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Module: Strategic Information Systems Management

Strategic Information Systems Management

Assignment One

What general explanations are given for the apparent “productivity paradox,” and which do you feel is most relevant to your business experience?

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1.1 Contents Page

2.1 Executive Summary:

- Productivity paradox is relationship between IT and productivity, the fact that investment in IT hasn't increased productivity in businesses

- Productivity is important due to it determines living standards and therefore nations consumptions depends o n what it produces

- The main reason causes for productivity paradox in 1970s to 1990s has been evaluated as caused by cyclical factors

- Is there a productivity paradox at all, this was debated by various authors but it does exist.

- Main explanations for paradox are: Mis-measurements of inputs and outputs, lags due to learning adjustment, redistribution, mismanagement of IT, Procyclical productivity and insufficient use of technologies

- In my opinion there is a productivity paradox and its caused by mis - measurement of tangible and intangible aspects of business as well as mis-management.

2.2 What is the Productivity Paradox?

The relationship between information technology (IT) and productivity is widely discussed in literature. Computing power has increase d vastly since the 1970s however the productivity, especially in the service sector, seems to have slowed. The Investment in information and computer technologies (**ICT**) in different sectors has increased but the per capita domestic product remains low. Despite massive investment and resourcing by companies and organisations worldwide in their IT systems, there still seems to be little pay - off. ***(Adaptation of Brynjolfsson, E. 1993).*** Simply the productivity paradox of information technology questions the cont ributions of IT to economic output and productivity, based on the fact that there has been a marked slowdown in productivity growth despite massive and growing investments in IT.

This can also be simplified to equation form:

$$\text{Productivity} = \frac{\text{Value Added}}{\text{Person-Hour Employed}}$$

2.3 Where is the Productivity Paradox Found?

The essence of the productivity paradox stems from the services sector and manufacturing sector of various countries industries namely economical developed countries (***Figure 1***). However nowadays the service industries run our economy so manufacturing industries have less emphasis on the productivity paradox. This is highlighted by ***(Baily, Gordon 1988)***. They have given rise to the so-called productivity paradox, which describes the inverse relationship between corporate performance and IT. (View ***Figure 2 and 3*** in appendices)

The two figures show that the average productivity growth has decreased over the years while investment in information technology h as steadily increased. Therefore, on the macro level productivity and IT investment correlate negatively.

Investigations in the banking industry have shown similar results ***(Roach 1987, Roach 1988)***. It is not legitimate though to draw the conclusion that I T does not have a positive impact on corporate profitability. The following arguments explain this reasoning:

- The learning curve of IT users might postpone effects for various years.
- On the macro level a profit impact of IT might disappear as IT merely improves the competitiveness of single corporations in industry
- Information technology might not support the shared vision of company.
- The output measures might not capture the impact of corporate IT.

The measurement problems are even more acute in services than in manufacturing. In part, "this arises because many service transactions are idiosyncratic, and therefore not subject to statistical aggregation" ***(Brynjolfsson, 1993)***. Also in manufacturing companies increasingly choose to outsource thus eliminating the less productive activities.

2.4 Why is Productivity Important

Productivity growth determines living standards therefore a nation's level of consumption depends on what it produces. Slow productivity growth limits the rate at which real income improves (***Pilat, 1996***). According to ***Nordhaus (1982)***, it is low productivity growth which more than any other factor impedes a rise in living standards. Productivity is the fundamental economic measure of a technology's contribution. With this in mind, companies and organisations have increasingly begun to question their huge investments in computers and related technologies (***Kemerer & Sosa, 1990***).

Strassmann, Paul A. (1997) contributes to this by adding, "that the performance of the stock market, the prospects of achieving a balanced budget and the ability to finance Social Security plus Medicare all depend on the expectation of steadily rising productivity gains." Therefore Productivity contributes to out society as a whole this is why the productivity paradox is so widely reported and blamed for our shortfalls.

2.5 Overview of Productivity in Decline

From the 1970s to the late 1990s most industrialised countries encountered lower growth rates than in the 1960s. This delay reoccurred again however in the mid 1990s there was an improvement on the 1980s but once again if fell in 2001. This highlights the improvement wasn't structural. (***OECD, 1996, 2000***)

The main explanations and literature for the fall in productivity in the past are:

- The shift from industry to services i.e. productivity in services is assumed to be more difficult to achieve than in physical production.
- The oil crises of 1973 and 1979.
- Cyclical factors and negative effects of the slower returns from economies of scale.
- Slower rates of growth of the capital stock caused by earlier capital withdrawals and by delayed capital replacements.
- A decline in labour's contribution to productivity growth.
- Less intense research and development.

(Nordhaus, 1982) (***Olson, 1988***)

2.6 Review

Reviewing the literature, the correlation between higher IT spending and lower productivity at the level is not compelling because so many other factors affect productivity. Until recently, IT systems were not a major share of the economy. This section highlights various argum ents and introduces an important question namely is there a ***Productivity Paradox*** at all and what other major reasons in literature, that have caused productivity to decrease.

3.1 Is there a Productivity Paradox at all?

Darby (1984) claims "that a careful analysis within the viewpoint of the entire twentieth century discloses no important variation in what is variously described as growth in total factor productivity or technical progress". Other economists believe that the capital stock in information and computer technology is too small to exert a meaningful impact on national economic statistics ***(Sichel, 1997)***.

Strassmann, Paul A. (1997) adds his own view to this question is there a paradox. He states, “The term "paradox" is used when reasoned acts deliver results, which are counter to expectations. I think that therein lies the fallacy, and perhaps arrogance, of thinking about computers as a paradoxical phenomenon. Computers are indeed a miraculous technology. Therefore, management has been led to expect delivery of fantastic gains in productivity. The press, the vendors and the consultants have reinforced such convictions.”

Strassmann (1997) highlights that there is:

- No correlation between computer spending and profitability;
- No evidence that during the last decade the productivity of information work in the US has improved.

Gordon, 2001 states since 1995 there were signs in the USA that computers and the Internet were finally contributing in the business sector to increase productivity. According to ***Gordon*** the "new economy" (the Internet and the accompanying acceleration of technical change in computers and telecommunications) does since 1995 provide real productivity gains. However these gain are more sited within the manufacturing sector.

A further reason for the small direct impact of the Internet on productivity growth may have been the inadequate ICT infrastructure. Internet has had an effect on productivity to date due to being able to obtain competitors' market share and sales rather than increase them. While development in web sites has increased costs due to the duplication of the sites and this in turn has reduced the accessing speed for the consumers.

Coax, (2002) highlights this in a study of the Dutch society of people having Internet access by cable - in the period from February 21, 2000 to January 30, 2002, revealed that 61 per cent of the respondents judged the opportunity costs of getting access to the Internet too high, that is the speed of Internet access by cable is insufficient. Huge investments are needed to have the required infrastructure.

Investigating the relationship between investment in information technology and productivity show that results remain ambiguous. Studies confirmed the existence of a productivity paradox and other s find a positive relationship between investment in information technology and productivity. Investment in ICT in the early 1970s was only a fraction of that invested in the 1980s was overshadowed by far by investment in machinery, buildings and other ass ets ***(Piller, 1997).***

3.2 Main Explanations for the Paradox

This section analyses the fact that if there is a paradox the main explanations of the paradox would be grouped into six categories based on the reading, which I have covered.

3.2.1 Mis-measurement of Inputs and Outputs

Estimates of productivity that are based on GDP are subject to two similarly biased particularly niggling problems. One of the problems is identifying generally acceptable units of output when quality changes are involved. Another is the difficulty of identifying acceptable units of input.

MEASUREMENTS IN OUTPUT:

- Simply that output and output statistics can be very unreliable.
- When new products or features are introduced into the market and they cant be compared so its value can be nearly impossible to measure.
- Inadequate accounting of the benefits from new goods and services that are not included in the price index.
- Inadequate accounting in the price index of the changing quality of goods and services, such as customer service
- Inadequate accounting of measurement of government services. i.e. measured by input, leads to the fact that the creation of real output in this category assumes zero productivity growth.
- Inadequate accounting of different investments in ICT.
- ***Brooke (1991)*** argues that lower costs of information processing have enabled companies to handle more products and variations of existing products. This has reduced economies of scale and has therefore resulted in higher unit costs of output.

(Bresnahan and Greenstein, 2001)

MEASUREMENTS IN INPUT:

- Life cycles of ICT are shorter and not taken into account. Therefore capital is being over valued, which in turn means productivity is undervalued.
- According to ***Denison (1989)*** If the quality of work life is improved by computer usage then lower wages can be paid. This then may be compensated for by unmeasured improvements in work life that are not accounted for in government statistics.
- Increased technological improvements of computer and information technologies hinder the comparison of investment in information technologies over time.
- Inadequate imputing of education and implementation costs. The life cycle of these investments is longer than that of the hardware both cannot be depreciated at the same pace. But if it is done, then input costs are high.
- Labour input may also be overestimated. Artificially raising the short-term costs associated with computerisation and the subsequent benefits would be masked by the subsequent expensing of the next, larger, round inputs.
- IT purchases may also create long-term liabilities in software and hardware maintenance, leading to an underestimate of IT's impact on costs. ***(Bresnahan and Greenstein, 2001)***

In a case study of the finance, insurance and real estate sector, where computer usage and the numbers of information workers are particularly high, ***Baily and Gordon (1988)*** identified a number of practices by the Bureau of Economic Analysis (BEA) which tend to understate productivity growth. Their revisions add 2.3% per year to productivity between 1973 and 1987 in this sector.

The above-mentioned measurement problems can at least partly explain the productivity paradox of information in computer technology. According to ***Griliches (1994)*** there are reasons to believe that difficulties in measuring input and output have worsened because the "unmeasurable sectors" account for an increasing share of overall output. It is especially so in the service sector where output is notoriously difficult to measure. Consequently a great part of the production paradox may well be a purely statistical illusion.

3.2.2 Lags due to learning and adjustment

A second explanation for the paradox is that the benefits from IT can take years to show up.

David (1990) suggests that low productivity levels are symptomatic of an economy in transition. Although his analogy to the electrification of factories at the end of the nineteenth and beginning of the twentieth century is not very convincing, it is still plausible tha t computerisation does not automatically increase productivity because of time lags and organisational problems and for other reasons. New technologies may not have an immediate impact on business productivity.

Brynjolfsson et al. (l991) suggests that many expected it to take at much as five years for IT investments to pay-off. Generally, while the benefits from investment in infrastructure can be large, they are indirect and often not immediate.

Workers also need training to use computers and have to acq uire the necessary knowledge to cope with amount of information generated by them. For this reason firms, and society at large, have to invest in upgrading human capital, and this can cause a temporary decline in productivity.

Therefore, if short-term costs and benefits are measured, the investment will appear to be counterproductive ***(Brynjolfsson, 1993)***. In the long run one can expect to reap the benefits of the learning process. This hope may, however, also be frustrated because computer technology is changing very fast and workers are constantly involved in acquiring new knowledge in the software and hardware which directly contribute to the production of final goods and services ***(Chapman, 1997).***

Morrison and Berndt (1990) investigated various sectors of the US manufacturing industry from 1971 to 1986. The investigation summaries the some of the above authors points by underpinning their work and summarising this category into two simple points.

- Applying marginal cost theory there was too much investment in IT and too little in other capital goods.
- Reduction in cost of personnel, energy and material - potential benefits of corporate investment - does not correlate with IT investment. Only the reduction in material cost is proved to have a positive correlation with information technology investment.

A current example of this theory would be the NHS, currently they are trying to implement EPR (electronic patient records) within the UK. However a number of issues have occurred namely training, so in the short run I don't see them being able to increase their productivity due to the fact the staff will have to use the new system and learn to use it effectively, then in the long run when they become efficient with the system then they will be able to increase productivity. ***(Based on presentation about EPR in week one)***

3.2.3 Distribution of income / Redistribution

The third cause in literature for the productivity paradox is to consider modifications in income distribution. Namely rising income differentials can withhold the growth of purchasing power of the mass of consumers and with this they may become reluctant in buying new services therefore reducing productivity in companies due to the fact their goods will be expensive in relation to consumers income ***(Gordon, 2001)***.

An example of this would be once again refereeing to Coax - a Dutch society of people having Internet access by cable - in the period from February 21, 2000 to January 30, 2002, not only revealed that the opportunity costs of getting access to the Internet are too high but also revealed that 43 per cent of the 5,871 respondents judged the subscription prices as being too high ***(Coax, 2002)***.

As shown by coax 2002 study the crucial variable is namely the development of purchasing power of the mass of consumers. With a fall in real income, a non-proportional decline of consumers' demand for ICT -using goods and services can be deduced using Pasinetti's theory of the dynamics of consumers' demand ***(Pasinetti, 1983, pp. 71-5)***.

He shows that increases in per capita income necessarily imply non - proportional expansion of demand. Simply Applying this empirical law to services, the demand for highly priced ICT -using goods and services can be classified as being income elastic. Therefore to realise a structural improvement in purchasing power for most consumers to obtain benefits of economies of scale in the production of ICT -using goods and services require a redistribution of income from the upper layers of earners to the households at the bottom half of the incomes scale.

To evaluate this in business terms and more relevant to the subject ***Brynjolfsson, (1993)*** states “IT may be beneficial to individual firms, but unproductive from the standpoint of the industry as a whole or the economy as a whole: IT rearranges the shares of the pie without making it any bigger.” He also states “Unlike the other possible explanations, the redistribution hypothesis would not explain any shortfall in IT productivity at the firm -level: firms with inadequate IT budgets would lose market share and profits to high IT spenders.”

3.2.4 Mismanagement of Information and Technology

A fourth possibility is that, on the whole, IT really is not productive at the firm level. The investments are made nevertheless because the de cision-makers aren't acting in the interests of the firm. Instead, they are increasing their slack, building inefficient systems, or simply using outdated criteria for decision-making. Therefore sometimes the productivity paradox is attributed to mismanagement ***(Brynjolfsson, 1993)***.

Cron and Sobol (1983), looked at a sample of wholesalers. They found that on average, IT's impact was not significant, but that it seemed to be associated with both very high and very low performers. This finding has engendered the hypothesis that IT tends to reinforce existing management approaches, helping well-organised firms succeed but only further confusing managers who haven't properly structured production in the first place .

An example for mismanagement can be when ICT investments are made although such investments are not in the best interest of the firm. I.e. Managers may also decide to invest in ICT out of fear that otherwise they may be missing the boat. In such cases their investments may turn out to be unproductive and give rise to the productivity paradox. Once again a good example for this maybe the NHS and EPR systems, due to the fact they have seen it implemented in the US and they are trying to complete.

With the introduction of computers firms and institutions were everywhere confronted with high costs. These were not only due to the integration of computers in existing production techniques but also to the development of "new" products that caused problems with measuring the added value. This was especially the case where products were sold below cost to acquire enough customers to justify the initial outlay for this development.

Giving away products for free, or for relatively low prices in order to acquire a sustainable market share, does in the long run effect income distribution. Consequently measured production and productivity growth in the initial phase of the marketing of new products is undervalued and becomes overvalued in the maturing phase. (***David, 1991)***

Sometimes a new product turns out to be a failure. This then has a negative impact on aggregate performance figures. It follows that only when firms succeed in conquering a sustainable market share their investment will yield profits, and raise the measured productivity rates. The result is that IT might increase organisational slack instead of output or profits. This is consistent

with arguments by ***Roach (1989a)*** that manufacturing has made better use of IT than has the service sector because manufacturing faces greater international competition, and thus tolerates less slack.

Sometimes the benefits do not even appear in the most direct measures of IT effectiveness. The rapidly evolving technology leaves little time for time -tested principles to diffuse before being supplanted. IT can create unanticipated bottlenecks at each human in the information processing chain. More money spent on IT won't help until these bottlenecks are addressed. Successful IT implementation process must not simply overlay new technology on old processes. Once again the NHS are doing this with EPR.

3.2.5 Procyclical productivity

The hypothesis of procyclical productivity - productivity rates reflect the business cycle - imposes a re-evaluation of the hypothesis of the productivity paradox ***(Reijnders, 1990)***. The hypothesis contains the explanations for the productivity paradox

- When workers are not immediately dismissed with a decline in output productivity rates will fall due to the underemployment of the active labour force.
- When economies of scale are taken into account, i.e. when a rise in input results in a relatively larger increase in output, then a decline in output during recessions will lead to a decline in productivity
- When the levels of output fall, then as long as firms believe that output and labour demand will recover at some future period, employees with firm-specific human capital will be retained on the payroll to preserve their human capital.
- When output declines it is difficult to change the scale of operations to sustain productivity. For example, a shrinking workforce can be disruptive in terms of the coordination and teamwork. Adjustment cost involves a productivity penalty for downsising.

- When all plants increase output simultaneously, productivity is higher than when only some firms increase output. A rise in productivity of a firm will only be reflected in the overall productivity rate when the entire value chain of firms is adequately integrated ***(Baily et al, 1996)***.

A good example of procyclical productivity is when Rover and BMW were partners and then BMW walked away due to the decline in demand for rover cars. This in turn left Rover having to reduce the staff to match the decline in productivity. Therefore Rover only kept firm-specific employees. ***Case Study: Rover (v) in leaning centre video section)***

The explanations for procyclical productivity suggest that procyclical productivity not only manifests itself in the short run but also in the long run. With increasing returns productivity rates fall as so on as demand diminishes. Because of the reduced demand plants have to adjust their output and productivity rates will fall. When output declines it is difficult to rearrange the production process so as to sustain productivity ***(Hart and Malley, 1999).***

3.2.6 insufficient use of technologies

To benefit from computers managers have to re-engineer their company to match their business i.e. strategic alliance. A full think or all business processes must be completed to allow for this alignment of business and IT to happen. ***(Chapman, 1997).*** A key issue that needs to be considered is to increase the skills of employees thus stopping overload of information. To aid productivity the workforce must be disciplined as well. This is where most organisations breakdown due to the require changes being to costly and time consuming so they just resort back to their old hierarchy.

Brynjolfsson and Hitt's (1998) explain that changing business processes are not easy due to abandoning normal business practices and focusing on systems as a whole.

Not only changes within a firm are necessary, investment in ICT also requires that customers be prepared to use the new techniques. For example, a firm may invest in electronic commerce but will not obtain the expected returns before a very large number of its potential customers have access to the Internet.

Furthermore, investment in ICT can improve efficiency of production of part of the final product, but when other firms that contribute to the final product are too inward looking, are too much concentrating on their own operational efficiency, new inefficiencies can arise which thwart the advantages obtained from the initial investment.

Once again the NHS would be a good example due to the fact when they have their new EPR system they will not be using them to their full capacity, due to some of the data being stored on paper while a snapshot will be on the system, if they have to check validity of paper records then old hierarchy or process will apply. Also have to consider the fa ctor if customers are prepared for the new booking system and able to access online.

To summaries business won't be prepared for the new system when they procure them thus leading to a reduced productivity.

4.1 Which Explanation to the Paradox in my Opinion is More Justifiable

The closer one examines the data behind the studies of IT performance, the more it looks like mis-measurement is at the core of the "productivity paradox". Rapid innovation has made IT intensive industries particularly susceptible to the problems associated with measuring quality changes and valuing new products. Increased variety, improved timeliness of delivery and personalised customer service are additional benefits that are poorly represented in productivity statistics. These a re all qualities that are particularly likely to be enhanced by IT. Because information is intangible, increases in the implicit information content of products and services are likely to be under-reported compared to increases in materials content.

This view is held by some economists believing that the economy is in a transition phase toward a new type of economy. According to these new economists there are more technical changes, more new products, more changes in consumer services, in methods of delive ry and in other innovative areas, than is consistent with governments' productivity statistics.

However there are other options to consider mainly that the fact that firms continue to invest large sums in the technology suggests that the individuals within the firm that make investment decisions are getting some benefit or at least believe they are getting some benefit from IT. So basically there is too much of a blind belief that computers will improve productivity . Therefore highlighting that there is a mismanagement issue.

To conclude ***(Brynjolfsson, 1993)*** states “it is common to focus only on the mismanagement explanation, but a closer examination of the principal studies and the underlying data underscores the possibility that measurement difficulties may account for the lion's share of the gap between our expectations for the technology and its apparent performance.

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6.1 Appendices

Figure 1: Productivity paradox of IT is an international phenomenon (1995)

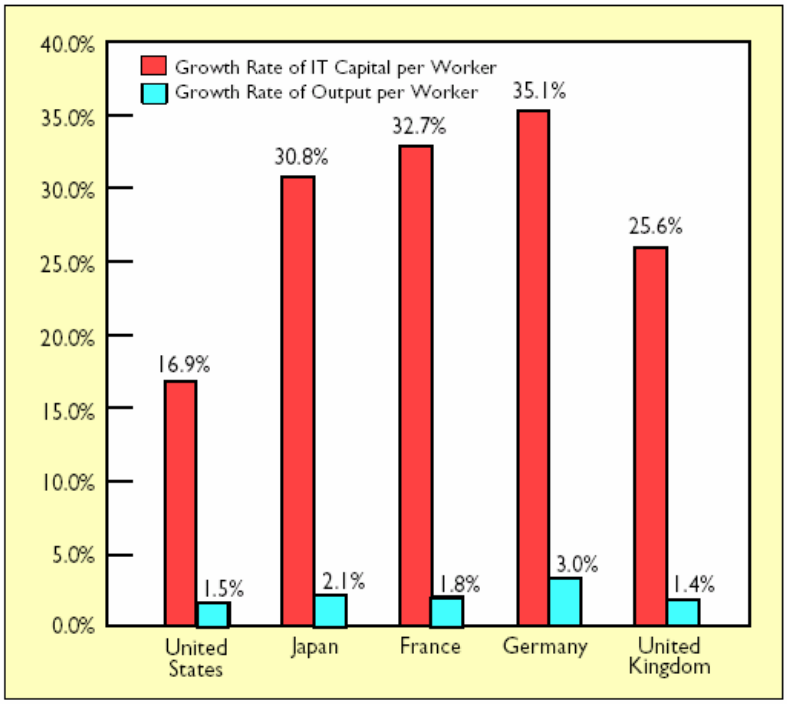


Figure 2: Productivity is measured in this context as average annual increase of productivity (output/hour in %)

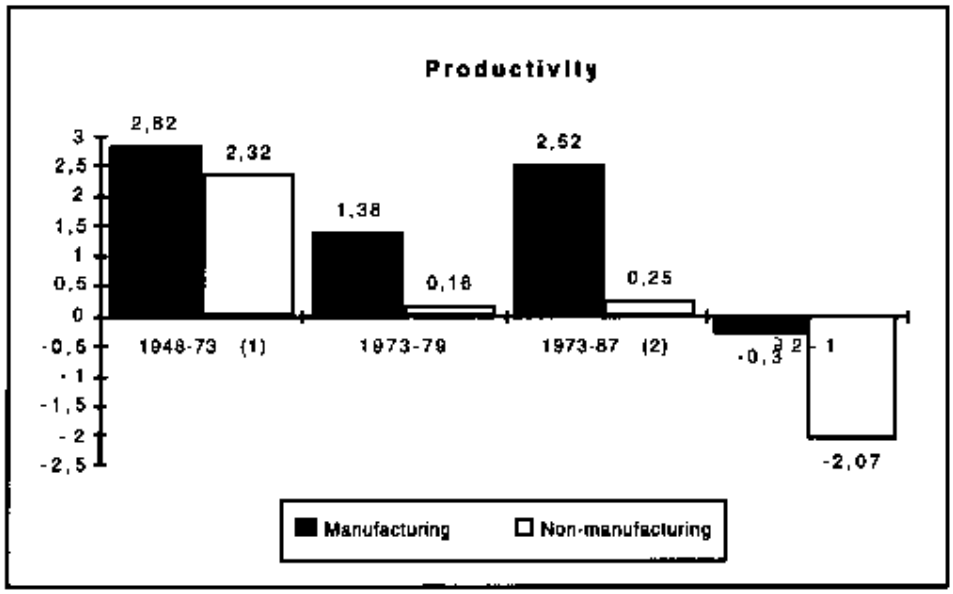
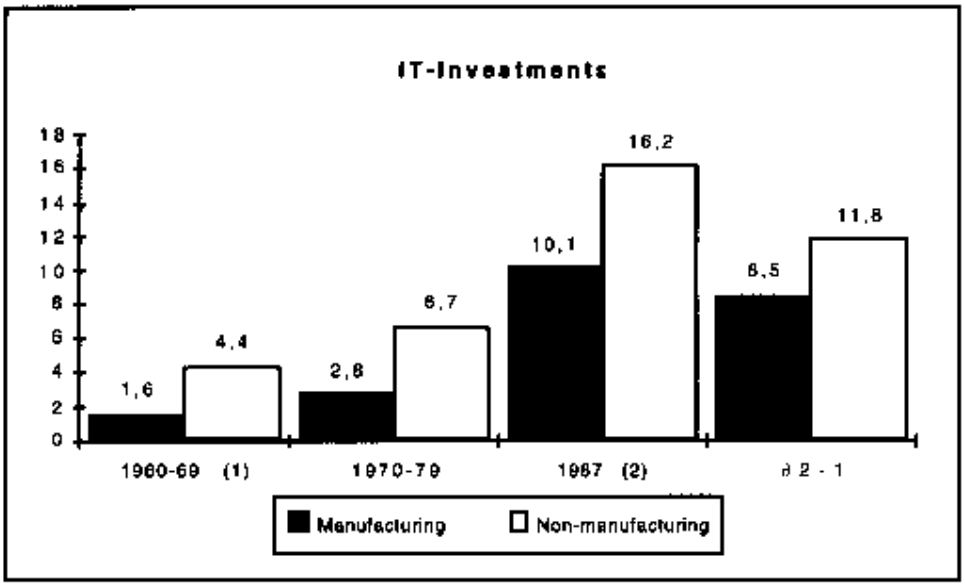


Figure 3: IT-investments are measured by the share of IT investments within overall investment (in%)



All diagrams from August 1998/Vol. 41, No. 8 COMMUNICATIONS OF THE ACM