affairs.

[2] COM(82)365 of June 1982, COM(82)641 of October 1982 (see *European Economy* No 14), and COM(83)218 of April 1983 (see this issue of *European Economy*).

the period (Italy: up 4,2 points; France: up 1 point), except in the United Kingdom, but there the tax burden in 1980 was almost 4 points higher than the 1970-74 average.

This increase in the tax burden is before deductions for depreciation which represent a greater drain on operating surpluses in periods of changes in relative prices (energy) and in which technology rapidly becomes obsolescent.

1.2 *Investment incentives*

1.2.1 Any change in taxation affects decisions to invest to the extent that it changes the expected return on the investment; tax neutrality means that a change in the tax rate leads neither to a change in the price of capital, nor, therefore, to a substitution effect between production factors. If there is no uncertainty, the conditions for neutrality are:[1]

(i) the deductibility of the economic depreciation of fixed assets;

(ii) the deductibility of interest costs;

(iii) taxation of capital gains at the same rate as income;

(iv) inflation adjustment.

It is clearly a fairly complex matter to assess existing taxation systems in the light of the theoretical concept of neutrality and therefore each system's (positive or negative) incentive content; the assessment depends on assumptions concerning 'true' economic depreciation, inflationary expectations, etc.

As an example, we give here the result of estimates for a number of industrialized countries.[2] Although the estimates agree as to signs, the differences in incentive intensity show how far the results depend on the methodology used.

Effects of taxation (decrease or increase in the cost of capital) as a percentage of the value of fixed assets

	D	F	I	UK	NL	B	USA	Japan
IMF	−5,5	+4,4	+5,0	+13,1	+6,2	−2,2	+12,8	−3,4
IFO	−18,5	+3,4	:	±0	:	:	+10,4	−17,8

According to other estimates,[3] in 1978 company taxation was fairly close to a situation of 'partial' neutrality (i.e. leaving out of account the treatment of capital gains), the difference being expressed in percentage points as follows (+ denotes a more favourable effective situation):

Effects of taxation[1] as a percentage of the value of fixed assets: difference between the 1978 situation and a theoretical situation in which taxation is partly neutral

D	F	I	UK	N	B	USA	Japan
−0,2	+1,8	+2,6	+6,6	−0,1	+0,1	+1,5	−0,2

[1] These are the effects of taxation on the required rate of return.

1.2.2 Apart from the question of the actual incentive content of tax measures in relation to the conditions of neutrality described above, tax measures that affect the volume of resources available for investment can be classified into categories as follows:

(i) exemption from or the reduction of certain taxes which are levied independently of progressive personal income tax (sole proprietorships) of corporate income tax, but which affect the scope for self-financing. Examples are:

  (a) the business tax in France (reduced in 1980 and 1981; the possibility of authorizing local authorities to grant exemptions from the taxes they collect—including the business tax—is at present under consideration); and the tax on industry and trade, in the Federal Republic of Germany (recently, the tax base was significantly reduced),

  (b) the net wealth tax in the Federal Republic, the Netherlands and Denmark;[4]

(ii) reduction in the rate of taxation. Table 3 of communication COM(83)218 of 18 April shows the corporation tax situation in Member States at the end of 1982. In general there are lower rates for small firms. In Ireland the rate of corporation tax was temporarily reduced to 10% on 1 January 1981 for manufacturing firms. In France, a provision exempting new industrial firms from direct taxation has just been announced;

[1] The conditions for neutrality are also fulfilled if there is immediate 100% depreciation and non-deductibility of interest payments.

[2] Quoted by W. Leibfritz: 'Steuerliche Investitionsanreize und -hemmnisse im In- und Ausland', *IFO-Schnelldienst* 22/82.

[3] *Source:* G. Kopitz: 'Factor prices in industrial countries', *IMF Staff Papers*, September 1982.

[4] In France, the wealth tax does not apply to business assets (assets required by their owner for the exercise of an industrial or commercial occupation as his principal activity, or interests or shares in companies if their owner's principal activity is exercised within the company).
In the Federal Republic of Germany, wealth tax (*Vermögenssteuer*) gives rise to double taxation. The company itself must pay the wealth tax, the basis being 0,7% of company assets, while the shareholders, if liable to the same tax, pay a tax of 0,5% on their shares; wealth tax payments are not deductible from the base for corporation tax and the tax on industry and trade.
Under budget decisions for 1984, the German Government has proposed exemption from the tax up to DM 125 000 and a further 25% reduction in tax values for business assets, and a reduction in the rate of the tax for companies to 0,6%.

(iii) a change in the tax base, especially through (a) depreciation allowances and (b) the constitution of tax-exempt reserves:

(a) Tax depreciation is especially important for investment policy,[1] and can be a major incentive; firms find them particularly attractive because, among other things, of their automatic nature.

From the economic point of view, arrangements for depreciation are an incentive when they permit deductions for depreciation greater than economic depreciation (if the other conditions for neutrality are fulfilled: see point 1.2.1). National tax laws define accelerated depreciation differently,but they all refer to the possibility of depreciation over and above that considered 'normal' under the law (with the definition of 'normal' again differing according to country). For exaple, in Italy the only 'normal' method recognized is straight-line depreciation. The geometric degressive method of depreciation is considered normal in the Federal Republic of Germany and the Netherlands, and an incentive in France.

Consequently, it is not easy to measure the 'true' incentive element offered by accelerated depreciation rules, especially since real economic depreciation varies between industries, between assets, and over time (as a result of inflation and technological progress). The complexity of tax rules makes comparison between countries difficult; thus a depreciation method which is relatively less favourable may be partly compensated by a shorter tax life.

Depreciation may be accelerated by increasing the rate of depreciation in the early years, by reducing the tax life of the assets (which permits higher amounts to be written off each year over a shorter period),[2] by bringing the start of the tax life forward (e.g. to the ordering date rather than the moment at which the equipment is brought into use) or by using a method more favourable to the taxpayer (e.g. changing from straight-line depreciation to declining-balance depreciation).

Accelerated depreciation improves cash flow and saves interest charges; as a result the prospective profitability of the investment increases and this may call forth new investment. In other words the tax liability is postponed, which corresponds to an interest-free loan (and one therefore granted to the enterprise irrespective of its creditworthiness).

The advantage is, however, realized in the future; where the obstacle to investment lies in the difficulty in raising funds to finance new investment, and the reserves built up in the past are insufficient (notably, in the case of new enterprises), subsidies, low-interest loans or guarantees may be more direct incentives.

Accelerated depreciation gives rise to effective tax rates which vary according to asset life and may therefore offer advantages that vary from one sector to another and as a function of the structure of a firm's assets.[3]

The assessment for tax purposes of depreciation provisions on the basis of historical cost is one of the main factors determining the real tax burden on business profits. Other factors are stock valuation, the taxation of nominal capital gains and the tax deductibility of nominal interest, or the fact that the reduction of the real terms is not taken into account.

We shall confine ourselves here to indicating the possible solutions as regards the calculation of provisions for depreciation, without touching on the questions concerning inflation accounting in general. The possible solutions are:

— depreciation at replacement cost, which takes account of the inflation rate. This is conceptually the most satisfying approach; however, it poses practical problems, in particular that of the choice of the price index to be used to calculate the replacement cost. In Denmark the Law of 1 September 1982 on depreciation for tax purposes provides for indexation of the amount giving rise to depreciation;

— the revaluation of depreciable assets. The difference between the calculated depreciation of the historical cost and the calculated depreciation of the replacement cost is subtracted from taxable profits when tax laws authorize revaluation. There is still the problem of which index to use, and this makes this system fairly complicated and not transparent. In France, enterprises have been required or

[1] See also Chapter 9 of the Annual Economic Review 1981-82: 'Some structural properties of subsidies, investment incentives and energy taxation' (*European Economy* No 10 of November 1981).

[2] One of the main changes introduced in the USA by the 1981 Economic Recovery Tax Act was the change from a system which tried to make tax life coincide with actual life to the system of 'accelerated cost recovery' which provided for four lengths of asset life, namely three years (e.g. for vehicles), five years (all other capital goods), 10 years (construction by public service enterprises) and 15 years (construction). The possibilty of declining-balance depreciation was retained.

[3] For example, see the estimates of effective tax rates for each category of assets resulting from the new system of depreciation introduced in the USA in J.G. Gravelle: 'Effects of the 1981 depreciation revisions on the taxation of income from business capital', *National Tax Journal*, March 1982.

allowed to revalue their fixed assets on the basis of their value at 31 December 1976 (without this having any consequences for tax purposes). In Italy, a 1975 Law permitted, *inter alia*, the revaluation of balance sheets so that tax depreciation could be based on the revalued figures for fixed assets. A new law has just been adopted on the subject: 'Visentini bis';

— the setting up of reserves to take account of inflation (provisions for price rises);

— the possibility of accelerated depreciation, which partly reduces the problem. In particular, the first-year allowance of 100% for the depreciation of certain assets in the United Kingdom and Ireland, although not designed to take account of inflation, has effectively compensated for its effects.

(b) A special example of provisions for the constitution of tax-exempt reserves for investment is provided by Denmark: sole proprietors may deduct from taxable income for the tax year amounts up to 25% of profits to be set aside in an investment fund. These amounts must be used within six years of the end of the tax year during which they are set aside to depreciate by anticipation the historical costs of equipment goods purchased. Provisions that have not been used in the time allowed are subject to retrospective taxation. Wage and salary earners under 40 years of age may also deposit amounts, deductible from taxable income, with a view to setting up a business; these amounts must be used for depreciation by anticipation of business equipment.

In Belgium the Recovery Law of 10 February 1981 provided for a tax-free allowance of 5% of profits or 28% of the amount of non-distributed profits for investment within three years. This system has since been replaced by a system of investment deductions (see below).

(iv) tax deductions for investment: these are allowances amounting to a certain percentage of the investment to be set against taxable income or tax payable. When they are deducted from tax, they are often called 'tax credits' ('investment tax credit' in the USA, where these allowances are one of the main investment incentives along with accelerated depreciation).

(a) In Belgium, Royal Decree No 48 of 22 June 1982 provides for the possibility of deducting from taxable profits a certain percentage of the cost of investment, depending on the nature of the investment: energy conservation, research and development, and others (with unlimited carry-forward if profits during the relevant tax year are insufficient).

(b) In France, the provisions for deduction of a fraction of the amount invested during the tax year, which were introduced in December 1980, were amended in December 1981 (new rates of deduction, supplementary conditions that manning levels must be maintained or increased), and finally discontinued to be replaced on 1 January 1983 by improved provision for accelerated depreciation.

(c) An example of allowances to be set against tax payable is provided in the Italian Finance Act for 1983, which temporarily (to end 1984) authorizes firms in manufacturing industry to increase deductions for VAT by an amount equal to 6% of the cost purchasing of depreciable equipment (including imports but excluding buildings). Similar measures have been used in France and Belgium;

(v) Tax aids to investment: these are incentives granted whether or not tax is due. The *Investitionszulage* in Germany is such an incentive: it is granted under a tax law for purposes of regional development and to promote investment in research and development. The investment subsidy is thus a negative tax. In the Netherlands a certain percentage of the investment (depending on the type of investment, regional criteria, etc.) is deducted from tax payable or reimbursed when the amount exceeds the amount of tax payable; the system is therefore a cross between tax credits and subsidies, and, unlike the *Investitionszulage*, expenditure under the Netherlands system is categorized under budget expenditure.

1.2.3. Tax provisions for offsetting losses by carrying back future profits or carrying forward previous profits may also constitute an investment incentive, although less direct than the method described above, to the extent that their effects on risk-taking are positive and, in the case of carry-back, that they improve the firm's liquidity. Remarks on carry-back and carry-froward of losses will be found at point 4.3 of communication COM(83)218.

In the draft 1984 budget of the Federal Republic of Germany, the maximum amount of losses that can be carried back is doubled (from DM 5 million to DM 10 million).

1.2.4. Under certain conditions the various types of investment incentive may represent the same net advantage to firms (e.g. the advantages of accelerated depreciation may under certain conditions be equivalent to those of tax deductions). However, some features of incentives such as their relation to profits, the rate of taxation or the interest

rate, or whether they result in definitive or temporary reductions in the tax burden may effect their attractiveness to investors. The box shows an overall classification of the various incentives (including subsidies) in relation to these factors.

Incentives may be independent of profits (tax payments, investment grants: see column 1 of the box), in which case there is no discrimination between profitable firms and firms making a loss or generating inadequate profits because of temporary or structural problems or because they are newly established.

When tax provisions lead to a reduction in the tax base (accelerated depreciation, tax-free reserves, favourable stock valuation, carry-back or carry-froward of losses), the advantage to the investor depends on the existence of profits and on the rate at which profits are taxed (the higher the rate, the greater the incentive: see column 2 of the box).

When permissible reductions in the tax base result in a loss for tax purposes, the advantage depends on whether this loss can be carried back or forward. In the United Kingdom, the leasing of investment goods enables firms that are not eligible for certain tax incentives (in particular, 100% depreciation the first year) because of insufficient profits for tax purposes to take at least partial advantage of the incentives in terms of lower leasing costs; thus the leasing sector acts as a redistributor of tax incentives to firms that could not otherwise turn them to account.

Some features of investment incentives

	Relationships between investment incentives and			Deferral of tax
	profits	rate of tax	interest rate	
	(1)	(2)	(3)	(4)
1. Reduced or zero tax rates	+	+	=	●
2. Accelerated depreciation				
2.1 at historic cost	+	+	+	★
2.2 at replacement cost	+	+	=	●
3. Stock valuation provisions	+	+	+	★
4. Tax-free reserves	+	+	+	★
5. Investment allowances against				
5.1 taxable profit	+	+	(−)(=)	●
5.2 tax liability	+	(+)(−)	(−)(=)	●
6. Investment payments	=	(+)(−)	=	●
7. Losses				
7.1 carried back	+	+	+	★
7.2 carried forward	+	+	−	●
8. Investment grants	(=)(−)	(−)	(+)(=)	●
9. Interest-rate subsidies	(=)(−)	(−)	(=)	●
10. Subsidies for cost of inputs, excluding 9	(=)(−)	(−)	=	●

Note

Columns (1), (2), (3):
+ : the investment incentive is positively related to profits, the rate of tax, the interest rate;
− : the investment incentive is negatively related to profits, the rate of tax, the interest rate;
= : the investment incentive is independent from profits, the rate of tax, the interest rate;
(+), (−), (=): the incentive can be, under certain conditions, positively or negatively related to profits, the rate of tax, the interest rate, or independent from them.

Column (4):
★: the incentive consists in the deferral of tax;
●: the incentive is a definite advantage.

The value of subsidies (tax aids, premiums, interest subsidies) is inversely related to the rate of taxation (i.e. the higher the tax rate, the lower the value of subsidies) when the subsidies are subject to tax or reduce the amount of deductible expenditure.

Incentives may represent a definitive advantage to the investor (investment allowances, tax credits, investment grants, interest-rate subsidies or loans at reduced rates, reduced rates of taxation, favourable stock valuation provisions, carry-back or carry-forward of losses), or lead to deferral of tax payment (special depreciation schemes, temporarily tax-free reserves).

Clearly, the real advantage of deferral of tax payment (which corresponds to an interest-free loan) is in improved cash flow; it depends on the rate of interest (irrespective of the fact that the rate of interest determines the discounted value of any investment incentive and thus influences the economic calculations of investors in all cases) and varies with the life of assets.

Apart from the specific features of the various tax mechanisms, other aspects have special importance for assessing company taxation in general and any distortions (or correction of distortions) that may be generated by incentives.

Such aspects include:

(i) the definition of categories of expenditure or assets eligible for tax concessions (e.g. equipment but not buildings, intangible investment);

(ii) the criteria of eligibility for exemptions or concessions (e.g. small firms, innovative firms);

(iii) the conditions attaching to incentives (e.g. job conservation, increase in exports).

2. Channelling savings to firms

2.1. The availability of adequate external resources, in particular risk capital, is a necessary condition for firms to innovate and expand. The modernization of capital markets in the Community is essential in this respect; but incentives to channel savings towards firms may also have favourable effects. The principal factor of tax discrimination between various types of financing[1] is the incentive to borrow provided by the deductibility of debt interest[2] (both for sole proprietorships and for companies). In simple terms (and except where no profits are available), with a tax rate of 50%, the cost of borrowing is half the cost of using own funds.

In certain Community countries it is possible to deduct the return on equity from the tax base:

(i) in Greece, dividends are deductible;

(ii) in France, there is partial and temporary deduction. The Law of 13 July 1978 provided for deduction from the tax base of dividends on new shares issued against cash between 1 January 1977 and 31 December 1981, for seven years only (10 years for non-voting preference shares), on condition the dividends paid do not exceed 7,5% of the cash contribution. These arrangements have been extended to 31 December 1987, and amended. Dividends paid can be deducted for 10 years following the setting up of a new company or an increase in the capital of an existing company;

(iii) in Belgium, partially and temporarily. The Royal Decree of 27 November 1977 introduced exemption from corporation tax for profits distributed during five years on shares purchased in 1978 which represent capital contributions to newly-formed companies or companies which have increased their capital; the profits may not exceed 5% of the relevant capital. The measure was extended to capital invested in 1980, 1981, 1982 and 1983. Royal Decree No 15 of 9 March 1982 introduced exemption from corporation tax for part of the income distributed during five years on shares or new shares, provided that the income does not exceed 8% of the capital contributed in 1982 or 1983 (13% of capital contributed and a period of 10 or nine financial years if the company undertakes to pass the tax saving on to the shareholder). The tax relief is granted provided that at least 60% of the equity capital raised is allocated to direct or indirect investment[3] in Belgium.

2.2 Another form of discrimination is the double taxation of dividends, in the hands of the company and in the hands of the shareholder (through corporation tax and income tax):

[1] The—different—question of the efficiency of the allocation of funds if firms are encouraged to borrow rather than using internal funds is not solved (see *Theoretical and empirical aspects of corporation taxation*, OED, 1974).

[2] Tax legislation on directors' loans or advances, which can be used either to overcome temporary difficulties, or to finance the expansion or the conversion of the firm's activity and which are particularly advantageous for SMEs, generally limits:
(i) the rate of deductible interest (by reference to the market rate, or to the central bank rate which is generally lower);
(ii) the deductibility of interest where such loans amount to more than a certain proportion of the company capital so that contributions of capital are not disguised as directors' loans.

[3] Broad definition of investment: any physical or non-physical asset, new or second-hand, whether or not depreciable, used for the exercise of the company's activity in Belgium, and investment in the equity of Belgian companies.

this does not exist in the case of the sole proprietorship, but some people argue that the discrimination is justified because of the advantage of the limitation of risk for incorporated businesses.

Double taxation (classical system) is complete in the Netherlands, Luxembourg and the United States. Partial relief from double taxation may be granted by one of the following methods or a combination of them:

(i) the deduction of dividends paid from the corporation tax base (e.g. Greece, France and Belgium, see above);

(ii) lower rates of tax for distributional profits ('split-rate' systems, e.g. Federal Republic of Germany and Japan);

(iii) partial credit for tax on dividends received by the shareholder (Belgium, Denmark, France, Ireland, Italy, United Kingdom, Japan).

Double taxation can be eliminated by a full tax credit (Federal Republic of Germany).[1]

Table 3 in communication COM(83)218 shows the rates of corporation tax, tax credit and withholding tax in the EEC, the United States and Japan.

The 1975 proposal for an EEC directive concerning the harmonization of systems of corporation tax and of withholding tax on dividends, on which Parliament has not yet given its opinion, provides for tax credit at a rate between 45% and 55% of the rate of corporation tax.

2.3. In general, capital contributed to an enterprise by an individual or by another enterprise is not a cost deductible from the contributor's income or taxable profit.

There are exceptions, some of which have been introduced recently:

France:

(i) Deductibility from taxable income of net purchases (purchases less sales) of French shares up to a limit of FF 6 000.

(ii) Law No 78-741 off 13 July 1978 ('Monory Law') permits individuals, temporarily and within certain limits, to deduct from their taxable income sums invested, between 1 June 1978 and 31 December 1981, (a) in the purchase of quoted or similar-ranking shares of French companies, quoted oil certificates, rights or scrip certificates or allotment certificates attaching to such securities, and shares in open-ended investment companies (SICAVs) or units in unit trusts; (b) by subscription to operations to constitute or increase capital by French public or private limited liability companies.

(iii) From 1 January 1983, new arrangements, the 'equity savings account' replaced deductions under the Monory Law. Taxpayers opening such an account with an approved intermediary are entitled to a reduction in tax equal to 25% of net purchases of transferable securities up to a maximum of FF 7 000 a year for individuals and FF 14 000 a year for married couples. The savings must be new, i.e. not resulting from the sale of securities.

Belgium: Royal Decree No 15 of 9 March 1982 allows taxpayers to deduct from taxable income declared for the years 1982 to 1985 the sums paid for the purchase of new shares or interests in Belgian companies or Belgian unit trust certificates, up to a ceiling of BFR 40 000 (plus BFR 10 000 for each dependent), provided that the shares are held for at least five years. This advantage is an alternative to the income from shares being exempted from personal income tax.

United Kingdom: Under Section 52 of the Finance Act 1981, shareholders subscribing in any one year to at least UKL 500 worth of shares issued by small companies embarking on new forms of activity can, under certain conditions, deduct the amount subscribed from their income up to a limit of UKL 10 000. Capital subscribed in this way must remain in the company for at least five years; the company must not form part of a group.

In the budget of March 1983, the government proposed substantial improvements to this scheme ('business start-up scheme'). Called from now on the 'business expansion scheme', it is to be prolonged to April 1987, and extended to cover existing unlisted firms. The ceiling on deductions, which had already been raised to UKL 20 000, will be set at UKL 40 000. The limit of 50% of ordinary shares is to be removed.

2.4. As to the tax treatment of the return on the equity of companies (dividends), Table 3 in communication COM(83)218 summarizes the provisions in force for tax credits and withholding tax.

In Belgium, the Law of 8 August 1980 provided that where income from contributions of capital was exempt from corporation tax, it was exempt from personal income tax for five years, on certain conditions (the cash contribution on which the dividend accrues must be evidenced by a registered

[1] However, since the tax credit cannot be set against the tax on trading profit (Federal Republic of Germany) or local income tax (Italy), the shareholder cannot be fully compensated for the tax paid on the profit at company level, even with a 100% tax credit (Federal Republic of Germany).

security, subscribed for and paid by the recipient of the income; limit: BFR 30 000 for each tax year, but BFR 75 000 in 1981). The Royal Decree of 9 March 1982 exempts from personal income tax the income from shares which is normally exempt from corporation tax (see point 2.2), with no limit as to amounts, and for all recipients, whether or not they have subscribed for the securities to which the profit attaches. Added to this there is exemption for 10 years from succession and the duty on gifts. For profits exempt in this way, the withholding tax on investment income discharges the liability in full.

2.5. Two matters not dealt with in this article should be mentioned, as they are particularly important from the point of view of channelling savings to firms. They are:

(i) the tax treatment of capital gains and losses, particularly for securities and shares owned by private individuals;

(ii) taxation of the various financial intermediaries.

Provisions on these matters are very complex, and vary from one Member State to another; they will be dealt with in a forthcoming article.

3. Taxation and types of enterprises

Using a rough and very simplified classification, it is possible to assess the advantages (or disadvantages) of the various incentive measures that affect self-financing and external financing by reference to the type of enterprise (SME large enterprises; quoted and non-quoted enterprises) and/or by reference to the various phases in the development cycles of an enterprise.

3.1. *Self-financing and external financing*

(i) Any measure which reinforces self-financing is of particular advantage to SMEs, which for various reasons do not have access to securities markets, and gives them easier access to bank credit; the greater the administrative complications, the smaller the advantage.

(ii) Apart from exemption or partial relief from tax not linked to profits and the application of lower tax rates (provided for in several national tax systems), accelerated depreciation, inflation accounting (revaluation of balance sheets), investment allowances and the carry-back or carry-forward of losses are therefore of special advantage to SMEs.

(iii) The tax incentives relating to shares and dividends, and to bond interest, are of advantage to listed companies and companies with access to the new-issue bond market (generally, large companies). For small and medium-sized enterprises, the practical advantage may lie in the taxation of capital contributions and the remuneration of shares, and the taxation of directors' loans.

(iv) The elimination of tax penalties on financial intermediaries such as unit trusts and investment trusts may help to improve the working of the stock exchange and therefore to encourage financing through share issues, which is specific to medium-sized and large companies: the relaxation of restrictions on equity investment in unlisted undertakings can make external financing easier for small and medium-sized firms.

(v) The taxation of capital gains and losses may encourage capital contributions from private individuals and financial intermediaries (unit trusts, but also venture capital companies), with favourable effects for both large and small enterprises.

3.2. *Taxation and phases of development of enterprises*

The influence of the various tax arrangements on the self-financing and external financing of enterprises clearly differs according to the state of development of the enterprise. Very briefly, the following phases may be distinguished:

(i) Creation and start-up phase of the enterprise: the most useful measures are exemption from charges which are not related to profits (e.g. business tax, tax on net capital, registration taxes, etc.). It will be recalled that, in general, the effect of such incentives is to facilitate and assist the creation of new enterprises, and not to trigger it; however, they may help to reduce the mortality rate of newly-created enterprises.

Reduction in the tax base (depreciation allowances, reserves, etc.) are advantageous if tax losses can be carried forward to later years (see Belgium, unlimited carry-forward for losses relating to the first five financial years; also the Netherlands, for losses relating to the first six financial years); the same is true of deductions from taxable profit, while deductions from tax liability may be useful if they come off charges not linked to profits, e.g. VAT.

The carry-back or carry-forward of losses are also very suitable. Investment payments, subsidies, cheap loans, interest-rate subsidies, guarantees and lower input cost may also have favourable effects. By contrast rules which favour external financing, where they concern the capital markets (shares and bonds), are of no advantage, though they may have some impact when they make it easier for private individuals to contribute capital and earn a return on such capital (including capital gains), or facilitate the deduction of any losses from the income or the tax liability or contributors of capital (tax consolidation).

(ii) Expansionary phase: for SMEs, reliefs on contributions from third parties or from the owner or the partners, as loans or as equity, and the possibility of consolidating any losses with profits or with the tax liability of contributors of capital. For large enterprises, favourable taxation of self-financing, and smooth operation of capital markets (including international capital markets).

(iii) 'Normal' phase of the life of the enterprise: see preceding point on the advantage of the various tax arrangements depending on the size and/or legal status of the enterprise.

(iv) Phase of internal or external conversion: at this stage, all tax incentives which are not linked to profits, and the carry-forward and the carry-back of losses are useful particularly in the case of an enterprise which made profits in the past and has to undertake conversion or restructuring investment. Doubts may be expressed as to the advisability of investment payments, allocated irrespective of whether profits are earned, when there is surplus capacity.

(v) Temporary or structural difficulties: tax reliefs for the transfer or acquisition of holdings by third parties, including the possibility of deducting losses from the income or the tax liability of contributors of capital. It is important to guard against the danger of keeping non-viable enterprises alive purely for tax reasons.

Tax and financial measures in favour of investment

COM(83)218, Brussels, 18 April 1983

Introduction

At its meeting on 15 November 1982, the Council approved the procedures proposed by the Commission in its communication COM(82)641; it agreed that the Commission would continue to assess the tax and financial measures introduced to help investment in the Member States and would submit any conclusions for consideration by the Council at one of its meetings in the first half of 1983. The European Council of 3 and 4 December 1982 confirmed the Council's conclusions.

This communication sets out the results of an examination of existing measures in the Member States designed to increase the resources of enterprises available for investment by:

(i) increasing self-financing margins, and

(ii) channelling a larger proportion of savings into the financing of productive investment.

1. The case for measures to help increase the resources available for investment

As a result of a prolonged period of high inflation and because of insufficient adjustment to structural changes, the productive system of the European economies eventually deteriorated. This is reflected:

(i) in losses of competitiveness for certain industries, branches and products;

(ii) in inadequate market shares for new high-technology products;

(iii) in an imbalance in the financial structures of enterprises;

(iv) in a large number of business failures, some of them involving major companies.

On several occasions, and in particular in its June communication on the problem of investment (COM(82)365), the Commission has stated that the restoration of a climate more favourable to business investment depends on the existence of a number of macro-economic conditions which will:

(i) ensure greater security of the international environment, and

(ii) increase the stability of the economic framework within the Community.

Any progress in these areas depends chiefly on national macro-economic policies, on coordinating them within the Community and on closer international cooperation.

Nevertheless, in the opinion of the Commission, specific structural measures to improve business taxation and financing may be a significant aspect of the required overall strategy, the macro-economic components of which were defined in the Commission communication to the European Council in March. This is because:

(i) the macro-economic room for manoeuvre is still limited in certain Community countries;

(ii) there is an urgent need to eliminate as many obstacles as possible which may represent bottlenecks not only in conditions of slow growth, but also in the event of a significant improvement in macro-economic conditions;

(iii) the potential impact of such measures in terms of improving the general investment climate and business confidence is substantial;

(iv) it is necessary to reduce certain burdens on productive activity, since the level of most production costs will inevitably remain higher in the Community than in some of its trading partners.

If any specific measure to stimulate investment is to be effective, its introduction must not cause a significant net deterioration in the general macro-economic conditions which influence business behaviour; the repercussions on budget equilibrium and interest rates are of particular importance here since they could easily wipe out the beneficial effects of specific stimulatory measures through their effects on investor behaviour.

Bearing this in mind, the Commission considers that any improvement in tax arrangements for investment should avoid adding to budget deficits and should be financed by reducing certain subsidies notably those which, by helping ultimately uncompetitive businesses to survive, deflect resources from profitable investment.

Action to modernize the financial markets and break down barriers between them, which has made progress in recent years, must also be continued and stepped up, the relevant measures must be designed in a Community context promoting integration along the lines indicated by the Commission in its communication on financial integration. [1]

2. The need to improve both self-financing and external financing through the raising of equity capital

In the Community countries, the financing of business investment differs in the relative reliance on loan capital and shareholders' funds, whether internally generated (self-financing) or raised externally (issue of shares).

[1] See COM(83)207 final.

Although this situation may be due to some extent to the institutional features of financial markets, the following points are also worth considering:

(i) a structure of investment financing based primarly on self-financing may mean that established enterprises escape market control as regards resource allocation and management capabilities: however, the financial markets cannot fulfil this role unless they are sufficiently developed and operate in a satisfactorily efficient manner, which is not always the case, particularly in certain Member States;

(ii) access to adequate external funds is a prerequisite for innovation and expansion in certain phases of the life-cycle of enterprises, particularly small and medium-sized businesses. However, access to external finance in the form of equity capital and loan capital normally depends on an adequate flow of self-financing. Low self-financing ratios cannot be sustained indefinitely, because they undermine the possibility of remunerating equity capital and because a high gearing ratio increases the risk for potential lenders;

(iii) in view of the increased risk due to greater uncertainty, and the innovative effort necessary to preserve competitiveness and employment, investment must be financed through an adequate flow of risk capital (self-financing and equity raised externally);

(iv) the scope for financing growth and innovation by borrowing is limited by the present slow-growth situation, by the availability of credit and the level of interest rates, which depend partly on restrictive policies aimed at bringing down inflation, and by the imbalance in the financial structures of enterprises, often characterized by a high gearing ratio.

To sum up, although the possibilities for impoving the conditions for medium- to long-term borrowing must be disregarded, the main focus must be on action on two fronts, self-financing and external financing through the raising of equity capital, so as to help restore sounder financial structures and to permit a faster rate of adjustment to change.

3. Increasing firms' self-financing margins

3.1. *Taxation and self-financing*

Self-financing capacities depend primarily on profitability, i.e. on the relative movements of prices and production costs, but also on the amount and structure of taxes (including social security contributions) borne by enterprises. Therefore:

(i) to the extent that depreciation allowances must be based on historic cost, [1] taxation does not allow for the effects of inflation and of the acceleration of technical progress on the real value of productive capital, and this gives rise to the taxation of apparent profits.

Although the scope for tax depreciation is not the only aspect of the interrelationship between taxation, inflation and profits, it is the most important from the point of view of investment policy. According to some estimations, in the Federal Republic of Germany, where inflation has been relatively modest in comparison with the Community average, taxes on the apparent profits resulting from the method of calculating depreciation for wear and tear probably represented over one third of the tax liability of enterprises subject to tax; in Italy, historic-cost depreciation for a sample of manufacturing firms in 1981 was probably under half the amount of replacement-cost depreciation;

(ii) taxation is insufficiently adapted to the requirements of new enterprises and of innovation, in particular high-risk and deferred-profitability innovation. This is a problem which, by definition, cannot be solved by taxing profits less heavily, but other tax measures are possible;

(iii) the burden of taxes not linked to profits (e.g. the *taxe professionnelle* in France, *Gewerbesteuer* in the Federal Republic of Germany; the net wealth tax in the Federal Republic of Germany, Luxembourg, the Netherlands and Denmark) weighs more heavily in periods of slow growth and declining profits.

It is not possible in the context of this document, to present a more detailed analysis of the implications of the burden represented by employers' social security contributions, which in some Member States make up a significant proportion of labour costs and tax revenue (see Table 1: some 29% of total taxes in France, Italy and the Netherlands). Clearly, it is the total cost of labour which influences enterprises' self-financing margins; but at least part of the social security contributions paid by enterprises is used to finance costs (health expenditure for example) which should not weigh mainly on one particular sector of the economy. Consequently, these charges affect the self-financing capacity of enterprises differenly in the Member States. As it stressed in its communication to the Council 'Social security

[1] The Fourth Directive on annual accounts does not advocate a uniform method as regards the relationship between taxation and accounting. Nevertheless, the directive took account of this problem in a number of respects. First, besides normal value adjustments, exceptional value adjustments are permitted for taxation purposes alone (Article 35 (1) (d), Article 39 (1) (e)). In addition, the notes on the annual accounts must show the extent to which the calculation of the profit or loss for the financial year has been affected by a valuation of the items which by way of derogation from the valuation principle was made with a view to obtaining tax relief (Article 43 (1) (10)).

problems - Points for consideration' (COM(82)716 of 17 November 1982), the Commission considers that national measures in this area must be taken in the economic context of the single market, and that the Community as a whole should be able to benefit from the experience of the various Member States.

3.2. *Investment incentives*

All the Member States use general measures to give direct or indirect encouragement to enterprises to invest; on top of these there are more selective measures (e.g. regional or industry measures). At this stage, we have confined our analysis to general tax incentives.

Essentially, these measures are the reduction of the rate of tax on profit (often they will favour certain categories of enterprises), the reduction of the tax base (in particular through the rules governing depreciation), the deductibility of a percentage of the investment from the taxable profit (e.g. in Belgium, Denmark and Greece), the formation of tax-free reserves (e.g. in Denmark) or the reduction of tax liability in accordance with the investment (tax credit in Luxembourg and the Netherlands; investment payment in the Netherlands, where the portion in excess of the tax liability is paid out; 'negative VAT' in Italy).

The following general comments may be made:

(i) Reductions of the tax base are advantageous for profit-making enterprises and if losses can be carried back or forward; the same is true of deductions from taxable profits. Where enterprises are not profit-making, the reduction of charges which are not linked to profits, or tax subsidies, are clearly more attractive.

This raises the question whether investment should be facilitated irrespective of whether the enterprise is profitable. Such an approach might be justified in the case of new enterprises and innovative enterprises engaged in deferred-profitability activities or in order to get through a difficult cyclical situation without needlessly undermining the productive potential of the economy.

(ii) Temporary incentives may prove effective where the object is to accelerate investment spending; but the stability of an environment favourable to investment is essential in order to encourage businesses to invest and innovate.

(iii) The real efficacy of the various incentives depends on the extent to which they represent a definite advantage or merely compensate, to varying degrees, for the effects of inflation on the rebuilding of productive capital.

(a) The national tax laws provide for various forms of accelerated depreciation which, although generally presented as an incentive mechanism, in fact also mitigate the effects of rising prices; in France, the Finance Act for 1983 temporarily improved the possibilities of accelerated depreciation (in certain cases, first-year depreciation will go up to 70%).

(b) In Ireland and the United Kingdom, the possibility of 100% first-year depreciation enables the effects of inflation on the depreciation of productive capital to be almost fully offset. In order to reduce distortions between industries and enterprises, a 75% initial allowance has recently been introduced for buildings alongside the 100% capital allowances for plant and machinery.

(c) Other arrangements make it possible to allow for the effects of inflation, either systematically or occasionally: reserves for price increases; the indexation of depreciation allowances (this possibility was introduced in Denmark by the Law of September 1982 on tax depreciation); the revaluation of balance sheets (a law on this subject has just been approved in Italy).

In this area, it is important for the arrangements introduced

(a) to be simple and transparent;

(b) not to be *ad hoc* remedies, introduced piecemeal, but structural elements of taxation.

3.3. *Encouraging risk-taking*

The analysis of other tax arrangements existing in the Member States which affect self-financing suggest that changes to the rules on the carry-back or carry-forward of losses could have favourable effects on risk-taking.

(i) The improvement of these rules, which enable losses to be set against past or future profits, would encourage the establishment and expansion of enterprises and the introduction of new deferred-profitability products and production processes. The carry-back of losses may also enable enterprises in temporary difficulties and making losses after a period of profits to finance investment in loss-making years, and may thus have some regulatory effect on the economic cycle.

(ii) Another advantage of lengthening the carry-back or carry-forward period is that it helps to lower the risk threshold for the enterprise without necessarily involving losses of tax revenue.

(iii) Introducing in all the Member States the possibility of carrying losses back over the two previous financial years and forward indefinitely would bring the relevant tax rules into line with the most favourable general system which exists in the Community (see Table 4).

(iv) The carry-back of losses makes tax revenue more difficult to predict, but in a transitional phase shortfalls caused by an improvement of existing systems might be restricted by initially setting a ceiling, expressed as an absolute amount, on this form of relief.

3.4. *Readjustment in the tax burden on enterprises*

Generally speaking, and to allow for the slowdown in growth, the structural adjustment of the productive system could be helped by not increasing or even actually decreasing the tax burden on enterprises, in particular the charges not linked to profits.

(i) In its communication on budget discipline and economic convergence (COM(82)422) of 1 July 1982, the Commission stressed that efforts to reduce the deficits must be concentrated on the area of public expenditure, and that increases in taxation were undesirable because of the high level already reached by the rates of tax and social security contributions.

(ii) More specifically and without prejudging the institutional problem of the financing of local authority expenditure, the local authorities' budget difficulties must not lead to an increase of the tax burden on the productive sector and have the effect of reducing or wiping out any advantages introduced under general taxation, and of distorting competition between enterprises.

(iii) Certain exemptions from or changes to charges not linked to profits have recently been introduced (e.g. for the business tax in France and the Federal Republic of Germany); further progress in this area is desirable, as are direct or indirect reductions in the net wealth tax which exists in certain Member States; a study might also be made of ways of modifying the Community VAT system so as to reduce the causes of some residual tax having to be borne by enterprises.

4. Channelling savings into the financing of investment

In this area, the objective must be to improve the possible choices so that:

(i) enterprises are in an optimum position to implement a financial strategy for growth and innovation, based on the guarantee of a stable flow of funds;

(ii) savers can have access to financial assets which, in terms of return and risk, match their investment preferences.

This would allow for a more effective, growth-oriented use of the available savings.

In order to achieve these two objectives, the main focus must be on improving the operation of the capital markets, by eliminating distorsions and adapting capital market regulation and taxation in such a way as to bring them into line with the most effective systems inside or outside the Community.

Because of the complexity and variety of rules in the member countries for channelling savings into the financing of investment, this document confines itself to indicating a number of guidelines xhich, though not detailed in all their implications as regards laws and regulation, form a precise frame of reference recommended by the Commission. This frame of reference is as follows.

4.1. *Greater transparency of company accounts*

This is essential if the capital markets and the financial institutions are to be effective in performing their role of savings intermediaries.

This is essential if the capital markets and the financial institutions are to be effective in performing their role of savings intermediaries.

Without prejudice to the strengthening of national measures in this area, the incorporation into national law of the directives already approved by the Council, and the rapid adoption of the Commission proposals concerning company accounts should improve the publicity and transparency of company activities throught the Community.

4.2. *Conditions of access by firms to risk capital should be improved* so that the prime consideration for enterprises in devising their financial strategies will be the assessment of risk and balance-sheet equilibrium.

Easing the double taxation of dividends by means of a tax credit, along the lines of the 1975 proposal for a directive concerning the harmonization of systems of company taxation, would help to reduce the bias in favour of debt finance which exists in certain Community countries.

Temporary provisions in France and Belgium allow firms under certain conditions partially to deduct dividends on new shares or units from taxable profits: in France, this allowance is granted for 10 accounting years from the establishment of the firm or the increase in capital; in Belgium, it is granted on condition that at least 60% of the new capital is used for investment.

The establishment of more favourable conditions for raising risk capital by enterprises must also be achieved by:

(i) *facilitating direct access to risk capital by:*

(a) broadening the range and reducing the cost of services provided by financial and banking institutions when issuing and placing company shares;

(b) simplifying and making more transparent the technical and legal conditions and reducing the costs, particularly the tax costs, associated with the raising of equity capital by listed companies and companies coming to the stock market for the first time. In this connection the Commission proposes studying, together with the Member States, the scope for amending the Community system of registration duty by ending the duty or at least reducing it: when companies are formed or capital increased, duty is charged at the rate of 1% on contributions to capital and is not deductible in Denmark, Greece, Ireland and the United Kingdom;

(c) creating or modernizing markets in securities representing risk capital where unlisted companies can have access to risk capital on terms suited to their phase of development. The lack or inadequacy of such markets is a particular constraint on the growth of innovating small and medium-sized companies, in that the difficulties of realizing the investment discourages the contribution of funds.

In the United States, this role is filled by the 'over-the-counter market', which in 1979 accounted for 26% of transaction and 13% of the capitalization of all United States stock exchanges. In the United Kingdom, the unlisted securities market, set up under the auspices of the London Exchange but forming an entirely separate market, has been in existence since November 1980: on this market, only 10% of equity capital needs to be offered to the public and a number of tax and other concessions applicable to unquoted securities remain available. Special markets have been set up in Denmark and the Netherlands: the second-tier market recently opened in France performs the same function.

(ii) *developing schemes of collective investment:*

(a) Indirect shareholdings must be developed by promoting collective investment undertakings.

The advantages of a greater role for collective investment undertakings are: the stabilizing effects which they can exercise on the share market, to the extent that their investment strategy is geared to long-term considerations, and their objective of ensuring asset growth balances that of seeking immediate profits; the economies of scale and the risk-spreading achieved through the collective administration of savings; the possibility they offer small investors of reaching the minimum investment threshold so that they overcome one of the major obstacles to a significant level of remuneration.

Apart from the elimination of double taxation, these considerations justify treatment at least as favourable for such undertakings as for individual savers, together with all the tax advantages enjoyed by these.

The Commission calls upon the Council to adopt, as quickly as possible, the proposal for a directive for the coordination of laws, regulations and administrative provisions regarding collective investment undertakings for transferable securities (CIUTS) and the proposal for a directive on the liberalization of transactions in units issued by CIUTS;

(b) a similar, more specialized function can be performed by investment companies and in particular venture capital companies; the other institutions which collect savings such as insurance companies and pension funds should play a more active role in channelling savings into enterprises, if not directly then at least through specialist intermediaries, and this should be helped by relaxation of the rules which place constraints on such institutions to invest in shares.

(iii) *the channelling of savings into equity capital,* through tax rules which are stable and, on certain conditions, encourage the direct or indirect investment in shares: this would redress the balance compared with the tax concessions generally granted for home-ownership saving.

Tax concessions in the form of a reduction in income tax when shares are purchased, are granted subject to certain conditions, in France and Belgium (in the latter country, as a possible alternative to the exemption of natural persons' share income); in the United Kingdom, the business start-up scheme introduced in 1981 permits an individual resident who invests an amount limited to UKL 20 000 in 1982/83 and 1983/84 in the shares of certain small companies engaged in new forms of activity to set that investment against his taxable income for the year, subject to certain conditions. Significant improvements to these measures have, moreover, been proposed. Also in the United Kingdom, losses incurred by individuals or investment companies on the disposal of shares in certain unlisted companies may be set against income; this may have incentive effect by reducing the risk threshold.

In addition, a *policy of employee wealth formation,* in particular through share-buying schemes, could help to improve savings diversification, and partially reduce the upward pressure on wage costs. There is a strong case for improving existing schemes and improving the advantages they grant.

5. Summary and conclusions

5.1. This paper analyses the main general measures adopted in the Member States in favour of investment.

5.2. The measures are assessed in terms of their contribution to increasing the resources available to firms for investment by improving self-financing margins and by channelling more savings into productive investment.

5.3. In connection with self-financing, three main problems arise:

(i) The taxation of apparent profits resulting from the effects of inflation on the rebuilding of productive capital: it is unclear how far the various incentives provided represent a definite advantage, and how far they merely compensate, to varying degrees, for the effects of inflation. The Commission recommends the adoption by the Member States of arrangements to eliminate in a structural manner the adverse effects of inflation on resources intended for rebuilding productive capital.

(ii) The limits imposed on offsetting losses with past or future profits: these limits reduce firms' ability to deal with temporary difficulties and to face up to the requirements of expansion and innovation. The Commission recommends that tax rules for carry-back or carry-forward of losses should be brought into line with the most favourable system existing in the Member States.

(iii) The burden of business taxes, particularly those that do not depend on profits, in a period of slow growth and high risk: the Commission thinks that this burden should not be increased—and even that it ought to be reduced—particularly for taxes not linked to profits.

5.4. Among measures to improve external financing of undertakings, the Commission recommends:

(i) greater transparency of company accounts, which is essential to improve access to equity capital and borrowed funds;

(ii) the following measures, to improve the flow of risk capital:

  (a) attenuation of double taxation of dividends;

  (b) improvement in the conditions of direct access by firms, especially strongly innovative small and medium-sized firms, to risk capital;

  (c) channelling of savings into risk capital, in particular through the development of forms of collective investment;

  (d) encouragement of wealth formation among wage and salary earners.

5.5. Some progress has been made on these fronts in the past few years in the Community. But a considerable effort is still required, particularly in some Member States where the situation is far from satisfactory.

In particular, for reasons of convergence, it is important to encourage business investment in the Member States with the most acute problems of inflation and balance of payments, so as to attenuate the adverse effects of economic readjustment on production potential.

The Commission would request the Council to approve the guidelines sketched out in Section 3 and 4 of this communication for the adaptation of company taxation and the channelling of savings into productive investment, allowing for special situations.

For its part, the Commission will bear these guidelines in mind during its work on harmonization in collaboration with the Member States.

Table 1

Taxation of enterprises

	Taxes on corporate income [1]			Employer's social security contributions		
	As % of GNP at factor cost					
	1970	1980	Increase/ decrease in percentage points	1970	1980	Increase/ decrease in percentage points
B	2,7	2,9	+0,2	7,7	9,5	+1,8
DK	—	—	—	—	—	—
D	2,1	2,0	−0,1	6,3	8,3	+2,0
GR	0,6	1,3	+0,7	—	—	—
F	2,7	2,8	+0,1	10,7	14,0	+3,3
IRL	—	—	—	—	—	—
I	1,4	1,9	+0,5	9,5	10,2	+0,7
NL	2,8	3,4	+0,6	8,2	10,4	+2,2
UK	3,9	3,5	−0,4	3,1	4,3	+1,2
USA	3,6	3,2	−0,4	3,4	5,0	+1,6
Japan	4,5	5,0	+0,5	3,4	4,8	+1,4

	Taxes on corporate income			Employer's social security contributions		
	As % of total taxes (including social security contributions)					
	1970	1980	Increase/ decrease in percentage points	1970	1980	Increase/ decrease in percentage points
B	7,0	6,0	−1,0	19,9	19,8	−1,0
DK	—	—	—	—	—	—
D	5,3	4,5	−0,8	16,3	18,7	+2,4
GR	2,1	3,8	+1,7	—	—	—
F	6,7	5,9	−0,8	26,3	28,9	+2,6
IRL	—	—	—	—	—	—
I	4,6	5,4 [2]	+0,8	30,9	29,7 [2]	−1,2
L	—	—	—	—	—	—
NL	6,6	5,5	−1,1	19,5	29,3	+0,8
UK	8,9	8,2	−0,7	7,1	10,1	+3,0
USA	11,1	9,6 [2]	−1,5	10,4	14,3	+3,9
Japan	21,1	17,9	−3,2	11,3	14,5	+3,2

[1] Unincorporated enterprises are included under households. Therefore, international comparisons should be interpreted carefully.
[2] 1979.

Source: 'International comparison of taxes and social security contributions, 1970-80', in *Economic Trends*, December 1982. Central Statistical Office, London.

Table 2

Tax burden on enterprises [1]

(Current and capital taxes as a percentage of gross operating surplus) [2]

	F	I	NL [3]	D [3]	UK
1970-74	12,8	10,7	7,8	3,9	14,8
1975-80	13,8	14,9	8,1	4,2	12,6
1975	12,3	14,3	10,3	3,1	13,0
1976	14,9	14,1	8,5	3,8	8,3
1977	14,9	15,1	7,9	4,7	10,1
1978	12,3	16,6	7,4	4,5	11,3
1979	12,9	15,5	6,7	4,9	14,0
1980	15,5	14,0	7,9	—	18,7

1 Sector S(10), i.e. non-financial corporate and quasi-corporate enterprises. ESA definition: enterprises whose distributive and financial transactions are distinct from those of their owners—and which are principally engaged in the production of goods and non-financial market services.

2 The gross operating surplus (ESA definition) corresponds to the sector's gross domestic product at market prices after deduction of taxes linked to production and imports, less subsidies and less compensation of employees.
It includes all other income generated in the course of production, together with consumption of fixed capital.

3 For the Federal Republic of Germany and the Netherlands, the sector S(10) includes all pertnerships and non-financial sole proprietorships.

Table 4

Carry-forward and carry-back of losses

	Carry-forward	Carry-back
B	5 [1 2]	0
DK	5	0
F	5 [1]	0
D	5	2 [3]
GR	3	0
IRL	∞	1
I	5	0
L	5	0
NL	8 [2]	2
UK	∞	1 [4]
USA	15	3
Japan	5	1

1 The portion of the tax loss corresponding to depreciation can be carried forward indefinitely.

2 For initial losses no limit.

3 Up to DM 5 million.

4 Three years for losses deriving from 100% depreciation (can be set against income and capital gains); three years for the first four years' trading losses (can be set against income; for individual enterprises only).

Table 3

Corporation tax, tax credit and withholding tax

(situation at 31.12.1982)

Member State	Rate of corporation tax	Rate of tax credit (a) as % of the gross dividend (b) as % of corporation tax	Withholding tax on dividends (subject to the provisions of double taxation conventions)
Belgium	45% (profits in excess of BFR 14 500 000) [1] (special solidarity fund surcharge)	(a) 40,7% of the dividend (b) 49,8% of the tax	20%
Denmark	40%	(a) 25% of the dividend (b) 37,5% of the tax	30%
Federal Republic of Germany	56%: undistributed profits 36%: distributed profits	(a) 9/16 of the dividend (b) 100% of the tax on distributed profits	25%
France	50%[1]	(a) 50% of the dividend (b) 50% of the tax	0% (residents) 25% (non-residents)
Greece	45%: corporation tax on undistributed profits 15%: surcharge [2] Actual overall rate: 48,5%	No tax credit but dividends are deductible from profits	42% and 47% for registered shares; 45% and 53% for bearer shares
Ireland	50% (profits in excess of IRL 35 000) [1]	(a) 30/70 of the dividend (b) 42,9% of the tax	No withholding tax
Italy	30%: corporation tax 16,2%: Ilor [2,3] Actual overall rate: 41,3%	(a) 33 1/3% of the dividend (b) 77,7% of corporation tax (47,2% of the total of the two taxes)	10% (residents) 30% (non-residents)
Luxembourg	40% (profits in excess of LFR 1 312 000) [1] (special unemployment fund surcharge)	No tax credit	15% (no withholding tax on dividends distributed by Luxembourg holding companies)
The Netherlands	48% (profits in excess of HFL 40 000) [1]	No tax credit	25%
United Kingdom	52% (profits in excess of UKL 225 000) [1]	(a) 3/7 of the dividend (b) 39,6% of the tax	No withholding tax
United States	from 15% [4] to 46%	—	—
Japan	40%: undistributed profits 30%: distributed profts	10%	20%

1 Lower rates apply to profits below this level. Ireland, manufacturing industry: 10% (temporary).
2 Deductible against income chargeable to corporation tax.
3 Imposta locale sui redditi (local income tax).
4 For the first USD 50 000 slice (from 1983).

Energy

Energy and the economy: a study of the main relationships in the countries of the European Community

Since the first oil shock, the relationship between energy aggregates and macro-economic variables has been the subject of numerous analyses designed primarily to establish the scope for changing the ratio of energy demand to economic activity and to highlight the role played in this by two economic variables, prices and investment. In an earlier document, the Commission departments reviewed the main developments in the energy sector from 1963 to 1973 and from 1973 to 1979 and defined the objectives and instruments of the Community's energy strategy. [1]

Since the end of the 1970s, further progress has been made in compiling energy and sectoral data. A more accurate analysis can therefore now be offered of the main relations and their developments. The changes which occurred following the second oil shock have also gradually turned out to be greater than originally supposed: from 1979 to 1982, energy consumption in the Community has fallen sharply in absolute terms, although this trend should be related to that of economic activity over the same period if its full implications are to be appreciated. Finally, there have been considerable theoretical developments in the analysis of the role of prices in the changes in energy demand and very many estimates are available today. The need has therefore arisen to review the different approaches and to use the newly available data to establish a simple and regularly updated system for estimating certain key elasticities of energy demand.

This background explains the structure of the study presented here. The first chapter surveys the trend in the principal energy aggregates and a brief analysis of their relationships with the economic variables: the second summarizes the main theoretical and empirical work on the elasticities of energy demand, and the third estimates energy demand functions for the industrial and household/tertiary sectors on the basis of the new data available to the Commission's staff.

[1] See *European Economy* No 9 of July 1981: Chapter 10: Energy.

Chapter I: Energy balances and economic activity in the European Community: the main findings for the period 1973-82 [1]

[1] Written by Michel Aujean of the Directorate General for Economic and Financial Affairs.

List of tables

Graphs

Since the first oil shock, the trends of the main energy aggregates (consumption, production, importation) have been quite different from those observed in the 1960s, as a result both of slower and less smooth economic development, and of the energy policies implemented by Community member countries. A comparison of energy aggregates and the corresponding macro-economic variables from 1973 to 1982 shows a major improvement in the efficiency of energy use in most consumer sectors (with the exception of transport): energy consumption per unit of GDP in the Community of Ten declined by 20% over the period. Nevertheless, consumption is still very sensitive to the level of activity, so that efforts to weaken the link must be resolutely pursued. Similarly, with the development of domestic energy production, Community dependence on imported energy, especially oil, has declined considerably (from 64% of all energy in 1973 to 45,6% in 1982); however, except in the United Kingdom and the Netherlands, it is still high, and weighs heavily on the balances of payments of many Member States. Greater independence is thus still essential both for security of supply and for the economic development of our countries.

Introduction

In the 'Energy' chapter of the 1982-83 Annual Economic Review,[1] a brief analysis of recent trends in the principal energy and economic aggregates showed that, as a result of the second oil shock, major changes had occurred in energy demand and earlier trends had been completely disrupted. The following section attempts to gauge the size and limits of these changes and to pinpoint the main causes. This is followed by sections on the main trends in energy supply (production and imports) and in the Community's dependence on external supplies of energy and oil. The study covers mainly the period 1973-82, with a division into two sub-periods (1973-79 and 1979-82) to identify the changes which occurred following the second oil shock.

It would also have been possible to break the larger period down into three sub-periods (1973-75, 1976-78, 1979-82) to follow economic and energy cycles more closely (see Graph 1.1.); but this would have expanded considerably the quantity of information supplied without improving the relevance of the findings and conclusions. Consequently, as the use of annual average rates of change would not be very meaningful in view of the cyclical features of the period 1973-79, the rates of change given in the text and the tables always relate to an entire period or sub-period. The energy statistics are from the SOEC's final energy balances (see box on page 36 for the main definitions); for resons of availability of data, the study and the main results concern the Community of Ten (EC 10) as a whole and seven individual countries (Belgium, Denmark, the Federal Republic of Germany, France, Italy, the Netherlands and the United Kingdom).

1. Energy demand: trend and components

1.1. *Overall trend of energy consumption*

Between 1973 and 1979, energy consumption in the Community of Ten again grew appreciably, although at a much slower rate than in previous years. Gross inland consumption of primary energy increased by 5,8% over the perod (see Graph 1.1 and Table 1.1). This growth in consumption was accounted for mainly by natural gas (an increase of 48,9 %) and by electricity (82%), mainly nuclear-generated, while oil consumption fell by 4,8%. This illustrates the diversification efforts already made during this period.

In the following period (1979-82), gross inland consumption of primary energy fell quite dramatically by 112,9% million toe[2] or 11,5%. This fall was accounted for mainly by oil (−20,8%) but also by solid fuels (−5,3%) and natural gas (−9,7%). Only consumption of primary electricity, mainly nuclear-generated, again increased (by 51,3%).

This general trend masks fairly substantial differences from one country to another, attributable partly to different energy potential but mainly to varying levels and structures of economic activity, as we shall see below. While energy consumption increased by an average of 5,8% in the Community from 1973 to 1979, it marked time or even declined in Belgium, Denmark and the United Kingdom, and increased by almost 8% in the four other countries covered by this study. Generally speaking, the stagnation in consumption recorded in the first three countries was due to a sharp reduction in oil consumption, while in the other countries oil consumption again increased or fell only moderately. In all the countries, there was a quite significant measure of replacement of oil by other sources of energy; this was reflected mainly in increased consumption of natural gas and primary electricity, the growth in consumption of solid fuels in some countries being offset by reduction in the two largest producer and consumer countries, the Federal Republic of Germany and the United Kingdom.

[1] *European Economy* No 14 of November 1982, Chapter 9, pp. 132-137.

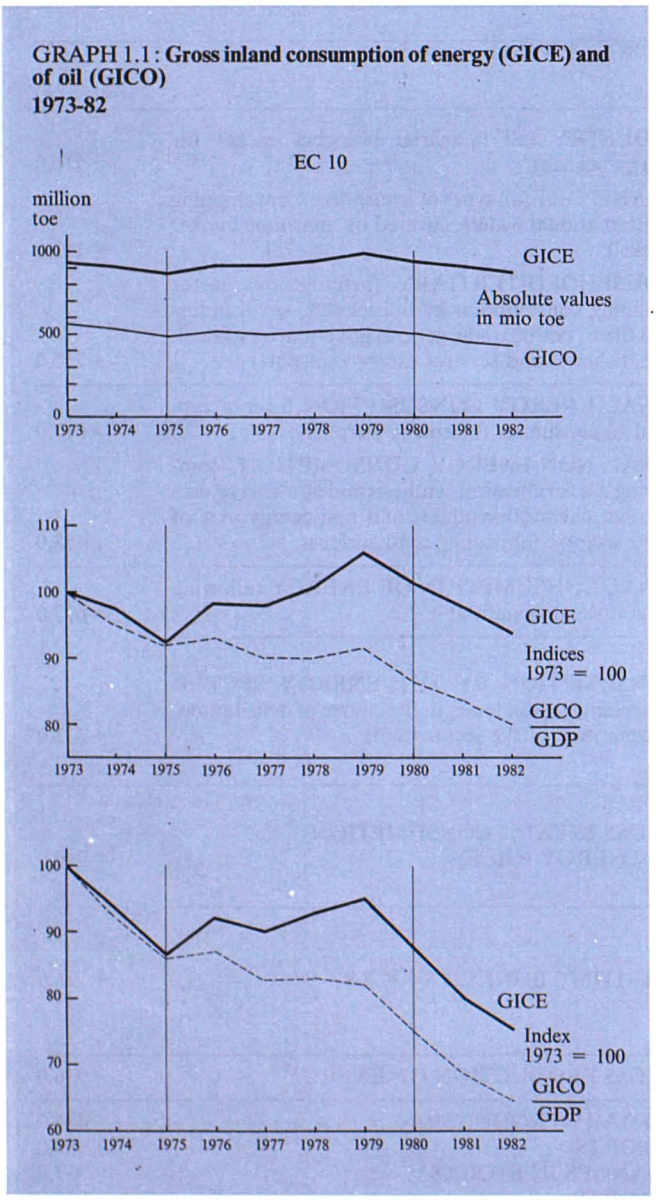
[2] toe = tonnes of oil equivalent.

Table 1.1

Gross inland consumption of primary energy, 1973-82

	1973		1979	1979/1973	1982		1982/1979	1973		1979	1979/1973	1982		1982/1979
	million toe	% share	million toe	%	million toe	% share	%	million toe	% share	million toe	%	million toe	% share	%
	Belgium							**Denmark**						
Solid fuels	11,3	23,2	11,4	+0,9	11,2	27,0	−1,8	2,3	11,3	4,3	+87,0	5,7	33,9	+33,0
Oil	30,3	62,1	25,1	−17,2	19,5	41,7	−22,3	18,0	88,7	15,7	−12,8	10,9	64,9	−30,6
Natural gas	7,2	14,7	9,3	+29,2	6,8	16,4	−26,9	0	0	0	0	0	0	0
Primary electricity and other	0	0	2,7	—	3,9	9,4	+44,4	0	0	0,3	—	0,2	1,2	−33,3
Gross inland consumption	48,8	100	48,5	−0,6	41,4	100	−14,6	20,3	100	20,3	0	16,8	100	−17,2
	FR of Germany							**France**						
Solid fuels	83,2	31,7	80,2	−3,6	78,5	32,1	−2,1	28,7	16,4	31,8	+10,8	29,0	16,7	−8,8
Oil	146,2	55,8	143,0	−2,2	108,7	44,4	−24,0	123,8	70,9	114,9	−7,2	87,9	50,7	−23,5
Natural gas	27,0	10,3	45,3	+67,8	38,4	15,7	−15,2	13,6	7,8	21,2	+55,9	21,2	12,2	0
Primary electricity and others	5,8	2,2	13,3	+129,3	19,0	7,8	+42,9	8,6	4,9	17,4	+102,3	35,3	20,4	+102,9
Gross inland consumption	262,2	100	281,8	+7,5	244,6	100	−13,2	174,7	100	185,3	+6,1	173,4	100	−6,4
	Italy							**The Netherlands**						
Solid fuels	8,1	6,6	10,1	+24,7	12,5	9,9	+23,8	3,2	5,2	3,3	+3,1	5,1	9,2	+54,5
Oil	95,2	77,9	95,6	+0,4	85,8	67,7	−10,3	29,5	48,0	30,6	+3,7	21,8	39,1	−28,8
Natural gas	14,2	11,6	22,8	+60,6	21,9	17,3	−3,9	28,5	46,4	32,4	+13,7	27,4	49,2	−15,4
Primary electricity and others	4,7	3,8	5,6	+19,1	6,5	5,1	+16,1	0,2	0,3	1,2	+500,0	1,4	2,5	+16,6
Gross inland consumption	122,2	100	134,1	+9,7	126,7	100	−5,5	61,4	100	67,5	+9,9	55,7	100	−17,5
	United Kingdom							**EC 10**						
Solid fuels	79,2	35,7	75,1	−5,2	62,5	33,3	−16,8	222,0	23,9	223,4	+0,6	211,5	24,2	−5,3
Oil	108,2	48,8	92,9	−14,1	74,3	39,6	−20,0	563,9	60,6	536,7	−4,8	425,5	48,8	−20,8
Natural gas	25,1	11,3	40,4	+61,0	38,2	20,4	−5,4	115,8	12,4	172,4	+48,9	155,7	17,9	−9,7
Primary electricity and others	9,2	4,2	11,4	+23,9	12,6	6,7	+10,5	28,9	3,1	52,6	+82,0	79,6	9,1	+51,3
Gross inland consumption	221,7	100	219,8	−0,9	187,6	100	−14,6	930,7	100	985,1	+5,8	872,2	100	−11,5

GRAPH 1.1: Gross inland consumption of energy (GICE) and of oil (GICO) 1973-82



Energy balance sheets

The energy statistics in this chapter are from the energy supplied balance sheets drawn up by the SOEC. [1] The salient feature of these balance sheets is that all flows are recorded on the basis of the real energy content of the source assessed with no substitution hypothesis or calculation of equivalence such as are used in the 'primary equivalents' balance sheets. The balance sheets for each source are brought together in aggregated balance sheets by converting quantities into a common unit—here it is the toe (tonne of oil equivalent), a standardized unit based on a calorie content of 41,86 gigajoules (10 joules). Energy supplied balance sheets record the losses occurring in the course of processing operations and thus give the quantities of energy actually made available to consumers, which can then be meaningfully compared with macro-economic data. They do not take account of losses at the final consumption stage, so that the yield of energy supplied may vary from one type of energy to another; in particular, they underestimate the contribution of electrical energy, which has the highest final yield.

To correct this shortcoming, the SOEC also publishes 'useful energy' balance sheets, derived from the energy supplied balance sheets, which show the energy really used by final consumers at their appliances. To draw up these balance sheets, it is necessary to know how many appliances are in use, how much energy is used by each type of appliance and what is the average yield of the appliances. The main advantage of this approach is that it is highly suitable for forecasting energy demand; it is discussed in Chapter II and used for the empirical work in Chapter III.

BSimple definitions are given below, accompanied by figures for EC 10 in 1981 (in million toe), as a guide to understanding and assessing the importance of the main aggregates of the energy supplied balance sheets on which the calculations in Chapter I are based.

The graphs and tables were drawn up on the basis of statistics from:

(i) *Energy supplied balance sheets*, published by the Energy Statistics Directorate of the SOEC;

(ii) *National accounts: ESA - Aggregates 1960-81* and *Sectoral databank 1960-81*, published by the SOEC.

[1] For further details, see *Principles and methodology of energy balance sheets*, SOEC, February 1980.

The period 1979-82 saw a general fall in energy consumption as economic activity contracted, although its extent again varied. Five countries recorded a sharp drop in their gross inland consumption of energy (down by about 15%, compared to a Community average of 11,5%), while there was only a moderate decline in France and Italy (about 6%).

This general decline in consumption affected mainly oil consumption, which fell by more than 20% in most countries (except in Italy where the fall was only 10%), and natural gas, which lost part of its previous gain. Consumption of electricity increased very sharply in almost all the countries, whereas consumption of solid fuels rose only in a few countries, and fell overall owing to a further decline in the largest countries.

This very general description of the main trends in gross inland consumption is no guide to the real changes in energy consumption, since it does not take into account the changes

The energy balance sheet (EC 10) in 1981

(million toe)

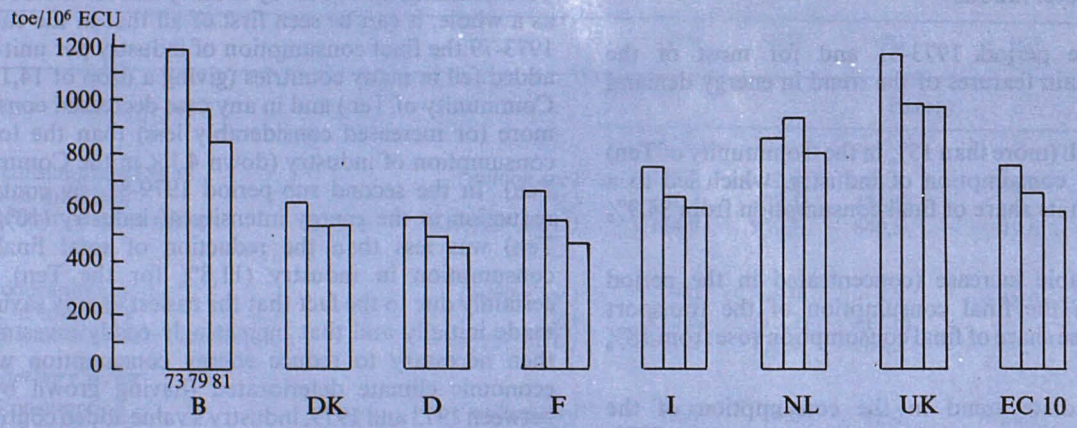
Consumption of energy supplied corresponds to the sum of final consumption for energy purposes in the three consumer sectors (industry, transport, household/tertiary) and final consumption for non-energy purposes (raw materials in industry, mainly chemicals and petrochemicals).		INDUSTRY (all industrial branches except the energy branch)	210,0
	+	TRANSPORT (all types of transport except shipping in international waters, covered by 'maritime bunker stocks')	+152,0
	+	HOUSEHOLD/TERTIARY (heterogenous sector including consumption by households, small industrial firms, crafts, trade, general government, agriculture, fisheries and services except transport)	+255,0
	=	FINAL ENERGY CONSUMPTION (energy supplied to consumers for energy purposes)	=617,0
	+	FINAL NON-ENERGY CONSUMPTION (comprising use for chemical synthesis and non-energy uses of other chemical synthesis and non-energy uses of other sectors: lubricants, road surfaces, etc.)	+58,0
	=	FINAL CONSUMPTION OF ENERGY (allowing for statistical deviation)	=677,0
To obtain this quantity of energy in a form suitable to satisfy demand by final consumers, the energy sector has processed, consumed and transported various energy sources. All the energy used for this purpose is aggregated.	+	CONSUMPTION BY THE ENERGY SECTOR (processing losses, losses in the course of distribution, consumption of the sector itself)	+233,0
Total consumption of energy supplied and consumption by the energy sector is the quantity of energy needed to satisfy inland consumption in the territorial unit considered.	=	GROSS INLAND CONSUMPTION OF ENERGY (GICE)	=910,0
To this total we may add supplies for ships on the high seas, irrespective of thier flags. These supplies may be treated as consumption, or preferably as exports, since bunker stocks are not in general related to the level of economic activity of a country.	+	MARITIME BUNKER STOCKS	+ 26,0
The grand total represents the country's aggregate demand for energy, and it should be equal to the aggregate supply: production imports, changes in stocks.	=	GROSS PRODUCTION OF ENERGY	= 936,0
		PRIMARY PRODUCTION	484,0
	+	IMPORTS	+680,0
	±	CHANGES IN STOCKS	+7,0
	−	EXPORTS	−235,0

in economic activity in the main energy-consuming countries or sectors. It is therefore now necessary to analyse final energy consumption by sector and relate it to representative aggregates of corresponding economic activity to get a better idea of actual energy consumption trends, by measuring what we may term the 'energy intensity' of economic activities.

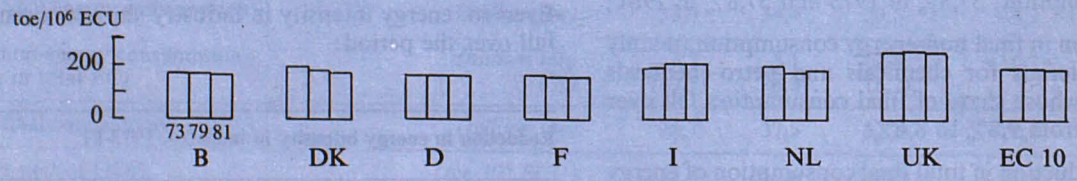
1.2 *Final energy consumption and energy intensity*

Tables 1.2.1 to 1.2.8 for each of the countries covered in the analysis, give details of gross inland consumption of primary energy according to the definitions reproduced in the box above. It is thus possible to trace, from 1973 to 1979 and then to 1981 (the 1982 data for final consumption are not yet

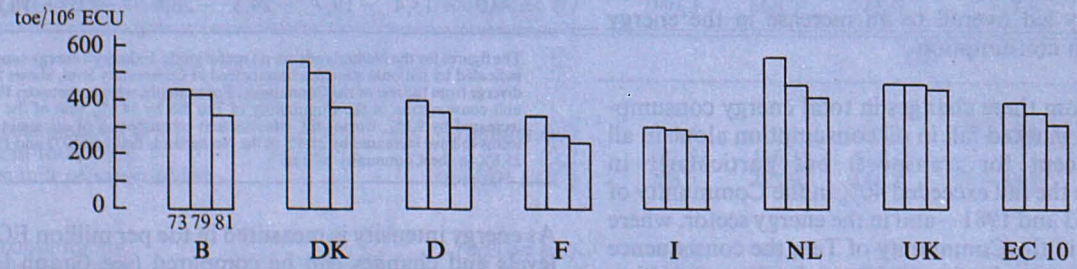
GRAPH 1.2: **Comparison of energy intensities 1973-1979-1981**



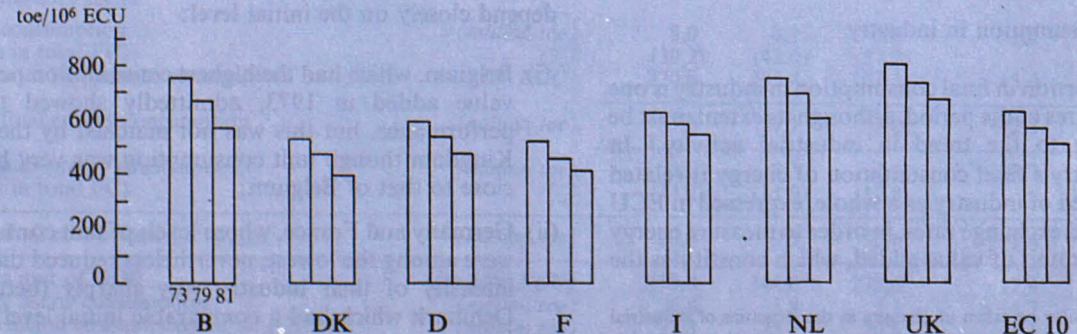
1. Final energy consumption in industry per unit of value added, in toe per million ECU



2. Final energy consumption in the transport sector per unit of private consumption, in toe per million ECU



3. Final energy consumption in the household/tertiary sector per unit of private consumption, in toe per million ECU



4. Total final energy consumption per unit of GDP, in toe per million ECU

available), the trends in the main components of energy consumption.

1.2.1 General observations

Throughout the period 1973-81 and for most of the countries, the main features of the trend in energy demand are as follows:

(i) a marked fall (more than 15% in the Community of Ten) in the final consumption of industry, which led to a reduction in its share of final consumption from 34,9% to 31,1 %;

(ii) an appreciable increase (concentrated in the period 1973-79) in the final consumption of the transport sector, whose share of final consumption rose from 18% to 22,5%;

(iii) an intermediate trend in the consumption of the household/tertiary sector: an increase up to 1979, followed by a fall, giving a roughly constant share of final consumption: 37,3% in 1973 and 37,8% in 1981;

(iv) a contraction in final non-energy consumption (mainly as raw materials for chemicals and petro-chemicals branches), whose share of final consumption fell over the period from 9,8% to 8,6%;

(v) a greater reduction in total final consumption of energy than in gross inland consumption of energy, because the marked decline in the use of oil and the increase in that of electricity led overall to an increase in the energy sector's own consumption.

Finally, apart from these changes in total energy consumption, there was a marked fall in oil consumption alone in all the sectors (except for transport) but particularly in industry—where the fall exceeded 40% in the Community of Ten between 1973 and 1981—and in the energy sector, where it exceeded 30% in the Community of Ten, the consequence here being a sharper reduction in gross inland consumption of oil than in that of final consumption.

1.2.2. Final consumption in industry

The general reduction in final consumption in industry is one of the main features of the period, although its extent must be seen in relation to the trend in industrial activity.[1] In Table 1.2, industry's final consumption of energy is related to the value added of industry as a whole, expressed in ECU at 1975 prices and exchange rates, in order to measure energy consumption per unit of value added, which constitutes the 'energy intensity' of industrial activity. The same was done with the final consumption of oil, although the relationship is less meaningful because only part of industry consumes oil. On examining the figures by country and for the Community as a whole, it can be seen first of all that in the sub-period 1973-79 the final consumption of industry per unit of value added fell in many countries (giving a drop of 14,1% in the Community of Ten) and in any case decreased considerably more (or increased considerably less) than the total final consumption of industry (down 4,1% in the Community of Ten). In the second sub-period 1979-81, by contrast, the reduction in the energy intensity of industry (10% for the Ten) was less than the reduction of total final energy consumption in industry (11,8% for the Ten). This is certainly due to the fact that the easiest energy savings were made initially and that increasingly costly investment was then necessary to reduce energy consumption while the economic climate deteriorated (having grown by 11,7% between 1973 and 1979, industry's value added contracted by 1,9% between 1979 and 1981).

Even so, energy intensity in industry showed a remarkable fall over the period:

Reduction in energy intensity in industry, 1973-81

(%)

B	DK	D	F	I	NL [1]	UK	EC 10
−30,0	−13,4	−19,7	−29,3	−20,1	−7,0	−16,8	−22,8

[1] The figures for the Netherlands are no useful guide. Industry's energy consumption, as indicated by national statistics harmonized at Community level, shows trends which diverge from the rest of the Community. For example, whereas between 1973 and 1979 unit consumption in the Community of Ten fell by 14,1%, that of the Netherlands increased by 9,1%; worse still, whereas unit consumption of oil, again in industry, seems to have increased by 25,3% in the Netherlands between 1973 and 1979, it fell by 25,8% in the Community of Ten.

As energy intensity is measured in toe per million ECU, both levels and changes can be compared (see Graph 1.2). It is interesting to note in this context that the improvements in industry's energy intensity in the various countries does not depend closely on the initial level:

(i) Belgium, which had the highest consumption per unit of value added in 1973, admittedly showed the best performance, but this was not matched by the United Kingdom though unit consumption was very high and close to that of Belgium;

(ii) Germany and France, whose levels of unit consumption were among the lowest, nevertheless reduced the energy intensity of their industry very sharply (better than Denmark which had a comparable initial level).

Nevertheless, levels of energy intensity in industry are highly dispersed in the Community; this is perhaps due to different

[1] Account should also be taken of changes in the structure of industrial activity, particularly the share of high energy-consumption industries, especially steel, in total industry; in some countries (notably Belgium), this goes far to explain the decline in industry's consumption (see also point 1.3).

Table 1.2.1

Main energy consumption indicators: Belgium

		1973	1979	1981	△ 1979/1973	△ 1981/1979	△ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	15,2	13,9	11,8	−8,6	−15,1	−22,4
(Share in total FC)	*(%)*	(41,4)	(37,1)	(36,5)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	1 184,0	959,1	840,8	−19,0	−12,3	−30,0
Transport							
3. Final consumption	*(million toe)*	5,0	5,9	5,7	+18,0	−3,4	+14,0
(Share in total FC)	*(%)*	(13,6)	(15,7)	(17,6)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	171,2	170,0	164,2	−0,7	−3,4	−4,1
Household/tertiary sector							
5. Final consumption	*(million toe)*	12,8	14,6	12,0	+14,1	−17,8	−6,3
(Share in total FC)	*(%)*	(34,9)	(38,9)	(37,2)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	438,4	420,7	345,8	−4,0	−17,8	−21,1
7. Total final energy consumption	*(million toe)*	33,0	34,4	29,5	+4,2	−14,2	−10,6
8. Final non-energy consumption	*(million toe)*	3,7	3,1	2,8	−16,2	−9,7	−24,3
(Share in total FC)	*(%)*	(10,1)	(8,3)	(8,7)			
9. Total final consumption (100%)	*(million toe)*	36,7	37,5	32,3	+2,2	−13,9	12,3
10. FC per unit of GDP	*(toe/10⁶ ECU)*	755,1	669,6	570,7	−11,3	−14,8	−24,4
11. Energy sector consumption	*(million toe)*	9,1	10,8	10,8	+18,7	0	+18,7
12. Gross inland consumption of energy (GICE)	*(million toe)*	45,7	48,5	43,3	+6,1	−10,7	−5,3
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	940,3	866,1	765,0	−7,9	−11,7	−18,6
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	4,6	3,1	2,2	−32,6	−29,0	−52,2
(Share in total FC)	*(%)*	(22,5)	(16,1)	(14,1)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	358,3	213,9	156,8	−40,3	−26,7	−56,2
Transport							
3. Final consumption	*(million toe)*	4,9	5,9	5,6	+20,4	−5,1	+14,3
(Share in total FC)	*(%)*	(24,0)	(30,6)	(35,9)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	167,8	170,0	161,4	+1,3	−5,1	−3,8
Household/tertiary sector							
5. Final consumption	*(million toe)*	8,0	8,1	5,8	+1,2	−28,4	−27,5
(Share in total FC)	*(%)*	(39,2)	(42,0)	(37,2)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	270,0	233,4	167,1	−13,6	−28,4	−38,1
7. Total final energy consumption	*(million toe)*	17,5	17,1	13,6	−2,3	−20,5	−22,3
8. Final non-energy consumption	*(million toe)*	2,9	2,3	2,0	−20,7	−13,0	−31,0
(Share in total FC)	*(%)*	(14,2)	(11,9)	(12,8)			
9. Total final consumption (100%)	*(million toe)*	20,4	19,3	15,6	−5,4	−19,2	−23,5
10. FC per unit of GDP	*(toe/10⁶ ECU)*	419,8	344,6	275,6	−17,9	−20,0	−34,3
11. Energy sector consumption	*(million toe)*	6,8	5,8	5,1	−14,7	−12,1	−25,0
12. Gross inland consumption of oil (GICO)	*(million toe)*	27,3	25,1	20,6	−8,1	−17,9	−24,5
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	561,7	448,2	364,0	−20,2	−18,8	−35,2

Table 1.2.2

Main energy consumption indicators: Denmark

		1973	1979	1981	△ 1979/1973	△ 1981/1979	△ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	3,4	3,3	3,3	−2,9	0	−2,9
(Share in total FC)	*(%)*	(20,7)	(19,9)	(24,2)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	616,5	532,0	533,7	−13,7	+0,3	−13,4
Transport							
3. Final consumption	*(million toe)*	3,2	3,4	3,1	+6,2	−8,8	−3,1
(Share in total FC)	*(%)*	(19,5)	(20,5)	(22,8)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	189,3	178,9	169,4	−5,5	−5,3	−10,5
Household/tertiary sector							
5. Final consumption	*(million toe)*	9,2	9,5	6,8	+3,3	−28,4	−26,1
(Share in total FC)	*(%)*	(56,1)	(57,2)	(50,0)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	544,4	500,0	371,6	−8,2	−25,7	−31,7
7. Total final energy consumption	*(million toe)*	15,8	16,2	13,2	+2,5	−18,5	−16,5
8. Final non-energy consumption	*(million toe)*	0,6	0,4	0,4	−33,3	0	−33,3
(Share in total FC)	*(%)*	(3,7)	(2,4)	(3,0)			
9. Total final consumption (100%)	*(million toe)*	16,4	16,6	13,6	+1,2	−18,1	−17,1
10. FC per unit of GDP	*(toe/10⁶ ECU)*	530,8	475,4	393,5	−10,4	−17,2	−25,9
11. Energy sector consumption	*(million toe)*	3,2	3,7	3,1	+15,6	−16,2	−3,1
12. Gross inland consumption of energy (GICE)	*(million toe)*	19,5	20,3	16,8	+4,1	−17,2	−13,8
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	631,1	581,7	485,5	−7,8	−16,5	−23,1
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	2,7	2,2	1,6	−18,5	−27,3	−40,7
(Share in total FC)	*(%)*	(19,4)	(16,5)	(15,7)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	489,6	354,7	258,8	−27,6	−27,0	−47,1
Transport							
3. Final consumption	*(million toe)*	3,2	3,4	3,0	+6,2	−11,8	−6,2
(Share in total FC)	*(%)*	(23,0)	(25,6)	(29,4)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	189,3	178,9	163,9	−5,5	−8,4	−13,4
Household/tertiary sector							
5. Final consumption	*(million toe)*	7,4	7,3	5,2	−1,3	−28,8	−29,7
(Share in total FC)	*(%)*	(53,2)	(54,9)	(51,0)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	437,9	384,2	284,2	−12,3	−26,0	−35,1
7. Total final energy consumption	*(million toe)*	13,3	12,8	9,8	−3,8	−23,4	−26,3
8. Final non-energy consumption	*(million toe)*	0,6	0,4	0,4	−33,3	0	−33,3
(Share in total FC)	*(%)*	(4,3)	(3,0)	(3,9)			
9. Total final consumption (100%)	*(million toe)*	13,9	13,3	10,2	−4,3	−23,3	−26,6
10. FC per unit of GDP	*(toe/10⁶ ECU)*	449,9	380,9	295,1	−15,3	−22,5	−34,4
11. Energy sector consumption	*(million toe)*	3,4	2,4	1,1	−29,4	−54,2	−67,6
12. Gross inland consumption of oil (GICO)	*(million toe)*	17,2	15,7	11,5	−8,7	−26,7	−33,1
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	556,6	449,9	332,4	−19,2	−26,1	−40,3

Table 1.2.3

Main energy consumption indicators: FR of Germany

		1973	1979	1981	△ 1979/1973	△ 1981/1979	△ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	68,6	66,5	60,5	−3,1	−9,0	−11,8
(Share in total FC)	*(%)*	(34,1)	(31,5)	(31,8)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	563,3	490,9	452,3	−12,9	−7,9	−19,7
Transport							
3. Final consumption	*(million toe)*	33,0	39,6	39,3	+20,0	−0,8	+19,0
(Share in total FC)	*(%)*	(16,4)	(18,8)	(20,7)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	165,9	164,5	161,1	−0,8	−2,1	−2,9
Household/tertiary sector							
5. Final consumption	*(million toe)*	78,8	85,7	72,5	+8,8	−15,4	−8,0
(Share in total FC)	*(%)*	(39,2)	(40,6)	(38,2)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	396,2	355,9	297,1	−10,2	−16,5	−25,0
7. Total final energy consumption	*(million toe)*	180,4	191,8	172,3	+6,3	−10,2	−4,5
8. Final non-energy consumption	*(million toe)*	20,5	19,4	17,7	−5,4	−8,8	−13,7
(Share in total FC)	*(%)*	(10,2)	(9,2)	(9,3)			
9. Total final consumption (100%)	*(million toe)*	200,9	211,2	190,0	+5,1	−10,0	−5,4
10. FC per unit of GDP	*(toe/10⁶ ECU)*	591,2	538,	474,0	−9,0	−11,9	−19,8
11. Energy sector consumption	*(million toe)*	61,0	70,6	67,8	+15,7	−4,0	+11,1
12. Gross inland consumption of energy (GICE)	*(million toe)*	262,2	281,8	257,8	+7,5	−8,5	−1,7
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	771,6	717,8	643,1	−7,0	−10,4	−16,7
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	26,2	20,4	13,1	−22,1	−35,8	−50,0
(Share in total FC)	*(%)*	(20,8)	(16,0)	(12,6)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	215,1	150,9	98,0	−29,8	−35,1	−54,4
Transport							
3. Final consumption	*(million toe)*	31,6	38,7	38,3	+22,5	−1,0	+21,2
(Share in total FC)	*(%)*	(25,1)	(30,4)	(37,0)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	158,9	160,7	157,0	+1,1	−2,3	−1,2
Household/tertiary sector							
5. Final consumption	*(million toe)*	50,0	50,7	37,2	+1,4	−26,6	−25,6
(Share in total FC)	*(%)*	(39,7)	(39,8)	(35,9)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	251,4	210,5	152,5	−16,3	−27,6	−39,3
7. Total final energy consumption	*(million toe)*	107,8	109,8	88,6	+1,9	−19,3	−17,8
8. Final non-energy consumption	*(million toe)*	18,1	17,8	15,0	−1,7	−15,7	−17,1
(Share in total FC)	*(%)*	(14,4)	(14,0)	(14,5)			
9. Total final consumption (100%)	*(million toe)*	125,9	127,5	103,6	+1,3	−18,8	−17,7
10. FC per unit of GDP	*(toe/10⁶ ECU)*	370,5	324,8	258,4	−12,3	−20,4	−30,3
11. Energy sector consumption	*(million toe)*	20,2	16,6	11,2	−17,8	−32,5	−44,6
12. Gross inland consumption of oil (GICO)	*(million toe)*	146,2	143,0	114,8	−2,2	−19,8	−21,5
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	430,2	364,5	286,4	−15,3	−21,4	−33,4

Table 1.2.4

Main energy consumption indicators: France

		1973	1979	1981	Δ 1979/1973	Δ 1981/1979	Δ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	46,1	46,1	38,1	0	−17,4	−17,4
(Share in total FC)	*(%)*	(33,5)	(32,1)	(28,6)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	657,9	553,6	465,0	−15,9	−16,0	−29,3
Transport							
3. Final consumption	*(million toe)*	25,9	31,2	32,2	+20,5	+3,2	+24,3
(Share in total FC)	*(%)*	(18,8)	(21,7)	(24,2)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	163,2	157,3	156,9	−3,6	−0,3	−3,9
Household/tertiary sector							
5. Final consumption	*(million toe)*	54,3	54,1	50,2	−0,4	−7,2	−7,6
(Share in total FC)	*(%)*	(39,5)	(37,6)	(37,7)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	342,2	272,8	244,6	−20,3	−10,3	−28,5
7. Total final energy consumption	*(million toe)*	126,3	131,4	120,5	+4,0	−8,3	−4,6
8. Final non-energy consumption	*(million toe)*	11,3	12,3	12,6	+8,8	+2,4	+11,5
(Share in total FC)	*(%)*	(8,2)	(8,6)	(9,5)			
9. Total final consumption (100%)	*(million toe)*	137,6	143,7	133,1	+4,4	−7,4	−3,3
10. FC per unit of GDP	*(toe/10⁶ ECU)*	521,2	456,0	415,7	−12,5	−8,8	−20,2
11. Energy sector consumption	*(million toe)*	35,4	39,2	45,6	+10,7	+16,3	+28,8
12. Gross inland consumption of energy (GICE)	*(million toe)*	174,7	185,3	180,5	+6,1	−2,6	+3,3
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	661,7	588,1	563,7	−11,1	−4,1	−14,8
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	22,7	20,5	13,1	−9,7	−36,1	−42,3
(Share in total FC)	*(%)*	(23,8)	(22,1)	(16,2)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	323,9	246,2	160,0	−24,0	−35,0	−50,6
Transport							
3. Final consumption	*(million toe)*	25,3	30,6	31,6	+20,9	+3,3	+24,9
(Share in total FC)	*(%)*	(26,6)	(33,0)	(39,1)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	159,4	154,3	154,0	−3,2	−0,2	−3,4
Household/tertiary sector							
5. Final consumption	*(million toe)*	37,5	31,4	26,9	−16,3	−14,3	−28,3
(Share in total FC)	*(%)*	(39,4)	(33,9)	(33,3)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	236,3	158,3	131,0	—33,0	−17,2	−44,6
7. Total final energy consumption	*(million toe)*	85,5	82,5	71,6	−3,5	−13,2	−16,3
8. Final non-energy consumption	*(million toe)*	9,7	10,2	9,2	+5,2	−9,8	−5,1
(Share in total FC)	*(%)*	(10,2)	(11,0)	(11,4)			
9. Total final consumption (100%)	*(million toe)*	95,2	92,7	80,8	−2,6	−12,8	−15,1
10. FC per unit of GDP	*(toe/10⁶ ECU)*	360,6	294,2	252,3	−18,4	−14,2	−30,0
11. Energy sector consumption	*(million toe)*	27,0	20,4	13,7	−24,4	−32,8	−49,2
12. Gross inland consumption of oil (GICO)	*(million toe)*	123,8	114,9	96,6	−7,2	−15,9	−22,0
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	469,0	364,6	301,6	−22,3	−17,3	−35,7

Table 1.2.5

Main energy consumption indicators: Italy

		1973	1979	1981	△ 1979/1973	△ 1981/1979	△ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	35,7	36,7	36,0	+2,8	−1,9	+0,8
(Share in total FC)	*(%)*	(36,4)	(34,6)	(35,0)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	745,6	638,8	595,7	−14,3	−6,7	−20,1
Transport							
3. Final consumption	*(million toe)*	19,4	24,9	25,4	+28,4	+2,0	+30,9
(Share in total FC)	*(%)*	(19,8)	(23,5)	(24,7)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	193,8	213,9	208,7	+10,4	−2,4	+7,7
Household/tertiary sector							
5. Final consumption	*(million toe)*	30,8	34,7	33,0	+13,0	−4,9	+7,1
(Share in total FC)	*(%)*	(31,4)	(32,7)	(32,0)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	307,7	298,1	271,1	−3,1	−9,1	−11,9
7. Total final energy consumption	*(million toe)*	85,9	96,3	94,4	+12,1	−2,0	+9,9
8. Final non-energy consumption	*(million toe)*	12,1	9,7	8,5	−19,8	−12,4	−29,8
(Share in total FC)	*(%)*	(12,3)	(9,2)	(8,3)			
9. Total final consumption (100%)	*(million toe)*	98,0	106,0	102,9	+8,2	−2,9	+5,0
10. FC per unit of GDP	*(toe/10⁶ ECU)*	635,1	588,9	550,9	−7,3	−6,5	−13,3
11. Energy sector consumption	*(million toe)*	24,5	28,8	28,1	+17,6	−2,4	+14,7
12. Gross inland consumption of energy (GICE)	*(million toe)*	122,2	134,1	130,4	+9,7	−2,8	+6,7
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	792,0	745,0	698,1	−5,9	−6,3	−11,9
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	17,3	14,7	14,3	−15,0	−2,7	−17,3
(Share in total FC)	*(%)*	(25,1)	(21,9)	(22,5)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	361,3	255,9	236,6	−29,2	−7,5	−34,5
Transport							
3. Final consumption	*(million toe)*	18,9	24,2	24,7	+28,0	+2,0	+30,7
(Share in total FC)	*(%)*	(27,5)	(36,0)	(38,8)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	188,8	207,9	203,0	+10,1	−2,4	+7,5
Household/tertiary sector							
5. Final consumption	*(million toe)*	22,7	21,0	18,2	−7,5	−13,3	−19,8
(Share in total FC)	*(%)*	(33,0)	(31,3)	(28,6)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	226,7	180,4	149,5	−20,4	−17,1	−34,0
7. Total final energy consumption	*(million toe)*	58,9	59,9	57,2	+1,7	−4,5	−2,9
8. Final non-energy consumption	*(million toe)*	9,9	7,3	6,5	−26,3	−11,0	−34,3
(Share in total FC)	*(%)*	(14,4)	(10,9)	(10,2)			
9. Total final consumption (100%)	*(million toe)*	68,8	67,2	63,6	−2,3	−5,4	−7,6
10. FC per unit of GDP	*(toe/10⁶ ECU)*	445,9	373,3	340,5	−16,3	−8,8	−23,6
11. Energy sector consumption	*(million toe)*	26,8	29,2	26,4	+9,0	−9,6	−1,5
12. Gross inland consumption of oil (GICO)	*(million toe)*	95,2	95,6	89,6	+0,4	−6,3	−5,9
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	617,0	531,1	479,7	−13,9	−9,7	−22,3

Table 1.2.6

Main energy consumption indicators: The Netherlands

		1973	1979	1981	Δ 1979/1973	Δ 1981/1979	Δ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	13,1	15,5	13,3	+18,3	−14,2	+1,5
(Share in total FC)	*(%)*	(26,5)	(27,8)	(27,5)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	855,9	933,4	796,2	+9,1	−14,7	−7,0
Transport							
3. Final consumption	*(million toe)*	7,2	8,4	8,6	+16,7	+2,4	+19,4
(Share in total FC)	*(%)*	(14,5)	(15,1)	(17,8)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	198,9	175,0	183,4	−12,0	+4,8	−7,8
Household/tertiary sector							
5. Final consumption	*(million toe)*	20,2	22,0	19,3	+8,9	−12,3	−4,5
(Share in total FC)	*(%)*	(40,8)	(39,4)	(39,9)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	558,0	458,3	411,5	−17,9	−10,2	−25,2
7. Total final energy consumption	*(million toe)*	40,5	46,9	41,2	+15,8	−12,2	+1,7
8. Final non-energy consumption	*(million toe)*	9,0	9,9	7,2	+10,0	−20,0	−27,3
(Share in total FC)	*(%)*	(18,2)	(17,7)	(14,9)			
9. Total final consumption (100%)	*(million toe)*	49,5	55,8	48,4	+12,7	−13,3	−2,2
10. FC per unit of GDP	*(toe/10⁶ ECU)*	759,2	702,8	611,1	−7,4	−13,0	−19,5
11. Energy sector consumption	*(million toe)*	13,1	13,7	12,4	+4,6	−9,5	−5,3
12. Gross inland consumption of energy (GICE)	*(million toe)*	61,4	67,6	60,7	+10,1	−10,2	−1,1
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	941,7	851,4	766,4	−9,6	−10,0	−18,6
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	2,5	3,4	2,5	+36,0	−26,5	0
(Share in total FC)	*(%)*	(10,4)	(14,5)	(13,4)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	163,3	204,7	149,7	+25,3	−26,9	−8,3
Transport							
3. Final consumption	*(million toe)*	7,1	8,3	8,5	+16,9	+2,4	+19,7
(Share in total FC)	*(%)*	(29,6)	(35,3)	(45,7)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	196,1	172,9	181,2	−11,8	+4,8	−7,6
Household/tertiary sector							
5. Final consumption	*(million toe)*	6,9	3,6	2,2	−47,8	−38,9	−68,1
(Share in total FC)	*(%)*	(28,8)	(15,3)	(11,8)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	190,6	75,0	46,9	−60,6	−37,5	−75,4
7. Total final energy consumption	*(million toe)*	16,5	15,3	13,2	−7,3	−13,7	−20,0
8. Final non-energy consumption	*(million toe)*	7,5	8,1	5,4	+8,0	−33,3	−28,0
(Share in total FC)	*(%)*	(31,2)	(34,5)	(29,0)			
9. Total final consumption (100%)	*(million toe)*	24,0	23,5	18,6	−2,1	−20,9	−22,5
10. FC per unit of GDP	*(toe/10⁶ ECU)*	368,1	296,0	234,8	−19,6	−20,7	−36,2
11. Energy sector consumption	*(million toe)*	5,5	8,4	8,3	+52,7	−1,2	+50,9
12. Gross inland consumption of oil (GICO)	*(million toe)*	29,5	30,6	26,8	+3,7	−12,4	−9,2
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	452,5	385,4	338,4	−14,8	−12,2	−25,2

Table 1.2.7

Main energy consumption indicators: United Kingdom

		1973	1979	1981	△ 1979/1973	△ 1981/1979	△ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	57,6	48,6	39,3	−18,8	−16,0	−31,8
(Share in total FC)	*(%)*	(37,5)	(30,7)	(29,1)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	1 164,0	983,8	968,7	−15,5	−1,5	−16,8
Transport							
3. Final consumption	*(million toe)*	29,8	32,8	32,0	+10,0	−2,4	+7,4
(Share in total FC)	*(%)*	(19,4)	(21,5)	(23,7)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	252,8	256,9	253,0	+1,6	−1,5	0
Household/tertiary sector							
5. Final consumption	*(million toe)*	54,0	59,1	55,8	+9,4	−5,6	+3,3
(Share in total FC)	*(%)*	(35,1)	(38,8)	(41,3)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	458,0	462,8	441,1	+1,0	−4,7	−3,7
7. Total final energy consumption	*(million toe)*	141,4	138,7	127,1	−1,9	−8,4	−10,1
8. Final non-energy consumption	*(million toe)*	12,3	13,8	8,0	+12,2	−42,0	−35,0
(Share in total FC)	*(%)*	(8,0)	(9,0)	(5,9)			
9. Total final consumption (100%)	*(million toe)*	153,7	152,5	135,1	−0,8	−11,4	−12,1
10. FC per unit of GDP	*(toe/10⁶ ECU)*	809,8	739,6	681,6	−8,7	−7,8	−15,8
11. Energy sector consumption	*(million toe)*	67,5	64,4	58,4	−4,6	−9,3	−13,5
12. Gross inland consumption of energy (GICE)	*(million toe)*	221,7	219,8	194,4	−0,9	−11,6	−12,3
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	1 168,1	1 066,0	980,8	−8,7	−8,0	−16,0
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	24,4	17,9	11,6	−26,6	−35,2	−52,5
(Share in total FC)	*(%)*	(31,1)	(24,8)	(19,2)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	493,1	376,3	285,9	−23,7	−24,0	−42,0
Transport							
3. Final consumption	*(million toe)*	29,5	32,4	31,6	+9,8	−2,5	+7,1
(Share in total FC)	*(%)*	(37,6)	(44,9)	(52,3)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	250,2	253,7	250,0	+1,4	−1,5	0
Household/tertiary sector							
5. Final consumption	*(million toe)*	13,3	12,5	9,8	−6,0	−21,6	−26,3
(Share in total FC)	*(%)*	(17,0)	(17,3)	(16,2)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	112,8	97,9	77,5	−13,2	−20,8	−31,3
7. Total final energy consumption	*(million toe)*	67,2	62,8	53,0	−6,5	−15,6	−21,1
8. Final non-energy consumption	*(million toe)*	11,2	9,3	7,4	−17,0	−20,4	−33,9
(Share in total FC)	*(%)*	(14,3)	(12,9)	(12,3)			
9. Total final consumption (100%)	*(million toe)*	78,4	72,1	60,4	−8,0	−22,2	−23,0
10. FC per unit of GDP	*(toe/10⁶ ECU)*	413,1	349,7	304,7	−15,3	−12,9	−26,2
11. Energy sector consumption	*(million toe)*	29,3	20,0	12,8	−31,7	−36,0	−56,3
12. Gross inland consumption of oil (GICO)	*(million toe)*	108,2	92,9	73,7	−14,1	−20,7	−31,9
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	570,0	450,5	371,8	−21,0	−17,5	−34,8

Table 1.2.8

Main energy consumption indicators: EC 10

		1973	1979	1981	Δ 1979/1973	Δ 1981/1979	Δ 1981/1973
		Energy					
Industry							
1. Final consumption (FC)	*(million toe)*	248,0	238,0	210,0	−4,0	−11,8	−15,3
(Share in total FC)	*(%)*	(34,9)	(32,0)	(31,1)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	755,3	648,8	583,4	−14,1	−10,0	−22,8
Transport							
3. Final consumption	*(million toe)*	128,0	152,0	152,0	+18,8	0	+18,8
(Share in total FC)	*(%)*	(18,0)	(20,4)	(22,5)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	189,8	188,7	185,8	−0,6	−1,5	−2,1
Household/tertiary sector							
5. Final consumption	*(million toe)*	265,0	286,0	255,0	+7,9	−10,8	−3,8
(Share in total FC)	*(%)*	(37,3)	(38,4)	(37,8)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	393,0	355,1	311,8	−9,6	−12,2	−20,7
7. Total final energy consumption	*(million toe)*	641,0	676,0	617,0	+5,5	−8,7	−3,7
8. Final non-energy consumption	*(million toe)*	70,0	69,0	58,0	−1,4	−15,9	−17,1
(Share in total FC)	*(%)*	(9,8)	(9,2)	(8,6)			
9. Total final consumption (100%)	*(million toe)*	711,0	745,0	675,0	+4,8	−9,4	−5,1
10. FC per unit of GDP	*(toe/10⁶ ECU)*	636,3	575,4	516,3	−9,6	−10,3	−18,9
11. Energy sector consumption	*(million toe)*	218,0	238,0	233,0	+9,2	−2,1	+6,9
12. Gross inland consumption of energy (GICE)	*(million toe)*	931,0	985,0	910,0	+5,8	−7,6	−2,3
13. GICE per unit of GDP	*(toe/10⁶ ECU)*	833,3	760,8	696,0	−8,7	−8,5	−16,5
		Oil					
Industry							
1. Final consumption (FC)	*(million toe)*	105,0	87,0	62,0	−17,1	−28,7	−40,9
(Share in total FC)	*(%)*	(23,8)	(20,2)	(16,9)			
2. FC per unit of value added	*(toe/10⁶ ECU)*	319,8	237,2	172,2	−25,8	−27,4	−46,2
Transport							
3. Final consumption	*(million toe)*	125,0	149,0	150,0	+19,2	+0,7	+20,0
(Share in total FC)	*(%)*	(28,4)	(34,7)	(40,9)			
4. FC per unit of private consumption	*(toe/10⁶ ECU)*	185,4	185,0	183,3	−0,2	−0,9	−1,1
Household/tertiary sector							
5. Final consumption	*(million toe)*	149,0	138,0	108,0	−7,4	−21,7	−27,5
(Share in total FC)	*(%)*	(33,9)	(32,1)	(29,4)			
6. FC per unit of private consumption	*(toe/10⁶ ECU)*	221,0	171,3	132,0	−22,5	−22,9	−40,3
7. Total final energy consumption	*(million toe)*	379,0	374,0	320,0	−1,3	−14,4	−15,6
8. Final non-energy consumption	*(million toe)*	61,0	56,0	47,0	−8,2	−16,1	−22,9
(Share in total FC)	*(%)*	(13,9)	(13,0)	(12,8)			
9. Total final consumption (100%)	*(million toe)*	440,0	430,0	367,0	−2,3	−14,7	−16,6
10. FC per unit of GDP	*(toe/10⁶ ECU)*	393,8	332,1	280,7	−15,7	−15,5	−28,7
11. Energy sector consumption	*(million toe)*	122,0	107,0	85,0	−12,3	−20,6	−30,3
12. Gross inland consumption of oil (GICO)	*(million toe)*	564,0	537,0	452,0	−4,8	−15,8	−19,9
13. GICO per unit of GDP	*(toe/10⁶ ECU)*	504,8	414,8	345,7	−17,8	−16,7	−31,5

industrial and energy consumption structures in the different countries, but also to less efficient energy use in certain countries, particularly Belgium, the United Kingdom and the Netherlands (see Graph 1.2). In the case of oil, the level of consumption per unit of value added in industry varies extremely widely from one country to another (as pointed out above, the proportion of industry's value added that is based on the use of oil differs between countries). Only its trend can therefore be analysed. The following emerges:

(i) the total consumption of oil in industry has fallen sharply (by 40,9% in the Community of Ten); generally speaking, the fall was more marked in the second sub-period (−28,7%) than in the first (−17,1%). Industry's share of final oil consumption thus fell from 23,8% in 1973 to 16,9% in 1981;

(ii) even more remarkable however, is the reduction in oil consumption per unit of value added, which in some countries reached or exceeded 50% between 1973 and 1981 (with an average reduction of 46% for the Community);

(iii) finally, a sharp reduction in the unit consumption of oil is frequently seen to be accompanied by a sharp reduction in energy consumption (Belgium, Germany and France): oil savings, far from compromising energy savings, reinforce them.

1.2.3 Final consumption in transport

In the absence of a more suitable economic aggregate, the energy consumption of the transport sector has been related to private consumption,[1] expressed in ECU at 1975 prices and exchange rates, in order to calculate a unit consumption of energy (in toe per million ECU).

Generally speaking, the final consumption of the transport sector grew appreciably during the period 1973-79, although only half as fast as during the period 1963-73, when the annual rate of expansion was over 5%. With the exception of Denmark (+6,2% only) and Italy at the other extreme (+28,4%), the increase in consumption over the whole period was close to the Community average in most countries (+18,8% for the Community of Ten).

Energy consumption per unit of private consumption varied fairly widely between countries: between the two extremes of Italy (+10,4%) and the Netherlands (−12,0%), the Community average stood close to zero at 0,6%.

During the second sub-period, the growth in consumption was halted practically everywhere: consumption was stationary in the Community of Ten in 1979 and 1981 at 152 million toe. Unit consumption showed a slightly greater fall than previously in the Community of Ten (−1,5%), reflecting fairly accurately the general trend.

Oil consumption increased between 1973 and 1981 to exceed 98% of final consumption in the transport sector. This sector thus became the largest consumer of oil, accounting for 40,9% of final oil consumption in 1981 (28,4% in 1973).

1.2.4 Final consumption in the household/tertiary sector

Any analysis of consumption in this sector is always made hazardous by the highly varied nature of its components: domestic consumption (heating, lighting, household appliances), service activities (distributive trades and the craft sector), agriculture and fisheries. Here again, unit consumption (energy intensity) was calculated in relation to private consumption expressed in ECU at 1975 prices and exchange rates.

As in the case of transport, total consumption in the household/tertiary sector generally increased during the 1973-79 sub-period, although more modestly (+7,9% for the Community of Ten) and with greater variation (ranging from −0,4% in France, the only exception, to +14,1% in Belgium). During the second sub-period, however, total consumption showed a significant fall, ranging from −4,9% in Italy to −28,4% in Denmark (−10,8% for the Community of Ten).

With economic activity growing more slowly (private consumption in the Community of Ten increased by 19,5% between 1973 and 1979 and by only 1,6% between 1979 and 1981), energy consumption per unit of private consumption in fact fell in the Community of Ten over the two sub-periods, although more sharply in the second than in the first sub-period and this in most countries (Community of Ten: 1973-79: −9,6%; 1979-81: −12,2%.

The reduction in energy intensity thus achieved between 1973 and 1981 is quite remarkable and in some countries reached similar rates to those in industry. However, Italy and especially the United Kingdom did much worse than the Community average.

Reduction in energy intensity in the household/tertiary sector, 1973-81

(%)

B	DK	D	F	I	NL	UK	EC 10
−21,1	−31,7	−25,0	−28,5	−11,9	−25,2	−3,7	−20,7

[1] The aggregate is, of course, only an approximate indication of the 'economic activity' to be related to the energy demand of these sectors. Moreover, some findings may be distorted or difficult to interpret because the aggregate is extremly sensitive to cyclical variations.

Total oil consumption in the household/tertiary sector, having fallen fairly modestly (by 7,4% in the Community of Ten) between 1973 and 1979 in most countries (with the notable exceptions of the Netherlands: −47,8%[1] and France: −16,3%), decreased sharply following the second oil shock (by 21,7% in the Community of Ten). The household/tertiary sector's share of oil consumption thus declined from 33,9% in 1973 to 29,4% in 1981.

The changes in unit consumption of oil differed substantially between countries in the two sub-periods, but the results offset each other over the period as a whole, and (with the exception of the Netherlands: −75,4%) the reduction was frequently close to the Community average of −40%. Here again, the countries which reduced their unit consumption of oil the most were also the most successful in reducing their unit consumption of energy.

1.2.5 Final energy consumption

The total consumption of the three sectors (i.e. final energy consumption) increased generally in the Community of Ten (by 5,5%) between 1973 and 1979 as a result of the growth in consumption by the tranport and household/tertiary sectors. The trends of final non-energy consumption varied widely according to country (from —33,3% in Denmark to + 12,2% in the United Kingdom), although, given the comparatively small part it plays, this scarcely affected total final consumption, which grew moderately (by 4,8% in the Community of Ten).

Final consumption was related this time to total GDP expressed in ECU at 1975 prices and exchange rates. The resultant final consumption per unit of GDP is fairly representative of the energy intensity of the different economies (see Graph 1.2): between 1973 and 1979, it fell in all Community countries in line with the sectoral results commented on above. Thus, taking into account economic growth of 15,9% between 1973 and 1979, energy intensity for the entire economy wa reduced by 9,6% in the Community of Ten.

In the second sub-period, the distinct fall in final consumption in industry and the household/tertiary sector and the stagnation in the transport sector led to an appreciable decline in final energy consumption (down 8,7% in the Community of Ten) together with a sharp contraction in final non-energy consumption (down 15,9% in the Community of Ten. Total final consumption therefore fell significantly (by 9,4% in the Community of Ten), although, given the low level of economic growth (GDP up by only 1% between 1979 and 1981), the reduction in consumption per unit of GDP is barely different at Community of Ten level (down 10,3%).

Over the period 1973 to 1981, as a whole, there was therefore a very marked reduction in the energy intensity of the Community economies:

Reduction in total energy intensity, 1973-81

(%)

B	DK	D	F	I	NL	UK	EC 10
−24,4	−25,9	−19,8	−20,2	13,3	19,5	−15,8	−18,9

The decline in energy intensity (i.e. for example, in the consumption of energy per unit of GDP) can be regarded as a *meaningful measure of the energy savings made.*[2] It results from the combination of two effects which are described in detail in Section 1.3: the first, the content effect, corresponds to the change in the energy content of each activity; the second, the structural effect, relects the trend in each activity's share of total economic activity. However, this second effect, which, to be captured completely, would require a high level of disaggregation of activities, is in fact usually underestimated. While the content effect alone should, strictly speaking, be regarded as corresponding to energy savings, it is usually, in view of what has been said, the wider concept of energy intensity which is used, thereby combining the content and structural effects, both then being regarded as lasting effects reducing energy demand.

Oil consumption trends were generally in the same direction but slightly more pronounced. Final consumption fell more sharply during the second sub-period (by 2,3% between 1973 and 1979 and by 14,7% between 1979 and 1981 in the Community of Ten). However, consumption per unit of GDP showed similar and appreciable variations during the two sub-periods (−15,7% and −15,5% respectively for the Community of Ten). Overall, the reduction in final oil consumption per unit of GDP was 28,7% for the Community of Ten, which indicates that quite remarkable oil saving were made.

Finally, Table 1.2 also gives the results for gross inland consumption of energy which are not very different from those for final consumption. The changes in the energy sector's own consumption usually reduce the 'energy savings' performance and improve the 'oil savings' performance for most countries, as we have already pointed out.

[1] Assuming, this time, that the consumption figures given in the energy balance sheets for the Netherlands are accurate (see note 1 of table on p. 38).

[2] See the definition given by R. Lattes and A. Jeanblanc: *Croissance économique, besoins d'énergie et économies d'énergie*, Commissariat à l'énergie atomique, November 1981, p. 40.

1.3 *Final consumption of energy and oil: analysis by component*

The above analysis has shown the main trends in the final consumption of energy and oil and in unit consumption (or energy intensity) in order to take account of the importance of changes (of level and structure) in economic activity. The analysis may be taken further by breaking down the change in final consumption into three components: [1]

(i) *the content effect*, which corresponds to the variation in consumption arising from a change in the energy content of each economic activity in the sectoral disaggregation: for example, the final energy consumption of industry per unit of value added;

(ii) *the structural effect*, which corresponds to the variation in consumption arising from changes in the structure of economic activities: share of industry's value added and share of services, etc. in GDP; then, within industry, share of certain sectors which are major energy consumers: steel industry, chemical industry, etc;

(iii) *the activity effect*, which corresponds to the variation in consumption produced directly by changes in the level of economic activity (GDP).

In fact, the main contribution of this breakdown is to isolate the content effect which, alone, corresponds strictly speaking to energy savings (as pointed out in point 1.2.5.), so that this result can be used to project energy demand. That is why the following remarks concentrate on the relative effects of reducing energy contents.

In this study, the breakdown has been made for energy and for oil between three sectors: industry, transport and the household/tertiary sector. In the absence of reliable branch-by-branch statistics for energy consumption by industry, the analysis has been made for industry as a whole, which undoubtedly has the effect of reducing the importance of structural effects. In the case of the transport and household/tertiary sectors, value added has been replaced by private consumption (as in Section 1.2), which, particularly in the case of the transport sector, makes the analysis less accurate. Nevertheless, the results for energy in Table 1.3.1. are fairly satisfactory, the adjustment is in general rather small and the effects revealed seem reasonable.

1.3.1 Final consumption of energy

Breaking down the change in final energy consumption [2] into three effects shows fairly clear differences between the two sub-periods studied.

In the period 1973-79, the chief component of the change in final consumption is without any doubt the level of economic activity, the rise in which is associated with an increase in consumption of 101,1 million toe for the Community of Ten. However, the content effect is also of considerable importance, at least as regards industry and the household/tertiary sector (as might be expected), since the reduction in energy content is as high as 61,3 million toe for the Community of Ten. This leaves the structural effect, which seems very low (+3,7 million toe for the Community of Ten) but it has probably been underestimated because the level of sectoral disaggregation is insufficient.

By sector, the results show:

(i) in industry: a very large content reduction effect (−35 million toe, or over 50% of the total content effect for the three sectors), reinforced in general by a fairly high negative structural effect, with one exception; in Italy, the positive structural effect reflects continuing industrialization (in contrast to the United Kingdom, where the negative structural effect is particularly pronounced). The net result is a decline in the demand for energy by industry, in spite of a high positive activity effect;

[1] This section owes much to Patrick Criqui's article 'Impacts du premier choc pétrolier sur les consommations d'énergie finale (France, Allemagne, Royaume-Uni et Japon)' in 'Les grands acteurs de la scène énergétique mondiale', *Économie Prospective Internationale* No 11, third quarter 1982, Documentation Française. He suggests the following breakdown:

If final consumption is:

$$FC = \sum_i \left(\frac{FC_i}{VA_i} \times \frac{VA_i}{GDP} \times GDP \right)$$

where FC_i = final consumption of sector i

VA_i = value added for sector i

GDP = gross domestic product of the country considered

then its variation may be expressed as the sum of three effects:

$$\Delta FC = \sum_i \left(\Delta \frac{FC_i}{VA_i} \right) \times \frac{VA_i}{GDP} \times GDP \quad (= \text{energy content effect})$$

$$+ \sum_i \left(\Delta \frac{VA_i}{GDP} \right) \times \frac{FC_i}{VA_i} \times GDP \quad (= \text{structural effect})$$

$$+ \sum_i \left(\Delta GDP \right) \times \frac{FC_i}{VA_i} \times \frac{VA_i}{GDP} \quad (= \text{activity effect})$$

$$+ \text{adjustment}$$

[2] Throughout this section, the analysis relates solely to consumption for energy purposes and excludes final non-energy consumption; consequently final consumption must here be taken to mean final consumption for energy purposes.

Table 1.3.1

Components of the change in final energy consumption

(10^3 toe)

	B		DK		D		F	
	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81
	Energy							
Final consumption by industry	−1 269	−2 122	−49	−15	−2 110	−5 980	−29	−7 980
Content effect	−2 887	−1 714	−466	+11	−8 816	−5 228	−7 309	−7 377
Structural effect	−289	−596	−17	+23	−2 408	−2 113	−525	−1 322
Activity effect	+2 312	+149	+443	−33	+10 487	+1 323	+9 310	+598
Adjustment	−405	+39	−9	−16	−1 373	+38	−1 505	+121
Final consumption by transport	+967	−275	+198	−349	+6 557	−336	+5 244	+1 046
Content effect	−35	−201	−176	−180	−279	−819	−936	−79
Structural effect	+157	−63	−17	−92	+1 581	−307	+1 214	+571
Activity effect	+761	+63	+417	−34	+5 127	+837	+5 013	+505
Adjustment	+84	−74	−26	−43	+128	−47	−47	+49
Final consumption by household/tertiary	+1 706	−2 502	+266	−2 699	+6 873	−13 249	−231	−3 879
Content effect	−517	−2 599	−750	−2 440	−8 016	−14 159	−11 014	−5 592
Structural effect	+401	−155	−49	−256	+3 776	−659	+2 546	+991
Activity effect	+1 949	+156	+1 199	−96	+12 244	+1 812	+10 511	+876
Adjustment	−127	+96	−134	+93	−1 131	−243	−2 274	−154
Final energy consumption	+1 404	−4 899	+415	−3 063	+11 320	−19 565	+4 984	−10 813
Content effect	−3 439	−4 514	−1 392	−2 609	−17 111	−20 206	−19 259	−13 048
Structural effect	+269	−814	−83	−325	+2 949	−3 079	+3 235	+240
Activity effect	+5 022	+368	+2 059	−163	+27 858	+3 972	+24 834	+1 979
Adjustment	−448	+61	−169	+34	−2 376	−252	−3 826	+16

	I		NL		UK		EC 10	
	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81
	Energy							
Final consumption by industry	+1 044	−768	+2 356	−2 162	−10 742	−7 554	−10 384	−27 858
Content effect	−5 114	−2 746	+1 186	−2 278	−8 982	−718	−34 968	−23 990
Structural effect	+1 028	+501	−831	+133	−7 023	−5 267	−8 355	−6 432
Activity effect	+5 934	+1 385	+2 079	−41	+5 005	−1 829	+38 728	+2 038
Adjustment	−798	+92	−78	+24	+258	+260	−5 789	+526
Final consumption by transport	+5 423	+496	+1 221	+198	+3 008	−829	+23 927	+200
Content effect	+2 012	−605	−865	+403	+483	−498	−742	−2 336
Structural effect	−62	+186	+640	−172	−90	+1 006	+3 937	+860
Activity effect	+3 231	+940	+1 568	−21	+2 575	−1 282	+20 320	+1 491
Adjustment	+242	−25	−122	−12	+40	−55	+412	+185
Final consumption by household/tertiary	+3 881	−1 691	+1 798	−2 679	−5 137	−3 315	+20 600	−30 325
Content effect	−960	−3 142	−3 609	−2 246	+566	−2 771	−25 556	−34 874
Structural effect	−98	+259	+1 794	−450	−163	+1 812	+8 152	+1 618
Activity effect	+5 130	+1 310	+4 399	−55	+4 666	−2 310	+42 075	+2 805
Adjustment	−191	−118	−786	+72	+68	−46	−4 071	+126
Final energy consumption	+10 348	−1 963	+5 375	−4 643	−2 597	−11 698	+34 143	−57 983
Content effect	−4 062	−6 493	−3 288	−4 121	−7 933	−3 987	−61 266	−61 200
Structural effect	+868	+946	+1 603	−489	−7 276	−2 449	+3 734	−3 954
Activity effect	+14 295	+3 635	+8 046	−117	+12 246	−5 421	+101 123	+6 334
Adjustment	−753	−51	−986	+84	+366	+159	−9 448	+837

(ii) in transport the content effect is generally very low, the structural effect is fairly low but positive (and not very significant), while the highly positive activity effect in all countries explains most of the growth in consumption;

(iii) in the household/tertiary sector, a strongly positive activity effect is accompanied by a positive structural effect (reflecting an increase in the share of private consumption in GDP). Although the decline in energy content is very large, especially in France and Germany, it is still equivalent to only 50% of the total of the other two effects.

The following period, 1979-81, still saw heavily negative content effects (−61,2 million toe), modest structural effects (−4,0 million toe), and, this time, much weaker although still positive activity effects (+6,3 million toe), as was to be expected. The net result of course is a substantial fall in final energy consumption. The results by sector show a very large reduction in the energy content of the household/tertiary sector (−34,9 million toe), a slightly lower reduction in industry (−24,0 million toe) and once more a fairly small reduction in transport (−2,3 million toe). The structural effect is unimportant except in industry (−6,4 toe), while activity effects are obviously very small: altogether, the largest reduction in energy consumption is in the household/tertiary sector.

So, although the period 1979-81 may seem to mark a break with the preceding period, with an appreciable fall in energy consumption (down 59 million toe for the Community of Ten), this is chiefly the result of two phenomena:

(i) a very large and virtually identical content effect in the two periods (down 61,2 million toe), which demonstrates that a high level of energy saving was maintained. This suggests that, since the least costly savings were made first, investment in the efficient use of energy was stepped up in the second period, despite the unfavourable economic situation. This effect seems to have continued and even to have grown stronger in 1982 for gross inland consumption of energy (see Section 1.4), but we do not yet have figures for final consumption;

(ii) a very high positive activity effect in the period 1973-79 (+101 million toe), followed by a very modest activity effect in the second period (+6,3 million toe), which reflects the contraction in economic activity. This effect continued in 1982 but is by its nature reversible.

The structural effect, as estimated here, was negligible on the whole, but of some importance at sectoral level.

All in all, it is therefore fair to say that the period following the second oil shock, while not strictly speaking marking a break in the trend of the energy-economy relationship, saw increased efforts to improve energy efficiency which are very important from the viewpoint of the Community's energy objectives.

It is interesting to specify the share of each sector in these results (see Table 1.3.2 below), to qualify some of the findings. The table shows clearly that, over the period as a whole:

(i) the household/tertiary sector reduced its energy content most, but was subject to a fairly marked positive structural effect;

(ii) the good results for industry's reduction in energy content are accompanied by a heavily negative structural effect, which explains the considerable overall reduction in the sector's energy consumption;

(iii) the transport sector is a case apart because the very small reduction in energy content means that its consumption is still largely determined by economic activity.

Table 1.3.2

Changes in final energy consumption: breakdown by sector, 1973-81

(thousand toe)

	EC 10		
	Industry	Transport	Household/ tertiary
Content effect	−58 958	−3 078	−60 430
Structural effect	−14 767	+4 797	+9 770
Activity effect	+40 766	+21 811	+44 880
Adjustment	−5 263	+597	−3 945
Total change in final energy consumption	−38 242	+24 127	−6 398

Finally, developments in certain countries are worth noting: (Cf. table 1.3.3) the considerable reduction in energy content achieved in Belgium (−7,9 million toe), Germany (−37 million toe) and France (−32 million toe altogether, but the results were better in the first sub-period than in the second because of the poor performance of the household/tertiary sector during the second period), while results are not nearly so good in other countries: the United Kingdom (−12 million toe) and Italy (−10,5 toe). It is also interesting that a highly negative structural effect is observed for the whole period only in the United Kingdom (−10 million toe), mainly owing to industry; a negative structural effect also developed in Germany from 1979 to 1981.

Lastly, for the period 1973-81 as a whole, we find that the content effect aggregated for the two sub-periods is usually greater than the activity effect: since the structural effect is small, the result is a net fall in the final consumption of energy for all countries, except Italy and the Netherlands — see Table 1.3.3 below.

Table 1.3.3

Components of the change in final consumption of energy, 1973-81

(thousand toe)

	B	DK	D	F	I	NL	UK	EC 10
Content effect	−7 953	−4 001	−37 317	−32 307	−10 555	−7 409	−11 920	−122 466
Structural effect	−545	−408	−130	+3 475	+1 814	+1 114	−9 725	−220
Activity effect	+5 390	+1 896	+31 830	+26 813	+17 930	+7 929	+6 825	+107 457
Adjustment	−387	−135	−2 628	−3 810	−804	−902	+525	−8 611
Total change in the final consumption of energy	−3 495	−2 648	−8 245	−5 829	+8 385	+732	−14 295	−23 840

1.3.2 Final consumption of oil

The above analysis can be extended to the final consumption of oil (or more strictly of petroleum products). [1] In this case the change in final consumption is broken down by three effects (see Table 1.3.4):

(i) the substitution effect, which corresponds to the change in the share of oil in energy consumption;

(ii) the content effect, which corresponds to the change in the energy content of the activity of the sector considered;

(iii) the activity effect, which corresponds to the change in activity of the sector concerned, or the value added of industry.

This means that this time the structural effect is not shown separately, but incorporated partly in the content effect and partly in the activity effect.

A comparison of overall results for the Community of Ten over the two sub-periods leads to the following general conclusions:

(i) the reduction of the oil content of economic activity was of a similar scale in the two sub-periods: −30 million toe from 1973 to 1979, and −28 million toe from 1979 to 1981. This means that relative oil savings were maintained at a high level (in parallel to the findings for aggregate energy);

(ii) substitution effects were heavily negative in both sub-periods (−35 million toe in 1973-79, and −32,6 million toe in 1979-81); this interesting finding needs to be analysed by sector;

[1] P. Criqui does this in the study already mentioned: we have used the same formulae, adapting them to the data available. In this case the final consumption of petroleum is formulated on the basis of its share in the final consumption of energy $\frac{PC}{FC}$ and of the energy intensity of the consumer sector i: $\frac{FC_i}{VA_i}$; we thus have:

$$PC = \sum_i \left(\frac{PC_i}{FC_i} \times \frac{FC_i}{VA_i} \times VA_i\right)$$

(for transport and the household/tertiary sector, value added is replaced by private consumption on the economic territory).

From which we deduce:

$$\Delta PC = \sum_i \left(\Delta\frac{PC_i}{FC_i}\right) \times \frac{FC_i}{VA_i} \times VA_i \quad (= \text{substitution effect})$$

$$+ \sum_i \left(\Delta\frac{FC_i}{VA_i}\right) \times \frac{PC_i}{FC_i} \times VA_i \quad (= \text{content effect})$$

$$+ \sum_i \left(\Delta VA_i\right) \times \frac{PC_i}{FC_i} \times \frac{FC_i}{VA_i} \quad (= \text{activity effect})$$

Table 1.3.4

Components of the change in the final consumption of oil for energy purposes

(10³ toe)

	B		DK		D		F	
	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81
				Oil				
Final consumption by industry	−1 552	−823	−462	−587	−5 804	−7 264	−2 221	−7 380
Content effect	−878	−376	−334	−3	−3 367	−1 604	−3 599	−3 280
Structural effect	−1 273	−420	−429	−579	−5 156	−6 001	−2 200	−4 650
Activity effect	+596	−97	+336	−7	+2 942	−255	+4 274	−330
Adjustment	+3	+70	−35	+2	−223	+596	−696	+880
Final consumption by transport	+962	−277	+197	−350	+7 076	−366	+5 257	+1 060
Content effect	−34	−198	−178	−231	−267	−800	−915	−78
Structural effect	+9	−6	0	−2	+650	−108	+102	+19
Activity effect	+926	0	+397	−125	+6 656	+514	+6 313	+1 064
Adjustment	+61	−73	−22	+8	+37	+28	−243	+55
Final consumption by household/tertiary	+88	−2 338	−188	−2 010	+505	−13 451	−6 062	−4 515
Content effect	−323	−1 220	−631	−1 869	−5 086	−8 263	−7 606	−3 246
Structural effect	−864	−1 138	−386	+80	−3 382	−6 727	−5 984	−2 410
Activity effect	+1 507	0	+924	−267	+10 533	+674	+9 359	+1 093
Adjustment	−232	+20	−95	+46	−1 560	+865	−1 831	+48
Final consumption for energy purposes	−502	−3 438	−453	−2 947	+1 777	−21 081	−3 026	−10 835
Content effect	−1 235	−1 794	−1 143	−2 103	−8 720	−10 667	−12 120	−6 604
Structural effect	−2 128	−1 564	−815	−501	−7 888	−12 836	−8 082	−7 041
Activity effect	+3 029	−97	+1 657	−399	+20 131	+933	+19 946	+1 827
Adjustment	−168	+17	−152	+56	−1 746	+1 498	−2 770	+983

	I		NL		UK		EC 10	
	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81	1973-79	1979-81
				Oil				
Final consumption by industry	−2 560	−420	+856	−899	−6 460	−6 366	−17 916	−24 579
Content effect	−2 478	−992	+218	−488	−3 777	−275	−14 805	−8 770
Structural effect	−3 001	−122	+343	−498	−2 369	−4 086	−14 345	−16 733
Activity effect	+3 457	+763	+214	+20	−942	−2 635	+12 307	−1 626
Adjustment	−538	−69	+81	+67	+628	+630	−1 073	+2 550
Final consumption by transport	+5 361	+508	+1 218	+195	+2 889	−828	+24 293	+185
Content effect	+1 960	−588	−834	+396	+479	−492	−724	−2 336
Structural effect	−45	+14	+9	−1	−63	−10	+474	+1 000
Activity effect	+3 078	+1 101	+2 314	−191	+2 452	−305	+24 300	+2 312
Adjustment	+368	−19	−271	−9	+21	−21	+243	−791
Final consumption by household/tertiary	−1 723	−2 801	−3 251	−1 470	−807	−2 699	−10 971	−29 722
Content effect	−708	−1 902	−1 231	−369	+139	−586	−14 369	−16 827
Structural effect	−4 060	−1 862	−3 549	−1 169	−1 879	−2 120	−21 133	−16 871
Activity effect	+3 696	+956	+2 246	−83	+1 105	−117	+28 969	+2 142
Adjustment	−651	+7	−717	+151	−172	+124	−4 438	+1 834
Final consumption for energy purposes	1 078	−2 713	−1 177	−2 174	−4 378	−9 893	−4 594	−54 116
Content effect	−1 226	−3 482	−1 847	−461	−3 159	−1 353	−29 898	−27 933
Structural effect	−7 106	−1 970	−3 197	−1 668	−4 311	−6 216	−35 004	−32 604
Activity effect	+10 231	+2 820	+4 774	−254	+2 615	−3 057	+65 576	+2 828
Adjustment	−821	−81	−907	+209	+477	+733	−5 268	+3 593

Table 1.3.5

Changes in the final consumption of oil for energy purposes: breakdown by sector, 1973-81

(thousand toe)

	EC 10		
	Industry	Transport	Household/ tertiary
Content effect	−23 575	−3 060	−31 196
Substitution effect	−31 078	+1 474	−38 004
Activity effect	+10 681	+26 612	+31 111
Adjustment	+1 477	−548	−2 604
Total change in the final consumption of oil for energy purposes	−42 495	+24 478	−40 693

(iii) activity effects were positive and very high in the first sub-period (+65,5 million toe), practically offsetting the negative content and substitution effects; as might be expected, they were low in the period 1979-81 (+2,8 million toe); this led to a major reduction in oil consumption for energy purposes during the second sub-period (−54 million toe).

Results by sector for the Community of Ten show:

(i) total content and substitution effects highest in the household/tertiary sector (−69 million toe in 1973-81: see Table 1.3.5), with a difference between the two sub-periods: substitution was most marked from 1973 to 1979, while the content effect grew stronger in 1979-81. The performance of the household/tertiary sector in respect of substitution corresponds to notable penetration of natural gas and electricity in this sector;

(ii) in industry, on the other hand, subsitution was stronger in the second sub-period, while content effects combined accounted for 54,5 million toe from 1973 to 1981;

(iii) in transport, only the activity effect was significant; it was highly positive from 1973 to 1979, close to zero from 1979 to 1981, and altogether it explains most of the growth of oil consumption in this sector (+24,5 million toe); there is no oil saving in transport as yet.

Finally, results by countries show particularly sizeable subsitution and content effects: mainly in Germany but also in France, the Netherlands and Belgium, while performances in the other two major countries. the United Kingdom and Italy, are much poorer. These results show once again that, in general, large oil savings have not prevented the substitution of other energy sources for oil (see Table 1.3.6).

1.4 *Conclusion: the evolution of demand and of energy saving*

The preceding sections have reviewed the various components of the change in the sectoral and total demand for energy in the two sub-periods covered by the analysis. The three sectors behaved differently according to country and period, making it difficult to formulate an overall assessment

Table 1.3.6

Components of the change in the final consumption of oil for energy purposes, 1973-81

(million toe)

	B	DK	D	F	I	NL	UK	EC 10
Content effect	−3 029	−3 246	−19 387	−18 724	−4 708	−2 308	−4 512	−57 831
Substitution effect	−3 692	−1 316	−20 724	−15 123	−9 076	−4 865	−10 527	−67 608
Activity effect	+2 932	+1 258	+21 064	+21 773	+13 051	+4 520	−442	+68 404
Adjustment	−151	−96	−257	−1 787	−902	−698	−1 210	−1 675
Total = change in the final consumption of oil for energy purposes	−3 940	−3 400	−19 304	−13 861	−1 635	−3 351	−14 271	−58 710

Table 1.4.1

Performance in respect of relative energy saving

(%)

	B	DK	D	F	I	NL	UK	EC 10
Final energy consumption per unit of GDP								
— 1973-79	−11,3	−10,4	−9,0	−12,5	−7,3	−7,4	−8,7	−9,6
— 1979-81	−14,8	−17,2	−11,9	−8,8	−6,5	−13,0	−7,8	−10,3
— 1973-81	−24,4	−25,9	−19,8	−20,2	−13,3	−19,5	−15,8	−18,9
Gross inland consumption of energy per unit of GDP								
— 1973-79	−7,9	−7,8	−7,0	−11,1	−5,9	−9,6	−8,7	−8,7
— 1979-81	−11,7	−16,5	−10,4	−4,1	−6,3	−10,0	−8,0	−8,5
— 1979-82	−15,5	−18,6	−14,1	−9,4	−8,7	−16,1	−12,5	−12,5
— 1973-81	−18,6	−23,1	−16,7	−14,8	−11,9	−18,6	−16,0	−16,5
— 1973-82	−22,2	−25,0	−20,1	−19,4	−14,1	−24,1	−20,1	−20,0

which takes sufficient account of these special features. So when, (see Table 1.4.1), we look at what may be considered each country's overall performance, we must bear in mind the numerous peculiarities of each country or sector which were reviewed in detail above.

Table 1.4.1 shows the trend of energy consumption per unit of GDP, considered to be representative of the trend in energy intensity of a country's economic activities, and hence of its energy saving, broadly defined. Two formulae were used, one taking final energy consumption as the basis and the other gross inland consumption of energy (which takes account of the energy sector's own consumption and losses), but the differences are not very great, and as we have already stated, the performance everywhere—except in the United Kingdom—for gross inland consumption is lower than for final consumption.

The figures show in particular that relative energy saving was above the Community average in Belgium, Denmark, Germany and the Netherlands, close to the average in the United Kingdom, Germany and France, and well below average in Italy. In the first four countries, the best results were recorded chiefly in the second sub-period; in France, where relative energy saving was the largest in the period 1973-79, the 1979-81 result was poor. Italy's performance was relatively modest in both sub-periods.

Table 1.4.2

Performance in respect of relative oil saving

(%)

	B	DK	D	F	I	NL	UK	EC 10
Final energy consumption of oil per unit of GDP								
— 1973-79	−17,9	−15,3	−12,3	−18,4	−16,3	−19,6	−15,3	−15,7
— 1979-81	−20,0	−22,5	−20,4	−14,2	−8,8	−20,7	−12,9	−15,5
— 1973-81	−34,3	−34,4	−30,3	−30,0	−23,6	−36,2	−26,2	−28,7
Gross inland consumption of oil per unit of GDP								
— 1973-79	−20,2	−19,2	−15,3	−22,3	−13,9	−14,8	−21,0	−17,8
— 1979-81	−18,8	−26,1	−21,4	−17,3	−9,7	−12,2	−17,5	−16,7
— 1979-82	−23,0	−31,8	−24,8	−25,9	−13,2	−27,4	−17,9	−21,8
— 1973-81	−35,2	−40,3	−33,4	−35,7	−22,3	−25,2	−34,8	−31,5
— 1973-82	−38,6	−44,8	−36,3	−42,4	−25,3	−38,2	−35,1	−35,8

Table 1.4.2 compares results for relative oil saving. The figures confirm the general point that oil saving and energy saving go hand in hand. Moreover, the figures for 1982 show a rather remarkable improvement in some countries' gross inland consumption of oil per unit of GDP.

Overall the relative saving achieved in the Community is high: a decrease of 20% between 1973 and 1982. It has been accompanied by a very considerable relative saving of (gross inland consumption of oil per unit of GDP): a decrease of 35,8% between 1973 and 1982. Both have made a remarkable contribution to the objective of reducing the Comunity's dependence on external supplies of energy and especially oil.

2. Energy production and imports: reduced dependence on external supplies

2.1 *Primary energy production*

In order to loosen the energy constraint and especially the oil constraint, the oil-importing countries and the Community countries in particular have not only made efforts to reduce consumption but have also expanded production from domestic sources so as to reduce dependence on external supplies. From 1973 to 1982 (see Table 2.1.1), this expansion was chiefly in output of oil and electricity—for the most part nuclear-generated—while solid fuel production continued to decline and natural gas production peaked and then began to fall.

The change in Community production during the period 1973-82 may be broken down as shown in Table 2.1.2:

The main trends can thus be seen more clearly:

(i) Solid fuel production contracted mainly in the first period and then more or less stabilized in particular in the two chief producer countries, Germany and the United Kingdom.

(ii) Oil production expanded most in the first period, in the United Kingdom of course, and is probably near its maximum at the present time.

(iii) Natural gas production rose significantly from 1973 to 1979 and thereafter fell back to the 1973 level chiefly because of the gradual exhaustion of Dutch reserves.

(iv) Electricity generation increased substantially in several countries between 1973 and 1979, but thereafter the increase in production was most remarkable in France while the other countries clearly felt the effects of the slowdown in their nuclear power programmes.

For the Community as a whole, the net effect of this process was a rise in primary production of almost 140 million toe, or 39,7%, from 1973 to 1982, with very remarkable results for some countries.

Table 2.1.1

Primary energy production

(million toe)

	1973					1979					1982				
	Solid fuels	Oil	Natural gas	Electr. + other	Total	Solid fuels	Oil	Natural gas	Electr. + other	Total	Solid fuels	Oil	Natural gas	Electr. + other	Total
B	5,8	—	—	—	5,9	4,5	—	—	2,8	7,4	4,9	—	—	3,8	8,8
DK	—	—	—	—	0,1	—	0,4	—	—	0,4	—	1,7	—	—	1,7
D	92,0	7,2	15,0	5,0	119,2	87,8	5,1	15,7	13,3	121,9	89,4	4,2	12,6	18,4	124,7
F	17,2	2,0	6,3	8,8	34,3	12,9	2,2	6,5	16,9	38,5	11,8	2,4	5,5	35,6	55,3
I	0,3	1,8	12,6	4,6	19,3	0,3	1,7	11,1	5,2	18,3	0,3	1,8	12,0	5,9	19,9
NL	1,2	1,5	53,8	0,3	56,8	—	1,6	70,8	1,2	73,6	—	1,9	52,5	1,3	55,7
UK	78,7	0,7	24,4	9,2	113,0	70,9	78,3	32,9	11,4	193,5	73,0	101,8	30,0	12,6	217,3
EC 10	197,7	13,2	112,2	28,2	351,3	180,2	89,3	137,5	51,2	458,2	183,8	114,8	114,2	78,0	490,8
% by type of energy	(56,3)	(3,8)	(31,9)	(8,0)	(100)	(39,3)	(19,5)	(30,0)	(11,2)	(100)	(37,4)	(23,4)	(23,3)	(15,9)	(100)
	△ 1979-73					△ 1982-79					△ 1982-73				
EC 10 growth rate (%)	−8,9	+577,0	+22,5	+81,5	+30,4	+2,0	+28,6	−16,9	+52,3	+7,1	−7,0	+770,0	+1,8	+177,0	+39,7

Table 2.1.2

Changes in Community production of primary energy

(million toe)

	1973-79	1979-82
Solid fuel: EC 10	−17,5	+3,6
of which: UK	−7,8	+2,1
F	−4,3	−1,1
D	−4,2	+1,6
B	−1,3	+0,4
Oil: EC 10	+76,1	+25,5
of which: UK	+77,6	+23,5
DK	+0,4	+1,3
D	−2,1	−0,9
Natural gas: EC 10	+25,3	−23,3
of which: NL	+17,0	−18,3
UK	+8,5	−2,9
D	+0,7	−3,1
Primary electricity and other: EC 10	+23,0	+26,8
of which: F	+8,1	+18,7
D	+8,3	+5,1
B	+2,8	+1,0
UK	+2,2	+1,2
Total: EC 10	+106,9	+32,6
of which: UK	+80,5	+23,8
NL	+16,8	−17,9
F	+4,2	+16,8
D	+2,7	+2,8
B	+1,5	+1,4
DK	+0,3	+1,3
I	−1,0	+1,6

2.2 *Imports and dependence on external supplies of energy*

Thanks to the efforts to reduce energy consumption and to expand domestic production, net energy imports into the Community fell significantly; however, the pattern varies according to energy source and country as Table 2.2.1 shows.

From 1973 to 1979, net energy imports fell sharply in the Netherlands and especially in the United Kingdom because of the development of oil and gas production in the two countries; they stabilized in Denmark but rose in the other countries because of the increase in imports of natural gas and solid fuel. For the Community, this meant a reduction of 109,0 million toe (18,3%) in net oil imports, an increase of 14,8 million toe (77,9%) in solid fuel imports and an increase of 32,2 million toe (80,5%) in natural gas imports. As a result of this diversification, imports were reduced by 61,3 million toe (or 9,9%) overall. Subsequently, from 1979 to 1982, net energy imports fell appreciably in all the countries except the Netherlands, but diversification was considerably curbed, notably by the reduction in energy consumption (so that although the figures for the Community of Ten still show an increase in net solid fuel and natural gas imports, this is due more to a fall in the exports of the major producer countries than to an increase in the other countries' imports). The energy imports of the Ten thus fell by 149,1 million toe (26,7%) from 1979 to 1982, with oil imports down by 163,8 million toe, solid fuel imports up by 7,4 million toe and natural gas imports up by 7,2 million toe.

In total over the period 1973-82 net energy imports fell by 210,4 million toe or 34%; the share of oil in imports was reduced from 96% to 79% in favour of solid fuel and natural gas which each now account for 10% of imports.

Table 2.2.2 gives the changes in the ratios expressing dependence on external supplies of energy and oil. From 1973 to 1979 the reduction in the Community's dependence on external supplies of energy (down from 64% to 55,2%) is mainly due to the changes in the United Kingdom and the Netherlands while the dependence of other countries remained unchanged or actually increased: this reflects the expansion of coal and gas imports which has been referred to above for this period. Dependence on external supplies of oil fell only moderately in all the countries except, of course, the United Kingdom, where it fell from 49,8% to 8,5%. Between 1979 and 1982, the reduction in dependence was generally more substantial than in the preceding period, except in the Netherlands where, because of the fall in natural gas exports, the dependence ratio increased. In Italy, the dependence ratio remained virtually unchanged over the period, because efforts to reduce consumption and to increase domestic production were inadequate, as the preceding sections have shown. The most remarkable performance was of course that of the United Kingdom, which became a net exporter of energy during this period (the dependence ratio thus being negative). France also performed well, managing to reduce dependence to 65,9%, from 81,3% in 1979.

The reduction of dependence on external supplies is even more marked for oil, as the above analyses indicate. Apart from the United Kingdom, Denmark's achievement is noteworthy, with dependence down from 91,1% in 1973 to 54,9% in 1982.

For the Community as a whole, the results are clearly very remarkable:

(i) dependence on external supplies of energy was reduced from 64% in 1973 to 45,6% in 1982;

(ii) dependence on external supplies of oil was reduced from 61,6% in 1973 to 36,0% in 1982.

However, the considerable impact of North Sea oil on dependence ratios must be borne in mind: dependence on imported energy and oil for the Community countries without the United Kingdom, although it declined considerably, is still high:

Table 2.2.1

Net imports of energy

(million toe)

	1973					1979					1982				
	Solid fuels	Oil	Natural gas	Electr. + other	Total	Solid fuels	Oil	Natural gas	Electr. + other	Total	Solid fuels	Oil	Natural gas	Electr. + other	Total
B	5,3	30,5	7,1	−0,1	42,9	6,8	28,8	9,4	−0,1	44,9	6,6	21,9	7,0	0	35,5
DK	1,9	18,4	0	0	20,3	4,6	15,3	0	0,3	20,2	5,8	9,5	0	0,2	15,5
D	−10,1	144,6	12,0	0,9	147,4	−12,1	144,9	30,5	0	163,2	−1,0	103,1	25,9	0,6	128,5
F	9,9	128,7	7,6	−0,2	145,9	18,0	121,4	14,7	0,5	154,6	15,0	85,6	16,0	−0,3	116,3
I	7,7	102,6	1,6	0,1	112,0	8,7	98,8	12,1	0,5	120,1	12,3	87,8	11,0	0,6	111,7
NL	1,7	40,0	−25,2	−0,1	16,3	3,5	38,5	−38,4	0	3,6	5,3	27,6	−25,0	0,1	8,0
UK	−0,8	113,0	0,7	0	112,9	1,1	18,9	7,5	0	27,6	−5,4	−28,0	8,2	0	−25,2
EC 10	19,0	596,2	4,0	0,7	619,9	33,8	487,2	36,2	1,4	558,6	41,2	323,4	43,4	1,5	409,5
% by type of energy	(3,1)	(96,2)	(0,6)	(0,1)	(100)	(6,0)	(87,2)	(6,5)	(0,3)	(100)	(10,0)	(79,0)	(10,6)	(0,4)	(100)
	△ 1979-73					△ 1982-79					△ 1982-73				
EC 10 growth rate (%)	+77,9	−18,3	+805	+100	−9,9	+21,9	−33,6	+19,9	+7,1	−26,7	+116,8	−45,8	+985	+114,3	−34,0

Table 2.2.2

Dependence on external supplies of energy [1] and oil [2]

	1973		1979		1981		1982	
	Dependence on external supplies of energy	Dependence on external supplies of oil	Dependence on external supplies of energy	Dependence on external supplies of oil	Dependence on external supplies of energy	Dependence on external supplies of oil	Dependence on external supplies of energy	Dependence on external supplies of oil
B	87,9	62,5	88,1	56,5	77,7	45,8	80,7	49,8
DK	100	91,1	97,4	73,8	100	60,6	89,6	54,9
D	55,5	54,4	57,3	50,9	51,4	42,0	51,9	41,7
F	81,0	71,5	81,3	63,9	70,1	51,0	65,9	48,5
I	86,7	79,4	86,3	71,0	86,0	68,2	85,4	67,1
NL	22,4	54,5	4,8	51,1	5,2	45,0	12,3	42,7
UK	49,7	49,8	12,4	8,5	−6,4	−9,2	−13,3	−14,8
EC 10	64,0	61,6	55,2	48,1	47,5	38,2	45,6	36,0
EC (without UK) [3]	68,4	65,2	67,2	59,3	60,1	48,4	57,8	45,7

[1] Dependence on external supplies of energy = $\frac{\text{net imports of energy}}{\text{gross inland consumption of energy + bunkers}}$ as %.

[2] Dependence on external supplies of oil = $\frac{\text{net imports of oil}}{\text{gross inland consumption of energy + bunkers}}$ as %.

[3] In this case, UK energy imports and consumption have been deducted from EC 10 figures; correspondingly (in the periods when that country was a net energy exporter) its exports have not been taken into account.

(i) dependence on external supplies for the Community excluding the United Kingdom reduced from 68,4% to 57,8%;

(ii) dependence on external supplies of oil was reduced from 65,2% to 45,7% (see Table 2.2.2).

Conclusion

This chapter has described the changes in the energy balance sheets of the Community countries from 1973 to 1982; the comparison has usually been between the two periods 1973-79 and 1979-82 (or 1981 depending on the availability of data), chosen arbitrarily and clearly very different in a number of respects. However, while not revealing a real break in the energy-economy relationship, this distinction has permitted a clearer portrayal of the factors explaining the apparent trend, and in particular the reduction, in absolute figures, of energy consumption after 1979. The reduction can be put down to a combination of:

(i) a sustained rate of energy saving (through reduced energy intensity and above all reduced energy content) despite the fact that such saving was becoming increasingly difficult to achieve and called for investment which was not favoured by the economic situation of the 1980s; and

(ii) the effects of the recession, which meant that the economic activity effect on the growth of energy demand was inoperative.

Nevertheless, it would be wrong to conclude that as a result of their saving, the Community countries have broken sufficiently free from the energy constraint. This continues to represent a considerable burden on the external trade accounts of most of the energy-importing countries, as Table 2.3 demonstrates; the figures indicate the net trade positions by major category of product for the Community countries. They clearly show that for a number of countries, and for the Community of Ten, the energy bill still represents a very heavy burden and is responsible for, or actually makes up the main part of, the trade deficit. Although the volume of net energy imports has been reduced, their value, because of the rise in the oil price, has shot up so steeply that there are few countries which have the export capacity sufficient to balance their energy imports. The reduction of energy consumption per unit of GDP and of dependence on external supplies of energy are therefore still objectives of paramount importance for our countries.

As several studies have shown (and notably the two reports by the J. Saint-Geours group [1]), there is still vast potential in the Community for more rational use of energy. It should be stressed that, according to the main findings here, better Community performance on this front requires a considerable improvement in the results achieved by Italy and the United Kingdom, and also to some extent Belgium and the Netherlands, where energy intensity is still well above the Community average (see Graph 1.2).

[1] 'In favour of an energy-efficient society', Commission of the European Communities, *Studies—Energy*, No 4, 1979.
'Investment and employment in an energy-efficient society', 1981, *Study* No XVII/052/81, Directorate-General for Energy, Commission of the European Communities.

Table 2.3

Net trade positions by category of product (SITC), 1982

('000 million ECU)

	B/L	DK	D	F	I	NL	UK	EC 10
Food products	−1,0	3,1	−8,3	+3,3	−5,7	+4,9	−5,9	−8,1
Energy	−8,1	−2,9	−30,5	−27,9	−23,5	−1,7	+6,9	−91,3
Raw materials	−2,7	+0,1	−7,7	−3,0	−6,6	−0,6	−4,2	−24,2
Machinery and transport equipment	−0,6	−0,1	+52,0	+4,2	+6,8	−2,7	+2,2	+59,1
Other industrial products	+6,3	−1,9	+16,0	−0,1	+15,2	+2,5	−2,4	+29,5
Net trade position	−6,1	−1,6	+21,5	−23,5	−13,8	+2,4	−3,4	−35,0
Net trade position excluding energy	+2,0	+1,3	+52,0	+4,4	+9,7	+4,1	−10,3	+56,3

Chapter II: **Energy demand elasticities: a review of the literature** [1]

[1] This chapter has been written by N. Kouvaritakis, Expert at the Directorate-General for Science, Research and Development.

List of tables

Introduction

A review of the literature on energy demand functions produces results which are far from being uniform or satisfactory. It is difficult to find, in the work of the last decade or so, empirically estimated parameters that can readily be used for policy making and planning. Thus, in going through the mountain of existing empirical results, a critical eye and eclectic attitude is imperative. In the end, it appears that, econometric results based on the most recent years, elasticities that look plausible in the light of economic reality, consistent model specification through time and between sectors, the use of judgment as a supplement to computer-derived results, are essential criteria in 'screening out' the most relevant aspects of the energy demand literature.

In a fairly recent study (1980) by the Energy Modelling Forum [1], [1] 16 models were surveyed and used to shed light on the question of the aggregate elasticity of energy demand. The main conclusion was: 'Contrary to the popular conception, the energy demand elasticity cannot even be defined consistently without explicit specification of several factors. The point of measurement, method of aggregation, price change composition, time frame, taxes and regulations assumed can significantly affect the calculated value of the aggregate elasticity. Even if these factors are standardized, differences in parameter estimation approach and structural characteristics lead to a range of elasticity estimates.'

1. Aggregate demand for energy

1.1. *The aggregation problem*

Differences in elasticity estimates is a natural phenomenon of evolution.

It should be remembered that prior to 1973 most of the energy demand forecasting was performed via the energy/GDP relationship and the resulting coefficient was 'bent' by judgment to reflect changes in technology or the price of energy. After the first oil-price shock analysts discovered that 'prices matter'. So they tried to use the scant information that existed on fuel price data to estimate the missing price effect. It was after 1974 that the bulk of the energy studies appeared with a fuller specification, where energy prices are given a fair treatment. Energy economics is thus a far less mature subject than the main body of macroeconomics.

One of the main concerns in earlier and current studies is the problem of aggregating fuels into energy. The traditional method is the aggregation of fuels on the basis of their thermal content under ideal conditions. This concept of aggregation was challenged as early as 1965 by Turvey and Nobay [5]. The authors observed that demand theory suggests that in the case of a group of commodities, which are expressed in different quantity units aggregation should be done on the basis of monetary units. They suggested the alternative of expenditure and argued that 'the relevant conversion factors are either their marginal rates of transformation in production or their marginal rates of substitution in consumption. Thus, when they are looked at in relation to other purchases, fuel imputs should be valued at marginal cost to the consumer'.

But in practice those who chose to aggregate fuels in terms of expenditures, rather than BTU equivalent, [2] are faced with the rapid escalation of prices after 1973 which calls for the use of moving rather than constant weights. In volatile periods as in the past decade, if fuel prices constitute the weights used to aggregate the different fuel quantities, then in order to capture the changing structure of the energy market the use of moving price weights is necessary (as in the Paasche concept of indexing). This practice, however, creates a formidable identification problem because one of the independent variables, price, has been used in both sides of the equation.

A more sophisticated solution to the problem of aggregation has been suggested by Diewert [6], whose theoretical work strongly supports a production function approach. An equivalent methodology is also proposed by Hudson and Jorgenson [7] based on a unit-cost function. According to the authors, the solution to the aggregation problem has, as a starting point, a cost function where the price of energy becomes a function of the price of individual fuel prices. However, both the production function and the cost function approach, to the problem of computing the price and quantity of aggregate energy, require far more information than needed to determine the price elasticity of energy [3] namely the full specification of a production function involving capital stock evaluations, labour energy and materials as well as their respective factor prices. The escalation of complexities and the computer costs involved have led the working group of Energy Modelling Forum [1] to avoid using either the Diewert or the Hudson-Jorgenson approach and instead to use the more economical and direct

[1] Figures in brackets refer to bibliography at the end of this chapter.

[2] BTU: British thermal unit.

[3] However, either the production function or the factor cost share approach does not eliminate the need to aggregate individual fuels. Energy still enters into the equations in terms of values rather than physical quantities.

approach of index numbers, which provides an approximation to the production or cost function approach. Consequently, the methodology followed by the Energy Modelling Forum [1] is in line with the less sophisticated work proposed earlier by Turvey and Nobay [5].

An improvement to the aggregation of fuels on the basis of BTUs is the distinction between primary energy and delivered or useful energy. In an early paper (1968) Adams and Miovic [8] pointed out that fuels have different efficiencies when they are used in alternative technologies. The 'useful' energy concept has subsequently been used by many researchers in applied work. The empirical results are usually more satisfactory especially in countries where major interfuel substitutions have taken place (Dunkerley [10]).

But the elasticities obtained from useful energy data may be biased (a point also raised in [2]). The thermal efficiency adjustment implies that prices for individual fuels fail to reflect such differences in thermal efficiencies. This problem can be overcome if prices are aggregated on a useful energy basis. Additionally elasticity estimates vary as a result of the adjustments made for efficiency differences. Hence they depend on the efficiency factors applied to convert final energy into useful energy. But efficiency factors do not exist on a nationally agreed country-by-country and sector-by-sector basis. These considerations have consequently led many researchers to use the traditional BTU aggregated data unadjusted, as they appear in numerous statistical sources.

1.2. *Aggregate demand for energy — Empirical results*

Empirical results on the aggregate demand for energy appear either on a national time series basis or on a regional pooled time series cross-section basis. The lack of price variability, especially before 1973, has led many researchers to use time series data across a number of countries. However, the main weakness of using pooled data is the fact that the resulting elasticities refer to a long-term unspecified period. The data variability across countries implies similar behaviour between countries that reach a similar development stage, a hypothesis that may or may not materialize but until it does the time required is unspecified. Thus the estimated elasticities equally reflect this long-term but unspecified time interval. This weakness disappears when time series data are used on their own. The time interval is then fixed (year, quarter, etc.) and the computed short-term or long-term elasticities refer to such specific interval.

1.2.1. In Table 1.1 a number of studies are reported, which have used the pooling technique on data for industrialized countries. The values of the estimated income elasticities range between 0,83 and 1,27 (a much narrower range than the price elasticities). These values are not far off from unity, something that has been the usual finding of many studies based on time series data.

The price elasticities assume values between −0,31 and −0,87. Judging from the studies that provide a split in the period investigated (Dunkerley, Kouris), it appears that the bigger the sample the bigger the estimated elasticity; something confirmed by the Nordhaus study which is based on a similar period. [1] The OECD study using more recent data is able to capture the entire period of the first oil-price shock (1973-78), in this most recent period the price elasticity increases significantly compared to the entire estimation period (1960-78). Indeed in periods of sharp price fluctu-

[1] This observation, however, is more of statistical significance rather than economic significance. In other words as the sample increases the variability of the price variable also increases thus producing a stronger effect. On the contrary when the sample of estimation becomes smaller variability is reduced and the resulting elasticity is weaker.

Table 1.1

Regional energy demand elasticities from pooled data

Author		Countries covered	Period	Data	Elasticity	
					Income	Price
Dunkerley	[10]	11	1953-74	Useful energy	1,23	−0,61
Dunkerley	[10]	11	1960-76	Useful energy	1,20	−0,47
Kouris	[11]	7	1955-70	Primary energy	0,84	−0,77
Kouris	[11]	7	1965-70	Primary energy	1,27	−0,31
Nordhaus	[12]	7	1959-72	Useful energy	0,79	−0,85
OECD	[13]	11	1960-78	Final energy	1,00	−0,69
OECD	[13]	11	1973-78	Final energy	0,83	−0,87

ations one would expect consumers' frustrated expectations about the future, to increase the price effect.

1.2.2. In Table 1.2 time series results for selected countries are reported (the studies quoted refer to a number of countries but for reasons of simplicity and space, the results for only the USA and the big four European countries are mentioned).

Here also the income elasticities from the time series country results are clustered around unity, with two important exceptions: Italy's elasticity is consistently the highest and the United Kingdom's the lowest. In the case of Italy its rapid industrialization during the 1960s and the early 1970s must account for this higher value compared to other industrialized countries. This, of course, is the problem with aggregate data, in that there is no allowance for 'sifts' over time in the various sectors of the economy.

In the case of the United Kingdom the low income elasticity in the first instance appears to be explained by the lack of adjustment for different fuel efficiencies. The useful energy data used in the Dunkerley [10] study seem to improve this situation as the UK income elasticity takes a value just over one.

Table 1.2

Income and price elasticities, aggregate demand for energy, time series results

	FR of Germany	France	Italy	United Kingdom	USA
Author: Dunkerley [10]	Period: 1960-76			Data: useful energy	
Income	1,34	1,19	1,80	1,04	0,98
Short-term price	−0,41	−0,39	−0,31	−0,08	−0,24
Long-term price [1]	—	—	—	—	—
Author: Kouris [16]	Period: 1960-78			Data: final energy	
Income	0,87	0,96	1,06	0,43	0,77
Short-term price	−0,18	−0,14	−0,11	−0,18	−0,16
Long-term price [2]	−0,51	−0,39	−0,34	−0,41	−0,47
Author: Nordhaus [12]	Period: 1956-72			Data: useful energy	
Income [3]	0,29	1,11	1,07	0,57	0,39
Short-term price	−0,44	−0,16	−0,33	−0,42	−0,26
Long-term price [4]	−0,89	—	−0,50	−0,49	−0,57
Author: OCDE [13]	Period: 1960-78			Data: final energy	
Income	1,08	1,16	1,41	0,57	1,02
Short-term price	−0,11	−0,10	−0,14	−0,10	−0,09
Long-term price [5]	−0,44	−0,41	−0,55	−0,42	−0,38
Author: Pindyck [17] [6]	Period: 1960-74			Data: expenditure on energy	
Income	0,87	0,89	0,90	0,89	0,82
Short-term price	—	—	—	—	—
Long-term price [7]	−1,01	−1,08	−0,98	−1,10	−1,06

1 No-long term reaction has been allowed for.
2 A Koyck distributed lag hypothesis was assumed.
3 The computed long-term income elasticities were: FR of Germany = 0,6; France = not computed; Italy = 1,6; UK = 0,7; USA = 0,8.
4 A partial adjustment hypothesis was assumed. For France the long-term elasticity is not quoted because the lagged term had a negative sign.
5 An Almon distributed lag scheme was assumed with seven-year lags.
6 Since no aggregate elasticities have been computed, the elasticities quoted here are weighted averages of the sectoral elasticities that appear in the original study. The Pindyck study focuses on the long run so the short-term price elasticities are not quoted.
7 For each sector a different dynamic structure has been assumed.

However, the Nordhaus [12] study, which has equally been adjusted by engineering-type efficiency factors, produces a much lower short-term and long-term income elasticity and in line with the results of unadjusted data studies. [1]

Another odd feature of the Nordhaus [12] study is the comparatively high short-term price elasticities for all countries except for France. Two other studies (Kouris [16] and OECD [13]), which also allow for long-term adjustments, produce short-term price elasticities which, in general, are at least half the size of those reported by Nordhaus [12]. One explanation may be that the adjustment for different fuel efficiencies generally increases the size of the price elasticity.

In the two studies (Kouris [16] and OECD [13]) which use unadjusted energy data the long-term price elasticities range between $-0,4$ and $-0,5$, a very narrow band indeed. [2]

The Pindyck [17] study comes up with the highest elasticities for the period considered. This seems to be implausible especially since only one year, from the first oil price explosion period, has been included in the sample. [3] The main difference, however, between the Pindyck [17] study and the rest, is the use of expenditures on energy rather than physical quantities consumed.

The crucial effect that one would wish to assess in a survey of energy studies, is the short and long-term price impact on energy demand. A general weakness of all the studies mentioned here is that none is recent enough to include the effects of the second oil-price shock. Clearly the inclusion of the 1979-81 data should yield results somehow different and more pertinent for the future. Even the inclusion of the first oil-price shock does not free the results from some oddities: the short-term UK price elasticity is estimated to be in the range of $-0,08$ and $-0,42$, the long-term price elasticity for Germany ranges between the values of $-0,44$ and $-1,01$. These observations point to the realization that unless data, time period and specification become more standardized, the results obtained are bound to show considerable fluctuations.

1.3. *Some general remarks about aggregate energy elasticities*

A survey of the empirical results on energy demand reveal that there are a multitude of sources responsible for elasticity differences. Perhaps the major one is time. Pre-1973 studies naturally undermined or neglected the price effect. But as we enter the 'energy crisis' period the impact of price on energy demand becomes progressively more and more dominant. The 1974 OECD projections [18], for example, were based on an area aggregate long-term elasticity of $-0,30$. By contrast the 1982 OECD energy outlook [18] is based on an implicit long-term price elasticity of $-0,65$.

Another source of differences in elasticity estimates is the often overlooked specification of the long-term income elasticity. In the case of the long-term price elasticity the implicit behaviour is meaningful and essential in energy demand projections. An increase in the price of energy generates conservation trends which are long lasting. The restructuring of the industrial capital stock and of appliances in the household, the trends in vehicle fleet efficiencies, etc., are elements which change slowly as a result of changes in energy prices.

The same dynamic mechanism does not really apply in the case of the income elasticity. The income effect on energy demand is indirect because it depends on the utilization of the energy-using equipment. Even if, because of high past incomes, the capital stock or the appliances in the household have accumulated over time there is no guarantee that they will be fully utilized in any given time period: thus high past incomes (unlike past prices) have little influence on energy demand now. It is essentially current income changes which, by setting the utilization rate of the existing energy-using equipment, determine (together with prices and other factors) the level of energy demand.

Some researchers have sought the solution to the shortcomings of the simple single equation models in an increase in sophistication. It is argued that simple models ignore the interaction between energy and the other inputs of the production process. The lag structure (i.e. Koyck, Almon, partial adjustments) is externally imposed and the result is often unrealistically high price elasticities. More sophisticated specifications are needed to allow the speed of adjustment of input factors to long-run equilibrium to be endogenous and time-varying rather than fixed ad hoc (see Berndt *et all.* [25]).

In this framework the ratio of energy to capital is endogenized and represents a measure of short-run capacity use. The path to equilibrium is based on continuous economic optimization while the speed of adjustment for 'quasi-fixed' factors is being determined by cost-minimization behaviour. This specification is claimed to produce clearly defined short, medium and long-run elasticities. Nevertheless, it is recognized that this is done at the expense of a lot of degrees of freedom.

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[1] Even under different specifications (i.e. Almon lags) the Nordhaus [12] study produces an income elasticity for the United Kingdom between 0,6 and 0,7.

[2] Although different price series have been used and different dynamic assumptions imposed on the data.

[3] An additional unsatisfactory feature of the Pindyck [17] study is the close proximity of the country income and price elasticities. This is primarily due to the specification chosen (for more explanations see next section on sectoral demand elasticities).

On the lines of this theorizing—see Berndt [25]—the US manufacturing sector has been investigated. The surprising feature in this study was the measurement of the income elasticity which, at the value of 0,23, was even below the short-run price elasticity. This seems unrealistic since a 1% increase in both income and price would result on balance in a lower energy demand in the short term. In a similar dynamic optimization model Berndt, Fuss and Waverman [26] came up with the implausible result that the long and short-run price elasticities in the US manufacturing sector differ only minutely.

Such results, as well as the skepticism that the Pindyck [17] findings generate, appear to cast doubts about the validity of overly sophisticated models. It is an open question whether firms or households act in a complicated way. There is a growing feeling that unduly increased model sophistication, for the time being, is probably of more theoretical than practical use.

2. Sectoral demand studies

Identification of energy demand behaviour should be carried out at the sectoral level. When energy demand is analysed at the aggregate (total economy) level, many meaningful 'shifts' within the structure of the economy are lost. Aggregate equations are essentially input-output 'devices' and they can tell us no more than the amount of energy required for the production of a unit of GDP plus any price-induced conservation trends. At the sectoral level, however, the different time profile of adjustments which take place in households and firms can be investigated. Besides, the general phenomenon in industrialized economies of increased demand for services over time—something that would bias aggregate elasticities downward [1]—does not impair empirical results on a sector-by-sector basis.

2.1. *Energy demand functions for the industrial sector*

Energy demand in the industrial sector can best be viewed as derived demand stemming from the need to use the services of various inputs (capital, labour, energy, materials) in the production process. Profit maximization and cost minimization are the main optimalities embedded in most model specifications.

2.1.1. In a recent sectoral demand study Cato [27] has used a variant [2] of the pooling technique to estimate sectoral demand elasticities for most OECD countries.

The study was performed on data covering the 1959-77 period and the dynamic mechanism assumed was partial adjustments. For the entire EEC manufacturing sector the author quotes short and long-term output elasticities equal to 0,52 and 0,95 respectively. The short and long-term price elasticities were −0,05 and −0,09 respectively. For the USA, Canada and Japan as a group, and the manufacturing sector, Cato [27] reports short and long-term output elasticities of 0,21 and 0,72 while for the short and long-term price elasticity the values were −0,09 and −0,31 respectively.

[1] Clearly when the economy moves towards more services it also becomes less energy-intensive and thus the impact of income and price on energy demand becomes less pronounced.

[2] The so-called random coefficient regression first developed by Swamy [28].

Table 2.1

Elasticities with respect to industrial demand for energy (pooled time series cross-section data)

Author		Countries covered	Period	Data	Elasticity	
					Income	Price
Dunkerley	[10]	9	1960-76	Useful energy	1,13	−0,20
Griffin and Gregory	[29]	9	1955-69	Share of energy [1]	—	−0,79
Nordhaus	[12]	7	1956-72	Useful energy	0,76	−0,52
OECD	[13]	11	1973-78	Final energy	0,97	−0,55
Pindyck	[17]	10	1959-74	Share of energy [1]	0,75	−0,80 [2]

[1] The elasticities have been estimated from a translog specification and factor share equations.
[2] In the original study both income and price elasticities appear for each country individually but they were derived from a pooled sample. Thus for the sake of comparison we have calculated the weighted average elasticity for the group of countries.

As the author admits himself an unsatisfactory result of the specification chosen was the implicit assumption of the partial adjustment hypothesis which constrains the dynamic mechanism for both income and price to be the same. Besides, the reported results with respect to the price elasticities do not appear to be plausible. In particular, a long-term price elasticity of $-0,09$ for the EEC manufacturing sector appears to be improbably small and would suggest only a minute long-term restructuring of the production process following an energy price increase.

For the industrial sector as a whole several authors have produced area elasticities on the basis of pooling time series data of a number of countries. A number of them are listed in Table 2.1.

As already observed in the case of aggregate (total economy) income elasticities, the output elasticity of the industrial sector is close to unity even though the sample refers to pooled data which theoretically capture long-term elasticities.

The price elasticities quoted in Table 2.1 range from $-0,2$ to $-0,8$. But the range narrows if we take into account the different specification of the models used. Both the Griffin-Gregory [29] and the Pindyck [17] studies start with a translog cost function [1] and estimate the price elasticity of the share of energy (being one of the factors of production) rather than of actual energy quantities consumed. Thus when energy quantities (raw or adjusted for efficiency) are used, the computed long-term price elasticity for the industrial sector of developed economies ranges between $-0,2$ and $-0,6$.

2.1.2. Of the studies quoted in Table 2.2 the Nordhaus [12] results seem the least convincing, being in general out of line compared with the other studies. The specification chosen and in particular the partial adjustment hypothesis which imposes a long-term reaction on income is probably responsible for these bad results. The IEA [32] results, where no long-term income reaction has been assumed or even the completely static formation of the Dunkerley [10] study, suggest that the income elasticity is more robust when it is computed as a year-on-year effect rather than distinguishing between short and long-term income reactions.

The long-term price elasticities of the Griffin [31] and Pindyck [17] studies are very similar and for all countries there appears to be a converging value of $-0,8$. It should be noted, however, that although the authors quote different elasticities for each country the results are derived from a pooled sample and thus the reaction picked up by the elasticities essentially pertains to some average behaviour. Of course, the specification permits differential elasticities to be calculated but this does not significantly change the results which cluster around an average value. In fact the hypothesis of a common slope and differential intercepts [2] could very well have been used so that the price elasticity would be identical for all countries.

The IEA [32] study produces a long-run price elasticity half the size of the one produced by Pindyck and Griffin. Nevertheless, the IEA results are consistent with the range of elasticities produced by the pooling technique (quoted in Table 2.1) on raw or efficiency-adjusted energy data. The $-0,4$ average long-term price elasticity quoted by the IEA falls in the middle of the $-0,2$ to $-0,6$ range suggested by similar studies quoted in Table 3.

Although the Pindyck-Griffin and the IEA studies produce long-term price elasticities which differ in size by a factor of two, there is a common feature in all: the individual country elasticity differences are very small indeed. Something which suggests that in the industry sector of industrialized countries the long-term reactions with respect to energy price changes are similar.

In all studies reported in Table 2.2 the income elasticity for Italy is higher compared to the other countries. This is natural in view of the industrialization stage of Italy compared to other Western countries. But the results again point to an aggregation problem. When there are sectors within industry (i.e. heavy industries) which change faster than the rest, then the aggregate elasticity would tend to reflect such structural changes. Hence a disaggregation which would at least distinguish between light and heavy industries (and consequently between less and more energy-intensive industries) appears to be preferable to follow.

The results of the Dunkerley [10] study reveal that a static version of the demand for energy in industry is unsatisfactory. The computed yearly price elasticities are usually far too big [3] and a misspecification which ignores the existence of any time lags can lead to the computation of even positive price elasticities (France). However, as the results surveyed so far suggest, any dynamic structure chosen should be flexible enough to allow for differential reactions with respect to the income and the price effects.

2.2. *Energy demand functions for the residential/commercial sector*

The basic characteristic of energy demand behaviour in the residential/commercial sector is the multi-activity purpose

[1] A theoretical framework originating from the work of Christensen, Jorgenson and Lau [30].

[2] A common assumption in pooling different country time series.

[3] Mainly because they absorb part of the missing long-term price effect.

Table 2.2

Elasticities with respect to industrial demand for energy (time series results)

	FR of Germany	France	Italy	United Kingdom	USA
Author: IEA [19]	Period: 1960-79			Data: final energy	
Income	1,10	0,96	1,15	0,65	0,77
Short-term price	−0,19	−0,18	−0,14	−0,18	−0,15
Long-term price [1]	−0,45	−0,39	−0,40	−0,40	−0,36
Author: Dunkerley [10]	Period: 1960-76			Data: useful energy	
Income	0,74	0,72	1,38	0,33	0,87
Short-term price	−0,26	0,29	−0,73	−0,31	−0,60
Long-term price [2]	—	—	—	—	—
Author: Griffin [31]	Period: 1965 [3]			Data: share of energy	
Income	—	—	—	—	—
Short-term price	—	—	—	—	—
Long-term price [4]	−0,80	−0,80	−0,79	−0,80	−0,79
Author: Nordhaus [12]	Period: 1956-72			Data: useful energy	
Income	0,24	0,17	1,18	−0,02	0,63
Short-term price	−0,11	−0,47	−0,82	−0,79	−0,21
Long-term price [5]	−0,21	−0,82	—	−0,88	−0,33
Author: Pindyck [17]	Period: 1959-74			Data: share of energy	
Income	0,76	0,78	0,86	0,78	0,62
Short-term price	—	—	—	—	—
Long-term price [6]	−0,82	−0,82	−0,84	−0,84	−0,75

1 A Koyck lag distribution scheme was used to derive the long term.
2 No long-term reaction has been assumed.
3 The model was estimated from pooled international data for manufacturing. Four benchmark years were included (1955, 1960, 1965, 1969) but the elasticities reported here have been calculated by Griffin for 1965 for all sample countries.
4 The elasticities are derived from a cost share regression model where only the long-run price effect is investigated.
5 A partial adjustments hypothesis was assumed. The long-term income elasticities not quoted in the table are: USA = 1,0; France = 0,3; FR of Germany = 0,5; Italy = not computed for wrong lag term sign; UK = 0,02.
6 Elasticities computed from a translating model of specification.

use of energy and the long-term nature of adjustments due to the very slow changes in the housing stock. The long-term price elasticities then are usually bigger in the residential/commercial sector compared to the other sectors of the economy.

The difficulty with the residential/commercial sector is that most statistical sources lump into this sector data from also the agricultural and public administration sectors. Thus modelling the so-called 'domestic' sector becomes more difficult because the economic theory postulates, about consumer behaviour, do not apply *mutatis mutandis* on the agricultural and public administration sectors. Additional data problems also arise from the way the residential/commercial sector data are constructed: some sources [1] calculate the residential/commercial energy consumption data as a residual. Hence any statistical discrepancies that exist in the consumption data of the other sectors re-appear in the computed data for the residential/commercial sector.

[1] As in the OECD series 'Energy balances'.

Table 2.3

Elasticities for the residential/commercial sector (pooled time series cross-section data)

Author		Countries covered	Period	Data	Elasticity	
					Income	Price
Dunkerley	[10]	9	1960-76	Useful energy	1,73	−0,60
Griffin	[31]	17	1955-72	Useful energy	1,03	−0,95
Nordhaus	[12]	7	1959-72	Useful energy	1,08	−0,79
OECD	[13]	11	1973-78	Final energy	0,99	−1,00
Pindyck	[17]	9	1960-74	Expenditure on energy	1,00	−1,10

2.2.1. *Price and income elasticities from pooled time series* of a number of countries are reported in Table 2.3. All studies (except the OECD study) use as an income variable GDP per capita. In the studies where a temperature variable [1] is used, an elasticity of about 0,3 is reported.

The results of the five studies quoted in Table 2.3 are a lot more uniform than in the case of either the aggregate elasticities or the industrial sector elasticities. The income elasticity is very close to unity except in the Dunkerley study. In the Griffin study [2] the share of agriculture in total GDP has been used to allow for distortions created in the data from variations in the agricultural sector which is part of the residential/commercial sector. The inclusion of this variable indeed made an impact on the results as the income elasticity dropped (from 1,39 to 1,03) and the price elasticity rose (from −0,80 to −0,95). In the Pindyck study the income elasticity was constrained to unity since, by assumption, the starting point was a homothetic and stationary indirect utility function with unit total expenditure.

As expected the price elasticities (long-run) are generally bigger than in the aggregate total economy or the industry demand functions. Three studies report a price elasticity about unity and the other two not far from unity. The long-run nature of changes in the housing stock would support such long-term elasticities. But as already argued the difficulty with pooled data is the unspecified time span of adjustment.

2.2.2. In Table 2.4 *individual country income and price elasticities* from a number of studies are listed. A general dichotomy emerges from comparing the size of the price elasticities between the translog expenditure type of formulation (Griffin, Pindyck) and the formulations based on physical units (Dunkerley, Nordhaus, IEA). The long-term elasticities computed by the former are generally much higher and consistently above unity. In the latter group (the Dunkerley study is not strictly comparable because it has a static specification) only the US price elasticity as computed in the Nordhaus study has a high long-term price elasticity value (of −1,5). All other long-term price elasticities are well below unity, with values around −0,7.

A closer look at the Griffin [31] results reveal an inconsistency. When pooling of cross-sections and time series is performed, the author reports a price elasticity equal to −0,95 (presumably long-term). But when the individual country long-term price elasticities are calculated from each fuel elasticity, then the elasticity takes on average a value as high as −1,4. For reasons of clarity the fuel elasticities estimated in the Griffin [31] study are quoted in Table 2.5.

It is obvious from these results that the implicit energy price elasticities that can be computed for the residential/commercial sector are heavily affected by the high elasticities for coal and gas. However, these high elasticity values are accepted by the author on the basis of certain attractive theoretical properties, 'the translog model has the desirable property that as a fuel share approaches zero, the price elasticity rises, just as the standard linear demand curve becomes more elastic as consumption declines'. Thus because the share of gas and particularly coal has been small in the household of many industrialized countries a translog specification on historical data may yield a very high elasticity for these fuels. Consequently if there is a 1% increase in all fuels simultaneously then these results would imply a reduction in energy demand well above what can be expected. While at the same time the resulting long-run price elasticity of energy is

[1] Usually measured in degree days.

[2] A number of pooled regressions have been run but the results quoted here refer to the pooled dynamic equation.

Table 2.4

Elasticities with respect to residential/commercial demand for energy (time-series results)

	FR of Germany	France	Italy	United Kingdom	USA
Author: IEA [19]	Period: 1960-79			Data: final energy	
Income	0,73	1,06	1,21	0,58	0,73
Short-term price	−0,13	−0,17	−0,08	−0,09	−0,12
Long-term price [1]	−0,65	0,70	−0,70	−0,60	−0,70
Author: Dunkerley [10]	Period: 1960-76			Data: useful energy	
Income	2,43	2,04	2,17	1,62	1,18
Short-term price	−0,33	−0,41	−0,66	−0,01	−0,15
Long-term price [2]	—	—	—	—	—
Author: Griffin [31] [3]	Period: 1955-72			Data: fuel shares	
Income	—	—	—	—	—
Short-term price	—	—	—	—	—
Long-term price [4]	−1,30	−1,20	−1,50	−1,60	−1,40
Author: Nordhaus [12]	Period: 1956-72			Data: useful energy	
Income	0,60	0,93	0,65	0,97	0,17
Short-term price	−0,35	−0,07	−0,63	−0,36	−0,55
Long-term price [5]	−0,76	−0,14	−1,05	−0,38	−1,53
Author: Pindyk [17]	Period: 1960-74			Data: expenditure of energy	
Income [6]	1	1	1	1	1
Short-term price	—	—	—	—	—
Long-term price [7]	−1,05	−1,11	−1,12	−1,09	−1,10

1 A Koyck dynamic mechanism was initially used. Some results modified by judgment. Temperature elasticities computed were about 0,3 for France, FR of Germany and United Kingdom and zero for USA and Italy.
2 No dynamic mechanism allowed for.
3 In the original study only individual fuel elasticities were computed from fuel share equations. Hence we have constructed the implicit weighted average energy elasticities using consumption shares as weights.
4 The elasticities obtained from a general translog model of fuel consumption.
5 A partial adjustments mechanism was assumed. The long-term income elasticity is: USA = 0,47; France = 1,86; FR of Germany = 1,30; Italy = 1,10.
6 Income elasticity constrained to unity by assumption.
7 The elasticities computed from a translog model of consumption expenditure and for the year 1973.

Table 2.5

Residential/commercial sector own fuel price elasticities

	Coal	Gas	Oil	Electricity
USA	−42,9	−1,7	−1,0	−0,7
France	−2,9	−2,6	−1,0	−0,7
FR of Germany	−2,9	−4,0	−1,0	−0,6
Italy	−12,7	−1,8	−1,0	−0,7
United Kingdom	−3,2	−1,9	−1,2	−0,7

considerably higher than that computed by classical long-run methodologies such as the pooling technique.

The Dunkerley study [10] reveals once again that static versions of a relationship which is essentially dynamic may lead to implausible results. According to this study a 1% increase in income will induce within a year a more or less 2% increase in energy demand in the residential/commercial sector, something which contrasts sharply with the results of all other studies mentioned here.

The most surprising results in the Nordhaus [12] study refer to the USA where the income elasticity obtained is very

small, while the price elasticity is very high. In fact the long-term income elasticity (of about 0,5) is three times smaller than the long-term price elasticity (of about −1,5). This implies that energy price increases lead, in the USA, to very rapid displacement of energy in the household regardless of equal increments in incomes. Joskow and Baughman [32] found a long-term price elasticity for the residential/commercial sector of the USA equal to −0,60, while Nelson [33] found for the housing sector of the USA a price elasticity as low as −0,30. Both these studies as well as those reviewed in Table 2.4 [1] suggest that the long-term price elasticity of the US residential/commercial sector is not as high as −1,5 but instead its true value lies in the −0,7 to −1 region.

2.3. *Energy demand functions for the transport sector*

The demand for energy in the transport sector is in fact demand for oil as this is the main fuel used (99% of energy requirements in the transport sector of the OECD region are met by oil). In this sector, which uses practically only one source, the demand for motor gasoline commands a predominant position. Thus most of the empirical work on the transport sector actually refers to the demand for motor gasoline.

2.3.1. In Table 2.6 area elasticities for industrialized countries are quoted. Some studies refer to the energy consumption in transport while others refer to gasoline demand. The studies which refer to the total energy in transport typically use gasoline prices as a proxy for energy prices in that sector. Hence the results should be treated with caution.

Studies on motor gasoline demand have an additional advantage which stems from well documented statistics: car stock data, the average efficiency of cars as well as distance travelled, constitute a well structured framework within which motor gasoline demand can be analysed empirically. Thus many researchers have been able to 'get into the structure' of gasoline demand by estimating equations for the distance travelled and the efficiency of cars.

Other researchers have followed the less direct or reduced form approach where gasoline demand is made a function of income and prices variables, while a stock adjustment principle is supposed to capture the long-term effect of car ownership. The Cato [27] study, in Table 2.7, is of this type. Similarly the Kouris [34] study has followed the reduced form approach with a permanent income hypothesis rather than actual income. [2] The Griffin [31] and Pindyck [17]

[1] Except of course, the Griffin study (with an elasticity of −1,40). However, as pointed out, the results from aggregating individual fuel elasticities are highly suspect in this study.

[2] One of the reasons that the income elasticity is higher than in the other studies. However, in using this dynamic formation to project the 1974-76 period, Kouris [35] found that the forecast errors were bigger when the long-term adjustments were used and smaller when only the short-term (static) version of the model was used. Hence he concluded that the income and price variables capture a short-term behaviour and that the reduced form approach is inadequate to model motoring habits or car saturation levels.

Table 2.6

Elasticities with respect to energy/gasoline demand in the transport sector (pooled time series cross-section data)

Author		Countries covered	Period	Data	Elasticity	
					Income	Price
Cato	[27]	17	1959-77	Gasoline	1,13	−1,09 [1]
Dunkerley	[10]	9	1960-76	Useful energy	1,09	−1,00
Griffin	[31]	18	1955-72	Gasoline	0,33	−1,28
Kouris	[34]	7	1956-73	Gasoline	1,73	−0,75 [1]
Nordhaus	[12]	7	1956-72	Useful energy	1,34	−0,36
OECD	[13]	11	1973-78	Final energy	1,00	−1,12
Pindyck	[17]	11	1960-74	Gasoline	0,84	−1,31 [2]

[1] A dynamic hypothesis was assumed in the original studies so the elasticities quoted here refer to the implicit long-run values.
[2] The values of theses elasticities are obtained after 25 years of long-run adjustments.

studies follow the structural approach to modelling gasoline demand, and they coincide in the estimation of the long-term gasoline price elasticity (with a value equal to −1,3). The Griffin [31] study also produces a much smaller income elasticity (0,33) in comparison to the other studies. But this is mainly due to using, as the dependent variable, gasoline consumption per car. Hence in this formulation an implicit car stock variable exists with an elasticity constrained to unity, so that gasoline demand on its own is affected not only by an income elasticity equal to 0,33, but also by another related factor, the car stock which has an elasticity equal to 1. [1]

[1] In fact the Griffin [31] gasoline demand equation had an additional independent variable, car stock per capita, with an estimated elasticity equal to −0,59. Thus a combined 1% increase in income and the car stock—other factors remaining constant—would lead to the following net change in gasoline demand 0,33+1−0,59=0,74. Because of the interdependence of the income variable and the car stock variable the broad income effect in the Griffin study can be thought of as equivalent to 0,74.

Table 2.7

Elasticities with respect to energy/gasoline demand in the transport sector (time series results)

	FR of Germany	France	Italy	United Kingdom	USA
Author: IEA [19]	Period: 1960-79			Data: gasoline	
Income	0,85	0,85	0,95	0,85	0,80
Short-term price	−0,20	−0,17	−0,18	−0,12	−0,26
Long-term price [1]	—	—	—	—	—
Author: Cato [27]	Period: 1959-77			Data: gasoline	
Income	0,05	0,58	0,17	0,36	0,21
Short-term price	−0,10	−0,21	−0,14	−0,18	−0,14
Long-term price [2]	−0,91	−0,51	−0,70	−1,13	−1,08
Author: Dunkerly [10]	Period: 1960-76			Data: useful energy	
Income	1,50	1,27	1,46	1,85	1,06
Short-term price	−0,54	−0,18	−0,18	−0,08	−0,03
Long-term price [3]	—	—	—	—	—
Author: Nordhaus [12]	Period: 1956-72			Data: useful energy	
Income	0,79	1,62	0,61	1,54	0,24
Short-term price	−0,13	−0,66	−0,09	0,02	−0,02
Long-term price [4]	−0,28	—	−0,23	0,03	−0,76
Author: Pindyck [17]	Period: 1960-74			Data: gasoline	
Income	0,07	0,07	0,07	0,07	0,07
Short-term price	−0,12	−0,13	−0,05	−0,13	−0,11
Long-term price [5]	−1,38	−1,60	−1,13	−1,77	−1,26

1 The long-term reaction has been assumed to be represented by the average car efficiency which was an exogenous variable to the model. The income elasticity in fact refers to the car stock elasticity.
2 A partial adjustments hypothesis was assumed. The long-term income elasticities were: USA = 1,62; France = 1,41; FR of Germany = 0,45; Italy = 0,85; UK = 2,25.
3 No long-term reaction has been assumed.
4 A partial adjustments hypothesis was assumed. No long-term elasticities calculated for France because the lag term coefficient was outside the *a priori* range. The long-term elasticities were: USA = 0,83; FR of Germany = 1,65; Italy = 1,53; UK = 2,20.
5 The structural approach has been followed (i.e. allowing for distance travelled and car efficiencies). The long-term elasticities calculated after the elapse of 25 years. The long-term income elasticities were: USA = 0,84; France = 0,87; FR of Germany = 0,84; Italy = 0,84; UK = 0,90.

From the three studies (Dunkerley, Nordhaus, OECD) which analyse energy rather than gasoline demand, two (Dunkerley and OECD) produce quite similar income and price elasticities, both close to unity. In the Nordhaus study the income elasticity is much higher, about 1,3, while the price elasticity is much lower, about −0,4. This difference in elasticities is probably due to the period of estimation. The Nordhaus study uses none of the post-energy-crisis years in the sample of estimation. Consequently the absence of strong consumer reaction to higher prices is reflected by the weaker price elasticity. At the same time the income elasticity is higher reflecting primarily the accumulation of the vehicles in a period of healthy economic growth.

2.3.2. In Table 2.7 individual country elasticities are reported from a number of studies. The results show vividly that, depending on the specification chosen, the estimated elasticities can differ markedly.

The Pindyck study, with slow adjustments and elasticities derived from a pooled sample, produces the smallest one year income elasticities of any of the reported studies. In addition the income elasticities are almost identical in both the short and long term. As regards the estimated long-term price elasticities of the Pindyck study, they are the highest compared to the other studies. The responsibility for these conflicting results lies probably in the long-term adjustment periods, which are calculated to be as long as 25 years, while the average life of a car on the road is estimated at between 7 and 12 years.

Both the Cato and Nordhaus studies are based on a partial adjustment hypothesis and yet the resulting elasticities are quite different. It appears then that the differences in the estimation period (1959-77 versus 1956-72) and the data chosen (gasoline versus total energy) are responsible for large differences in the computed elasticities. Clearly income and gasoline price variables are gross approximations for total energy demand in the transportation sector. Finer disaggregation (i.e. individual demand functions for gasoline, aviation fuels, fuel oil for shipping, etc.) is necessary if energy use in the transportation sector is to be modelled properly.

The short-term price elasticities as computed in three of the studies (Cato, IEA, Pindyck) seem to be relatively uniform. They suggest, for the industrialized countries, a one-year gasoline price reaction in the region of −0,1 to −0,2. This is in accord with prior expectations about the short-term price inelasticity of gasoline demand and hence its use as a good tax revenue instrument. Little can be said about the income elasticity of gasoline demand, mainly because of the wide differences in the results.

2.3.3. The investigation of the abundant US literature on gasoline demand (see Table 2.8) does not produce such widely conflicting results. Judging from the studies reviewed

Table 2.8

US price elasticities with respect to motor gasoline demand

Author	Time period	Short-run elasticity	Long-run elasticity
Mc Gillivory [35]	1951-69	−0,22	−0,69
Anderson [36]	1952-72	−0,11	−0,60
Dahl [37]	1935-72 [1]	−0,44	−0,78
Cato *et al.* [38]	1959-73	−0,24	−0,36
Sweeny [39]	1957-74	−0,22	−0,73
US DOE [40]	—	−0,16	−0,55 [2]
Kouris [41]	1955-81	−0,40	−1,02

[1] The 1942-46 period omitted from estimation.
[2] The short-run elasticity has been derived judgementally and is part of the short-term integrated forecasting system of EIA. The long-run elasticity, also judgemental, is part of the demand analysis system of EIA.

the short-term price elasticity in the USA seems to lie in the −0,2 to −0,4 neighbourhood. As regards the long-term price elasticity of gasoline demand there appears to be a consensus around the value of −0,7. In the only study where most up-to-date data have been used (Kouris [41], 1955-81 period) the long-term price elasticity is the highest, about −1. In this study gasoline demand has been modelled through the structural approach (just as in the Dahl [37] and the Sweeny [39] studies) and the results suggest a strengthening of the long-term reaction as we enter the post-1973 period of higher prices.

2.4. *Conclusions on the sectoral demand analysis*

A survey of the empirical results on energy demand functions has highlighted a number of causes responsible for conflicting evidence on price and income elasticities. Among these causes the most prominent were:

(i) choice of fuel aggregation (i.e. primary energy, final energy, useful energy, expenditure on energy);

(ii) choice of sectoral breakdown (i.e. aggregate functions versus sectoral functions, subdivision of industry into heavy and light industries, the treatment of the transportation sector at the energy level or at the fuel level);

(iii) choice of dynamic specification (i.e. partial adjustments, Koyck geometric declining schemes, polynominal or Almon lags, translog specification);

(iv) choice of data intervals (i.e. annual time series versus cross-sectional data or pooled cross-section and time series data); and

(v) choice of time period of estimation (the critical factor here is the number of post-1973 years included in the sample).

It is not surprising then that many researchers have sought the solution to these problems in the judgemental adjustment of econometrically derived results. In this spirit the World Energy Outlook, prepared by the IEA [19], was based on judgementally projected elasticities into the future. This procedure was followed because factors such as technological progress, structural shifts within industry, appliance saturation levels in the household, etc., cannot adequately be captured by econometric techniques. Hence an allowance for the variation of these factors should be made and one way is to alter the size of the income and price elasticities in future periods.

However, in applied energy work the only evidence we have is that of the past. Thus every effort should be made to improve the information flow embedded in historical data. In view of the results surveyed in the literature the use of a BTU fuel aggregation procedure adjusted for relative fuel efficiencies should improve results, especially when ample engineering data exist. Furthermore, if fuel efficiency factors on a time series basis exist then the major difficulties from the usually missing technological progress factor could also be solved.

The breakdown of energy demand into a number of industrial sectors where light and heavy energy users are treated separately is clearly an advantage. A similar breakdown ought to be made in the so-called 'domestic' sector as well as a differentiation between alternative fuel demands in the transportation sector.

The choice of dynamic specification is crucial. Based on the literature surveyed, it appears that neither a sophisticated translog type of specification, nor a simple partial adjustment hypothesis yields promising results. On the contrary, the flexibility of a polynominal distribution lag scheme or the Koyck specification, where the income variable may or may not be distributed over time, appears to be more appealing.

The type of data used (either cross-section or pooled data) should be treated with caution because of the implicit long-term reaction which does not have a clear time dimension. It was argued (and there is supportive evidence in the empirical results), that the use of an income variable for long-term projections is essentially of a short-term nature, and hence the annual income elasticity is the appropriate measure to use.

Lastly (and very importantly) the time span included in the estimation period is very crucial indeed. The pre-1973 period in energy studies is interesting but not so relevant. It is only when the full impact of the two oil price shocks is included in the sample of observations, that the resulting income and price elasticities can be thought of as being representative for at least the immediate future.

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Chapter III: Energy demand elasticities: a model, with results for five Community member countries [1]

[1] This chapter has been written by N. Kouvaritakis, Expert at the Directorate-General for Science, Research and Development.

List of tables

Graphs

Introduction

This chapter proposes a complete, if highly aggregated, model for energy demand built on the lines sketched in the conclusions to the preceding chapter reviewing the literature on energy demand elasticities. This model, called Esteden, has been used to evaluate the main energy demand elasticities in five countries: FR of Germany, France, Italy, the Netherlands and the United Kingdom; the country-by-country approach was adopted because available data take the form of time series by country from 1960 to 1981.

The sectors examined are the residential/commercial sector and industry, which together account for over 75% of final energy consumption in the European Community. As remarkable results have generally been achieved in these sectors in terms of reducing energy intensity, it was interesting to evaluate the corresponding price and income elasticities. In specifying the model, attention was focused on coherent distinctions between:

(i) *short-term price effects* (i.e. changes in energy consumption that do not result from a long-term investment, but rather reflect the immediate reaction of consumers to a change in the price of energy);

(ii) *long-term price effects* (i.e. reactions to price changes that imply long-term investment, covered by introducing an appropriate dynamic formula);

(iii) *the effects of structural change* (e.g. changes in the share of high-energy-consumption industries in total industrial output, central heating penetration and saturation in the dwelling stock, etc.);

(iv) *purely short-term or marginal income effects* (i.e. those that are independent of the effects of structural change);

(v) *specific variables* corresponding to the special features of energy consumption by the sector (e.g. degree-days);

(vi) *other autonomous effects* (i.e. general trends that are independent of the above factors).

Special care was taken to include the period 1979-81 in the estimation sample, so as to take as full account as possible of the very large increase in the prices of energy products that occurred during that period.

Eurostat data and definitions were used wherever possible, in particular energy consumption by fuel, fuel prices, interest rates, other key macro-economic variables, industrial output by branch, degree-days, etc.

More specifically, the energy statistics (prices and quantities for various energy sources available to consumers) are taken from the energy prices databank of the SOEC. [1] These series were converted using yield factors calculated by the SOEC, to highlight the consumption and prices of 'useful energy', [2] pursuant to the conclusions reached in Chapter II. However, since fixed coefficients were used for conversion, changes in the yield of each energy source over the estimation period (technological progress) are not taken into account.

Most of the gaps in Eurostat data were filled from other sources, but an attempt was made to keep to the same definitions as far as possible. For a number of variables like average dwelling size, central heating penetration rates, etc., survey data were used, and some extrapolation was made to fill gaps in the time series. Unsatisfactory as this use of soft data might seem, the approach is in fact justified by the gain in terms of logical robustness and analytical potential.

The first part of this chapter is a theoretical description of the model, justifying the specifications and explaining the meaning of the energy demand function parameters for each of the two sectors. The second part includes a brief presentation, with comments, of the results of the estimation, referring to the earlier studies mentioned in Chapter II, and some general conclusions about the economic significance of the results obtained.

1. The Esteden model

The model proposed for estimating energy demand comprises specifications common to the industrial and residential/commercial sectors, and separate specifications for each sector corresponding to the different structural variables incorporated.

1.1. *The general approach*

The *quantity of energy consumed* in year t is defined as:

$$U_t = \sum_j CN_{jt}\, u_{j(t)}$$

where U_t is the 'useful' energy consumed, CN_j the energy supplied by source j, and u_j the conversion factor to obtain the quantity of useful energy supplied by u_j (since each energy source has a different yield coefficient depending on the sector of use and technology applied). The reader will recall that the choice of useful energy as the variable avoids biases that would otherwise affect the estimations in view of the switch from less efficient sources (solid fuels) to more

[1] See *Energy price indices 1960-80*, SOEC, 1982.

[2] See the box in Chapter I on the main definitions in energy balance sheets, and the discussion of useful energy in Chapter II.

efficient ones (hydrocarbons, electricity) that occurred throughout most of the period under study.

Energy prices are dealt with at two levels, to separate short-term and long-term price effects.

First, real prices are defined by reference to an appropriate deflator (consumer price CPI_t for the residential/commercial sector, wholesale price of manufactures WPI_t for the industrial sector) to identify the *short-term price effects*. The formulae for real energy prices as an average, weighted for quantities consumed, and expressed in useful energy, are as follows:

Industry

$$P^w_{et} = \frac{\sum_j CN_{jt}\, u_{j(t)}\, P_{jt}}{U_t\, WPI_t}$$

Residential/commercial

$$P^c_{et} = \frac{\sum_j CN_{jt}\, u_{j(t)}\, P_{jt}}{U_t\, CPI_t}$$

where P_{jt} is the final price to consumers of one gigajoule of energy from source j in national currency, fully taxed to the residential/commercial sector and net of VAT to the industrial sector.

Secondly, to isolate *the long-term price effect*, real energy prices are calculated with reference to the cost of capital depreciation LRK_t defined as follows:

$$LRK_t = \frac{r_t \cdot e^{rt \cdot T}}{e^{rt \cdot T} - 1} CGI_t$$

where:

r_t = the long-term interest rate;

CGI_t = the index of the price of gross fixed capital formation in the sector (i.e. housing in the residential/commercial sector; GFCF excluding housing in industry);

T = the optimal period for capital depreciation; this should be determined by experiment to obtain the best possible adjustment.

This leads to the formula for the second component of the real energy price P_{et} as a weighted average price, which takes the same form for both sectors:

$$P^k_{et} = \frac{\sum_j CN_{jt}\, u_{j(t)}\, P_{jt}}{U_t\, LRK_t}.$$

Finally, *a variable noted* D_t is incorporated for both sectors to express annual changes in weather conditions through the *number of degree-days* each year. D_t is equal to the sum, over a year, of the daily deviations of an indoor reference temperature from an observed average outdoor temperature. The justification for including this variable in the energy demand function of the residential/commercial sector is obvious, but it has also been included in industry's demand function, since a fair share of the energy consumed by industry is used for space heating, and cannot be distinguished in total energy consumption of the sector.

1.2. *The energy demand function of industry*

1.2.1. As well as the price variables described above, specific variables are used in the model for the industrial sector to account for activity effects, i.e. both income or output effects and structural effects. For industry, account must be taken not only of changes in industrial output but also of changes in industrial structure, distinguishing between high-energy-consumption branches and others. An index has thus been constructed to represent changes in energy-intensive output:

$$CI_t = \sum_i \omega_i X_{it}$$

where:

X_{it} = index of output of branch i;

$$\omega_i = \frac{U_{i75}}{U_{75}}$$

ω_i represents branch i's share in 1975 (U_{i75}) in total useful energy consumed by industry in 1975 (U_{75}); detailed information on energy consumption by branch is available for 1975 in energy input-output tables. [1]

The branch breakdown, isolating the high-energy-consumption branches, is as follows:

(i) ferrous and non-ferrous ores and metals and metal products (NACE CLIO 130 + 190);

(ii) non-metallic mineral products (NACE CLIO 150);

(iii) chemical products, rubber and plastic products (NACE CLIO 170 + 490);

(iv) paper and printing products (NACE CLIO 470);

(v) other branches (NACE CLIO 210 to 510 except 490).

Thus the industrial sector's demand for energy in year t can be expressed as:

$$U_t = U_{t-1} A \left(\frac{P^\omega_{et}}{P^\omega_{et-1}}\right)^{\alpha_0} \left(\frac{P^\omega_{et-1}}{P^\omega_{et-2}}\right)^{\alpha_1} \prod_{l=1}^{L}$$

$$\left(\frac{P^k_{et-l}}{P^k_{et-l-1}}\right)^{\beta(l)} \left(\frac{CI_t}{CI_{t-1}}\right)^{\gamma} \left(\frac{D_t}{D_{t-1}}\right)^{\delta} \varepsilon_t$$

[1] See *Energy balance sheets based on the input-output tables, 1975*, SOEC.

The function takes the form of ratios between the values of the explanatory variables in two consecutive years because:

(i) multicolinearity leading to biased estimates is nearly always removed by such specification;

(ii) the equation can be used for forecasting without substantial forecasting error adjustments (which would be required if the predicted and actual values in the most recent period were too far out of line);

(iii) estimates of the parameters are scale independent and the resulting model is sensitive to changes at the margin. Similarly, under this specification the true variation can be adequately explained even with statistics of apparently mediocre quality.

1.2.2. Interpretation of parameters

Below we explain the meaning of each of the demand function parameters, and point out its main features.

A is a *constant* representing *autonomous growth factors*, i.e. changes in the demand for energy induced by technological or structural change, independent of prices and of levels or composition of output (i.e. of the other explanatory variables). Its value is expected to be less than one, which implies other things being equal that autonomus technological progress improves the average efficiency of energy use for production even when real energy prices do not change.

$(\alpha_0 + \alpha_1)$ represents the *short-term price elasticity*, i.e. the response of demand to price changes that does not involve new technologies, new machinery or substantial (and time-consuming) changes to existing machinery. In other words, this response takes the form of administrative decisions, part of the day-to-day work of managing industrial firms.

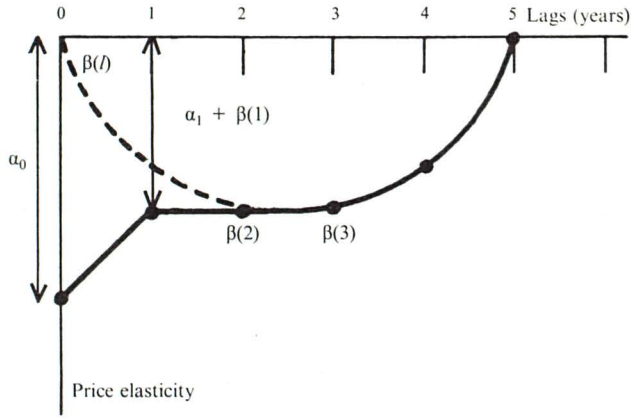
$\beta(l) = \beta_0 + \beta_1 l + \beta_2 l^2$ is a polynomial distributed lag structure subject to the following constraints:

(i) either it is zero at the end of the period: $\beta(l + 1) = 0$;

(ii) or it is zero at the beginning and the end: $\beta(0) = 0$ and $\beta(1 + 1) = 0$.

The *long-term price elasticity* of energy demand is thus defined as equal to $\sum_{l=1}^{L} \beta(l)$. It represents the response to changes in energy prices involving investment decisions, the effects of which are lagged. Clearly the long-term interest rate, which is an important factor in determining the price of capital P^k, strongly influences long-term responses to changes in energy prices.

Altogether, in view of the formula for the polynomial expression $\beta(l)$ (second-degree function), the graphic representation of short-term and long-term price effects over time should give a parabola something like this:



γ is the *output elasticity of energy demand*. The term CI_t representing output is weighted for the relative energy intensity of certain industrial branches; it enables us to isolate the effects of changes in industrial structure from other effects: short-term and long-term price effects, autonomous technical progress, etc. At all events, the weightings adopted should mean that the value of output elasticity will be statistically more robust, but in general lower for the period 1960-81 than the elasticities obtained in most of the traditional studies that do not allow for the effects of changes in the pattern of output.

δ is the *elasticity of energy demand in relation to weather conditions (degree-days)*. This elasticity may be expected to be much lower for the industrial sector than for the residential/commercial sector.

1.3. *The energy demand function for the residential/commercial sector*

1.3.1. On the residential/commercial side, the basic approach must be supplemented with explanatory variables specific to this sector. Energy demand by the residential/commercial sector is essentially derived from the need for heating, so space heating is the factor to be incorporated specifically. [1] Since centrally-heated premises consume much more energy than others (from 1,3 times to twice as much), the share C_t of centrally-heated premises, in the total dwelling stock, is adopted as an explanatory variable.

[1] Specific consumption of electricity, i.e. light uses such as for lighting, domestic appliances, etc. has been explicitly deducted from the consumption of the residential/commercial sector and therefore excluded from the field of study.

If H_t is the dwelling stock in square metres, and μ the energy intensity factor of central heating in relation to heating by individual appliances, then the impact of the size of the dwelling stock on the demand for energy is defined as:

$$SP_t = (1 - C_t)H_t + \mu C_t H_t$$

The trend of this structural variable is indirectly linked to the trend of income; its effects are accompanied by the mainly short-term direct effects of the real disposable income of households, RDI_t.

Finally, the number of degree-days D_t may be an important variable in explaining energy demand by the residential/commercial sector.

The energy demand function to be estimated is therefore:

$$U_t = U_{t-1} A \left(\frac{P^c_{et}}{P^c_{et-1}} \right)^{\alpha_0} \left(\frac{P^c_{et-1}}{P^c_{et-2}} \right)^{\alpha_1} \prod_{l=1}^{L}$$

$$\left(\frac{P^k_{et-l}}{P^k_{et-l-1}} \right)^{\beta(l)} \left(\frac{SP_t}{SP_{t-1}} \right)^{\gamma_1} \left(\frac{RDI_t}{RDI_{t-1}} \right)^{\gamma_2} \left(\frac{D_t}{D_{t-1}} \right)^{\delta} \varepsilon_t$$

Here again, the expression is in ratio form for the reasons given at the end of point 1.2.1.

1.3.2. Interpretation of paramters

Some of the parameters are simply mentioned here, as they are exactly parallel to those used in the demand function for industry (see point 1.2.2); only the parameters specific to the residential/commercial sector are explained in detail.

A = constant representing autonomous change

$(\alpha_0 + \alpha_1)$ = short-term price elasticity

$\sum_{l=1}^{L} \beta(l)$ = long-term price elasticity.

The aggregate price effect should develop over time along a similar parabola to that given above for the industrial sector.

$(\gamma_1 + \gamma_2)$ may be interpreted as representing *income elasticity in the broad sense*. It is the sum of two elasticities.

γ_1 covers part of the income effect, to the extent that the term SP_t reflects the penetration of central heating in the dwelling stock and the effects of the growth of this stock (in number of dwellings and area).

γ_2 is the direct income effect, but because of the specification it does not cover the effects of an increase in the dwelling stock or central heating penetration, and thus expresses only the marginal propensity to consume energy from disposable income. Since heating is considered a necessity, this income elasticity may well be very low.

Using the formula, central heating saturation can be illustrated: as C_t approaches 1, $\frac{SP_t}{SP_{t-1}}$ tends towards $\frac{H_t}{H_{t-1}}$. In industrialized countries with low rates of population growth, the rate of expansion of the dwelling stock is very small, so that $\frac{H_t}{H_{t-1}}$ tends towards 1. Thus the aggregate income effect is correctly reflected in γ_2, which is indeed income elasticity.

On balance, comparison between estimated elasticities $(\gamma_1 + \gamma_2)$ or γ_2 on the one hand, and those calculated in a more traditional way on the other, will probably be rather difficult in view of the specifications:

(i) estimations based on useful energy are different from those based in general on energy supplied;

(ii) the distinction between direct income effects and the effects of central heating penetration should mean that income elasticity γ_2 is much lower than traditional income elasticities.

Finally, δ represents the degree-days elasticity of demand, which is included in the equation in order to sharpen the other parameters by removing the variation due to this obvious term.

2. Summary results for the industrial sector

Table 3.1 summarizes the main econometric results obtained in the Esteden study with regard to the industry sector. The goodness of fit represented here by the correlation coefficient (see also actual versus fitted demand in Graphs 2.1 to 2.5) can be considered as satisfactory, particularly since the model has been expressed in ratio form (i.e. it explicitly sets out to explain the changes in the levels rather than the levels themselves), while at the same time priority in this study was not given to high correlations, but rather to the 'economic logic' robustness of the resulting model.

No autocorrelation of residuals was encountered (Durbin-Watson statistics being in general marginally higher than two), conforming to early expectations that the problem would not occur given the ratio specification chosen.

In all instances in the Esteden study, the elasticity of industrial energy consumption with respect to degree-days was found to be statistically insignificant, very small and was often omitted. Similarly, the constant term (representing 'autonomous' growth) was found to be often insignificant

Table 2.1

Energy demand elasticities: the main results for the industrial sector

	Cumulative price elasticity			Output elasticity	Correlation coefficient[1]
	1 year	2 years	Total		
FR of Germany	−0,08	−0,33	−0,37	+0,65	0,951
France	−0,17	−0,51	−0,53	+0,35	0,926
Italy	−0,26	−0,27	−0,31	+0,56	0,961
The Netherlands	−0,31	−0,31	−0,38	+0,68	0,958
United Kingdom	−0,24	−0,40	−0,40	+0,55	0,958

[1] R^2 corrected for degrees of freedom.

and at times unreasonable and has therefore been excluded in many cases.

With regard to *price elasticities,* it is worth noting that despite the apparent differences between countries, these are not sufficiently large to be statistically significant at the 99% level of confidence. In fact, a broad assumption of a short-term price elasticity of −0,2 and a long-term price elasticity of −0,4 could serve as an adequate average approximation for the five countries studied here—an approximation which would not deviate substantially from results such as those used by the IEA (see Chapter II).

Short-term price elasticities (1 year) range from −0,08 in Germany (lowest probably because of the preponderance of vertical integration in energy-intensive industries) to −0,31 in the Netherlands (highest perhaps because of the relatively large size of its export and spot-market orientated chemical sector).

The estimated *long-term price elasticities* fall in the −0,3 to −0,4 range for all countries, with the notable exception of France with an estimated long-term price elasticity of −0,53. It is not immediately obvious why French industry should display such a strong sensitivity to energy prices in the longer term. It may, however, be worth noting that France has the smallest relative ponderation of energy-intensive industries in its total industrial output. The possible rationale here would be that energy-intensive industries are *a priori* energy price conscious, whereas industries where the energy bill represents a mall percentage of costs would tend to react strongest when prices surge. The latter would also partly explain why earlier studies, which did not cover one or both of the energy price shocks, have failed to indicate the special price sensitivity of French industry.

The most striking difference, however, between the present study and the earlier ones lies in the magnitude of the elasticity operating beyond the third year. In the Esteden study this effect is in general much smaller. The main reason for this, we believe, is the effect of the model specification with regard to the income variable. The latter is a sum of industrial output weighted by energy intensity and it therefore takes into account structural change at the outset.

In other words, a large part of what is termed as the very long-term elasticity in the earlier studies measures the extent to which lower energy prices over a sufficiently long period tend to encourage the growth in energy-intensive industries and the converse in cases of high energy prices.

In this respect, the evidence of the present study suggests that investments into energy-saving equipment requiring long gestation periods have only a limited effect in determining aggregate energy consumption patterns. Attention should, however, be drawn to the fact that the length of the sample period (21 years) is not sufficient to establish firmly long-term behaviour. A more appropriate method to be used in order to obtain robust results in this respect is pooling time series and cross-section observations together and using perhaps only the most recent decade while leaving the earlier decade to establish the long-term pattern. Such an estimation would not produce long-term elasticities by country but should provide more definitive answers on the importance of long-term price effects on a Community-wide basis.

The *output elasticities* range from +0,35 (France) to +0,68 (The Netherlands) but again, although robust, do not differ from each other in a statistically significant way at the 99% level of confidence.

A comparison of the Esteden output elasticities with those obtained in earlier studies discussed in Chapter II presents some interest (see Table 3.2).

Table 2.2

Elasticities with regard to output

	IEA (1960-79)	Pindyck (1959-74)	Esteden (1960-81)
FR of Germany	+1,10	+0,76	+0,65
France	+0,96	+0,78	+0,35
Italy	+1,15	+0,86	+0,56
The Netherlands	—	—	+0,68
United Kingdom	+0,65	+0,78	+0,55

It is strikingly apparent that the elasticities obtained in the Esteden study are markedly lower than those of the earlier studies. This could be entirely due to the specification of the ouput variable in the Esteden study, particularly if one considers that in the past energy-intensive industries have either experienced high growth rates (chemicals) or high volatility (iron and steel). An aggregate industrial output measure would mask this variability and subsequently produce higher elasticities (as the least squares technique attempts to explain variability of the dependent variable by means of a less variable independent one). The implications of our results are, however, wide and far reaching in the sense that if one assumes energy price stability and no reversion to industrial patterns of the past (no major revival of the iron and steel industry or no increase in the share of the chemical industry in aggregate industrial production), the growth in energy consumption is likely to be half what would be suggested by applying the same assumptions on, for example, the IEA model.

3. Summary results for the residential/commercial sector

Table 3.1 summarizes the main econometric results obtained in the Esteden study with regard to the residential/commercial sector.

The overall performance of the equations as measured by the correlation coefficients corrected for degrees of freedom is satisfactory (see also Graphs 3.1 to 3.5 of actual versus fitted energy demand), except for the United Kingdom where the erratic movement of energy consumption in the domestic sector (decline between 1962 and 1967, sharp increase between 1967 and 1969, a sharp drop in 1970-72 and a steep increase in 1975-79) are hard to explain in terms of existing variables. Consequently a shortened interval (1972-81) had to be used.

Conforming to prior expectations, no autocorrelation of residuals was encountered—the Durbin-Watson statistic exceeding 2 in all cases. The inclusion of the constant (autonomous growth or decline term) invariably produced either perverse or unreasonable results and has thus been omitted. The implication is that there is no systematic effect over time other than that captured by the included variables.

Regarding *price elasticities*, a working hypothesis of a short-term (1 year) elasticity of −0,26 and a long-term one of −0,45 for the whole of the five countries would not be significantly different from the results obtained for the individual countries. These price elasticities are somewhat larger than those obtained for the industrial sector. More significantly, the longer-term effects (from the third year onwards) seem to be more pronounced for the domestic sector than for the industrial sector. A possible explanation of this observation could be the greater diversity of criteria used by consumers in the residential sector when deciding on energy-saving investments.

Table 3.1

Energy demand elasticities: the main results for the residential/commercial sector

	Cumulative price elasticities			Elasticity with respect to structural variable SP_t	Elasticity with respect to RDI_t	Degree-days D_t	Correlation coefficient
	1 year	2 years	Total				
FR of Germany	−0,10	−0,26	−0,29	+0,96	+0,31	+0,68	0,974
France	−0,49	−0,65	−0,72	—	+0,60	+0,98	0,966
Italy	−0,26	−0,37	−0,45	+0,19	+0,73	+0,15	0,993
The Netherlands	−0,22	−0,25	−0,31	+0,39	+0,38	+1,16	0,966
United Kingdom	−0,27	−0,48	−0,49	—	+0,32	+0,04	0,546

These general observations apart, it is clear from the above table that energy price elasticities in the Esteden study do display considerable variation from country to country, namely from −0,10 (FR of Germany) and −0,49 (France) with regrad to the short term (one year), and from −0,29 (FR of Germany) to −0,72 (France) in the long term. These differences are not easy to explain except by a much closer scrutiny of the actual data used.

For example, in Germany the data on central heating penetration indicated early saturation in the late 1970s while in France central heating penetration appeared to be proceeding at a rapid pace during the same period. Thus in Germany the slowdown in penetration adequately explains the levelling off in consumption when, as in France, the same phenomenon could only be adequately explained by a strong energy price reaction. Since the data on central heating penetration were from entirely different sources (surveys), differences in coverage and definitions could by themselves explain the differences in behaviour and some homogenization of sources could have resulted in more standardized results. It was not possible to carry out this homogenization for the Esteden study and substantial possibilities for improvements on the models exist through future work in this area.

The degree data (crucial in this sector) also suffer from similar defects with regard to standardization and coverage (see below).

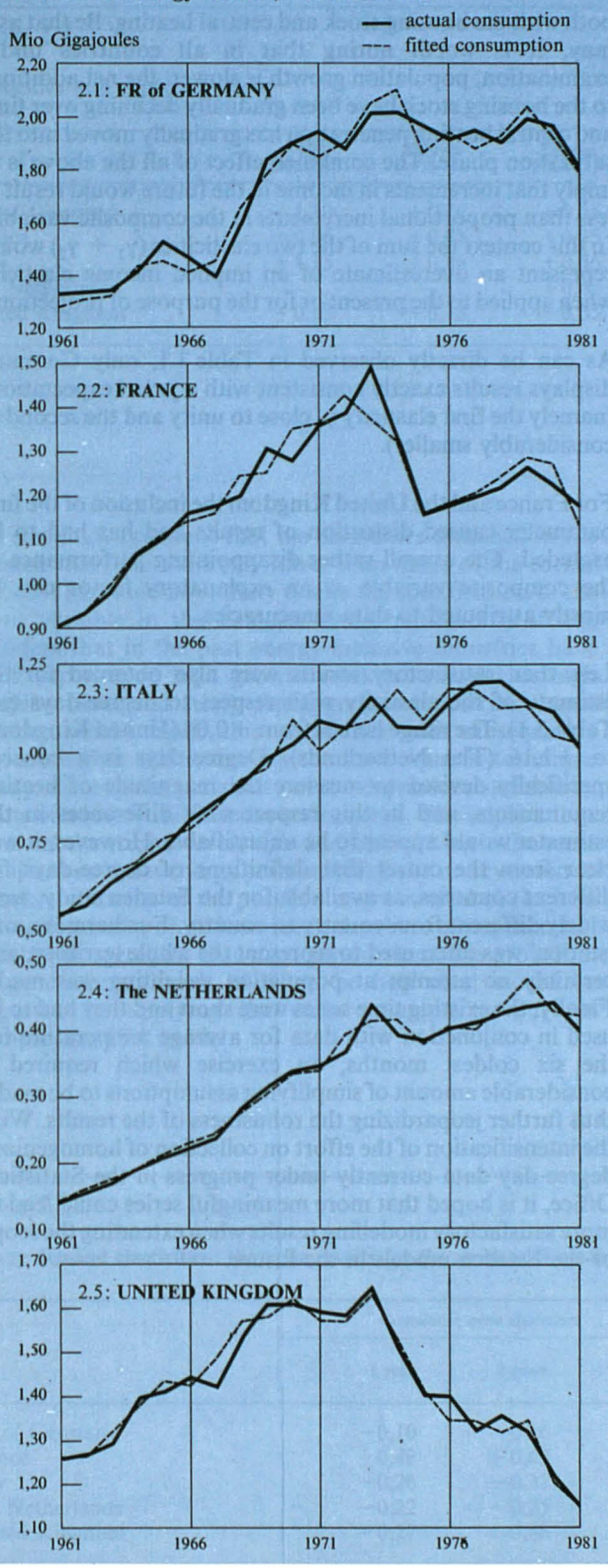
A direct comparison with other studies in the sphere of *income elasticities* would not be fruitful for the reasons mentioned in the section dealing with the theoretical specification of the model: namely the introduction in this study of *two 'income' type variables*, the one incorporating information about the housing stock, its average size and central heating penetration, and the other theoretically capturing the marginal propensity to consume energy out of disposable income. Neither would it be fruitful to examine the sum of those two elasticities and compare it against earlier studies because to do so would by default imply that there exists perfect proportionality (an elasticity of unity) between real disposable income and the composite variable, a very debatable proposition in view of the various penetration and saturaion effects encountered when dealing both with the housing stock and central heating. Be that as it may, it is worth noting that in all countries under examination, population growth is slower, the net additions to the housing stock have been gradually declining over time and central heating penetration has gradually moved into the saturation phase. The combined effect of all the above is to imply that increments in income in the future would result in less than proportional increments in the composite variable. In this context the sum of the two elasticities ($\gamma_1 + \gamma_2$) would represent an overestimate of an implied income elasticity when applied to the present or for the purpose of projections.

As can be directly observed in Table 3.1, only Germany displays results exactly consistent with *a priori* expectations (namely the first elasticity γ_1 close to unity and the second γ_2 considerably smaller).

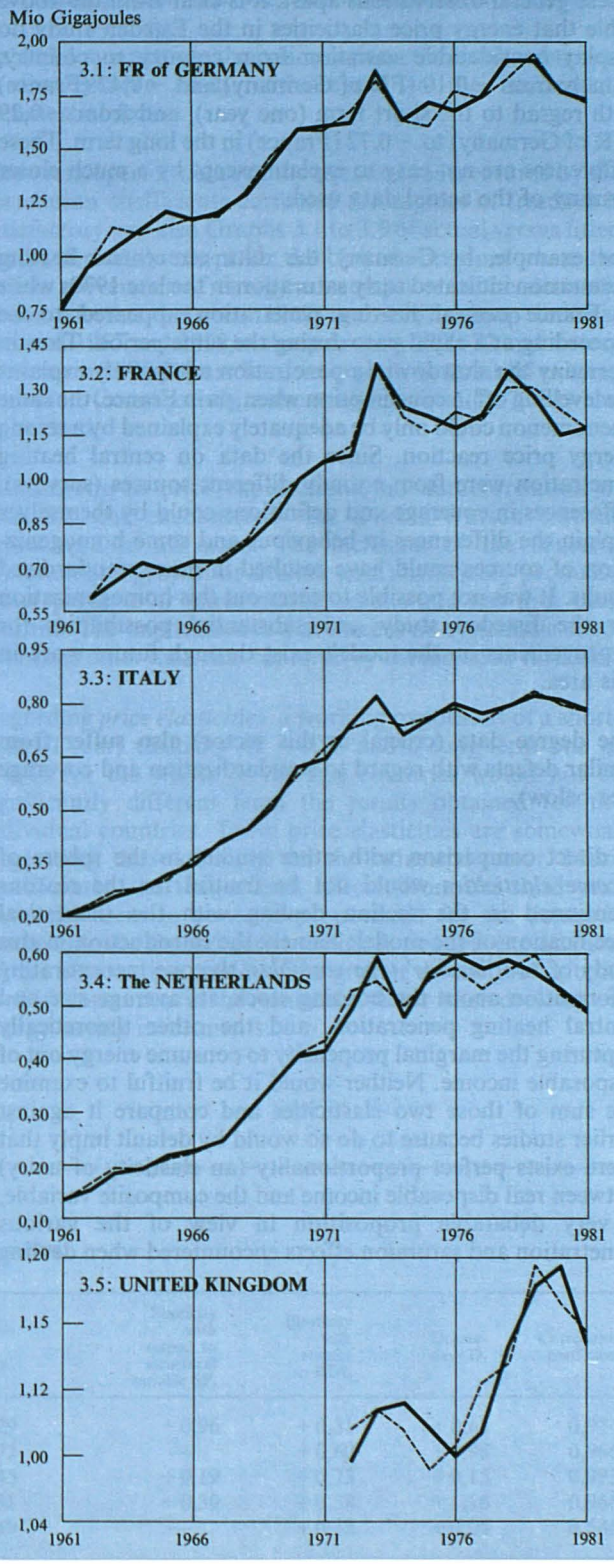
For France and the United Kingdom the inclusion of the first parameter caused distortion of results and has had to be excluded. The overall rather disappointing performance of the composite variable as an explanatory factor can be mostly attributed to data inaccuracies.

Less than satisfactory results were also obtained for the estimate of the elasticity with respect to degree-days (see Table 3.1). The range here is from +0,04 (United Kingdom) to +1,16 (The Netherlands). Degree-days is a concept specifically devised to measure the magnitude of heating requirements, and in this respect such differences in the estimates would appear to be unjustifiable. However, it was clear from the outset that definitions of degree-days for different countries, as available for the Esteden study, were widely different from country to country. Furthermore, one 'station' was often used to represent the whole territory, and certainly no attempt at population weighting was made. Finally, the existing time series were short and they had to be used in conjunction with data for average temperature for the six coldest months, an exercise which required a considerable amount of simplifying assumptions to be made, thus further jeopardizing the robustness of the results. With the intensification of the effort on collection of homogenized degree-day data currently under progress in the Statistical Office, it is hoped that more meaningful series could lead to more satisfactory modelling results when extending the scope of the Esteden models in the future.

GRAPH 2: **Energy demand, industrial sector**



GRAPH 3: **Energy demand, residential/commercial sector**



Foreign trade

The foreign trade of the Community, the United States of America and Japan

With the slackening-off of the high growth rates recorded in the industrialized economies ever since the war, the countries concerned have attempted to offset the contraction in domestic activity by developing exports. Another reason for this strategy, which was adopted by all the countries concerned, was the need to restore trade-balance equilibrium, adversely affected by the new trend of energy costs. With everyone resorting to the same tactic, international trade relations inevitably came under pressure and, in Europe, the question of the Community's competitive capacity in the face of the commercial dynamism of its principal world partners came to the fore.

Since the early 1980s Commission departments[1] and the European Parliament[2] have on several occasions considered the problem of Community competitiveness in relation to the United States and Japan. Their thinking was based on existing studies of market shares and import and export structures, where the pace of change has been increasingly rapid over the past few years.

Since then, the statistical basis for such studies has been brought up to date and considerably improved by estimations of foreign trade series in volume, so that observed magnitudes can now be interpreted without interference from the trends due specifically to changing prices.

Two chapters deal with the exploitation of this new information. The first follows on from earlier work and presents the findings of a comparison of real foreign trade by the Community, the individual Member States, the United States and Japan. The conclusions reached confirm that the key sectors of Community industry have not always managed the technological adjustment required if the Community is to keep control over its development choices.

Chapter II examines series for the price and income elasticities of those countries' foreign trade on the basis of systematic estimations of export and import functions evaluated from 1964 to 1981. The main advantage of this approach, based on a tried and tested methodology, is that it provides up-to-date and comparable results that reflect the features of trade between the protagonists on the international stage. It establishes that there is a direct link between the elasticities obtained and the choice of import or export specialization of producers in the industrialized countries. Greater adaptability to international demand on the part of some of these producers enables them to take better advantage of current changes in international trade.

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1 See 'External trade and competitiveness' in *European Economy* No 14, Brussels, 1982, Chapter 10, p. 138; Commission of the European Communities, *Dossiers*, 'The competitiveness of the Community industry', Brussels, 1982.

2 S. Leonardi: 'Report on the competitiveness of the Community industry', Doc. 1-1335/82 of 14.3.1983, and resolution of the European Parliament on the competitiveness of Community industry (OJ L 135, 24.5.83).

Chapter I: Community foreign trade: the equipment goods industry under threat [1]

[1] This article has been written by P. Goybet and P. Zangl of the Directorate-General for Economic and Financial Affairs.

List of tables

Graphs

The analysys of the volume of foreign trade leads to a simple conclusion: the Community, the world's premier exporter of manufactured goods, has preserved that share of world trade which its industrial prowess and service expertise allowed it to conquer, but its relative slowness in the field of technological innovation has weakened its position in the area of equipment goods and made it more vulnerable to foreign import penetration.

Such underachievement affects most of those industrial sectors that export machines and material which comprise fixed capital investment for a developed country and this led to a deterioration of a balance of payments which had been traditionally in surplus. For the Community this denoted its dominant position on the foreign equipment goods markets based upon the uncontested hold over its internal market, thus allowing the exercise, together with the USA, of a determining influence upon the development of production structures and the process of innovation. The Community is in the process of losing its lead both on the home and foreign markets. The nature and design of high technology products which now account for a rising proportion of Community imports lead its principal partners to play a growing and, sometimes, determinant role in the modernization not only of Community industrial enterprises but also of those which produce services for both households and producer sectors.

These imports certainly have the effect of contributing to the restructuring and adaptation of production systems, but they also increase Community dependence on foreign technological innovation.

This deterioration in the Community position on both internal and external markets has increased during the course of the last few years, especially for the overall industrial machine sector, and even more so for the machine tool sector. This has lead to protectionist reactions on the part of some producers just as in the USA, which, like the Community, is subject to Japanese competition in frontier technology robotics and flexible manufacturing systems.

However, accepting the 'simple answer' of protectionism would in the end damage the Community's competitiveness by further widening the technological gap and reinforcing external constraints. While the Community certainly must reconquer its position in relation to the most advanced industrialized countries if it is to consolidate its international standing, it will not be restored to its proper place unless Community industry first re-establishes itself on its own market. This new approach, which may well be under way in the auto sector, is the only one that can lead to the restoration of trade equilibrium. To gain control of the Community market, not only a massive effort of research and investment in new products and processes is required, but also an improvement in the functioning of this vast domestic market. These conditions are necessary if the Community's equipment goods industry is to be in a position to offer a competitive range of products.

Introduction

Since 1973 the three main competitors of world trade have further expanded their openness to foreign trade as the share of their imports of goods and services in GDP increased between 1973 and 1981 from 11 to 16% for extra-Community trade, from 6 to 10% for the USA and 10 to 14,6% for Japan. The reltive importance of exports grew in a similar fashion. This growing openness is in evidence for trade in goods as much as in services. However, neither the other OECD member countries nor non-OECD countries experienced a similar growth.

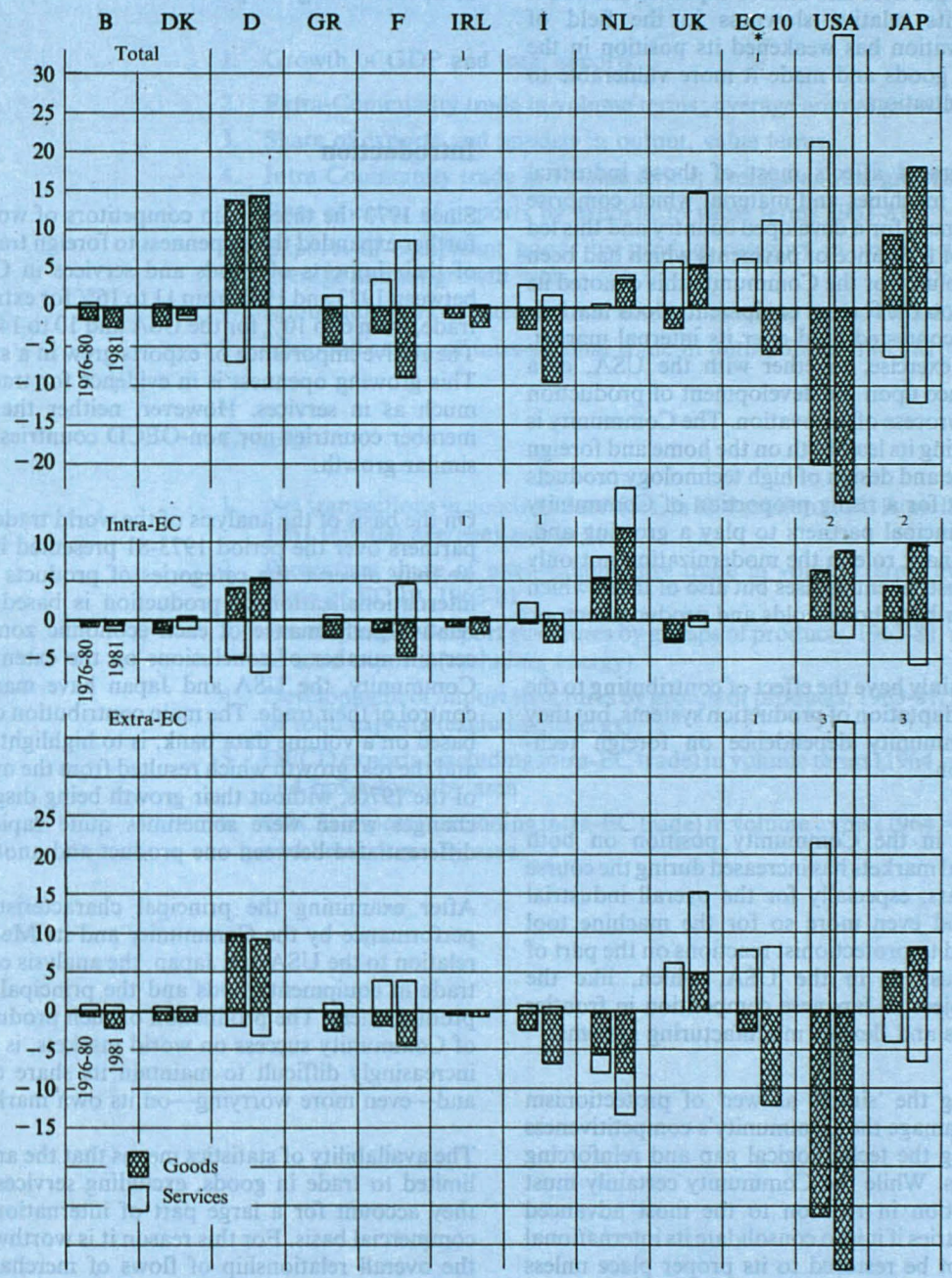
On the basis of the analysis of the world trade of these three partners over the period 1973-81 presented in this chapter, we may observe the categories of products on which this internationalization of production is based, compare the relative performance of each economic zone and draw a certain number of conclusions on the extent to which the Community, the USA and Japan have managed to keep control of their trade. The main contribution of this analysis, based on a volume data bank, is to highlight those changes and the real growth which resulted from the many upheavals of the 1970s, without their growth being disguised by price changes which were sometimes quite rapid and greatly differentiated between one product and another.

After examining the principal characteristics of overall performance by the Community and its Member States in relation to the USA and Japan, the analysis concentrates on trade in equipment goods and the principal sectors which produce them. The production of such products, spearhead of Community success on world markets, is now finding it increasingly difficult to maintain its share of world trade and—even more worrying—on its own markets.

The availability of statistics means that the analysis must be limited to trade in goods, excluding services, even though they account for a large part of international trade on a commercial basis. For this reason it is worthwhile to outline the overall relationship of flows of merchandise trade to corresponding flows of services, before proceeding with a detailed analysis of flows of merchandise imports and exports.

Graph 1 shows, overall, not only that the situation differs greatly between countries but also, that those countries

GRAPH 1: **Net transactions in goods and services, in '000 million ECU from 1976 to 1981 (annual average) and in 1981**



* EC 9 from 1976 to 1981 (first column); EC 10 in 1981 (second column).
1 Provisional data.
2 Trade with Community countries.
3 Trade with non-Community countries.

Source: Eurostat.

characterized by a 'structural' surplus in goods trade (Germany, Japan) finance a large deficit on the import services, with the contrary situation holding in general for other countries. This may be partly explained by the comparative advantage of certain countries in the export of services, which consequently reduces their import requirements. The surplus on tourism receipts accumulated by a country, for example, is related to the material advantage of geographical location or climate; predominance in international merchandise transport, for which maritime navigation has always played a determining role, depends as much on the possession of a modern fleet as on a maritime tradition which by definition, is difficult to acquire. (The Japanese balance, for example, is in constant deficit on this item.) The importance of insurance (cover for goods in transit) stems from the existence in certain countries of long-established companies which operate world-wide and enjoy a monopoly in this activity.

As a result, those countries which experience a large deficit on service trade are subject to a greater constraint to remain competitive on the international goods market since so as to generate surpluses that will finance this deficit. Thus, the trade surplus of 9 700 million ECU recorded by Japan in 1981 on bilateral trade with the Community is reduced by 60% by Japan's deficit on services.[1]

On the contrary, the Community as a whole, France, Italy, the Benelux countries, Greece and, above all, the USA recorded positive balances on service trade thus limiting the effects of their deficits on goods trade, the USA even managing in 1981 to exceed by 10 000 million ECU the deficit recorded on goods trade. The United Kingdom and the Netherlands occupy a special position, being in surplus on goods thanks mainly to energy; they are traditionally net exporters of services, something which allowed them to achieve a particularly high surplus on goods and services in 1981, recorded mainly with the Community by the Netherlands and with the rest of the world by the United Kingdom.

Thus the conclusions arrived at in the analysis of goods trade must be placed in the context of 'goods and services'. France and Italy have not, as a result of their relative strength in services trade, experienced all the pressures necessary for the adaptation of their production apparatus. Likewise Japan, lacking natural energy sources and depending on externally-provided services, is forced to depend on the success of its exports of goods which has encouraged it to resort, to a greater extent than its competitors, to aggressive industrial strategies so as to reinforce its competitiveness. But the commercial and industrial dynamism of the Community's partners' exports also has more direct consequences: within the context of competition among the large economies, whose objective is to conquer new markets or to defend their production in competition with more competitive foreign suppliers, the Community would appear to be menaced in the sectors where success will determine the success of its process of structural adjustment. An accentuation of its dependence in the trade of high technology products would prove more disturbing than equal imbalance in goods and services trade: it could gravely affect both the rate and direction of changes in its production structures.

1. Merchandise trade: an overall view

The examination of series of foreign trade data expressed in value terms (US dollars) disguises the real importance of changes that have occurred in the flows of exports and imports. The trends of prices and exchange rates partially distort any assessment of the industrialized countries' capacity to react to the economic disturbances which have occurred since 1973 and which have caused them to seek to bolster their growth by developing their trade.

Consequently, unless otherwise indicated, the following analyses of the external trade of the OECD countries have been made at constant prices and exchange rates (on the basis of 1975 prices) by deflating the figures for merchandise trade in value terms (US dollars) by price indices—in unit values—using a new method explained in the annex.

The Community's good overall performance on world markets

Between 1973 and 1981—a period in which it was thrown off balance by two oil price shocks and was affected even more than its major trading partners by weak growth (twice negative, in 1975 and 1981)—the Community succeeded in maintaining a high growth rate in the volume of its exports to the rest of the world (see Table 1). At 4,9% per year on average, its performance was better than the OECD average, almost one percentage point better than that of the United States but more than three percentage points worse than that of Japan. The efforts made to tap new markets and to maintain its world market share are reflected even more clearly in the apparent average elasticity of its exports with respect to GDP, which increased from 1,7 between 1964 and 1973 to 2,5 between 1973 and 1981. Over the same periods, the change for the United States was from 1,4 to 1,9 and for Japan from 1,5 to 2,3.

The performance of these three major industrial powers bears witness to their growing control over world trade. According to GATT figures, this same elasticity at world

[1] See D. Wilson: 'Japan: The other side of the trade war' in *The Banker*, London, Vol. 132, No 681, p. 315.

level stood at 1,4 on average between 1964 and 1973 (thus broadly matching the figures mentioned above), but it then fell to 1,2 during the following period.

A new distribution of growth in world trade appears to be emerging gradually. Following a period, before 1973, in which the sharp growth of GDP and exports was shared by the various world areas, the contraction in the rate of economic growth since then is having a greater adverse effect on the export gains of Third World and State-trading countries than on those of the major OECD countries.

This trend, which first was masked by the positions of the oil-producing countries, has been particularly noticeable in the new period of sharply deteriorating economic growth, which began in 1980. Whereas at world level the volume of exports increased by an annual average of only 0,7% between 1979 and 1981, the Community maintained a high rate of export growth (almost 4,5% per year) and the United States and Japan even succeeded in increasing their rates appreciably, while the other industrialized countries did not experience a similar level of growth.

In 1982 the negative growth of GDP in the industrialized countries generally and the decline in slaes to non-oil developing countries probably entailed a slight fall in the export volme not only of the OECD countries, but also of the developing countries, whether or not they export energy products; only the Eastern bloc countries seem to be increasing their sales abroad.[1]

Maintenance of Member States' positions on third markets and sharp cyclical fluctuations in their exports within the Community

International markets have remained prime outlets for almost all the Community Member States (see Table 2). As from the first oil shock, Italy and France seized the new international opportunities to maintain the rate of their exports outside the Community at a very high level; most of the other countries succeeded in compensating for the fall in the growth of their exports on Community markets by positive rates of growth on world markets.

[1] According to 'GATT international trade 82/83, provisional figures'.

Table 1

Growth of GDP and total exports (average annual growth in volume terms)

(%)

	1964-73	1973-81	1973-75	1975-79	1979-81
World					
GDP	6,0	3,0	0,7	4,7	1,2
Exports	8,5	3,5	0,2	6,6	0,7
OECD					
GDP	5,0	2,3	0,3	3,9	1,3
Exports	9,4	4,4	0,0	7,6	2,8
Exports excluding intra-Community trade	8,7	4,9	0,8	7,2	4,5
EC 10					
GDP	4,8	2,0	0,3	3,6	0,5
Exports, extra-Community	8,1	4,9	3,7	5,8	4,4
Exports, intra-Community	11,4	3,2	−2,0	8,7	−2,2
United States					
GDP	4,1	2,2	−0,8	4,3	1,0
Exports	5,9	4,1	2,3	3,7	6,8
Japan					
GDP	10,7	3,7	0,7	5,1	3,8
Exports	15,7	8,5	5,3	7,5	13,9

Source: GATT and Volimex.

Table 2

Extra-Community trade in volume terms; average annual growth rates

(%)

	All products					Agricultural products					Energy products				
	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81
Exports															
B	9,2	5,0	−1,4	8,0	5,6	−3,1	11,7	29,8	7,7	3,6	11,7	−0,5	−0,6	−2,8	4,1
DK	8,4	4,6	3,1	3,7	8,1	1,6	6,3	6,2	4,3	10,7	18,0	−7,9	−4,8	0,3	−24,7
D	8,8	5,0	2,8	4,6	8,2	15,1	4,7	−2,7	1,5	19,7	3,8	7,0	−9,0	11,1	16,4
GR	12,3	7,8	14,8	6,7	3,6	1,8	−1,7	0,8	−1,8	−3,8	36,1	−2,5	−8,9	8,4	−15,7
F	8,3	6,5	7,9	6,3	5,5	6,6	10,3	3,8	3,9	31,8	4,7	5,3	−3,2	14,5	−3,1
IRL	15,1	13,1	0,7	19,1	14,6	6,2	30,8	8,2	22,8	79,5	14,4	−20,2	−29,1	−13,5	−23,6
I	9,4	8,3	11,3	10,4	1,5	4,4	5,9	1,5	9,6	3,1	8,8	−4,7	−16,0	4,7	−10,5
NL	7,2	4,9	3,2	4,9	6,7	4,6	9,0	4,1	7,0	18,4	6,4	−3,5	−6,4	0,6	8,3
UK	6,3	0,6	−1,0	3,5	−3,6	11,3	12,9	1,6	6,1	42,3	4,2	13,5	−13,7	26,5	20,4
EC 10	8,1	4,9	3,7	5,8	4,4	5,9	8,4	3,1	4,9	2,7	6,8	2,6	−9,2	9,3	2,1
USA [1]	5,9	4,1	2,3	3,7	6,8	7,7	4,4	−5,5	11,5	1,0	1,0	6,1	−0,3	4,6	16,0
Japan [1]	15,8	8,5	5,3	7,5	13,9	−2,3	−5,0	−24,7	6,5	−4,5	15,2	6,3	−5,7	17,3	−1,5
OECD [2]	8,7	4,9	0,8	7,2	3,9	6,1	4,0	−5,1	8,9	4,1	6,7	1,0	−8,1	7,9	−2,6
Imports															
B	7,7	2,2	−5,4	8,6	−2,2	−1,4	5,1	6,9	3,7	6,4	12,2	−2,2	−11,6	5,9	−7,7
DK	7,7	−0,7	−5,9	3,1	−2,9	1,6	4,6	−2,2	6,7	7,6	8,0	−4,1	−0,5	−4,4	−6,8
D	7,0	3,8	−2,1	8,8	0,0	2,3	0,7	−2,0	4,0	−2,9	8,4	−1,3	−6,5	4,1	−6,4
GR	9,7	−1,0	0,5	10,1	−21,2	7,4	0,4	14,8	4,0	−18,4	17,2	−5,1	0,1	3,8	−24,7
F	7,3	2,5	−3,5	7,7	−1,6	1,8	−0,2	−6,0	3,8	−2,0	11,0	−1,9	−8,0	6,2	−10,5
IRL	5,7	5,7	−6,1	15,0	0,5	3,0	−4,3	−10,7	−4,7	3,3	7,0	−11,8	−0,8	−0,4	−38,4
I	8,2	0,6	−8,2	7,8	−4,2	6,1	−2,5	−9,8	4,4	−8,1	9,1	−2,4	−9,5	4,0	−7,2
NL	9,7	−0,4	−8,1	6,5	−5,6	4,5	4,1	10,7	2,2	1,6	15,2	−8,5	−22,8	2,6	−13,9
UK	5,2	−1,9	−9,9	5,8	−8,2	−2,2	−2,2	−12,2	6,9	−8,8	5,7	−9,8	−13,2	−7,0	−11,8
EC 10	7,1	1,1	−6,0	7,5	−3,6	1,9	0,2	−4,0	4,3	−3,3	9,5	−3,9	−10,7	2,8	−9,5
USA [1]	9,8	0,6	−9,5	8,6	−3,9	2,5	0,6	−4,6	2,8	1,4	11,6	−0,9	−4,1	8,4	−14,4
Japan [1]	13,9	0,5	−6,4	6,6	−4,2	10,4	0,2	−6,8	8,1	−7,3	15,6	−0,5	−3,4	3,0	−4,3
OECD [2]	9,0	0,8	−5,0	6,0	−3,6	4,1	0,7	−3,5	4,5	−2,7	10,5	−2,2	−6,4	3,8	−9,4

[1] Total trade.
[2] OECD excluding intra-Community trade.

Source: Volimex.

While the subsequent upturn saw a return to a high rate of growth of intra-Community trade (even higher than that of exports to the rest of the world), the results for the last two years (1980 and 1981), during which growth in the Community again contracted, are even more divergent (see Table 3). With the exception of Denmark and a marginally positive figure for Ireland, the exports of all the other Member States to their partner Community countries all fell in volume terms (by up to 5,4% in the case of Italy), whereas the rate of expansion of their extra-Community sales was clearly positive. Italy's poor performance in these last two years followed outstandingly good results between 1973 and 1979. This deterioration was caused by reduced sales of intermediate products and particularly by the fall in its exports of basic consumer items to the rest of the world, which had grown by 15% between 1973 and 1979 and which declined by 4% between 1979 and 1981. Exporters in the United Kingdom, by contrast, pursued a different strategy. Taditionally, at least since 1963, United Kingdom exports to the Community have increased more rapidly than those to non-member countries. Following accession in 1973, this trend was reinforced, although the United Kingdom's performance was adversely affected both by falling demand in European countries (particularly during the two recessions) and by its inability to change its trade flows rapidly enough to tap new markets in the growth areas of the world.

Table 2 *(continued)*

Extra-Community trade in volume terms; average annual growth rates

(%)

	Manufactured products					Intermediate products					Equipment goods				
	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81
Exports															
B	8,9	3,7	−2,3	6,1	5,3	7,6	1,0	−6,1	4,2	2,1	10,2	4,5	10,4	−0,8	9,8
DK	8,7	5,4	3,3	4,5	9,6	11,3	6,4	1,5	7,7	9,1	8,1	5,7	8,2	2,5	10,1
D	8,2	4,9	3,1	4,9	6,7	11,5	4,3	−1,1	7,8	2,8	6,7	4,6	6,2	2,3	8,0
GR	19,1	13,1	27,2	9,0	8,4	30,0	11,6	28,5	2,7	14,3	16,7	21,5	66,4	3,3	22,6
F	8,1	7,0	8,5	7,1	5,4	9,3	5,4	1,0	8,0	4,8	8,9	7,6	18,4	4,9	2,9
IRL	17,7	13,4	1,4	20,9	11,4	26,4	14,2	11,2	20,3	5,8	10,9	16,4	4,8	21,3	18,9
I	9,2	9,5	13,3	11,2	2,6	9,8	10,3	16,9	11,5	2,0	9,6	8,4	16,9	5,9	5,2
NL	7,5	5,7	3,1	6,1	7,7	13,9	3,5	−4,2	7,2	4,3	3,9	8,2	15,3	4,6	8,6
UK	6,8	−0,5	−1,9	2,7	−5,6	7,7	−0,4	−6,4	6,1	−6,5	4,4	0,8	6,2	−1,2	−0,4
EC 10	8,0	4,9	3,8	6,0	3,9	10,0	4,1	−0,5	7,7	1,9	6,6	5,2	10,0	2,7	5,5
USA	8,1	7,5	6,6	6,1	11,4	7,2	4,6	−2,8	11,2	−0,3	11,6	8,7	11,0	3,4	17,6
Japan	13,8	8,8	5,3	7,9	14,4	16,4	4,1	9,2	3,8	−0,	15,8	11,5	4,3	11,1	19,9
OECD [1]	9,0	5,8	2,6	7,0	6,7	9,9	3,7	−0,5	8,1	−0,4	9,1	7,4	7,5	5,2	11,8
Imports															
B	7,3	4,3	−4,3	11,3	0,2	8,2	1,3	−8,7	7,5	0,1	6,4	7,9	5,5	9,5	7,1
DK	9,2	−0,9	−7,4	5,1	−5,6	10,2	−2,1	−10,8	5,1	−6,8	9,1	0,0	−1,1	1,8	−2,2
D	9,1	6,3	−0,6	12,0	2,5	8,3	3,1	−3,0	9,6	−2,9	11,3	11,1	5,1	15,3	9,1
GR	10,3	−0,2	−1,4	17,4	−26,8	−13,0	−1,5	−4,6	1,0	−1,8	12,9	3,3	4,4	27,0	−32,4
F	8,7	6,1	−0,8	11,0	3,8	9,0	3,2	−1,4	7,5	−0,3	12,8	8,7	1,7	12,3	8,6
IRL	5,5	11,0	−5,7	23,8	5,1	11,1	5,5	−16,5	27,0	−8,1	1,5	18,3	3,4	29,7	12,7
I	8,3	4,3	−5,9	13,2	−1,9	9,6	3,0	−5,5	12,4	−5,6	10,5	7,1	2,0	10,6	5,4
NL	7,8	5,0	1,0	10,4	−1,2	9,5	4,5	−0,2	9,1	0,5	7,9	6,7	5,9	11,6	−1,7
UK	6,0	0,5	−7,4	9,1	−7,6	5,5	−1,3	−3,0	4,4	−10,2	14,1	6,7	−1,3	14,6	−0,1
EC 10	7,7	3,9	−3,6	11,0	−1,6	8,1	2,0	−3,9	8,2	−3,9	11,1	8,0	2,4	13,5	3,3
USA [1]	9,2	4,8	−9,9	13,7	3,4	8,6	4,1	−8,3	11,3	3,2	13,3	6,2	−7,5	14,5	4,8
Japan [1]	14,0	2,1	−8,2	9,7	−1,8	12,7	2,1	−12,0	11,1	−0,1	10,1	3,8	−1,4	7,3	2,1
OECD [2].	9,1	3,3	−3,7	8,7	0,1	9,4	1,9	−5,2	7,4	−1,2	10,5	5,1	0,6	8,6	2,7

[1] Total trade.
[2] OECD excluding intra-Community trade.

Source: Volimex.

Table 2 *(continued)*

Extra-Community trade in volume terms; average annual growth rates

(%)

	Food products					Basic consumer items				
	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81
Exports										
B	16,8	12,1	−15,2	26,4	16,4	9,9	5,3	−7,6	14,6	1,2
DK	6,4	4,5	2,8	6,4	8,1	12,0	5,1	1,4	4,1	11,2
D	13,9	13,3	−8,2	21,9	20,9	8,5	5,9	−2,0	9,8	6,4
GR	8,9	14,0	17,3	24,2	−6,6	20,4	11,8	17,0	10,6	9,3
F	7,5	10,6	−5,0	17,5	14,1	4,4	5,4	−0,1	7,0	8,0
IRL	17,1	11,9	−7,3	24,2	9,5	14,5	8,8	−1,7	12,9	11,7
I	3,5	15,4	13,9	13,5	20,8	8,8	9,9	0,9	22,7	−4,0
NL	7,2	6,5	−2,8	7,8	13,7	4,3	2,4	−5,0	6,0	2,7
UK	8,9	0,2	−1,8	1,1	1,1	11,0	−4,3	−14,1	8,9	−17,7
EC 10	8,4	8,4	−3,1	12,5	12,6	8,5	3,9	−5,2	11,8	−1,7
USA [1]	0,9	7,9	0,6	11,2	9,2	7,8	6,5	6,2	8,4	3,2
Japan [1]	5,8	3,3	−6,8	5,5	9,8	4,1	3,3	1,1	−0,3	13,1
OECD [2]	5,2	6,7	−3,5	10,1	10,3	7,7	3,8	−5,2	9,9	1,1
Imports										
B	2,5	0,4	−5,5	3,4	0,6	9,4	5,9	−6,4	20,2	−7,2
DK	3,4	4,7	−1,5	11,4	−1,8	10,5	−2,3	−12,5	7,3	−9,3
D	4,7	2,3	−9,0	8,1	3,0	10,2	5,6	−0,3	11,9	−0,4
GR	6,5	−12,2	−13,2	10,8	−44,3	5,9	0,4	−3,7	2,6	0,1
F	0,3	2,3	−2,0	4,7	2,0	11,0	7,3	−2,8	16,0	1,3
IRL	3,5	5,8	0,9	14,1	−4,7	8,1	6,0	−11,0	17,9	2,1
I	2,6	−1,6	−14,3	10,9	−11,1	8,8	4,9	−10,4	18,2	−3,2
NL	5,0	5,4	−1,1	8,9	5,1	7,9	3,1	−2,5	10,7	−5,4
UK	−2,6	−5,9	−8,2	−4,5	−6,2	8,0	−1,4	−13,7	12,4	−13,3
EC 10	0,7	−0,2	−7,0	4,2	−1,8	9,0	2,9	−7,4	13,2	−5,4
USA [1]	6,7	−0,2	−11,3	7,1	−2,7	5,3	4,7	−15,2	−16,8	3,8
Japan [1]	11,4	3,3	11,3	2,0	−1,7	24,3	−0,2	−18,1	15,2	−8,8
OECD [2]	4,2	0,0	−3,9	3,3	−2,5	9,0	3,1	−8,6	12,5	−2,3

[1] Total trade.
[2] OECD excluding intra-Community trade.

Source: Volimex.

Thus, between 1979 and 1981, the United Kingdom recorded two negatieve rates of export growth: −2,4% with the Community and −3,6% with the rest of the world. These figures include oil exports, which increased by almost 10% on average to the Community and by 20,4% to non-member countries during these last two years. Taking manufactured products alone, the United Kingdom's exports fell by 5,0% and 5,6% respectively.

Great variability in the growth rate of OECD country imports but slower contraction of import penetration following the second oil shock

The major industrialized countries show great similarity of import behaviour. The cyclical sensitivity of their import penetration ratios to variations in their economic growth has been particularly marked during the various phases of recession and expansion (see Table 2).

Taking all imported products together, the average apparent elasticity of imports with respect to GDP has fallen sharply since 1973, with a drop between the periods 1964-73 and 1973-81 from 1,5 to 0,55 in the case of the Community and from 1,3 to 0,2 in the case of Japan.

The overall results are considerably distorted, however, by the reduction in energy imports, which fell in volume terms by 3,9% per year in the Community between 1973 and 1981 (by 2,2% for all OECD countries). It is therefore more relevant to consider only imports of manufactured products (i.e. excluding agricultural and energy products). Their average elasticities with respect to GDP are around 2, which means an increase in the case of the Community and no change in the case of the USA. Only that of Japan falls from 1,4 before 1973 to 0,7 after 1973.

The first recession of 1974-75 had, even for this type of product, caused a sharp drop in import growth rates, which turned heavily negative in the United States, Japan and each of the Community countries (except the Netherlands). Since 1980, however, and despite the further general decline in national GDP levels, a number of Member States have maintained a relatively sharp growth of extra-Community imports, thus helping to keep the international trading system open.

Once again, the picture in the United Kingdom is different from that in its main European partner countries. Whereas, in 1974-75, its GDP fell by an average of 0,9%, its imports from the Community continued to grow by 4,3% a year. By contrast, while in 1980 and 1981, following two years in which its GDP fell by 2% a year, the United Kingdom recorded a reduction in the rate of growth of its imports from the Community of −1,2%, but this reduction is less than that of its non-Community imports (−7,6%) whereas that of the Community excepting the United Kingdom coming from the rest of the world remains positive, at +0,6%.

Thus, at intra-Community level, and in terms of both imports and exports, a slowdown in activity in the Member States generally leads to a more than proportional contraction of intra-Community imports and exports. On the other hand, both the nature of the manufactured products imported from third countries (which are frequently not replaceable by European products) and acceptance of the implications of the Community's participation in open international division of labour tend to keep the rate of growth of extra-Community imports at a higher and more stable level.

In the medium term and over this period of analysis ending in 1981, it can be seen that, while the pressures brought to bear at individual industry level in the Community to restrict the penetration of certain foreign products have led to a reduction in some import penetration ratios, this effect has been offset overall by the growth in imports of other categories of product.

The Community, a key promoter of the open trading system

Besides the volume growth in import and export flows, or the trend of its average elasticities with respect to GDP, the extent to which a country is open to trade in industrial products is shown by the proportion of its industrial output which is exported (export ratio) and by the ratio of imports to industrial output (penetration ratio). These data are given here in dollars at current prices, but since they consist in a relationship between two values, any distortions largely drop out (Table 3).

The Community's export ratio *vis-à-vis* the rest of the world is the highest of the industrialized countries. In 1980, it stood at 18,4%, more than three percentage points higher than that of Japan (15%) and more than twice that of the United States (8,9%). However, the difference is even wider in the case of import penetration ratios. At 13,8%, the Community's ratio is five percentage points higher than that of the United States (8,6%) and more than twice that of Japan (5,7%).

These figures, which are unrelated to the size of the country concerned, demonstrate more than anything else the Community's acceptance of increased import penetration as a counterpart to the efforts it makes to maintain its presence on third-country markets. Its surplus on trade in industrial products, which has remained relatively constant since 1970, enables it to finance its purchases of energy and agricultural products. The imbalance in Japanese trade stands out by contrast. In 11 years, the export ratio for manufactured products increased by five percentage points, whereas its import penetration ratio changed by only 1,2 percentage points, making for a growing surplus on industrial trade.

Table 3

Share of exports (X) and imports (M) in output (P) in value terms

(%)

	1970			1973			1975			1980		
	$\frac{X}{P}$	$\frac{M}{P}$	$\frac{X-M}{P}$	$\frac{X}{P}$	$\frac{M}{P}$	$\frac{X-M}{P}$	$\frac{X}{P}$	$\frac{M}{P}$	$\frac{X-M}{P}$	$\frac{X}{P}$	$\frac{M}{P}$	$\frac{X-M}{P}$
					Manufactured products							
EC 9												
Total	23,8	19,8	4,0	28,0	23,2	4,8	31,0	23,6	7,4	35,8	31,0	4,8
1. Intra-EC	11,0	11,0	0,0*	13,6	13,6	0,0*	14,0	14,0	0,0*	17,4	17,2	0,2
2. Other industrialized countries	6,9	5,7	1,2	7,5	5,9	1,6	7,2	6,0	1,2	8,2	8,4	−0,2
3. Rest of the world	6,0	3,1	2,9	6,9	3,8	3,1	9,7	3,5	6,2	10,2	5,4	4,8
USA												
Total	5,8	5,5	0,3	6,3	6,9	−0,6	8,3	6,9	1,4	8,9	8,6	0,3
1. Intra-EC	1,4	1,4	0,0	1,4	1,7	−0,3	1,6	1,5	0,1	2,1	1,7	0,4
2. Other industrialized countries	2,2	2,8	−0,6	2,6	3,3	−0,7	3,0	3,2	−0,2	2,9	3,9	−1,0
3. Rest of the world	2,2	1,3	0,9	2,3	1,9	0,4	3,7	2,2	1,5	4,0	3,0	1,0
Japan												
Total	10,0	4,5	5,5	9,6	4,6	5,0	12,9	4,5	8,4	15,0	5,7	9,3
1. Intra-EC	0,9	0,7	0,2	1,1	0,7	0,4	1,2	0,7	0,5	1,8	0,8	1,0
2. Other industrialized countries	4,3	2,3	2,0	3,6	2,1	1,5	4,0	2,1	1,9	5,1	2,6	2,5
3. Rest of the world	4,8	1,4	3,4	4,9	1,7	3,2	7,7	1,8	5,9	8,1	2,3	5,8
					Equipment goods							
EC 9												
Total	32,7	20,3	12,4	37,4	24,3	13,1	42,8	24,9	17,9	46,3	32,8	13,5
1. Intra-EC	13,4	13,3	0,1	16,1	16,0	0,1	16,2	16,2	0,0	19,7	19,3	0,4
2. Other industrialized countries	10,1	6,2	3,9	10,9	6,9	4,0	10,7	7,3	3,4	11,3	10,5	0,8
3. Rest of the world	9,2	0,8	8,4	10,4	1,4	9,0	15,9	1,4	14,5	15,3	3,0	12,3
USA												
Total	9,2	5,8	3,4	10,0	7,6	2,4	14,8	7,9	6,9	15,7	11,6	4,1
1. Intra-EC	2,0	1,7	0,3	2,0	2,1	−0,1	2,4	2,1	0,3	3,4	2,8	0,6
2. Other industrialized countries	3,9	3,7	0,2	4,3	4,7	−0,4	5,6	4,8	0,8	5,3	6,7	−1,4
3. Rest of the world	3,3	0,4	2,9	3,7	0,8	2,9	6,8	1,0	5,8	7,0	2,1	4,9
Japan												
Total	12,6	3,7	8,9	14,4	2,8	116	20,2	3,2	17,0	26,7	3,6	23,1
1. Intra-EC	1,2	0,8	0,4	1,9	0,7	1,2	2,3	0,8	1,5	3,8	0,8	3,0
2. Other industrialized countries	5,7	2,7	3,0	6,0	1,8	4,2	7,1	2,0	5,1	10,4	2,2	8,2
3. Rest of the world	5,7	0,2	5,5	6,5	0,3	6,2	10,8	0,4	10,4	12,5	0,6	11,9

Source: World Bank data bank, Washington.

Table 4

Intra-Community trade in volume terms, average annual growth rates

(%)

	All products					Agricultural products					Energy products				
	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81
Exports															
B	11,9	2,9	−4,4	8,5	−0,5	8,4	4,2	11,1	1,5	3,2	9,2	4,5	1,6	4,4	7,7
DK	5,4	4,3	2,0	5,5	4,1	−0,2	6,6	11,7	4,6	5,5	20,3	4,2	−3,5	5,6	9,5
D	10,6	3,1	−3,5	9,1	−1,7	14,4	3,4	7,7	1,2	3,4	0,2	−1,6	−7,3	9,4	−15,5
GR	15,3	2,3	5,8	2,6	−1,6	−3,4	3,5	27,4	−3,0	−4,4	—	−21,7	−11,8	−13,0	−43,7
F	13,7	2,8	−2,8	8,4	−2,4	17,0	2,0	−11,1	9,1	2,3	7,4	2,0	−8,5	9,8	−2,1
IRL	7,5	7,5	8,5	10,6	0,7	−2,8	−6,3	8,9	−12,5	−7,7	8,2	−18,3	−5,2	−24,5	−17,7
I	12,0	5,0	2,1	12,1	−5,4	2,1	4,6	12,8	5,5	−4,7	9,8	−11,7	−27,2	11,5	32,9
NL	12,7	1,2	−2,1	5,3	−3,3	9,4	5,7	14,5	2,1	4,4	8,5	−4,5	−17,7	4,4	−7,1
UK	9,4	5,0	0,4	11,3	−2,4	6,8	8,3	14,7	0,4	−3,0*	5,6	16,9	−1,2	31,3	9,6
EC 10 intra	11,4	3,2	−2,0	8,7	−2,2	8,6	3,9	4,8	4,5	1,7	6,6	−0,	−13,2	9,8	−4,9
For information															
EC 10 extra	8,1	4,9	3,7	5,8	4,4	5,9	8,4	3,1	4,9	21,7	6,8	2,6	−9,2	9,3	2,1
Imports															
B	12,0	1,9	−2,0	6,7	−3,5	14,4	2,7	−1,9	5,0	2,7	6,8	0,4	−1,4	3,7	−4,2
DK	5,6	0,6	−2,9	6,5	−6,9	7,5	12,4	−2,9	16,7	20,6	2,9	−3,8	−10,3	7,4	−17,1
D	12,4	2,2	0,1	7,3	−5,3	6,3	2,6	0,5	3,1	3,8	17,0	−1,9	−3,7	2,6	−8,6
GR	7,8	5,7	−3,0	10,3	5,6	9,2	3,7	−22,6	14,3	20,2	15,6	−15,6	−31,4	4,0	−30,1
F	12,4	4,1	−3,0	9,1	1,3	5,3	7,2	22,5	3,0	1,4	2,1	4,1	−4,0	13,1	−4,2
IRL	11,4	4,8	−8,7	15,3	−0,7	2,7	8,3	1,3	7,6	17,2	14,9	−0,1	−12,8	4,9	3,7
I	12,7	4,1	−4,6	9,0	3,3	12,4	3,1	−3,1	8,3	−0,6	8,5	11,6	35,5	−6,8	31,9
NL	9,0	2,3	−0,1	7,3	−4,7	12,7	3,0	2,2	4,0	1,7	1,1	8,4	−8,2	26,8	−6,6
UK	9,9	5,6	3,1	11,2	−2,5	4,1	1,8	9,9	−5,4	9,1	8,7	−4,7	−4,3	3,6	−20,0
EC 10	11,2	3,2	−1,3	8,4	−2,1	7,9	3,3	3,3	3,2	3,7	8,1	0,3	−3,3	6,2	−7,1
For information															
EC 10 extra	7,1	1,1	−6,0	7,5	−3,5	1,9	0,2	−4,0	4,3	−3,3	9,5	−3,9	−10,7	2,8	−9,5

Source: Volimex.

The outward-looking nature of the European productive system becomes even clearer if intra-Community trade is taken into account, since this is roughly equivalent in volume to extra-Community trade. Taken as a whole, therefore, the Member States have on average traded almost 36% of their industrial output without curbing the growth of import penetration.

As already poited out, the international competition which the industrialized countries have been engaged in since the beginning of the 1970s in order to increase their market shares has proved particularly successful outside the economic area which they form. Whether we take the Community, the United States or Japan, the ratio of their exports to other industrialized countries has varied only slightly, increasing by no more than 1,5 percentage points or so between 1970 and 1980. Exports to the rest of the world, by contrast, have increased much more sharply (by 1,7 percentage points in the case of the USA, by 3,3 percentage points in the case of Japan and by as much as 4,2 percentage points in the case of the Community). This trend has been at the expense of the developing countries which, despite the increased value of their exports, have not benefited to the same extent from improved penetration of OECD markets.

European integration is continuing at a slow pace but the disruptions happen at a time of oil price increase

Between 1964 and 1973, intra-Community trade in manufactured products increased annually by between 9 and 13 % depending on the Member State, that is by between four and five percentage points more than trade with the rest of the world. Helped by this buoyancy, trade between the United Kingdom and Ireland on the one hand and the rest of the

Table 4 *(continued)*

Intra-Community trade in volume terms, average annual growth rates

(%)

	Manufactured products					Intermediate products					Equipment goods				
	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81
Exports															
B	11,9	2,2	−5,4	7,6	−0,8	12,5	0,4	−10,3	8,4	−4,0	10,8	3,3	−1,3	7,7	−0,5
DK	5,2	4,4	0,1	6,5	4,5	11,6	8,7	−3,4	18,1	3,2	11,5	3,0	−0,9	5,3	2,5
D	10,8	3,7	−3,7	9,4	0,2	11,7	3,0	−6,9	10,5	−1,5	8,9	2,7	−4,5	8,1	−0,2
GR	24,3	5,9	5,0	6,9	4,9	28,8	−1,4	−10,3	9,3	−11,8	14,9	11,9	26,9	3,0	16,4
F	13,3	3,0	−1,6	8,6	−2,9	11,8	3,5	−3,9	10,5	−2,6	15,5	2,6	0,1	8,4	−5,8
IRL	11,6	10,7	11,0	14,7	2,7	18,0	11,9	2,2	21,8	3,4	15,3	22,0	5,5	34,4	16,3
I	13,0	6,3	3,4	12,9	−3,3	14,3	7,0	3,3	11,8	1,3	11,8	4,1	−1,2	11,5	−4,5
NL	13,5	2,5	−0,3	6,5	−2,5	18,6	2,3	−4,5	8,8	−3,1	12,1	1,6	5,9	4,7	−8,4
UK	10,3	3,1	−1,1	9,7	−5,0	10,4	5,9	0,1	13,1	−1,9	9,2	1,3	−3,1	6,6	−4,1
EC 10	11,7	3,6	−1,8	9,1	−1,6	12,9	3,0	−5,4	10,4	−2,2	10,7	2,9	−1,8	8,2	−2,5
For information															
EC 10 extra	8,0	4,9	3,8	6,0	3,9	10,0	4,1	−0,5	7,7	1,9	6,6	5,2	10,0	2,7	5,5
Imports															
B	12,1	2,1	−2,2	7,2	−3,4	12,4	2,9	−3,1	8,6	−2,1	10,5	0,4	−0,7	3,8	−5,0
DK	5,6	1,4	−1,5	6,4	−5,1	7,9	2,6	−5,8	9,3	−1,8	3,9	−1,6	0,5	2,6	−11,3
D	13,1	3,4	−0,6	8,7	−2,8	12,9	2,9	−4,9	10,1	−3,2	13,5	4,0	0,9	9,9	−3,9
GR	8,1	10,7	−1,7	17,4	10,9	10,1	2,5	−6,7	7,7	2,0	6,2	13,1	1,9	23,7	4,7
F	13,0	4,0	−4,0	9,4	1,6	13,2	3,1	−7,9	10,4	−0,5	11,6	2,9	−5,0	6,9	3,3
IRL	12,4	2,8	−15,6	16,5	−2,7	13,9	5,6	−7,9	18,6	−4,3	12,6	−2,3	−27,0	16,0	−7,1
I	12,5	3,9	−5,7	10,0	2,0	12,9	3,2	−10,7	14,2	−3,0	10,1	4,3	−3,6	6,8	7,8
NL	9,2	1,9	−0,0	6,4	−4,6	10,5	1,5	−5,4	7,0	−2,2	6,7	0,3	2,6	4,2	−9,2
UK	9,6	7,7	4,3	14,1	−1,2	13,9	8,8	5,3	14,3	1,1	13,7	7,5	0,6	17,9	−4,7
EC 10	11,5	3,8	−1,9	9,4	−1,2	12,4	3,0	−5,5	10,7	−1,8	10,5	3,3	−1,6	8,7	−2,1
For information															
EC 10 extra	7,7	3,9	−3,6	11,0	−1,0	8,1	2,0	−3,9	8,2	−3,9	11,1	8,0	2,4	13,5	3,3

Source: Volimex.

Table 4 *(continued)*

Intra-Community trade in volume terms, average annual growth rates

(%)

	Food products					Basic consumer items				
	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81
Exports										
B	15,8	6,7	3,0	7,3	9,4	11,2	2,1	−4,4	6,5	0,2
DK	1,0	2,8	2,7	3,2	2,3	9,7	8,7	−4,6	12,2	16,1
D	21,0	10,9	13,9	12,1	5,9	15,3	5,5	−0,1	10,3	2,0
GR	16,9	0,1	6,4	−2,6	−0,4	30,1	13,9	18,9	10,6	15,8
F	13,1	−2,7	6,1	−1,0	−13,9	13,0	3,0	−4,1	8,0	0,5
IRL	6,9	4,6	23,3	4,9	−12,0	15,1	5,3	−0,1	9,3	3,2
I	8,7	10,7	11,2	15,0	1,9	14,8	7,9	8,3	14,8	−5,2
NL	10,6	4,9	3,0	6,1	4,2	11,6	0,8	−4,8	5,4	−2,3
UK	13,2	7,9	10,2	9,7	2,0	12,4	1,8	−1,1	11,9	−19,3
EC 10	10,3	5,9	6,4	7,3	3,2	13,2	4,2	−0,7	9,9	−1,5
For information										
EC 10 extra	8,4	8,4	−3,1	12,5	12,5	8,5	3,9	−5,2	11,8	−1,7
Imports										
B	12,8	6,2	1,1	10,5	3,1	14,6	2,4	−4,8	10,2	−5,1
DK	6,6	11,5	11,4	9,6	15,4	6,8	2,9	−3,1	10,6	−5,5
D	9,8	4,1	3,3	4,5	4,2	14,5	2,9	1,0	7,3	−3,7
GR	12,9	12,9	−4,2	11,9	35,2	10,3	15,7	−3,0	7,7	19,5
F	13,6	9,0	8,2	10,9	6,1	16,6	6,2	1,1	12,1	0,0
IRL	12,7	12,3	5,7	16,7	10,3	9,9	6,3	−4,5	14,7	1,3
I	17,4	4,6	5,5	6,7	−0,4	15,3	3,6	−13,8	13,9	3,1
NL	14,6	8,7	6,1	12,7	3,6	11,5	2,6	0,4	7,0	−3,8
UK	3,7	3,1	14,0	0,8	−2,4	5,1	11,0	1,4	19,0	5,8
EC 10	10,3	5,8	6,6	6,8	3,0	12,8	4,5	−1,3	10,4	−0,9
For information										
EC 10 extra	0,7	−0,2	−7,0	4,2	−1,8	9,0	2,9	−7,4	13,2	−5,4

Source: Volimex.

higher for imports originating in Member States than for those originating outside the Community (an exception was the last period 1974-81 where the slight fall-off in intra-Community trade is almost entirely attributable to German trade since 1975).

The favourable growth of intra-Community trade was, however, determined more by agricultural and energy products than manufactures: the share of intra-Community trade in the Community's total volume of imports of manufactured products (at constant 1975 prices and exchange rates) reached a maximum close to 11% in 1976, falling consistently until 1980 to rise again slightly in 1981 (see Graph 2). If food products are excluded, the majority of groups of manufactured products have followed similar growth patterns, moderately for intermediate products and for current consumption goods but markedly on the contrary, for equipment goods, whose share of intra-Community trade in imports fell from a maximum of 71% in 1970 to 60% in 1981. Furthermore, the aberrant trend of UK trade, which contributed to maintaining the level of intra-Community trade, should be borne in mind. The volume of intra-Community trade excluding the UK share expanded by only 3,3% from 1973 to 1981 (compared with 3,8% for the whole Community), while, even more significantly, the volume of extra-Community exports by the Community countries other than the United Kingdom expanded by 6,2% (compared to 4,9% with the UK) and that of imports by 5,2% (compared to 3,9%). Behind the favourable growth of intra-Community trade on the whole, therefore, a more disturbing state of affairs is discernable in relation to manufactured goods imports, particularly equipment goods, which is reinforced by the analysis of extra-Community flows.

GRAPH 2: **Percentage share of intra-Community trade in volume terms in total trade of EC 10, 1963-81**

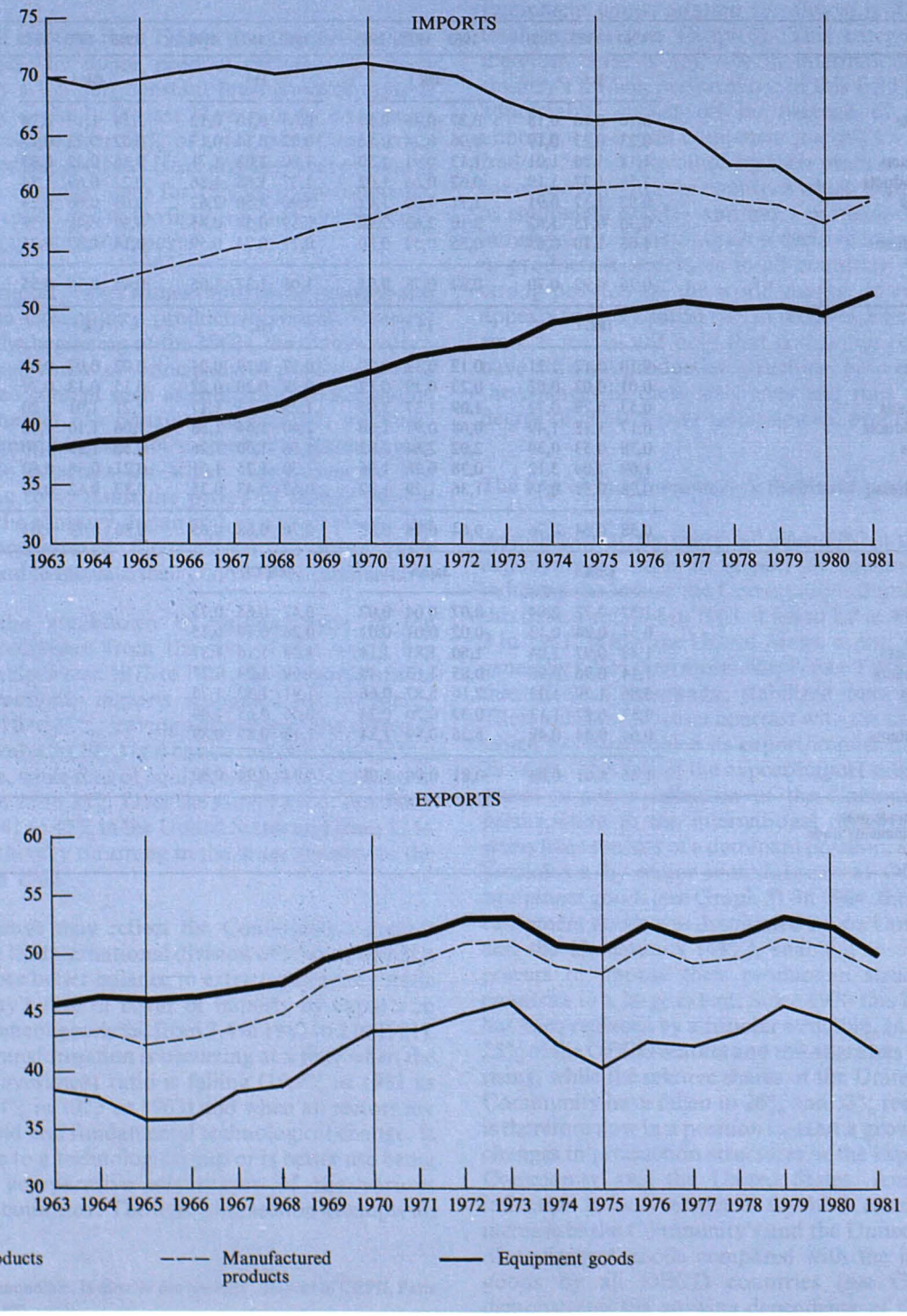


Table 5

Rate of cover of imports by exports, in value terms 1963-81

	1963	1973	1981	1963	1973	1981	1963	1973	1981	1963	1973	1981	1963	1973	1981
	B [1]			**DK [1]**			**D [1]**			**GR [1]**			**F [1]**		
Agricultural products	0,10	0,10	0,18	0,37	0,46	0,59	0,04	0,10	0,12	2,54	1,17	0,74	0,18	0,36	0,66
Energy products	0,23	0,23	0,19	0,06	0,24	0,16	0,22	0,14	0,13	0,02	0,22	0,17	0,17	0,09	0,09
Manufactured products	1,12	1,20	1,01	1,13	0,91	1,30	1,90	2,03	1,71	0,16	0,32	0,85	1,65	1,46	1,54
intermediate products	1,54	1,27	1,19	0,62	0,66	1,02	1,37	1,68	1,86	0,22	0,69	1,84	1,61	1,44	1,67
equipment goods	0,82	1,37	0,91	1,71	1,00	1,42	5,90	4,50	2,62	0,03	0,06	0,23	2,50	1,94	1,86
food products	0,33	0,73	1,62	2,16	2,63	2,82	0,19	0,39	0,85	0,39	0,48	3,19	0,68	0,84	1,75
basic consumer items	1,08	1,10	0,83	0,55	0,52	0,80	0,77	0,74	0,59	0,14	0,39	0,75	1,99	1,17	0,81
Total	0,76	0,92	0,70	0,84	0,78	0,91	1,01	1,37	1,05	0,44	0,38	0,55	0,88	0,93	0,79
	IRL [1]			**I [1]**			**NL [1]**			**UK [1]**			**EC 10 [1]**		
Agricultural products	0,10	0,12	1,21	0,12	0,12	0,20	0,17	0,19	0,24	0,02	0,07	0,22	0,11	0,17	0,29
Energy products	0,01	0,02	0,02	0,23	0,19	0,12	0,29	0,20	0,22	0,15	0,13	0,79	0,19	0,16	0,19
Manufactured products	0,53	0,79	0,77	1,09	1,37	2,05	1,23	1,13	1,17	1,21	1,01	1,20	1,37	1,37	1,47
intermediate products	0,17	1,18	1,49	0,68	0,91	1,60	1,40	1,64	1,58	1,06	1,10	1,46	1,19	1,32	1,60
equipment goods	0,38	0,53	0,39	2,02	2,84	2,83	1,56	1,30	1,26	5,50	1,99	1,70	3,41	2,45	1,97
food products	1,09	2,04	3,12	0,38	0,28	1,06	1,30	1,25	1,61	0,21	0,38	0,80	0,41	0,62	1,28
basic consumer items	0,28	0,31	0,36	1,36	1,29	1,82	0,62	0,43	0,35	0,83	0,62	0,60	0,95	0,77	0,75
Total	0,38	0,64	0,76	0,64	0,76	0,82	0,76	0,68	0,65	0,80	0,79	1,03	0,83	0,94	0,80
	USA [1]			**Japan [1]**			**OECD [2]**								
Agricultural products	1,52	2,72	2,84	0,07	0,04	0,02	0,47	0,63	0,75						
Energy products	0,51	0,24	0,13	0,02	0,01	0,01	0,26	0,19	0,15						
Manufactured products	1,47	0,97	1,04	1,60	1,81	3,14	1,24	1,16	1,37						
intermediate roducts	1,14	0,96	0,96	0,85	1,13	1,49	1,09	1,09	1,27						
equipment goods	3,86	1,29	1,33	2,16	5,87	9,66	1,91	1,52	1,75						
food products	0,81	0,87	1,13	0,39	0,20	0,24	0,56	0,65	1,00						
basic consumer items	0,64	0,44	0,49	6,26	0,89	1,24	1,12	0,87	0,89						
Total	1,35	1,01	0,83	0,81	0,96	1,08	0,94	0,94	0,90						

1 Extra-Community trade only.
2 Excluding intra-Community trade.

Source: Volimex

The Community's openness to extra-Community trade has scarcely altered the structure of its exports, while its imports of equipment goods account for a growing proportion of that trade

The almost total stability since 1963 in the structure of intra-Community trade by major product category has been accompanied by a virtually constant breakdown of exports to the rest of the world. In the last 20 years or so, equipment goods have accounted for 50% of total extra-Community exports, intermediate products (steel and chemical products) for 25%, basic consumer items for 15% and agri-foodstuffs for 10% (see Graphs 3 and 4; the figures exclude energy, both in the case of imports and exports).

This structural rigidity bears witness both to the strength and weakness of the Community productive system: strength because, since the beginning of the 1960s, the Community's sales abroad have consisted principally of products with a high value-added content such as equipment goods and its share of this market has remained substantial; weakness because the Community has not succeeded in increasing its specialization in products for which world demand has remained strong throughout the period of slower growth since 1973. On the contrary, Japan and, to a lesser extent, the USA have concentrated their efforts on using their technological lead to increase their control over this market.[1]

By contrast, the breakdown by product type of the Community's purchases from the rest of the world has altered appreciably. From 1973 to 1981, the proportion of its total extra-Community imports accounted for by energy increased from 20 to 37%; leaving aside energy, the shares of intermediate products (20%) and basic consumer items (25%) remained stable, while that of equipment goods increased in eight years from 23 to 33%. Over the same period, this share increased from 41 to 45% in the United States and from 12 to 16% in Japan, thereby returning in the latter country to the same level as in 1963.

This major change may reflect the Community's greater participation in the international division of labour, which is tending to restore better balance to extra-Community trade (the Community's rate of cover of imports by exports in respect of equipment goods fell from 3,4 in 1963 to 2 in 1981), although this transformation is occurring at a time when the Community's investment ratio is falling (19,9% in 1981 as opposed to 22,4% in 1973 or 1963) and when all sectors are undergoing rapid and fundamental technological change. Is this process due to a technological gap or is better use being made of the comparative advantages of the various manufacturing countries? The following section attempts an explanation.

[1] See 'Économie mondiale: la montée des tensions', Report of CEPII, Paris 1983, p. 149 et seq.

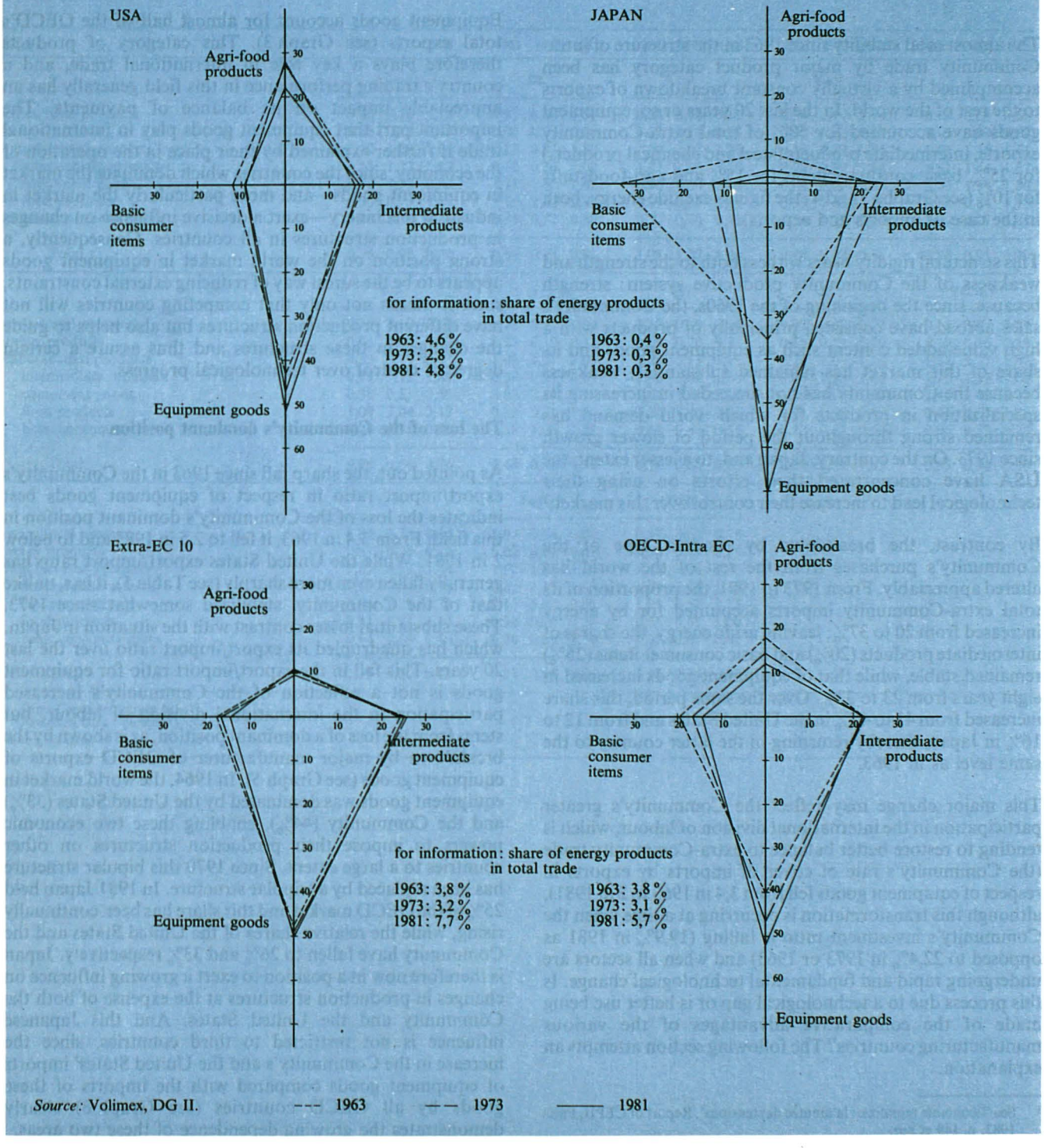
2. The Community's trade in equipment goods in difficulty — The central role played by equipment goods in international trade

Equipment goods account for almost half of the OECD's total exports (see Graph 3). This category of products therefore plays a key role in international trade, and a country's trading performance in this field generally has an appreciable impact on its balance of payments. The important part that equipment goods play in international trade is further explained by their place in the operation of the economy, since the countries which dominate the market in equipment goods—and more particularly the market in industrial machinery—exert a decisive influence on changes in production structures in all countries. Consequently, a strong position on the world market in equipment goods appears to be the surest way of reducing external constraints, since it means not only that competing countries will not have different production structures but also helps to guide the changes in these structures and thus assure a certain degree of control over technological progress.

The loss of the Community's dominant position

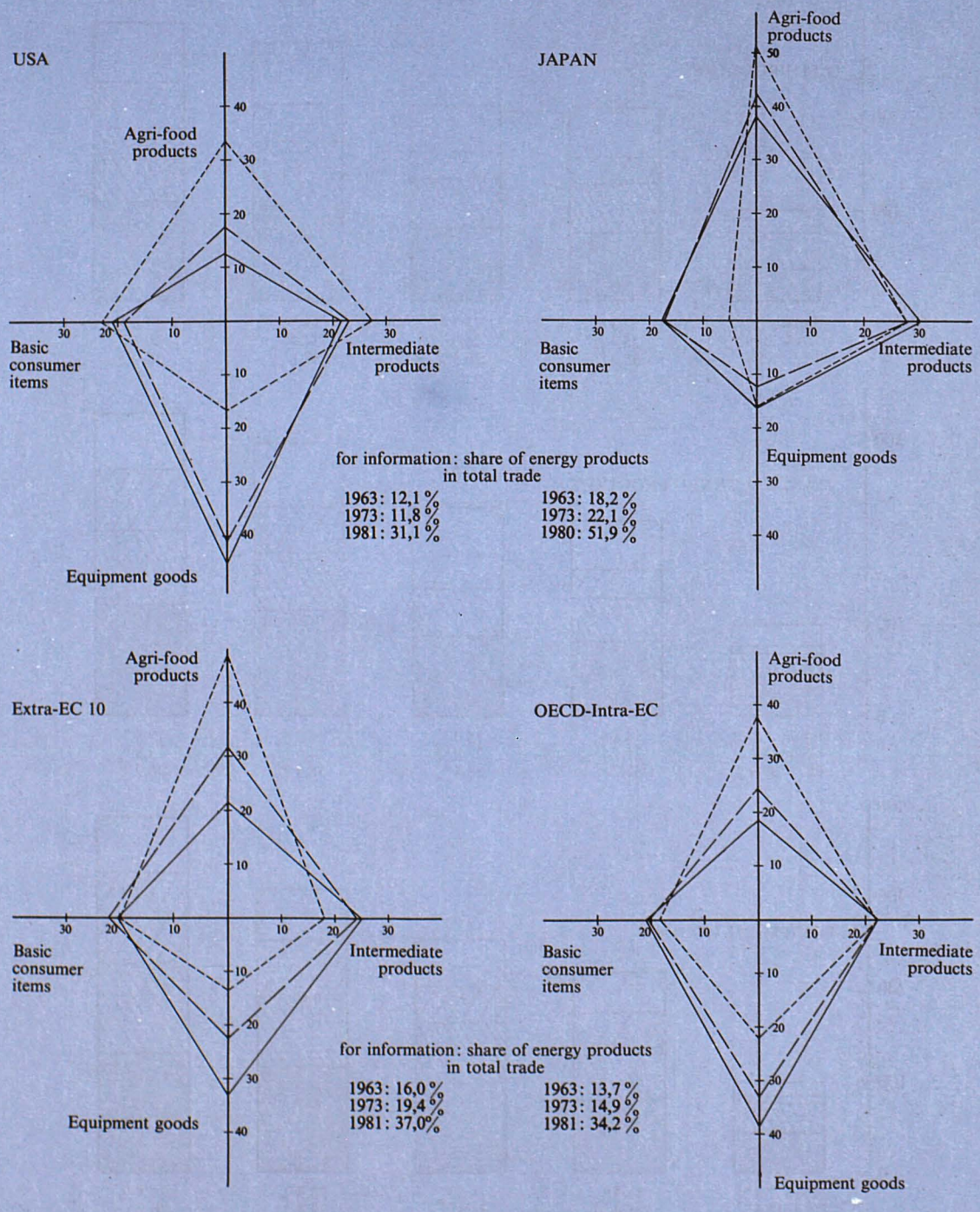
As pointed out, the sharp fall since 1963 in the Community's export/import ratio in respect of equipment goods best indicates the loss of the Community's dominant position in this field. From 3,4 in 1963, it fell to 2,5 in 1983 and to below 2 in 1981. While the United States export/import ratio has generally fallen even more sharply (see Table 5), it has, unlike that of the Community, stabilized somewhat since 1973. These substantial losses contrast with the situation in Japan, which has quadrupled its export/import ratio over the last 20 years. This fall in the export/import ratio for equipment goods is not a reflection of the Community's increased participation in the international division of labour, but stems from the loss of a dominant position, as is shown by the breakdown by major manufacturer of OECD exports of equipment goods (see Graph 5). In 1964, the world market in equipment goods was dominated by the United States (33%) and the Community (44%), enabling these two economic powers to impose their production structures on other countries to a large extent. Since 1970 this bipolar structure has been replaced by a tripolar structure. In 1981 Japan held 25% of the OECD market and this share has been continually rising, while the relative shares of the United States and the Community have fallen to 26% and 33% respectively. Japan is therefore now in a position to exert a growing influence on changes in production structures at the expense of both the Community and the United States. And this Japanese influence is not restricted to third countries, since the increase in the Community's and the United States' imports of equipment goods compared with the imports of these goods by all OECD countries (see Graph 6) clearly demonstrates the growing dependence of these two areas.

GRAPH 3: **Development of export structures by groups of products, 1963-1981, as a % of total exports (excluding energy)**



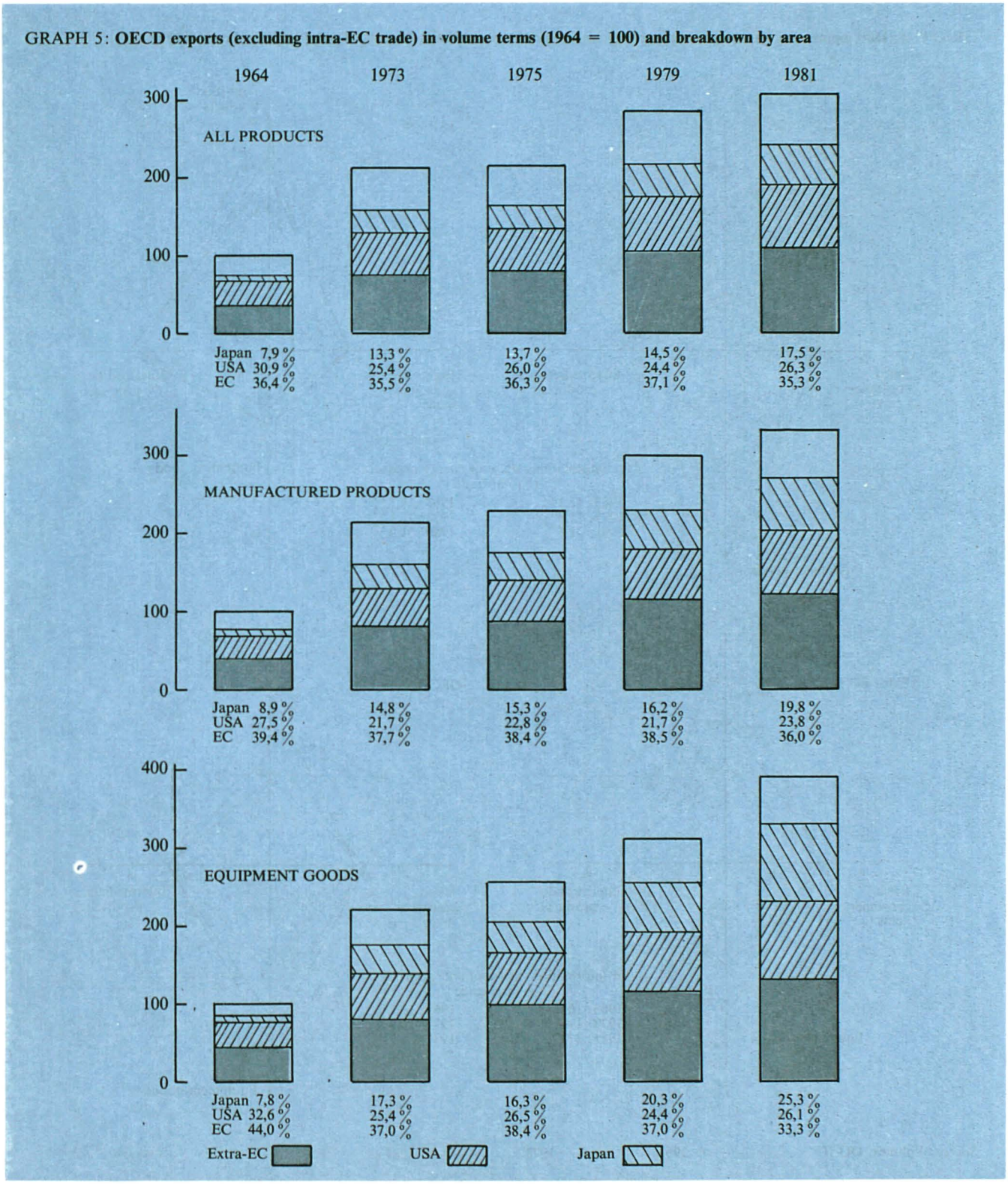
Source: Volimex, DG II.

GRAPH 4: **Development of import structures by groups of products, 1963-81, as a % of total imports (excluding energy)**

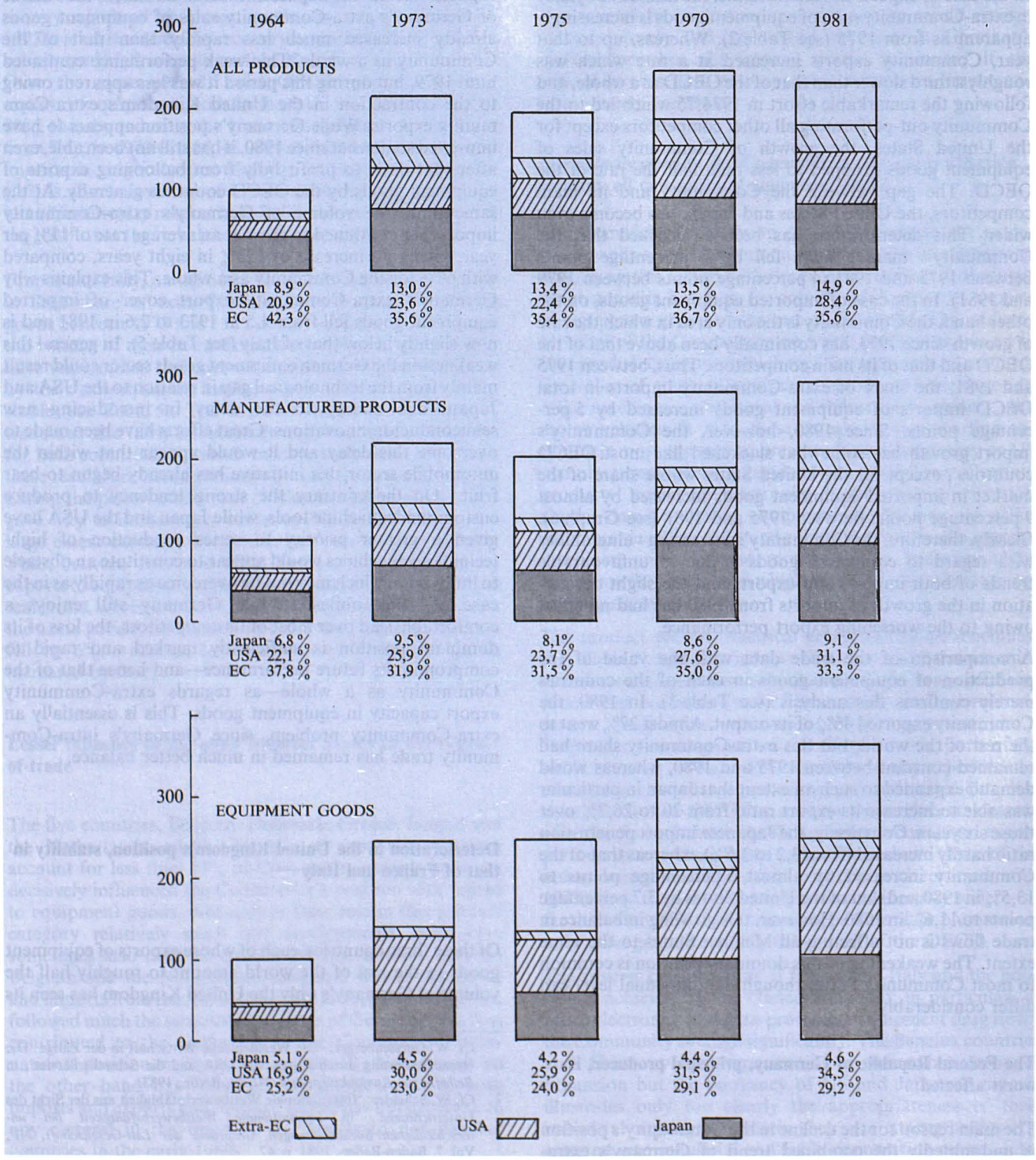


Source: Volimex, DG II. --- 1963 —— 1973 ——— 1981

GRAPH 5: **OECD exports (excluding intra-EC trade) in volume terms (1964 = 100) and breakdown by area**



GRAPH 6: OECD imports (excluding intra-EC trade) in volume terms (1964 = 100) and breakdown by area



An unfavourable trend both in exports and in imports

In the case of exports in volume terms, the lack of buoyancy in extra-Community sales of equipment goods is increasingly apparent as from 1975 (see Table 2). Whereas, up to that year, Community exports increased at a rate which was roughly a third slower than that of the OECD as a whole, and following the remarkable effort in 1974/75 which led to the Community out-performing all other competitors except for the United States, the growth of Community sales of equipment goods dropped to less than half the rate of the OECD. The gap between the Community and its main competitors, the United States and Japan, has become even wider. This deterioration has been so marked that the Community's market share fell by 5 percentage points between 1975 and 1981 (4 percentage points between 1979 and 1981). In the case of imported equipment goods, on the other hand, the Community is the only area in which the rate of growth, since 1973, has continually been above that of the OECD and that of its main competitors. Thus, between 1975 and 1981, the share of extra-Community imports in total OECD imports of equipment goods increased by 5 percentage points. Since 1980, however, the Community's import growth has somewhat slackened like most OECD countries', except for the United States whose share of the market in imported equipment goods increased by almost 9 percentage points between 1975 and 1981 (see Graph 6). Clearly, therefore, the Community's increasing vulnerability with regard to equipment goods is due to unfavourable trends of both imports and exports and the slight deceleration in the growth of imports from 1980 has had no effect owing to the worsening export performance.

A comparison of the trade data with the value of the production of equipment goods in each of the countries merely confirms this analysis (see Table 3). In 1980, the Community exported 46% of its output. Almost 27% went to the rest of the world, but this extra-Community share had remained constant between 1975 and 1980, whereas world demand expanded to such an extent that Japan in particular was able to increase its export ratio from 20 to 26,7% over those six years. Conversely, the Japanese import penetration ratio hardly increased (from 3,2 to 3,6%), whereas that of the Community increased by almost 5 percentage points to 13,5% in 1980 and that of the United States by 3,7 percentage points to 11,6% in 1980. However, this growing imbalance in trade flows is not affecting all Member States to the same extent. The weakening of this dominant position is common to most Community States though the individual level can differ considerably.

The Federal Republic of Germany, principal producer, is worst affected

The main reason for the decline in the Community's position is undoubtedly the combined trend of Germany's extra-Community exports and imports of equipment goods, this country being the Community's principal manufacturer and exporter. Under the impact of the first oil shock, the volume of Germany's extra-Community sales of equipment goods already increased much less rapidly than that of the Community as a whole. This weak performance continued until 1979, but during this period it was less apparent owing to the contraction in the United Kingdom's extra-Community exports. While Germany's position appears to have improved somewhat since 1980, it has still not been able, even after that date, to profit fully from ballooning exports of equipment goods by the OECD countries generally. At the same time, the volume of Germany's extra-Community imports has continued to grow at an average rate of 11% per year, giving an increase of 125% in eight years, compared with 60% for the Community as a whole. This explains why Germany's extra-Community export cover of imported equipment goods fell from 4,5 in 1973 to 2,6 in 1981 and is now slightly below that of Italy (see Table 5). In general this weakness in the German equipment goods sector could result mainly from the technological gap in relation to the USA and Japan, due mainly to the delay in introducing new semiconductor innovations. Great efforts have been made to overcome this delay and it would appear that within the automobile sector this initiative has already begun to bear fruit.[1] On the contrary the strong tendency to produce custom-made machine tools, while Japan and the USA have given a greater priority to series production of high-technology machines would appear to constitute an obstacle to innovation which may not be overcome as rapidly as in the case of automobiles.[2] While Germany still enjoys a comfortable lead over most of its competitors, the loss of its dominant position is sufficiently marked and rapid to compromise its future performance—and hence that of the Community as a whole—as regards extra-Community export capacity in equipment goods. This is essentially an extra-Community problem, since Germany's intra-Community trade has remained in much better balance.

Deterioration in the United Kingdom's position, stability in that of France and Italy

Of these three countries, each of whose exports of equipment goods to the rest of the world amount to roughly half the volume of Germany's only the United Kingdom has seen its

[1] Cf. W. Gerstenberger: 'Die Westdeutsche Wirtschaft in der Zange: Die Herausforderung durch Japan, die USA und die Schwellenländer', in *Beihefte zur Konjunkturpolitik*, No 29, Berlin, 1983.

[2] Cf. W. Scheider: 'Internationale Wettbewerbsfähigkeit aus der Sicht des Unternehmens', in *Internationale Wettbewerbsfähigkeit bei unterschiedlichen Sozialordnungen, Gespräche der List-Gesellschaft*, NF, Vol. 7, Baden-Baden, 1983, p. 47.

position deteriorate sharply since 1973, while France and Italy have generally maintained their positions. Thus, by 1981, the volume of the United Kingdom's extra-Community exports of equipment goods was roughly back to its 1973 level. After a healthy recovery between 1973 and 1975, it subsequently fell, recording a loss of some 10% in 1981 alone. Over the same period, total OECD extra-Community exports of equipment goods increased in real terms by almost 80%, thereby reducing the United Kingdom's market share from 7,6% in 1973 to 6,6% in 1981. At the same time, with its imports having increased sharply, its export/import ratio (1,7) is now below that of France (1,9). Its position on the intra-Community market has also deteriorated slightly, with the result that the imbalance in its total trade has worsened.

France and Italy, on the other hand, saw neither a reduction in their share of extra-Community exports of equipment goods between 1973 and 1981 nor an explosive expansion in the volume of their extra-Community imports which might have undermined their overall equilibria. This is confirmed by their export/import ratios, which have remained fairly stable (see Table 5). The trend of their intra-Community trade was also fairly balanced during that period. However, for both countries, but much more so in the case of France, these results are based primarly on very good performances during the period of the first oil shock, which subsequently gave way to increasingly unfavourable trends, which to a large extent explains the growth in France's trade deficits. Thus, between 1979 and 1981, France's extra-Community exports of equipment goods increased annually by only 3% in real terms, whereas those of the OECD grew by 12%; during the same period, its exports to other Community countries fell by 6%, while its total imports of equipment goods increased by 3,3%.

Lesser influence of the other Member States on the volume of trade

The five countries, Belgium, Denmark, Greece, Ireland and the Netherlands, which, because of their size, together account for less than 15% of Community exports have not decisively influenced the Community's position with regard to equipment goods. Not only is their role in this product category relatively small but developments there have sometimes also differed quite markedly, notably between Belgium and the Netherlands. Belgium, whose exports to and imports from the rest of the world have, in volume terms, followed much the same trend as those of Germany, has thus contributed to the weakening of the Community's international position on equipment goods. The Netherlands on the other hand has recorded favourable trends in both imports and exports and, unlike France, has not experienced any reversal in the trend of its exports to non-member countries in the early 1980s.

It can be seen from this country-by-country analysis that the weakening of the Community's position is attributable first and foremost to developments in Germany. Restoring the Community to its former position on the world market remains closely tied up with a recovery in Germany's performance but the impact would be limited if the difficulties that have been apparent recently in France and Italy were to continue.

The deterioration in the Community's position is affecting virtually all categories of equipment goods

The Community's declining competitiveness in the equipment goods sector is common to all the product categories making up this sector, with the exception of metal products, which account, however, for only 8% of Community exports of equipment goods to the rest of the world. This reduced presence of the Community on world markets shows up in four product categories which together represent over 80% of the value of trade in equipment goods: electrical goods, office machines, agricultural and industrial machinery, and motor vehicles. It is in these categories that we find the products most exposed to pressure from Community or US manufacturers for some regulation of trade flows of certain products: consumer electronics in the case of electrical goods, data-processing equipment in the case of office machines, machine tools and robots in the case of industrial machinery and, of course, motor vehicles. These are at the same time the products in which Japan has recorded its most striking successes.

The product groups 'electrical goods and office machines' (see Table 6) embrace industrial and consumer electronics and electrical equipment as well as the entire range off data-processing machines (main-frame, mini- and micro-computers, peripherals, electronic office equipment, etc.). Following an average annual rate of growth of exports of 5% to 7% between 1973 and 1981 the Community experienced a rate of change similar to preceding years and only slightly less than that for the OECD as a whole. Nevertheless, whereas after the first oil shock the Community recorded an export performance in these sectors which was above those of the industrialized countries, this situation was reversed after 1975. Since then the gap has grown considerably wider—so far that after 1979 the Community performance plummeted, only managing a rate 40% below that of the OECD.

The adverse performances of France and Italy and the poor results achieved by the United Kingdom, in particular, in office electronics and data-processing equipment drag down the Community average significantly. The Benelux countries and Germany are experiencing a somewhat stronger expansion but the buoyancy of US and Japanese exports illustrates only too clearly the appropriateness of their industrial strategies, which they are strengthening by entering into industrial and trade cooperation agreements.

Table 6

Exports of equipment goods by product category in volume terms, average annual growth rates

(%)

	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81	1964-73	1973-81	1973-75	1975-79	1979-81
	Belgium [1]					**Denmark** [1]					**FR of Germany** [1]				
Metal products	2,4	12,6	13,0	11,0	15,4	4,9	7,5	15,6	2,1	10,9	6,1	7,4	14,9	4,8	5,4
Agricultural and industrial machinery	11,0	5,0	22,8	−2,6	4,2	6,8	4,4	14,3	−1,6	7,4	7,8	3,8	11,6	0,3	3,4
Office machines	19,6	6,7	16,9	4,6	1,4	9,7	9,8	10,1	8,6	11,7	8,2	3,8	−1,1	4,3	8,1
Electrical goods	5,9	9,7	13,6	6,0	14,1	9,0	6,1	11,7	5,8	1,5	8,7	6,5	9,3	6,5	3,8
Motor vehicles	25,6	−2,7	−8,4	−6,0	10,7	13,1	8,8	14,4	3,3	14,8	7,6	2,2	−1,5	0,5	9,8
Other transport equipment	−8,1	5,3	33,5	−16,2	31,1	11,5	5,5	−12,6	9,9	17,5	−4,5	13,0	−4,4	5,8	52,3
Total equipment goods	10,2	4,5	10,4	−0,8	9,8	8,1	5,7	8,2	2,5	10,1	6,7	4,6	6,2	2,3	8,0
	Greece [1]					**France** [1]					**Ireland** [1]				
Metal products	40,7	14,2	48,9	1,0	11,9	4,1	10,8	25,8	5,2	8,2	29,6	2,0	−1,7	−4,1	19,7
Agricultural and industrial machinery	—	31,3	65,7	4,6	64,1	11,1	6,7	25,4	−0,4	4,1	13,0	14,2	1,6	18,1	19,8
Office machines	—	27,7	52,9	7,7	49,9	4,9	8,8	10,6	12,8	−0,6	—	—	—	—	—
Electrical goods	17,2	20,7	77,0	8,6	1,6	10,6	9,5	19,9	7,8	3,0	37,2	10,0	−11,2	23,8	7,7
Motor vehicles	—	32,7	103,3	−0,3	53,4	10,0	6,9	17,6	2,9	5,0	15,4	6,2	−28,8	77,1	−43,1
Other transport equipment	—	—	—	—	—	6,7	5,9	1,0	13,9	−4,0	—	−3,0	6,6	11,6	−33,2
Total equipment goods	16,7	21,5	66,4	3,3	22,6	8,9	7,6	18,4	4,9	2,9	10,9	16,4	4,8	21,3	18,9
	Italy [1]					**The Netherlands** [1]					**United Kingdom** [1]				
Metal products	13,2	11,6	24,6	7,6	6,0	8,9	7,8	8,9	2,6	17,6	−0,3	2,6	11,6	0,2	−1,1
Agricultural and industrial machinery	12,5	8,0	17,0	6,4	2,5	10,4	7,1	16,1	4,4	4,1	5,2	1,9	11,2	−3,9	5,0
Office machines	6,8	4,3	2,4	9,4	−3,5	6,4	9,3	23,0	5,4	4,3	6,3	2,2	4,3	1,7	1,3
Electrical goods	11,2	10,3	14,3	9,6	7,8	−1,1	15,1	18,1	12,5	17,7	6,3	−1,2	−5,1	−1,3	3,0
Motor vehicles	11,9	4,0	21,0	−1,2	−1,1	11,5	14,3	44,0	−1,0	20,9	1,1	−2,8	5,9	−7,3	−2,2
Other transport equipment	−7,1	13,2	3,9	12,5	24,9	9,8	−5,5	8,1	−8,3	−12,3	9,7	6,5	10,5	22,3	−22,2
Total equipment goods	9,6	8,4	16,9	5,9	5,2	3,9	8,2	15,3	4,6	8,6	4,4	0,8	6,2	−1,2	−0,4
	EC [1]					**USA**									
Metal products	5,2	8,4	17,9	4,4	7,4	4,4	6,9	9,3	3,8	11,0					
Agricultural and industrial machinery	8,1	4,6	14,6	0,2	4,1	—	10,1	28,5	−1,6	17,6					
Office machines	7,2	5,3	4,3	6,2	4,3	18,4	10,1	−0,7	10,5	21,2					
Electrical goods	6,7	6,7	8,7	6,3	5,5	13,7	7,8	1,8	6,7	16,4					
Motor vehicles	7,1	2,4	4,8	−0,7	6,3	—	1,8	11,2	−3,2	4,1					
Other transport equipment	1,5	7,7	2,2	10,7	7,4	—	10,4	−4,4	13,9	19,8					
Total equipment goods	6,6	5,2	10,0	2,7	5,5	11,6	8,7	11,0	3,4	17,6					
	Japan					**OECD** [2]									
Metal products	6,3	9,2	5,9	8,5	14,0	5,7	7,6	11,8	5,6	7,5					
Agricultural and industrial machinery	17,1	13,2	8,6	11,9	20,8	6,9	6,9	15,9	1,2	10,2					
Office machines	10,4	11,8	−5,3	17,4	19,6	9,5	8,2	−0,7	10,0	13,9					
Electrical goods	15,1	15,0	−2,9	19,7	25,6	10,7	9,0	3,8	9,4	13,6					
Motor vehicles	31,2	15,6	15,4	15,8	15,2	12,4	4,9	5,8	2,0	9,8					
Other transport equipment	16,5	−0,6	3,3	−10,0	16,9	8,9	8,5	−0,2	10,8	13,3					
Total equipment goods	15,8	11,5	4,3	11,1	19,9	9,1	7,4	7,5	5,2	11,8					

1 Extra-Community trade.
2 Excluding intra-Community trade.
Source: Volimex.

In the agricultural and industrial machinery sector, which comprises, in addition to machine tools, the entire range of machinery and mechanical equipment used in industry, Member States' performances on third-country markets have been particularly poor. Between 1973 and 1981, the volume of Community exports probably rose by no more than 40%, as against 120% for the United States and as much as 170% for Japan. In spite of the existence of long-standing marketing networks and growing world demand, the Community is gradually losing its market shares. The main reasons are to be found in the technological gap separating it from its main competitors, as is demonstrated by the results for high-technology products (see Box 3).

Admittedly, as slight recovery has been under way since 1980 thanks primarily to the better performances of Belgium, France and the United Kingdom. The improvement was, at least up to the end of 1981, less pronounced in Germany and did not materialize at all in Italy. This recovery though was preceded by a period (1975-79) in which the volume of exports did not change, and it did not exceed an average annual growth rate of 4,1%, compared with 10,2% for the OECD as a whole, 17,6% for the United States and as much as 20,8% for Japan (see Table 6). For this reason, it can hardly be seen as a reversal of trend. The most one can say is that the worsening of the Community's competitive position is no longer gaining momentum.

Machine tools, a prime example of how the Community's industry is falling behind

Machine tools are capital equipment used in the manufacture of other capital equipment and hence of other machine tools. Even more so than in the case of equipment goods generally and industrial machinery, the central importance that attaches to the machine-tool sector goes well beyond the mere dimensions of value added, employment or indeed export performance (see Table 7). This is because the trend in the productivity and hence competitiveness of all equipment goods sectors is largely dependent on the performance of the machine tools essential to equipment goods manufacture.

If there is one sector above all others in which the operation of the investment accelerator is strongly felt, it is the machine-tool sector, which is as a result highly sensitive to fluctuations in the business cycle. This does not make it easy to generate a return on capital invested in this sector and constitutes an obstacle to the introduction of new technologies. In Europe and the United States alike, this difficulty is magnified by the fact that the sector is made up of medium-sized companies which, being unable to invest sufficiently in the R&D activities essential to the introduction of new technologies, whether production or product technologies, risk an increase of their technology gap. These are the reasons why the main traditional machine-tool manufacturers, the Community and the United States, have been hardly prepared for the far-reaching changes now taking place.

By contrast, the structural features in Japan appear to have been more conducive to carrying out this transformation. First, the organization of the credit system and the industrial structure in Japan certainly facilitate investment in high-risk areas. Second, in comparison with the United States and the Community, Japan was handicapped in the early 1970s by a shortage of skilled labour capable of producing high-quality industrial machinery. By attempting to rectify this shortcoming by introducing microprocessors, Japan without doubt placed itself in the vanguard of a radical transformation in the machine-tool sector, involving a switch from numerically controlled to computer-controlled machine tools. In addition, the introduction of robots capable of handling parts for machining made it possible to install multi-purpose machining stations that permit a rate of capacity utilization three times that for machinery forming part of a traditional production line. The expected improvement in robot performance in the years ahead should make it possible to increase this gap even further.

Given the scale of this transformation, it seems clear that the only manufacturers that will remain competitive will be those that manage to ensure that the progress on software and data-processing components keeps in step with that on the more mechanical part of machine tools. There is little doubt that, for the moment, Japan has best managed this combination and that it has solid achievements on which to build. By contrast, the United States, which combined from the outset a strong position in computers with an efficient machine-tool industry, has been less successful in this respect and, as a result, has been a net importer since as early as 1978 (see Table 7). Lastly, it would seem that the machine-tool industry in the Community has been handicapped by the fact that the dissemination of inflation technology has lagged behind that in other countries. Nevertheless, the Community is still the world's leading exporter, and it would therefore be a mistake to believe that it cannot close the gap. But this will be possible only if the Community dimension is harnessed in such a way that this sector is able to retain the important position that its hold on the internal market has always conferred upon it.

Automobiles: a changing sector

The automobile sector is undergoing a long and difficult phase of technological and competitive adjustment which first became apparent in about 1975, when exports to the USA and Third World markets fell. Among the large producers only Germany, France and Japan have been permanently in trade surplus. Expressed as a proportion of national production this surplus has, since 1970, remained

Table 7

Main indicators of international trade in machine tools, 1963-81

Year [1]	Exports / Imports [2]	SI [3]	Import penetration ratio [4]	Exports / Imports [2]	SI [3]	Import penetration ratio [4]	Exports / Imports [2]	SI [3]	Import penetration ratio [4]
	FR of Germany			**France**			**Italy**		
1963	368 59	2,0	—	59 96	0,7	—	63 111	1,1	—
1970	690 179	1,9	10,5	116 191	0,7	35,7	191 124	1,5	21,7
1978	2 515 574	1,7	12,5	471 387	0,7	30,6	676 249	1,2	20,6
1981	2 912 766	1,7	16,5 [5]	510 699	0,6	38,2 [5]	918 369	1,2	29,9 [5]
Year [1]	Exports / Imports [2]	SI [3]	Import penetration ratio [4]	Exports / Imports [2]	SI [3]	Import penetration ratio [4]	Exports / Imports [2]	SI [3]	Import penetration ratio [4]
	United Kingdom			**USA**			**Japan**		
1963	126 77	0,9	—	195 42	0,9	—	17 83	0,2	—
1970	211 136	1,1	34,1	305 135	0,9	3,3	90 159	0,4	6,6
1978	551 505	0,8	42,1	841 914	0,7	9,3	1 139 142	1,0	2,9
1981	657 550	0,8	50,1 [5]	1 583 1 876	0,9	13,6 [5]	1 824 263	1,1	4,6

1 For 1963 and 1970, SITC Rev. 1, code 7151; for 1978 and 1981, SITC Rev. 2, code 736.
2 Values in '000 million current US dollars, for exports and imports.
3 Specialization index. The method of calculation is described in the box on trade in high-technology products.
4 Import penetration ratio (in relation to sector's output).
5 1980 data.

static in France and risen slightly in Germany and very strongly in Japan (see Table 8). Although the increase in Japan is largely explained by the rapid expansion of its exports to the rest of the world, it would not have happened if, as in the past, the Japanese market had not remained tightly closed to foreign imports. Thus, Japan imports less than 1% of the value of domestic production, i.e. in current 1981 values, about the same as France and Germany in 1963, while prices have quadrupled since then. Those two countries on the contrary, have continued to open their domestic markets to foreign suppliers: the ratio of imports to domestic production rose, in 1980, to 23% for France and 15% for Germany. However, the two countries differ greatly as to their success on export markets: the value of Germany exports is more than twice that for France at a level which, since 1980, has been just below the equivalent level for Japan. The position of the Italian and British auto industries has greatly deteriorated in the meantime, since the early 1970s in the United Kingdom and since 1978 for Italy. The latter has become a net importer since 1979, while the United Kingdom succeeded in maintaining a degree of balance between imports and exports. The outlook is however, improving in both those countries. Finally the US automobile balance has been in deficit since 1968 but it should be noted that for a long time US producers have adapted the strategy of direct investment in overseas markets.

These country-by-country developments highlight Japan's success in penetrating foreign markets, at the expense of its partners because it occurred against a background of shrinking world markets. In real terms, demand, output and international trade in motor cars all contracted from 1979 to 1981.[1] These distortions provoked a reaction among other world manufacturers, and led to more and more political negotiations that have resulted in some relaxation of the pressure from Japanese output. Since 1981, Japan has been prevailed upon to limit exports to the USA to 1 680 000 cars a year (by an agreement in force until March 1984), and those to Canada to 202 000 cars between January 1983 and March 1984. The Europeans have only managed to persuade Japan to moderate exports for an unspecified period; this commitment, which was confirmed early in 1983, does not involve definite quotas but will be adaptable to the trend of Community demand. The restrictions adopted by some of the Member States will nevertheless remain in force, such as the Italian import quota (adopted in 1956) of 2 200 Japanese cars, or the French and British quotas of 3% and 11% for the Japanese shares of their respective markets.

At best, these measures may offer some respite on the Community's internal market, but they obviously do not reinforce the position of the Community auto industry on third markets. The Community has undertaken large investments in the modernization of production structures which should permit it to reinforce its position on the internal market while at the same time reducing impediments to trade. These investments can only be made profitable, and thereby allow further investment, if the Community can continue to succeed in selling about one quarter of its production on foreign markets. However, it is quite possible that the limitation measures, which will divert the Japanese export effort towards other markets, will reinforce the Japanese on markets which are vital for the Community. If this should prove to be the case the protectionist measures in the automobile trade, even if the period of their applicability is limited, will have adverse effects for the future of the European auto industry, paradoxically placing in jeopardy the restructuring which they were intended to facilitate.

[1] See 'International trade in 1981/82', GATT, 1982, pp. 97 et seq.

Table 8

Main indicators of international trade in automobiles, 1963-81

Year [1]	Exports Imports [2]	SI VP (a) VU (b) [3]	Imports penetration ratio [4]	Exports Imports [2]	SI VP (a) VU (b) [3]	Imports penetration ratio [4]	Exports Imports [2]	SI VP (a) VU (b) [3]	Imports penetration ratio [4]
	FR of Germany			**France**			**Italy**		
1963	1 914 226	2,2 1,2	—	671 257	1,7 0,8	—	355 287	1,3 0,6	—
1970	4 755 1 274	1,5 1,0	12,6	1 897 849	1,5 0,7	15,7	1 125 649	1,0 0,5	19,6
1978	20 451 6 848	1,4 0,8	17,7	9 750 4 648	1,3 0,6	20,1	4 647 3 334	0,7 0,6	30,3
1981	25 705 6 518	1,4 1,0	15,0 [5]	10 527 6 476	1,1 0,7	22,6 [5]	4 776 6 027	0,4 0,6	41,8 [5]
Year [1]	Exports Imports [2]	SI VP (a) VU (b) [3]	Imports penetration ratio [4]	Exports Imports [2]	SI VP (a) VU (b) [3]	Imports penetration ratio [4]	Exports Imports [2]	SI VO (a) VU (b) [3]	Imports penetration ratio [4]
	United Kingdom			**USA**			**Japan**		
1963	1 392 84	1,4 1,8	—	1 463 575	0,4 1,3	—	153 28	0,2 1,1	—
1970	2 012 398	0,8 1,1	6,6	3 599 5 163	0,5 1,0	11,2	1 469 94	0,8 1,2	0,8
1978	5 712 6 034	0,4 0,6	36,3	13 250 22 525	0,6 0,8	18,1	17 183 520	1,6 2,1	0,9
1981	6 284 6 534	0,4 0,5	41,4 [5]	16 035 27 743	0,4 0,5	16,6 [5]	29 128 461	2,0 2,1	0,9 [5]

1 For 1963 and 1970, SITC Rev. 1, codes 7321 to 7328 and 7333; for 1978 and 1981, SITC Rev. 2, codes 781 to 784, 78611, 78681, 78612, 78689.
2 Values in '000 million current US dollars, for exports and imports.
3 Specialization index. The method of calculation is described in the box on trade in high-technology products.
4 Import penetration ratio (in relation to sector's output).
5 1980 data.

Source: Volimex and World Bank data bank, Washington.

(a) Passenger cars.
(b) Transport vehicles.

List of boxes

1. Bilateral trade between the Community and the United States, 1973-81

In the period 1973-81, the volume of bilateral trade between the Community and the United States grew at broadly comparable rates in the two directions. However, Community exports to the United States did not keep pace with the buoyancy of that market since US imports of Community goods expressed as a proportion of total imports fell, by over 6 points in the closing years of the period, while the US share of the Community market contracted by only 2 percentage points. There was still a large structural deficit in the Community's merchandise trade with the United States, the Community's rate of cover of imports by exports slipping here from 0,86 in 1973 to 0,84 in 1981 (after dipping to a low of 0,65 in 1980).

In the case of agricultural products, Community exports to the United States expanded rapidly although, given their very low initial level, the Community's rate of cover did not show any significant change. It remained at a sufficiently low level to enable the United States, in spite of the criticisms directed by the US Administration at the common agricultural policy, with charges that it encourages unfair competition, to go on running large surpluses with the Community, mainly due to US sales of soya and gluten—to replace traditional grain feedingstuffs—which European livestock converts into elaborate agricultural products.

The United States' edge was at times also very great in manufactures, for which the Community recorded a cover rate in bilateral trade that was greater than unity in 1973 but had fallen to 0,86 by 1981. This deterioration in the Community's competitive position reflects the growth-rate differential and the Community's contracting shares of the US market, contrasting with a gain in American market shares in the Community.

Trade in intermediate products appears to have escaped this adverse trend to some extent, judging by the respective growth rates and by the cover rate, which rose from 1 in 1973 to 1,4 in 1981 although the result in terms of market shares is less positive. This is attributable mainly to the Community's healthy performance on chemical products and the contraction in steel imports. The changing pattern of trade in intermediate products induced some improvement in the US share of the Community market and a reduction in the Community's share of the US market, but Community steel products still make up a substantial proportion of US imports (11% in 1981), and this explains why US steel producers are so sensitive about them. Bilateral negotiations have produced an agreement on voluntary export restraint by the Ten.

In equipment goods, the Community performed badly in the United States, not only in growth-rate terms but also in terms of its market shares and cover rate. This adverse trend was apparent in virtually all product categories but was particularly pronounced for office machines (computers), electrical goods (electronic equipment) and motor vehicles, even though the cover rate for the latter remained high, not because of a strong performance by the Community but on account of the weakness of US sales abroad. Agricultural and industrial machinery was the only sector in which trade remained relatively balanced and the cover rate actually improved; this therefore, was one of the very few success stories in Community trade with the United States.

The United States itself, though unable to take full advantage of the expansion in Community imports of equipment goods from non-member countries, stepped up its exports by an average of 5% a year, a healthy performance that enabled it to improve its trade balance with the Community by over 20% in eight years. Two sectors accounted for the bulk of this improvement, electronical goods and office machines. Together, they made up 24% of Community imports. As a result, the United States now has a market share of over 50% in imports from outside the Community of computers, office electronics and other data-processing equipment.

It is in basic consumer items though that the United States' pre-eminence was most apparent, showing up a wide gap between the growth rate of imports and that of exports, in declining shares of Community products on the US market and in a very pronounced deterioration in the Community's cover rate. This situation is largely attributable to the collapse in textile, clothing and footwear exports to the United States, which, for its part, managed to consolidate its position on the corresponding markets in the Community. However, in view of the rapid appreciation of the dollar since 1981 and the high price elasticity of these products, some weakening of the US position may be expected.

Since 1958, bilateral trade has invariably shown a large surplus for the United States, the record year being 1980 with a surplus of 17 800 million ECU. In 1982, the surplus stood at 10 900 million ECU and was spread over a very wide range of product categories. In bilateral trading relations, therefore, the Community is in the weaker position. None the less, with the crisis continuing, the accusation of protectionism is often made on both sides by pressure groups who have encountered obstacles to sales of their products or who are afraid of a diversion of exports from other producer countries, whose traditional outlets have been closed up.

In the context of this triangular competition in trade between the world's three leading producers, the recent increase in broad-ranging industrial agreements between US and Japanese firms may represent a further threat to the Community.

Community-United States bilateral trade

	Average annual growth rate of bilateral trade (volume) 1973-81		Share of imports from: United States in total imports by: EC (extra-EC) (value)				EC rate of import cover [1]		Structure of bilateral imports (%) 1981	
	EC	USA	1973	1981	1973	1981	1973	1981	EC	USA
1. Agricultural products	1,9	9,2	22,0	24,3	8,2	10,2	0,12	0,17	13,7	2,8
2. Energy products	11,4	8,3	2,7	2,9	5,6	7,5	0,81	1,72	7,1	14,5
3. Manufactured products	4,0	2,0	20,5	22,6	26,5	20,5	1,05	0,86	78,1	79,9
3.1. Intermediate products	0,6	3,6	17,8	20,1	30,0	25,5	1,01	1,14	16,3	22,2
— ores and metals	−5,4	2,3	7,9	9,0	24,5	21,1	1,92	2,60	3,6	11,2
— non-metallic minerals	1,5	−2,3	18,4	19,2	37,5	29,1	1,80	1,13	1,6	2,2
— chemical products	2,6	7,5	38,9	33,9	41,1	33,3	0,50	0,67	11,0	8,8
3.2. Equipment goods	5,0	2,1	38,5	34,1	28,4	21,1	0,96	0,73	45,2	39,5
— metal products	3,9	2,0	22,3	21,4	23,1	18,3	1,13	0,95	1,4	1,6
— agricultural and industrial machinery	3,1	7,1	40,7	40,5	45,5	40,4	0,92	1,02	12,8	15,6
— office machines	13,1	0,7	47,3	50,8	29,0	16,1	0,42	0,19	11,5	2,7
— electrical goods	5,1	2,4	35,1	31,2	15,1	10,6	0,46	0,34	12,3	5,1
— motor vehicles	0,3	−6,3	15,7	6,9	28,3	16,6	10,17	7,74	1,1	10,6
— transport equipment	−1,5	6,7	53,9	38,3	29,7	34,3	0,37	0,57	6,0	4,0
3.3. Food products	4,8	−1,7	13,7	18,3	22,9	19,9	0,88	0,76	5,6	5,1
3.4. Basic consumer items	5,0	0,7	9,3	10,9	21,6	14,6	1,60	1,00	11,1	13,1
— textiles and clothing	6,0	−4,3	6,7	6,4	18,6	10,1	1,83	1,02	2,1	2,5
— leather and footwear	3,9	−2,5	2,9	2,6	33,3	17,6	17,12	9,27	0,2	2,1
— wooden products and furniture	6,4	20,9	5,3	8,2	2,4	6,7	0,24	0,51	1,3	0,8
— paper and printing products	4,5	5,7	13,4	15,1	6,9	6,6	0,27	0,24	3,4	1,0
— rubber products	5,5	−2,0	28,3	24,8	44,1	28,2	2,61	1,42	1,1	1,9
— other manufacturing products	4,3	—	11,5	16,0	39,3	24,7	2,23	1,39	3,0	4,9
4. Products n.e.s.	9,7	—	33,4	11,9	25,8	24,9	1,52	2,16	1,1	2,8
5. Total	3,3	3,2	17,4	15,3	22,6	16,1	0,86	0,84	100,0	100,0

[1] US imports from EC divided by EC imports from the USA.

Source: Volimex.

2. Bilateral trade between the Community and Japan, 1973-81

In bilateral trade between the Community and Japan, the volume of Community imports has risen three times as fast as that of Japanese imports since 1973; Japan's share of the value of Community imports has therefore grown while the Community's share of the value of Japanese imports has contracted. However, this contraction was due to the enormous size of Japan's energy imports (accounting for over 50% of total imports in 1981) and to the associated price effect. In volume terms, imports from the Community as a proportion of Japan's total imports rose from 6,6% in 1973 to 7,8% in 1981.

The Community's share of Japan's manufactured imports remained virtually unchanged at 15% but, bearing in mind the fact that Japan's imports increased at an average annual rate of 2%, this is attributable more to the sluggish growth in Japan's manufactured imports generally than to a genuine breakthrough by the Community. The growth rate of Japan's exports to the Community (averaging 9% a year), the increase in their share of total Community imports from the rest of the world (up 50%) and the deterioration in the Community's cover rate for manufactures are clear indications of the growing imbalance in trade with Japan. In 1982, the bilateral trade deficit amounted to 11 600 million ECU.

The main cause of the deficit is the growing trade imbalances in equipment goods and in basic consumer items. Leaving aside transport equipment other than motor vehicles, the equipment goods sector is not one in which the trend of bilateral trade has been favourable to the Community. In all cases, the growth rates for Japanese exports to the Community were well in excess of those for Community exports to Japan, which were actually negative in a fair number of cases. This resulted in a general decline in the rate of cover by Community products of purchase of equipment goods from Japan. The decline reached dramatic proportions in the case of industrial machinery, officie machines, electrical goods and motor vehicles. The consequence is severe imbalance in export structures, with equipment goods now accounting for over 80% of Japanese exports to the Community but for under 35% of Community exports to Japan.

The same deterioration is discernible in trade in basic consumer items. Bilateral trade, which showed a surplus of 50% in 1973, was in deficit in 1981. This turnaround was caused in large measure by the worsening trend in textiles and clothing, which was not offset by the more favourable movement in trade in leather goods and in wooden products and furniture.

The Community's trade deficit with Japan would have been even larger if it had not stepped up exports of food products and intermediate products. While the Community's performance in food products, remarkable as it may be, is based on its natural comparative advantage, the satisfactory gains in trade in intermediate products are probably the only positive feature in what is a particularly sombre picture. The improvement in trade in ferrous and non-ferrous metals, primarly steel products, was mainly due to the sharp contraction in trade in steel products coupled with a significant slowdown in Community imports from the rest of the world in 1981; the Community's stronger competitive position therefore rests on the firm foothold it has on the Japanese market for chemical products.

Foreign products and firms have to overcome many barriers that have less to do with tariffs than with Japan's socio-cultural and socio-economic system if they are to penetrate the Japanese market or set up there.[1] This disequilibrium in trade relations between the Community and Japan has been the cause of frequent negotiations between them although these have not prevented the Community from lodging a general complaint with the GATT. But the matters giving cause for concern to economic policy-makers and industrialists in the countries trading with Japan go beyond the direct effects of the mounting trade deficit. Japan in fact needs its surpluses in order to finance its imports of agricultural and energy products and, above all, its deficit on services (see introduction to this chapter). The problem is Japan's extreme concentration on exports of products that shape today's on-going technological revolution. Its success on export markets for motor vehicles, public-sector electronics equipment or robotics is, by virtue of the information technology these product categories embody, a sign of its technical and commercial supremacy in areas in which the influence of European industry is gradually waning. If the Community does not manage to harness its own potential, it will have to undergo structural changes that are imposed from outside.

[1] See J. Zerche: 'Sozialpolitische Kosten and ihr Einfluß auf die Wettbewerbsfähigkeit', in *Internationale Wettbewerbsfähigkeit bei unterschiedlichen Sozialordnungen, USA, Japan, Bundesrepublik Deutschland, Gespräche der List-Gesellschaft*, New Series, Vol. 7, Baden-Baden, 1982, pp. 103 et seq.

Community - Japan bilateral trade

	Average annual growth rate of bilateral imports (volume) 1973-81		Share of imports from: Japan in total imports by: EC (extra-EC)				EC rate of import cover [1]		Structure of bilateral imports (%) 1981	
					EC Japan					
			(value)							
	EC	Japan	1973	1981	1973	1981	1973	1981	EC	Japan
1. Agricultural products	−7,4	0,5	0,5	0,4	1,0	0,8	1,06	1,39	0,6	2,0
2. Energy products	30,3	12,1	0,0	0,1	0,1	0,1	4,64	0,73	0,5	0,9
3. Manufactured products	9,0	1,6	6,4	10,1	15,3	15,7	0,71	0,40	98,8	95,5
3.1. Intermediate products	−2,5	1,8	4,7	3,8	10,2	10,5	0,98	1,34	8,8	28,3
– ores and metals	−10,2	2,2	3,9	2,1	1,8	2,5	0,24	0,72	2,4	4,2
– non-metallic minerals	1,2	2,3	5,5	4,7	11,5	10,4	0,66	0,62	1,1	1,7
– chemical products	2,6	3,1	6,2	5,6	36,2	26,1	2,06	1,77	5,2	22,4
3.2. Equipment goods	12,7	1,1	14,7	21,2	30,1	23,7	0,40	0,18	80,1	34,3
– metal products	4,0	−0,4	9,4	8,7	33,1	26,3	0,49	0,35	1,6	1,4
– agricultural and industrial machinery	9,1	−1,8	7,0	9,6	36,4	31,0	1,23	0,52	8,6	10,9
– office machines	14,3	−3,5	18,6	21,2	31,4	15,7	0,44	0,11	13,7	3,7
– electrical goods	13,9	4,2	18,5	26,8	19,4	13,8	0,19	0,08	30,1	6,2
– motor vehicles	16,5	2,7	29,0	41,5	50,4	68,2	0,20	0,09	19,8	4,2
– transport equipment	5,8	9,5	12,7	14,2	19,2	26,5	0,21	0,52	6,3	7,9
3.3. Food products	−2,7	9,5	1,2	0,9	7,8	14,2	1,86	6,51	0,8	12,1
3.4. Basic consumer items	3,1	−0,9	2,8	3,2	17,4	15,5	1,57	0,93	9,2	20,8
– textiles and clothing	5,1	−2,4	2,8	2,8	16,8	16,9	2,48	1,39	2,5	8,6
– leather and footwear	−6,4	10,7	3,8	1,4	26,5	31,1	1,03	4,04	0,3	2,9
– wooden products and furniture	−8,1	2,6	1,1	0,7	2,1	2,1	0,42	0,70	0,3	0,6
– paper and printing products	9,7	−1,7	1,0	1,4	13,0	7,8	1,34	0,73	0,9	1,6
– rubber products	4,6	11,6	9,3	8,2	25,9	31,3	0,38	0,60	1,0	1,5
– other manufacturing products	2,6	−3,6	5,4	7,7	32,3	25,9	1,75	0,58	4,1	5,7
4. Products n.e.s.	—	—	1,9	0,2	14,6	12,3	1,23	15,23	0,0	1,6
5. Total	8,3	2,3	4,2	5,4	8,3	5,4	0,72	0,41	100,0	100,0

[1] Japan imports from EC divided by EC imports from Japan.

Source: Volimex.

3. Innovation and trade in high-technology products [1]

Technological advance takes two main forms: the technology of new production processes and the technology of new products. While the former involves improving the productivity of an economy's productive system, the latter is reflected in sectoral switches in production to high technology, more sophisticated or entirely new products. Together, they contribute directly to structural change in the economy and are the main source of long-term economic growth.

The possession of technology, or a relatively high level of R&D spending will not by itself trigger technological change or induce economic growth. Technology needs to be translated into actual manufacturing processes and products. In the absence of technological innovation, structural change and economic growth are impossible.

An economy's competitiveness and hence the growth-rate differentials between countries are determined by the relative progress made in the field of technological innovation. Such progress essentially means expanding international market shares for new-technology products and a growing concentration on exports of such products, coupled with an increasingly high degree of national self-sufficiency in high-technology products and processes.

The following tables give the main findings of international comparisons of innovation based on trade in high-technology products.

Table I lists, using the United Nation's Standard International Trade Classification (SITC, Rev. 2) adopted by most industrialized countries in 1978, product groups which, within manufacturing as a whole, are characterized by a fairly high level of R&D spending on production processes or on the product marketed. An effort was made to find the corresponding groups from the SITC, Rev. 1, so as to estimate the results for the period prior to 1978. Selection posed no problems for the sectors with a high R&D content, but delimitation was more arbitrary in the less high-technology sectors.

Table II gives the values of exports (fob) and imports (cif) of these products, expressed in current dollars, for the Community, the United States and Japan for the years 1963, 1970 and 1981. The Community as a whole emerges as the most important trading area for high-technology products, recording a positive balance, yet also remaining a major importer (USD 43 000 million), a testimony to its firm commitment to free trade principles.

Taking Community trade, the strong position of Germany is clearly apparent. While, in 1981, the Community and the United States were still the largest exporters of products in this category, Japan, which played only a minor role in 1963, now ranks between the two. The Community and the United States have imported gradually more high-technology products, so that their cover rates fell from 3,3 to 1,4 and from 3,1 to 1,0 respectively in the period 1963-81, whereas Japan's cover rate increased from 2,2 to 6,9.

Table III shows the relative importance of trade in high-technology products in each country's total in manufactures. The twofold increase since 1963 in the share of these products in Japan's exports indicates the progress it has made by concentrating on 'knowledge-intensive', high value-added and export-oriented products.

The United States' performance is slightly better than the Community's but is still overshadowed by Japan's. The individual Community countries' performances differ depending on the degree of their scientific development, with Italy, Denmark and the Netherlands showing remarkably poor results considering the relatively advanced state of their scientific and technological infrastructure.

The high score for Ireland is influenced by high-technology investment from abroad, while the results for the United Kingdom reflect the much worse figures obtained for exports of low-technology products than for exports of high-technology products.

Table IV gives the results of the calculations[2] of the comparative advantage enjoyed in trade in high-technology products by the Community countries, the United States and Japan, by reference to each country's relative importance in total trade in manufactures in the industrialized world (OECD).

It can be seen that the degree of specialization in high-technology exports has risen rapidly in Japan and showed a long-term decline in the United States. The index would be higher though if the definitions of 'high-technology products' were more restrictive.

The Community index has fallen since 1963, as has the index for the United States although the level there is still high in absolute terms. However, the gap between the Community and the United States is much narrower if we focus only on Community trade with the rest of the world.

Table V gives the values of bilateral trade flows of high-technology products between the Community, the United States and Japan; these again reveal Japan's tendency to concentrate on achieving self-sufficiency in these products.

The Community's large deficit with Japan and its somewhat smaller deficit with the United States confirm that much of the Community's trade in this sector is with technologically less advanced countries.

[1] By Brendan Cardiff, Directorate-General for Economic and Financial Affairs.

[2] The index of specialization is calculated as follows:

$$\frac{X_{ij}/\Sigma x_j}{X_i/\Sigma x}$$

where X_{ij} = exports of product j by country i; Σx_i = total world exports of product j; X_i = total exports of manufactures by country i; Σx = total world exports of manufactures.

Table I

Classification of selected high-technology sectors: Standard International Trade Classification (SITC) Revision 2 for 1978 and 1981 and Revision 1 for 1963 and 1970 data

SITC 2 CODE	Description of product sector	SITC 1 CODE
523	Other inorganic chemicals; inorganic or organic compounds of precious metals	514
524	Radioactive and associated materials	515
541	Medicinal and pharmaceutical products	541
714	Engines and motors, non-electric (reaction engines, gas turbines, turbo-propellers)	7116
716	Rotating electric plant	—
7187	Nuclear reactors	7117
736	Machine tools for working metal	7151
752	ADP machines and units thereof (including peripheral equipment)	7143
761	Television receivers [1]	724
763	Gramophones and other sound recorders	8911
764	Telecommunications equipment [1]	—
771	Electric power machinery other than that shown under 716	7221
773	Equipment for distributing electricity	723
774	Electric medical apparatus including radiology	726
775	Household equipment, electrical or not	7250
776	Valves, tubes, diodes, transistors, microcircuits	7293
781	Passenger motor-cars	7321
7821	Motor vehicles for transport of goods	7323
7911	Electrical rail locomotives	7312
792	Aircraft and associated equipment	734 / 8999
871	Optical instruments and apparatus	8613
872	Medical instruments and appliances	8617
874	Measuring, checking, controlling instruments	7295 / 8619
8811	Photographic cameras and equipment (other than cinematographic)	8614
8812	Cinematographic cameras, projectors including sound recorders	8615
8822	Photographic films, plates and paper	8624
8841	Lenses, prisms and other optical items	8611
885	Watches and clocks	864
Total	Total of high technology	Total

[1] For SITC 1, Code 724 includes both TV receivers and telecommunications equipment (764 and 761 of SITC 2).

Table II

Trade in high-technology products, 1963, 1970, 1981

('000 million current US dollars)

Country	1963	1970	1981
Belgium/Luxembourg	0,57	1,67	9,08
	0,49	1,27	6,57
Denmark	0,11	0,31	1,52
	0,27	0,70	2,16
France	1,29	3,36	19,3
	0,79	2,38	17,53
FR of Germany	3,53	7,77	41,99
	0,76	3,37	22,98
Greece	0,00	0,00	0,15
	0,11	0,28	1,00
Ireland	0,01	0,06	1,42
	0,10	0,22	1,71
Italy	0,75	2,35	10,75
	0,83	1,77	12,68
The Netherlands	0,68	1,40	6,14
	0,91	2,11	7,92
United Kingdom	2,26	3,79	18,79
	0,59	1,72	18,65
EC total	9,22	20,68	109,16
	4,85	13,82	91,21
Extra-EC	5,61	11,60	61,10
	1,69	4,86	42,91
United States	4,32	8,45	52,22
	1,40	7,97	50,55
Japan	0,81	4,61	56,09
	0,37	1,33	8,09
Canada	0,32	3,25	12,61
	0,66	2,87	14,36

First line: exports fob;
second line: imports cif.

Table III

Share of exports of high-technology products in total manufactured exports 1963, 1970, 1981 [1]

	B/L	DK	F	D	GR	IRL	I	NL	UK	EC	USA	Japan
1963	15	15	21	27	2	10	19	25	23	23	29	16
1970	17	17	24	25	2	14	21	20	22	22	28	25
1981	22	17	25	28	6	30	17	18	28	24	33	38

[1] 1963 and 1970 data based on SITC Rev. 1; 1981 data based on SITC Rev. 2.

Table IV

Specialization indices in trade in high-technology products

(OECD average = 1,00)

Country	1963	1970	1978	1981
Belgium/Luxembourg	0,65	0,72	0,81	0,80
Denmark	0,65	0,70	0,63	0,60
France	0,93	1,00	0,96	0,88
FR of Germany	1,20	1,06	0,99	1,00
Greece	0,07	0,07	0,16	0,20
Ireland	0,42	0,61	0,92	1,07
Italy	0,83	0,87	0,65	0,60
The Netherlands	1,10	0,85	0,68	0,64
United Kingdom	1,02	0,94	0,92	1,00
EC total	1,01	0,94	0,88	0,87
Extra-EC	1,11	1,07	0,96	1,04
United States	1,27	1,18	1,27	1,19
Japan	0,72	1,07	1,27	1,37

Table V

Estimated imports of high-technology products Community, United States, Japan — 1963-81

('000 million current US dollars)

Declarants \ Partners	Imports (CIF) EC	USA	Japan
	1963		
EC	(3,16)	0,86	0,07
USA	0,75	—	0,26
Japan	0,11	0,21	—
	1970		
EC	(8,86)	2,42	0,40
USA	2,21	—	1,93
Japan	0,33	0,85	—
	1978		
EC	(37,72)	9,9	5,13
USA	7,45	—	11,14
Japan	1,31	2,60	—
	1981		
EC	(48,30)	15,35	9,58
USA	9,86	—	20,76
Japan	1,64	4,96	—

Methodological annex: The assessment of volume trade flows

1. The Volimex data bank

Volimex is the Commission's bank of annual bilateral trade data, in volume and value terms, for 22 OECD member countries that send in returns and 29 partner areas or countries, broken down into 23 products. It contains a coherent set of satistics for each OECD country on commercial trade in current dollars and at constant 1975 prices and exchange rates. Construction of the price (or unit value) series raised a number of methodological problems; the main ones are dealt with below, but the estimated price series obtained cannot, at all events, be regarded as more than a sectoral approximation to true import and export prices. Until 1980, basic statistics were supplied by the OECD; since 1981, they have come from the United Nations Statistical Office in Geneva.

1.1. *Grouping the products*

The figures are broken down into 23 product groups compatible with NACE-CLIO (R25) grouped into broad categories. This classification was obtained by drawing up two keys (one for the 1 500 products of the SITC-Rev. 1 and one for the 1 900 products of the SITC Rev. 2),[1] which lead to the establishment of continuous series covering the period 1963-81 for the following 23 product groups:

1 — Agriculture, forestry, fisheries
2 — Coal, lignite, briquettes
3 — Products of coking
4 — Oil and natural gas
5 — Electric power, gas, steam and water
6 — Nuclear
7 — Ores and metals
8 — Non-metallic minerals
9 — Chemical products
10 — Metal products
11 — Agricultural and industrial machinery
12 — Office machines
13 — Electrical goods
14 — Motor vehicles
15 — Other transport equipment
16 — Food product
17 — Textiles and clothing
18 — Leathers, skins, footwear
19 — Wooden products and furniture
20 — Paper and printing products
21 — Rubber and plastic products
22 — Other manufacturing products
23 — Products n.e.s.

and the following broad categories:
Energy products (2 to 6)
Manufacturing products (7 to 22)
comprising:
— Intermediate products (7 to 9)
— Equipment goods (10 to 15)
— Current consumption goods (17 to 22)

[1] See SITC Rev. 2, Unted Nations, Department of Economic and Social Affairs, Statistical Office, *Statistical Papers* No M34, New York, 1975.

1.2. *Volume figures*

The basic figures supplied by the OECD and the UN are in terms of value, usually with data on the quantity traded for each basic product category. This provides a statistical basis for the calculation of unit value indices (exports or imports in value divided by the corresponding quantity) for all bilateral flows. The calculation implies a certain number of methodological alternatives. First, classical unit value indices may be calculated on the basis of a basket of goods whose composition does not change over the calculation period. The disadvantage of this approach is that it considerably narrows the statistical basis of the index: calculations can cover only products for which bilateral trade values and quantities are given each year. If information is missing for a single product in the finest SITC breakdown for a single year, that product must be eliminated from the calculations. This restriction holds for any index, but it is particularly important in foreign trade indices—so much so that numerous bilateral flows do not exist at all during a period. Consequently, a traditional price index calculated for a basket of products is not really representative of prices as a whole for a group of products, and cannot therefore be used as the basis for deflating. To correct this shortcoming, Volimex unit value indices have been calculated using the chain-linked method, where all the products bilaterally traded in at least two consecutive years are taken into account. Unit value indices are calculated on the basis of changing baskets and weights that are assumed to provide a fairly faithful representation of the trend of unit prices for goods traded; the indices are evaluated from one year to the next, aggregated and chain-linked to form a series of price indices both for imports and for exports.

The problem of choosing between Paasche and Laspeyres indices arose when the unit value series for the 23 product groups were aggregated. The main advantage of the Laspeyres index is that it uses constant weights; but this ceases to be particularly useful when chain-linked indices are available. Chain-linked Laspeyres and Paasche indices for

year ($t + 1$) in relation to year t for all products together are as follows:

$$I^{l}_{t+1,t} = \frac{\sum_{i=1}^{u} q_i^t p_i^{t+1}}{\sum_{i=1}^{u} q_i^t p_i^t} \qquad \text{(Laspeyres)}$$

$$I^{p}_{t+1,t} = \frac{\sum_{i=1}^{u} q_i^{t+1} p_i^{t+1}}{\sum_{i=1}^{u} q_i^{t+1} p_i^t} \qquad \text{(Paasche)}$$

Every year, the system of weights (q_i) changes, with the weights used in the Paasche index for year t equal to those used in the Laspeyres index for year ($t + 1$). Consequently, except for the quantities used as weights in the first year of the series of Laspeyres indices, or the final year of the series of Paasche indices, the same system of weights is used in both series with one year's difference, one being an arithmetic and the other a harmonic mean. Although there is little change from one system of weights to the next, it has been found that the Laspeyres index for any year is always higher than the Paasche—as could be expected in view of the negative sign of most import and export price elasticities. The advantages of the methodological clarity of the Laspeyres index are not apparent once the indices are chain-linked, so there is no reason to give preference to either base-year or current-year weights. Consequently, it seemed best to adopt the classic middle way: Fisher's 'ideal' index, which is the geometric mean of the Laspeyres and Paasche indices.

1.3. *The quality of the figures*

Apart from their drawbacks in relation to true price indices, the quality of unit value indices calculated in this way depends mainly on the statistical quality of the import and export returns sent in by the countries. This quality improves as the percentage of return covering both value and quantities rises.

In most cases, the percentage is satisfactory—for example, both magnitudes are given for over 90% of Belgium's exports in 1980—, but the United States and Canada have much lower than average statistical coverage (under 60%, and 65% respectively). This implies a more cautious approach in analysing the indices and thus the real figures for these countries' imports and exports than for others.

The United Kingdom's exports in 1981 cause a problem because the long drawn-out civil service strike meant that figures for exports from May to August were incomplete. The missing figures have been estimated by UK statisticians on the basis of a sample survey, so that the annual values for 1981 are less reliable.

2. The treatment of intra-Community trade

Intra-Community trade raises a problem for comparative studies of the Community and the other countries or areas. On the assumption that the Community participates as such in the international division of labour, it seems logical to base comparisons on figures for external trade excluding intra-Community trade. This approach thus logically implies excluding intra-Community trade from the reference figure for the total trade of OECD countries. This was done in Table 2, where the OECD row gives total trade of all OECD countries with the rest of the world excluding trade between Community countries. However, there is no need to correct the figures for the United States and Japan, which obviously include trade with the Community countries, just as figures for extra-Community trade cover all trade by all Community countries with all non-Community countries, and in particular with the United States and Japan.

Chapter II: The external constraint and the operation of the price and income elasticities of external trade in the Community countries, the United States of America and Japan [1, 2]

[1] This chapter has been written by Ph. Rollet, Researcher at the CNRS, Centre de recherches européennes et internationales, University of Lille I.

[2] The opinions expressed in this chapter are those of the author and do not necessarily represent those of the Commission.

List of tables

Introduction

The estimation of import and export demand functions has always been of interest in trying to understand the factors that govern international trade and the implications of the interplay of those factors for economic policy. For example, it is necessary to know price and income elasticities of external trade to assess the consequences for a country's trade balance and those of its partners of changes in par values, tariff policies or subsidies; to comprehend the mechanisms by which changes in price or growth rates are transmitted between countries; and, more generally, to evaluate the severity of the external constraint on each country as a result of its degree of openness and the extent of its participation in the international division of labour.

Many relevant studies have been carried out, especially since the work of Houthakker and Magee [1] [1] and that of Adams [2] in the early 1970s, which atempted to estimate sufficiently reliable parameters—in spite of the uncertainty that inevitably surrounds foreign trade data—to inform economic policy decisions. Some of these studies concentrate on international comparisons and deal with the foreign trade of the main Community countries, the United States and Japan; unfortunately, the periods they cover are usually rather distant: the late 1950s and the 1960s (Houthakker and Magee, Basev [3] and Taplin [4] under the Link project), or at best, for the most recent study (Deppler and Ripley [5]), the very early 1970s. Little work has been done to date to take account of the changes in international trade since 1973 described in Chapter I. The data bank for foreign trade statistics in volume terms [2] now makes possible international comparisons with a fairly fine breakdown, so knowledge of the mechanisms that regulate foreign trade has been updated and the general view provided by available studies has been supplemented in three main ways:

(i) systematic international comparisons have been made between the Community countries, the USA and Japan;

(ii) elasticities have been estimated over a long period (1964-81), but also over shorter periods to allow in particular for changes following the first oil shock;

(iii) elasticities have been estimated for trade with the rest of the world, but also, in view of the importance of the Community to our economies, for trade with the Community itself.

The exercise is not without risk, in view of the numerous problems of methodology and the controversies surrounding this matter—studied in detail in recent work by M. Goldstein and M.S. Khan [6], particularly in connection with the specification of models and the choice of variables: problems of estimating export and import supply functions, problems relating to the choice of price indices (difficulties of measurement, differences in price structures from one country to another, biases introduced by the use of unit values rather than the true prices of imports and exports, which are incompletely known), to the stability of relationships over time and to lags in adjustment. As always in these cases, the availability of statistics largely determines the nature of the relations estimated; there is sometimes a wide disparity between what is possible and what is formulated theoretically. The approach adopted here is traditional, and the formulations used for export and import functions are those most often used in the relevant literature (see Box 1), being confined to variables of relative price and national or international demand.

By confining the enquiry to the essential factors of external competitiveness and by concentrating on the international comparison aspect rather than theoretical refinements, it has been possible to define more precisely the nature of the external constraint that affects each of the European countries and their main industrialized competitors in very different ways, reflected in particular in differences between the trends of their trade balances and the number of currency realignments since the introduction of the EMS.

This constraint, which is largely determined by the extent to which a country's productive system is adapted to the structures and trends of domestic and world demand and by its degree of price competitiveness, is reflected both in the price and income elasticities of imports and exports and in the comparative rates of inflation and economic growth (see Box 2). The trend in the trade balance thus depends, first, on price elasticities and inflation differentials: if, for example, a country exhibits high price elasticities, this means that its trade balance will be especially sensitive to changes in relative prices where these are not offset by exchange rate movements, and that it will therefore have to attempt to bring down its inflation rate to a level comparable to that of its international trading partners. It depends, secondly, on the difference between the income elasticities of imports and exports and on economic growth differentials, the combined impact of which may accentuate or mitigate that of price elasticities and relative prices. Even if inflation rates are comparable, a country may experience an underlying improvement in its trade balance if the income elasticity of its exports is greater than that of its imports, as long as its economic growth rate is identical to that of its trading partners.

The present analysis seeks to identify the nature and extent of the external constraint arising from the operation of these elasticities by estimating them over an extended period

[1] Figures in brackets refer to bibliography at the end of this chapter.

[2] See methodological annex on the evaluation of real trade flows (Chapter I of the section 'Foreign Trade' of this report).

(1964-81) for the Community countries, the United States and Japan, first in respect of their trade with the rest of the world and then in respect of their trade with the Community. It does not, however, attempt to measure the effect of specific exhange rate movements, which depend partly on the trend in the trade balance and partly on monetary factors.

1. Trade with the rest of the world

The extent of the external constraint on each country is, of course, dependent on the trends in its total trade and trade in manufactures but a finer analysis by main product category reveals that the trade results achieved reflect both the changes in international specialization and the breaks in trend that have occurred since the first oil shock.

Trade in goods and trade in manufactures: the unevenness of constraints in the Community and in the industrialized world generally

The results in terms of price and income elasticities are given in Tables 1 and 2. On the whole, they are fairly satisfactory: the coefficients of determination are usually very high, problems of auto-correlation are rare, and few problems arise with colinearity.

Price elasticities: exports more sensitive to relative price trends than imports

By and large, the estimations of price elasticities are only mediocre, particularly those for exports. This may be because of statistical phenomena (average values being only approximate indicators of the actual prices in external trade) or because of real phenomena in that a number of factors have in the last decade tended to restrict the role of prices in the regulation of international trade:

(i) in general international competition is more in the nature of oligopolistic competition than in that of pure and perfect competition and acts more on product differentiation than on prices;

(ii) a large and increasing proportion of international trade is intra-company trade carried on at transfer prices that bear no relationship to market prices, or barter trade, for which prices are not the essential variable.

In spite of these methodological problems, which may influence the results, some interesting conclusions can be drawn from the tables.

In the first place, a large number of price elasticities of imports, whether total imports or manufactured imports, are significant. But they are not very high (ranging from $-0,3$ to $-0,5$), an indication of the minor role played by prices in the regulation of imports, which would seem to be more influenced by the level of economic activity caused by the fact that a large proportion of goods which can be substituted for only with difficulty, either for physical reasons (energy products, raw materials, agricultural products) or for reasons to do with the increased participation of the Community countries in the international division of labour.

The price elasticities of exports are also significant in a number of countries. This is notably the case in Italy, whose total and manufactured exports are highly sensitive to price changes (elasticity of -2) probably because the country is highly specialized in the manufacture of unsophisticated products in which there is keen price competition, especially because the markets concerned (textiles, clothing, etc.) are also supplied by low-wage countries [8]. Elsewhere elasticities are very close to unity: Germany, France, United States, Japan (total exports), Belgium (manufactured exports).

The relatively high value of combined elasticities means that countries with high inflation rates are more vulnerable

Subject to the uncertainty attaching to data of this kind, it would therefore appear that the sum of the price elasticities of imports and exports in most Community countries is greater than unity. As a result, the likelihood is that trade balances react positively to any currency depreciation and to any fall in relative prices (and *vice versa*) although we are unable here to indicate the extent of the phenomenon and its mechanics (in particular, the lag in the beneficial effects). At the same time, this relatively high value of the combind elasticities means that the Community countries must not allow any widening of inflation differentials between them and the rest of the world as this may induce a deterioration in their trade balance and a fall in the value of their currencies. The countries with the greatest inflation problem taking the long-run trends, France, the United Kingdom and Italy (Table 3), thus have had no alternative but to bring down inflation sharply (a strategy successfully pursued in the United Kingdom) or to allow the value of their currencies to fall in order to keep their external accounts in balance. The latter constraint, in the shape of an adjustment via the exchange rate, weighs particularly heavily on Italy on account of the high value of its export price elasticities.

The external constraint does not, however, depend solely on the impact of price elasticities and relative prices. It can be mitigated or amplified by the impact of income elasticities and economic growth differentials.

Income elasticities

The estimates for income elasticities are invariably highly significant. Differing widely between countries, they not only

Table 1

Income and price elasticities of merchandise exports and imports (trade with the rest of the world; annual figures, 1964-81)

Exports						Imports				
Constant	Elasticities: World demand	Elasticities: Prices	R^2	DW		Constant	Elasticities: GDP	Elasticities: Prices	R^2	DW
−7,92	1,24 (41,9)	−0,63* (−1,63)	0,99	2,08	Belgium	−6,03	1,83 (49)	−0,38 (−4,4)	0,99	2,18
−8,15	1,25 (41,4)		0,99	1,86		−6,36	1,86 (34,4)		0,98	1,87
−8,15[b]	1,31 (24,8)	−0,99 (−4,2)	0,99	2,31	FR of Germany	−7,95	1,95 (52)	−0,23 (−3,4)	0,99	2,13
−4,64	1,13 (30,7)		0,98	1,85		−8,77	2,00 (47,5)		0,99	1,90
−9,87	1,37 (28,5)	+0,2* (0,38)	0,98	1,97	France	−6,96	1,85 (56)	−0,45[a] (−6)	0,99	2,21
−9,79	1,36 (29,8)		0,98	1,78		−4,81	1,70 (40,1)		0,99	1,87
−1,14	2,27[c] (42)	−0,83 (−2,3)	0,99							
−7,42	1,22 (14,1)	−1,87[a] (−3,70)	0,97	2,47	Italy	2,72	1,81 (34)	−0,28 (−4,8)	0,99	2,28
−10,9	1,40 (20,3)		0,96	1,66		4,86	1,62 (28,6)		0,98	1,86
−6,22[b]	1,16 (24,7)	+0,27* (1,35)	0,99	1,88	The Netherlands	−0,11	1,50 (34,4)	−0,33 (−4,4)	0,99	2,26
−7,30	1,21 (47,09)		0,99	1,88		−1,72	1,63 (34,4)		0,98	1,89
−1,05	0,92 (24,7)	+0,22* (1,62)	0,98	1,87	United Kingdom	−6,15	2,00 (26,9)	−0,24 (−3,7)	0,98	2,27
−1,15	0,93 (25,1)		0,97	1,87		−5,18	1,92 (20,2)		0,96	1,91
+4,9	1,51[c] (34,5)	−0,29 (−2,9)	0,98							
na	na	na	na	na	EC 9 extra	na	na	na	na	na
−4,4	1,16 (17,8)		0,95	1,78		0,48	1,34 (28,4)		0,98	1,92
−8,10	1,30 (12,2)	−1,50[a] (−3,3)	0,95	2,56	USA	−19,8[bb]	2,68 (19,1)	−0,40 (−5,18)	0,98	2,50
−10,45	1,42 (13,5)		0,92	1,51		−7,97	1,86 (12,8)		0,92	1,77
18,64	1,80 (16,4)	−0,89 (−2,1)	0,97	2,29	Japan	5,86	1,24 (22,6)	−0,31 (−2,6)	0,97	2,23
−21,9	1,96 (22,6)		0,97	1,45		7,11	1,15 (22,5)		0,97	1,74

Note: ( ) Student's t.
a — one-year lag on relative prices.
b — colinearity problem.
c — regression by reference to world GDP.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).
For each country, the results of the multiple regression (as a function of demand and relative prices) are given first, followed by the results of the simple regression (as a function of demand).

Table 2

Income and price elasticities of exports and imports of manufactures (trade with the rest of the world; annual figures, 1964-81)

Exports						Imports				
Constant	Elasticities: World demand	Elasticities: Prices	R^2	DW		Constant	Elasticities: GDP	Elasticities: Prices	R^2	DW
−3,72	1,05 (53,0)	−0,98[a] (−2,9)	0,99	2,11	Belgium	−12,56[b]	2,26 (22,0)	−0,20 (−2,6)	0,99	2,24
−3,48	1,03 (51,0)		0,99	1,90		−8,92	2,01 (47,8)		0,99	1,88
−2,92[b]	1,07 (16,5)	−0,48* (−1,7)	0,99	2,20	FR of Germany	−16,05	2,50 (61,0)	−0,0* (−0,1)	0,99	2,00
−0,88	0,96 (43,3)		0,99	1,89		−16,05	2,50 (61,0)		0,99	1,90
−5,99	1,18 (33,8)	+0,12* (0,2)	0,98	1,98	France	−12,40	2,21 (30,4)	−0,55[a] (−2,5)	0,99	2,17
−6,00	1,19 (34,9)		0,98	1,81		−10,16	2,05 (39,9)		0,99	1,82
−4,78	1,11 (22,2)	−2,05[a] (−5,5)	0,99	2,49	Italy	−0,93[b]	2,08 (14,8)	0,03* (0,4)	0,98	1,93
−8,90	1,32 (26,8)		0,97	1,70		−1,6	2,13 (35,7)		0,98	1,81
−5,73	1,14 (40,0)	0,05* (0,0)	0,99	1,99	The Netherlands	−3,63	1,76 (49,0)	0,02* (0,27)	0,99	1,98
−5,73	1,14 (40,0)		0,99	1,86		−3,45	1,75 (58,5)		0,99	1,92
1,80	0,80 (33,0)	−0,17* (−1,7)	0,98	2,10	United Kingdom	−17,9	2,99 (19,4)	−0,30 (−2,0)	0,97	2,21
1,63	0,80 (35,0)		0,98	1,91		−16,03	2,83 (27,4)		0,97	1,83
na	na	na	na	na	EC 9	na	na	na	na	na
−3,50	1,14 (8,7)		0,82	1,45		−7,69	1,89 (29,1)		0,98	1,85
1,56[b]	0,99 (5,4)	−0,74 (−2,6)	0,98	2,96	USA	−26,67[b]	3,13 (11,5)	−0,65 (−3,8)	0,97	2,63
−10,67	1,45 (22,3)		0,96	1,58		−12,56	2,15 (18,6)		0,97	1,79
−12,96	1,55 (22,9)	−0,42* (−1,0)	0,98	2,10	Japan	5,27	1,22 (15,6)	−0,33* (−1,0)	0,96	2,14
12,11	1,51 (26,9)		0,97	1,61		4,58	1,27 (20,4)		0,97	1,67

Note: ( ) Student's t.
a — one-year lag on relative prices.
b — colinearity problem.
c — regression by reference to world GDP.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).
For each country, the results of the multiple regression (as a function of demand and relative prices) are given first, followed by the results of the simple regression (as a function of demand).

Table 3

Price trends in the internationally traded goods sector (average annual rates of inrease)

(%)

	1963-73	1973-81
Belgium	3,2	5,6
FR of Germany	2,4	5,7
France	4,3	8,9
Italy	4,1	18,4
The Netherlands	3,5	6,4
United Kingdom	4,9	16,2
USA	3,6	11,6
Japan	2,7	7,7

Source: IMF International Financial Statistics - 1982.

express the rank order of the constraints that external trade places on economic growth in each country but also denote the extent to which growth in other countries frees them from this constraint.

Japan: well adapted to world demand; European countries: mediocre performance

The export elasticities are measured by taking as the indicator of demand the demand for imports in volume terms in the OECD area. [1] They thus permit an assessment of the degree to which export structures are geared to the trend in world demand: the countries that have shifted their specialization to products for which there is rapidly growing demand inevitably have higher elasticities than those specializing in products for which demand is sluggish on the world market [8].

The following classification emerges:

(i) First we have Japan, which has clearly adapted best to trends in world demand (elasticity of 1,8) and whose export growth can be put down largely to its ability to channel its resources towards products with the fastest growing markets.

(ii) Then we have the United Kingdom, which has an income elasticity of exports lower than unity, notably in the field of manufactures (elasticity of 0,8), reflecting its low structural competitiveness.

(iii) Lastly, we have a group comprising several Community countries (Belgium, FR of Germany, France, Italy, the Netherlands) and the United States with elasticities in the region of 1,3. The differences within this group are fairly small although the elasticities for France, Italy and the Netherlands in respect of manufactures are a little higher than those for the other countries, reflecting a significant shift in their specialization over the last 15 years.

[1] This accounts for most of the international demand facing the industrialized countries, although some aspects of international demand—that of the OPEC countries, for example—are not included.

Import elasticities with respect to GDP vary even more

The disparities between these countries are, however, much more pronounced where imports are concerned, and this corroborates the view that the problem of competitiveness in a number of Community countries has more to do with lesser resistance to imports than with a loss of market shares abroad. Generally speaking, the elasticities of imports with respect to GDP are in fact well in excess of 1 and not far from 2, reflecting the increasing openness of the different economies. If we take total trade, the external constraint imposed by imports is particularly weak in Japan (elasticity of 1,2) and the Netherlands (elasticity of 1,5), the other countries having elasticities of between 1,8 and 2. The differences are even wider in the case of manufactured imports, with elasticities of 1,2 for Japan and 1,8 for the Netherlands but 2,5 for Germany and even 3,0 for the United Kingdom.

These differences in the income elasticities of exports and above all imports reflect the differing abilities of countries to keep their trade balance in equilibrium, bearing in mind their economic growth rate and that of their main international trading partners (Table 4).

Table 4

The external constraint expressed by the relationship between the income elasticity of exports (λ) **and that of imports** (μ)

	1		2	
	Total	Manufactures	Total	Manufactures
Belgium	0,68	0,46	1,14	0,87
FR of Germany	0,67	043	1,00	0,76
France	0,73	0,53	1,21	1,03
Italy	0,71	0,57	1,28	1,15
The Netherlands	0,77	0,63	1,49	1,25
United Kingdom	0,46	0,27	0,78	0,51
USA	0,49	0,32	0,88	0,64
Japan	1,45	1,27	2,35	2,43

1 Income elasticities of exports with respect to OECD demand for imports.
2 Income elasticities of exports with respect to world GDP.

The external constraint is tightest on the United Kingdom, and loosest in Japan. Taking total trade, we find that the external constraint arising from the income effects alone is particularly heavy in the United Kingdom and probably also in the United States, allowing for the fact that trade represents only 10% of GDP there compared with almost 30% for the United Kingdom. Even if UK prices were to rise at the same rate as prices in the rest of the world, a rate of economic growth identical to that in other countries would, in the long run, produce a deterioration in the UK trade balance. In order to keep its trade balance (and its exchange rate) unchanged, the United Kingdom would, other things being equal, have to register growth 25% lower than that of its partners (0,78 times the rate recorded there). This probably goes a long way towards explaining the slower economic growth in the United Kingdom in the last 15 years. By contrast, the external constraint imposes very little strain on Japan and the Netherlands, whose economies are able, or so it would seem, to grow at least half as fast again as those of their partners without this inducing a deterioration in their trade balance. To a lesser extent this is also true of France and Italy, which are thus able to make up somewhat for the highly unfavourable long-run trend in their relative prices. The same rank order is discernible for manufactures, although the income elasticities have a rather unfavourable effect in Germany.

The strength of the external constraint also depends on initial positions

To a large extent, however, the effect of income elasticities depends on the initial positions; in this sense, countries with an export cover of imports much higher than 1 (Japan and Germany) have greater freedom of manoeuvre than the other countries. Having started with a large trade surplus in manufactures, Germany for instance could, other things being equal, have appreciably higher economic growth rates than the other countries over a very long period before suffering a significant deterioration in its trade balance, and this in spite of the high income elasticity of its manufactured imports.

The fact remains that the external constraint weighs very unevenly on the industrialized countries, with the Community countries roughly divided into two groups: the low-inflation countries (Germany, Belgo-Luxembourg Economic Union, the Netherlands), which benefit from the favourable effect of price elasticities and, in the case of the Netherlands, from that of income elasticities, and the countries where inflation is or has been high (United Kingdom, Italy and, to a lesser extent, France), where price elasticities impose a severe external constraint, with the United Kingdom also having to contend with the burden imposed by income elasticities.

Trade by main product categories: income elasticities as a reflection of the trend in international specialization

The impact of the external constraint can be measured with somewhat greater precision by evaluating the import and export functions at a disaggregated level.

Price elasticities: rather poor results by sectors

Estimating these elasticities for the major product categories is complicated by additional econometric problems, and it is virtually impossible to make any international comparisons (see Tables 5 and 6). It should be noted, however, that:

(i) price elasticities are invariably very low for imports;

(ii) in the case of exports, it is virtually only basic consumer items and, to a lesser extent, food products that generally have significant elasticities. Since these categories tend to include a high proportion of unsophisticated products exposed to keen price competition, their elasticities are usually close to unity. In the other categories, the results are more diverse although some exports from certain countries at times react quite markedly to changes in relative prices (equipment goods in Belgium and the United States and virtually all categories in Italy).

Income elasticities reflect developments in international specialization

The results obtained for income elasticities are, of course, better (Tables 7 and 8). On the export front, the salient feature is that, for each product category, the observed ranking of countries in respect of total trade changes and becomes more accentuated, reflecting clearly the trend in international specialization in each country:

(i) For intermediate products, the rank order is identical to that observed for total trade; however, the elasticities for the Netherlands (1,5) and Italy (1,3), both of which have increased their market shares and degree of specialization in this branch (with the index of specialization [1] rising respectively from 0,9 to 1,4 and from 0,7 to 0,9 between 1963 and 1981), approach that for Japan (1,6).

(ii) For equipment goods, which occupy a strategic position in the industrial system and for which there is a rapidly growing demand on world markets, there is a widening gap between Japan (elasticity of 1,7) which has increased its degree of specialization, particularly in the most strategic products like digital-command machine

[1] See Box 3 in Chapter I of the section 'Foreign Trade' of this report for the definition of this index.

Table 5

Price elasticities of exports; world trade broken down by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	*	−0,73[a]	+0,81[b]	−1,32[a]	−2,02	−0,84
FR of Germany	−0,48	−1,07	*	+0,56[a]	*	−1,06
France	*	−0,91	*	*	*	−1,09
Italy	−1,61	*	−2,45	−1,08[a]	−2,55[b]	−0,97[a]
The Netherlands	*	−0,87	*	*	*	−1,71[a]
United Kingdom	2,26	0,84	*	−0,24	*	−0,39
EC 9 (trade with rest of world)	*	*	*	*	*	*
USA	−0,70	*	*	−0,92[b]	−1,65	−1,44[ab]
Japan	−0,77	*	*	*	*	*

Note: a — one-year lag on relative prices.
b — colinearity problem.
* — non-significant elasticity (with a possible error of 5%).

Table 6

Price elasticities of imports, broken down by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	−0,39[b]	*	−0,26[b]	*	*	*
FR of Germany	−0,33[b]	*	*	*	*	*
France	−0,17[b]	*	−0,87[ab]	*	−0,60	*
Italy	−0,25[b]	−0,62	−0,54[ab]	*	+0,35[b]	*
The Netherlands	−0,46[a]	*	−0,26[a]	*	*	*
United Kingdom	−0,36	−0,13	*	−0,66	*	−0,56
EC 9 (trade with rest of world)	*	*	*	*	*	*
USA	*	na	−0,48[b]	*	na	−0,85[b]
Japan	na	na	na	na	na	na

Note: a — one-year lag on relative prices.
b — colinearity problem.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).

Table 7

Income elasticities of exports with respect to world demand, by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	**1,34**	2,29	0,87	1,01	2,51	1
	1,23	1,98	0,93	1,01	2,48	1
FR of Germany	*	3,04	1,16	0,57	3,42	1,26
	0,21	3,09	1,13	0,72	3,28	1,20
France	**1,01**	2,92	1,15	**1,23**	1,78	0,91
	0,76	2,78	1,17	**1,22**	1,75	0,95
Italy	0,43	1,23	1,30	0,99	1,10	1,25
	*	1,21	1,43	1,10	1,74	1,40
The Netherlands	**1,01**	2,47	1,57	**0,91**	1,73	0,85
	0,70	2,47	1,55	**0,90**	1,71	0,83
United Kingdom	1,77	1,97	0,94	0,57	1,59	1,91
	1,20	2,40	0,92	**0,60**	1,60	0,92
EC 9 (trade with rest of world)	na	na	na	na	na	na
	0,73	2,06	1,17	0,75	2,69	1,00
USA	*	2,24	0,96	**0,81**[b]	1,06	0,65[b]
	*	2,20	1,01	**1,81**	1,17	1,18
Japan	*	*	1,66	1,74	0,75	0,34
	1,65	−1,2	1,56	1,65	0,73	0,29

Note: a — one-year lag on relative prices.
b — colinearity problem.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).
The first row gives the results of the multiple regression, and the second those of the simple regression.

tools, and the European countries, much less dynamic in this sector. Even Germany, long predominant, is losing ground (the index of specialization fell from 1,4 to 1,1, compared with an increase for Japan from 0,8 to 1,4), and the elasticity of its exports to world demand is only 0,7; this confirms the findings of the analysis of trade in Chapter I.

(iii) For basic consumer items, on the other hand, the rank order changes significantly with fairly high elasticities for Italy, which has considerably increased its specialization in this sector, particularly in textiles, leather and clothing (an increase in the index of specialization from 1,5 to 1,8), and for Germany, where the trend is similar if less pronounced (an increase from 0,5 to 0,8 in the index and an elasticity of 1,2), but a very low one for Japan (0,3), which has done much to move out of these products in which it was highly specialized in 1963 (index of 1,6 in 1963 falling to 0,5 in 1981).

(iv) Lastly, for food products, the elasticities for all the Community countries are higher than those for their industrialized competitors (from 1,8 to 2,5, compared with 1 for the United States and 0,7 for Japan), with Germany standing out very clearly from its partners (elasticity of 3,4). These performances are comparable to the development of international specialization, with the index of specialization rising from 1 to 1,4 for the Community, and from 0,2 to 0,8 for Germany, and falling from 1,1 to 1 for the United States and from 0,5 to 0,15 for Japan between 1969 and 1981.

The income elasticities of imports also reflect these changes in the way the Community countries participate in the

Table 8

Income elasticities of imports from the rest of the world, by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	2,26 1,37	1,18 1,18	2,17 1,87	2,02 1,82	1,96 1,96	2,57 2,53
FR of Germany	2,12 1,47	0,87 0,84	2,37 2,24	2,98 2,98	1,48 1,55	2,71 2,70
France	1,66 1,28	0,58 0,58	2,12 1,86	2,11 2,11	1,65 1,44	2,60 2,62
Italy	1,69 0,97	1,03 0,90	2,37 2,10	2,13 2,29	1,68 1,91	2,12 2,11
The Netherlands	1,99 1,36	1,39 1,45	1,79 1,80	1,49 1,47	2,06 2,14	1,97 1,99
United Kingdom	0,60 *	−0,21 −0,27	2,64 2,92	(5,26) 5,21	−0,46 −0,39	2,96 2,60
EC 9 (trade with rest of world)	na 1,02	na 0,37	na 1,65	na 2,96	na *	na 2,02
USA	2,49 2,68	na 0,39	2,25 1,87	3,60 2,98	na 1	2,82 1,54
Japan	na 1,22	na 0,87	na 1,16	na 1,02	na 1,18	na 1,94

Note: a — one-year lag on relative prices.
b — colinearity problem.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).
The first row gives the results of the multiple regression, and the second those of the simple regression.

international division of labour. They are very high for basic consumer items, an indication of the increased dependence on imports of most Community countries in the case of products manufactured in large measure in the newly industrializing countries and the developing countries (elasticities usually in excess of 2,5, except in Italy and in the Netherlands), and in some cases for equipment goods (3,0 in Germany, 5,2 in the United Kingdom, 2,1 in France and 3,0 in the United States). The latter product category is an area in which the technological gap between the Community and Japan in particular has grown wider in recent years (the elasticity for Community trade with the rest of the world is 3,0). By contrast, these elasticities are very low in the case of agricultural products (equal to or lower than unity in most Community countries).

The external constraint facing each of the industrialized economies thus reflects in large measure the trend in their international specialization and the shifts in world trade. By the same token, these differences in price and income elasticities reveal that movements in relative prices and, above all, changes in economic growth rates, do influence the product structure of trade balances. As a result, the impact on the trade balance of economic growth and of any reflationary measure will differ from one country to the next. Any action to underpin economic activity will weigh relatively more heavily on imports of basic consumer items in France than in the other countries and on imports of equipment goods in Germany and the United Kingdom. [1] *A fortiori*, a policy of boosting economic activity through consumption will not, because of these differences, have the same effects as a policy of investment-led recovery, since the situation will obviously differ from one industrialized

[1] Assuming a continuation of the underlying trend in international specialization observed in recent years.

country to another. What is more, in response to the shifts in international specialization, the external constraint changed significantly after the first oil shock.

Breaks in the trend since 1973

In the wake of the first oil shock and the sharp change in the relative prices of energy and raw materials, the industrialized countries have had to make considerable efforts to adapt their productive structures to the new conditions of international competition. This is clear from the trend of income elasticities estimated [1] for the periods 1964-73 and 1973-82 (see Tables 9 and 10).

[1] These periods are too short to gauge price elasticities accurately. In general, the shortness of the periods also affects the quality of regressions, particularly for the period 1973-81, where fluctuations were wider. The object of the elasticities calculated here was mainly to assess breaks in foreign trade trends since 1973; the elasticities should not be compared directly with those for longer periods.

The export drive after the first oil shock

*182*Overall, the elasticities of exports with respect to world demand rose slightly after 1973 (except in the Netherlands), reflecting the export drives mounted by all industrialized countries. In the Community countries in particular, however, these export drives concentrated, somewhat paradoxically, on non-manufactures. Doubtless because of the keener competition between industrialized countries in this area, the elasticities of exports of manufactures with respect to world trade were thus more or less stable and, in some cases, actually fell (Belgium, the Netherlands, United Kingdom). Italy is the only country in which this elasticity rose significantly (from 1,1 to 1,6). At sectoral level too, pronounced differences are apparent between the two periods depending on the strategies pursued by the countries concerned in adapting to the crisis and to the new conditions of international competition (Table 10). For the Community countries, the elasticities of exports with respect to demand were lower in the period after 1973 for basic consumer items

Table 9

Income elasticities of imports from the rest of the world, by main sector (1964-73 and 1973-81)

Country	Period	Total	Energy	Agriculture	Manufactures	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	1964-73	2,11	2,24	1,12	2,15	2,16	1,99	1,80	2,59
	1973-81	1,59	*	1,61	1,92	1,63	1,30	2,72	2,87
FR of Germany	1964-73	2,10	2,25	0,80	2,56	2,49	2,90	1,62	2,80
	1973-81	1,84	*	0,92	2,48	1,97	3,36	1,65	2,31
France	1964-73	1,81	1,71	0,50	2,15	2,15	2,29	1,01	2,63
	1973-81	1,56	*	0,88	2,04	1,55	1,92	2,43	2,81
Italy	1964-73	1,90	1,71	1,30	2,20	2,22	2,41	1,85	2,10
	1973-81	1,56	*	*	2,35	2,43	2,43	1,51	2,74
The Netherlands	1964-73	1,85	2,60	1,22	1,72	1,92	1,41	1,83	2,00
	1973-81	1,40	*	1,62	1,91	1,52	1,62	3,79	2,04
United Kingdom	1964-73	2,15	1,92	−0,21	2,45	2,64	4,55	*	2,67
	1973-81	2,45	−4,74	*	4,18	2,88	7,04	−1,12	4,31
EC 9 (trade with rest of world)	1964-73	1,52	2,02	0,37	1,71	1,82	2,41	0,21	1,96
	1973-81	1,43	*	0,75	2,67	1,83	4,05	0,73	2,62
USA	1964-73	2,64	2,68	0,63	2,54	2,28	3,66	1,87	1,45
	1973-81	1,11	*	0,47	2,54	1,99	3,06	*	2,93
Japan	1964-73	1,33	1,55	0,99	1,25	1,21	0,94	0,95	2,05
	1973-81	0,49	*	0,60	0,92	1,08	0,87	0,64	0,89

Note: * Non-significant elasticity (with a possible error of 5%).

and for equipment goods (in both cases, with the exception of Italy) and higher for food products (with the exception of the United Kingdom) and intermediate products (with the exception of Belgium and the Netherlands). Conversely, Japan has put the main emphasis on equipment goods (elasticity rising from 1,5 to 1,9) and on food products.

The even greater drive to reduce imports, particularly of manufactures

The most far-reaching changes, however, involved imports, where the difference between total trade and manufactured trade is even more pronounced. After 1973, all the countries apart from the United Kingdom witnessed a significant fall in the income elasticity of their total imports (from 2 to 1,5 or 1,6 in most Community countries). Even so, the drive to reduce import dependence in response to the changes in relative prices was not the same in all countries. Although at an already low level, the income elasticity of Japan's imports fell much more than that of the other countries, even for total imports (from 1,3 to 0,5). As for manufactures, the trends have been quite different: income elasticity remained relatively stable in most European countries.

On the other hand, it declined significantly in Japan and rose very sharply in the United Kingdom (from 2,4 to 4,2), probably cancelling out the beneficial effects of North Sea oil on UK imports. At sectoral level too, marked differences are discernible: the income elasticity of imports was much higher

Table 10

Income elasticities of exports with respect to world demand, by main sector (1964-73 and 1973-81)

Country	Period	Total	Energy	Agriculture	Manu-factures	Inter-mediate products	Equipment goods	Food products	Basic consumer items
Belgium	1964-73	1,17	1,05	1,69	1,11	1,03	1,03	2,47	1,08
	1973-81	1,48	*	1,59	0,79	0,69	0,73	2,86	0,77
FR of Germany	1964-73	0,99	*	3,21	0,89	1,06	0,68	2,83	1,13
	1973-81	1,25	*	1,15	0,87	1,10	0,61	3,99	0,97
France	1964-73	1,18	0,55	3,08	1,07	1,01	1,15	1,44	0,89
	1973-81	1,46	*	2,09	1,05	1,21	0,93	2,63	0,76
Italy	1964-73	1,12	0,78	0,87	1,10	1,07	0,98	1,08	1,20
	1973-81	2,19	2,60	1,71	1,63	1,63	1,29	3,90	1,61
The Netherlands	1964-73	1,18	0,97	1,89	1,15	1,60	0,81	1,69	0,94
	1973-81	0,94	*	1,85	0,78	0,93	0,72	1,81	0,39
United Kingdom	1964-73	0,79	0,65	1,73	0,79	0,89	0,57	1,67	1,04
	1973-81	1,23	*	3,75	0,63	0,92	0,42	1,38	0,71
EC 9 (trade with rest of world)	1964-73	0,89	0,70	1,47	0,82	0,98	0,60	1,84	0,87
	1973-81	1,42	*	2,45	1,78	1,17	0,69	3,97	0,97
USA	1964-73	1,00	*	1,30	1,19	0,73	1,80	*	0,95
	1973-81	2,20	−2,49	3,16	1,59	1,57	1,63	3,06	0,94
Japan	1964-73	1,79	1,66	−0,60	1,42	1,59	1,50	1,23	0,49
	1973-81	2,07	*	*	1,49	*	1,88	1,66	*

Note: * Non-significant elasticity (with a possible error of 5%).

for consumer goods after 1973 (stiffer competition from the developing countries and the newly industrializing countries), except in Germany and Japan (the latter having vigorously reined back the growth in imports of these goods), while it was lower for intermediate products (except in Italy and the United Kingdom). The situation in the other sectors varies a great deal between countries. In Germany and the United Kingdom for instance, the income elasticity of imports of equipment goods rose significantly.

Overall, the Community countries have been relatively successful after 1973 in reducing the external constraint imposed by the operation of income elasticities, the notable exception being the United Kingdom. But it would seem that their adjustment efforts have failed to match those of Japan, notably in manufactures.

2. Intra-Community trade

Close on 50% of the Community countries' trade in goods is between themselves (the percentage is much higher in the case of the smaller countries). The trends in intra-Community trade consequently have a great influence on the external constraint, which, as we have seen, affects each country differently. We will therefore now examine the specific features of intra-Community trade, first in aggregate and then at sectoral level.

Trade in goods and trade in manufactures

By and large, the results are fairly satisfactory from an econometric angle in spite of a number of problems of colinearity that primarily affect imports of manufactures (Tables 11 and 12).

Price elasticities: intra-Community imports seem slightly more sensitive to changes in relative prices. In the case of intra-Community exports, the proportion of significant price elasticities is virtually the same as that for trade with the rest of the world. Generally speaking, they are of the same order of magnitude, except in Italy, where they are much lower. The price elasticities of imports are also fairly low but, in so far as the results are comparable, given the uncertainty affecting price indicators, they are slightly higher than those for world trade, at least where total imports are concerned. This is particularly so in Belgium ($-0,69$ as against $-0,38$), Germany ($-0,9$ as against $-0,23$), France ($-0,84$ as against $-0,45$) and Italy ($-0,8$ as against $0,32$) and probably reflects the fact that Community suppliers have to compete with suppliers from the rest of the world in intra-Community trade. As a result, any change in relative prices in the Community has a significant impact on the volume of intra-Community imports and hence probably on the geographical distribution of suppliers.

Income elasticities for exports close to unity

The elasticities of exports with respect to Community demand (measured by the volume of Community imports) are fairly close to unity in all the Community countries, even the United Kingdom. The spread is probably so narrow because member countries' shares of intra-Community trade have changed only little in the last 15 years and, at any event, less rapidly than their shares of world trade, whether for total trade in goods or for trade in manufactures. By contrast, the elasticity of Japanese exports is much higher (1,6), which is testimony to that country's dynamism on the Community market, even though this market takes only a limited share of its total exports, the exact figure varying from product to product.

Income elasticities of imports are, however, higher

But the differences are much more pronounced for imports. Within the Community, elasticities range from 1,6 (the Netherlands) to 3,8 (United Kingdom) in the case of total imports. And so, as with world trade, the external constraint arising from the operation of income elasticities stems in the main from imports.

The rank order of the countries subject to this constraint is similar to that observed for world trade; to a large extent, intra-Community trade involves the same external constraint as trade with the rest of the world.

A further feature of import elasticities is that they are generally higher for Community trade than for trade with the rest of the world (2 against 1,9 for Belgium, 2 against 1,8 for France, 2,4 against 1,8 for Italy, and 3,8 against 2 for the United Kingdom). This mirrors the effects of the establishment of the common market and the ensuing expansion in intra-Community trade, although these effects have considerably slackened since the first oil shock. For example, the elasticities of intra-Community imports declined much more after 1973 than those for imports from the rest of the world.

This pattern was particularly clear in the case of manufactures, where imports from outside the Community soared during the 1970s. Here too, the United Kingdom is an exception since it continued to favour Community suppliers after it had joined the Community. The weakening of the 'common market' effect for the original six Member States is also discernible in exports, albeit to a lesser extent. Thus, after 1973, the elasticity of manufactured exports rose in only two countries (United Kingdom and Italy), held steady in Germany and declined sharply in the other countries (Belgium, France, the Netherlands) (Tables 13 and 14). These results closely reflect the specific features of the pattern and trend of intra-Community trade which also show up at sectoral level.

Table 11

Income and price elasticities of merchandise exports and imports (intra-Community trade; annual figures, 1964-81)

Exports						Imports				
Constant	Elasticities		R^2	DW		Constant	Elasticities		R^2	DW
	World demand	Prices					GDP	Prices		
−2,14	1,0 (44,0)	0,19 (0,45)	0,99	1,97	Belgium	−8,37	1,97 (39,9)	−0,69 (−5,0)	0,99	2,25
−1,99	1,0 (67,7)		0,99	1,91		−10,43	2,11 (32,9)		0,98	1,81
−1,27[b]	1,0 (37,5)	−0,58 (−2,7)	0,99	2,14	FR of Germany	−9,65	2,02 (27,3)	−0,90 (−7,2)	0,99	2,51
−0,12	0,93 (56,3)		0,99	1,90		−15,24	2,42 (25,3)		0,97	1,74
−3,65	1,10 (48,8)	−0,84 (−2,2)	0,99	2,09	France	−10,62	2,06 (30,6)	−0,84[a] (−2,3)	0,98	2,15
−4,16	1,12 (51,6)		0,99	1,85		−10,74	20,6 (31,2)		0,98	1,76
−2,21	1,0 (22,4)	−0,73[a] (−1,9)	0,98	2,17	Italy	−6,11	2,48 (49,6)	−0,58[a] (−4,5)	0,99	2,18
−3,86	1,1 (34,1)		0,98	1,79		−4,56	2,35 (35,6)		0,98	1,78
−5,43[b]	1,18 (19,3)	−0,88 (−3,8)	0,98	2,30	The Netherlands	−1,97[b]	1,61 (13,2)	−0,15* (−0,8)	0,99	2,13
−2,52	1,03 (30,4)		0,98	1,78		−3,14	1,70 (46,1)		0,99	1,90
−3,08	1,03 (25,3)	0,44* (1,9)	0,97	1,84	United Kingdom	−27,8	3,79 (27,0)	−0,12* (−0,8)	0,98	2,06
−3,25	1,05 (23,3)		0,97	1,71		−27,6	3,76 (27,6)		0,98	1,77
5,44[b]	0,61 (4,4)	−0,92 (2,6)	0,96	3,0	USA [1]	−12,3[b]	2,04 (6,7)	−0,52 (−4,1)	0,79	2,90
−1,12	0,95 (16,5)		0,94	1,67		2,98	0,96 (4,4)		0,55	1,82
−16,13[b]	1,69 (15,6)	−0,78 (−2,1)	0,98	2,30	Japan [1]	3,96	1,18 (15,4)	−1,07 (−3,1)	0,96	2,40
−20,0	1,89 (33,5)		0,98	1,41		2,60	1,28 (14,8)		0,93	1,54

Note: ( ) Student's t.
a — one-year lag on relative prices.
b — colinearity problem.
c — regression by reference to world GDP.
* — non-significant elasticity (with a possible error of 5%).

For each country, the results of the multiple regression (as a function of demand and relative prices) are given first, followed by the results of the simple regression (as a function of demand).

[1] Bilateral trade with the Community.

Table 12

Income and price elasticities of exports and imports of manufactures (intra-Community trade; annual figures, 1964-81)

Exports						Imports				
Constant	Elasticities: World demand	Elasticities: Prices	R^2	DW		Constant	Elasticities: GDP	Elasticities: Prices	R^2	DW
−0,58	0,93 (50,0)	−2,18[a] (−3,7)	0,99	2,14	Belgium	−17,26[b]	2,56 (22,6)	−0,34 (−3,9)	0,99	2,36
−0,59	0,93 (41,4)		0,99	1,86		−11,12	2,14 (37,5)		0,98	1,83
−2,09[b]	1,04 (21,8)	−0,84 (−2,5)	0,99	2,13	FR of Germany	−17,4	2,56 (33,0)	+0,07[a] (2,3)	0,98	1,85
0,08	0,93 (67,0)		0,99	1,91		−17,9	2,59 (32,1)		0,98	1,76
−3,43	1,08 (65,0)	−1,29 (−4,2)	0,99	2,13	France	−10,06[b]	2,01 (16,9)	+0,37* (1,0)	0,98	1,86
−3,29	1,08 (48,5)		0,99	1,83		−11,45	2,11 (28,6)		0,98	1,73
−3,14	1,05 (20,0)	−1,09[ab] (−2,4)	0,99	2,25	Italy	−1,07[b]	2,05 (14,2)	+0,17 (2,2)	0,98	1,65
−5,46	1,17 (36,3)		0,98	1,75		−4,51	2,34 (34,4)		0,98	1,77
−4,01	1,10 (32,0)	−0,30* (−0,2)	0,98	2,01	The Netherlands	−3,44	1,72 (38,3)	0,0* (0,0)	0,99	2,0
−4,05	1,10 (34,4)		0,98	1,76						
−2,72	1,02 (28,4)	0,02* (0,1)	0,98	1,99	United Kingdom	−34,2	4,30 (13,3)	−0,15* (−0,6)	0,97	2,09
−2,79	1,02 (34,6)		0,98	1,80		−33,9	4,29 (19,7)		0,96	1,60
−3,54	1,08 (5,9)	−0,16* (−0,4)	0,96	2,20	USA [1]	−17,14[b]	2,37 (6,2)	−0,50 (−2,4)	0,87	2,71
−5,11	1,16 (22,5)		0,96	1,61		−5,2	1,54 (8,9)		0,83	1,77
−15,6	1,67 (33,2)	−0,83 (−2,2)	0,98	2,14	Japan [1]	3,71	1,19 (17,4)	−0,87 (−3,3)	0,95	2,40
−15,9	1,69 (30,5)		0,98	1,43		3,86	1,19 (13,6)		0,92	1,57

Note: ( ) Student's t.
a — one-year lag on relative prices.
b — colinearity problem.
c — regression by reference to world GDP.
* — non-significant elasticity (with a possible error of 5%).
For each country, the results of the multiple regression (as a function of demand and relative prices) are given first, followed by the results of the simple regression (as a function of demand).

[1] Bilateral trade with the Community.

Table 13

Income elasticities of exports with respect to world demand and Community demand (1964-73 and 1973-81)

		Total		Manufactures	
		1964/73	1973/81	1964/73	1973/81
Belgium	Total	1,17	1,48	1,11	0,79
	Intra	1,05	0,96	1,04	0,72
FR of Germany	Total	0,99	1,25	0,89	0,87
	Intra	0,92	0,98	0,93	0,94
France	Total	1,18	1,45	1,07	1,05
	Intra	1,20	0,90	1,10	0,84
Italy	Total	1,12	2,19	1,10	1,63
	Intra	1,03	1,49	1,11	1,52
The Netherlands	Total	1,18	0,94	1,15	0,78
	Intra	1,16	0,56	1,20	0,65
United Kingdom	Total	0,79	1,24	0,79	0,63
	Intra	0,84	1,53	0,90	1,11
USA [1]	Total	1,00	2,20	1,19	1,59
	Intra	0,80	1,48	1,16	1,47
Japan [1]	Total	1,79	2,07	1,42	1,49
	Intra	1,97	1,87	1,74	1,79

[1] Bilateral trade with the Community.

Table 14

Income elasticities of imports from the rest of the world and from the Community (1964-73 and 1973-81)

		Total		Manufactures	
		1964/73	1973/81	1964/73	1973/81
Belgium	Total	2,11	1,59	2,15	1,92
	Intra	2,44	1,38	2,40	1,57
FR of Germany	Total	2,10	1,84	2,56	2,48
	Intra	2,79	1,55	2,94	1,94
France	Total	1,81	1,56	2,15	2,04
	Intra	2,37	1,78	2,44	1,78
Italy	Total	1,90	1,56	2,20	2,35
	Intra	2,57	2,02	2,54	2,03
The Netherlands	Total	1,85	1,40	1,72	1,91
	Intra	1,78	1,66	1,80	1,45
United Kingdom	Total	2,15	2,45	2,45	4,18
	Intra	3,17	4,44	3,21	5,76
USA [1]	Total	2,64	1,11	2,54	2,54
	Intra	2,18	0,57	2,09	2,16
Japan [1]	Total	1,33	0,49	1,25	0,92
	Intra	1,25	1,02	1,11	0,98

[1] Bilateral trade with the Community.

Intra-Community trade by product category

Price elasticities: widely scattered results

As in the case of trade with the rest of the world, the significant results obtained here for price elasticities are widely scattered (see Tables 15 and 17) and make it difficult to carry out any international comparison. Even so, the results for intra-Community exports differ in two important respects from the results reviewed earlier:

(i) there is no significant price elasticity for basic consumer items;

(ii) intra-Community exports of intermediate products are on the other hand highly sensitive in a number of cases to changes in relative prices (elasticity of close on 2 for Belgium, Italy, the Netherlands and Japan).

Income elasticities linked to changes in market shares

In contrast to the situation for total trade, the elasticities of exports with respect to Community demand differ substantially from unity (see Tables 16 and 18); while the Community countries' shares of total intra-Community trade showed little change, the changes at sectoral level were more marked, reflecting once again the shifts in member countries' specialization within the Community [9]. The trends observed here are fairly similar to those in trade with the rest of the world although elasticity comparisons alone are unable to tell us whether or not they are more pronounced in certain sectors. The following in particular should be noted:

(i) for agricultural products, the high elasticity in Germany and France, which appear to have stepped up significantly their intra-Community specialization in this sector, and the low elasticity in Italy;

(ii) for intermediate products, the high elasticities in Italy and the Netherlands, also apparent in their trade with the rest of the world;

(iii) for equipment goods, the fairly high elasticity in France, which appears to have benefited more from intra-Community trade than from trade with the rest of the world in this sector;

(iv) for food products, the salient position of Germany and the United Kingdom;

(v) for consumer goods, the high elasticity in Germany and Italy, also apparent in their trade with the rest of the world.

The oil shock also induced a break in sectoral trends. However, in contrast to the situation for trade with the rest of the world, the swings recorded at sectoral level are generally in line with those observed for each country in respect of total trade (Table 19). After 1973, member countries' specialization within the Community has probably changed much less than their specialization outside the Community.

The Community's weakness in the equipment goods sector

The income elasticities of imports also reflect these shifts in international specialization and a certain symmetry is discernible between the elasticity values for exports and those for imports. In several cases, a relatively high value for one is associated with a relatively low value for the other: income elasticities of imports of agricultural products are low in France and Germany as are those of imports of intermediate products in the Netherlands. By the same token, while they are systematically higher than world elasticities in most sectors because of the intensification in the division of labour between Community countries up to the beginning of the 1970s, the income elasticities of imports are lower for equipment goods, bearing witness yet again to the Community's overall weakness in this strategic sector (Table 20). After 1973, however, and with a few exceptions such as imports of food products in France and Belgium, income elasticities of imports within the Community fell generally, like those for total trade. This was even true of basic consumer items, where there was some substitution between suppliers within the Community and those outside the Community (developing countries, newly industrializing countries).

Conclusion

In spite of the statistical limitations (lack of any proper series of import and export indices and need to use unit values as an approximation) and in spite of the econometric limitations (large number of non-significant price elasticities), the results obtained for price and, above all, income elasticities permit a coherent set of economic conclusions.

The estimated values provide a fairly faithful picture of trends in the international specialization of the Community countries and of their main industrialized competitors. They reveal that the external constraint imposed by their participation in the international division of labour weighs unevenly on each of them in both the medium and the long term, depending on their trade structures, their initial positions and their capacity to move into promising new markets. They also point to the need for a convergence of inflation rates between countries competing internationally and for continuation of the restructuring efforts that have been undertaken (more enthusiastically in some countries than in others) since the first oil shock as a means of easing the pressures on the trade balance and on exchange rates. Any widening of differentials between countries could jeopardize economic and monetary integration in the

Community by increasing the incentives to interfere with free trade. For, as we have seen, the Community countries' trade balances, and particularly their exports, are fairly sensitive to movements in relative prices (the sum of the price elasticities of imports and exports is probably greater than 1 in most countries, notably Italy). To this extent, the external constraint is heavier for countries where inflation was or still is high, namely Italy, the United Kingdom and France, compelling them to work for a rapid alignment of their inflation rate on that of their partners so as to reduce their trade imbalances and/or the tendency for their currencies to depreciate.

Yet the impact of prices on the trade balance is sometimes offset or accentuated by the operation of the income elasticities of imports and exports. Thus, a number of differences emerge between countries on the export front which reflect their differing degrees of dynamism in export markets. The most pronounced differences though are encountered at the level of imports, in particular manufactured imports, an indication that the external constraint arises essentially from an uneven degree of resistance to import penetration of the domestic market where this is not counterbalanced by a strong export position. During the last 15 years, the operation of income elasticities has proved particularly beneficial to Japan, which in this respect has been distinctly more fortunate than the other industrialized countries, and, within the Community, to the Netherlands and also to Italy and France, both of which have thus been able to neutralize some of the harmful effects of unduly rapid inflation. By contrast, it has had a relatively adverse impact on the United Kingdom and this probably explains why economic growth had to be slower there than in the other countries. Lastly, in Germany, income elasticities have, on balance, had a neutral effect on total trade but have worked to the slight detriment of trade in manufactures as a result of the surge in imports.

Yet the effect of income elasticities, which is apparent in intra-Community and extra-Community trade alike, could prove to be less favourable in the present economic context of low international growth. There is a serious risk here that a country stimulating economic growth in isolation may suffer a deterioration in its trade balance since there will be insufficient export demand, whether internationally or within the Community, and since its imports will climb sharply as its GDP grows, even if the long-run income elasticity of its exports is greater than that of its imports. In this sense, removing the external constraint, which is currently weighing heavily on certain countries (France, Italy), requires not only a strong attack on inflation in those countries but also a concerted revival of growth at international or Community level.

However, the efforts already under way to adapt productive structures have probably helped to reduce the external pressure reflected in income elasticities. For instance, the income elasticity of imports fell significantly in most countries after the first oil shock. But those efforts must be continued or even stepped up, following the example of Japan. The Community countries must adopt a two-pronged response: they must recapture their former shares of the Community market for equipment goods, which has seen a rapid increase in imports from non-member countries, in spite of the slowdown in investment in the Community, and they must regenerate the Community market, which seems to be no longer providing the same stimulus to Member States' trade as in the past.

Table 15

Price elasticities of intra-Community exports, by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	*	*	−1,8[a]	*	*	*
FR of Germany	*	*	*	*	*	*
France	*	*	*	−1,42	*	*
Italy	−2,36	*	−2,09	*	−1,49[b]	*
The Netherlands	*	−0,68	−2,12	*	*	*
United Kingdom	2,6[b]	*	*	*	*	*
USA [1]	−0,92	*	*	−0,97[b]	−1,16	*
Japan [1]	na	−1,62	−1,94	*	*	*

Note: a — one-year lag on relative prices.
b — colinearity problem.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).

[1] Bilateral trade with the Community.

Table 16

Income elasticities of intra-Community exports, by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	1,54 1,45	1,14 1,16	0,93 0,85	1,04 1,03	1,23 1,22	0,79 0,80
FR of Germany	* *	1,71 1,70	0,96 0,92	0,90 0,81	1,90 1,89	1,13 1,14
France	0,93 0,67	1,67 1,66	0,99 0,98	1,37 1,33	0,88 0,85	0,89 0,93
Italy	* *	0,60 0,59	1,16 1,21	1,03 1,06	0,81 1,03	1,17 1,25
The Netherlands	1,15 0,83	1,33 1,38	1,34 1,35	1,22 1,21	0,96 0,95	0,74 0,73
United Kingdom	3,10 1,90	1,08 1,22	1,05 1,09	0,92 0,95	1,57 1,54	1,00 0,96
USA [1]	−0,58 *	0,62 0,67	0,70 0,71	0,81 1,92	0,42 0,51	0,88 0,92
Japan [1]	na na	−0,80 −1,20	1,41 1,23	2,41 2,44	−0,64 −0,60	0,54 0,49

Note: a — one-year lag on relative prices.
b — colinearity problem.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).
The first row gives the results of the multiple regression, and the second those of the simple regression.

[1] Bilateral trade with the Community.

Table 17

Price elasticities of intra-Community imports, by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	−0,41[b]	−0,59	−0,31[b]	−0,75[b]	*	−0,27[b]
FR of Germany	−0,57[b]	*	−0,48	0,07	*	*
France	*	1,5[ab]	−1,03[ab]	*	−0,35	*
Italy	*	*	−0,61[ab]	*	+0,62[b]	*
The Netherlands	*	*	−0,43[a]	*	*	*
United Kingdom	−0,28	+0,37[a]	+0,65	−0,64	+0,31	−1,1
USA [1]	−0,90[b]	*	−1,49[a]	−0,67[b]	−0,65[b]	−0,60[b]
Japan [1]	na	na	na	na	na	na

Note: a — one-year lag on relative prices.
b — colinearity problem.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).

[1] Bilateral trade with the Community.

Table 18

Income elasticities of intra-Community imports, by main sector (annual figures, 1964-81)

	Energy	Agriculture	Intermediate products	Equipment goods	Food products	Basic consumer items
Belgium	2,04 1,21	2,61 2,42	2,61 2,25	2,23 1,74	2,57 2,59	2,80 2,59
FR of Germany	3,60 2,50	1,35 1,29	2,82 2,54	2,65 2,72	1,97 2,06	2,84 2,79
France	0,71 0,96	1,44 1,64	2,32 2,00	1,51 1,79	2,86 2,76	2,87 2,83
Italy	2,44 2,35	2,41 2,35	2,59 2,21	1,76 2,15	2,64 3,05	2,35 2,58
The Netherlands	0,89 0,83	2,36 2,21	1,79 1,74	1,31 1,31	2,83 2,96	1,99 2,08
United Kingdom	1,33 *	1,22 1,49	4,90 5,70	5,66 5,23	1,30 1,72	4,32 3,70
USA [1]	9,90 7,2	3,24 3,14	3,31 1,84	3,15 1,87	1,44 0,58	1,89 0,92
Japan [1]	na na	na 1,15	na 1,15	na 0,78	na 2,27	na 1,78

Note: a — one-year lag on relative prices.
b — colinearity problem.
na — data not available.
* — non-significant elasticity (with a possible error of 5%).
The first row gives the results of the multiple regression, and the second those of the simple regression.

[1] Bilateral trade with the Community.

Table 19

Income elasticities of imports from the Community, by main sector (1964-73 and 1973-81)

Country	Period	Total	Energy	Agriculture	Manu-factures	Inter-mediate products	Equipment goods	Food products	Basic consumer items
Belgium	1964-73	1,05	1,06	1,18	1,04	1,03	1,03	1,43	0,89
	1973-81	0,96	1,88	0,97	0,72	0,60	0,93	1,09	0,56
FR of Germany	1964-73	0,92	*	1,75	0,93	0,93	0,84	1,92	1,14
	1973-81	0,98	*	0,85	0,94	0,94	0,81	1,77	1,04
France	1964-73	1,20	0,63	2,11	1,10	0,95	1,45	1,02	1,00
	1973-81	0,90	1,59	0,94	0,84	1,00	0,87	0,58	0,70
Italy	1964-73	1,03	0,84	0,36	1,11	1,09	1,06	0,86	1,17
	1973-81	1,49	*	1,06	1,52	1,39	1,39	1,68	1,56
The Netherlands	1964-73	1,16	1,15	1,12	1,20	1,48	1,33	1,09	0,84
	1973-81	0,56	*	1,43	0,65	0,80	0,47	0,81	0,32
United Kingdom	1964-73	0,84	0,88	0,77	0,90	0,83	0,90	1,34	0,90
	1973-81	1,53	4,92	2,77	1,11	1,33	0,82	1,57	1,21
USA [1]	1964-73	0,80	−0,51	*	1,16	0,61	2,20	*	0,81
	1973-81	1,48	*	0,92	1,47	1,23	1,62	1,44	1,10
Japan [1]	1964-73	1,97	na	−0,35	1,74	1,75	2,47	−0,56	0,64
	1973-81	1,87	na	−2,50	1,79	*	2,45	*	0,64

Note: * — non-significant elasticity (with a possible error of 5%).
na — data not available.

[1] Bilateral trade with the Community.

Table 20

Income elasticities of imports from the Community, by main sector (1964-73 and 1973-81)

Country	Period	Total	Energy	Agriculture	Manu-factures	Inter-mediate products	Equipment goods	Food products	Basic consumer items
Belgium	1964-73	2,44	1,90	3,19	2,40	2,53	2,09	2,35	2,88
	1973-81	1,38	*	1,40	1,57	1,74	0,71	3,25	2,15
FR of Germany	1964-73	2,79	3,70	1,44	2,94	2,92	3,08	2,12	3,21
	1973-81	1,55	*	0,99	1,94	1,84	2,39	1,52	1,66
France	1964-73	2,37	0,65	1,38	2,44	2,38	2,24	2,58	3,09
	1973-81	1,78	2,29	2,29	1,78	1,55	1,28	3,36	2,53
Italy	1964-73	2,57	2,13	2,55	2,54	2,40	2,39	3,19	2,93
	1973-81	2,02	2,73	1,85	2,03	2,10	2,04	1,74	2,22
The Netherlands	1964-73	1,78	*	2,67	1,80	1,94	1,40	2,50	2,26
	1973-81	1,66	5,40	1,46	1,45	1,17	0,84	4,25	1,75
United Kingdom	1964-73	3,17	2,28	1,27	3,21	4,46	4,52	1,18	1,90
	1973-81	4,44	*	*	5,76	5,50	7,06	*	7,80
USA [1]	1964-73	2,18	12,3	2,48	2,09	2,93	1,98	1,85	1,47
	1973-81	0,57	3,90	3,88	2,16	1,71	3,29	*	1,41
Japan [1]	1964-73	1,25	na	1,31	1,11	0,92	0,83	2,06	1,94
	1973-81	1,02	*	*	0,98	1,64	*	1,90	*

Note: * — non-significant elasticity (with a possible error of 5%).
na — data not available.
[1] Bilateral trade with the Community.

1. Export and import functions

The relations tested seek to capture the main structural characteristics of external trade. They are thus confined to the key determinants of competitiveness (relative prices and degree of adaptation to domestic or export demand). They take the following form:

For imports: $M_{ij} = f\left(\frac{PM_{ij}e}{PD_i}, Y_i\right)$

where M_{ij} = imports of i from j, in volume and national currency;

PM_{ij} = price (average value) of imports of i from j, in US dollars;

e = exchange rate;

PD_i = domestic price of i, measured here by the price of value added in national currency;

Y_i = GDP, in volume and national currency;

j = world or EC.

For exports: $X_{ij} = g\left(\frac{PX_{ij}}{PX_{nj}}, D_j\right)$

where X_{ij} = exports of i to j, in volume and in US dollars;

PX_{ij} = price of exports (average value) of i to j, in US dollars;

PX_{nj} = price of OECD exports (average value) to j, in US dollars;

D_j = indicator of export demand measured by the volume of 'OECD' imports (trade with the rest of the world) or EC imports (intra-EC trade) or, in some cases, by the GDP of the entire OECD area or the entire EC, in volume and in US dollars.

Since we were mainly interested in international comparisons, the equations tested were given a traditional form (double log) permitting a simple interpretation in terms of elasticities, and no systematic effort was made to find the form of equation that best suited each country. Hence:

$$\text{Log M} = \beta \text{ Log}\left(\frac{PM\,e}{PD}\right) + \mu \text{ Log Y} + \text{Constant}$$
with $\beta < 0$, $\mu > 0$

$$\text{Log X} = \alpha \text{ Log}\left(\frac{PX_i}{PX_n}\right) + \lambda \text{ Log D} + \text{Constant}$$
with $\alpha < 0$, $\lambda > 0$

These functions were estimated for the period 1964-81 and the sub-periods 1964-73 and 1973-81 using annual figures. A twofold disaggregation of external trade was applied:

i) a geographical disaggregation with regressions on trade with the rest of the world and, to take account of the importance of the Community market for our economies, on intra-Community trade;

(ii) a sectoral disaggregation with regressions on total trade in manufactures but also in the main product categories.

In some cases, a one-year time lag was built into relative prices where this made for better results since the response of imports or exports to changes in relative prices is not immediate and may, in some countries, exceed a period of several months. Likewise, the results of the simple regressions were systematically calculated by reference to GDP or export demand in order to take account of the relative imprecison of price indicators.

2. Operation of the price and income elasticities of external trade and the external constraint

The price and income elasticities of external trade reflect an economy's structural characteristics. Depending on the value of these elasticities but also on its price trends and economic growth rate relative to its competitors, each country has a different capacity for keeping its trade balance in equilibrium.

This is apparent from the following model:

Let

$X = \left(\frac{e \cdot P}{p^*}\right)^{\alpha} D^{\lambda}$ where X = volume of exports;

p^* = export price charged in the internationally traded goods sector;

P = domestic price charged in the internationally traded goods sector;

e = exhange rate;

D = world demand;

α, λ = price and income elasticities of exports ($\alpha < 0, \lambda \geqslant 0$)

and

$M = \left(\frac{p^*}{e \cdot P}\right)^{\beta} Y^{\mu}$ where M = volume of imports;

Y = national GDP;

β, μ = price and income elasticities of imports ($\beta < 0, \mu > 0$)

The rate of cover (of imports by exports) in value terms is written:

$$T = \frac{e\,PX}{p^*M}$$

and, in trend terms, if we put $\alpha' = -\alpha$ et $\beta' = -\beta$, we get:

$$\hat{T} = -(\alpha' + \beta' - 1)\,\hat{e} + (\alpha' + \beta' - 1)(\hat{p}^* - \hat{p}) + (\lambda\hat{D} - \mu\hat{Y})$$

where $\hat{}$ indicates the growth rates.

The trend in the trade balance in value terms thus depends on the price elasticities (α and β), the income elasticities (λ et μ), the price differentials ($\hat{p}^* - \hat{p}$), the exchange rate movements ($\hat{e}$), and the comparative rates of economic growth ($\hat{D}$ et $\hat{Y}$). In other words, it is determined both by factors linked to the structural characteristics of external trade (elasticities) and by economic performance (inflation and economic growth).

We see that:

(i) the higher the price elasticities, the more the trend in the trade balance depends on changes in relative prices or in the exchange rate;

(ii) the lower the price elasticities or the smaller the inflation differential, the more the trend in the trade balance depends on income elasticities and economic growth.

The impact of the income elasticities and economic growth is represented by the term $(\lambda\hat{D} - \mu\hat{Y})$. This can be rewritten to take account of the economic growth differential between the country in question and the rest of the world ($d = \hat{Y} - \hat{D}$). We then get $\lambda\hat{D} - \mu\hat{Y} = (\lambda - \mu)\,\hat{Y} - \lambda d$, an expression indicating that:

(i) assuming the national economy and the economies in the rest of the world are growing at the same rate and that the other factors influencing equilibrium in the trade balance (notably prices) are fixed, the trend in the trade balance depends on the difference between the income elasticity of exports and that of imports, which expresses the extent of the external constraint to which a country is subject;

(ii) the adverse impact of the income elasticities ($\lambda < \mu$) may be offset by below-average growth in the national economy while a beneficial effect ($\lambda > \mu$) permits faster growth than in the rest of the world. The growth rate enabling the initial rate of cover to be maintained is given by $\hat{Y} = \frac{\lambda}{\mu}\hat{D}$, λ/μ, being another way of expressing the constraint imposed by the income elasticities.

We can thus see that situations may differ considerably from one country to another depending on certain structural characteristics (price elasticities and income elasticities vary between countries, certain economies have much higher rates of inflation than others, and certain economies enjoy faster growth rates) but also on the general direction of economic policy. For example, assuming that inflation rates and price or income elasticities are much the same between countries, a country may be able to achieve higher growth at the expense of some deterioration in its trade balance or some measure of currency depreciation or to accept a stronger currency at the expense of slower economic growth.

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