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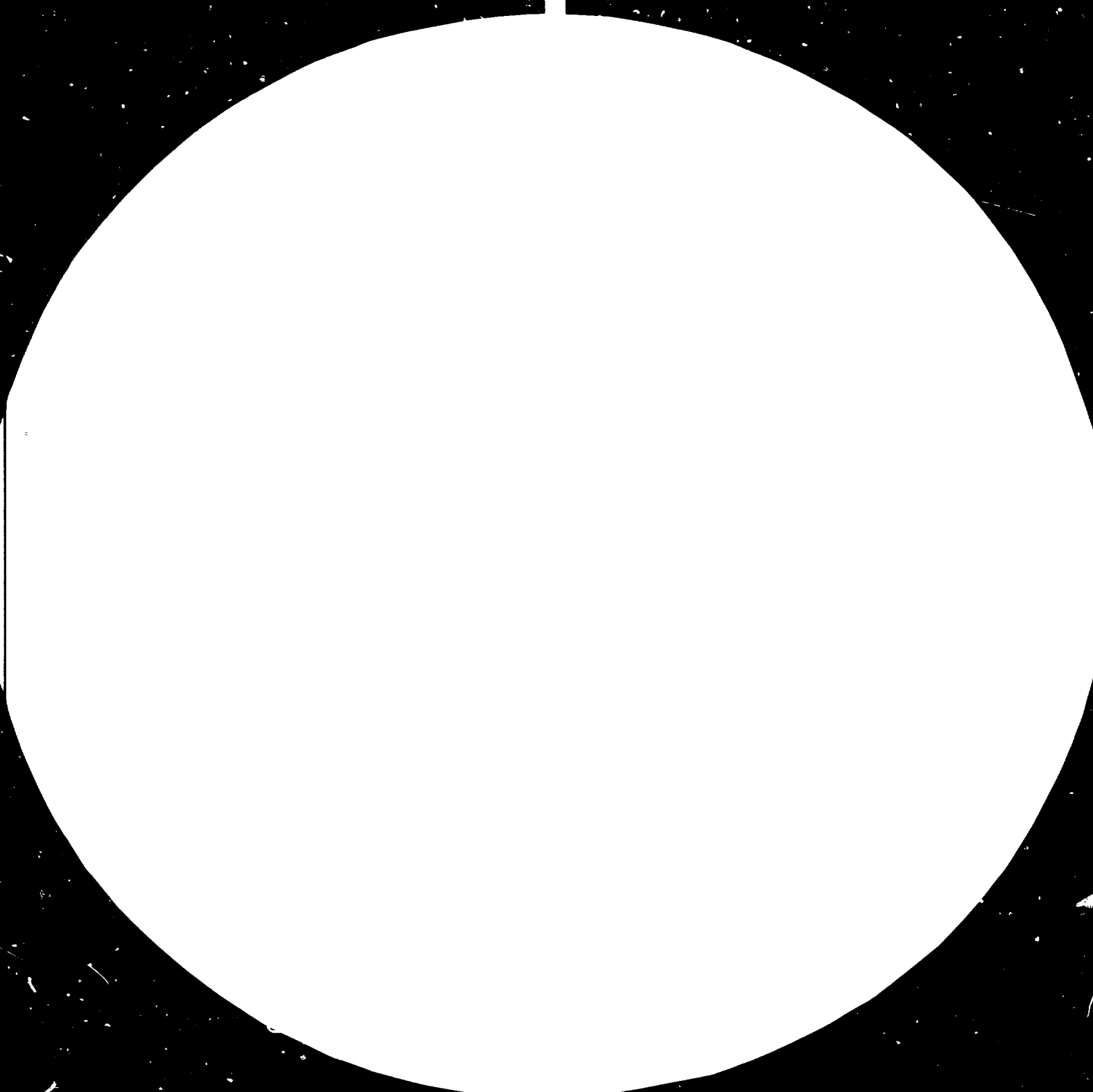

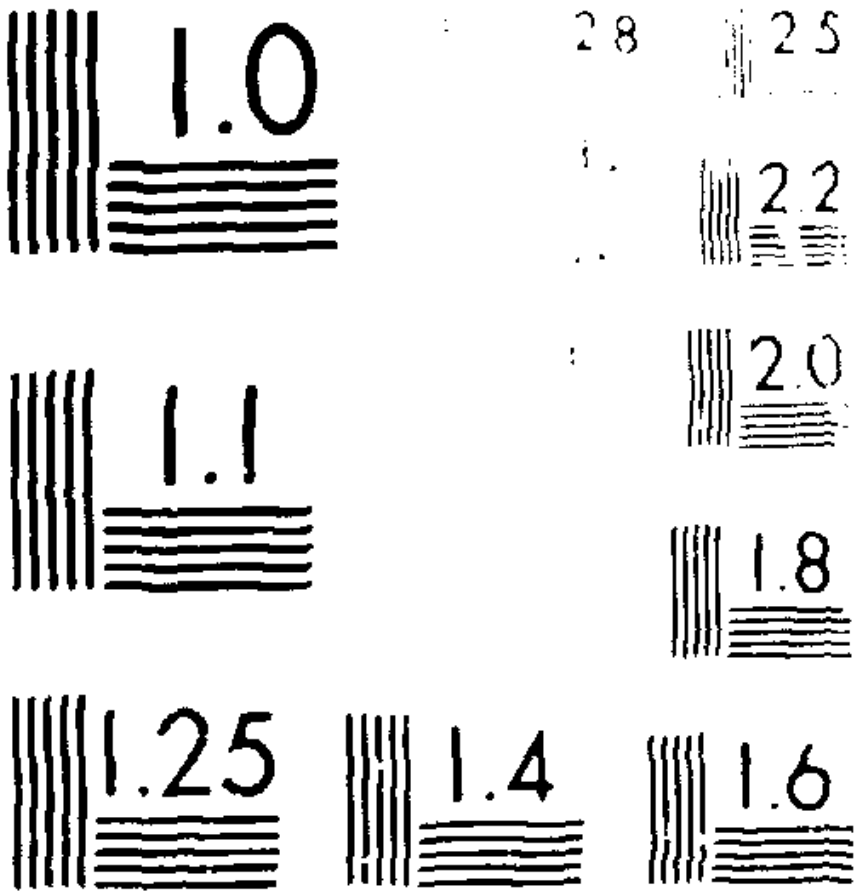
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EXCHANGE OF VIEWS WITH EXPERTS ON THE IMPLICATIONS OF TECHNOLOGICAL ADVANCES IN MICROELECTRONICS FOR DEVELOPING COUNTRIES

Vienna, 10-12 June 1981

BACKGROUND PAPER: BP. 3

AN OVERVIEW OF THE ELECTRONICS INDUSTRY IN EUROPE *

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AN OVERVIEW OF THE ELECTRONICS INDUSTRY IN EUROPE

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1 INTRODUCTION

It is now widely recognised that the United States was the first nation to perceive the commercial possibilities stemming from the rapid development of electronics technology during and after the Second World War, and to embrace enthusiastically the enormous growth possibilities represented by the development of the transistor as a practical, new device in the mid-1950's. As discussed more fully elsewhere (1) the very substantial lead which the US built up in electronics during the 60's and 70's was based on the synergy between the mutually-dependent military, computer and component sub-sectors. In short, it was the pressures of the Cold War and the Russian launch of the Sputnik which provided a major incentive for accelerated developments in defence and aerospace, for which the enabling factor was the development of significantly faster and more powerful computing systems. These, in turn, required the development of much more sophisticated solid-state devices such as the transistor and integrated circuit, so that all three sectors were mutually supportive and, ipso facto, all came to be globally dominated in due course by American companies.

As is also widely understood, Japan has in recent years been developing a very significant electronics capability of its own. In this case, the strategy seems to have been more deliberately conceived, and was based initially on developing from the early Japanese successes in transistor radios into a very substantial consumer electronics industry. From this vantage point, the Japanese now appear to be establishing a globally-competitive capability in all of the key areas of electronics, but especially in computers and microelectronics (eg: the VLSI programme).

In Europe, the development of the electronics industry has been rather like the curate's egg; good in some parts, bad in others. With the benefit of hindsight, it is clear that Europe has suffered from the lack of a central planning body such as MITI, to develop and 'sell' an overall (European) strategic approach. Thus, the nations of Europe have until recently left the development of the electronics industry more or less to chance and, in my view, have been fortunate that a number of individual European companies, with very little encouragement from their respective governments, have nevertheless struggled to establish significant market positions in particular sub-sectors against their American and Japanese competitors.

On the other hand, over the past year or two most European nations have finally - albeit, belatedly - come to realise the great importance of electronics, and an industrial and technological renaissance is now under way in Europe, the future of which, needless to say, is extremely difficult to predict. My objective here, however, is to make an intelligent attempt to forecast the development of the electronics industry in Europe over the next decade. In order to set things in perspective, I begin with my company's views on the size and growth of the overall global electronics industry, thereafter focusing down on Western Europe in general and the microelectronics scene in particular.

2 THE WORLDWIDE GROWTH OF ELECTRONICS

Figure 1 shows our forecast of the global electronics market, growing from about $368 bn in 1981 to $845 bn in 1991, broken down into the United States, Japan, Western Europe and the Rest of the World (RoW). (In this figure, and throughout this paper, all values are expressed in terms of 1980 US dollars, at the rates of exchange pertaining on 1 March, 1981).

This figure represents an overall compound average annual growth rate (CAAGR) of about 8.5% in real terms - which some may feel is conservative by the historic standards of the electronics industry. Individual regions can be seen to be growing at rates as low as 7% in the case of the US (which can be classified as a relatively mature electronics market), to a high of 10% in the Rest of the World.

It is interesting, in my view, to look at what these data mean in the terms of per capita expenditure on electronics (Figure 2). According to our projections, per capita expenditure per annum (in real terms, it should be emphasised) will roughly double in the US and Japan, and will increase by factors of 2.3 and 2.7 in Western Europe and RoW, respectively, giving a world average per capita annual expenditure of almost $200 by 1991. This does not seem at all excessive given the huge expenditure by then in the developed world in all areas of electronics - not least, consumer products, computers, communications and office automation - supported by anticipated large expenditures in almost all countries in areas such as telecommunications, instrumentation and industrial control.

Figure 3 represents our forecast of global electronics production in 1981 and our projections to 1991. In this case, we believe that the growth of production - while still substantial - will be marginally slower (5.5%) in Japan than in the US (6%), substantially faster (9%) in Western Europe and very rapid indeed (15%) in RoW. This latter figure comes about through a variety of causes, including the obvious point that an increasing proportion of manufacturers in the industrialised countries will shift part of their production 'off-shore' in order to take advantage of lower labour costs.

By comparing Figures 1 and 3, the projected trends in the balance of trade in these regions can be obtained, as illustrated in Figure 4. By and large, the changes we predict are not large. This is a necessary condition of such projections since it is unlikely - given all of the other factors causing economic instability - that the world could cope with very substantial changes in net trade in an industrial sector as important as electronics.

3 ELECTRONICS IN WESTERN EUROPE

The forecast made in Figure 1 was that the total Western European electronics market, currently about $103 bn, will by 1991 amount to approximately $244 bn. excluding military markets. To look more closely at this market, Figures 5 & 6 show the breakdown by main countries and main product sectors, respectively.

Looking at the breakdown by country, Figure 5 illustrates our belief that national growth among the 'big four' will be highest in the Federal Republic of Germany (10%) and lowest in Italy (7%). The Rest of Europe (RoE) should show at least average growth (9%) due to the relative immaturity of its current markets for electronic products.

In the individual product sectors (Figure 6), it can be seen that relatively high growth is being forecast for sectors such as telecommunications, office equipment and instrumentation. On the other hand, consumer electronics markets are expected to show real growth of only 5% per annum, and in the computer sector we are forecasting some slowing down of growth to an annual rate of 8%.

Turning now to the production of electronic goods in Western Europe, Figure 7 gives our estimates for 1981 in billions of 1980 dollars. This table shows the breakdown by the eight main product sectors against the four largest countries plus the Rest of Europe, from which it can be seen that 1981 production in West Germany will be larger than in any other single European nation by a substantial margin, followed by France and the UK, with Italy trailing substantially behind. By way of a reminder, the total forecast 1981 production value of $98 bn should be compared with the total West European market of $103 bn shown in the previous two figures. Thus, the current (ie: 1981) European balance of trade in electronics, excluding military, should turn out to be about $5 bn, in terms of 1980 dollars, or approximately 4.9% of the total market.

That the trade gap is so small may appear surprising at first sight considering the relative weakness of the European electronics industry. It can be accounted for, however, by the particular importance of the telecommunications, communications, computer and consumer electronics sectors in which Europe currently has a substantial production capability, albeit some of it under non-European ownership.

One of the key questions, of course, is how this trade balance in electronics is likely to change over the next decade. This is obviously a difficult forecasting job and is particularly hazardous since the trade gap, by definition, is the difference between two very large numbers (ie: the total market versus the total production). As any mathematician knows, this is a process which is particularly vulnerable to error. Nevertheless, some attempt needs to be made to analyse this trend since it is likely to affect to some degree the strategies not only of European companies and governments, but also of those non-European companies considering inward investment into Europe as a means of increasing market penetration.

We deal fairly constantly with such problems in this company and, at the present time, we believe that the most probable scenario for European production in 1991 is founded on three principal assumptions. Firstly, it is our view that many of the European nations will benefit from increasing determination, on the part of both industry and governments, to catch up with the US and Japan. This acceleration of effort will stem largely from an increasing realisation at Board and Ministerial levels of the profound importance of electronics technology to the future economic well-being of nations, and to the realisation by Boards of Directors that electronics represents one of the most promising areas for future industrial growth.

Secondly, as the European electronics industry moves slowly (but, we believe, surely) into higher gear, it will begin to benefit not only from enhanced credibility in world markets, but also from the economies of scale inherent in the production economics of many electronic goods. Thus, the improved technological posture and cost structure should lead to increased exports.

The third major factor is our belief that due to a combination of tariff increases (actual or threatened), quota restrictions (also actual or threatened), orderly market agreements (OMAs), etc., there will be increased incentives for non-European producers of electronic goods to invest in

manufacturing facilities in Western Europe.

Taking all of these factors into consideration, together with our visibility of the growth of the electronics industry world-wide, we emerge with the forecast of 1991 West European electronics production (billions of 1980 dollars) shown in Figure 8. This indicates on the left how the predicted $232 bn of production output will break down by product sector, and on the right by geographical region. It will be seen that France is forecast to make slow but steady progress towards catching up with West German production, but will still lag by $14 bn (1980 dollars) in 1991. Individual predicted growth rates for product sectors and geographical regions can, of course, be calculated from the data given here and in Figure 7.

The overall effect is that the European electronics trade gap in 1991 will be the difference between the previously mentioned total market, excluding military, of $244 bn and the predicted production (again excluding military) of $232 bn, representing essentially the same adverse situation in percentage terms (ie: 4.9%) as in 1981.

At this point, however, it needs to be re-emphasised that, by the very nature of the problem, forecasts such as these are uncertain and can only be regarded as an indication of the general trends in accordance with the scenario already presented. Since this was a reasonably optimistic scenario, it could be concluded that the trade situation might, in fact, turn out to be substantially worse than we are presently projecting.

4 THE EUROPEAN INTEGRATED CIRCUIT INDUSTRY

Focusing down now on the integrated circuit industry, Figure 9 shows the breakdown of the West European IC market by products, indicating a five-fold growth in real terms from about $2.2 bn (1980 dollars) in 1981 to $11 bn in equivalent terms in 1991. It will come as no surprise, I suspect, that we forecast that the main components of this spectacular growth will be the microprocessor and memory segments, and with substantial growth also in the MOS logic category. Only in the bipolar segments is the Compound Annual Average Growth Rate (CAAGR) below 10%.

Figure 10 shows the same market data by country and little comment seems necessary, except to say that the overall CAAGR is 17.5%, with FRG and France falling above, and the UK and RoE below, this average.

A market of $11 bn (in 1980 dollars) in 1991 clearly represents a very substantial and exciting opportunity for the world's IC producers, and it may be of some interest to discuss briefly how this market might divide in the future. As a starting point, Figure 11 shows a table of European IC market shares in 1980, indicating only the top 10 participants and that a multitude of other producers represent 15.6% of the total market.

Once again, it is clearly an extremely difficult problem to forecast how market shares will change since they depend, inter alia, on the performance, commitment, financial resources, etc. of not only individual companies but of the governments which may or may not be supporting them. If, however, we look at the problem first of all in global terms, and try to compare the relative capabilities of the US, Japan and Europe, it becomes obvious that in every case, in the simplest possible terms, there are three basic possibilities:

1. No change
2. Increased capability

3. Reduced capability

If careful consideration is given to the various forces which will work to change these relative capabilities, it is our view that in the case of the US the most probable result will be a relatively insignificant change in its global capability. The reasons for this conclusion are, of course, complex but, boiled down to their essentials, add up to the view that it is extremely difficult to imagine the US falling significantly behind the rest of the world in an area of electronics technology in which it has developed - over two decades - an immense momentum and commitment. On the other hand, given the very high present penetration by American companies of the world's IC markets, combined with the accelerating efforts being made in Japan and Europe, it is difficult to believe that the 'capability' of the US can increase substantially. In our view, therefore, the next most likely change in the US would be a reduction in its relative capability due to the aforementioned enhanced pressures from its foreign competitors; and the least likely, therefore, is an increase in the US capability.

Turning to Japan, the level of commitment by both governments and industry to achieving parity with the US in the semiconductor sector leads inevitably to the conclusion that the most probable outcome in that country will be an enhanced relative capability. It follows naturally from this that the next most probable outcome is 'no change', with a diminution in relative capability being most unlikely.

In Europe, the developing commitment of governments and companies again leads to the conclusion that the most probable development will be an improved relative capability. In this case, however, it is our view that, for many reasons, the final result is likely to be either success or failure, rather than the maintenance of the status quo. In other words, the recent awakening of activity in the IC sector in Europe is, we believe, in some respects a 'do or die' effort, and that whereas some of the national efforts may succeed, others will not.

Taking all of these - and, indeed, many other - factors into consideration, we conclude that the most likely overall scenario is a fairly static capability in the US, coupled with enhanced capabilities in both Japan and Europe. It may seem that these assumptions are mutually incompatible but, given the enormous lead which the US currently enjoys, there is clearly room for substantial improvements in the performance of both Japan and Europe without there being a significant diminution in US capability. Nevertheless, the conclusion is that, so far as Europe is concerned, the indigenous producers will increase market share (together with the Japanese) at the expense of the US producers, albeit in a marketplace which, it will be remembered, is forecast to grow by a factor of about 5 in real terms.

Thus we now have a postulated framework for making a guessstimate of the possible market shares in Europe in 1991, as shown in Figure 12. Concentrating solely on the top 10 we can see that in 1980, six of these places were occupied by American companies, one by a Japanese and three by Europeans. It is our belief that the forces acting during the 1980s will change these numbers to 4, 2 and 4 respectively, as shown.

Emphasising again that what follows is highly speculative, we also show in this figure our belief that 6 of these 10 places will probably be held by - in alphabetical order - Motorola, National, NEC, Philips, Siemens and Texas Instruments. In addition, we believe that there will be one from Intel, Fairchild or ITT; one from Fujitsu, Hitachi, Matsushita, Mitsubishi, Oki and Toshiba; and two from SGS-Ates, one French company and one British company.

You will note, however, that we have not had the courage to identify which of the several current prospects will be the 'successful' French or British companies.

It hardly needs to be added that this is obviously only a small part of the total picture. It is not possible to predict how many IC companies from these three geographical regions will be competing in the European market in 1990, although the number could be less than today due to the rapidly-increasing costs of starting, and then establishing, a viable activity in the IC industry. However, this will be counter-balanced to some extent by a certain degree of proliferation of small companies serving specialised market sectors. What can be said, in conclusion, is that this $11 bn market is likely to be contested vigorously and that, given their natural advantages, if the Europeans and Americans allow the Japanese to capture a major part of it, they will really have only themselves to blame.

References:

1. Mackintosh, I. M., 'A Prognosis of the Impending Intercontinental LSI Battle', Microelectronics J., vol. 9, p. 24, Dec., 1978.

2. Also published in Spectrum, vol. 15, p.51, June, 1978.

THE WORLDWIDE ELECTRONICS MARKET
1981 - 1991

(Billions of 1980 US Dollars)

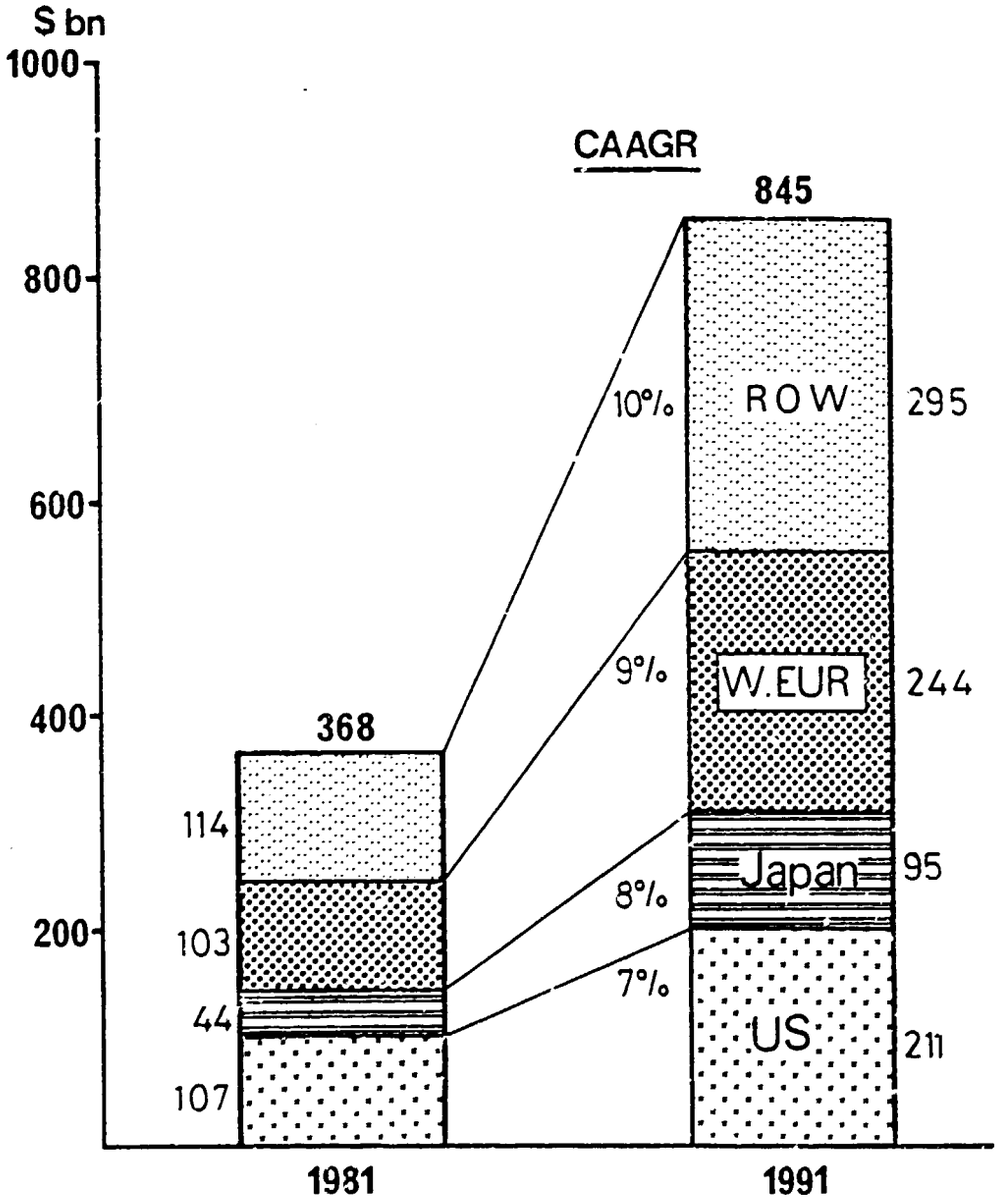

Figure 1

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GROWTH OF PER CAPITA EXPENDITURE ON ELECTRONICS, 1981-1991

1980 US Dollars

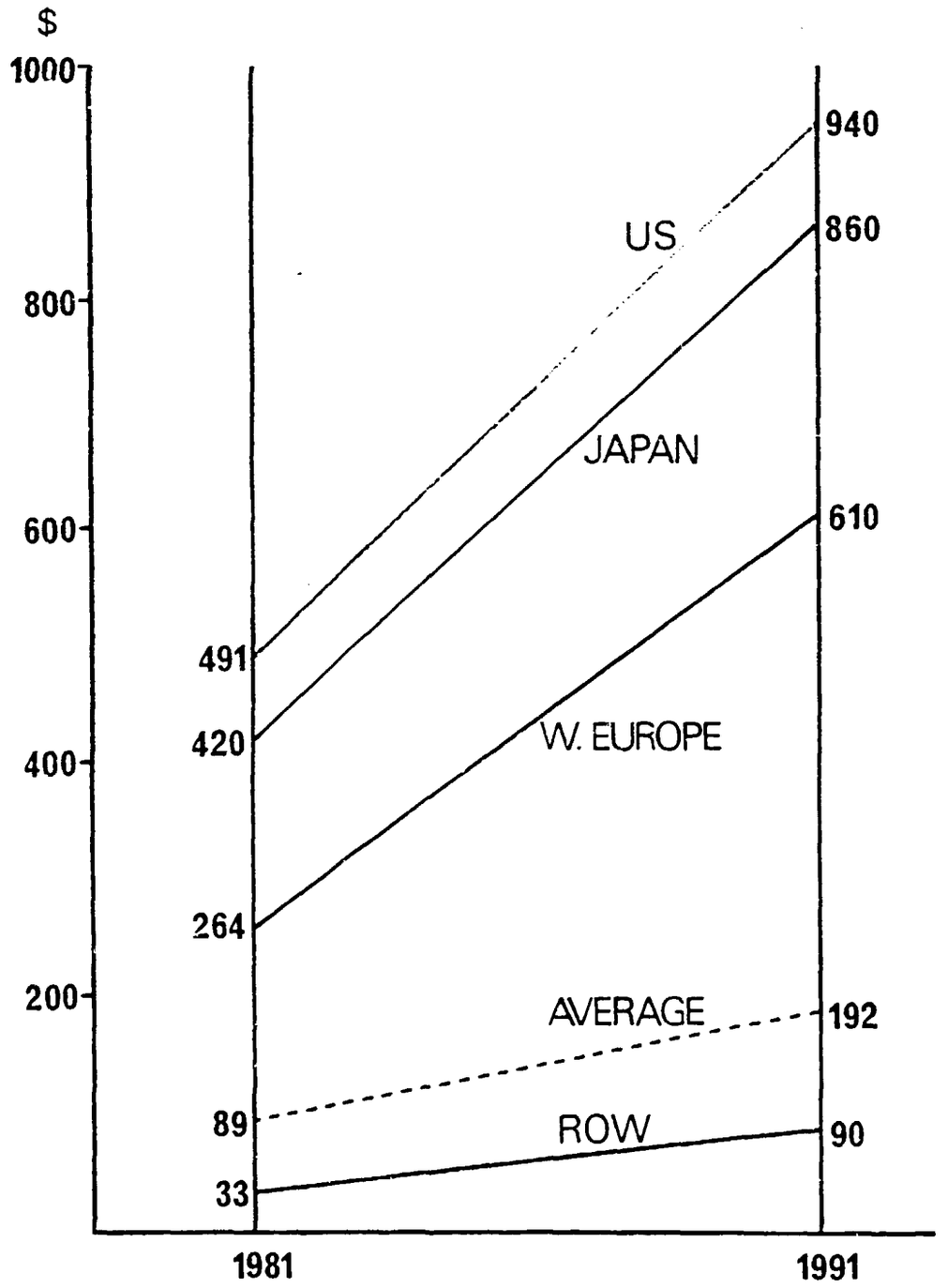

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Figure 2

TRENDS IN WORLDWIDE ELECTRONICS PRODUCTION 1981-1991

(Billions of 1980 US Dollars)

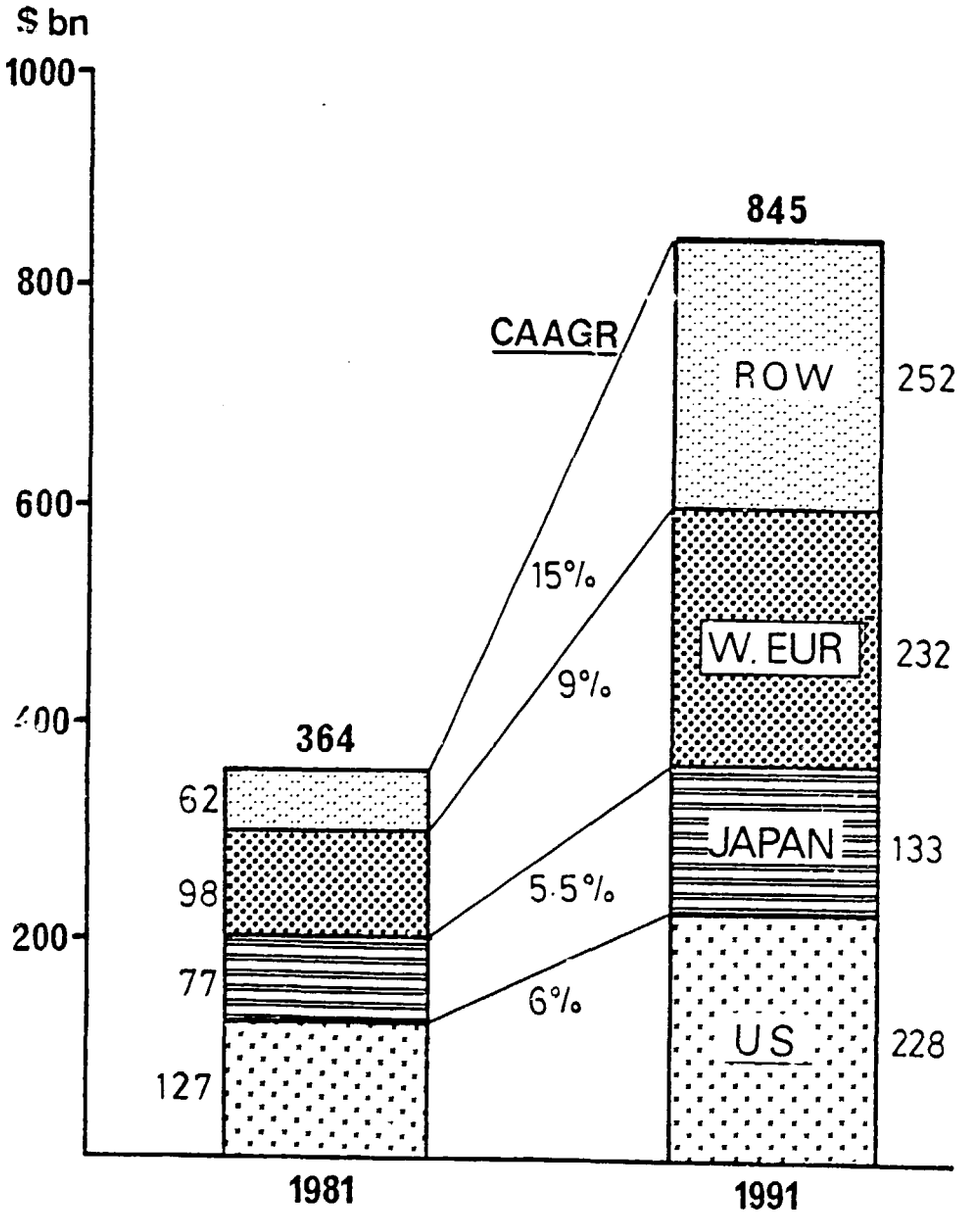

FIGURE 3

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TRENDS IN ELECTRONICS BALANCE OF TRADE 1981-1991

(Billions of 1980 US Dollars)

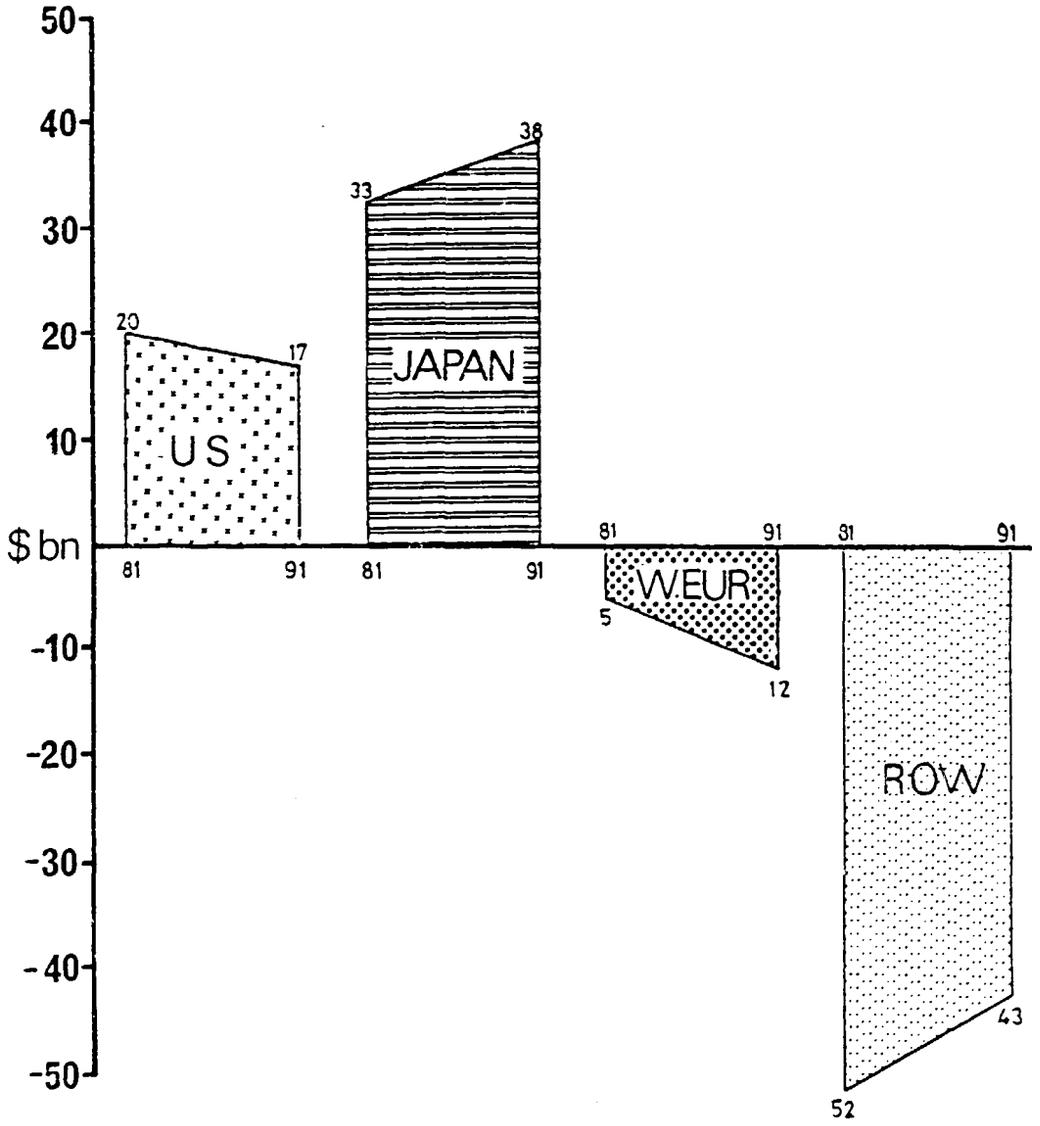

Figure 4

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GROWTH OF WEST EUROPEAN MARKETS BY MAIN COUNTRIES

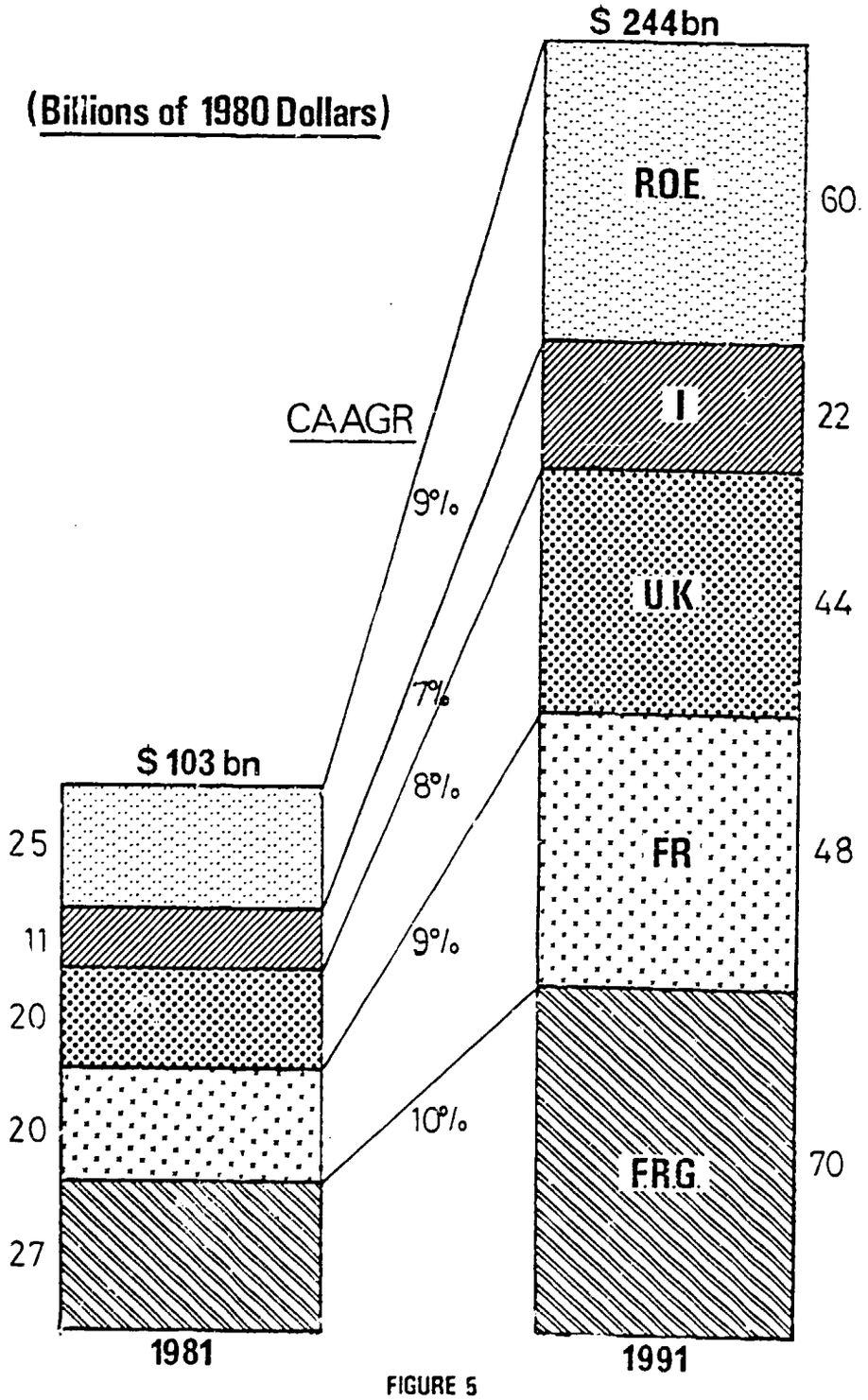

FIGURE 5

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GROWTH OF WEST EUROPEAN ELECTRONICS MARKETS BY MAIN PRODUCT SECTORS

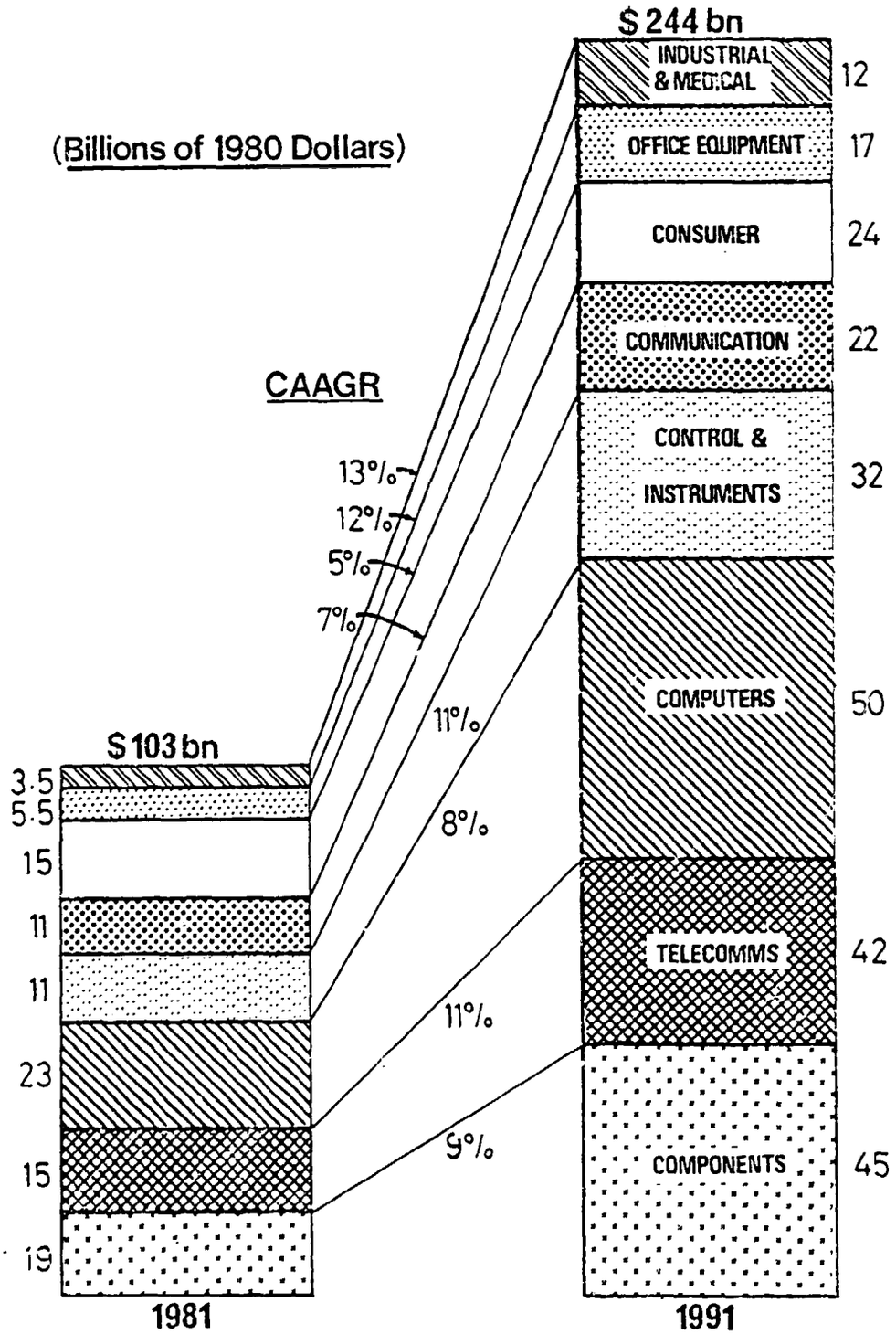

FIGURE 6

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WEST EUROPEAN 1981 ELECTRONICS PRODUCTION

(Billions of 1980 US Dollars)

SECTOR \ COUNTRY	FRANCE	FRG	ITALY	UK	RoE	TOTAL
COMPUTERS	4.5	4.5	2.5	4.5	2.5	18.5
OFFICE EQUIPMENT	Ø	1.5	0.5	1.0	1.5	4.5
CONTROL & INSTRU.	1.0	4.5	0.5	2.5	3.0	11.5
MEDICAL & INDUSTRIAL	0.5	1.5	0.5	1.0	1.0	4.5
COMMUNICATIONS	4.0	2.0	1.5	3.5	2.0	13.0
TELECOMMUNICATIONS	5.5	4.0	1.5	2.5	4.5	18.0
CONSUMER	1.5	4.0	1.5	1.0	3.5	11.5
COMPONENTS	2.5	6.0	1.5	3.0	3.5	16.5
TOTAL	19.5	28.0	10.0	19.0	21.5	98.0

Ø = LESS THAN $0.5 bn.

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FIGURE 7

FORECAST OF 1991 WEST EUROPEAN ELECTRONICS PRODUCTION

(Billions of 1980 Dollars)

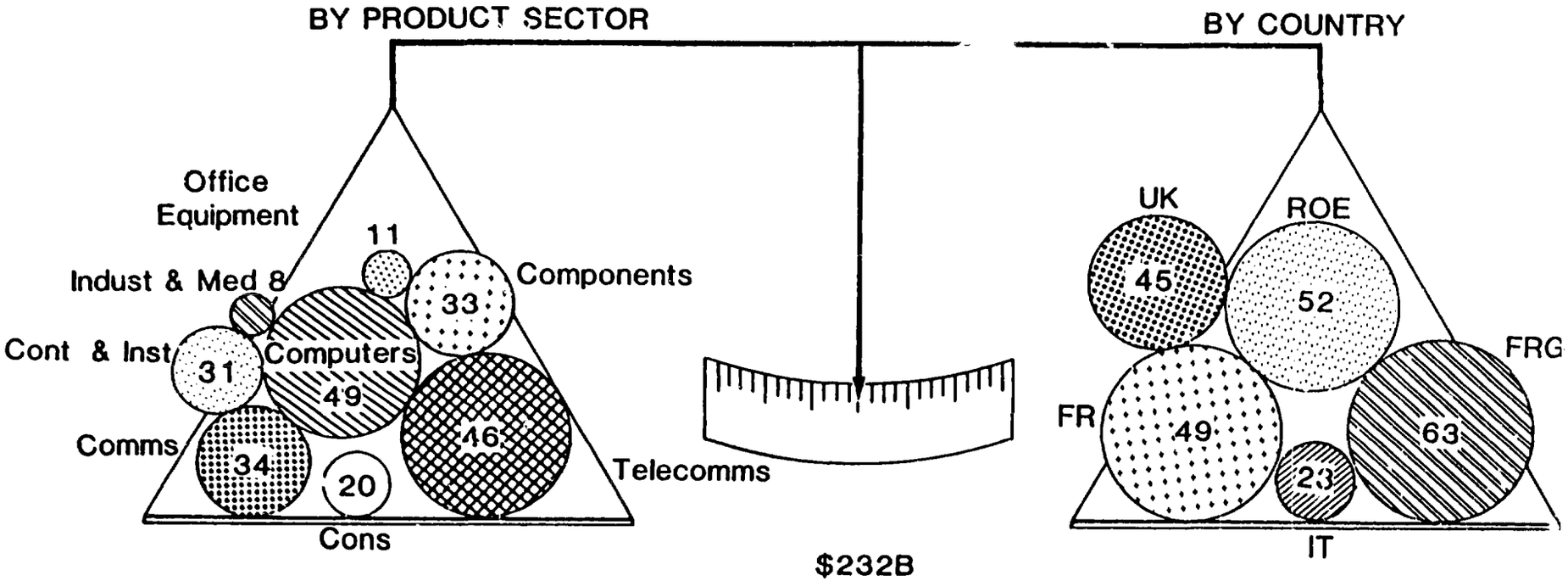

Figure 8

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WEST EUROPEAN MERCHANT IC MARKETS
BY PRODUCTS

(Millions 1980 Dollars)

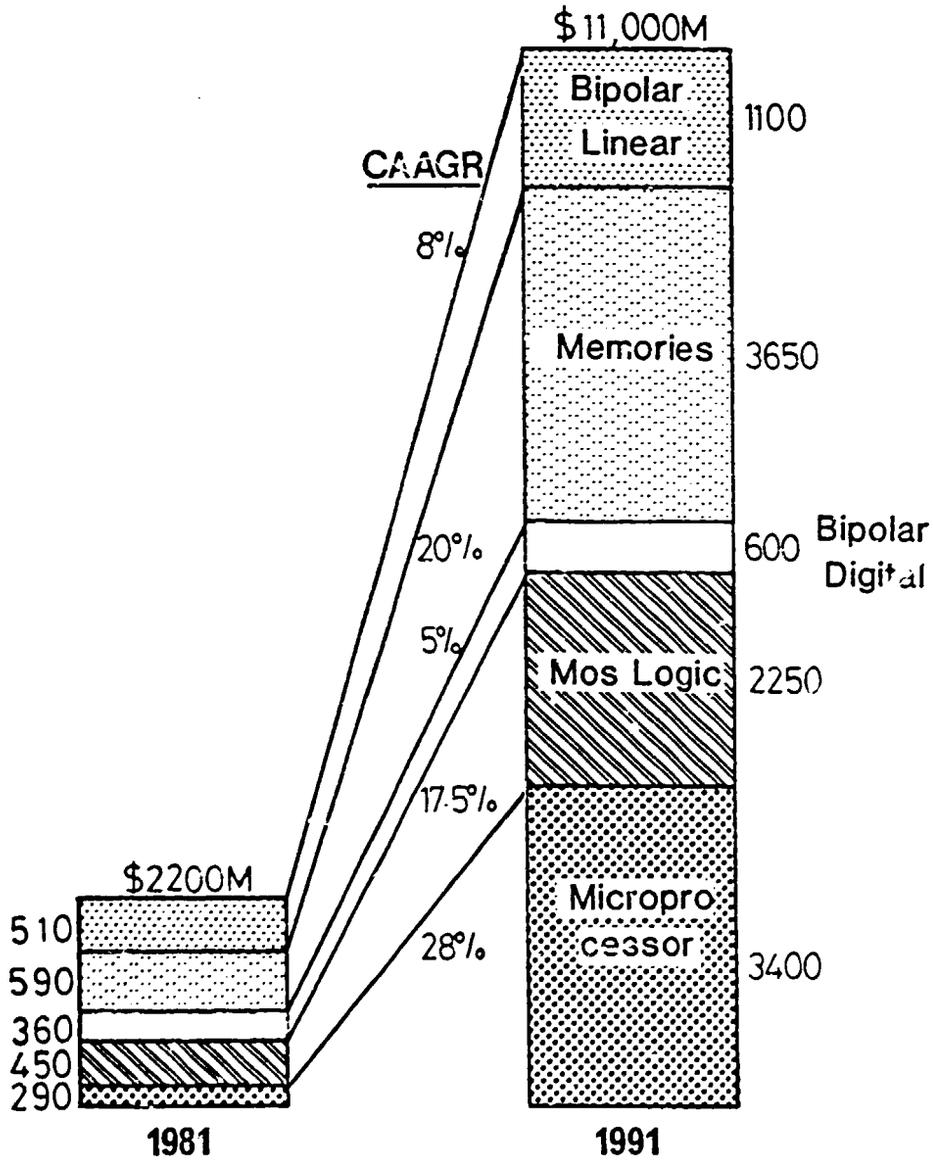

Figure 9

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WEST EUROPEAN MERCHANT IC MARKETS BY COUNTRY

(Millions 1980 Dollars)

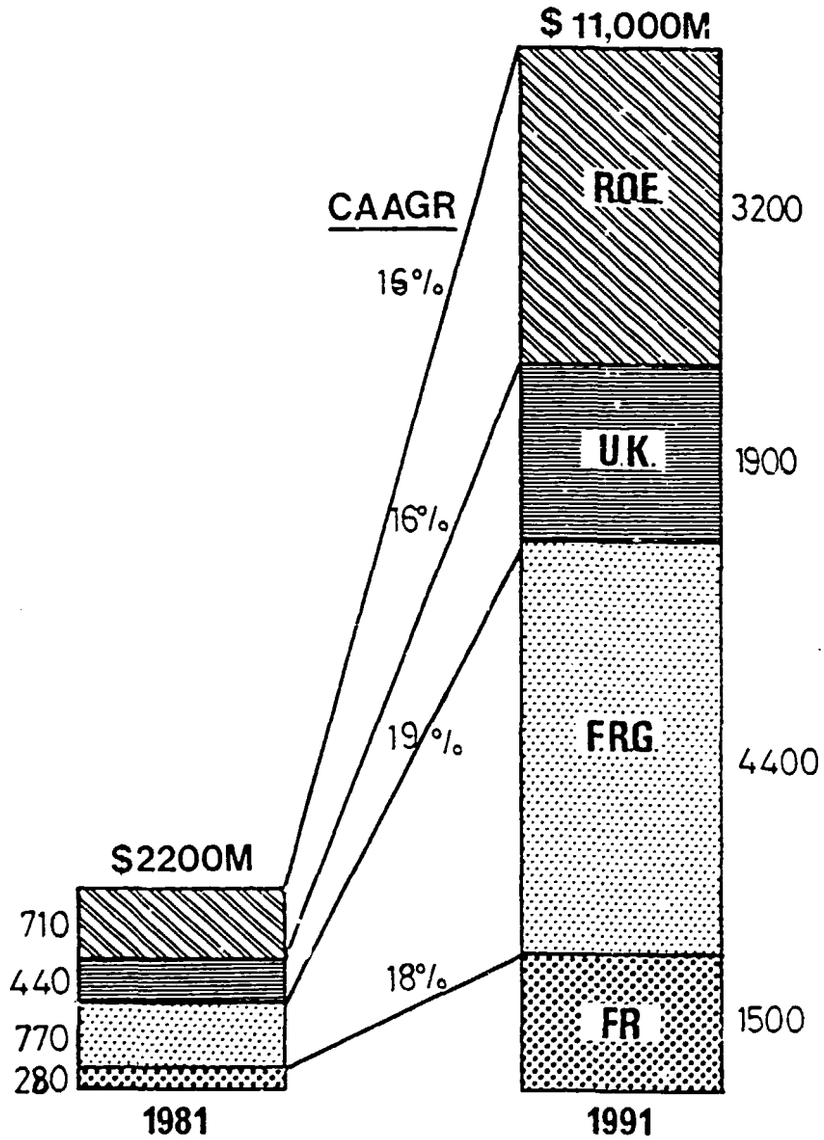

Figure 10

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1980 EUROPEAN IC MARKET SHARES

	APPROX SALES $m	%
1 PHILIPS	280	14.3
2 TEXAS INSTRUMENTS	240	12.3
3 INTEL	c.200	c.10.3
MOTOROLA		
NATIONAL		
6 FAIRCHILD	c.150	c.7.7
SIEMENS		
8 SGS-ATES	115	5.9
9 NEC	85	4.4
10 ITT	75	3.8
OTHERS	255	13.0
TOTALS	$1950M	100

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POSSIBLE TOP TEN EUROPEAN MARKET SHARES IN 1991

	USA	JAPAN	EUROPE
1980	6	1	3
1991	4	2	4

E.G.

USA	JAPAN	EUROPE
TI	NEC	PHILIPS
NATIONAL	ONE FROM: FUJITSU	SIEMENS
MOTOROLA	HITACHI	TWO FROM: SGS-ATES
ONE FROM: INTEL	MATSUSHITA	ONE FRENCH CO
FAIRCHILD	MITSUBISHI	ONE BRITISH CO
ITT	OKI	
	TOSHIBA	

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FIGURE 12