Module: **Educational Economics**

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Fundamentals of Educational Economics[1]

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1. Basic Concepts

The economics of education is a special branch of economics, applying economic theories, principles and methods to educational processes. Internal aspects of the educational sector are treated as well as the interrelations with other subsystems of a society. The economic analysis of education can yield a better understanding of the economic prerequisites and implications of education and training and thereby helps to improve the rational basis of educational planning and politics. On the other hand, a purely economic approach would be inadequate, because education as a whole can only be understood when other disciplines as pedagogics, psychology and sociology also contribute their specific ways of analysis. (Fig. 1). *Education* itself has *different aspects*, which can be described by a range of terms, which are in part overlapping, but nevertheless emphasize different ways of looking at the topic: qualifying, learning, training; socializing, raising, en-/acculturing (Fig. 2).

A key concept of the economic analysis of education is the *production and use of qualifications*: in a more narrow and primarily labour market oriented view we can define qualifications as capabilities, attitudes, skills and knowledge, which allow an individual to carry out a certain task or job. This definition leaves out important spheres like non-paid work, especially home work, reproductive and consumptive capabilities, which all play an important role in the process of development (Fig. 3). *Different types of qualifications* can be distinguished with regard to influenciability, functionality, transferability, and labour market (Fig. 4).

Education can also be differentiated according to the *institutional setting* where it takes place. Families, schools (including colleges and universities) and firms are the major agencies. While schooling either has a more general, vocational or academic orientation, out-of-school educational activities can be more or less integrated with work. To one extreme, almost every kind of non-repetitive work implies some training-on-the-job. To the other extreme, firms may organize internal courses of instructions or send their apprentices or employees to external courses. The latter way may be offered by schools or specialized training enterprises. The more dissociated from work the training gets, the more it changes from an informal to a formal measure. This is even stronger for all kinds of recurrent education, where blocks of work and education alternate during working life (Fig. 5).

Economic evaluation of educational investment projects should take into account the following *criteria* (Fig. 6):

- Direct economic returns to investment, in terms of the balance between the opportunity costs of resources and the expected future benefits measured by increases in the productivity of educated workers
- Indirect economic returns, in terms of external benefits affecting the incomes of other members of society
- Fiscal benefits in the form of higher taxes paid as a result of increased incomes
- Satisfaction of demand for skilled manpower, which takes into account pay patterns, employers' hiring practices, and other indicators of manpower utilization
- The private demand for education (in the light of the private rate of return to educational investment, the level of fees, and other private costs) and social and other factors determining individual demand for education
- Internal efficiency of educational institutions, in terms of the relationships between inputs and outputs, measured by wastage and repetition rates, and other cost-effectiveness indicators
- The geographical and social distribution of educational opportunities
- The distribution of financial benefits of education and financial burdens
- The effect of the distribution of educational opportunities on income distribution and the contribution of education to the reduction of poverty
- The links between educational investment and investment in other sectors, including health and agricultural development.

Since decision making is always done in advance of the actual investment, evaluation cannot be confined to an ex-post procedure dealing with projects finished, but has also to take into account future developments. This forces the educational planner to deal with the so-called "*forecasting trilemma*" (Fig. 7), expressing three conflicting goals, hardly to be met simultaneously:

- a high degree of accuracy,
- highly disaggregated results (informational content),
- looking ahead as far as possible (forecasting period).[2]

2. Demand for Education

Educational investment, whether based on cost-benefit analysis, forecasts of manpower demand, or other criteria, cannot be adequately assessed unless estimates of future demand for education and student numbers are taken into account. The number of pupils or students enrolled in education is determined by a *variety of economic and noneconomic factors*. Obviously, government policy on the supply of places and the allocation of funds for education has an important influence on demand, since it determines the level of fees and the level of financial support for students (through scholarships, grants, or loans). Social factors and attitudes are also important, however.

Because the terms *social demand* and *private demand* are often used interchangeably, confusion sometimes arises in discussions of demand. The total number of pupils or stu-

dents enrolled in an education system is the result of a series of private investment decisions. Together, however, these private or individual decisions constitute societal demand (Fig. 8).

Educational planning based on this axiom is widely known as the social demand approach. Its underlying rationale is that social investment should aim to *satisfy private demand*, and that the policy maker must therefore forecast future demand by taking into account all the economic and non-economic factors that determine private demand for education. *Enrollment projections* are necessary, whether investment decisions are based on forecasts of private demand, manpower demand, analysis of costs and benefits, or simply on rough judgements about the cost-effectiveness and relative advantages of different projects. To forecast enrollments accurately, then, analysts need to consider three basic factors: demographic trends (Fig. 9), which will provide accurate estimates of the school-age population; the determinants of private demand for education, that is, the factors that determine whether or not pupils or students choose to enroll in education; and promotion, repetition, and dropout, which will indicate how many of the pupils or students who originally enrolled will remain in the system and ultimately graduate.

The rapid population growth in developing countries means that the school-age population is much higher as a proportion of the total population than in developed countries, where the rate of population growth is lower. The demographic burden is therefore much greater in low-income and lower-middle-income countries (except for China), increasing the *demographic pressure* on education (Fig. 10) despite planned reductions in fertility rates. Nevertheless, *declining fertility* will help to reduce the demographic pressure on education. One of the factors that has contributed to a reduction in fertility in developing countries is in fact education. The relationship is a complex one, however, and increased education may, in some cases, increase fertility before reducing it. Thus there are many reasons why population forecasts may be inaccurate. For purposes of school enrollment projections, however, many of the births that will determine the size of the future school-age population have already taken place. Much more uncertainty surrounds *future enrollment rates*.

Economic analysis of the private demand for education must take into account a number of factors that help to determine demand, such as the *private costs of education* including both earnings forgone and fees and other direct costs such as expenditure on books or materials. Also important are *sex*, *region*, the expected *private benefits* (in the form of increased lifetime earnings), the level of *personal disposable income*, and *unemployment rates* (Fig. 11).

One of the most powerful determinants of the demand for secondary and higher education, and even of primary school enrollment rates in some developing countries is the level of family income. Poor families will certainly find it difficult to pay fees, but even free education imposes a substantial financial burden through earnings forgone and out-of-pocket expenses for clothes, travel, books, or materials. Moreover, poor families on the average tend to have more school-age children than higher income families. In rural areas, where many of the poorest families live, communications are likely to be difficult and there may be no access to a local school.

An equally powerful reason for keeping children at home is that poor families need the additional income that even very young children may generate. From the time they are five or six years old, children of both sexes can make important contributions to the household through house-work and child care as well as productive work. In many developing countries, girls are expected to contribute to child care or home production at a much earlier age than boys. This is but one reason why girls are less likely to be enrolled in education. Many poor families regard the education of girls as a low priority, whereas the education of sons is considered an investment in security for old age.

The demand for education is further influenced by a bundle of *social and cultural factors*:
- ❑ father's / mother's education
- ❑ father's / mother's occupation
- ❑ family size
- ❑ kinship patterns
- ❑ ethnic group
- ❑ religion
- ❑ language (at home and in school)
- ❑ geographic location and proximity of schools
- ❑ attitudes and values
- ❑ taste for schooling ("educogenic families")

3. Costs of Education

The classification of educational costs raises the following economic, financial, and institutional as well as technical questions:
- ❑ What has to be sacrificed? (*economic issues*)
- ❑ When does money have to be paid? (*financial issues*)
- ❑ Who has to pay? (*institutional issues*)
- ❑ What is the function of the inputs? (*technical issues*).

Budget data normally distinguish between recurrent and capital expenditure (Fig. 12). Conceptually, the distinction is straightforward. *Recurrent expenditure*, as the term implies, recurs regularly and covers expenditure on goods and services that bring immediate and shortlived benefits. Thus expenditure on consumable goods, such as materials and teachers' salaries, is classified as recurrent expenditure. *Capital expenditure* includes the purchase of durable assets, such as buildings or equipment, that are expected to yield benefits over a longer period. There are, however, many intermediate items such as textbooks that may be difficult to describe as short-lived or long-lived, consumable or durable. The usual convention is to define one year to serve as the accounting period, and thus goods or services used up within one year are regarded as recurrent costs.

The cost of any investment must be measured by its *opportunity cost*, rather than simply by monetary expenditures (Fig. 13). Economic (as opposed to financial) analysis of investment in education thus attempts to estimate the total cost of an investment in terms of alternative opportunities forgone (Fig. 14). This means that it is necessary to identify all the *resources*, both human and physical, that are used in an education project, and not

simply those for which an expenditure item appears in the *budget* of private households, firms and the Ministry of Education. Indeed, some of these items may appear in the budgets of other ministries. Some of the resources used in education do not appear in any budget and thus cannot be captured as an expenditure. For example, a local community may donate land for a school or may provide free food or lodging for teachers. One of the most important resources in education is the time devoted by teachers, pupils, and students and by instructors and apprentices.

The opportunity cost of student time is estimated in terms of the value of the alternative opportunities that are forgone by society; the monetary value of this cost can be derived simply by calculating *earnings forgone*. The wages and salaries that a student must forgo in order to enroll in education rather than find employment represent a cost not only to the individual or to his or her family, but also to society, since they reflect the value of the goods or services that the student could have produced in employment. In countries with a high level of *unemployment*, actual earnings may overestimate the opportunity costs of time, since the alternative to education for some students would be unemployment rather than a wage. Even if unemployment is severe, the probability may be positive, though less than unity. Such probabilities can therefore be used as weights and can be applied to the observed earnings of secondary school leavers to provide an estimate of the opportunity cost of students' time.

For the individual, forgone earnings often represent the largest proportion of the *private costs* of education. Scholarships, bursaries, or other forms of financial aid should be deducted from indirect private costs (Fig. 14). Expenditure on scholarships or fees should not be included in the estimate of the *social costs* of education, however, since this represents a *transfer payment*, which transfers purchasing power from one group in society to another. Transfer payments do not use up real resources, but simply transfer the power to purchase resources, and therefore do not involve any opportunity costs.

The total cost of the resources that society devotes to education includes the cost of *teachers and other staff*, *books*, *other goods and services* such as heating or electric power, and the value of buildings and equipment. If the land or buildings are already owned by the government, their value cannot be considered an expenditure, but this does not mean that they have no opportunity cost. The opportunity cost of buildings and equipment is usually estimated by means of *amortization* (Fig. 12). If a school building is assumed to have a life of thirty years, say, then the capital cost of the building may be amortized over thirty years to give the annual value of the building. This is sometimes called *imputed rent.* Before capital costs can be amortized, certain assumptions must be made about the average life of the building or equipment and the social discount rate that measures the opportunity cost of capital.

The difference between private and social costs of education depends on the extent to which individual students or their families are *subsidized* by other members of society, either by means of *scholarships* that cover all or part of tuition fees or earnings forgone, or by means of *low or zero fees*. Although scholarships constitute a transfer payment and therefore are not included in social costs, the level of government expenditure on scholarships does help to determine the disparities between social and private rates of return.

Social costs for educating a graduate have to take into account *wastage* of resources. If 50 percent of the pupils enrolled in secondary schools were to drop out before completing their schooling, the cost of educating these dropouts would have to be divided among those who successfully complete their education. A number of developing countries have to provide ten years of primary schooling - instead of a normal or prescribed period of five years - to produce one successful school completer because of dropout and repetition. Wastage and repetition increase the social costs of education without correspondingly increasing the benefits.

Since costs of education are the quantities of used ressources multiplied by their prices, it is very important, wether we employ *current* or *real* prices (Fig. 15). Because inflation distorts intertemporal comparisons, long-term analyses of cost trends apply real prices. If opportunity costs are to be estimated with any degree of accuracy, *shadow prices* may have to be used to measure the true economic value of resources when their market prices are distorted, for example, through government control of exchange rates or wages and salaries.

Finally, it is very important to realize that educational investments put future burdens on the budgets (follow-up costs; Fig. 15). Opposite to the short-term orientation of decisionmakers in the „political market", planners of educational as well as of all other kinds of infrastructure have to keep in mind, that sooner or later maintenance and repair of buildings and equipment have to be taken care of.

To investigate whether there are economies of scale, it is necessary to distinguish between average and marginal costs, and also between fixed and variable costs (Fig. 16). *Average cost*, often called unit cost, simply represents total expenditure or cost divided by the total number of students or pupils. For many purposes, a simple average may be sufficient, but in some cases it can be misleading. It would be misleading, for example, to calculate the average expenditure per student simply by adding together expenditure on primary, secondary, and higher education and then dividing this by the total number of students, regardless of the relative proportions in each level. In such a case, a weighted average applying the relative proportions of enrollments as weights would be more appropriate, particularly if the proportions are likely to change over time.

In practice, it is often extremely difficult to identify *marginal costs*, but the concept is nevertheless important since marginal costs indicate the cost consequences of expanding the system, whereas average costs indicate the amount of money or resources devoted to each student in the existing system. Whether marginal costs are equal to average costs depends on the degree of utilization of resources in the existing system. If there is spare capacity, then it would be possible to increase enrollments without incurring substantial expenditure; there would be *economies of scale*, and marginal costs would be below average costs. If existing facilities are overcrowded, however, there may by *diseconomies of scale,* and marginal costs may exceed average costs.

The concept of *cost functions* can be used to investigate the relationship between average and marginal costs. The form of the cost function is partly determined by the relationship between fixed and variable costs. This distinction depends upon whether costs vary with the level of output: in the case of education, the number of students enrolled. A very

simple, *linear* cost function has been estimated for an Educational Television Project in Brazil (Fig. 17): TC = $ 971.000 + 87 * N, which means that total cost (TC) can be divided into fixed cost (FC = $ 971.000), that is invariant with the number of students reached per year (N), and variable cost (VC = $ 87). In this case, the marginal cost (MC*)* of one additional student is equal to the variable cost of $ 87, and average cost (AC) will fall with every increase in the number of students, because the fixed cost is shared between more students. Eventually, however, as N becomes very large, the fixed cost per student will become negligible, and AC will approximate MC ($ 87). The implied recommendation for educational planning is quite obvious:

- Definitely avoid a too small number of participants, e.g. less than 5.000 students.
- Try to reach about at least 15.000 students.

Although marginal costs steadily decrease with the number of students in the case of a linear cost function, this decline eventually becomes almost negligeable, once a certain number of participants is surpassed. In the example of Fig. 17 it would not make too much sense to struggle very hard for an expansion beyond about 20.000 students.

Moreover, the assumptions that lead to linear cost functions are better suited to correspondence courses than to presence learning systems. It is quite obvious that marginal costs do not indefinitely come down while increasing the size of a school, vocational training center, or university. Otherwise, a country would send all pupils to just one school. Besides the severe administrative and organizational problems of mass educational institutions well known from „over-sized“ universities, additional costs for transportation and/or lodging students would arise, that would finally make marginal cost rise again (Fig. 18).[3] On the other hand, very small schools cause relatively high costs, too. Increasing effenciency of better utilization of specialized rooms and teaching equipment not only reduce unit costs by spreading fixed costs over more student heads, but even help to get marginal costs smaller. So, some kind of *non-linear* cost function (e.g. s-shaped) is more appropriate than a linear one. Although decisions on the desired sizes of schools, universitites etc. cannot purely be made with respect to costs, it makes sense not to fall short of the minimal marginal cost and not to exceed the minimal unit cost.[4]

The distinction between *fixed* and *variable costs* is not the same as between capital and recurrent costs, since some recurrent costs (for example, the salaries of central administrative staff) may not vary with respect to student numbers, whereas others will. In the very long run, all costs are variable. Fixed costs play an important role where education is rather capital-intensive and/or quite independent of the number of participants reached, e.g. in radio-based or television-based distance learning. The cost of installing a broadcasting network, for example, is fixed and does not vary with the number of students using the system, whereas the cost of face-to-face instruction or correspondence teaching material will vary directly with the number of students.

This brief review of alternative cost concepts shows that there is no simple answer to the question "What is the cost of education?". It depends on the type of decision to be made. *Comparisons between* unit costs of education in *developed and developing countries* during the 1970s reveal some striking differences. Unit costs at all levels were much higher in developed than in developing countries, and the gap between the poorest and the richest countries has been growing. If unit costs are compared with GNP per capita, however,

then education represents a much heavier economic burden in developing countries, particularly at the secondary and higher levels.

Another way of looking at this striking difference is that each university student costs two or three times as much as one primary school pupil in developed countries, but costs ten times as much in most developing countries, and thirty or forty times as much in Africa. These differences raise a number of questions about the possibility of *cost reductions*: are these enormous cost differences due to inefficiencies, waste, and extravagant provision of facilities, as has sometimes been suggested, or are they due to the low levels of enrollment in higher education in developing countries? Psacharopoulos compared average cost and enrollment data for eighty-three countries and concluded that average costs are lower in countries with high levels of enrollment and that the cost per student with respect to per capita income declines sharply after an enrollment ratio of 2 to 3 percent and steadies out thereafter. This means that average cost may be expected to fall as university enrollment increases.

4. Costs of Firm-Based Vocational Training

Although costs of firm-based vocational training are calculated in similar manner as the costs of school-based education (and training), some specific aspects have to be observed due to the fact, that apprentices are not only engaged with training but also with productive work[5]. These productive services cause *training benefits* for the firm, which have to be evaluated at shadow prices. Deducting training benefits from the firm's *gross training costs* often leads to much lower *net training costs* and sometimes even to *net training benefits* (Fig. 19). While in industrialized countries such net benefits are suspected of being due to poor training quality ("*exploitation*“ instead of good training), they may be a strong argument for firm-based vocational training in developing countries, because they ease *financing* vocational education.

Apprentices can be trained at a variety of *learning places*: workplace, training workshop, in-firm seminar rooms, part-time vocational schools etc. They have different *cost schemes*. The special mix of these learning places constitutes a training technology, which influences costs and benefits (Fig. 20). Since vocational training relies heavily on *part-time instructors* (especially during training on-the-job), only a fraction of their salaries have to be accounted as personnel costs. This is another important difference to school-based systems, which employ (in some countries rather costly) full-time teachers.

To calculate the training benefits from apprentices productive work, we have to multiply four components consecutively (Fig. 21):

- the number of days of productive work per year
- hours of trivial, easy, and difficult tasks per day
- performance degree in easy and difficult tasks relative to an averagely skilled employee
- hourly wage of an averagely skilled employee.

The days of productive work make up just for about half of a year's workdays (Fig. 22), varying from 40% within larger industrial companies (94 out of 227 days) to 60% in smaller crafts shops (136 out of 226 days). To come up with an estimate of the hours of productive work apprentices spend per day with trivial, easy, and difficult tasks, one can questionaire the training administrations, the intructors, and the trainees (Fig. 23). During the next step the hours of apprentices` productive work per day are multiplied by estimates of their performance degrees (performance relative to a skilled worker's performance in easy and difficult tasks)[6]. This renders the so-called „skilled worker's equivalent hours of productive work" (Fig. 24). Further multiplication of these values by the hourly wage of a skilled worker yields the wage budget the company saves by employing (and training) an apprentice instead of a skilled worker. This final result seems to be a valid estimate of training benefits (Fig. 24).

The most comprehensive empirical research on firm-based vocational training has probably been done for the German „dual system". Some of the key results may be presented here (Fig. 25 to 35). Yearly gross costs of training (in nominal prices) have quadrupled from 6.948 DM to 29.573 DM within two decades (Fig. 25). It is quite interesting to compare costs of the dual system training to cost of schooling and higher education (Fig. 26). The first obvious difference are the apprentices wages, which bring up the gross costs well above schools and even higher education. Of course this is an overexageration. If we deduce training benefits, which only occur in the dual system, the yearly expenditure per student in higher education (19.284 DM) exceeds the yearly net costs per apprentice (17.826 DM). But even then, dual system training is much more expensive then schooling (6.892 DM).

While benefits have always been about equal in industry/commerce and crafts, gross costs and therefore net costs as well are higher in the first sector (Fig. 27). Interestingly enough, the cost structure has proven to be very stable, with a fraction of nearly 90% accountable to (instructor and trainee) personnel costs (Fig. 28). While gross costs increase steadily with company size, benefits do not decline in a linear mode. Nevertheless a rather steep increase in net costs can be observerd, when the number of employees exceeds 500 (Fig. 29). Separate data for big business would clearly prove in-house training to be a very expensive affair. With respect to different branches, again, benefits do not vary as much as gross costs do (Fig. 30). Relatively high benefits in the building trade are due to the good chances of integrating apprentices into productive tasks rather early, while high gross training costs are caused by high capital intensity in the chemical industry and by high trainee salaries in banking and insurance. Remarkable differences in training costs and benefits can also be observed with respect to occupations (Fig. 31/32).

All the above magnitudes are groupewise averages. Fig. 33 reminds us, that net costs are actually widely spread ranging from some companies with extremely high net costs to some others, which even achieve net benefits from training. Contrary to the „exploitation hypothesis" we recognize, that the latter group is rather small. This suggests that the motivation to supply training opportunities does not stem from *benefits during the training period*, but rather from *benefits after training*. The main reasons, why companies offer in-house training, support the view, that the dual system is also an excellent screening and recruitement device (Fig. 34 top). Although these „opportunity benefits" are hard to measure in monetary terms, rough estimates for AEG at the beginning of the 1990's are

quite impressive (Fig. 34 bottom). This also seems to explain, why not only the participation in dual system training rises with firm size, but also the chances to keep these apprentices as skilled employees afterwards (Fig. 35).

5. The Benefits of Education

Education yields direct and indirect benefits both to individuals and to society (Fig. 36). The most obvious *direct benefit* is, that better educated employees receive higher lifetime earnings than those who are less educated. Provided one accepts the critical assumption that the relative earnings of workers reflect their productivity differentials (Fig. 43), the higher productivity of educated manpower will most probably also yield benefits to their employers, e.g. by reducing unit costs of products („benefit sharing"). Since trained individuals only receive higher net income, the income tax differentials attributable to education are definitely direct fiscal benefits to the state, even if higher earnings were not caused by higher productivity.

Education also yields a set of *indirect benefits* (non-monetary and/or external). Most of them are extremely difficult to measure empirically, and some of them are at least controversial, since they are under suspicion of ideological prejudice (questions marks in Fig. 36).

In the case of *private benefits*, it is not necessary to make any assumptions about the link between education and productivity. If educated workers earn more than uneducated workers, the higher lifetime earnings represent a direct financial benefit to the individual regardless of why employers choose to pay them higher wages. In the case of *social benefits*, however, it makes an important difference, if more investment into education leads to higher national income (via higher productivity), or if higher national income allows for more consumption of educational services (Fig. 37).

Data on the *lifetime pattern of earnings* can be obtained in two ways. One is to follow the career of a sample of workers over a period of time to discover how their earnings change. This is known as a longitudinal or cohort study. The second method, which is the one used in most cost-benefit studies, is to obtain data on the earnings of a sample of workers of different ages at a single point in time. This information can be used to estimate the effect of age (a proxy for work experience) and education on earnings and thus to construct age-earnings profiles.

Age-earnings profiles are available for about fifty countries. They generally show a strong relationship between earnings and education: throughout the world, both in developed and in developing countries, the average lifetime earnings of educated or trained workers are higher than the average earnings of illiterate workers, or of those with lower levels of education and training (Fig. 38). Average labour earnings tend to rise to a peak in mid career or later and then stabilize or decline until the age of retirement.[7] The *typical characteristics of age-earnings profiles* are:

- Earnings are highly correlated with education; at every age the highly educated earn more than workers with less education, and there is no crossing of profiles.
- Earnings rise with age to a single peak and then flatten or fall until retirement age.
- The profiles are steeper for higher-educated individuals than for those with less education.
- The higher the level of education, the later the age at which earnings reach their peak.

Monthly gross earnings of emloyess under social security in Germany illustrate all four characteristics (Fig. 39), with just one exception: the crossing of the profile of high school graduates ("Abitur") with profiles of vocational training and even untrained young employees. Compared to untrained employees vocational training, which includes dual system as well vocational full time schooling here, grants just a very moderate advantge in earnings. Compared to employees with finished higher education at universities or fachhochschulen vocational training falls short dramatically. This seems to at least partially explain why higher education is much more attractive to young people than entering the dual system. Taking net income instead of labour earnings even more polarizes the population into those with higher education and those without (Fig. 40). Be ware two important conceptual differences between Fig. 40 and Fig. 39:

- Fig. 39 just takes into account employees under social security thus excluding civil servants, the self-employed, insignificant employment, unemployed persons seeking employment and people outside the the labour force (e.g. the retired and students without jobs).
- Net income in Fig. 40 excludes income tax but includes all other sources of income, especially pensions an capital income which play an important role at later ages and prevent income from comimg down.

Figures 39 and 40 both use median earnings and income respectively. To gain insight into the dispersion of income, Fig. 41 is more meaningful. From this point of view vocational training is something like an "insurance" against becoming a small earner at the price of missing the chance to reach the really high income groups. The distribution fits well to the idea sociologist have of the "Facharbeiter" as a social group.

Earnings also reflect *other forms of investment in human capital*, including on-the-job training. The fact that average earnings increase with age indicates, that work experience improves workers' productivity. Beyond that other influencable and non-influencable personal characteristics as well as environmental and institutional conditions affect earning capacity (Fig. 42). Regression analysis and earnings functions estimated for workers in the United States and other developed countries suggest that *natural (genetic) ability* accounts for slightly less than 20 percent of the additional earnings of educated workers. When other factors such as race, sex, and family background are included, education is still the most important single determinant of earnings. A review of the evidence in developed countries shows that the most likely value for the so-called alpha coefficient (the proportion of the extra earnings that can be attributed to education) is about 0,7 to 0,8. Less is known, however, about the effects of other factors on earnings in developing countries.

When earnings are used to measure the benefits of education, two problems immediately arise. First, *if labour markets are not competitive*, then relative wages are not necessarily a good measure of the relative productivity of educated and less educated workers. Second, earnings cannot be used to measure the benefits of education for workers in the *non-wage sector* of the economy. The age-earnings profiles used to calculate social rates of return are usually derived from urban labour market surveys, and there is little information on how education affects the earnings of the self-employed or rural incomes.

Since wages may not be a reliable measure of productivity in some cases, it is preferable to measure the effect of education on *physical measures of output*, rather than to use wage differentials as a proxy for productivity differences. Only a few studies following this approach have been undertaken, most of them in the agricultural sector. The results show a positive effect of education on agricultural output but can hardly be extrapolated to the production or service sector of the economy. In these modern sectors it is very difficult to isolate productivity gains from improved education in physical terms.

Research into the question of how years of schooling, ability, cognitive skills etc. affect earnings has also shed light on another issue surrounded by fierce controversy. *Human-capital-theory* holds that the amount (and quality) of education, reflected in higher certificates, influence productivity, thus leading to higher lifetime earnings, since workers are payed according to their marginal product (Fig. 43). This model can soundly explain the observed positive correlation between certificates and income.

Critics of human-capital-theory have argued that education merely identifies workers with genuine superior ability and personal attributes (such as motivation and attitudes to work, authority, or modernization) and thus is used as a convenient screening device (Fig. 44). That is to say, education simply confers credentials that employers can use to select workers and to determine relative wages and salaries. In the literature on the economics of education and labour market theory this line of reasoning is called the *screening hypothesis*, *credentialism* or *filtering theory*. It presents an alternative explanation for the above mentioned positive correlation between certificates and income, which itself is not at stake. Even if education does not enhance workers' skills and productivity, it can still be a profitable private investment, but society derives much less benefit from it.

In the first place, when a distinction is made between initial and *persistent screening* - or what one study describes as "weak" or "strong" versions of the screening hypothesis - it is very hard to find evidence that employers keep paying wages above a worker's productivity after the employee has been under their observation for some time. *Initial screening*, on the other hand, certainly exists; that is to say, employers may hire someone on the basis of expected productivity, as indicated by the candidate's educational qualifications. But there is nothing wrong with that, since employers need to use selection criteria when hiring workers, and it is both more efficient and equitable for education to be used as a criterion rather than race, religion, caste, or social background. At the same time, the screening hypothesis has been of some value in emphasizing that education not only imparts vocationally useful knowledge and skills, but also affects attitudes, motivation, and value, all of which help to determine a worker's productivity and employability.

Thus, the belief that education raises the productivity of workers through both cognitive and non-cognitive effects is not entirely incompatible with the idea that many employers use education as a convenient screening device. It may be that they do not need the skills directly imparted by education but do value the attitude and abilities normally associated with education, including the social and communication skills indirectly fostered by education (extrafunctional qualifications in Fig. 4). In developing countries, education has been particularly effective in improving attitudes toward innovations and modernization. In other words, the productivity and screening functions of education are not mutually exclusive, and both bring economic benefits.

6. Rates of Return to Educational Investments

Rate of return calculations are a very comprehensive way to merge the cost and benefit analysis. The extra earnings must be compared with earnings forgone and direct costs of education. The rate of return can be calculated as the rate of interest at which the present value of the positive and negative areas become equal (the green and red areas in Fig. 38). With an interest rate of 0% the net present value is equal to the undiscounted overall difference benefits and cost. As the interest rate increases, future values get more and more discounted, bringing down the net present value continuously until it finally even gets negative (Fig. 45). The internal rate of return is marked by the point where the net present value curve crosses the interest rate axis.

International comparisons of rates of return estimates for forty-four countries have revealed these general patterns (Fig. 46):

- The returns to primary education (whether social or private) are highest among all educational levels.
- The private returns are in excess of social returns, especially at the university level.
- All rates of return to investment in education are well above the 10 percent yardstick commonly used by developing countries to indicate the opportunity cost of capital.
- The returns to education in developing countries are higher than the corresponding returns in more advance countries.

These conclusions have some important policy implications for the choice of investments in developing countries. First, there is now abundant evidence that education is a *profitable* social as well as private investment. The fact that the average rate of return in developing countries is considerably higher for primary education than for secondary or higher education suggests that *top priority* should be given *to primary education* as a form of investment in human resources. The evidence shows, however, that secondary and higher education are also profitable investments and therefore should be pursued alongside primary education in a programme of *balanced development of human resources*.

Second, the large discrepancy between the private and social returns to investment in higher education has some bearing on financing policy. Evidence on the rate of return suggests that a *shift of part of the cost burden from the state to individuals* and their families is not likely to be a disincentive to investing in higher education, given its present high private margin of profitability.

Third, the fact that rates of return are lower in advanced countries suggests that as a country develops, or the capacity of its educational system expands, the returns to educational investment decline. A drastic fall in the returns is unlikely, however, as there is some evidence that in countries like the U.S., where a substantial expansion of education has occurred over the last decades, the rates of return have declined, but not drastically. The same pattern of remarkable stability of earning differentials can been observed for Germany (Fig. 47).

The relative stability of rates of return, despite a rapid expansion of education in recent decades, suggests that the *demand for educated workers has by and large kept pace with the increased supply* generated by educational expansion. This situation may be partly due to technological advances, but the influence of technological change on the demand for educated workers is a complex question that still needs further analysis. Although technological change may reduce total demand for labour, it is likely to increase the demand for educated relative to uneducated labour. Thus the rate of return on education - which depends on earning differentials - may remain high. This is what Jan Tinbergen once called the "race between educational expansion and technology" (Fig. 48). Fig. 49 empirically supports this theory with data from Germany. While the proportion of university graduates within the labour force has almost doubled over two decades, their relative income advantge has just been very slightly affected.

Another question in developing countries is how best to provide vocational training. There have been fewer attempts to apply cost-benefit analysis to vocational training than to formal schooling, but a number of examples do exist. The results suggest that in some cases *vocational training may be a substitute for formal schooling*. Many problems such as the interaction between formal schooling and vocational training arise in cost-benefit comparisons of different forms of training. Nevertheless, this is a promising area for further research, and the evidence so far suggests that social, corporate, and private returns to vocational training in developing countries are high enough to justify expanding training activity.

7. Suggested Literature

- Carnoy, M. (ed.): International Encyclopedia of Economics of Education (2nd Edition). Oxford 1995. ISBN 0-08-042303-5
- Federal Ministary of Education, Science, Research and Technology: Basic and Structural Data (Latest Edition). Bonn

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[1] The paper was prepared as pure teaching material and partially draws on Psacharopoulos, G., Woodhall, M.: Education for Development. Washington (D.C.) 1985.

[2] An empirical investigation into the forecasting trilemma of the General Educational Plan for Germany 1973 – 1985 can be found in Sommer (1991: 179 – 189).

[3] The negative effect of „oversizing“ on marginal educational cost may not be confused with the negative effect of „overcrowding“ on educational quality, although in real life they appear to be two sides of the same coin.

[4] The marginal cost curve cuts the average cost curve at its minimum from down under.

[5] The costing model of vocational training described here was devoloped at the beginning of the seventies with regard to the German „dual system“ by the „Costs and Finacing of Professional and Vocational Training Commission“, established the government of the Federal Republic of Germany.

[6] Apprentices efficiency increases as training proceeds, gradually leading their productivity towards that of a skilled worker. This holds to easy and – to a less extent – to difficult tasks, although even after four years of training, there is still a gap to the performance of an experienced woker. This gap is an interesting indicator of *increasing productivity after the training period* through training-on-the-job!

[7] The further increase of income for the age group 60 –65 in Fig. 36, especially for graduates from universities and colleges, is not contradictory to the human-capital-hypothesis of decreasing labour earnings, because of the overcompensatory effect over capital income für elderly people.

Fundamentals of Educational Economics

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Classifying the Economics of Education

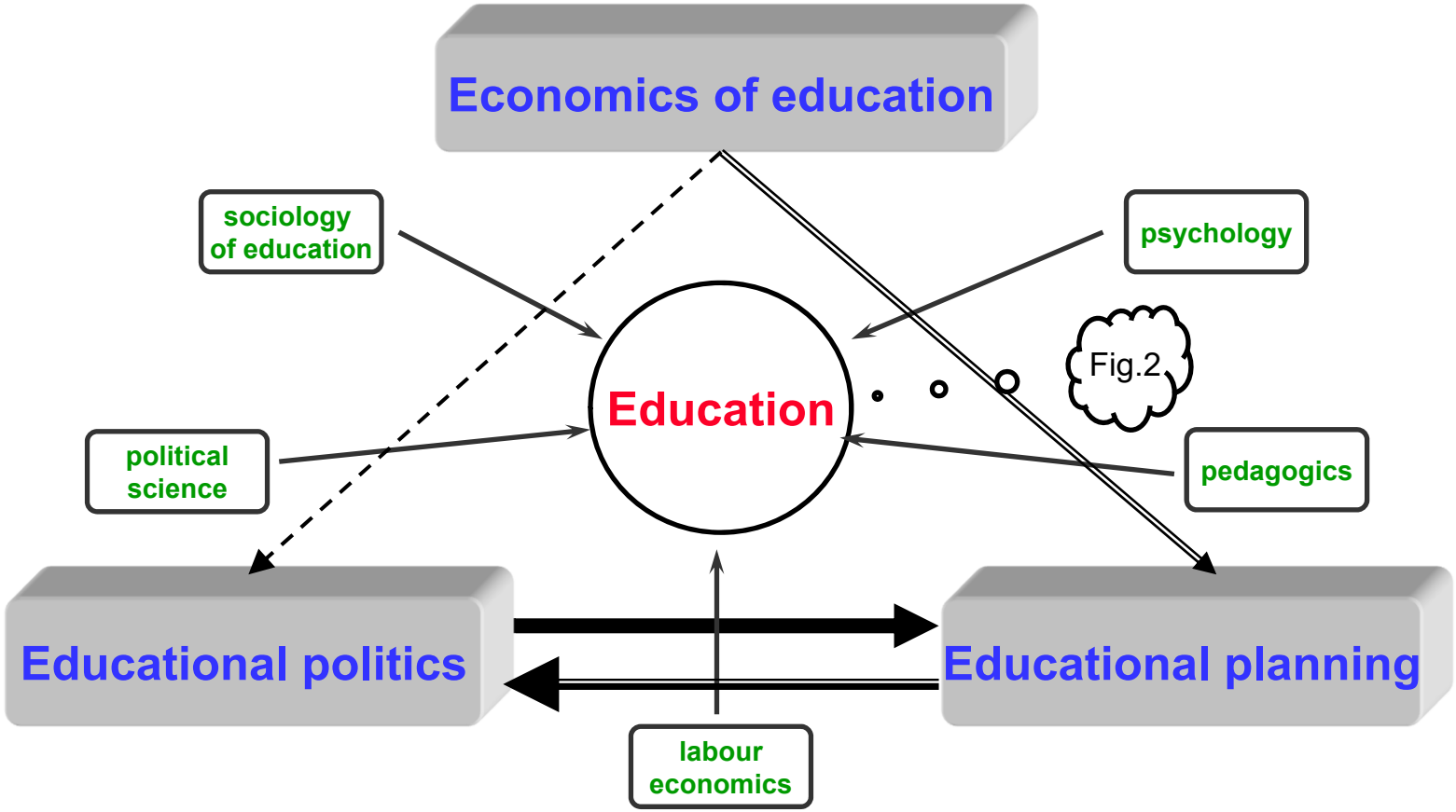
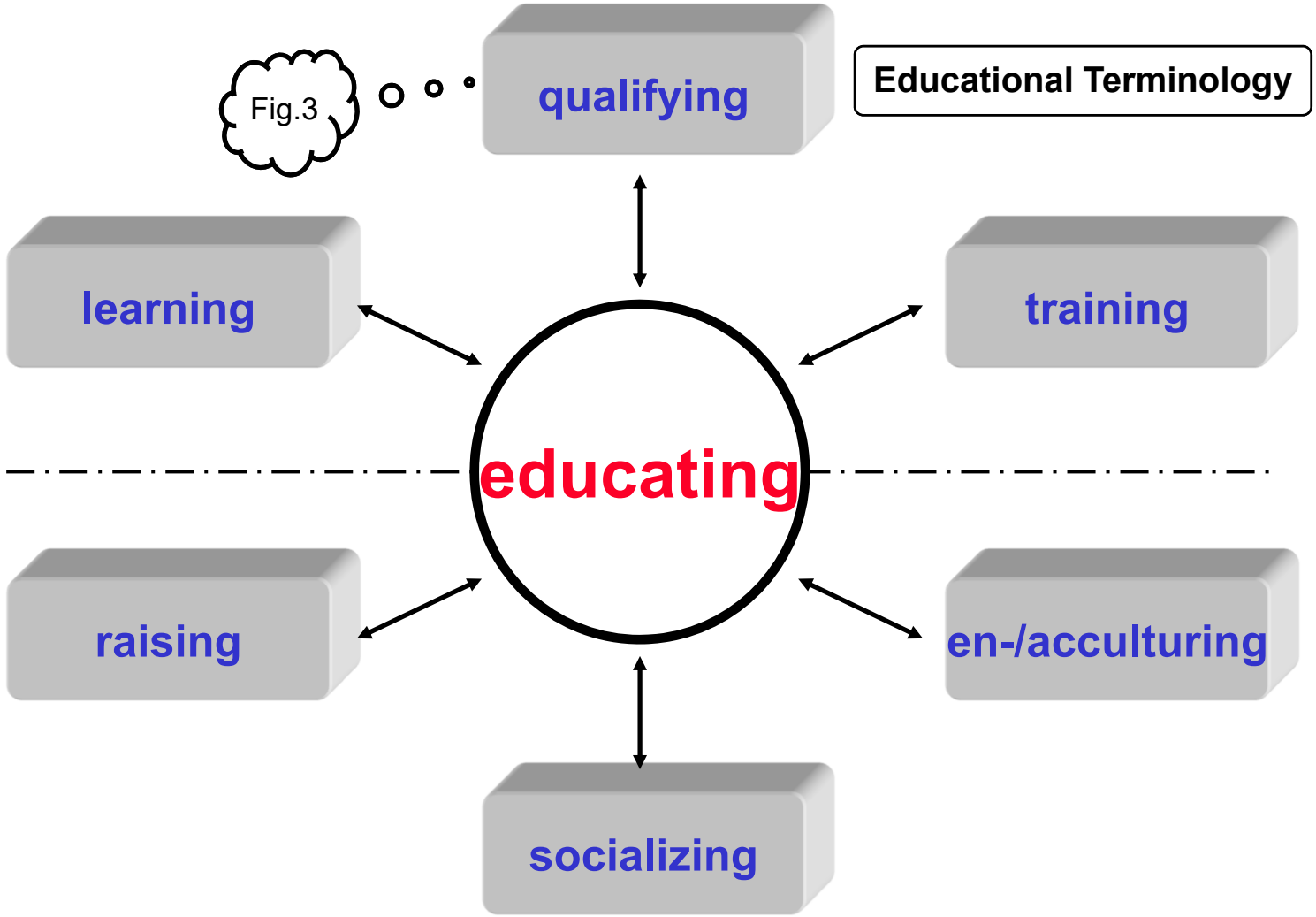


Fig.3



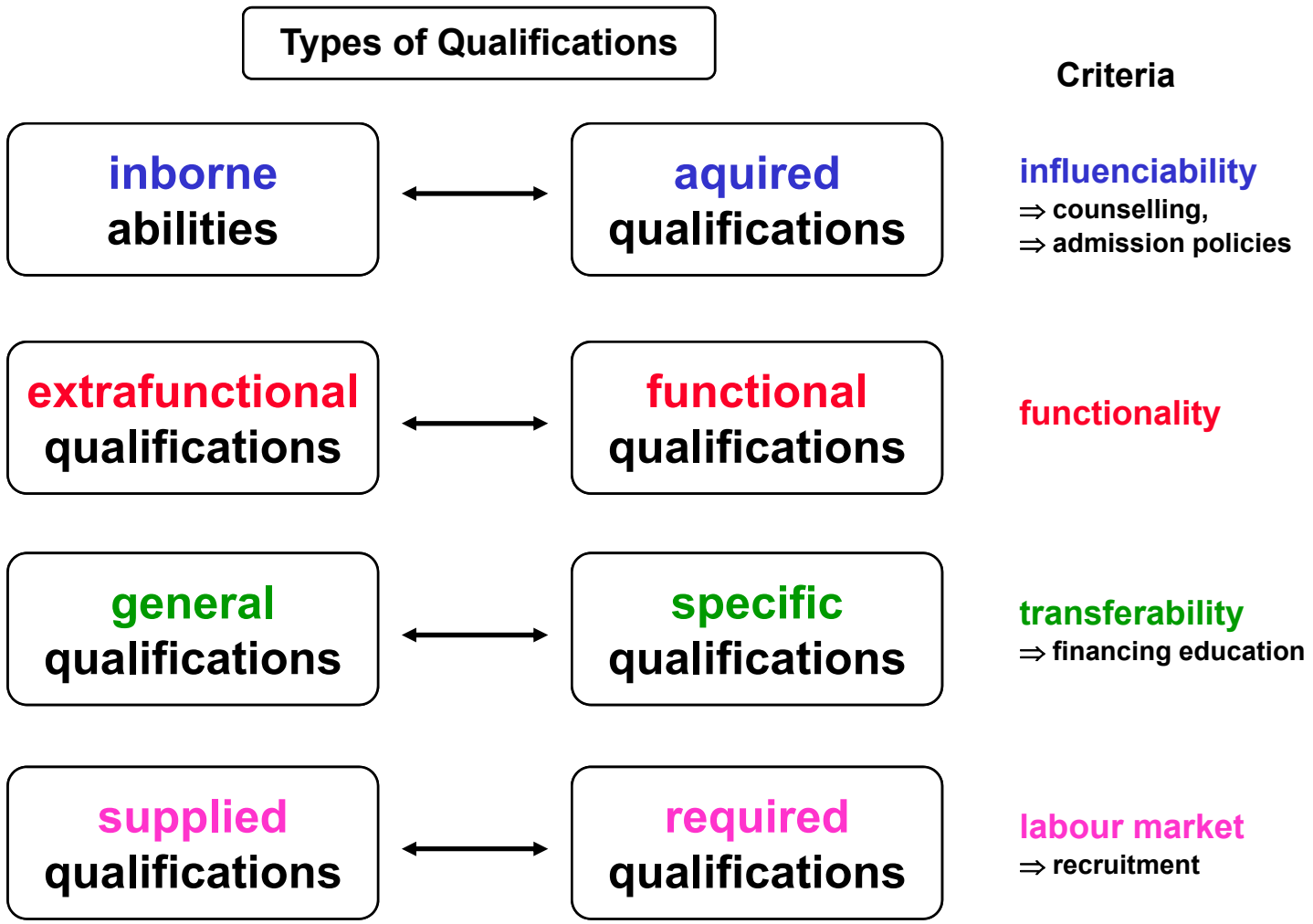
Defining Qualifications

Capabilities, attitudes, skills, knowledges, talent

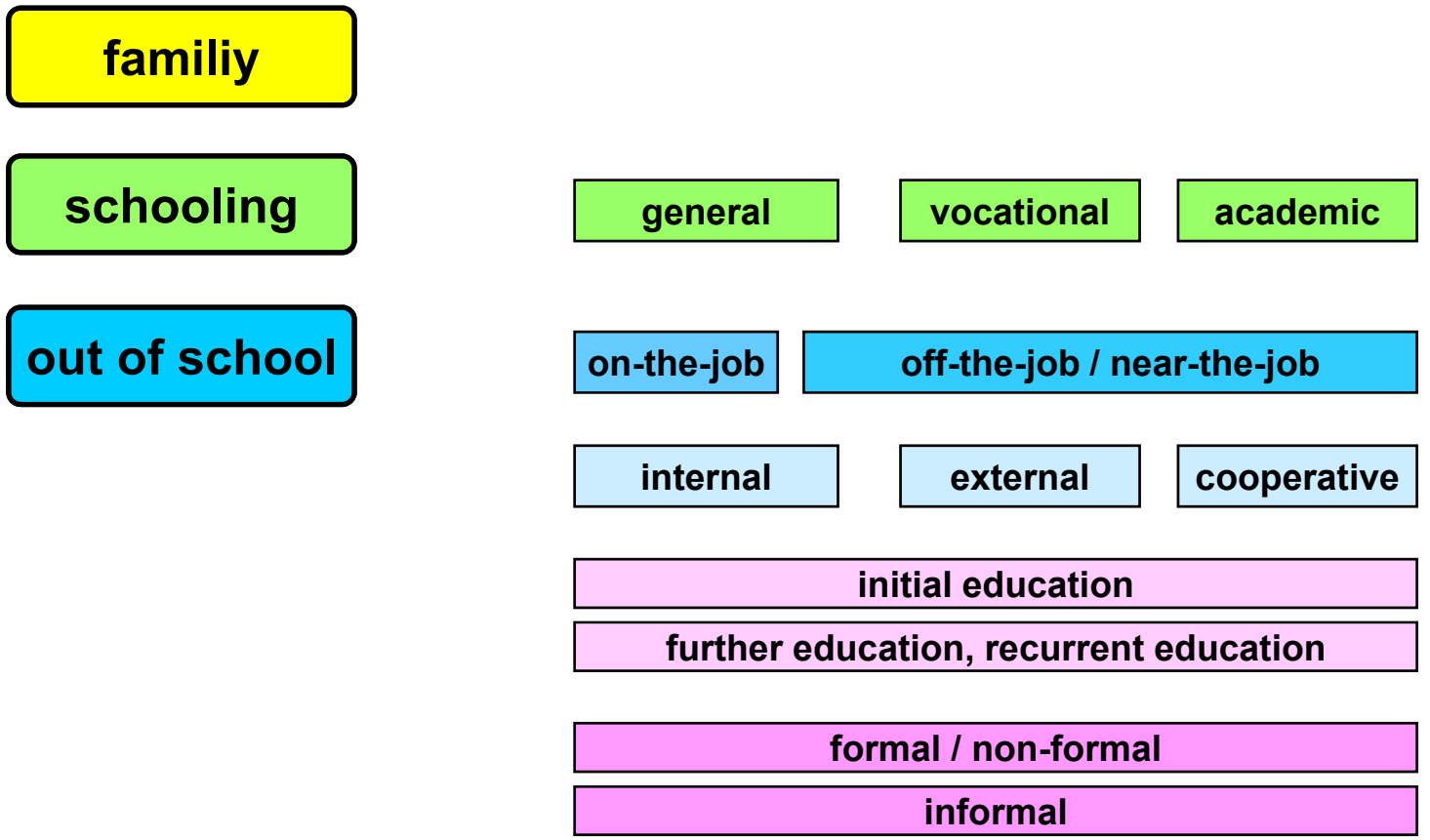
which allow an individual to carry out a certain task or job

Conceptual extensions:

- **Non-payed work**
- **Reproductive capabilities**
- **Consumptive capabilities**



Institutional Aspects of Education and Training



Criteria for the Economic Evaluation of Educational Investments

Direct economic returns
balance between the opportunity costs of resources and the expected future benefits measured by increases in the productivty of educated workers

Internal efficiency
measured by wastage and repetition rates, and other cost-effectiveness indicators

Indirect economic returns
external benefits affecting the incomes of other members of the society

Geographical and social distribution of educational opportunities

Fiscal benefits
higher taxes paid as a result of increased incomes

Distribution of financial benefits and burdens of education

Demand for skilled manpower
taking into account pay patterns, and employer‘s hiring practices

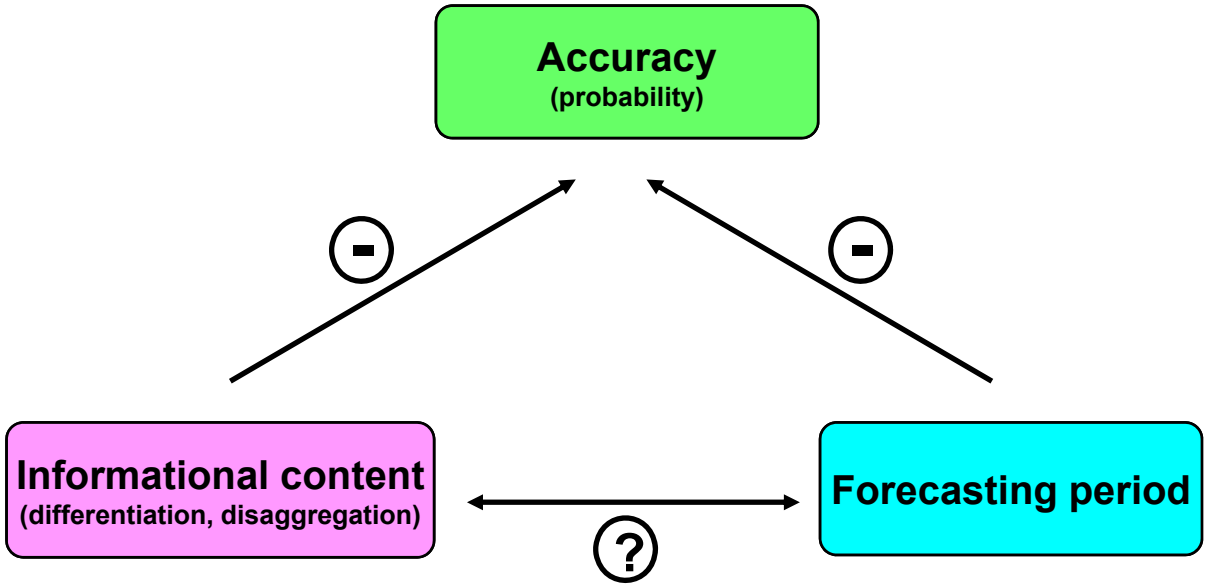
Effect of education on income distribution
including the reduction of poverty

Private demand for education
in the light of private rate of return and social factors influencing individual demand for education

Links between education and investment in other sectors
including health and agricultural development

Source: Psacharopoulos / Woodhall [1985: 25-26]

Forecasting Trilemma



Social Demand Approach (SDA)

Private Demand for Education

(1) Determinants of Private (Individual) Demand (students, parents, households)

Fig.11

Aggregation

Social Demand for Education

Educational Policy Goal:
Satisfying Individual Demand for Education

Social Demand Approach

(2) Demographic Trends

Fig.10

(3) rates of promotion, repetition, and dropout; length of education

- Forecast of enrollments (*flow*)
- Forecast of pupils, apprentices, students (*stock*)
  - Forecast of repeaters
- Forecast of leavers (*flow*)
  - Forecast of graduates
  - Forecast of dropouts

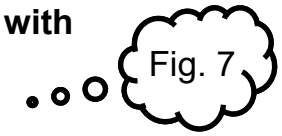
Demographic Development

Factors of uncertainty for (long-term) educational planning:

1. **Fertility** (time horizon of beginning uncertainty)
   - Primary education: short-term (6 years from now)
   - Secondary education / vocational training: mid-term (10 to 12 years from now)
   - Higher education: long-term (18 to 20 years from now)
2. **Migration**
   - Uncertainty of forecasts differs heavily between countries and with general socio-political conditions

Uncertainties of educational forecasts rise with

⇨ the time horizon
⇨ the disaggration in qualifications
⇨ regional differentiation



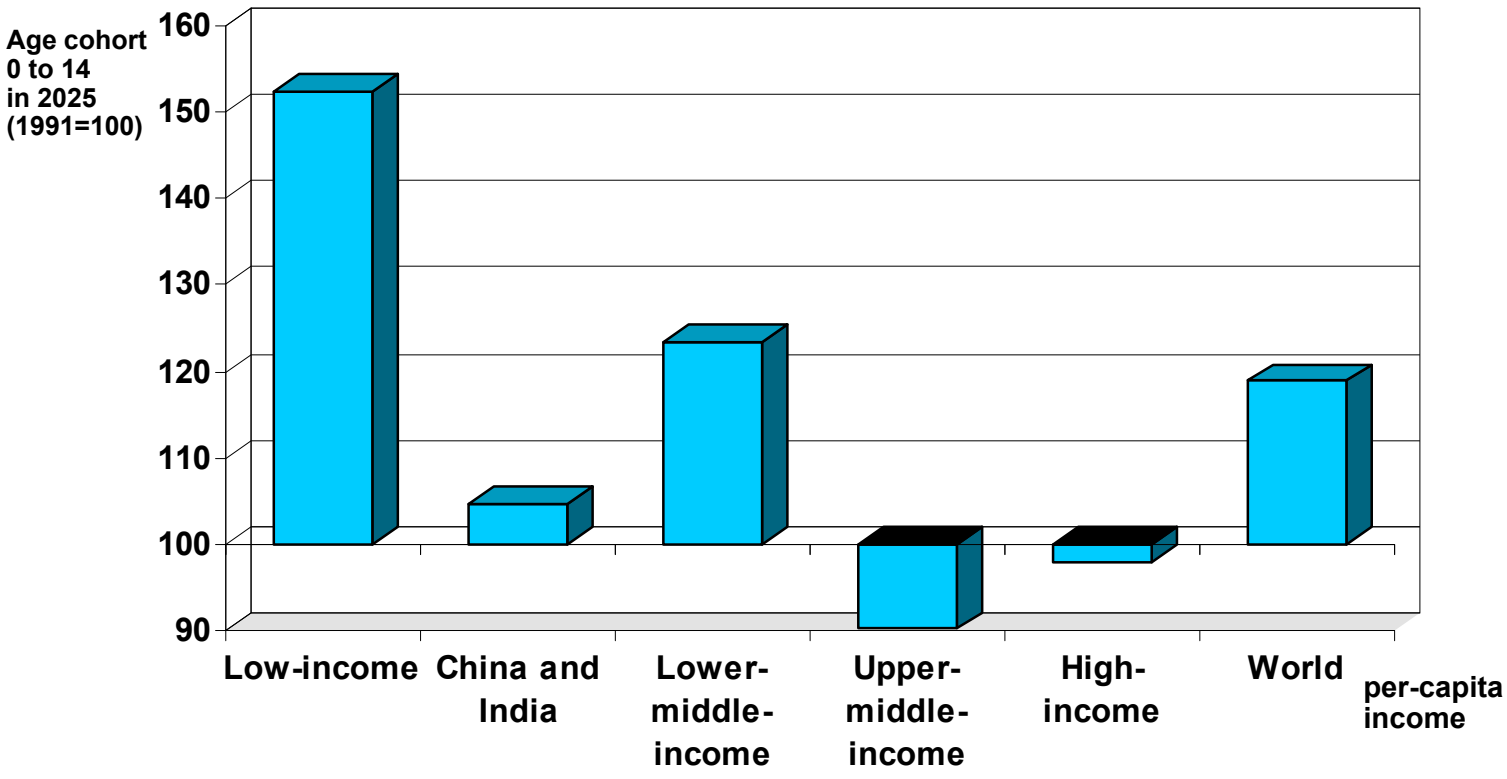
Demographic pressure on education:

1. increasing population: birth rates exceed death rates
2. age strucure of population: high proportion of school-age population
3. "race" between demographic growth and educational expansion

Repercussion of educational expansion on demographic growth:

⇨ long-term decline in fertility (negative feedback)

Demographic Pressure on Education



Source: Word Development Report 1993

Determinants of Private Demand for Education

1. **Disposable family income**
2. **Occupation / education of father / mother**
   - aspiration spiral towards the next educational level
   - "educogenic families"
3. **Private costs**
   - earnings forgone of pupils, apprentices, and students from regular or informal employment
   - help forgone within households
   - fees, expenditures on books, teaching materials, accommodation, food, clothing, travelling
4. **Number of school-aged children**
5. **Region (urban / rural) and distance to school / training site / university**
6. **Sex of children**

   Socio-cultural and religious infuences, e.g. the following "traditional" attitudes:

   girls: "mary anyway", "have poor job chances"; therefore: "education is not a profitable investment"

   boys: "contribute to family income and provision of parent's old age"; therefore: "education is a profitable investment"
7. **Affiliation to religious or ethnic group, language (at home and in school)**
8. **Quality of education**

⇨ **Increasing equality of educational opportunities at the lower levels**
⇨ **Increasing competiton at the subsequent levels of education**

Expenditures for Education

1. Personnel expenditures
2. Expenditures on non-durables
3. Financial costs (interest)

→ *recurrent expenditure **

4. Expenditures on durables
   a. land and buildings
   b. equipment

→ *capital expenditure ***

* recurrent **expenditure**: consumption during the accounting period

** capital **expenditure**: period of use is longer than the accounting period

capital **costs**: proportionate capital expenditure, attributable to the accounting period
⇨ patterns of depreciation (amortization)
⇨ estimation of the expected lifespan of buildings and equipment

Social costs of primary and secondary education:			
teacher salaries:	55 %	capital costs:	5 %
other recurrent costs:	10 %	earnings forgone:	30 %

Expenditures vs. Costs

educational expenditures
expenditures, but no costs

expenditures = costs

educational costs
costs, but no expenditures

Example:
Expenditure on durables
⇨ "payment today - consumption tomorrow"

Example:
1. Opportunity costs
⇨ benefits, which would have been yielded by alternative utilization of ressources
2. Estimated costs (depreciation, rent, interest etc.)

Direct and Indirect Costs

1. Direct costs

a. direct costs of private households (pupils, apprentices, and students and their families)

b. direct costs of enterprises (private und state-owned)

c. direct costs of the state (educational budget of all territorial authorities at the national, regional, and local level including non-educational administrations)

2. Indirect costs = "opportunity costs"

a. indirect costs of private households: net earnings forgone = gross earnings – tax (corrected by unemployment rate) minus grants / apprentice‘s income

b. indirect costs of enterprises: loss of production

c. indirect costs of the state: taxes and social security contributions forgone

social costs	**=**	**1**	**+**	**2**
private costs	**=**	**1a**	**+**	**2a**

Current vs. Real Prices

cost = quantity * price of input

costs in current prices **costs in real prices**

Start-up vs. Follow-Up Costs

start-up costs
- initial investment

follow-up costs:
- maintenance
- repair
- replacement

Some Further Cost Concepts

total cost

- financial requirements
- human capital stock

average cost (unit cost)

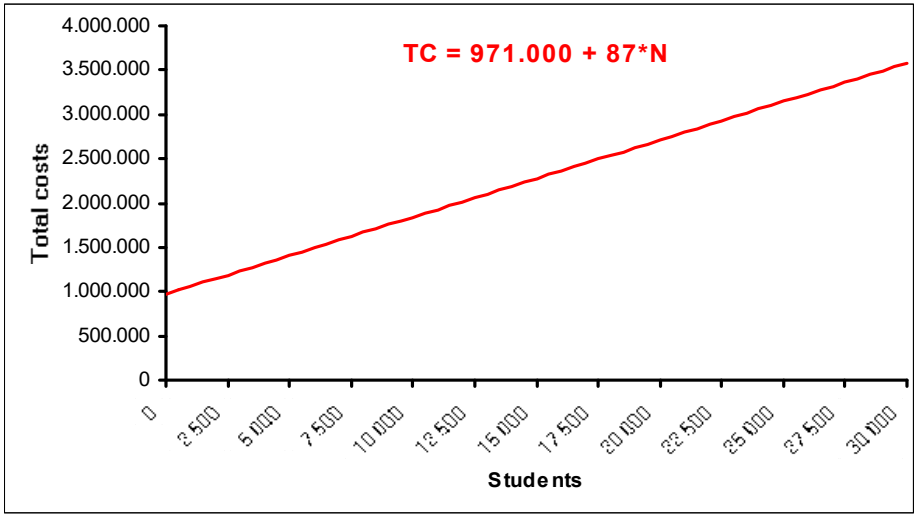
- per pupil / apprentice / student
- per graduate

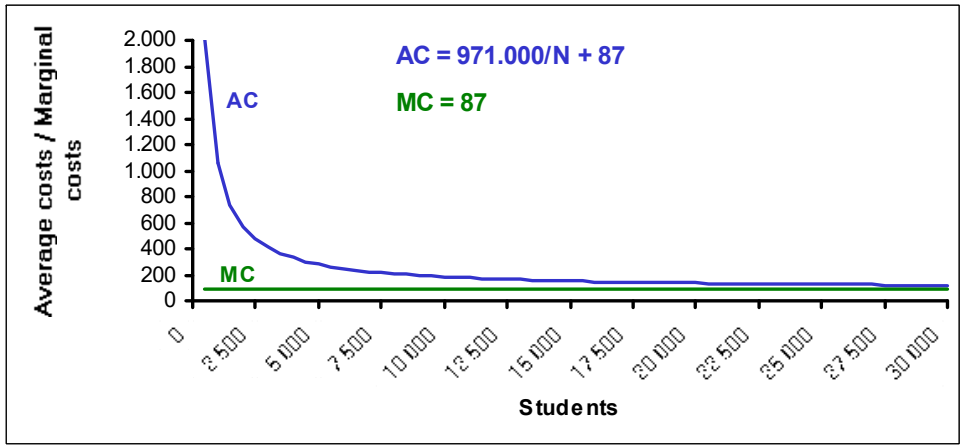
- cost comparisons
  (➔ evaluation of efficiency)
- cost predictions

marginal cost

- economies of scale
  (➔ expansion or new establishment)

fixed costs, interval-fixed costs and variable costs



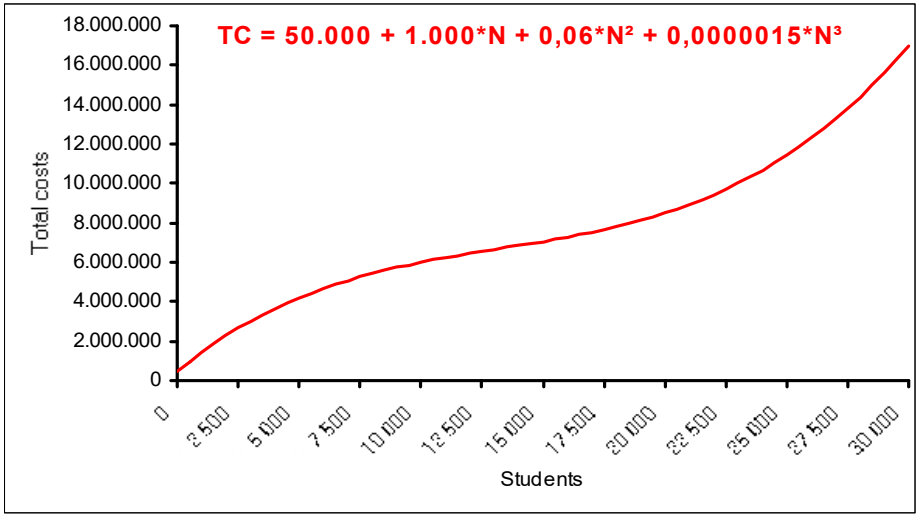


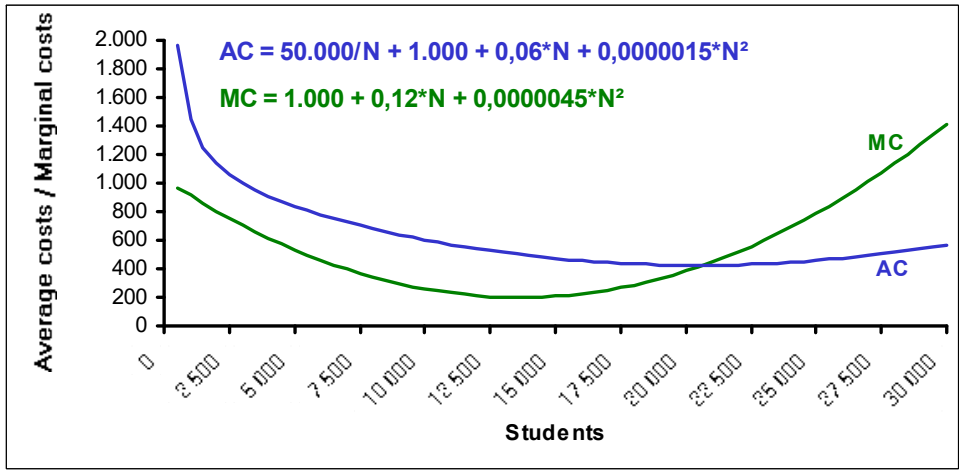
Linear Cost Function

Cera Educational Television Project, Brazil 1978

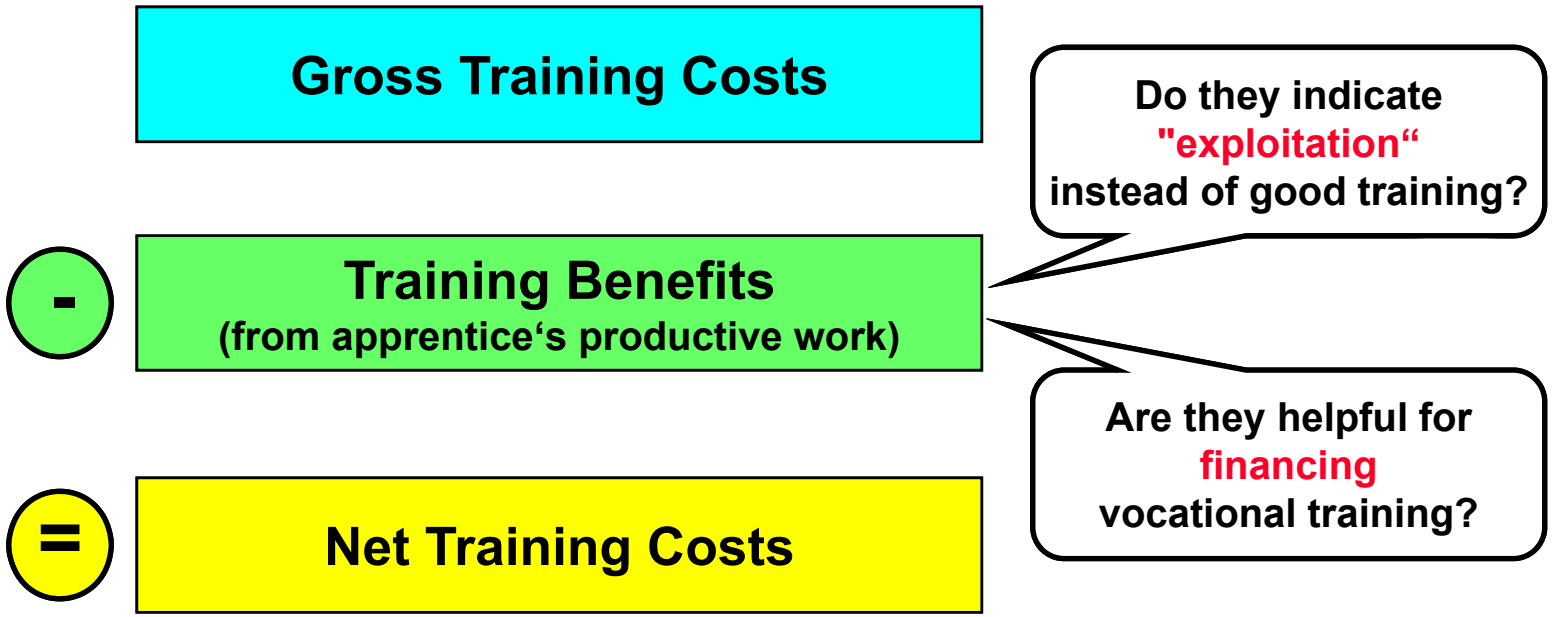
N = 19.800
AC = 136,6

Non-Linear Cost Function

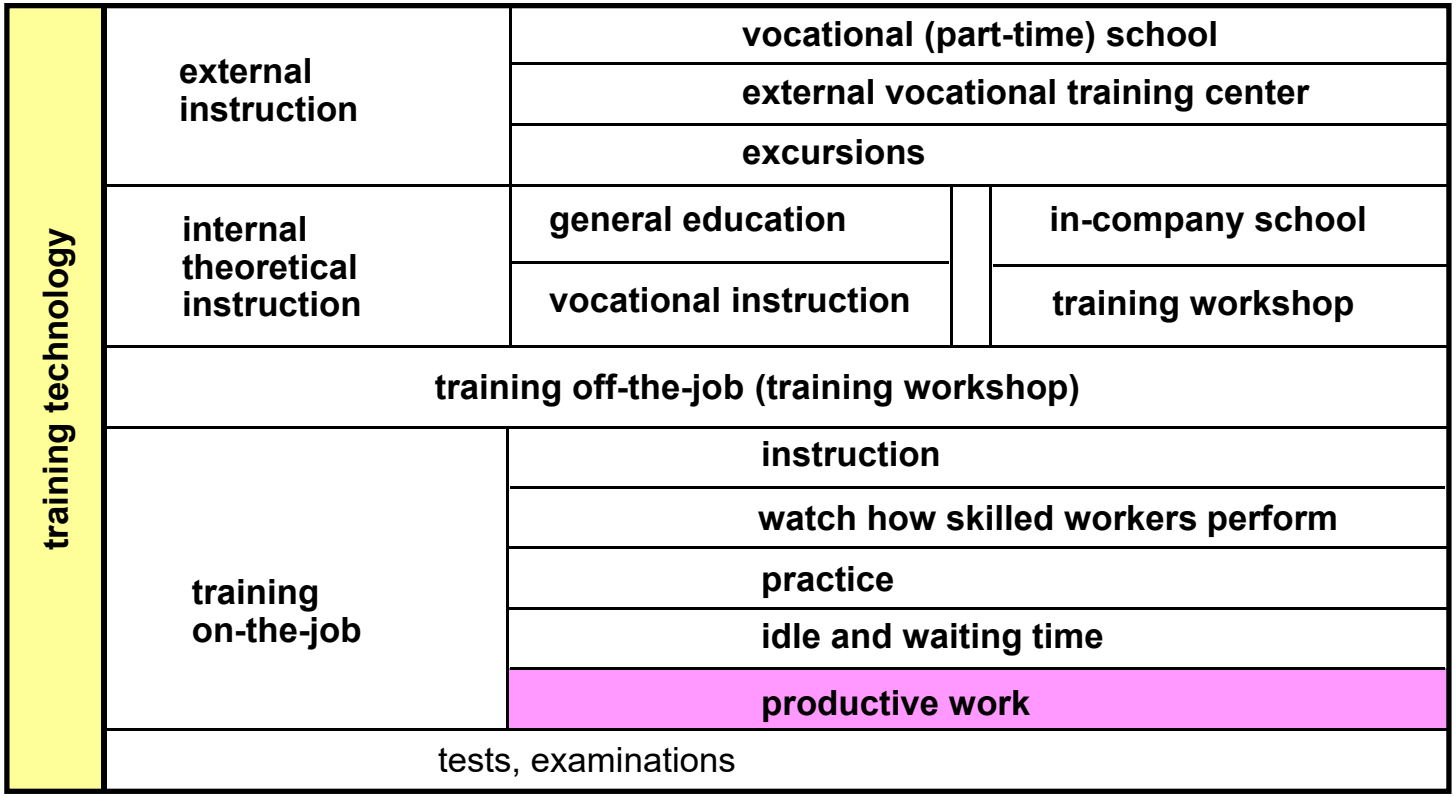




Gross and Net Costs of (Firm-Based) Vocational Training



Time Structure of (in-company) Vocational Training



Calculation of Training Benefits

Days of productive work per year

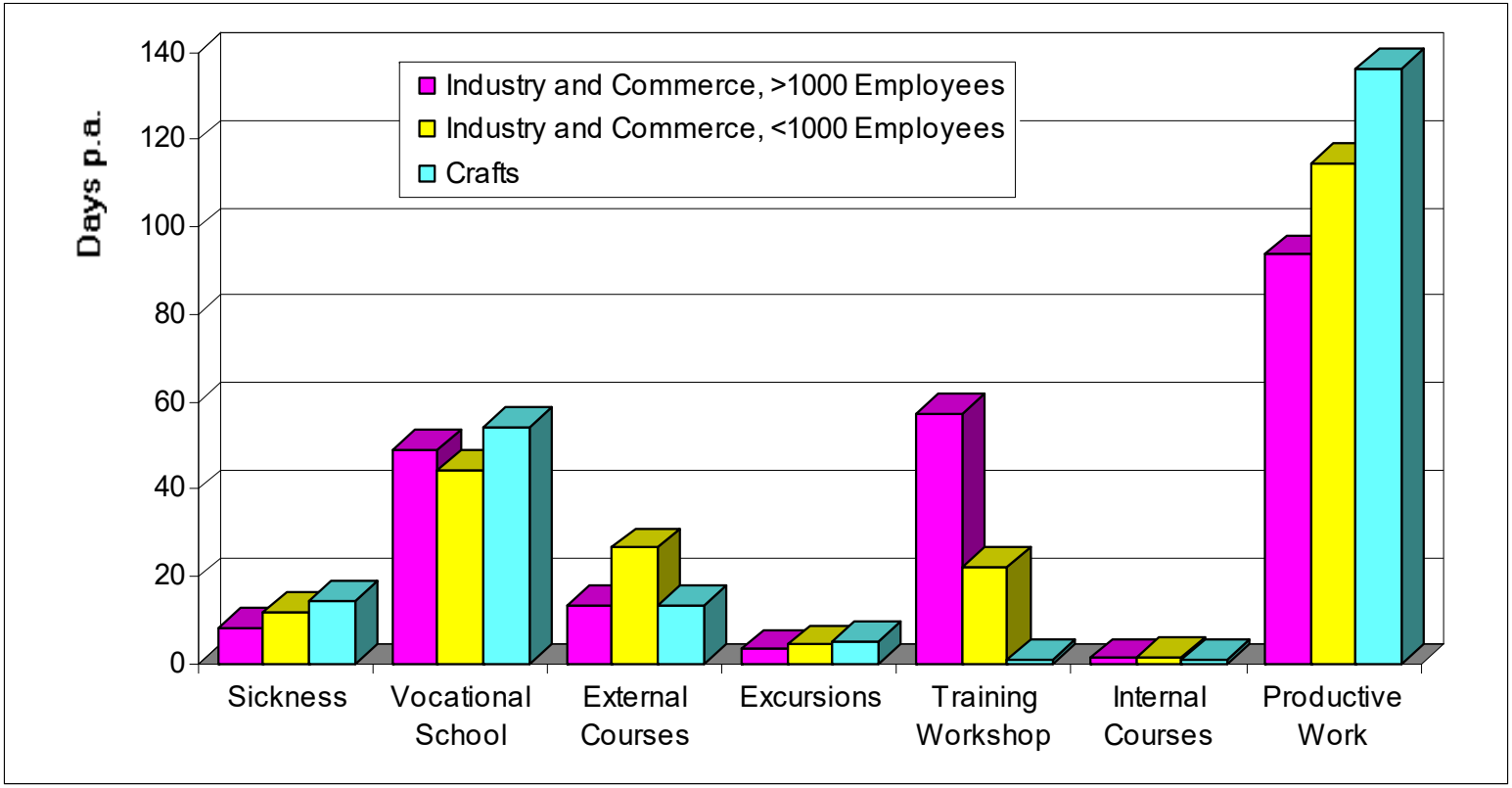
* Hours of trivial, easy, and difficult tasks

* Performance degree in easy and difficult task relative to an averagely skilled employee

* Hourly wage of an averagely skilled employee

= **Training Benefits**

Time Structure of (in-company) Vocational Training, Germany 1972



Productive Time by Skill Level of Tasks and Year of Training

Hrs. per day

Year of Training	Trivial Tasks				Easy Tasks			
	Administ.	Instructors	Trainees	Average	Administ.	Instructors	Trainees	Average
1.	0,10	0,13	0,15	0,13	1,80	1,89	1,59	1,76
2.	0,07	0,09	0,18	0,11	2,45	2,51	1,72	2,23
3.	0,06	0,09	0,22	0,12	3,01	2,87	1,62	2,50
4.	0,05	0,10	0,20	0,12	3,35	2,64	2,13	2,71
Average	0,08	0,10	0,18	0,12	2,41	2,42	1,67	2,17

Difficult Tasks				All Tasks			
Administ.	Instructors	Trainees	Average	Administ.	Instructors	Trainees	Average
1,40	1,39	2,05	1,61	3,30	3,41	3,79	3,50
1,85	1,92	3,87	2,55	4,37	4,52	5,77	4,89
2,11	2,14	2,44	2,23	5,18	5,10	4,28	4,85
2,35	2,67	2,91	2,64	5,75	5,41	5,24	5,47
1,80	1,85	2,86	2,17	4,29	4,37	4,71	4,46

Hrs. p.a.

Year of Training	Trivial	Easy	Difficult	All Tasks
1.	14,57	202,40	185,53	402,50
2.	13,03	256,07	292,87	561,97
3.	14,18	287,50	256,45	558,13
4.	13,42	311,27	303,98	628,67
Average	13,80	249,17	249,55	512,52

Performance Degree by Year of Training (Skilled Worker = 100)

Year of Training	Trivial Tasks				Easy Tasks				Difficult Tasks			
	Administ.	Instructors	Trainees	Average	Administ.	Instructors	Trainees	Average	Administ.	Instructors	Trainees	Average
1.	100	100	100	100	34	35	39	36	14	18	26	19
2.	100	100	100	100	55	57	64	59	34	38	44	39
3.	100	100	100	100	75	75	77	76	53	57	56	55
4.	100	100	100	100	84	85	85	84	64	68	66	66
Average	100	100	100	100	60	61	66	62	39	43	47	43

Skilled Worker's Equivalent Productive Time (hrs. p.a.)

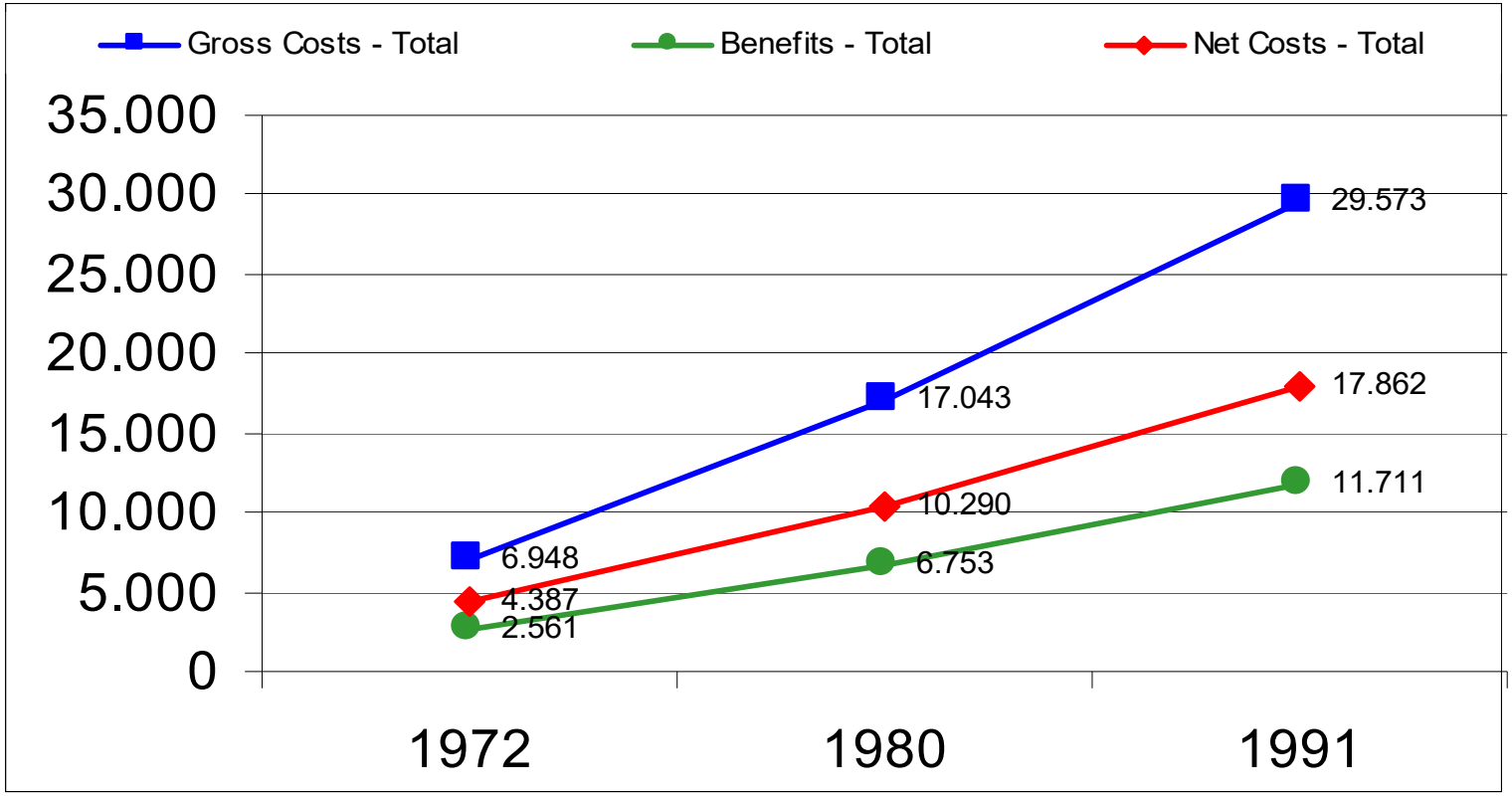
Year of Training	Trivial	Easy	Difficult	All Tasks
1.	14,57	73,11	35,88	123,56
2.	13,03	149,89	113,20	276,13
3.	14,18	217,43	141,92	373,53
4.	13,42	262,88	199,90	476,19
Average	13,80	154,95	107,15	275,90

Training Benefits =
Saved Skilled Workers‘ Salaries through Apprentices‘ Productive Work (DM p.a.)

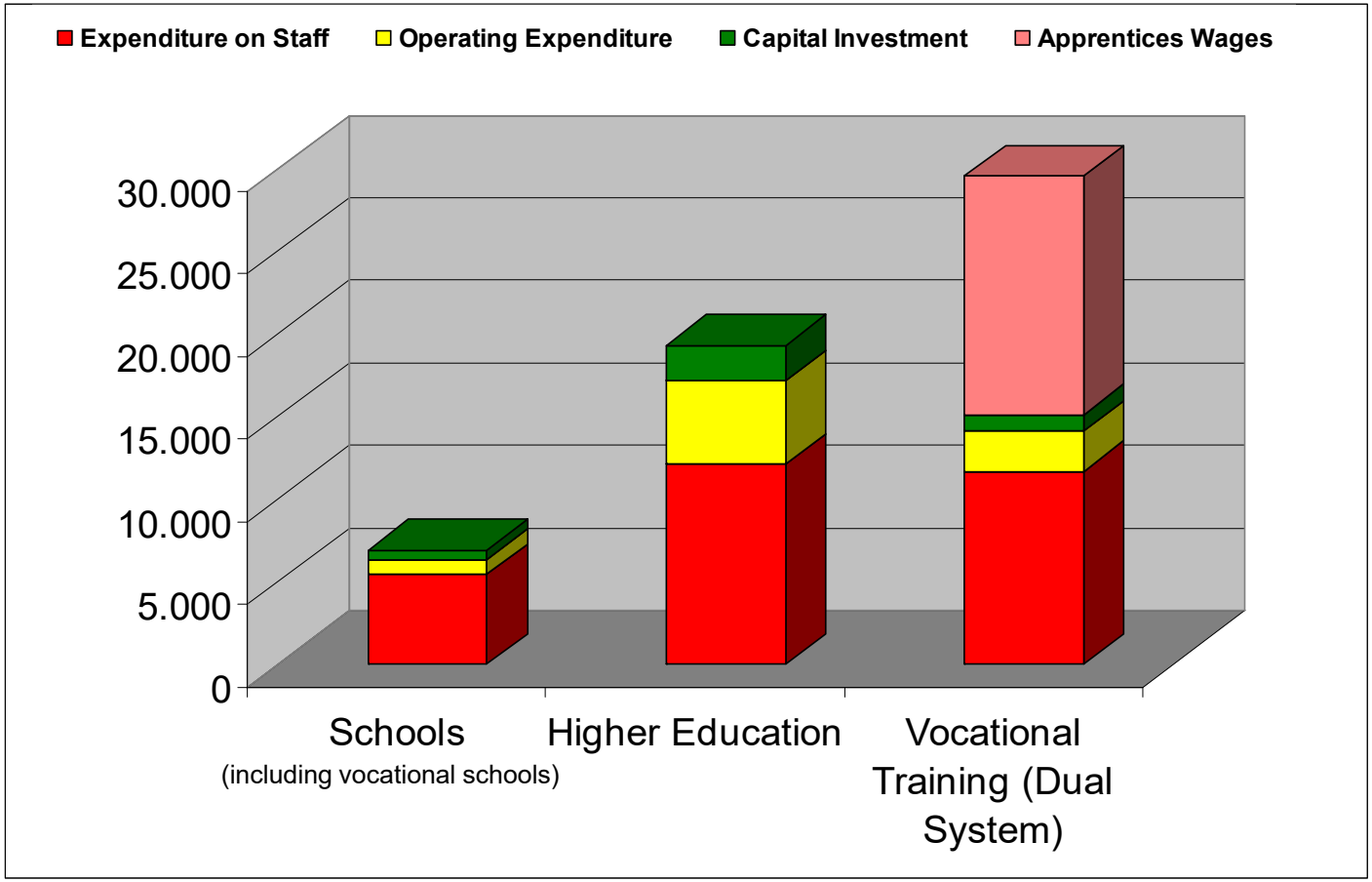
Year of Training	Trivial	Easy	Difficult	All Tasks
1.	145,67	731,14	358,82	1.235,62
2.	130,33	1.498,93	1.132,03	2.761,29
3.	141,83	2.174,27	1.419,19	3.735,29
4.	134,17	2.628,75	1.998,99	4.761,91
Average	138,00	1.549,48	1.071,48	2.758,97
Total	552,00	7.033,08	4.909,04	12.494,12

Wage of Skilled Workers (DM per hr.)		
10,00 DM		

Gross Costs, Benefits, and Net Costs , Germany 1972, 1980, 1991 (DM p.a.)

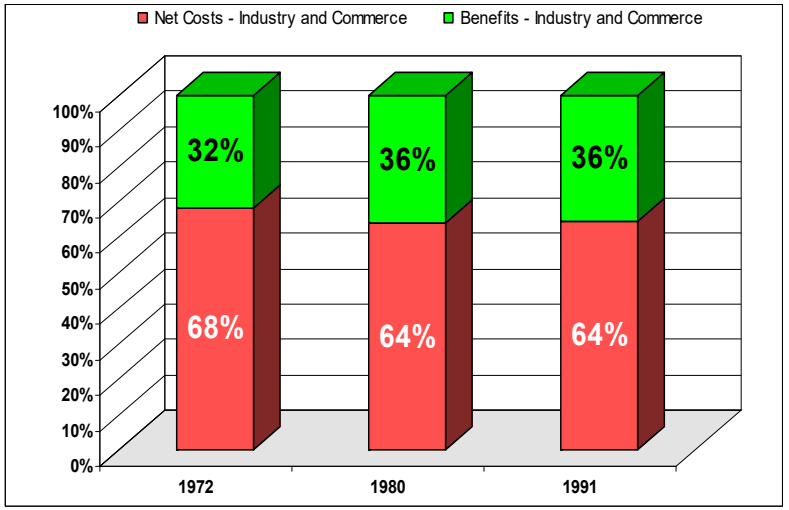


Comparing Expenditure per Student to Costs per Apprentice, Germany 1991 (DM)

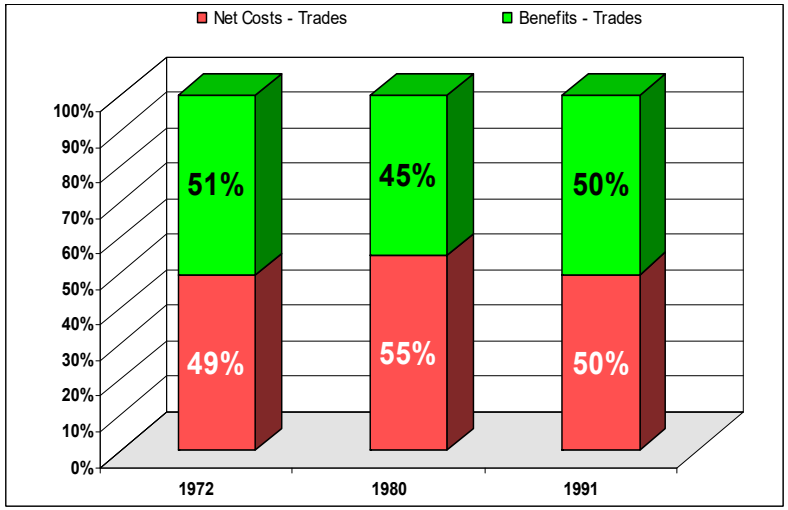


Gross Costs, Benefits, and Net Costs by Sectors, Germany 1972, 1980, 1991 (in %)

Industry and Commerce

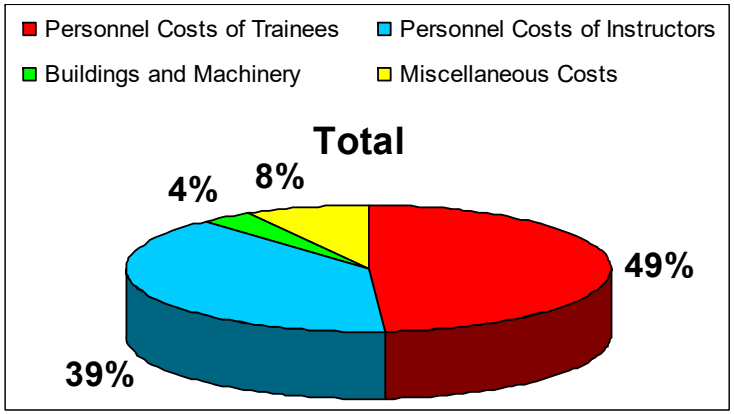


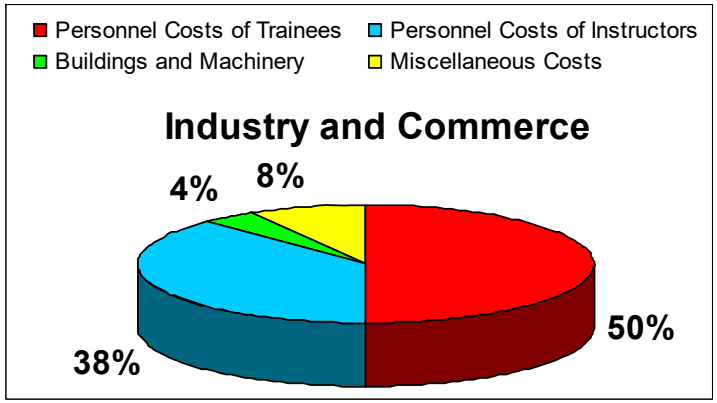
Crafts

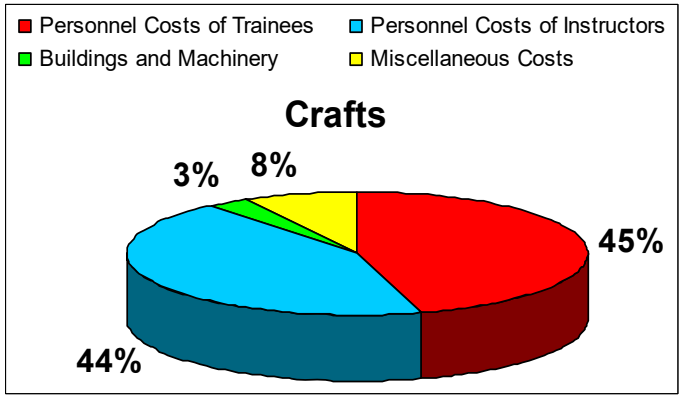


Costs, Benefits by Sector	1972	1980	1991
Net Costs - Industry and Commerce	5.395	12.446	20.509
Benefits - Industry and Commerce	2.507	6.996	11.315
Gross Costs - Industry and Commerce	7.902	19.442	31.824
Net Costs - Crafts	2.582	7.949	12.353
Benefits - Crafts	2.659	6.564	12.536
Gross Costs - Crafts	5.241	14.513	24.889

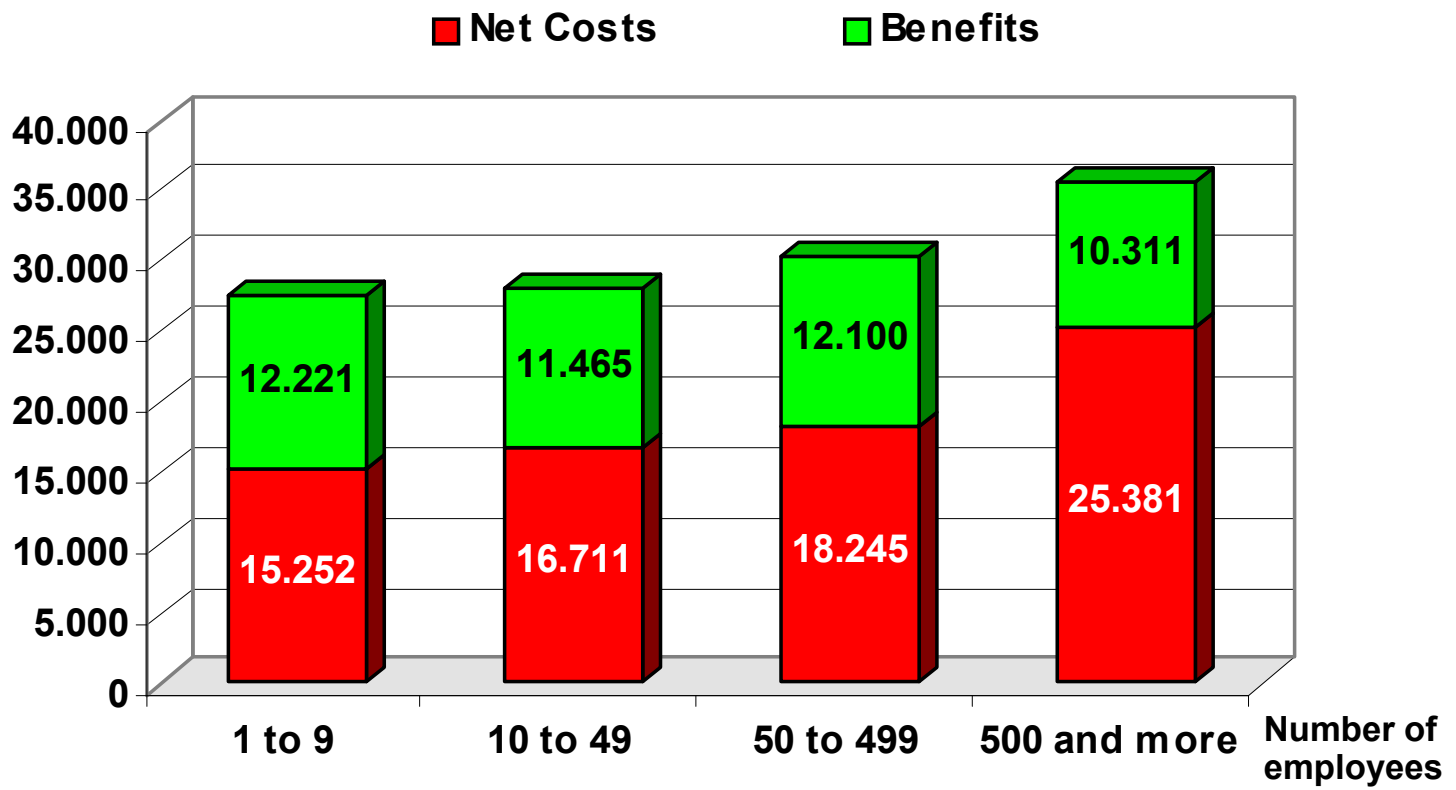
Structure of Gross Costs, Germany 1991



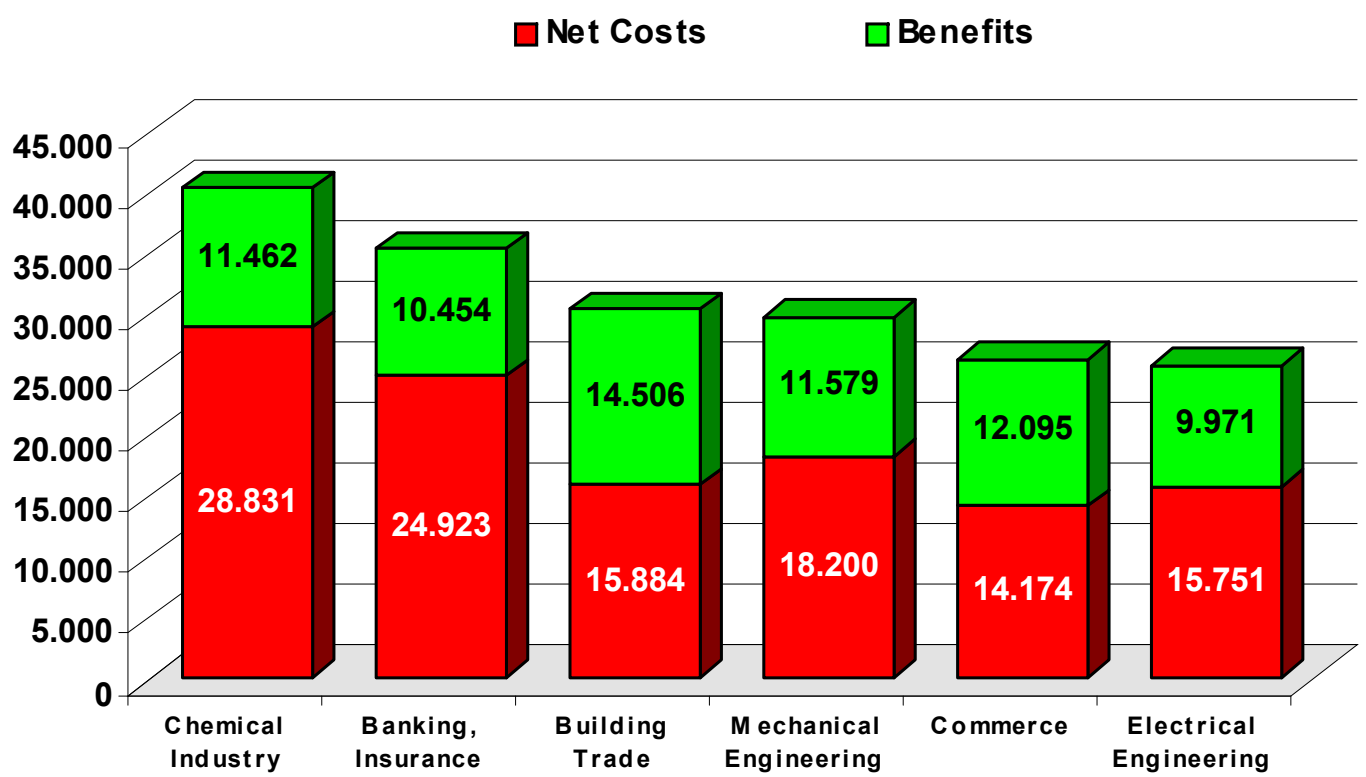




Gross Costs, Benefits, and Net Costs by Company Size, Germany 1991 (DM p.a.)



Gross Costs, Benefits, and Net Costs by Branches, Germany 1991 (DM p.a.)

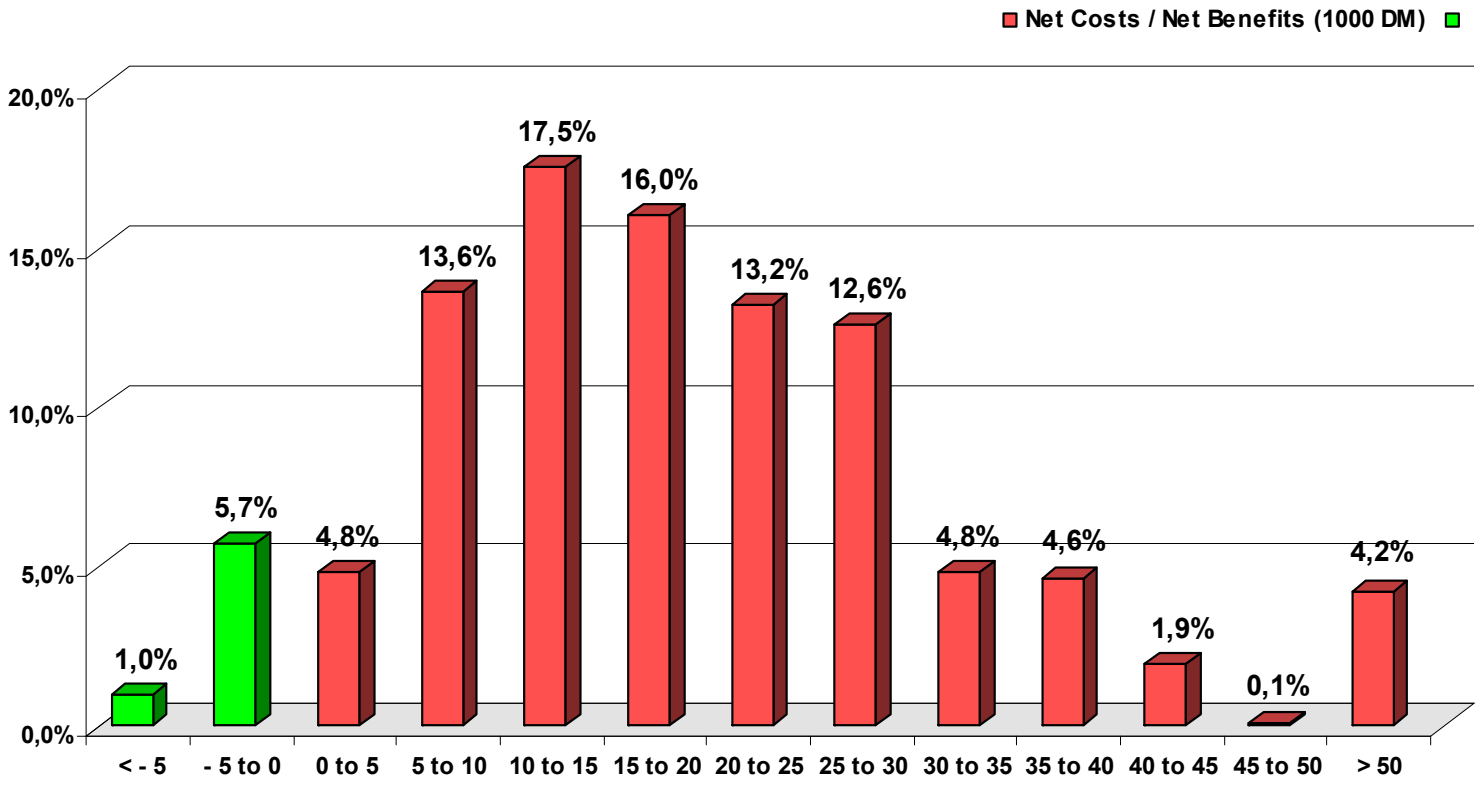


Gross Costs, Benefits, and Net Costs by Occupations, Germany 1980 (DM p.a.)

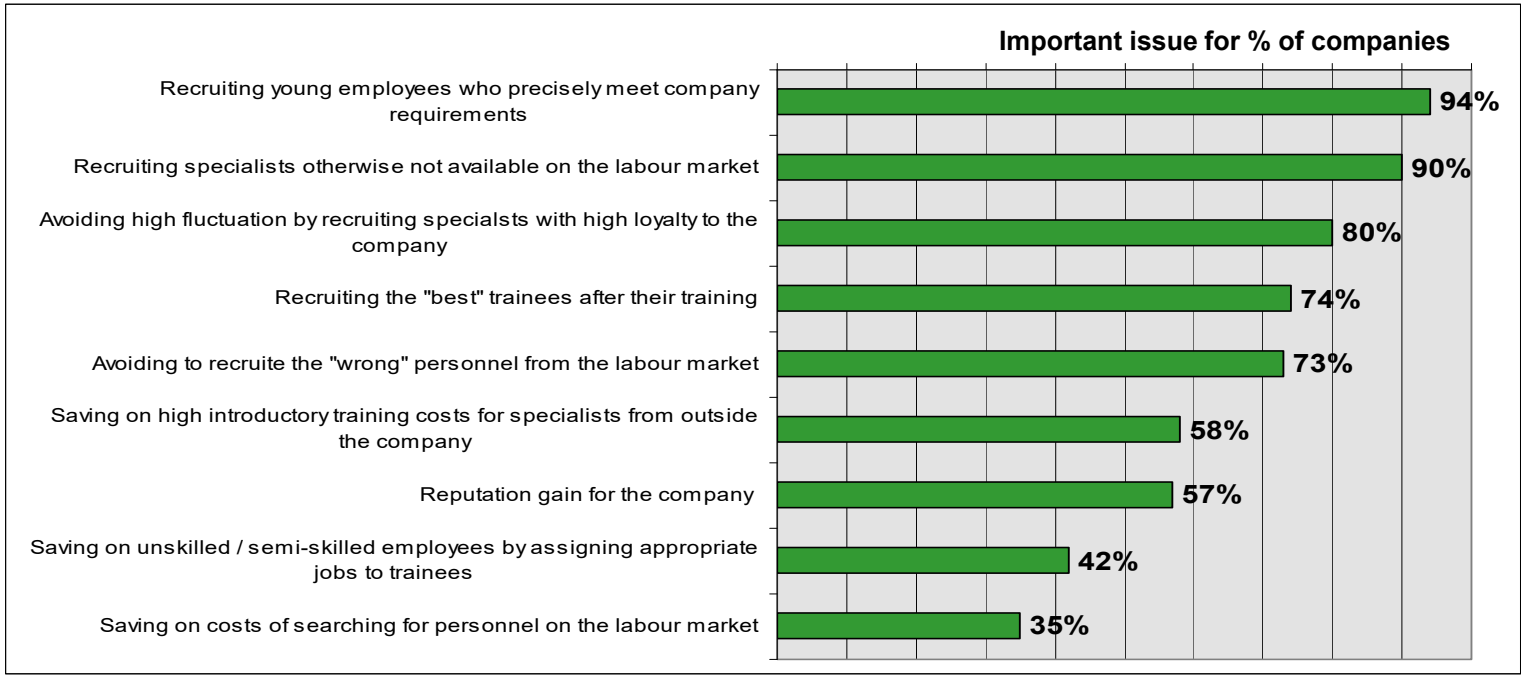
Recognized Occupations	Gross Costs	Benefits		Net Costs
	(DM)	(DM)	in % of gross costs	(DM)
Industry and Commerce	**19.442**	**6.995**	**36**	**12.447**
Bank Clerk	22.563	6.117	27	16.447
Architectural Draughtsman	20.214	8.157	40	12.057
Tailor	19.640	6.115	31	13.525
Machine Fitter (Plant Technology)	26.257	6.332	24	19.925
Office Clerk	21.998	8.213	37	13.785
Chemical Labaratory Assistent	27.101	5.234	19	21.867
Cutting Mechanical (Turning)	30.698	5.720	19	24.978
Printer	24.438	7.445	30	16.993
Clerk in Retail Trade	13.528	8.441	62	5.087
Electronics Technician (Power Systems)	19.924	6.150	31	13.773
Industrial Clerk	20.368	9.157	45	11.211
Clerk in Wholesale and Foreign Trade	18.634	7.912	42	10.723
Clerk in Hotel and Restaurant	16.958	8.430	50	8.582
Cook	16.553	8.130	49	8.423
Machine Fitter	19.382	5.453	28	13.929
Mechnic	22.536	4.836	21	17.700
Technical Draughtsman	19.884	5.152	26	14.733
Salesman	14.439	6.027	42	8.412
Toolmechanic	23.743	5.654	24	18.089

Recognized Occupations	Gross Costs (DM)	Benefits (DM)	Benefits in % of gross costs	Net Costs (DM)
Crafts	**14.513**	**6.564**	**45**	**7.949**
Baker	14.513	7.694	53	6.759
Electrical Fitter	13.211	6.545	50	6.666
Butcher	15.837	7.597	48	8.240
Hairdresser	11.433	3.966	35	7.467
Gas and Water Fitter	15.695	6.177	39	9.519
Motor-vehicle Mechanic	14.754	5.291	36	9.463
Agricultural Machinery Mechanic	11.899	6.023	51	5.876
Painter and Varnisher	14.622	9.492	65	5.130
Bricklayer	19.465	7.295	37	12.170
Radio and TV Technician	12.349	5.829	47	6.520
Mechanic	14.677	7.158	49	7.519
Joiner	13.759	7.410	54	6.346
Salesman in Food Trade	13.693	7.886	58	5.807
Dental Technician	18.685	6.398	34	12.287
Central Heating and Ventilation Fitter	15.807	7.437	47	8.371
Carpenter	20.058	7.527	38	12.532
Professions	**17.512**	**6.236**	**36**	**11.276**
Pharmacist's Assistent	12.505	6.637	53	5.868
Physician's Assistent	18.776	5.927	32	12.849
Assistent in Bussiness and Tax Consultan	19.614	5.748	29	13.867
Lawyer's Assistent	11.798	4.525	38	7.273
Dentist's Assistent	18.397	7.810	42	10.587
Public Sector	**23.689**	**3.733**	**16**	**19.956**
Communications Electronics Technician	25.965	764	3	25.201
Social Insurance Clerk	27.754	6.230	22	21.525
Clerk in Public Administration	19.093	5.000	26	14.093
Agriculture	**13.825**	**10.181**	**74**	**3.644**
Gardner	11.858	9.453	80	2.405
Farmer	15.525	10.809	70	4.716

Distribution of Net Costs, Germany 1991 (in %)

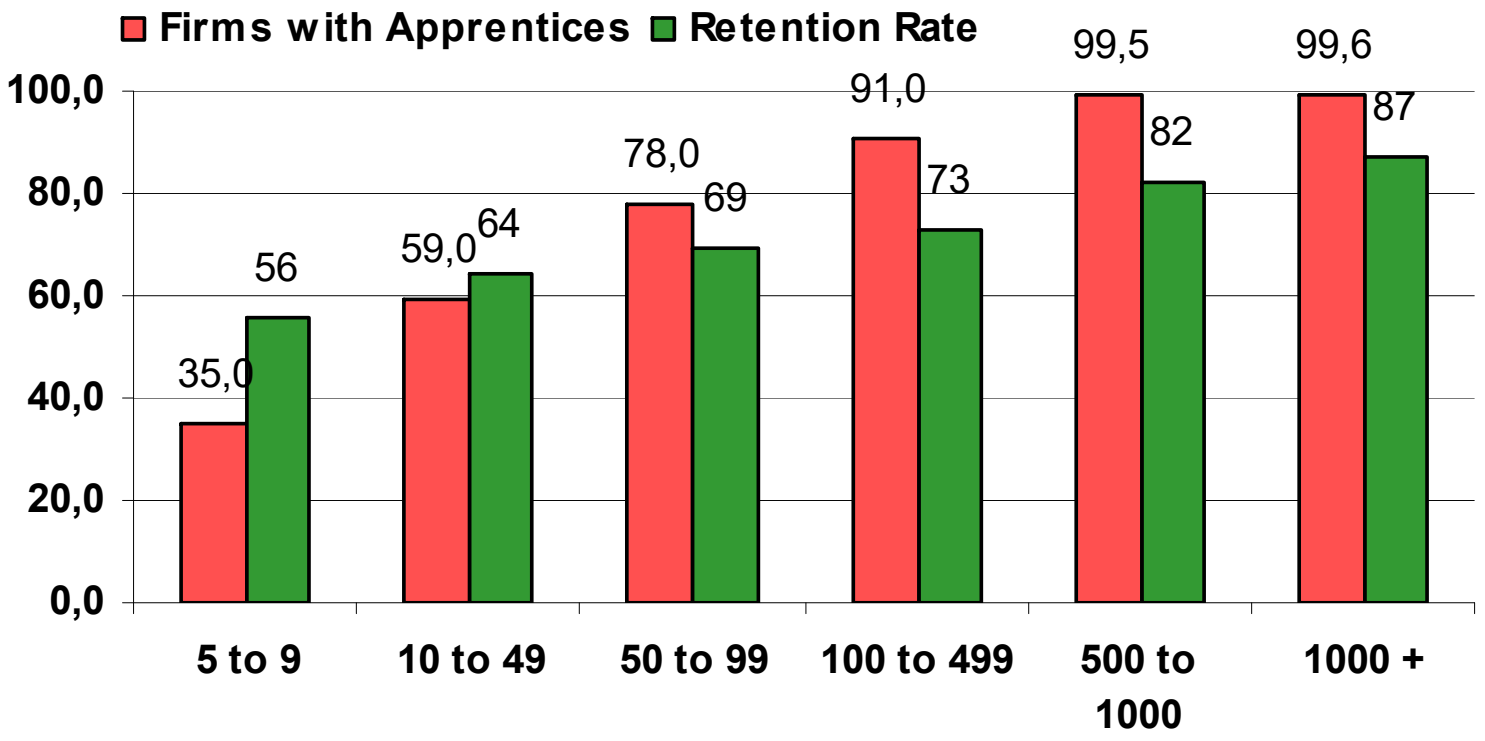


Benefits after Training, Germany 1991



Opportunity benefits per apprentice in technical vocational training at AEG	
Minimizing recruitement costs	1.000 - 4.700 DM
Saving on higher wages for externally recruited skilled workers	2.400 - 2.700 DM
Saving on high introductory training costs for externally recruited skilled workers	4.100 - 13.100 DM
Saving on costs for further recurrent training	2.100 - 2.200 DM
Total	**9.600 - 22.700 DM**

Dual System participation and post-training retention by firm size
Germany 1985 (%)



Direct and Indirect Benefits

1. Direct benefits of education

a. **direct benefits for the individual:** higher lifetime (net) earnings
b. **direct benefits for the enterprises:** higher productivity of trained employees and their co-workers ("employment-related beneficiaries")
c. **direct benefits for the state:** higher taxes and social security contributions
d. **direct benefits for others:** higher labour participation and old-age assistence for parents

2. Indirect benefits of education (non-monetary)

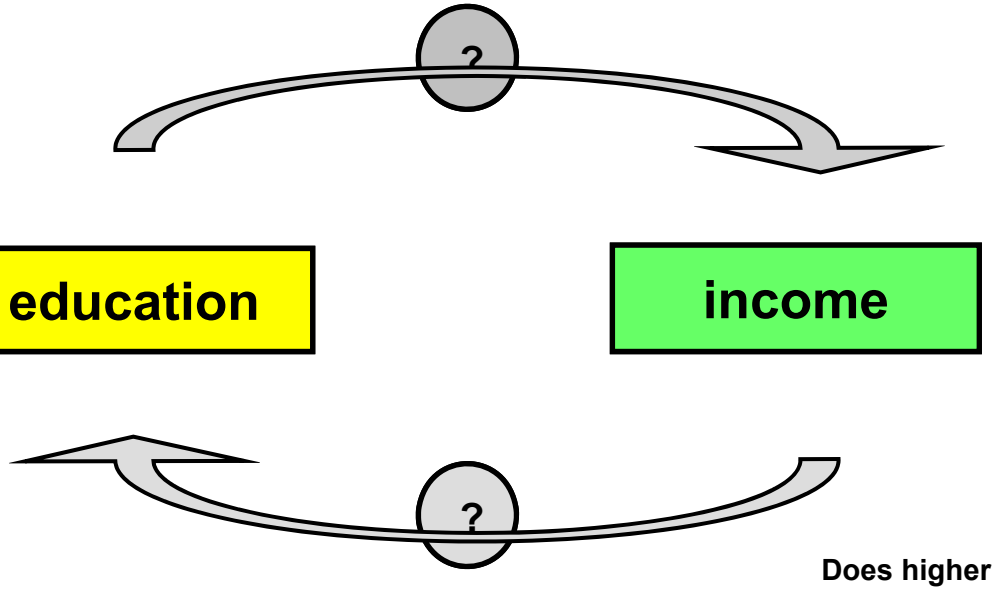
a. **indirect benefits for the individual:** better occupational options, more pleasent working conditions, higher social prestige
b. **indirect benefits for the enterprises:** better working atmosphere (?)
c. **indirect benefits for the state:** social stability (?), acceptance of basic common social and political values (?), reduction of crime (?)
d. **indirect benefits for others:** intergenerational and neigbourhood effects (?)

social benefits = 1 + 2
private benefits = 1a + 2a

Education and Income: what‘s the Cause, what‘s the Effect

Education as investment

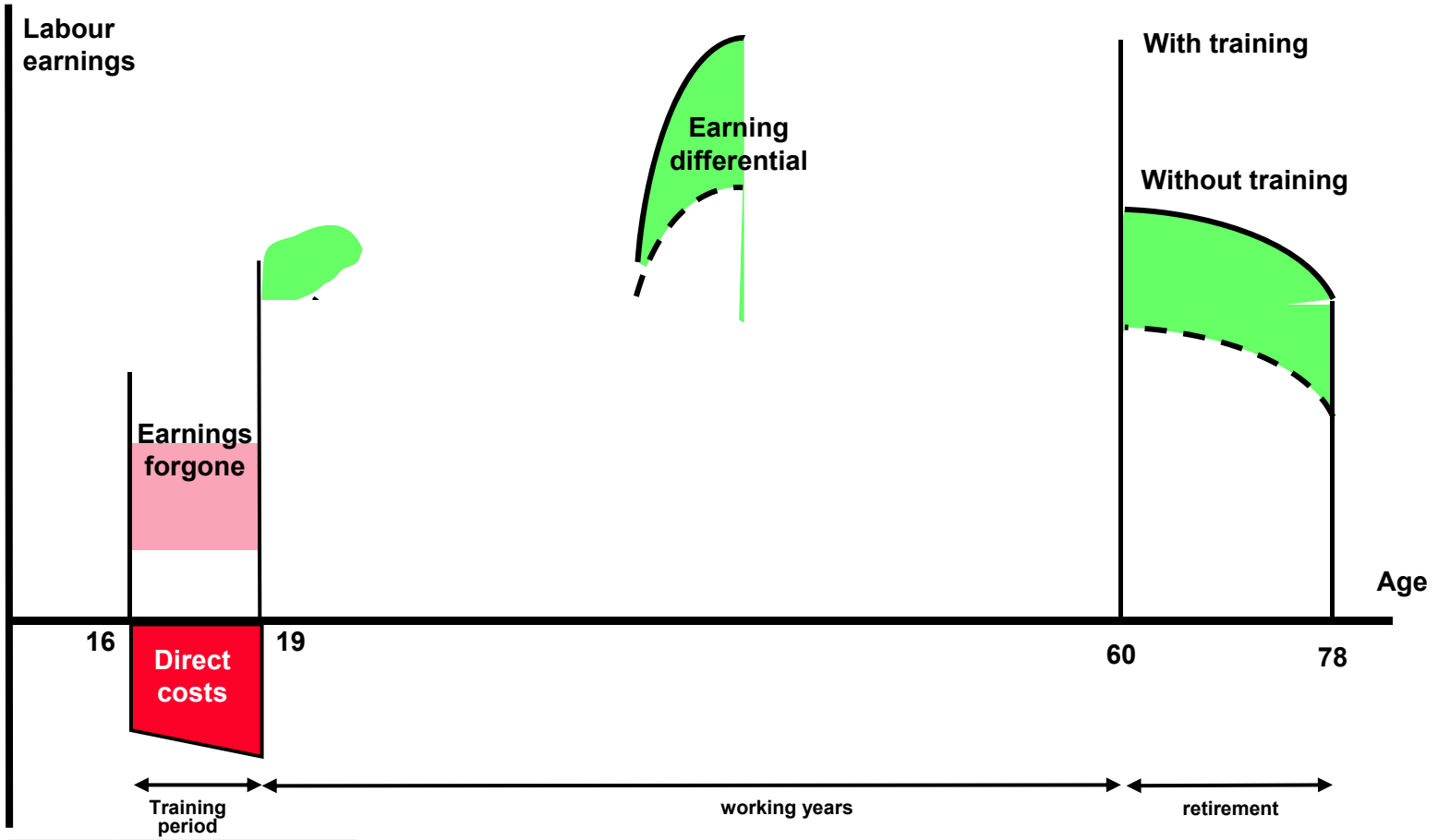
Does better education lead to higher national income?



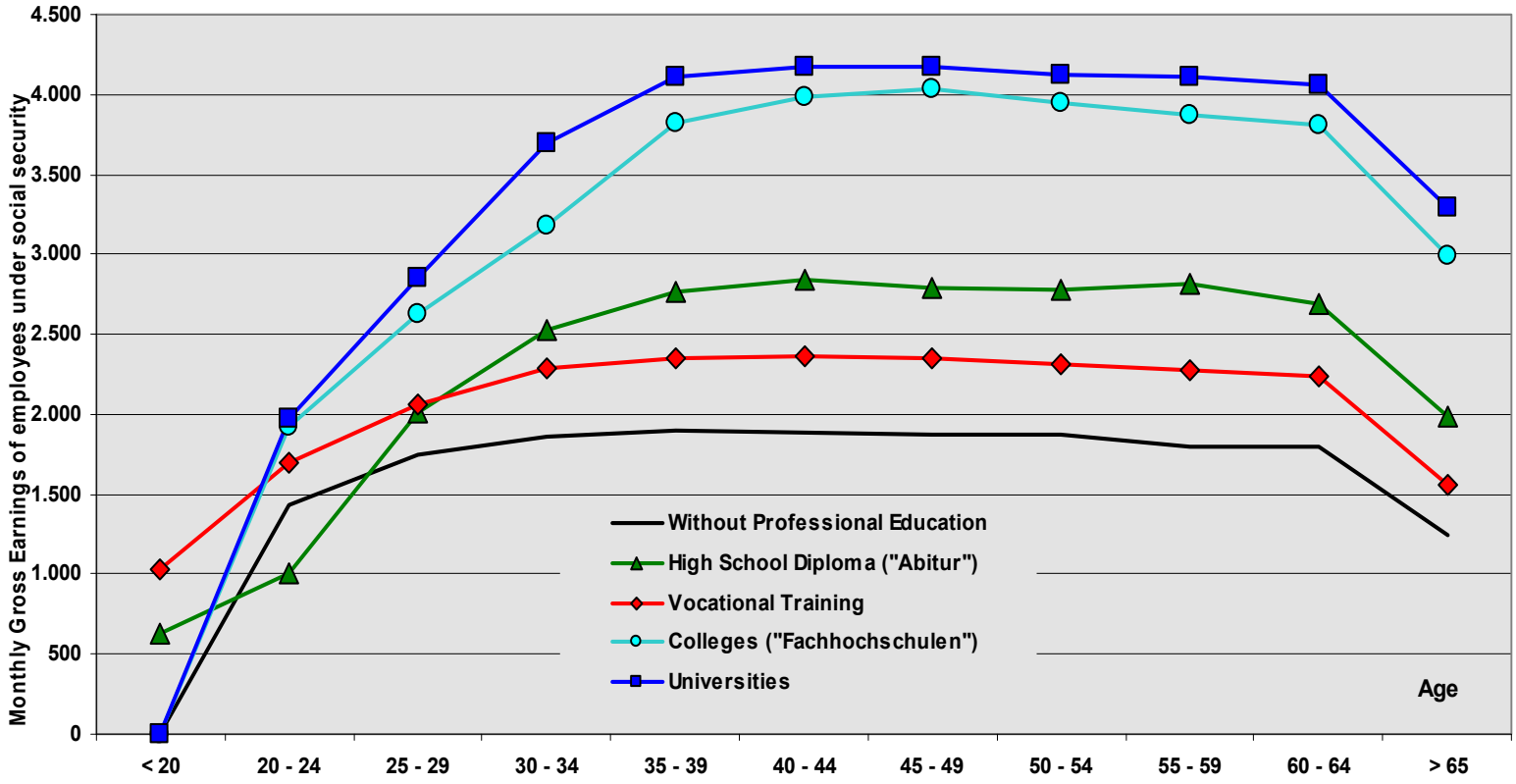
Does higher national income allow for better education?

Education as consumption

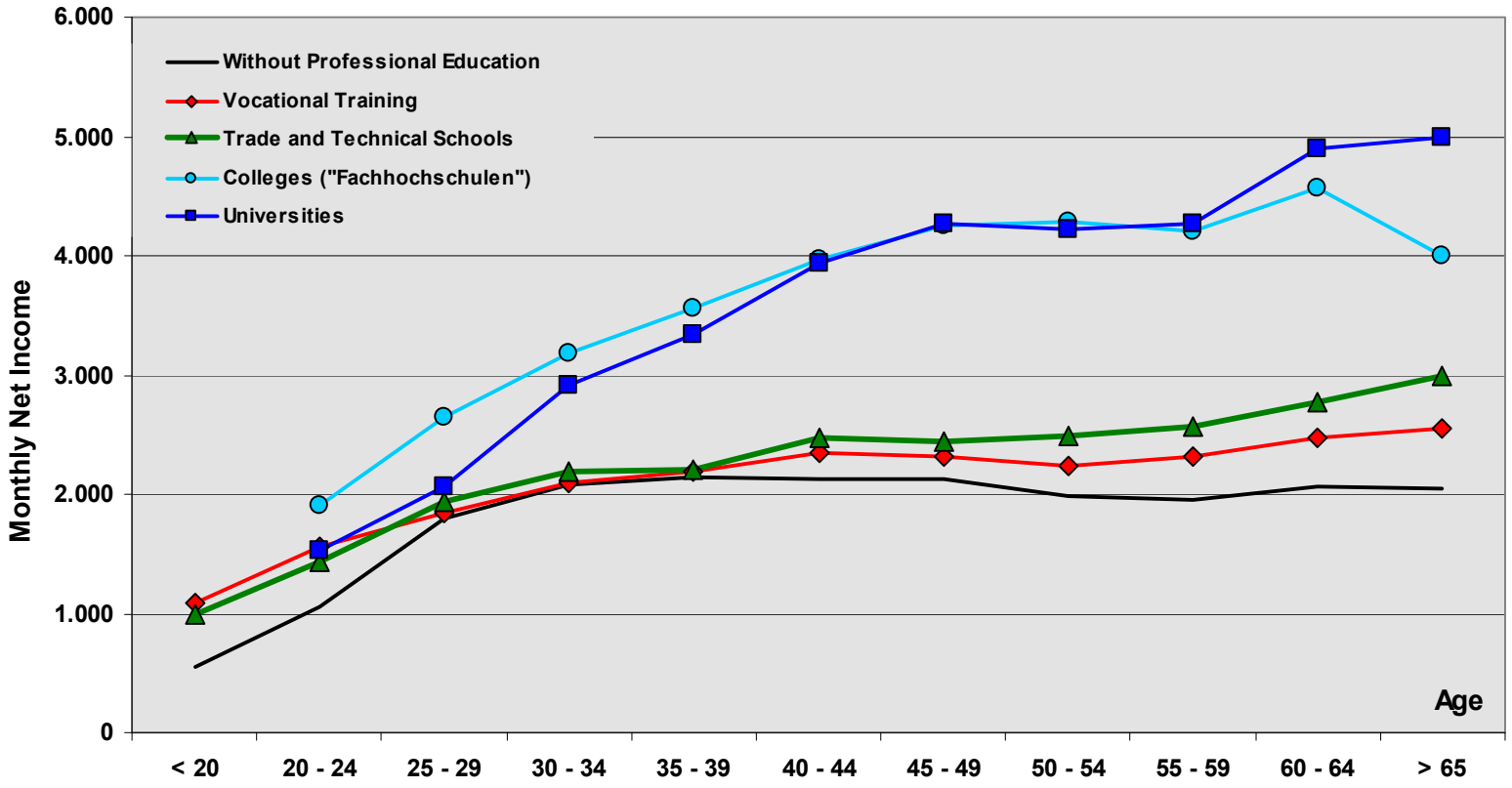
Rate of Return to Education / Training



Age-Earning-Profiles by Level of Education, Germany 1976

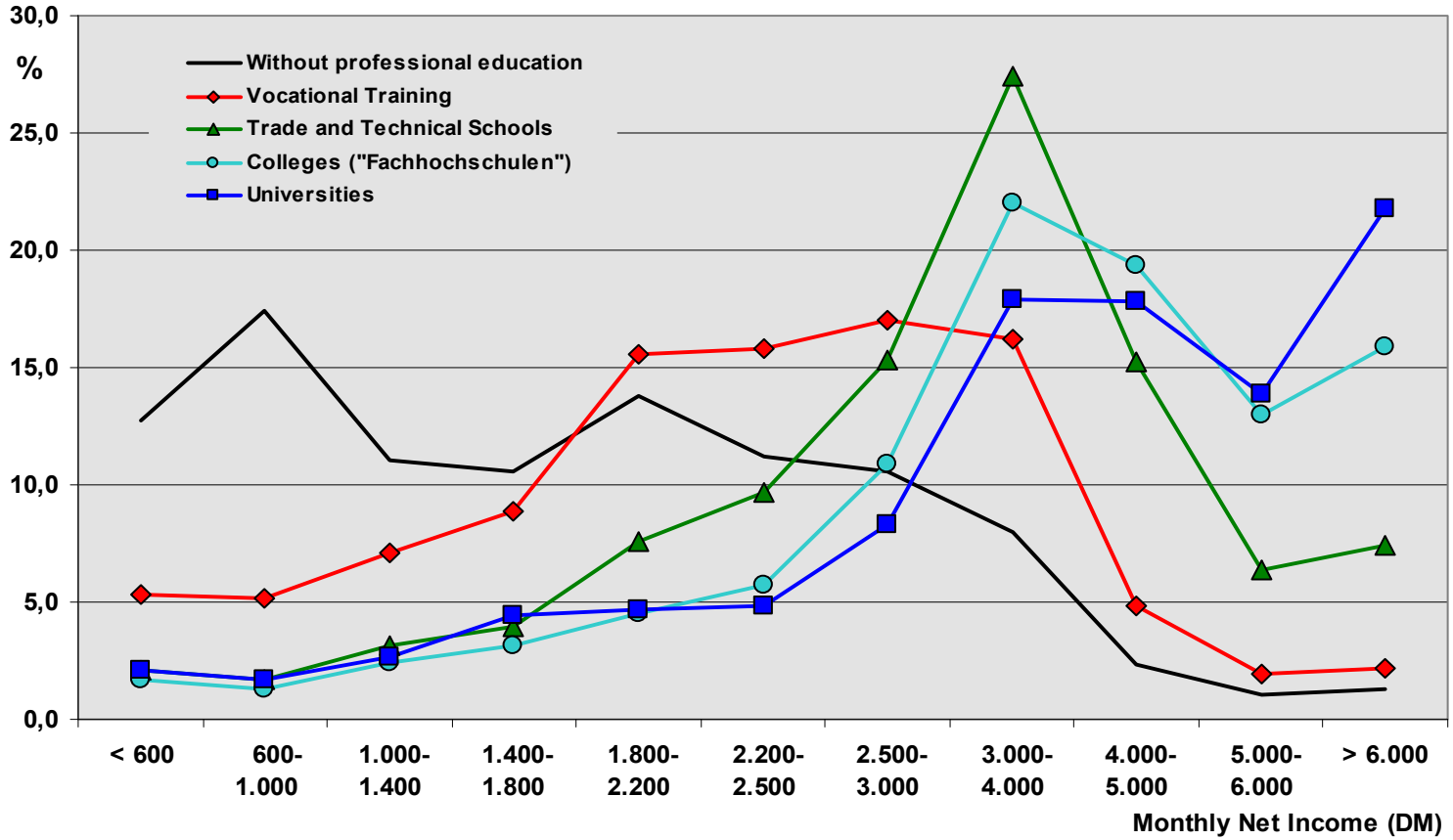


Age-Net Income-Profiles by Level of Education, Germany 1991



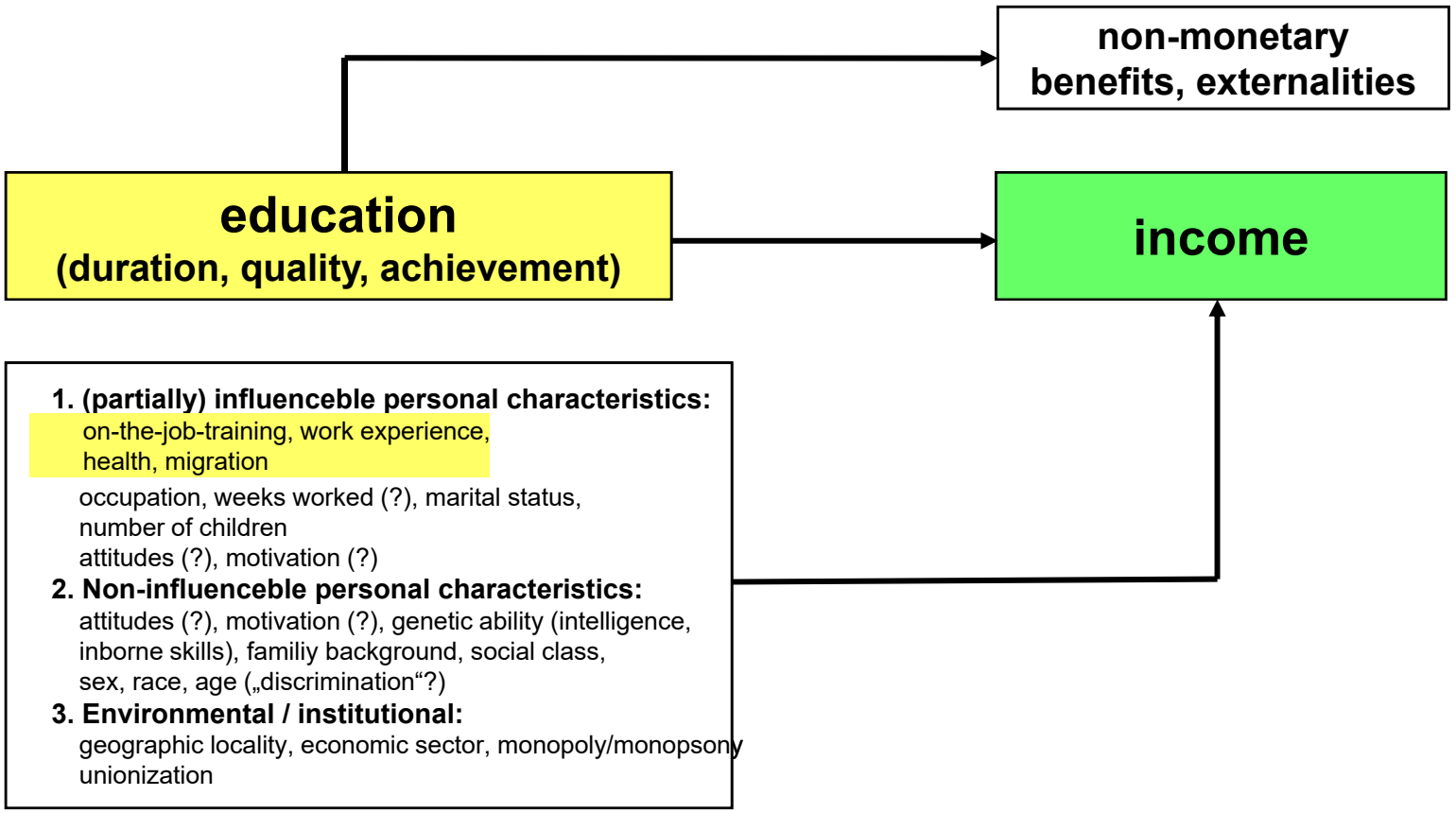
Source: Statistisches Bundesamt [1991?]

Distribution of Net Income by Level of Education, Germany 2000 (%)

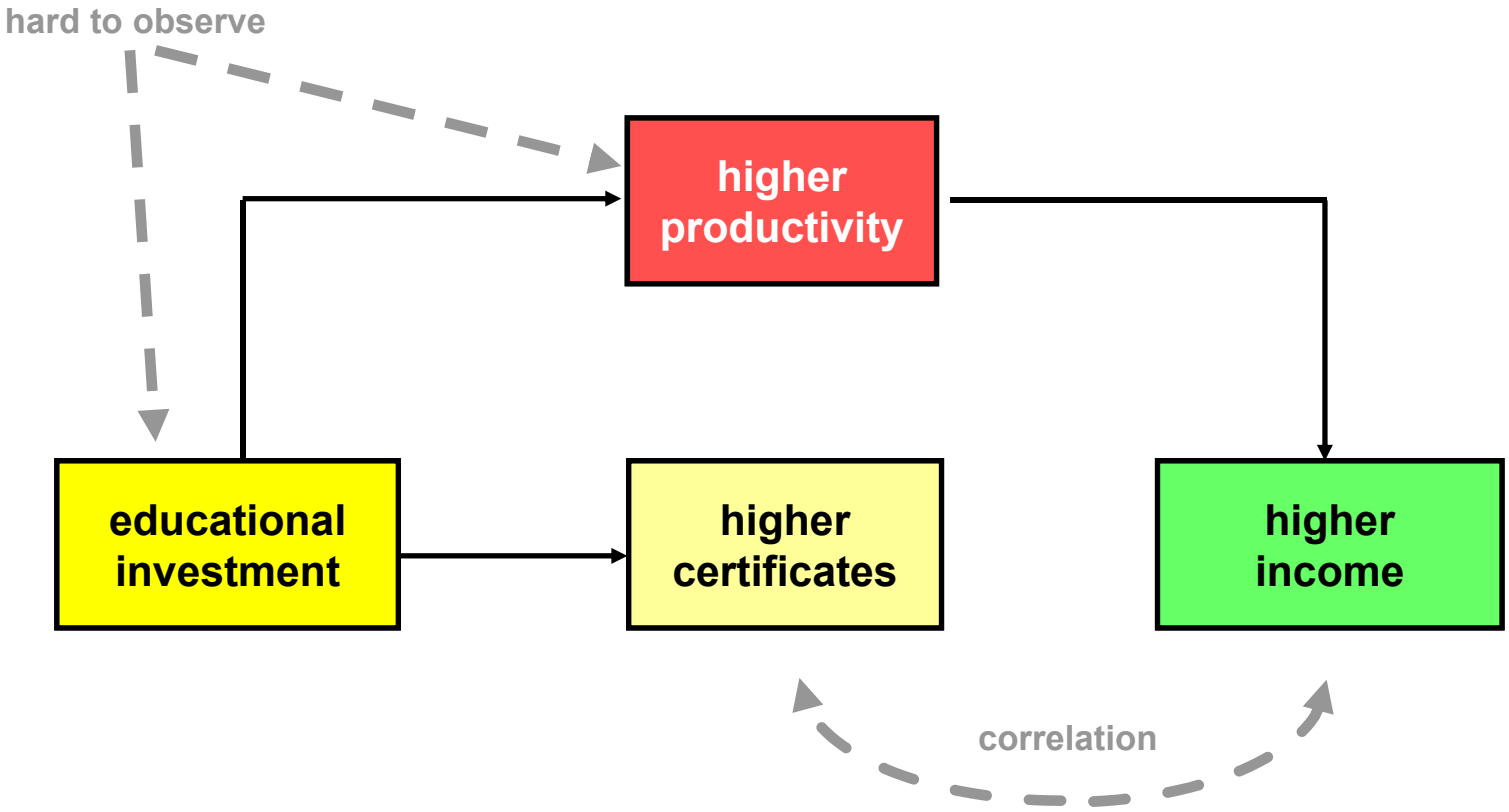


Source: Statistisches Bundesamt [2002?]

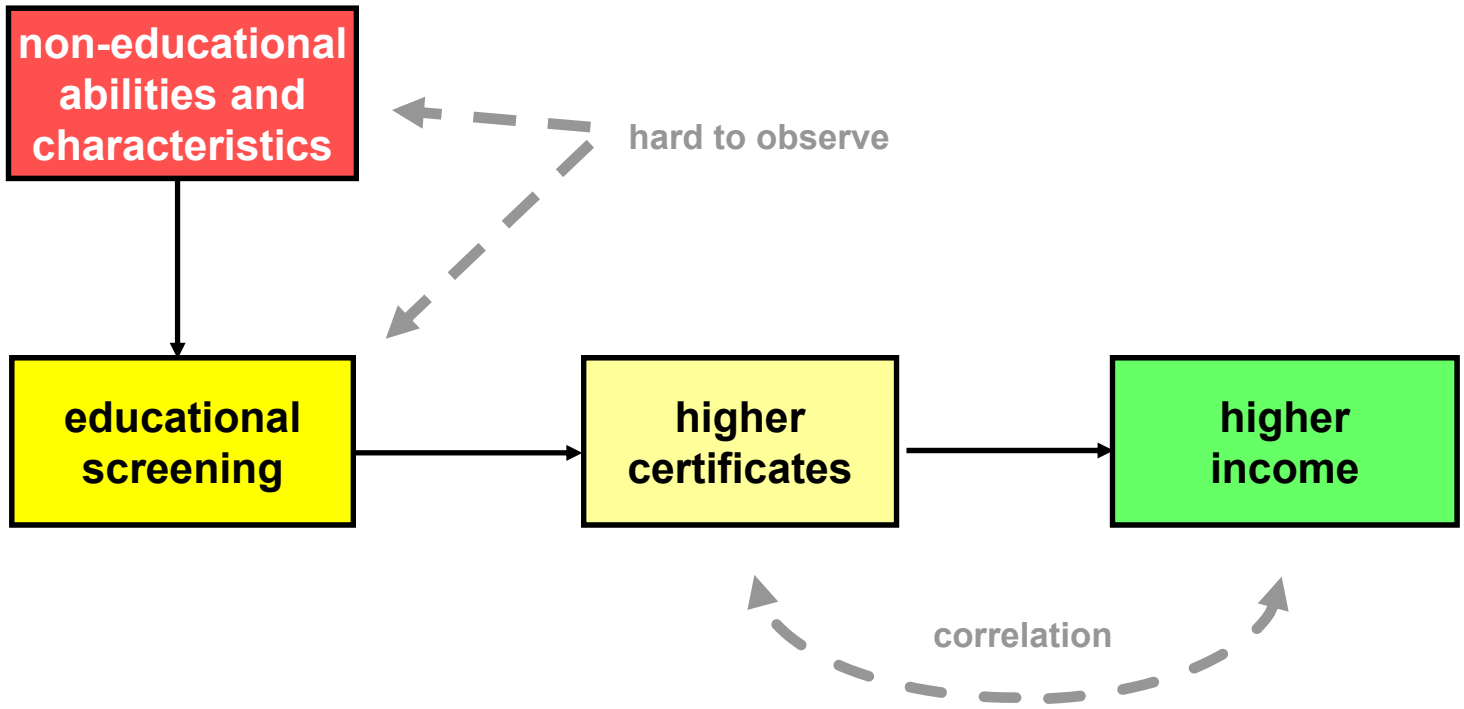
Education and Income: other Factors, other Benefits



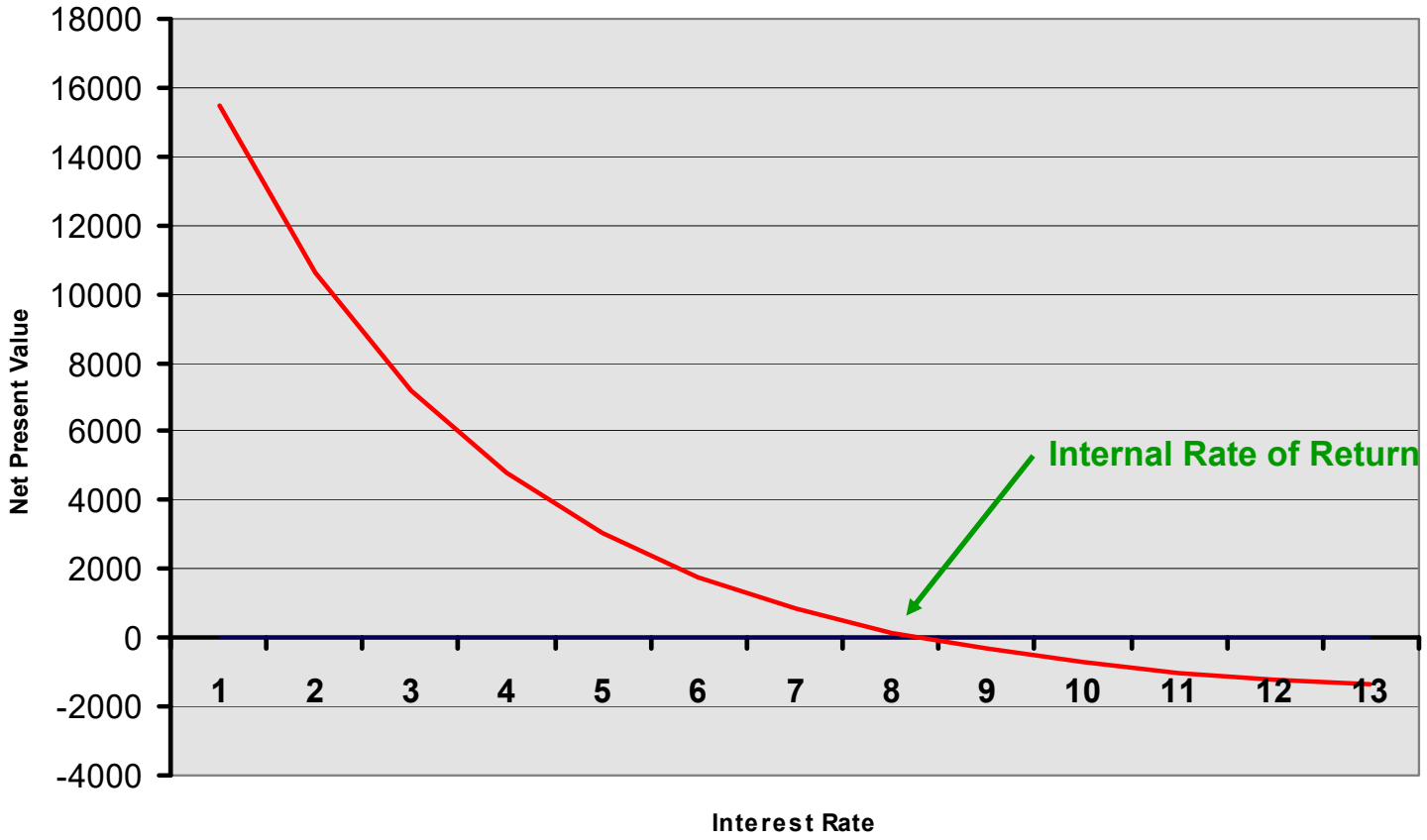
Education and Income: Human-Capital Theory



Education and Income: the "Screening Hypothesis"
(Filtering Theory / Credentialism)



Internal Rate of Return Calculation



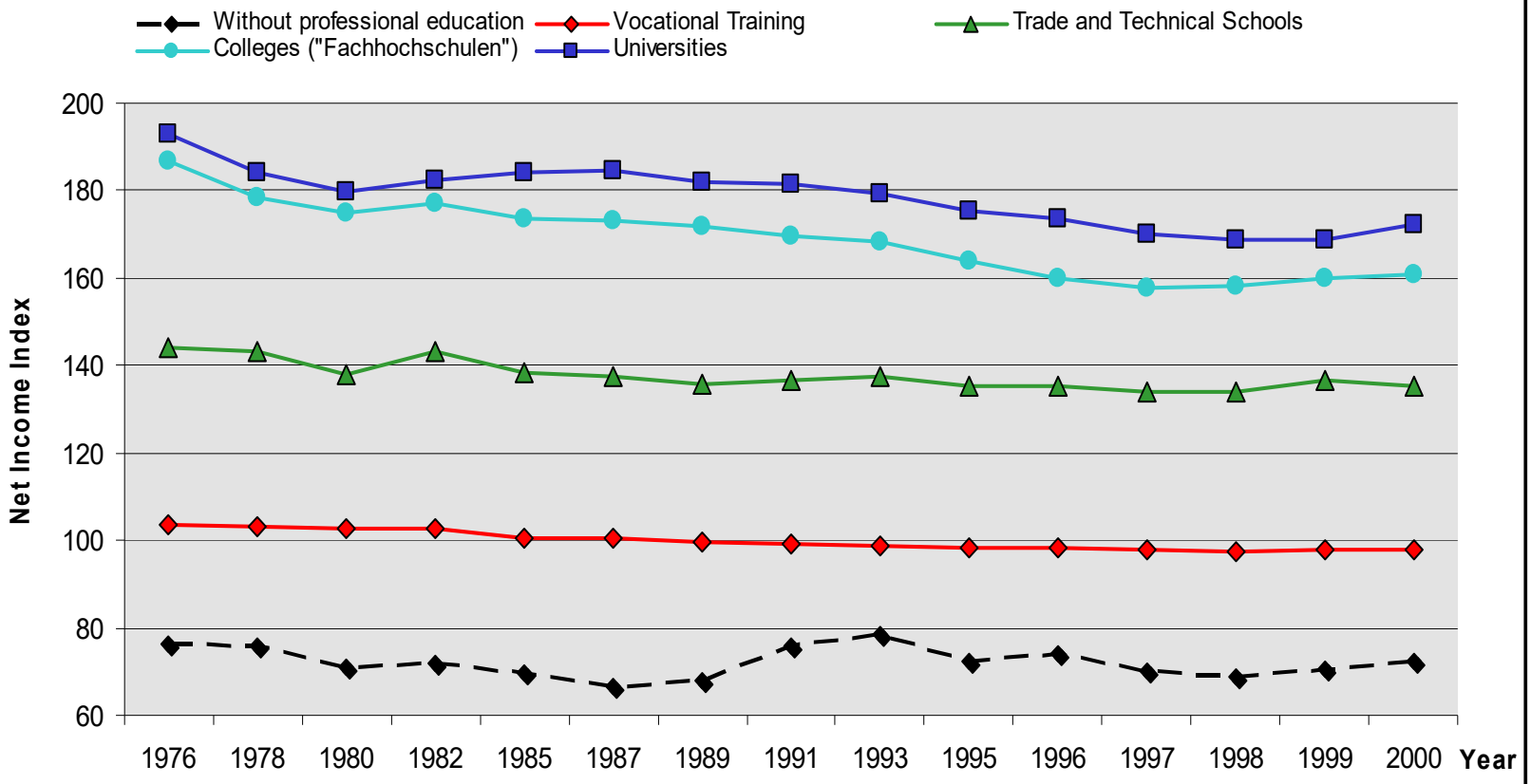
Social and Private Rates of Return to Education

Country Type and Region	Social Rates of Return			Private Rates of Return		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Region						
Africa	28	17	13	45	26	32
Asia	27	15	13	31	15	18
Latin America	26	18	16	32	23	23
Country Type						
Intermediate	13	10	8	17	13	13
Advanced	n.c.	11	9	n.c.	12	12
Gender						
Male				19	16	15
Female				17	21	14
Subject						
Economics			13			
Law			12			
Social sciences			11			
Medicine			12			
Engineering			12			
Sciences, Math			8			
Agriculture			8			

Source: Carnoy, M. (ed.): International Encyclopedia of Economics of Education, 2nd. Edition, Cambridge 1995, p. 367

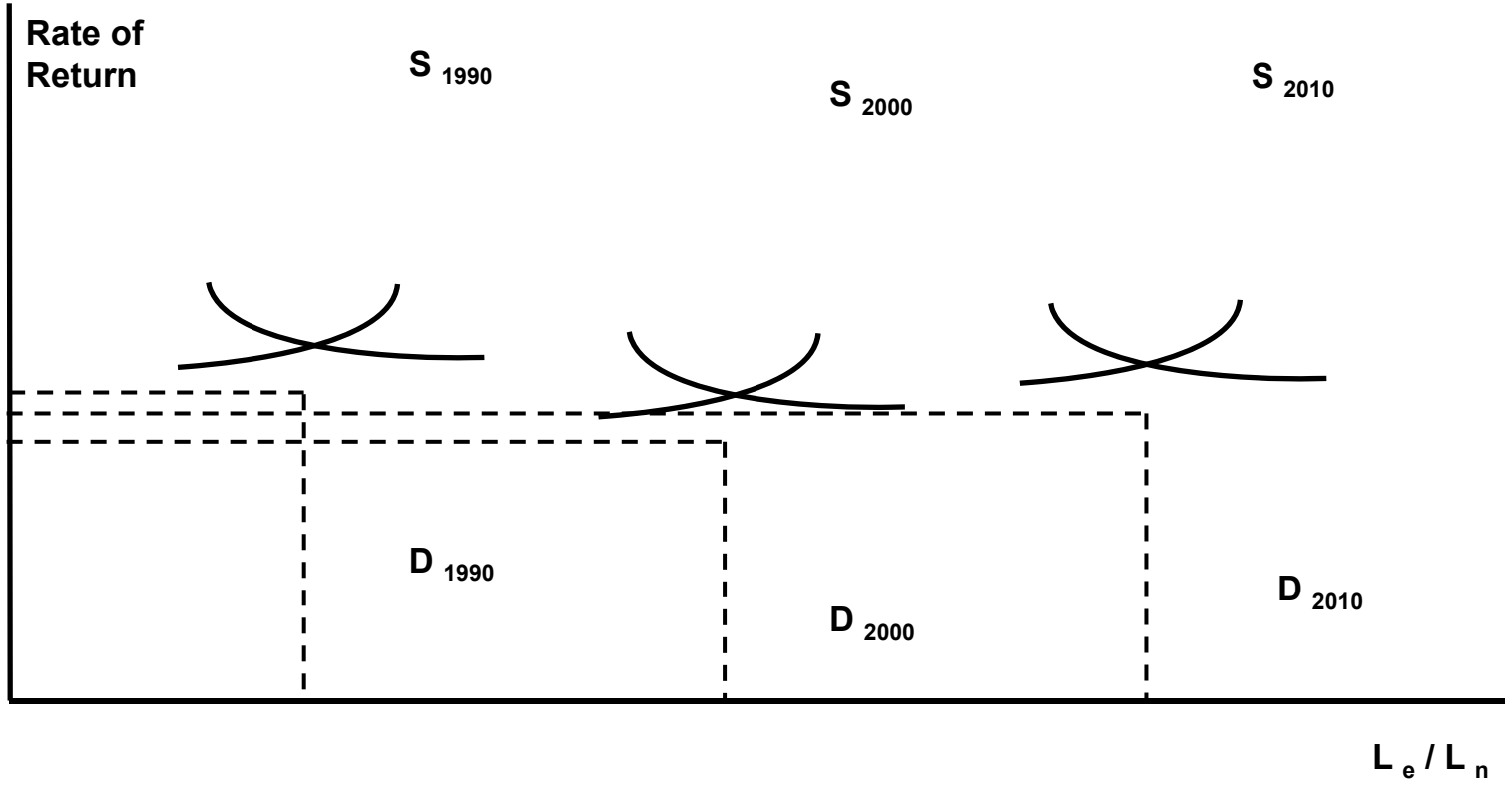
Earning Differentials by Level of Education, FRG, 1976 - 2000

(median earnings indices; average earning of all employees = 100)

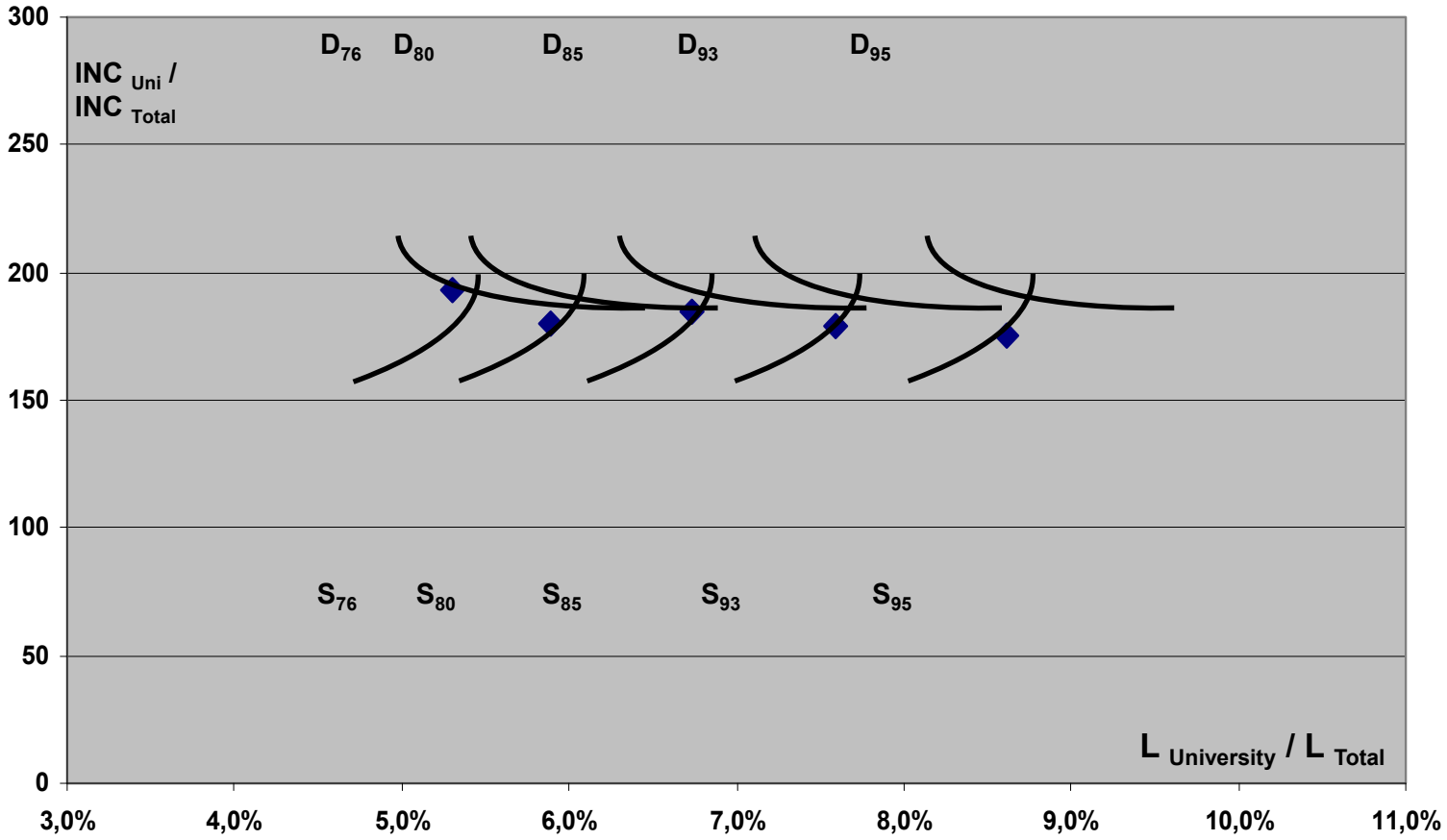


Source: Statistisches Bundesamt

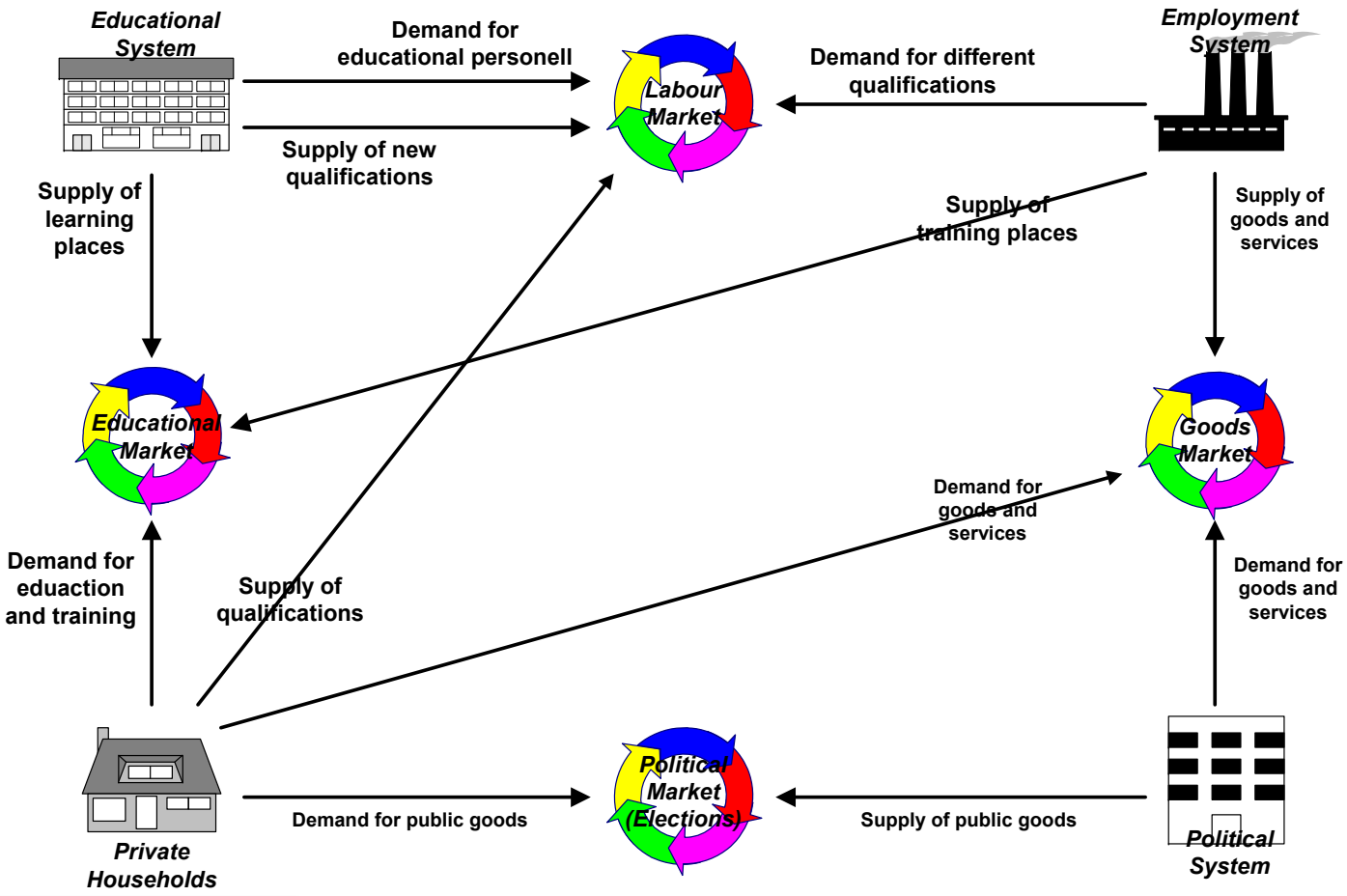
„Race“ between Educational Expansion and Technology



Shift in Supply and Demand of Univerity Graduates, FRG 1976 - 1995



Exchange between Educational Market and other Markets



Categories of Manpower Requirements